PROPERTY/LIABILITY INSURANCE RISK MANAGEMENT AND SECURITIZATION

Biography
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Abstract

This paper presents a comprehensive framework for property/liability insurance risk management and securitization. Section 2 presents a rationale for P/L insurance risk management. Sections 3 through 6 describe and evaluate the four categories of P/L insurance risk management techniques: (1) maintaining internal capital within the organization, (2) managing asset risk, (3) managing underwriting risk, and (4) managing the covariance between asset and liability returns. Securitization is specifically discussed as a potential method of managing underwriting risk. Lastly, Section 7 outlines four key guidelines for cost-effective risk management.

1. INTRODUCTION

In recent years, the property-liability insurance industry has witnessed intense competition from alternative risk management techniques, such as large deductibles and retentions, risk retention groups, and captive insurance companies. Moreover, the next decade promises to bring additional competition from new players in the P/L insurance industry, including commercial banks and securities firms.

In order to survive in this competitive new landscape, P/L insurers must manage total risk in a cost-efficient manner. This paper provides a rationale for P/L insurance risk management, then describes four categories of risk management techniques utilized by insurers. Lastly, the paper closes with some general guidelines for cost-effective management of risk.

2. RATIONALE AND TECHNIQUES FOR RISK MANAGEMENT

Rationale for Property/Liability Risk Management

According to traditional financial theory, publicly owned corporations should be concerned only with undiversifiable, or systematic, risk; modern portfolio theory implies that corporate shareholders can eliminate unsystematic risk through portfolio diversification.

More recent corporate risk management theories have suggested, however, that all corporations - public and private - must manage *total* risk, even after considering the benefits of individual diversification.[1] These newer theories emphasize the importance of internal cash flow as a source of financing [11], the implications of nonlinearity in the tax code [30], and the substantial costs of bankrupcy and financial distress.

In addition, financial firms, including property/liability insurers, both stock and mutual, have three other unique reasons to manage total risk. The first reason stems from the minimum regulatory solvency constraints that generally apply to these businesses. For many financial firms, franchise value, the opportunity to invest in positive-NPV contracts sometime in the future, comprises a significant portion of the firm's total value. If the firm's actual surplus falls below the minimum regulatory hurdle, the firm risks losing a substantial asset – its franchise value. Therefore, by limiting total firm risk to an acceptably low level, the firm protects this franchise value.

Secondly, by managing its total risk, the financial firm secures a higher price for its products in the marketplace. This higher price results from the higher degree of security in the firm's promises. This second rationale, however, may be less important in the U.S. property/liability industry, where policyholders are often protected by state guarantee funds. Nevertheless, recent research suggests that competitive P/L insurance premiums are negatively related to default probabilities, even in the presence of guarantee funds [31].[2]

Lastly, customers of financial firms generally prefer not to share in the investment risks of the firm. Robert C. Merton explains this principle as follows [20]:

> *In general, customers, unlike investors in the firm, prefer to have the payoffs on their contracts as insensitive as possible to the fortunes of the firm itself. For example, a customer who buys a warranty on his new car from an automobile manufacturer wants the repairs paid for in the event that the car is defective. In fact, he has a contract that pays for repairs in the joint contingency that the car is*

[1] Total risk includes both systematic, or economy-wide, risk and unsytematic, or firm-specific, risk.
[2] Also note that guarantee funds protection is not extended to non-admitted insurance companies or reinsurers.

defective and the automobile manufacturer is financially solvent. Even if an actuarially fair reduction in the price of the warranty were made to reflect the risk of insolvency, it is likely that the customer would still prefer the warranty with the least default risk.

Techniques for Property/Liability Risk Management

Property/liability insurance firms utilize a variety of methods to manage total risk. These methods can be grouped into four broad categories: (1) managing the amount of total capital, (2) managing the risk of the investment portfolio, (3) managing the risk of underwriting portfolio, and (4) managing the covariance between the assets and liabilities. The following sections will describe the specific techniques in each of these four categories.

3. INSURANCE CAPITAL AS A TOOL FOR MANAGING RISK

Conceptually, the simplest method for managing the firm's total risk is to raise enough capital to reduce the probability of default to an acceptably low level. Harrington, et al., emphasize three significant costs to a P/L insurer of raising and holding capital: double taxation, agency costs, and asymmetric information [14]. As shown below, the importance of these costs has been overestimated in the current literature.

Double Taxation and Insurer Capital

P/L insurers largely overcome the problem of double taxation through two investment techniques: (1) offsetting taxable bond interest with insurance underwriting losses, thereby passing through the higher return on debt to the shareholder as a lower-taxed equity return[3]; and (2) holding the taxable portion of the asset portfolio in tax-favored investments such as municipal bonds and common stocks.

The optimal asset allocation that maximizes market value depends on the assumed relationship between the expected return on taxable bonds and common stocks of equivalent risk. In competitive P/L insurance

markets, prices will adjust until insurance shareholders earn no more than a fair expected rate of return. Even so, the optimal asset allocation will eliminate the burden of double taxation. The author's recent *Proceedings* paper provides a detailed numeric illustration [34].

One complication, however, may result from the nonlinearity, or convexity, of the corporate tax code. The convexity problem arises when the marginal corporate tax rate is an increasing function of the pre-tax value of the firm. In this case, the firm's corporate tax liability (in dollars) becomes a convex function of pre-tax firm value.

Let's illustrate the convexity problem with a simple, one-period insurance example. Assume that the insurer collects premium of $100 (net of expenses) at time 0, in return for assuming an expected loss payment of $105 at time 1. The insurer then invests the $100 premium in risk-free taxable bonds (paying a 5% interest rate) with a one-year maturity. The insurer's shareholders have contributed $100 of surplus, which will be invested in risk-free municipal bonds paying a 3.5% interest rate.

