PRICING FOR CREDIT EXPOSURE

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Abstract

This paper incorporates financial theory with insurance pricing. A general procedure to price for credit exposure has been developed and extended to several insurance products. For retrospectively rated insureds with a below-investment-grade rating from a credit rating agency, the credit exposure is significant to the insurer. If this exposure is ignored, operating results may be negatively affected, as it is likely that some additional premium amounts will not be collected. The principles of credit exposure pricing can be extended to the pricing of surety bonds as outlined in Section 6. In addition, the concepts outlined in this paper may be used to: 1. establish a bad debt reserve for GAAP statements; 2. provide insurance regulators with an additional method to determine collateral requirements; 3. estimate surety bond loss ratios; and 4. provide banks with an additional methodology to price letters of credit which collateralize unpaid claim liabilities.

1. INTRODUCTION

The term "credit exposure" is defined as the possibility that one entity will suffer a financial loss due to the inability of a second entity to satisfy its contractual obligations (as a result of the poor financial health of the second entity). Credit exposure, as it relates to underwriting activities of property-casualty insurance companies, refers to the possibility that the insurance company may not be able to collect premiums, deductibles, and other charges when due. This paper will focus on the credit risk associated with issuing retrospectively rated policies and will outline a procedure to price this credit exposure. In addition, the credit exposure pricing

model will be extended to other areas of credit risk exposure, such as surety bond pricing.

For retrospectively rated policies, the insurance company collects premium from the insured based on paid or incurred losses until all claims are closed, or until the insured and insurance company agree on a price to end the retrospective accountings. Thus, if the insured files for bankruptcy, the insurance company may not be able to collect all the additional retrospective premiums due. These additional premiums represent a credit exposure to the insurance company. The insurance company may be obligated to pay claims associated with the expired policy even though additional premiums are not forthcoming.

The discussion below is divided into six sections. Sections 2 through 5 deal with the credit exposure associated with retrospectively rated policies. Section 6 describes a pricing model for surety bonds. Section 7 discusses additional applications of the credit exposure pricing model.

2. MAGNITUDE AND QUALITY OF THE CREDIT EXPOSURE

The magnitude of the credit exposure refers to the absolute amount of the expected additional premium due the insurance company on expired policies. Credit exposure results from the nature of retrospectively rated plans. For incurred loss plans, an insured typically receives a return premium at the first retrospective accounting, and thereafter the insured pays additional premium to the insurance company as losses develop. This procedure is similar to the insurance company "lending" the insured the difference between ultimate premium and the collected retrospective premium. This difference between the ultimate premium and the collected premium defines the magnitude of the credit exposure.

For an incurred loss retrospectively rated plan, the insurance company collects standard premium during the first 12 months of the policy period. At 18 months and annually thereafter, a retrospective accounting is performed via the following formula:

$$R_t = (B + (C \times E) + (C \times L_t)) \times T . \tag{2.1}$$

R_t is the retrospective premium at time period t and is subject to a maximum and minimum premium. The maximum and minimum premiums are factors of the standard premium.

B is the "basic charge" and covers expenses, profit, and the insurance charge. The basic charge is determined by a factor multiplied by standard premium. The factor C is the loss conversion factor and covers a load for loss adjustment expenses. E is the charge for limiting losses for individual claims that enter the retrospective rating formula. T is the tax multiplier and covers premium tax and some premium-based assessments. The tax multiplier and basic charge may also include a provision for residual market assessments.

L_t is the aggregate case incurred loss amount at time t, limited by the per claim amount. Thus, there is no provision for incurred but not reported (IBNR) losses in the standard incurred loss retrospective rating formula.[1] The magnitude of the credit exposure is proportional to the IBNR.

