Chapter 2

Components of Insurance Firm Value, and the Present Value of Liabilities

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INTRODUCTION

In this chapter* we discuss the relation between the market value of insurance company owners' equity and various components that contribute to that value. The effect of firm insolvency risk on each component of value is discussed in turn. One natural consequence of this analysis is a conceptual framework for estimating the value of insurance liabilities.

RISK AND THE COMPONENTS OF EQUITY VALUE

The market value of insurance company owners' equity is defined as the difference between the market value of assets and the market value of liabilities. For purposes of valuation, it is helpful to partition more finely the components of equity value. In this chapter, we will partition the value of insurance company owners' equity, or stock in the

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case of a stock company, into its four major components: franchise value, market value of tangible assets, present value of liabilities, and put option value. (See Exhibit 1.)

These components have the following elements. The franchise value stems from what economists call "economic rents." It is the present value of the "rents" that an insurer is expected to garner because it has scarce resources, scarce capital, charter value, licenses, a distribution network, personnel, reputation, and so forth. It includes renewal business.[1] Franchise value is dependent on firm insolvency risk. The less insolvency risk there is, the more likely the firm is to stay solvent long enough to capture all the available economic rents arising from its renewal business, its distribution network, its reputation, and so forth.

The next two of these components can be netted together, producing what we will call "net tangible value." This value is simply the market value of tangible assets, less the present value of liabilities.[2] This net tangible value is independent of what *kind* of assets an insurer has, but does depend on the *amount* of assets it holds. For instance, if the firm swaps Treasury securities worth $5 billion for junk bonds worth the same (but with higher coupons and/or face values), or swaps them for $5 billion worth of pork belly futures, the market value of tangible assets is the same. Similarly, the present value of the *promised* cash flows to insurance consumers remains the same (although the quality of the promise has changed — more will be said about this later). Therefore, the net tangible value of the firm at any given moment is unaltered by the kind of assets the firm holds. Moreover, it is completely independent of firm insolvency risk, although how this value evolves over time will depend on risk.

Put option value arises from the limited liability enjoyed by equityholders when their firm issues debt (*i.e.,* insurance policies, the major debt of an insurance company). It is the value to equityholders of capturing the upside earnings while not incurring all the downside costs of default. The insolvency put option increases in value as the insurer takes on more risk. If the insurer faces minimal insolvency risk, there may be little benefit inuring to it from this component of value; but if it is a risky firm, the implicit insolvency put option may be of considerable value.

Exhibit 1: Market Value of Insurance Equity

[1] It is reduced (usually slightly) by the present value of payments that the solvent insurer is expected to pay to state insurance insolvency guaranty programs, to the extent that these payments are not fully offset by state and federal tax reductions.

[2] Elsewhere this has been referred to as "liquidation value." However, because that expression is laden with connotations that are unhelpful in this context, we prefer to use the expression "net tangible value" here. In an actual liquidation, assets are sometimes unloaded at "fire sale" prices. This reduction in value may or may not be more than offset if the liquidator is able to extract favorable terms from assumption reinsurers, because the book of business transferred may still have some renewal value.

	Market Value of Equity	=	Market Value of Assets	−	Market Value of Liabilities			
Market Value of Equity	=	Franchise Value	+	Market Value of Tangible Assets	−	Present Value of Liabilities	+	Put Option

In what follows, we will use the more compact notation to represent the above equations:

$$MV(E) = MV(A) - MV(L) \tag{1}$$

$$MV(E) = FV + MV(TA) - PV(L) + PO \tag{2}$$

At this point it is useful to pause and consider these juxtaposed equations. It is clear that the right-hand-sides of both equations must be equal to each other. It is equally clear that the market value of liabilities differs from the present value of liabilities unless the market value of assets is defined as the sum of the franchise value, market value of tangible assets, and put option (*i.e.,* unless $MV(A) \equiv FV + MV(TA) + PO$).