While the *expected* loss payment is $105, the amount of this payment is not certain. In fact, assume this payment has an equal probability of being either $85, $105, or $125. In order to emphasize the convexity problem, we will assume that the effective corporate tax rate is 35% when taxable income is positive and 0% when taxable income is negative. That is, we make the extreme assumption of no tax carryovers. Also, we ignore the AMT and proration provisions of the insurance tax code.

Given these assumptions, the following table calculates the insurer's tax liability for each of the three possible loss amounts:

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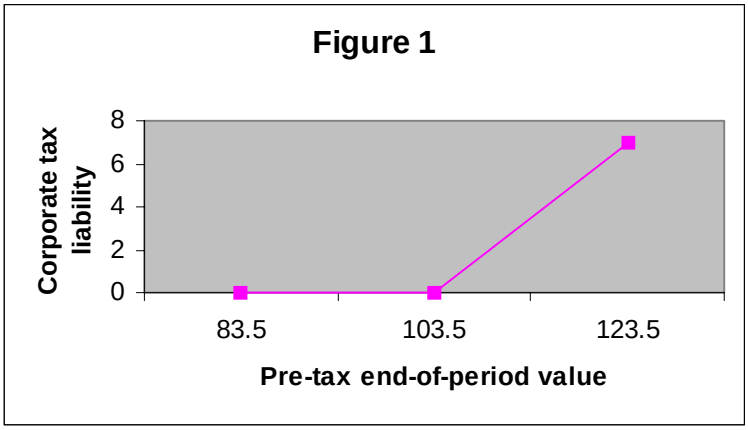
[3] In other words, the investor will pay less taxes than if the debt were held in his personal portfolio. Tepper discusses this "pass through" of bond returns as lower-taxed equity returns in the context of corporate pension funding [33, see especially Table 1 on page 6].

	High Loss	Expected Loss	Low Loss
(1) Premium	100	100	100
(2) Loss amount	125	105	85
(3) Underwriting income = (1) - (2)	-25	-5	15
(4) Taxable bond interest = $100 x 5%	5	5	5
(5) Tax-exempt bond interest = $100 x 3.5%	3.50	3.50	3.50
(6) Pre-tax end-of-period value = $100 + (3) + (4) + (5)	83.50	103.50	123.50
(7) Corporate tax liability = max{35% x [(3) + (4)],0}	0	0	7

Figure 1 graphically displays the corporate tax liability as a function of the pre-tax firm value, with a line fitted through the points to highlight convexity. Given the equal probability of the three loss outcomes, the expected tax payment is $2.33. That is, convexity prevents the insurer from eliminating the double taxation problem.



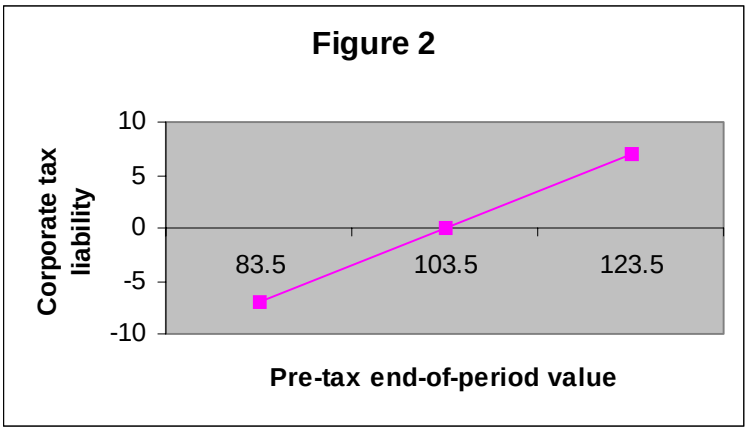
In this manner, the "cost" of convexity is $2.33.[4] Let's suppose now that the insurer could hedge the volatility in losses by acquiring a derivative instrument that would pay the insurer $20 when the underlying loss amount is $125, and require the insurer to pay $20 when the underlying loss amount is $85. The insurer could then lock-in an end-of-period pre-tax value of $103.50 and a tax liability of $0 – resulting in an expected tax savings of $2.33.

Given the equal probability of each state-of-the-world, the expected payment from the hedging instrument would be $0. Yet because of the transaction (and possibly information) costs of hedging, the hedge would

[4] In general, the "cost" of convexity is the difference between the expected tax payment and the tax on expected (taxable) income. In this example, the expected taxable income is $0 (that is, taxable income has

still result in a positive cost to the insurer. Provided that the cost of the hedge is less than the $2.33 expected tax savings, the hedge creates value.

The convexity in this initial example arises from the assumption of no tax carryovers. Let's assume now that the insurer can immediately utilize negative taxable income to offset taxable income in previous years (carryback) or future years (carryforward).[5] Specifically, a worse-case loss of $125 will result in a taxable



income of –$20 and a tax credit of –$7. As shown in Figure 2, the tax structure then becomes linear, not convex. Moreover, the expected tax liability is now $0 and the double taxation problem is eliminated.[6]

In general, after allowing for tax carryovers, convexity should only create significant costs for first-party lines of business with extremely volatile or skew aggregate loss distributions, such as earthquake coverage and catastrophe reinsurance.[7] For these lines, even if the insurer holds enough capital to comfortably absorb a worse-case loss, such a loss may still cause tax problems. Specifically, it may take many years of carryovers before the tax benefits of the large loss are fully realized; in the meantime, the insurer loses through the time value of money. For less volatile coverages, tax credits can often be utilized immediately

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an equal probability of being -$20, $0, or $20). Thus, the tax on expected taxable income is 0.35 x $0 = $0, and the "cost" of convexity is $2.33 - $0 = $2.33. For a further discussion, see [29, pp. 363-367].

