TOWARD A CERTAIN EQUIVALENT DISCOUNTED CASH FLOW MODEL

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Toward a Certain Equivalent Discounted Cash Flow Model of Insurance Ratemaking in a Regulatory Environment

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A basic tenet of financial theory is the competitive market's ability to establish efficient and equitable prices for financial securities. The competitive price is a fair price because it generates a rate of return to stockholders that is adequate but not excessive. To understand how competitive markets establish prices, financial theorists have developed models that mimic competitive prices. Such models are relevant to insurance ratemaking because insurance is also a financial security. Although insurance contracts are not traded on organized exchanges, they are priced, in some states, under competitive conditions. In states where prices are regulated, a competitive pricing model would help regulators because of their responsibility to maintain adequate but not excessive prices. Rate models based on sound financial theory would also promote the public understanding of ratemaking procedures and establish a higher common ground for debate. Rather than debating the propriety of the ratemaking procedure, participants could focus on the best measures of model variables.

This paper presents a special application of the most basic of financial pricing models--the discounted cash flow model (DCFM)--to insurance ratemaking.[1] The issue of appropriate interest credits to policyholder supplied funds is addressed in the context of

[1] Recent examples of financial models applied to the ratemaking process include Doherty and Garven (1986), Garven (1988), Hill and Modigliani (1987), and Myers and Cohn (1987).

financial theory's "Theory of the Firm." In the end, we argue for a discount rate that approaches the risk-free rate, the special case of DCFMs known as the certainty equivalent approach.

A cornerstone of financial theory is the rule of present value. Every introductory finance textbook presents an example similar to the following: $105 accumulated in a savings account over the course of one year has the same value as $100 today if the interest rate is 5%. The difference between the $100 today and the $105 in one year is the so-called time value of money. The $100 is the present value of the expected cash flow of the savings account. It is also referred to as the discounted price or the capitalized price. The $105 is the future value of the expected cash flow.

The most important point, which is often lost in the mechanics of present value calculations, is that the discounted price is the market price today. The future value is "tomorrow's" market price. In a market where competition has established 5% to be a fair and equitable return for the suppliers of capital at this risk level, the only appropriate price for $105 to be received in one year is $100 today.

A DCFM of setting insurance rates is simply an application of this very basic financial principle. The insurance premium should be the present value (i.e. price) of expected future losses and expenses. Such a model is fundamentally sound and well known. The following issues, which habitually arise in regulatory debate, are addressed below in the context of the DCFM: 1) recognizing the appropriate credit claims of policyholders commensurate with their incurred risk, 2) determining the appropriate interest rate for

discounting expected future losses and expenses, and 3) developing a measure of profit comparability between insurance companies and other service related firms.

Credit Claims of Policyholders and Their Right to Fair Returns:

In order to understand the claims of policyholders, it is helpful to consider the financial structure of all publicly traded firms, regardless of their line of business, and then draw an analogy between these firms and insurance firms specifically. Using this Theory of the Firm approach we want to draw the analogy between bondholders of all firms and policyholders of insurance firms.

The cash flow generated by the assets of publicly traded firms are paid to two classes of security holders--bondholders and stockholders. Stockholders own the residual claim to asset earnings, and bondholders own the first claim. Both claims are financial securities that are priced in competitive markets by discounting their expected cash flows with an appropriate risk-adjusted rate.

The risk of the cash flows to the stockholders, however, is fundamentally different from the risk of the cash flows to the bondholders. Bondholders worry about, and are therefore compensated for, default risk. If a company manages its assets with superior skill, a higher return is not paid to bondholders. They simply earn the rate of interest that was contractually established in the covenants of the bond. Likewise, if the assets are managed with inferior skills, a lower return is not paid to

bondholders. With either superior or inferior management, the return to bondholders is the same. They simply earn the contract rate of interest. Only if inferior management leads to a long-term deterioration in the productive quality of the assets of the firm will bondholders incur losses--namely default.

Stockholders, in contrast, are worried about net income volatility. Unlike Bondholders, their return is not fixed. It is determined entirely by the skill with which the assets of the firm are managed. Stockholders have contracted with the bondholders to pay a specific rate of interest regardless of the skill with which the assets are managed. The contract does not allow the stockholders to renegotiate a lower rate of interest for the bondholders if management should generate a poor return on assets (ROA). If the bondholders are promised, for example, a return of 10%, but the assets generate an ROA of only 6%, the bondholders still receive their 10%. The stockholders, however, suffer from a return lower than even the ROA. The flip side, of course, is that stockholders will earn a return greater than ROA when ROA exceeds the bond rate of interest. This allocation of risk and return through financial leverage drives the pricing of bonds and stocks in the competitive capital markets.