But this broad definition of the market value of assets is not universally used and, therefore, neither is the associated equivalence of market value of liabilities with present value of liabilities. For instance, oftentimes people will think of the market value of liabilities as being the same thing as the market value of debt from an investor's point of view. Thus, if a bond that is subject to credit risk has been issued, its market value is reduced below that of an otherwise comparable default-free bond. Accordingly, the market value of liabilities is reduced when the debt becomes risky. This is ironic from an insurance regulatory perspective. If the insurer is likely to default on its insurance policies, it would suggest that the liabilities are worth less than they would be if they were secure. The riskier a firm is, the lower would be the market value of its liabilities. Therefore, were the insurer to report this market value of liabilities to regulators, the lower market value could suggest the insurer is in better financial health than if the insurer were to report a present value of liabilities that is not reduced by the prospect of insolvency.[3]

From a financial economics perspective, a firm issuing a default-prone bond has issued a combination of a default-free bond along with a default put option. The value of the bond is reduced by the value of the put. The investor is long a default-free bond and short a put.[4] The issuer is short a default-free bond and long a put. This put option

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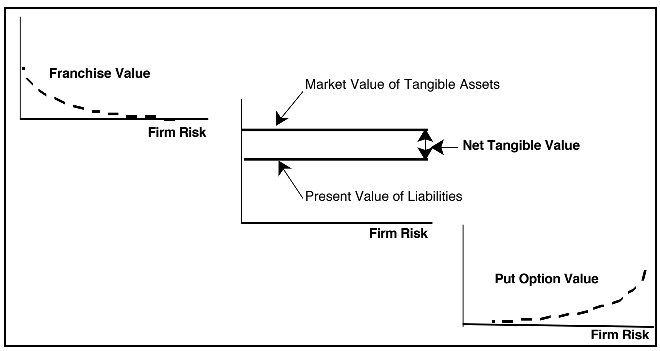
[3] Executive Life Insurance Company of California, a $16 billion insurer which bet heavily on junk bonds until its demise in 1991, is an example of a company whose market value of liabilities (under this definition) would have been reduced far below the present value of its promised cash flows to policyholders.

[4] This notion was introduced by R. C. Merton, "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates," *Journal of Finance*, May 1974, pp. 449-470, and "An Analytic

would normally be on the asset side of an "economic balance sheet," although it appears nowhere on the typical accounting statement.

In Exhibit 2, each of these components of value is displayed separately as a function of firm insolvency risk. When these value elements are displayed together, as in Exhibit 3, we can see how the overall market value of the firm is related to its risk exposure. As the firm increases in insolvency risk, firm market value increases, and as it decreases in risk, again there is an increase in firm value. This equity market value premium over net tangible value stems either from franchise value or from put option value, or from some combination of the two. This is not merely a theoretical construct. It has been accepted wisdom in the financial institutions literature for decades. Empirical research suggests the effect is pronounced in the case of insurance firms.[5] These insights will be helpful as we proceed to consider the valuation of insurance liabilities.

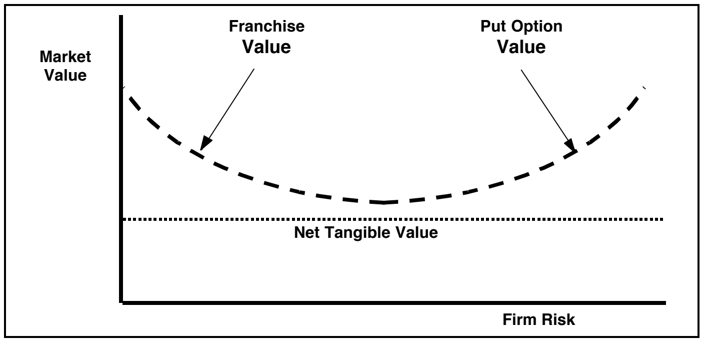
Exhibit 2: Insolvency Risk and the Components of Equity Value



Derivation of the Cost of Deposit Insurance and Loan Guarantees: An Application of Modern Option Pricing Theory," *Journal of Banking and Finance,* June 1977, pp. 3-11

[5] D. Babbel and K. Staking, "The Market Reward for Insurers that Practice Asset/Liability Management" *Financial Institutions Research,* Goldman Sachs, November 1989; "It Pays to Practice A/L M" *Best's Review, Property/Casualty Edition,* May 1991; K. Staking and D. Babbel, "The Relation between Capital Structure, Interest Rate Sensitivity, and Market Value in the Property-Liability Insurance Industry," *Journal of Risk and Insurance,* December 1995; "Insurer Surplus Duration and Market Value Revisited" *Journal of Risk and Insurance,* March 1998.