[5] In practice, the insurer cannot "immediately" recognize a carryforward, and thus loses the potential interest on the taxable recovery. See paragraph below.

[6] Since the expected tax payment equals the tax on expected (taxable) income, the "cost" of convexity is $0.

[7] For third-party coverages, insurers can (and do) reduce earnings volatility by managing IBNR.

through three-year carrybacks; if not, carryforwards will usually absorb the excess within a relatively short time period.[8]

Thus, for especially volatile lines, the nonlinearity of the tax code may create a significant tax cost. For these lines, most insurers choose to bear the alternative costs of reinsurance (or newer hedging options – see Section 5) to reduce the tax cost of holding large amounts of capital.

Agency Costs and the Perils of Free Cash Flow

Michael Jensen has stressed the agency costs of accumulating large amounts of cash within the organization [16]. According to Jensen, a corporation with excessive "free cash flow" will usually fall prey to two temptations: (1) investing in empire-building, negative-NPV projects, and (2) spending large amounts of cash on excessive perks.

The RJR Nabisco of the mid-1980s, for example, epitomized Jensen's theory. At its peak, RJR's tobacco business was generating $1 billion of cash every year. According to standard finance theory, RJR's managers should have used this massive cash flow to fund only investment opportunities with a positive-NPV, returning the balance to shareholders through stock dividends and buybacks.

But RJR's managers invested well beyond the point of acceptable return. The company funneled large amounts of money into the research and development of their smokeless cigarette, Premier, despite volumes of evidence against its marketability.[9] The Nabisco division spent $4 billion to modernize its bakeries in what one prominent executive later called "technology for technology's sake."

[8] For a detailed description of the carryover rules applicable to P/L insurers, see Chapter 13 of [27]. Also note that other provisions of the corporate insurance tax code, such as the AMT, can create a nonlinear tax function.

[9] Burrough and Helyar [5] describe the results of Premier's taste tests: "In its U.S. research laboratories, Reynolds scientists found that fewer than 5% of smokers liked its taste. In Japan, another team of researchers quickly learned to translate at least one sentence of Japanese: 'This tastes like [crap].' "

RJR's managers also fell into Jensen's second trap, spending massive amounts on luxurious perks. Burrough and Helyar vividly describe the pre-takeover excesses of RJR in the 1990 narrative, *Barbarians at the Gate: The Fall of RJR Nabisco* [5]. In 1986, the top 31 executives earned a total of $14.2 million and "no expense was spared" in decorating the company's new Atlanta headquarters. But even these lavish expenditures pale in comparison to the ultimate expression of RJR's excesses – its corporate air force:

> *When it was finished, RJR Nabisco had the Taj Mahal of corporate hangars, dwarfing that of Coca-Cola's next door. The cost hadn't gone into the hangar itself, but into an adjacent three-story building of tinted glass, surrounded by $250,000 in landscaping, complete with a Japanese garden. Inside a visitor walked into a stunning three-story atrium. The floors were Italian marble, the walls and doors lined in inlaid mahogany. More than $600,000 in new furniture was spread throughout, topped off by $100,000 in objets d'art, including an antique Chinese ceremonial robe spread in a glass case and a magnificent Chinese platter and urn… Among the building's other features: a walk-in wine cooler; a "visiting pilots' room," with television and stereo; and a "flight-planning room," packed with state-of-the-art computers to track executives' whereabouts and their future transportation wishes. All this was necessary to keep track of RJR Nabisco's thirty-six corporate pilots and ten planes, widely known as the RJR Air Force.*

But while RJR and other nonfinancial firms of the 1980s suffered from exorbitant agency costs by refusing to distribute their cash flow, the agency costs of holding capital are generally much lower for P/L insurers. In particular, P/L insurers are not as prone to invest the extra cash flow in negative-NPV projects. Instead, P/L insurers usually invest in the highly efficient capital markets, where assets are fairly priced with an NPV of zero. This is not to say that P/L insurers, in retrospect, have not made bad investments, such as overspending on real estate and junk bonds in the late '80s. But on a prospective basis, efficient capital markets provide that all assets are priced to yield an adequate expected return.

Moreover, a large accumulation of financial assets is not as likely to encourage insurance managers to overspend on opulent accommodations. While the management of nonfinancial firms often views extra cash as a slush fund, the managers of P/L insurers are accustomed to viewing financial assets as a mutual fund, deposited by shareholders and policyholders to earn an acceptable return. And every good mutual fund manager adheres to a basic investment principle: every dollar of expenses incurred by the fund company reduces investor returns proportionately.

Anecdotal evidence of the mutual fund analogy is provided by the Berkshire Hathaway experience. Berkshire Hathaway primarily manages its risk by holding massive amounts of internal capital. But the expense ratio for the Berkshire Insurance Group falls consistently below industry norms; in 1997, for example, the Berkshire Insurance Group produced a stellar underwriting expense ratio of 18.1%.[10] These low expenses may be explained in part by unique cost structure advantages, but, nonetheless, few industry observers accuse Warren Buffet of running a lax organization.