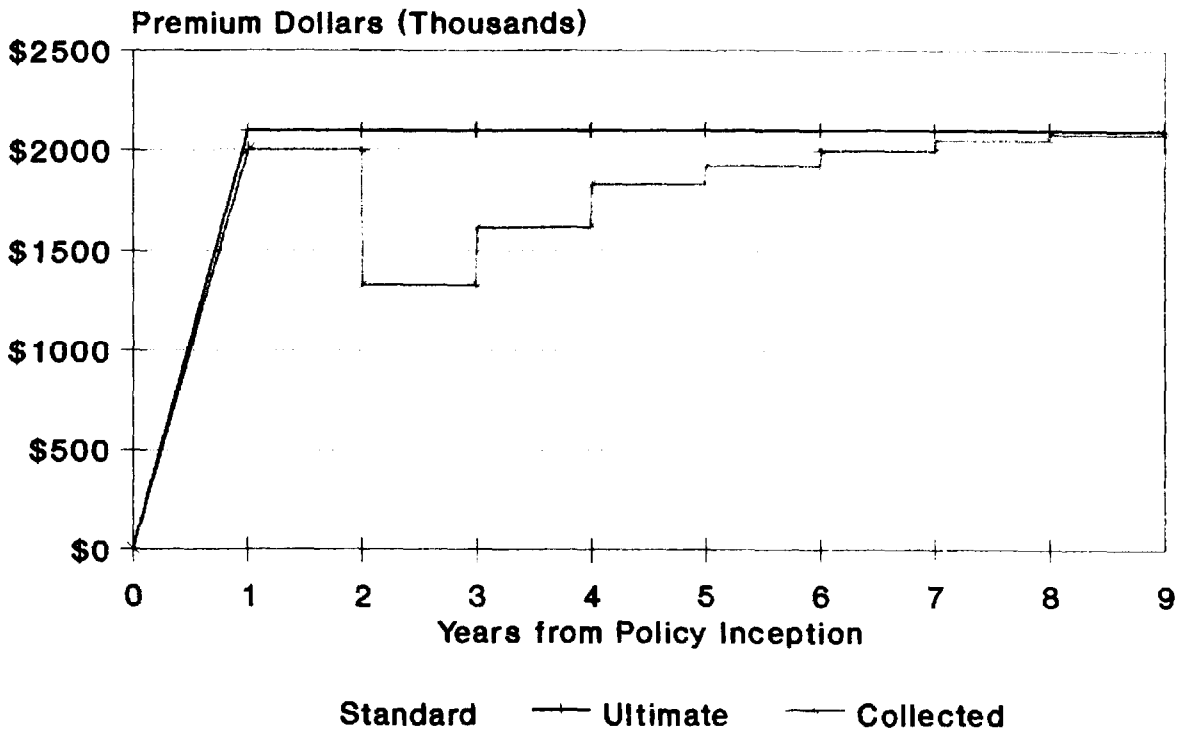
Figure 1 displays the projected transfer of funds for a standard incurred loss retrospectively rated plan. In this example, it is assumed that the insured is written for a one-year term and does not renew. The retrospective rating parameters and incurred loss development pattern are shown on Exhibit 1. For simplicity, the tax multiplier and loss conversion factor are both set equal to one. These assumptions do not affect the conclusions of the paper.

Exhibit 2 displays the amounts underlying the graph on Figure 1. The insurance company collects $2.0 million in standard premium during the first year. The first retrospective accounting is performed with incurred losses evaluated as of 18 months and $674,000 is returned to the insured.[2] Over the next seven years, the insurance company will collect the difference between the ultimate retrospective premium ($2.1 million) and the first retrospective accounting premium ($1.326 million), or $774,000. The

[1] IBNR is defined to include both incurred but not reported losses as well as development on existing case reserves.

[2] The example in this paper assumes that the billing and collection process takes six months. Therefore, the insurance company will return funds to the insured as of 24 months.

FIGURE 1
STANDARD INCURRED LOSS RETRO PLAN
INSURED WRITTEN FOR ONE YEAR



$774,000 is the credit exposure as of 24 months and, in essence, represents a loan by the insurance company to the insured. If the insured filed for bankruptcy 25 months after the inception of the retrospectively rated policy (one month after the insurance company returned funds to the insured), the insurance company could suffer a future earnings loss equal to $774,000.

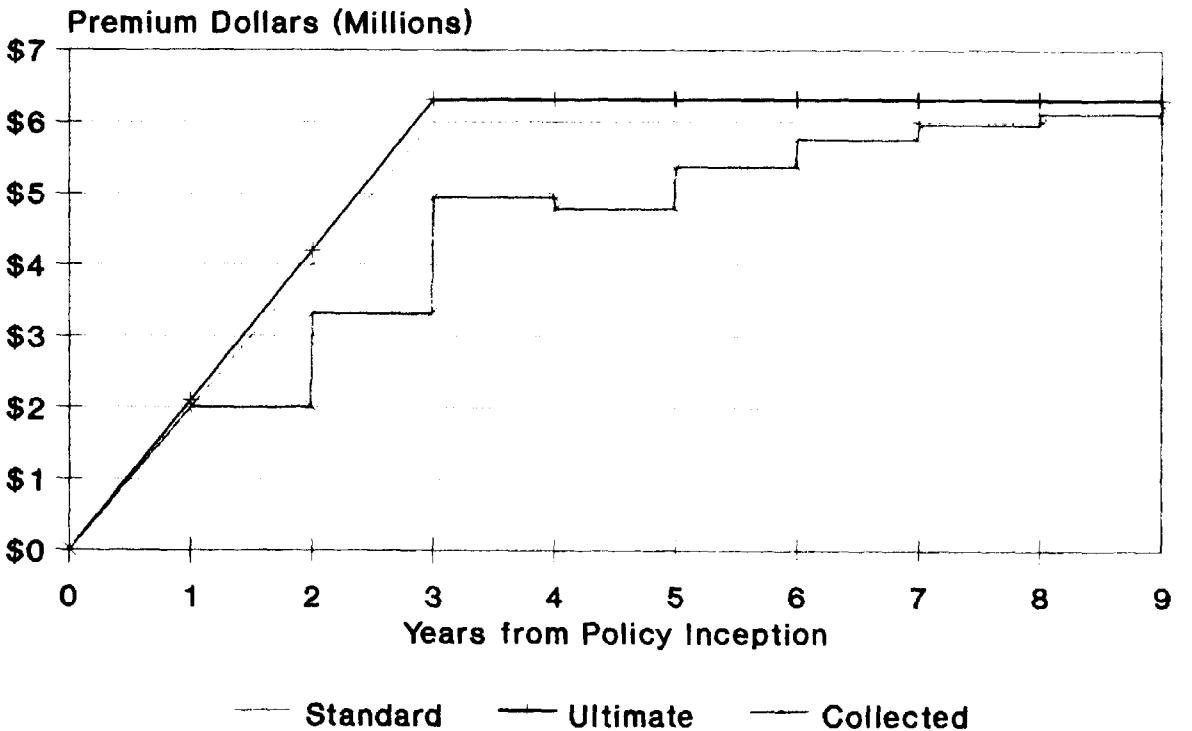
The credit exposure decreases as losses develop (assuming the insured pays the premium when due). The exposure equals zero when the insured pays the ultimate premium.