Understanding the unique difference in the risks incurred by bondholders and stockholders is critical to understanding how their securities are priced (i.e. discounted). Where insolvency probabilities are low, the expected cash flow to bondholders is discounted at a rate approaching the risk-free rate of interest. However, under the same conditions, the expected cash flow to

stockholders is discounted with a rate substantially higher than the risk-free rate of interest. Even when default risk is zero, a high probability of low returns to stockholders still exits because ROA may fall below the rate of return promised to bondholders.

The financial structure of an insurance company is similar to that of other publicly traded firms discussed above; it maintains assets (predominantly in its investment portfolio) which are financed with both debt and equity capital. However, the source of the debt financing is quite unique for an insurance firm. Rather than issuing bonds, insurance companies raise debt primarily by issuing insurance policies. Their customers, the policyholders, are also their bondholders. Policyholders advance the company prepaid insurance premiums which the company uses to fund the investment portfolio from which losses and expenses are paid.

When policyholders advance the premiums they are actually buying two securities: one is similar to an annuity and the other is pure insurance. Annuities are just a class of bonds that yield a constant payment which includes interest and principal. Policyholders could buy just insurance coverage, but this would require purchasing a new policy each day. Instead, they buy the first day's coverage and simultaneously buy the annuity-type obligation which, over the subsequent period, will pay the daily insurance premiums for the policyholders. Like bondholders, policyholders expect their annuity-type (bond-type) obligation to be fairly priced (i.e. earn a fair return).

The sum of the price of the annuity portion and the pure insurance coverage is the appropriate value of the insurance

premium. The price of each is simply the present value of their respective expected cash flows. The critical issue is finding the appropriate interest rate to use for discounting.

An Appropriate Interest Rate for Discounting Policyholder Claims:

To determine the appropriate discount rate for pricing the annuity-type (bond-type) portion and the pure insurance portion of the insurance premium, we must ascertain the riskiness of their respective cash flows. Based on the Theory of the Firm analogy of policyholders to bondholders developed above, the relevant question for pricing the annuity-type portion of the insurance is whether the insurance company might become insolvent. Moreover, even if the insurance company does become insolvent, would policyholders expect unpaid claims or unearned premiums to be lost? Would not an industry backed or government backed organization fulfill the outstanding obligations of the firm?

For the "typical" insurance company, on which the ratemaking process is centered, it seems appropriate for policyholders to expect zero insolvency losses. This expectation is based on the regulatory signaling and numerous protective devices that are created for the benefit of policyholders. In most states, policyholders are backed by the industry's Guaranty Fund which comes to the policyholders' rescue in the event of insolvency. State insurance codes prescribe the riskclass of investments acceptable for insurance company acquisition. Adequacy of capital tests trigger audit reviews by state departments of insurance should leverage appear excessive. Indeed the ratemaking process

itself sends a message of the state's concern for the financial security of policyholders. Therefore, to the "typical" policyholder of a rate regulated company the probability of firm insolvency appears extremely low. For all practical purposes then, the appropriate discount rate to price (discount) the annuity-type portion of the insurance premium is the risk-free rate of interest.

By instituting a credit equal to the risk-free rate of interest to policyholder accounts, regulatory agencies would affirm the fiduciary responsibility of insurance companies to safeguard the prepaid premiums and unpaid claims of policyholders. Moreover, the independence of investment returns (decisions) from funding sources would be implicitly acknowledged. The risk of unfavorable returns on the investment portfolio should be incurred by the stockholders, not the policyholders. Likewise, the chance of favorable results from the investment portfolio should accrue to the stockholders. The volatility with which the investment portfolio performance vacillates between favorable returns and unfavorable returns creates the risk incurred by stockholders. That risk is irrelevant to policyholders because their return is implicitly guaranteed in a regulatory environment.

Stockholders may magnify the volatility of investment portfolio returns further by operating the firm at a higher premium-to-surplus ratio. Those who prefer risk will invest in firms with high premium-to-surplus ratios. Risk-averse stockholders will invest in firms with low-premium-to-surplus ratios. The differences in ROEs of these firms will vary because the levered risk to stockholders varies. However, as long as

policyholders expect zero insolvency losses, their rate of return (credits) should not vary among insurance firms. They should all receive the risk-free rate. Neither the risk or returns of the investment portfolio or the risk created by the firm's equity level has any effect on the policyholders' returns as long as insolvency is precluded.[2]

Without the supervision of the states' Departments of Insurance and the industry's Guaranty Funds, policyholders would be at risk to lose their unexpired coverage or their unpaid claims in the event of insolvency. Policyholders would understand this prospect and demand a higher credit than the risk-free rate on the bond portion of their insurance premium. To grant a higher rate than the risk-free rate of return to policyholders insinuates the possibility that insolvency losses may be inflicted on policyholders. Only if the regulatory body wishes to proclaim that possibility should policyholders be credited with a rate greater than the risk-free rate. Even then, the rate of interest should vary according to premium-to-surplus ratios, as well as business lines.