Asymmetric Information and New Equity Issues

The previous two subsections contend that the costs to a P/L insurer of holding capital are relatively low. But if ex ante capital really is the most cost-efficient method of managing risk, an optimal strategy for risk management would quickly emerge: the P/L insurer should raise enough capital via seasoned equity offerings to lower the probability of default to a negligibly low level, thereby eliminating the need for reinsurance and other hedging strategies.[11] Yet, in reality, seasoned equity issues by insurers are rare and reinsurance is common. How do we explain this inconsistency?

The answer may lie in the theory of asymmetric information, developed largely by Myers and Majluf [25]. According to this theory, information asymmetries between managers and outside investors result in prohibitively high costs to issuing equity. The mere attempt to issue stock will cause share price to fall, as investors assume that management feels the stock is overvalued at its current price.

Moreover, Ross has argued that asymmetric information results in especially large issue costs to financial firms, including P/L insurers [28]. Ross emphasizes the "opaqueness" of financial firms. That is, the financial firm can quickly modify its total risk portfolio by changing its asset or liability composition; also, investors receive very little information about the financial firm's true operations, and the information that is published is often quickly outdated.

[10] Underwriting expenses ratioed to written premium. Source: 1997 Berkshire Hathaway Annual Report [2].

Thus, in the presence of asymmetric information, ex ante capital becomes a scarce and valuable commodity to the insurer. The company's current stock of ex ante capital represents a relatively inexpensive source for managing risk, but information costs discourage the insurer from raising additional capital.[12] This situation would create a "pecking order" theory of insurer risk management: the insurer first utilizes its existing stock of capital, then turns to other methods (see sections 4 though 6) to eliminate residual risk.[13]

But what are the empirical facts regarding the size and importance of information costs to P/L insurers? In other words, what are the actual market reactions to equity issue announcements by P/L insurers? Interestingly, the one comprehensive study published on the topic concludes that equity issues by P/L insurers are unaffected by asymmetric information. Instead, Akhigbe, Borde, and Madura conclude that there is no statistically significant market reaction in response to announcements by P/L insurers of equity offerings [1].

Akhigbe, et al., suggest that the unique operating environment of P/L insurers produces unique market reactions to security offerings. Specifically, the "necessity to support growth with adequate capital, lower agency costs, and market-driven capital requirements in the insurance industry are hypothesized to be the underlying factors contributing to these results."

In addition, the authors performed a cross-sectional analyses which suggested that "the abnormal returns associated with security offerings are driven to some extent by characteristics specific to the insurer." In other words, the significance of information costs may vary across the firms within the insurance industry. Firms with well-recognized growth opportunities may be credible issuers of new equity, whereas more stable firms may be seen as capitalizing on information asymmetries.

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[11] Mutual insurers, of course, cannot issue equity. Mutuals do, however, have access to quasi-equity funding such as surplus notes.

[12] Other issue costs, such as administrative costs and underwriting spreads, may also represent substantial sums. See [3, especially Figure 15-2 on page 394].

Market Evidence on Capital Costs and a Common Fallacy

The previous discussion concludes that the actual costs of internal capital are relatively low. The strongest evidence supporting this conclusion comes not from financial theory, but from the insurance market itself. If the actual costs of ex ante capital were relatively high, we would see many insurers returning large amounts of capital to shareholders through stock dividends and buybacks, then aggressively utilizing other risk management devices, such as reinsurance and cat options. In reality, stock dividends and buybacks by P/L insurers represent only a very small portion of their total equity market value.[14]

Yet, given the low costs of holding capital versus other risk management alternatives, why would P/L insurers *ever* offer stock dividends or buybacks? The answer may be related to the previous discussion on asymmetric information and "opaqueness." Because the only earnings information that investors receive is usually delayed and very subjective, the insurer must "put its money where its mouth is" to convince investors that its earnings are real. In other words, investors see dividends and buybacks as a *signal* that the company's earnings are genuine.[15]

In closing, let's briefly describe a common fallacy underlying some mathematical models that attempt to compare the cost of reinsurance and catastrophe options with the "cost of capital." Namely, these models often incorrectly compare the *net* cost of reinsurance and cat options with the *gross* cost of capital.[16] The net cost of reinsurance and cat options is the difference between the price charged for these contracts and their actuarially fair value. Likewise, the net cost of capital is the difference between the actual (after corporate tax) return on the invested capital and the return that shareholders would require from investing *directly* in equivalent risk securities.

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[13] This theory would resemble the "pecking order" theory of corporate capital structure advanced by Stewart Myers. [24]

[14] Also, witness the recent flourish of mutual insurers rushing to demutualize or form mutual holding companies. One of the most frequently-provided reasons for these moves is to allow the insurer to tap the financial markets to build up its capital base.

[15] See [3, p. 422] for a discussion on the information content of dividends.

[16] The recent models of Meyers [22] and Meyers and Kollar [23] utilize a "cost of capital" of 20%. No explanation is provided for this selection, but is appears to be a gross cost of capital. Harrington, et al.,

In the absence of double taxation, agency costs, and asymmetric information, the *net* cost of capital is zero. Specifically, in the absence of these costs, the insurer earns an expected return on invested assets that equals the shareholder's required return. And as mentioned earlier, in a competitive market, P/L insurance prices will adjust until shareholders earn their required rate of return on underwriting.

One may rightfully question, however, if P/L insurance policies truly are bought and sold in a competitive market. After all, virtually every actuary who handles rate filings for a living – the author included – will agree that regulators in certain states suppress rates below their actuarial value for political reasons. To the extent regulators effectively enforce such price ceilings, insurance underwriting is, on average, a losing proposition. Thus, managers of publicly-held insurers would improve their shareholders' wealth by forgoing underwriting entirely – then returning the assets to shareholders and allowing them to invest directly in the capital markets. Only mutual insurers, whose economic objectives go beyond maximizing shareholder wealth, could survive.[17]

But, in reality, publicly-held insurers have survived, and even thrived, for decades. In fact, returns on insurance stocks have generally outperformed the S&P 500. Capital continues to flow to existing stock companies, and mutuals are rushing to demutualize or form downstream stock holding companies. The bottom line is that no rationale investor would commit capital to an insurance company if he could earn a higher return by investing it himself.