The magnitude of the credit exposure for a specific insured at a specific point in time depends upon how much premium is yet to be collected. In general, the quicker the premium is collected, the smaller the credit exposure. Thus, plans with low loss limits will have a smaller credit exposure.

Figure 2 displays the situation where the insurance company insures the above-mentioned risk for three years at a standard premium of $2.0 million a year, and then the insured non-renews. Exhibit 3 displays the numerical backup for Figure 2. The collected premium at Year Two, $3.326 million, equals the first retrospective accounting premium of $1.326 million for the first year of the three-year period plus the $2.0 million in standard premium for the second year of the three-year period. The credit exposure is largest at Year Four, after all policies have had a retrospective accounting. The credit exposure at Year Four (four years after the inception of the first policy) is $1.53 million or 76.5% of the annual standard premium.

The National Association of Insurance Commissioners (NAIC) has recognized the significance of credit exposure and has altered the statutory Annual Statement twice in the last four years in order to provide more information on credit exposure. The 1988 Statement was altered to display the amount of additional premium that an insurance company anticipates collecting on retrospectively rated plans. Line 9.3 on page 2 of the Statement or line 33 on page 8 displays the additional premium amount (Accrued Retrospective Premium). Beginning in 1988, the Statement also required companies to display the amount of letters of credit,

FIGURE 2
STANDARD INCURRED LOSS RETRO PLAN
INSURED WRITTEN FOR THREE YEARS



collateral, and other funds that secure the accrued retrospective premiums (General Interrogatory # 31). In 1991, the Statement required that 10% of the amount of unsecured accrued retrospective premium be recorded as a non-admitted asset. These changes show that the NAIC recognizes the possibility that the additional premium due may not be collectible. The collectibility of the additional premium is a function of the quality of the credit exposure.

Francis Hope stated that "negative reserves; i.e., the anticipation of additional premium due the company, [should] be included in the Annual Statement, provided that one is fully confident that the money is truly forthcoming." [1] Hope probably intended this statement to refer to the accuracy of the retrospective premium reserve; however, it is equally important that the monies due the insurance company be collectible. Amounts due the insurance company may be uncollectible due to the insured's financial condition.

The quality (collectibility) of the credit exposure is largely determined by the insured's financial condition. If the insured files for bankruptcy, the insurance company may not be able to collect additional premium. Clearly, an insured in a strong financial position at policy inception is less likely to file for future bankruptcy than an insured in a poor financial position at policy inception. Section 3 outlines several methods to determine the financial condition of an insured.

Nationally, credit exposure has increased as the financial strength of American companies has decreased. The middle 1980s saw a large increase in the number of leveraged-buyouts (LBOs). The LBO activity resulted in companies replacing equity with debt, and, therefore, the financial strength of these companies has decreased. Bonds rated Caa by Moody's—the bonds closest to default—increased from $7.2 billion at December 1987 to $23.7 billion by March 1990. [2] For non-financial corporations, net interest expense as a percentage of earnings before interest and taxes rose from 18.2% in 1979 to 42.9% by year-end 1989. These statistics display the decrease in the credit quality of American corporations. Thus, insurance companies may not be able to collect as much retrospective premium on policies of the 1980s because relatively more insureds may file for bankruptcy.

3. ANALYZING THE QUALITY OF THE CREDIT EXPOSURE

This section outlines two approaches that can be used to determine the financial strength of a commercial insured:

1. ratio analysis; and
2. independent rating agencies' ratings.

Ratio Analysis

Ratio analysis depicts relationships between accounts on a firm's financial statement. The ratios can be used to measure a firm's financial health. Ratios can be classified as liquidity ratios, equity ratios, and profitability ratios.[3]

Liquidity ratios measure a firm's short-term debt paying ability. One commonly used liquidity ratio is the *current ratio*. The current ratio is a firm's current assets divided by its current liabilities. Short-term creditors use the current ratio to financially underwrite accounts. All other things being equal, the higher the current ratio, the more likely a firm will be able to pay its short-term debts. Even though credit exposure is similar to long-term debt, an insurance company will be interested in the liquidity ratios because if a firm cannot pay short-term debts it may not be able to pay long-term debts.

A commonly used equity ratio is the *debt-to-equity* ratio which measures the amount of relative debt of a firm. The higher the debt-to-equity ratio, the more financially leveraged the company. Since the company must eventually repay the debt, a company with a relatively high debt-to-equity ratio may not be able to pay additional insurance premium if the company falls on hard times.

A commonly used profitability ratio is the *times-interest-earned ratio*. The ratio is:

$$\text{Times Interest Earned} = \frac{\text{Income Before Interest and Taxes}}{\text{Interest Expense}}.$$

[3] Another classification of ratios is market ratios; however, these ratios are more relevant for investment decisions than for credit quality analysis.