Expenses and losses, unlike interest credits to policyholders, are not guaranteed. They may be more or less than anticipated. This possibility of variance from their anticipated level makes expenses and losses a risky cash flow. Risky cash flows should be discounted with risky rates of return. Unfortunately, estimating the appropriate risky discount rate is a difficult task. This is

[2] The irrelevancy of leverage can be further demonstrated with the Modigliani and Miller (1958) self-made leverage proposition.

especially true when the cash flows are not directly generated by publicly traded securities. The capital asset pricing model (CAPM) and the option pricing model (OPM) were developed by financial theorists to discount the cash flows of publicly traded securities. Applying these models to the expenses and losses of insurance operations requires considerable indirect inference and is subject to dispute.

An alternative procedure for discounting risky cash flows is to discount their "certain equivalent" with the risk-free rate. The following is an example. A $100 risky annuity might be the equivalent of an $80 riskless annuity. Discounting the risky annuity at a risky rate of 10% results in a value of $1000 ($100/.10). Discounting the riskless annuity at the risk-free rate of 8% also results in a value of $1000 ($80/.08). The $80 is the "certain equivalent" of the $100 risky cash flow. One is indifferent between owning a risky $100 cash flow or an $80 riskless cash flow. Discounting a certain equivalent cash flow with the risk-free rate generates the same results as discounting the risky cash flow with a risky rate of interest.

For insurance companies, the "certain equivalent" of losses and expenses is "premiums minus profits". The insurance company is willing to underwrite the risk of uncertain losses and expenses because of the possibility for profits. Profits buffer the shareholders against net income variability caused by risky cash flows of expenses and losses. Profits are in essence the price of risk for being in the insurance business. Subtracting profits from premiums leaves the certain equivalent of expenses and losses. By

extracting out the risk, only the certain equivalent remains which can be discounted by the risk-free rate. The certain equivalent method is appealing for ratemaking purposes because profits of service related companies can be observed and compared with the profits of insurance companies.

A Comparable Profit Measure:

Corporations arrive at a price for their products through price competition. The price is, in essence, the starting point for operations. From there, corporations can choose to "lever-up" with either a capital intensive asset base, or "lever-up" with a debt intensive capital structure. The decision reflects the objectives of the company and expresses management's preference for high risk or low risk.

Companies within the same industry may have entirely different management styles. Those with risky management styles "lever-up" with the expectation of achieving a higher return on equity. Risk-averse managers do the opposite. The only common thread that runs between these companies is the product price. Consumers force the product price to be the same because they will not pay more for an identical product offered elsewhere. In the insurance industry, an identical product within a business line is guaranteed coverage. The policyholders expect to be protected from lost coverage or lost claims in the event of firm insolvency because of the protective devices discussed above.

If we compare profit margins, return on assets, and return on equity by industry groups, the least variance should occur in the

comparison of profit margin on sales. The greatest variance should occur in the return on equity comparisons because some industry groups choose to lever-up, while others choose the comfort of equity financing. If the purpose of ratemaking is to establish fair prices, then its focus should be on a measure that reflects the stability of prices unencumbered by leverage effects. Ratemaking procedures that focus on return on equity distort the issue of fair prices with issues of leverage. While leverage certainly alters expected ROE, it does not impact product price. If policyholders don't have to worry about insolvency losses, then they will pay insurance premiums that are independent of the issuing company's leverage.

Using either ROA or an adjusted profit margin on sales would eliminate distortions from financial leverage. However, profit margin has the advantage of being expressed in a form equivalent to the insurance industry's underwriting profit provisions ratio. Several ratios are generically referred to as profit margins. These include the gross profit margin, the operating profit margin, and the net profit margin. For comparative purposes, the best performance measure is an adjusted net profit margin that excludes financial leverage effects net of tax:

$$\text{net profit margin} + \frac{\text{interest expense (1-tax rate)}}{\text{Sales}}$$

This is the "unlevered" net profit margin of a levered firm. With adjusted net profit margins, the operating performance of firms can

be compared without the distortions created by their respective managements' leverage choices.

The adjusted net profit margins of thirteen well-known service-firm groups appear in Table 1. Service firms are presented because of the service nature of insurance. The data was taken from the publications of Dun & Bradstreet (D&B), Roger Morris and Associates (RMA) and Statistics on Banking. D&B covers a greater number of firms and includes publicly traded companies. RMA compiles its data from commercial banks on the basis of companies to which they lend. Statistics on Banking is compiled by the FDIC and covers only financial data on commercial banks. The companies reported by RMA are typically smaller and often privately held. Although the breadth of D&B data is preferable, its presentation does not include interest expense information. Therefore, interest expense was taken from RMA and added (after taxes) to the net profit margins reported by D&B. A cursory comparison of these ratios suggests a profit margin in the 6% range appears fair for setting insurance premiums.