Of course, publicly-held insurers still face a variety of threats that may impact their *future* viability: for example, the threats of increased regulation and increased federal taxation (see section 7). Adverse developments in these areas could still force stock insurers to exit the business, leaving mutuals and capital market instruments to pick up the slack.

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correctly recognize the distinction between net and gross capital costs, but avoid providing an exact estimate of the net cost of capital.

[17] If the resources devoted to insurance underwriting were not earning a normal profit, publicly-held insurers would eventually be *forced* to exit the business by one of three mechanisms: (1) internal control

4. MANAGING THE TOTAL RISK OF THE INVESTMENT PORTFOLIO

The second major aspect of P/L insurer risk management involves managing the total risk of the investment portfolio. Insurance management is often tempted to increase the riskiness of the investment portfolio in order to increase its expected return. Yet, in perfectly competitive product and capital markets, the increase in expected return is exactly offset by an increase in shareholder's required rate of return, leaving firm value unchanged. The author's recent *Proceedings* paper utilized the Miller/Modigliani propositions to demonstrate the irrelevance of investment strategy in perfect markets [34]. Appendix A to this paper provides a formal proof based on the CAPM.

Moreover, in the presence of a risky investment portfolio, the amount of capital required to adequately manage risk depends on the variance of the assets, the variance of the liabilities, and the covariance between the return on the assets and the return on the liabilities [21]. By investing in risk-free securities, however, the required capital depends only on the variance of the liabilities.

Since it is very difficult for insurers to achieve superior profits on the left hand side of the balance sheet, most insurers strive for a conservative investment portfolio. Thus, by controlling risks for which there are no compensating rewards, insurers are able to make larger bets when the odds are in their favor, such as making a large underwriting commitment on a lucrative new product.[18]

5. MANAGING THE TOTAL RISK OF THE LIABILITIES

Traditionally, insurance theory has emphasized the law of large numbers. In theory, if all policies are independent, the insurance company can practically eliminate risk by writing a large enough volume of

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systems, (2) the market for corporate control, and (3) the discipline of the product and factor markets. See Jensen [17].

[18] See [3], pages 707-708 for a discussion of the importance of separating one's bets.

business. Unfortunately, within a given coverage and territory, independence is rarely achieved due to the presence of external background factors that affect all policies (such as economic conditions, weather patterns, etc.). As such, the law of large numbers does not hold as the size of the portfolio increases [9, p. 64].

Still, the insurer can obtain the benefits of diversification by expanding into new coverages or geographical territories. For example, consider a P/L insurer that offers only commercial general liability and business auto policies. One would expect, a priori, that the experience under environmental impairment liability (EIL) policies would bear only a slight correlation to the experience on the existing portfolio. Hence, by offering EIL coverage, this insurer could achieve greater diversification, and thus reduce the risk of its total underwriting portfolio. Similarly, an insurer offering property insurance only on the East Coast could expand into the Midwest.

Insurers are often reluctant, however, to diversify in this manner. In the previous example, the first insurer may enjoy a competitive advantage in underwriting the standard commercial liability policies; at the same time, one would expect that underwriters trained in CGL and business auto would lack the necessary expertise to handle pollution business. Likewise, the second insurer may lack the necessary marketing and distribution facilities in the Midwest. Hence, the practical value of diversification is limited. Insurers generally must look to other methods of handling correlated risk.

One other obvious method of managing the total risk of the liabilities is to reduce the amount of premium written in relation to the current capital base. This is really the flip side of raising capital to manage risk. Clearly, managing risk by eliminating profitable business is not a preferred alternative.

The remainder of this section compares the relative efficiency of traditional reinsurance and the newer catastrophe hedging tools in dealing with the problems of (1) basis risk, moral hazard and credit risk, and (2) federal income taxes. Lastly, the section closes with a discussion of the role of mergers in managing liability risk.

Reinsurance Versus Securitization: Basis Risk, Moral Hazard, and Credit Risk

A large portion of the current literature on the new catastrophe hedging tools describes their relative efficiency, versus traditional reinsurance, in dealing with the problems of basis risk, moral hazard, and credit risk [10].

Traditional reinsurance involves very little basis risk. There is no basis risk, for instance, in proportional (quota share) reinsurance. Unfortunately, this lack of basis risk also leads to a high cost of moral hazard, which increases the transaction costs of reinsurance. In addition, traditional reinsurance often entails high credit risk.

Conversely, cat options and cat bonds that are based on industry indices may possess significant basis risk, especially for insurers with atypical distributions of business. This increased basis risk lowers the cost of moral hazard. Also, these instruments can be designed with low credit risk.

In sum, the high moral hazard associated with traditional reinsurance leads to a higher transaction cost. But traditional reinsurance usually offers a better hedge and is therefore more effective at lowering the required amount of internal capital. For insurers with high costs of raising and holding sufficient capital (for example, insurers suffering from the problems of convexity and asymmetric information), the higher transaction costs of reinsurance may be justified. But for insurers with low capital costs, cat options and cat bonds may represent a cost-effective alternative. Meyers provides a mathematical model that compares the net cost of reinsurance to the net cost of options on a catastrophe index [22].