A firm that cannot pay its interest payments when due will eventually have financial problems. The higher the times-interest-earned ratio, the more money a firm will have available for general corporate purposes. Therefore, a firm with a high times-interest-earned ratio is not likely to default on premium payments in the near future.

A financial analyst can use these ratios as tools to evaluate the credit exposure of a prospective or current insured. These ratios have "rule-of-thumb" levels at which the firm is considered to be potentially deficient. As a technical note, the rule-of-thumb levels vary considerably by industry, and financially underwriting accounts is a complex procedure which often cannot be based solely on financial ratios. Therefore, for accounts that possess a significant credit exposure, the analyst should review all of the firm's published financial information (annual reports, 10-Ks, etc.) and meet with a financial officer of the firm. A firm's ratios may be acceptable; however, the firm may have a significant receivable from another firm in poor financial condition. Only the notes to the financial statements will highlight such a problem.

Independent Rating Agency Ratings

Several independent rating agencies rate the credit quality of companies. Insurance companies can use the agencies' ratings to supplement ratio analysis in order to determine the quality of the credit exposure. If the retrospective rating plan for a particular insured has a small credit exposure, it may be more cost effective for the insurance company to rely solely on the agency ratings. Three possible agency ratings are those of Moody's, Dun & Bradstreet, and Standard & Poor's.

Moody's publishes corporate bond ratings indicating the degree of default risk associated with a bond. The default risk on bonds may be similar to the default risk for retrospective premium payments because both are long-term obligations. Moody's bond ratings vary from Aaa (where interest payments are protected by a large and stable margin and the bond principal is secure) to C (the lowest class of bonds where the prospect of the bonds ever attaining any real investment standing is extremely poor).

Dun & Bradstreet provides credit ratings on three million domestic and foreign firms. Dun & Bradstreet's *Business Information Report* contains a summary section on each firm. The summary section includes a review of the company's financial condition and its sales and earnings trend along with the firm's payment record, as reported by suppliers. The report also includes other financial and operating information. Dun & Bradstreet supplies a composite credit approval rating from 1 to 4, with 1 being the highest rating.

Standard & Poor's publishes bond credit quality ratings. Standard & Poor's bond ratings vary between AAA and D. AAA is the highest rating and signifies that the capacity to pay interest and principal is extremely strong. A rating of D indicates that the firm has defaulted on interest or principal payments.

4. CURRENT INDUSTRY PRACTICES FOR MINIMIZING CREDIT EXPOSURE

The insured's financial condition will determine the quality of the credit exposure. For firms in excellent financial condition, the insurance company may believe it is not necessary to recognize the credit exposure. I will show later that the risk of default for firms in excellent financial health is minimal, so that it may be reasonable to ignore credit exposure for these accounts. However, for firms in average or below-average financial condition, the insurance company may want to take steps to reduce its credit exposure.

The insurance company can reduce credit exposure by:

1. not offering retrospectively rated plans;
2. requiring collateral for anticipated additional retrospective premiums; and
3. altering the cash flow parameters of retrospectively rated policies.

For very large accounts, the first option of not offering retrospectively rated plans and still writing the account is not feasible. Most large insureds believe that their loss experience should determine their premium payments. Even though the experience rating plan reflects loss experi-

ence, the insureds recognize that retrospectively rated plans will reflect favorable loss experience earlier and more directly.

The second option to reduce the credit exposure is for the insurance company to require collateral from the insured. A letter of credit (LOC) or surety bond may be obtained to secure additional premium amounts. This, in essence, transfers some or all of the credit exposure to the bank or surety.

For example, the insurance company may request collateral equal to the ultimate premium less premium paid to date. Thus, if the insured defaulted at any time, the insurance company's credit exposure would be fully collateralized. The insurance company could exercise the collateral and collect all expected future amounts due. However, if losses developed higher than anticipated, the insurance company may suffer an earnings loss.

For firms in below-average financial condition, the insurance company may require collateral equal to the maximum premium less premium payments to date. The additional collateral could be required due to the greater variability of ultimate losses for firms in poor financial condition. For example, firms in poor financial condition may be more likely to lay off workers and overlook loss control in order to cut costs. These measures may increase the variability of ultimate losses.

Finally, insurance companies may alter the cash flow of the retrospectively rated plan in order to minimize the credit exposure. Two ways to alter the plan are:

1. modify the funding of the retrospectively rated plan; and
2. use loss development factors to project losses used in the retrospective rating formula.

The funding for incurred loss retrospective rating plans could be modified in order to minimize the credit exposure. For example, a plan could be designed such that the insured pays full standard premium the first year, with no funds changing hands until 42 months, even though retrospective accountings are performed at 18 and 30 months. Using the figures on Exhibit 2, this plan would reduce the credit exposure from

$774,000 at Year Two to $100,000, as collected premium would equal $2 million until Year Four. At Year Four and subsequent, the credit exposure under the revised program would be identical to the credit exposure in Exhibit 2. While this approach does not eliminate the credit exposure, it substantially reduces the exposure for the first three years after policy inception. In return for holding onto the insured's cash for a longer period of time, the insurance company could increase the dividend amount. The dividend payment could be increased by the amount of additional investment income earned on the incremental funds from 18 to 42 months. The incremental funds are the standard premium less the normally calculated retrospective premiums from 18 to 42 months.