The purpose of this paper, however, is not to establish an acceptable profit margin, but to present the case for a DCFM of ratemaking that utilizes profit margins to estimate expense and loss ratios. Richard Woll (1987) offers such a procedure. Ratemaking debate can focus on the appropriate profit margin.

Table I
PROFIT MARGINS

	1987	1986	1985	1984	1983	Avg.
Commercial Banks						
Net Profit Margin	1.3	6.3	6.4	5.6	6.2	5.2
Interest Expense	0	0	0	0	0	0
Adj. Profit Margin	1.3	6.3	6.4	5.6	6.2	5.2
5399/Genl Mdse Stores						
Net Profit Margin	4.7	4.6	4.9	5.0	4.8	
Interest Expense*	0.4	0.6	0.6	0.4	0.6	
Adj Profit Margin	5.0	4.9	5.2	5.2	5.1	5.1
5651/Family Clothing						
Net Profit Margin	5.9	5.1	5.5	5.8	6.6	
Interest Expense	0.4	0.6	0.6	0.4	0.6	
Adj Profit Margin	6.2	5.4	5.8	6.0	6.9	6.1
5712/Furniture						
Net Profit Margin	4.8	5.0	5.0	4.7	4.6	
Interest Expense	0.3	0.4	0.4	0.4	0.3	
Adj Profit Margin	5.0	5.2	5.2	4.9	4.8	5.0
5722/Appliances						
Net Profit Margin	4.5	5.3	4.5	5.2	5.9	
Interest Expense	-0.1	0.4	0.4	0.4	-0.2	
Adj Profit Margin	4.4	5.5	4.7	5.4	4.8	5.0
5812/Restaurants						
Net Profit Margin	4.2	4.0	3.9	4.2	4.4	
Interest Expense	1.9	1.7	1.9	2.1	1.6	
Adj Profit Margin	5.5	4.9	4.9	5.3	5.2	5.1
6311/Life Insurance						
Net Profit Margin	6.4	6.7	8.0	5.9	4.8	
Interest Expense*	0.0	0.0	0.0	0.0	0.0	
Adj Profit Margin	6.4	6.7	8.0	5.9	4.8	6.4
6321 Health Insurance						
Net Profit Margin	4.8	6.2	5.2	3.7	3.9	
Interest Expense*	0.0	0.0	0.0	0.0	0.0	
Adj Profit Margin	4.8	6.2	5.2	3.7	3.9	4.8

	1987	1986	1985	1984	1983	Avg.
8062/Hospitals						
Net Profit Margin	3.6	4.5	4.9	3.5	3.6	
Interest Expense *	1.9	1.7	1.9	2.1	1.6	
Adj Profit Margin	4.9	5.4	5.9	4.6	4.4	5.0
8111/Legal **						
Before Tax Margin	16.2	13.9	13.5	14.6	14.4	
Net Profit Margin	10.7	7.0	6.8	7.3	7.2	
Interest Expense	1.4	1.1	1.0	2.1	2.6	
Adj Profit Margin	11.6	7.7	7.4	8.7	8.9	8.9
8611 Bus. Associations						
Net Profit Margin	5.7	4.9	5.2	4.5	3.7	
Interest Expense *	0.5	0.7	0.7	0.5	0.7	
Adj Profit Margin	6.0	5.2	5.5	4.7	4.0	5.1
8911/Eng/Architectural						
Net Profit Margin	6.5	7.1	7.3	6.8	6.4	
Interest Expense	0.9	1.5	1.3	1.1	1.3	
Adj Profit Margin	7.1	7.9	8.0	7.4	7.1	7.5
8931/Accounting **						
Before Tax Margin	14.4	15.6	15.9	14.6	16.4	
Net Profit Margin	9.5	7.8	8.0	7.3	8.2	
Interest Expense*	0.4	0.5	0.5	0.4	0.5	
Adj Profit Margin	9.8	8.1	8.3	7.6	8.5	8.5

Net Profit Margin - Source: Industry Norms and Key Business Ratios published by Dun & Bradstreet.

Interest Expense - Source: Annual Statement Studies published by Robert Morris and Associates (RMA).

For Commercial Banks:

Net Profit Margin - Source: Statistics on Banking

Adj Profit Margin - Equals: Net Profit + $\frac{\text{Interest Expense}}{(1\text{-Corp. Tax Rate})}$

* Data not available in RMA. Interest Expense based on industry with similar Debt/Equity ratio.

**Denotes partnerships. Profit margins reported are before tax and must be adjusted for taxes.

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