Reinsurance and Taxes

The current literature has devoted less attention to the relative efficiency of the newer cat hedging options in dealing with the issue of federal income taxes. Harrington, et al., point out that “profits on futures

positions are taxed directly, but there is no double taxation." [14] Offsetting this presumed tax advantage are the taxes paid on investment earnings from the investor's margin account.

These arguments miss an important advantage that traditional reinsurance holds over cat options and bonds. Specifically, cat options and bonds are priced to offer a positive expected return; this *entire* return will be taxed at the investor's marginal tax rate, which varies from 0% to 39.6% for individual investors. On the other hand, traditional reinsurers can manage their asset allocation and dividend strategy to minimize total corporate and personal taxes (see the earlier subsection on "double taxation"). In fact, as competition from newer hedging devices intensifies, reinsurers will be forced to efficiently manage taxes in order to survive.

Mergers

As mentioned earlier, companies are often reluctant to diversify across coverages and territories, because the necessary underwriting and marketing expertise is often lacking. Mergers often overcome this obstacle by providing both diversification and new areas of expertise.

The pure financial motive for mergers has even been suggested for nonfinancial firms [18]. That is, conglomerate mergers diversify the firm and reduce the probability of default; this allows the firm to take on a higher debt ratio and thereby benefit through the tax advantages of corporate borrowing. [12]

For P/L insurers, the diversification resulting from the merger will also lower the probability of default. This allows the insurer to reduce its reliance on other risk management techniques, such as reinsurance and internal capital. To the extent that these alternative techniques are costly to the firm, the merger creates value.

Two recent mergers in the P/L industry nicely illustrate the diversification benefits of combining two firms – one offering geographic diversification and the other providing diversification by coverage. First, Nationwide's recent unsolicited takeover of Allied Mutual was primarily motivated by Nationwide's desire

for geographic diversification [19]. Traditionally, Nationwide's substantial personal lines portfolio has been heavily weighted in the geographic region east of the Mississippi. Conversely, Allied Mutual possessed a strong personal lines market position and valuable network of agents in the western U.S. As such, the takeover promised to provide Nationwide with a wider geographic spread and substantial diversification benefits.

Second, St. Paul's recent $3.5 billion acquisition of USF&G offered St. Paul a broader range of specialty lines coverages [26]. St. Paul coveted USF&G's profitable specialty operations in surety bonding, reinsurance and alternative-risk transfer to complement its medical malpractice dominance.

Of course, not all mergers are motivated primarily by diversification. Even the St. Paul and USF&G specialty operations overlapped significantly in certain areas, such as technology coverage and financial institutions. Here, any diversification benefits are muted by the common external background factors mentioned earlier. In this case, the primary motivating factor for merging is not diversification, but achieving greater economies of scale.

6. MANAGING THE COVARIANCE BETWEEN THE ASSETS AND LIABILITIES

As discussed in Section 3, insurers often manage the total risk of their investment portfolio by holding a large proportion of risk-free assets. In theory, by removing the variance from the asset return, the covariance between the assets and liabilities is eliminated.

Unfortunately, the uncertain payment date of P/L liabilities creates covariance problems even in the presence of a risk-free investment portfolio. These covariance problems stem from the well-known issues of interest rate risk and reinvestment risk.

In response to interest rate risk, P/L insurers have utilized various asset/liability management strategies. To the extent that asset/liability management is possible, it reduces the required capital – which can be important for insurers with positive costs of raising and holding capital.

In practice, two fundamental issues arise with regard to asset/liability matching. First, given the highly variable nature of the amount and timing of insurance payouts, many authors have seriously questioned whether A/L management is even feasible [7, p. 500]. Second, one must determine exactly what to hedge, which is certainly not a trivial issue. If the major risk of the insurer's bond portfolio is uncertainty in the real interest rate, A/L matching represents the safest strategy. Conversely, if the major risk is uncertainty in the future inflation rate, short term investing is the safest approach [3, p. 659]. Until these questions are resolved with more certainty, A/L management will not effectively reduce risk.

7. GUIDELINES FOR EFFECTIVE RISK MANAGEMENT

In a broad sense, the "fair" P/L insurance premium can be given by the following formula: fair premium = discounted value of expected losses and expenses + risk management costs.[19] In this formula, risk management costs include all the *net* costs of managing total risk. For example, assume that the insurer manages risk by holding internal capital and purchasing reinsurance. The total risk management costs would include the net cost of capital necessary to support the policy (that is, double taxation, agency costs, and asymmetric information) as well as the net cost of reinsurance.

This pricing formula highlights the critical importance of cost-efficient risk management: an insurer that efficiently manages total risk will possess a pricing advantage over other insurers. Moreover, increased competition from advanced risk management techniques, such as self-insurance and captives, will force equilibrium prices down. At the limit, the competitive P/L insurance price for many lines[20] will simply

[19] Myers and Kollar have devised a similar pricing formula. The relation of this pricing formula to other common financial pricing models is discussed in Appendix B.

[20] Some lines, such as property cat coverages, will invariably require positive net risk management costs. Specifically, the convexity problem for these coverages will require some combination of costly internal capital, reinsurance, or cat options.

become the capitalized value of expected losses and expenses under the policy; that is, insurance will become a zero-NPV transaction for the buyer.

Producing a quantitative model for minimizing net risk management costs is difficult. For example, how does one quantify the net costs of agency issues or asset/liability management? Moreover, these costs will certainly vary considerably across firms.

As such, the final section does not attempt to derive a quantitative solution, but does offer some general guidelines for maintaining a low risk management cost structure. The first three guidelines apply to individual insurers; the fourth is an industry-wide guideline.