The retrospective rating plan could incorporate incurred loss development factors to minimize the credit exposure. The development factors would be applied to the incurred losses at 18, 30, and 42 months. These factors would be used to develop the losses that enter the retrospective rating calculation to an estimated ultimate level. Therefore, the expected credit exposure would be zero at 18, 30, and 42 months because collected premium will equal ultimate premium. This analysis ignores any variation in development factors by account. As in the preceding option, the dividend amount could be increased for the additional investment income earned by the insurance company.

5. PRICING THE CREDIT EXPOSURE

This section outlines a new method to price the credit exposure on retrospectively rated policies utilizing a financial risk charge (herein referred to as Charge). The Charge is intended to provide sufficient funds to the insurance company to offset the expected loss of funds (on a present value basis) due to premium defaults. This section assumes that the Charge will be an addition to the basic premium. Alternatively, the Charge could be incorporated through a dividend reduction. The dividend reduction Charge calculation is similar to the additional premium calculation. However, the present value analysis would be different because policyholder dividends typically are first paid 18 months after policy inception, as opposed to the basic premium which is usually collected at policy inception.

The Charge is largely a function of two factors:

1. the insured's financial condition; and
2. the nature of the retrospectively rated plan.

Insureds in poor financial condition at policy inception are more likely to default on future premium payments. In addition, the slower the loss development pattern, the more premium there is outstanding at any point in time. Hence, the relative magnitude of the credit exposure is larger in either case. In addition, there is a relationship between the development pattern and financial condition of the insured. The longer it takes to collect the ultimate premium, the more time there is for a good financial risk to turn bad. This is similar to the phenomenon in life insurance, where "select" risks deteriorate over time to average risks (in the aggregate). Thus, plans with low loss limits or plans that contain lines of insurance which develop quickly, will have a lower Charge. A paid loss retrospectively rated plan will have a relatively large Charge.

A formula for the Charge is developed below based on the insured's financial condition at policy inception for a three-line incurred loss retrospectively rated policy. The illustrative plan includes workers compensation, general liability, and automobile liability coverages. The parameters of the plan are displayed on Exhibit 1.

Moody's bond default probabilities were used to determine the probability of the insured defaulting on additional retrospective premium payments. The probabilities are published in "Corporate Bond Default and Default Rates." [2] As both bonds and additional retrospective premium payments are long-term obligations, bond default rates are used as a proxy for premium payment defaults. Moody's studied bonds by initial rating over a 20-year period in order to determine default probabilities by year and initial rating. A portion of Moody's table is reproduced in Table 1.

TABLE 1

AVERAGE CUMULATIVE DEFAULT RATES
(YEARS)

Bond Rating	1	2	3	4	5	6
Baa	0.2%	0.5%	0.9%	1.3%	1.7%	2.2%
Ba	1.7%	3.7%	5.5%	7.2%	8.9%	10.4%
B	7.0%	11.8%	15.9%	18.9%	21.1%	23.0%

The interpretation of the six-year value for B-rated bonds is that 23.0% of the bonds rated B at time period t will default by time period $t+6$. Moody's has defined default as any missed or delayed interest or principal payment. Thus Moody's default rates are a conservative estimate of retrospective premium defaults.

Moody's default probabilities are used for illustrative purposes. The Charge could be based on default probabilities from other rating agencies or other studies. All of the tools referenced in Section 3 can be used to determine the insured's financial condition and default probability.

The Charge can be calculated from Table 1 and an estimate of the incremental retrospective premium at each time period. On Exhibit 2, we can see an estimate of the incremental retrospective premium at specific points in time. For example, as of the second retrospective accounting, the insured will be billed \$288,000 (this is the estimated retrospective premium of \$1,614,000 at 30 months less the collected premium of \$1,326,000 at 18 months).

The financial risk Charge can be calculated as follows:

$$\text{Financial Risk Charge} = \sum_{t=3}^{\infty} P_t \times R_t/(1+i)^t, \tag{5.1}$$

where P_t = cumulative default probability through period t,

R_t = incremental retrospective premium at time t, and

i = an appropriate discount rate.

This calculation assumes that the basic premium will be increased by the amount of the Charge. Therefore, the calculation incorporates present value concepts (discounting) because the Charge is collected at policy inception, whereas the estimated premium defaults will occur over an extended period of time.

The time index begins three years after policy inception, as the financial exposure prior to the third year for standard incurred loss retrospectively rated plans is usually small. If the insurance company financially underwrites accounts, it is unlikely that the insured would file for bankruptcy in the first year-and-a-half after policy inception. In addition, at the first retrospective accounting, the insurance company typically returns funds to the insured because the first retrospective accounting premium is less than the standard premium.

The Charge calculation for an account with a Baa bond rating by Moody's and a premium payment vector as on Exhibit 2 is outlined on Exhibit 4. Column 1 on Exhibit 4 is the collected premium from Exhibit 2. Column 2 is the incremental collected premium, the additional premium the insurance company anticipates collecting at each accounting. Column 3 is the cumulative default probability based on Moody's default rates. Column 4 is the expected default amount which is Column 2 multiplied by Column 3. Column 5 is the present value of the expected default amount. For illustrative purposes, a 6% discount rate is used.

As displayed on Exhibit 4, the Charge for an insured with a senior unsecured bond rating of Baa and an anticipated premium collection vector as on Exhibit 2 is only 0.43% of standard premium (the sum of Column 5 divided by standard premium). Thus, the current industry practice, of not collateralizing the additional retrospective premium of insureds in good financial condition, may not be unreasonable. Insureds rated above Baa will have a lower Charge.