Limit Net Costs of Capital

In theory, if the net costs of raising and holding capital were nonexistent, the insurer could eliminate the need for other risk management methods. For example, there would be no benefit to underwriting diversification, either through mergers or otherwise: any additional capital needed to mitigate risk in the undiversified firm would have a net cost of zero. While it may not be possible to completely eliminate the net cost of capital, an insurer or reinsurer can still take action to significantly limit these costs. Of the three potential sources of capital costs, two can be largely reduced, namely double taxation and agency costs. Asymmetric information is largely outside the control of the individual insurer.

First, double taxation can be managed by prudent investment strategies. As mentioned earlier, it is possible to devise an optimal asset allocation to eliminate the effect of double taxation (ignoring convexity problems for extremely volatile lines). Moreover, most of the taxes paid by P/L insurers in recent years are voluntary taxes. That is, insurers are often motivated to realize investment gains unnecessarily to "dress up" the income statement. The author even heard recently of one insurance company that sold a portfolio of bonds and stocks at a profit at year-end,[21] paid taxes on the gain, then repurchased substantially the same

[21] The cash from the sale was not needed to pay losses or expenses.

portfolio. In order to compete with efficient insurance alternatives (namely, self-insurance and large deductibles for primary insurers and cat options and bonds for reinsurers) insurance firms must end the obsession with accounting earnings and focus instead on economic value.

Second, insurers must establish effective internal controls to reduce agency costs of capital. In today's active market for corporate control, insurers with ineffective internal controls and high expense ratios will quickly become targets for takeover. In other words, if insurers don't reduce their agency costs, capital markets will.

Bigger is Better

The last several years have seen an inexorable consolidation in the financial and insurance industries. The earlier discussion mentioned two possible reasons for the merger wave: gaining the benefits of diversification and achieving economies of scale. There may be limits of course, to the potential economies of scale. George Stigler describes these "diseconomies" of scale with the following analogy [32, p.159]:

> *This source of inefficiency of large size is given little weight in the popular literature: size is almost equated with efficiency. Yet anyone who watches a line of automobiles start forward as a traffic light changes will be impressed by how each additional driver starts a little later than his predecessor, so it takes considerable time for the motion to be communicated to the twentieth car, even when all the drivers can see the light change. This same slack is encountered in large organizations…*

Still, perhaps new computer and communications technologies have increased the minimum efficient scale for a P/L insurance company, with insurers scrambling to achieve this new efficient size. As such, insurers should not rule out merger opportunities, especially opportunities that offer both scale and added diversification.

Compare Reinsurance with Cat Options and Bonds

For volatile lines, the convexity costs of holding capital are often substantial. Insurers should then look to traditional reinsurance, cat options, or cat bonds to mitigate the volatility of these coverages. As with many other purchasing decisions, it pays to shop around. Insurers with relatively typical loss portfolios may lower credit risk and moral hazard costs by purchasing cat options.[22] If traditional reinsurance is selected, the cedant should look for a reinsurer that successfully manages it tax liability; hence, the importance of managing double taxation is especially important for reinsurers.

The Threat of Increased Federal Taxes

The 1986 Tax Reform Act modified the P/L insurance industry's tax structure by introducing proration of tax-exempt bond income, discounting of loss reserves, and the alternative minimum tax. As already mentioned, in order to compete effectively with newer, tax-efficient rivals, such as self-insurance (primary insurers) and cat options (reinsurers), P/L insurers must maintain a low tax burden. Unfortunately, policymakers in Washington continue to look for more methods to extract higher tax receipts from the industry. President Clinton, for example, recently proposed increasing the proration rate on tax-exempt bond income from 15% to 30% [4]. One can even envision political proposals to tax insurer's unrealized capital gains or limit the use of tax carryovers.

In order to remain relevant and maintain a level playing field, P/L insurers must push for a favorable tax structure. In addition to resisting political proposals to increase the effective tax rates for insurers, the industry should push for positive reforms as well. For instance, Jaffe and Russell discuss the idea of allowing insurers to accumulate tax-sheltered reserves to finance catastrophe losses [15]. Harrington points out that "this change would reduce the tax costs of holding capital and mitigate problems associated with

[22] To the extent that basis risk has increased, however, the insurer will require more internal capital. But if the insurer is following the previous guidelines for maintaining a low net cost of capital, the cost of the additional internal capital will be low.

possible loss of tax shields." [13] The industry must actively push for such proposals, and make sure that its side is heard in the political debate.

8. CONCLUSION

The importance to insurers of cost-effective risk management will continue to grow as competition intensifies from both within and outside the industry. Insurers that implement and maintain a cost-effective risk management program will achieve a pricing advantage in the marketplace. Insurers plagued with tax-inefficient investment strategies and agency costs will not survive in the long run.

This paper has presented both a rationale and an impetus for P/L risk management. Moreover, the four major categories of risk management were presented and evaluated. The paper did not, however, present a formal theory of risk management, but only a set of general guidelines. In order to develop a more formal, testable theory, more research must be performed on critical issues such as optimal P/L insurance asset allocation, the significance of agency costs, and the role of mergers in reducing risk.