However, for an account with a premium vector as contained in Exhibit 2 and a bond rating of B (which is below Baa), the Charge is 5.7% of standard premium (Exhibit 5). Moody's report did not calculate default rates for firms with ratings below B; however, these companies would probably have a Charge significantly above 5.7%. Exhibit 6 displays the

Charge calculation for a *paid* loss retrospectively rated plan for a firm whose bonds are rated B. Thus, the only difference between Exhibits 5 and 6 is the type of plan. As discussed previously, the Charge for a paid loss plan will be greater than the Charge for an incurred loss plan due to the slower premium collection pattern for the paid loss plan. For the paid loss plan displayed on Exhibit 6, the Charge is 10.2% of standard premium. The magnitude of this change indicates that ignoring the credit exposure on certain accounts may result in loss of earnings. This analysis assumes that the insurance company does not require any collateral (e.g., LOC) for the paid loss plan. If the insurance company receives collateral, the credit exposure would be reduced and, therefore, the Charge would be lower.

6. PRICING SURETY BONDS

A surety bond is an agreement by one party (the surety) to be responsible to another party (the obligee) for the conduct of a third party (the principal). If the principal fails to fulfill its obligation under the bond, the bond indemnifies the obligee for loss sustained as a result of such default, up to the amount of the bond.

Several states require employers who self-insure their workers compensation exposure to provide the state with a surety bond. If the self-insured employer files for bankruptcy, the surety is required to make loss payments in place of the self-insured employer. The surety's payments are limited by the face value of the bond. Some bonds are written such that the obligee can require the surety to make payment for the full face of the bond.

For self-insured workers compensation bonds, the bond price is a function of both the financial health of the self-insured employer and the payment pattern for losses. The concepts used to price credit exposure are directly applicable to pricing surety bonds. This section outlines a procedure to price surety bonds based on Moody's bond default probabilities and the workers compensation payment pattern displayed on Exhibit 7.

Exhibit 8 displays the pricing of a workers compensation self-insured bond, for a one-year period, for a company with a Moody's senior unse-

cured bond rating of B. The first column of Exhibit 8 displays the number of years from the time the bond was written. Column 2 displays the liability, or expected total needed reserves, by year. The total needed reserves equal case reserves plus IBNR reserves. Column 3 is the *incremental* default probability based on Moody's bond default rates. The incremental probabilities are utilized because it is assumed that the bond would be utilized to the full extent of the liability. Column 4 is the expected default in the year (Column 2 multiplied by Column 3). Column 5 is the present value (at a 6% discount rate) of the expected default stream. The sum of Column 5 is the discounted loss cost for this bond.

Based on this analysis, the loss cost for an insured with a Moody's bond rating of B purchasing a $1.8 million bond is $267,600 or 15% of the face of the bond. Insurance companies typically require collateral on surety bonds (e.g., an LOC) and the collateral will reduce the credit exposure and, therefore, the price of the bond. The bond price should include a provision for company expenses, loss adjustment expenses, and profit. Therefore, without collateral, the bond price would exceed 15% of the face value of the bond. This analysis ignores any recovery from the principal in a bankruptcy proceeding; therefore, the loss cost is conservative.

7. OTHER APPLICATIONS

The financial methodology outlined in this paper has several additional applications including:

1. Providing insurance companies a method to establish a bad premium debt reserve for GAAP statements;
2. Providing insurance regulators a method to determine collateral requirements for self-insured employers;
3. Providing insurance companies a method of estimating surety bond loss ratios; and
4. Providing banks an additional method to price letters of credit.

Estimation of Premium Bad Debt Reserve

The procedures outlined in Section 6 can be utilized to establish a bad debt reserve for expected premium defaults on retrospectively rated policies for GAAP statements. Referring to Exhibit 5, the expected default amount for this insured at policy inception is $149,200 (the sum of Column 4). The bad debt reserve for this account would then be the "earned" (based on pro rata earnings) portion of the $149,200. The expected default amount for the insured three years after policy inception is $59,140 (the calculation is displayed on Exhibit 9). The expected default amount should be calculated based on the insured's current bond rating and estimated premium collection pattern. The bad debt calculation should be performed by account and policy year and the results summed in order to estimate the bad debt reserve.

Collateral Requirements for Self-Insured Employers

The methodology outlined in this paper may help insurance regulators in determining collateral requirements for self-insured employers. As displayed in Exhibits 4 and 5, the Charge for an insured with a Baa bond rating (investment grade) is 0.43%, while the charge for an insured with a B rating (non-investment grade) is 5.7%, of standard premium. Insurance departments may want to institute a procedure whereby the face value of the surety bond as a percentage of total liabilities varies with the self-insured employer's bond rating. The Iowa workers compensation self-insurance statute [3] incorporates a somewhat related concept. In Iowa, an estimate of the self-insured employer's unpaid claim liability is multiplied by a ratio which varies from 0.00 to 1.00 in order to determine the indicated amount of collateral for the self-insured employer. The ratio is computed based on three financial ratios. A ratio of 0.00 indicates that the firm is in strong financial condition. The ratio gradually increases to 1.00 as the indicated financial condition of the firm deteriorates. As a technical note, Iowa does not rely solely on this procedure to establish collateral requirements. For example, there is a minimum bond requirement of $200,000.

State insurance departments will need to estimate default probabilities for employers not rated by Moody's or use a procedure which is similar to

the methodology used in Iowa. In addition, state insurance departments may want to require an actuarial opinion for an employer's self-insured liabilities. Insurance departments cannot determine an appropriate surety bond amount without an accurate estimate of the amount at risk, which frequently requires an actuarial opinion.

Surety Bond Loss Ratio

The procedures outlined in Section 6 can be utilized to determine a priori expected loss ratios for surety bonds. Referring to Exhibit 8, this insured has an expected loss of $286,000. Dividing by the premium charged gives the loss ratio. A similar calculation could be performed for all bonds written during the year and the results aggregated. A Bornhuetter-Ferguson projection method could then be used as one method to establish unpaid claim liabilities.

Pricing LOCs

The procedures utilized in Section 6 to price surety bonds can be used by banks to price LOCs collerateralizing insurance products. Typically, the insurance company will only draw down on the LOC in a bankruptcy situation and will draw the full amount of the LOC. Referring to Exhibit 8, the discounted loss cost of a $1.8 million LOC (supporting, for example, a deductible program) for an insured with a bond rating of B would be $267,600, or 15% of the LOC amount. This analysis assumes that the bank does not request collateral backing the LOC, and this analysis ignores expenses, profit, and any funds received in a bankruptcy proceeding.

8. CONCLUSION

As the number of financially related insurance products increases, it is important that financial theory be blended with actuarial pricing concepts. If the credit exposure associated with financially oriented insurance products is ignored, insurance company operating results will be negatively affected as insureds may default on some financial obligations (e.g., retrospective premium payments).

REFERENCES

[1] Hope, Francis J., Discussion of Fitzgibbon, "Reserving for Retrospective Returns," *PCAS* LIII, 1966, p. 185.

[2] Moody's Special Report: "Corporate Bond Default and Default Rates," April 1990.

[3] Workers Compensation Self-Insurance for Individual Employers, Iowa Administrative Code, Title 191, Chapter 57, pp. 1-6.

EXHIBIT 1

STANDARD INCURRED LOSS RETROSPECTIVE PLAN
REPORTING PATTERN

Assumptions:

Expected Losses = $1,800,000
Standard Premium = $2,000,000
Loss Conversion Factor (C) = 1.0
Tax Multiplier (T) = 1.0
Basic Charge (B) = 0.15
Lines of Insurance = Workers Compensation
General Liability
Automobile Liability
No Loss Limit

REPORTING PATTERN

Quarter	Incurred Losses as Percentage of Ultimate Losses
4	38%
6	57
10	73
14	85
18	90
22	94
26	97
30	99
34	100
38	100
42	100

EXHIBIT 2

STANDARD INCURRED LOSS RETROSPECTIVE RATING PLAN INSURED WRITTEN FOR A ONE-YEAR TERM*

Number of Years from Inception of Policy	(Amounts in Thousands) Ultimate Premium	Collected** Premium	Credit Exposure
1	$2,100	$2,000	$100
2	2,100	1,326	774
3	2,100	1,614	486
4	2,100	1,830	270
5	2,100	1,920	180
6	2,100	1,992	108
7	2,100	2,046	54
8	2,100	2,082	18
9	2,100	2,100	0

* Assuming insured non-renews after the one-year period.

** Assumes a two-quarter lag in collecting/returning funds. Standard Premium equals $2,000; Basic Charge equals 15%; Expected Losses equals $1,800; Loss Conversion Factor and Tax Multiplier equal 1.00.

EXHIBIT 3

STANDARD INCURRED LOSS RETROSPECTIVE RATING PLAN
INSURED WRITTEN FOR A THREE-YEAR TERM*
(AMOUNTS IN THOUSANDS)

Number of Years from Inception of Policy	Ultimate Premium	Collected** Premium	Credit Exposure
1	$2,100	$2,000	$ 100
2	4,200	3,326	874
3	6,300	4,940	1,360
4	6,300	4,770	1,530
5	6,300	5,364	936
6	6,300	5,742	558
7	6,300	5,958	342
8	6,300	6,120	180
9	6,300	6,228	72

* Assumes insured is written for three consecutive annual policy periods and then non-renews.

** Assumes a two-quarter lag in collecting/returning funds. Standard Premium equals $2,000; Basic Charge equals 15%; Expected Losses equals $1,800; Loss Conversion Factor and Tax Multiplier equal 1.00.