APPENDIX A: THE IRRELEVANCE OF INVESTMENT POLICY IN PERFECT MARKETS

Financial managers and CFOs of nonfinancial firms are faced with the very practical issue of determining the "optimal" amount of debt financing. Donald Chew has noted that investment bankers, when marketing debt securities to CFOs, "begin as a matter of course by demonstrating the positive effects of such instruments on EPS and ROE." Chew then explains the catch: "Because increased leverage means not only higher expected returns but also higher risks for equity investors, it is doubtful that such leveraging of EPS and ROE has any positive effect on stock prices." [6]

CFOs of insurance companies face a slightly different issue. Whereas CFOs of industrial firms must choose the best capital structure for a given corporate investment strategy, CFOs of insurance companies must select the "best" asset portfolio for a given capital structure. Insurance company CFOs are confronted by sales pitches from various asset managers promising to increase the investment return from the asset porfolio. Unfortunately, the higher expected returns are generally offset by higher risks, leaving stock price unchanged.

In other words, we can say (more formally) that increasing the riskiness of the investment portfolio increases both the expected return and the beta of the insurance company's equity in lockstep. The beta of the investment portfolio is defined as the covariance of the return on the asset portfolio and the return on the market portfolio, divided by the variance of the return on the market portfolio. As such, it is no surprise that we can use the CAPM to prove that asset allocation is irrelevant in perfect markets.

For simplicity, assume that the insurer will pay a *certain* loss payment of L at the end of one year, and that this payment is risk-free both before and after the change in investment strategy. The original asset allocation is comprised entirely of one-year, zero-beta government debt. The modified asset allocation has a beta greater than zero. The following symbols are utilized in the proof: r_f = risk-free rate of interest; r_m =

expected return on market portfolio, B = beta, m = market price of risk as defined in the certainty equivalent version of the CAPM = $(r_m-r_f)/Var(r_m)$. The proof proceeds as follows:

A_1 = value of asset portfolio at end of year

Vb = market value of equity prior to investment change = $[A_0(1+r_f) – L – mCov(A_1,r_m)] / (1+r_f)$

$= [A_0(1+r_f) – L] / (1+r_f)$

$= A_0 – [L / (1+r_f)]$

Va = market value of equity after investment change (B > 0)

$= [A_0(1+r_f+B(r_m-r_f)) – L – mCov(A_0(1+r),r_m)] / (1+r_f)$ (Note: r is the expected return on the asset portfolio with beta of B>0)

$= [A_0(1+r_f+B(r_m-r_f)) – L – A_0(r_m-r_f)B] / (1+r_f)$ (Note: this step follows from the fact that $Cov(A_0(1+r),r_m) = A_0Cov(r,r_m)$)

$= A_0 – [L / (1+r_f)]$

APPENDIX B: RELATIONSHIP OF SECTION 7 PRICING FORMULA TO OTHER FINANCIAL PRICING MODELS

Section 7 provides the following formula for a competitive P/L insurance premium:

Premium = Present Value of Expected Losses and Expenses + Risk Management Costs.

Specifically, risk management costs include the net cost of capital, reinsurance, and other hedging instruments. How does this formula compare to two common financial pricing models: (1) the DCF, or Myers/Cohn, model, and (2) the option pricing model?

First, consider the simplified case where there are no risk management costs, including no federal taxation. In this case, both the DCF formula and the Section 7 formula reduce to the following:

Premium = Present Value of Expected Losses and Expenses.

The original Myers/Cohn model proposed utilizing the CAPM to determine the discount rate for expected losses and expenses. But the authors were quick to point out that the model itself did not depend on the CAPM: any other method for determining the discount rate could be used.

In particular, this discount rate can be determined by contingent claims analysis. Specifically, Merton utilized contingent claims analysis to derive a specific formula for the (promised) yield on a risky debt payment as a function of the following four items: (1) the risk-free rate of interest, (2) the maturity of the payment, (3) the volatility of the firm's assets, and (4) the ratio of the present value (at the risk-free rate of interest) of the promised payment to the current value of the firm [20, p. 395].

Since Merton's analysis hinges on the same assumptions as the option pricing model, utilizing the Merton formula renders the DCF method (and the Section 7 method) equivalent to the option pricing method.[23]

[23] Applying the Merton formula in practice is difficult, since most P/L liabilities involve multiple payments in several time periods. See Merton's discussion on applying the formula to coupon bonds [20, pp. 409-411]. Of course, this problem is also a large obstacle to utilizing the option pricing method in practical situations.

This should not be surprising. The three methods should give similar answers because they are all tackling the same problem: determining the present value of a risky debt claim.

D'Arcy and Gorvett [8] have pointed out, however, that the DCF and option pricing models give widely different answers in the presence of federal taxes. But both methods – as well as the Section 7 method – are still working under the same underlying assumption. In the presence of taxes, both models dictate that the competitive premium equals the present value of a risky debt claim (that is, the policyholders claim) plus the present value of the federal government's tax claim on the business. So why the different answers?

Here, the differences arise not from fundamentally different approaches, but from different assumptions regarding federal taxes. These differences are closely related to the Section 3 discussion on taxation and convexity. Specifically, the option pricing model assumes a tax structure akin to the Figure 1 graph: no tax carryovers are possible. Conversely, the DCF model assumes a Figure 2 tax structure: perfect carrybacks and carryforwards. On the basis of the discussion in the text, the option pricing method would be better suited to the coverages for which convexity is a problem, such as earthquake and property cat coverage. The DCF model would be better suited to typical P/L lines.

Moreover, both the DCF model and the option pricing model have traditionally overstated the impact of double taxation: neither model incorporates the reality that insurers can manage their asset portfolio to minimize the impact of federal taxes. As mentioned in Section 3, an optimal asset allocation will eliminate the problem of double taxation.

Lastly, all three models should easily handle the additional risk management costs, such as the cost of agency issues, A/L management strategies, or reinsurance. One simply adds these costs on the back end. The problem, of course, involves estimating these costs and allocating them by policy.

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