EXHIBIT 4

FINANCIAL RISK CHARGE
FIRM'S BOND RATING Baa
(AMOUNTS IN THOUSANDS)

Number of Years from Inception of Policy	(1) Collected Premium	(2) Incremental Collected Premium	(3) Cumulative Default Probability	(4) Expected Default Amount	(5) Economic* Cost of the Default
1	$2,000	—	—	—	—
2	1,326	$(674)	—	—	—
3	1,614	288	.009	$2.59	$2.17
4	1,830	216	.013	2.81	2.23
5	1,920	90	.017	1.53	1.14
6	1,992	72	.022	1.58	1.11
7	2,046	54	.026	1.40	.93
8	2,082	36	.031	1.12	.70
9	2,100	18	.035	.63	.37
Total				$11.66	$8.65

Financial risk charge as a percentage of standard premium =

$$\frac{8.65}{2,000} = 0.43\%$$

* At a 6% discount rate. For example, $2.17 = 2.59/(1.06)^3$

EXHIBIT 5

FINANCIAL RISK CHARGE
FIRM'S BOND RATED B
(AMOUNTS IN THOUSANDS)

Number of Years from Inception of Policy	(1) Collected Premium	(2) Incremental Collected Premium	(3) Cumulative Default Probability	(4) Expected Default Amount	(5) Economic* Cost of the Default
1	$2,000	—	—	—	—
2	1,326	$(674)	—	—	—
3	1,614	288	.159	$45.79	$38.45
4	1,830	216	.189	40.82	32.33
5	1,920	90	.211	18.99	14.19
6	1,992	72	.230	16.56	11.67
7	2,046	54	.244	13.18	8.77
8	2,082	36	.255	9.18	5.76
9	2,100	18	.260	4.68	2.77
Total				$149.20	$113.94

Financial Risk Charge as a percentage of Standard Premium =

$$\frac{113.94}{2{,}000} = 5.7\%$$

* At a 6% discount rate. For example, $38.45 = 45.79/(1.06)^3$

EXHIBIT 6

FINANCIAL RISK CHARGE
PAID LOSS RETROSPECTIVELY RATED PLAN*
FIRM'S BONDS RATED B
(AMOUNTS IN THOUSANDS)

Number of Years from Inception of Policy	(1) Collected Premium	(2) Incremental Collected Premium	(3) Cumulative** Default Probability	(4) Expected Default Amount	(5) Economic*** Cost of the Default
1	$606	$606	—	—	—
2	1,056	450	.118	$53.10	$47.26
3	1,398	342	.159	54.38	45.66
4	1,632	234	.189	44.23	35.03
5	1,758	126	.211	26.59	19.87
6	1,992	234	.230	53.82	37.94
7	2,046	54	.244	13.18	8.77
8	2,082	36	.255	9.18	5.76
9	2,100	18	.260	4.68	2.77
Total				$259.16	$203.06

Financial Risk Charge as a percentage of Standard Premium =

$$\frac{203.06}{2{,}000} = 10.2\%$$

* Assumes that the plan converts to an incurred loss plan at 66 months and that all premium is collected at the end of the fiscal year.

** Assumes that due to financial underwriting the insured will not default in the first year. As a related point, if the insured defaulted during the first year, the insurance company may not be responsible for the full year's claim liability.

*** At a 6% discount rate.

Note: Exhibit 7 displays the payment pattern.

EXHIBIT 7

WORKERS COMPENSATION
LOSS PAYMENT PATTERN
(AMOUNTS IN THOUSANDS)

Number of Years from Inception of Exposure	Ultimate Losses	Payout Pattern	Percentage Outstanding	Amount Outstanding
1	$1,800	17%	83%	$1,494
2	1,800	42	58	1,044
3	1,800	61	39	702
4	1,800	74	26	468
5	1,800	81	19	342
6	1,800	85	15	270
7	1,800	88	12	216
8	1,800	91	9	162
9	1,800	94	6	108
10	1,800	97	3	54
11	1,800	100	0	0

EXHIBIT 8

PRICING A SURETY BOND
FIRM'S BONDS RATED B
(AMOUNTS IN THOUSANDS)

(1) Number of Years from Inception of Exposure	(2) Liability*	(3) Incremental Default Probabilities	(4) Expected Default Amount	(5) Economic** Cost of the Default
0	$1,800	.070	$126.0	$126.0
1	1,494	.048	71.7	67.6
2	1,044	.041	42.8	38.1
3	702	.030	21.1	17.7
4	468	.022	10.3	8.2
5	342	.019	6.5	4.9
6	270	.014	3.8	2.7
7	216	.011	2.4	1.6
8	162	.005	0.8	0.5
9	108	.004	0.4	0.2
10	54	.004	0.2	0.1
11	0	.004	0.0	0.0
Total			$286.0	$267.6

* Assuming a one-year exposure period. The liability is equal to the total needed reserve. Total needed reserve equals case reserves plus IBNR, or ultimate losses less paid losses. The total needed reserves can be derived from Exhibit 7. This pricing is conservative as it assumes the insured goes bankrupt when the exposure is the largest.

** At a 6% discount rate. For example, $38.1 = 42.8/(1.06)^2$

EXHIBIT 9

BAD DEBT RESERVE THREE YEARS AFTER POLICY INCEPTION
FIRM'S BONDS RATED B
(AMOUNTS IN THOUSANDS)

Number of Years from Inception of Policy	(1) Collected Premiums	(2) Incremental Collected Premium	(3) Cumulative Default Probability	(4) Expected Default Amount
3	$1,614	—	—	—
4	1,830	$216	0.070*	$15.12
5	1,920	90	0.118	10.62
6	1,992	72	0.159	11.45
7	2,046	54	0.189	10.21
8	2,082	36	0.211	7.60
9	2,100	18	0.230	4.14
Total				$59.14

* This is the probability that the insured will default in the next fiscal year.

Note: Assumes that the insured has not defaulted through Year Three. As a technical note, the firm's current bond rating, not the firm's bond rating at policy inception, is used in the calculation.