Exhibit 3: Components of Equity Value Combined



THE VALUATION OF INSURANCE LIABILITIES

When it comes to the valuation of insurance liabilities, the driving intuition behind the two most common valuation approaches — arbitrage and comparables — fails us. This is because, for the vast majority of insurance liabilities, there are neither liquid markets where prices can be disciplined by the forces of arbitrage and continuous trading, nor are there close comparables in this market. We are left in a predicament, but not an impasse. If we can re-focus our attention from "market value" to "present value," progress can be made.

A useful question to begin our valuation of liabilities is: "How much money would I need today to satisfy completely, on an expectations basis, the obligations imposed on me through the insurance policies I have written?" It turns out that this is not only a good starting point, but a strong case can be made that it is also a good ending point insofar as liability valuation is concerned. The actuarial profession can best serve insurance management, financial markets, regulators, and investors by addressing that question. It can then be left for others to argue about the value of the default put option, franchise value, and the spin-off values of certain lines of business.

If the focus is on determining the amount of assets necessary to satisfy, on an expectations basis, the obligations imposed by the liabilities, the next issue is how best to estimate that amount. We could take an indirect or a direct valuation approach. In the case of insurance companies, it becomes readily apparent that the indirect method of valuing liabilities may be quick, but is inefficient in addressing the question posed in the previous paragraph. Under the indirect method, tangible assets are valued and the market value of owners' equity is subtracted, presumably resulting in an estimate of the market value of liabilities. The problem with this approach, as can be seen by rearranging the terms of the equations in Exhibit 1, is that the equity value embraces the net value of default put options, franchise value, spin-off values, and perhaps other options, as well as the net tangible value; yet the market value of tangible assets (as distinguished from the market value of assets), omits one or more of these. Accordingly, the implied value of liabilities will be entangled with various options that are best relegated to the asset side of the balance sheet, as shown below:

$$PV(L) = FV + MV(TA) + PO - MV(E)$$
$$\neq MV(TA) - MV(E) = PV(L) - FV - PO$$

As can be seen to the right of the inequality above, subtracting the market value of equity from the market value of tangible assets will *understate* the present value of liabilities by the amount of franchise value and the default put option. While it is possible to estimate the values of the various options and add them to the value of the investment portfolio before subtracting the equity value to arrive at the present value of liabilities, this operation invokes several layers of subjective judgment and controversy that render the resulting liability calculation rather dubious.

With a more direct approach to the valuation of liabilities,[6] we can avoid a number of the pitfalls associated with the indirect approach, provided that we focus our attention on addressing the question posed in the second paragraph of this section. The present value of liabilities tells us the amount of tangible assets needed today in order to satisfy, on an expectations basis, our liabilities. (We may be able to satisfy them with fewer assets, if we get lucky, by taking interest rate, equity, or low credit quality bets, but *hope* should not be confused with *expectation*.) This present value, properly computed by means of Treasury-rate-based lattices or simulations properly calibrated to current Treasury security prices, takes into account any interest rate sensitivities in the cash flows.[7] Mortality and morbidity are factored in only on an expectation basis, although interest rate sensitivities are included to the extent that, with interest-sensitive policy surrenders and lapses, adverse selection is expected. (In practice, most companies do not currently take into account interest rate sensitivities of mortality and morbidity. As more reliable data become available, we suspect that they will.) Reserves and surplus needed to cushion variations from these interest-sensitive projections are not included in the present valuation of liabilities.

In insurance parlance, our present value of liabilities measure is analogous to the "actuarially fair value" concept developed by actuaries many decades ago. The major difference is that our measure modernizes it by explicitly accounting for stochastic interest rates and the cash flows that relate to them. Because we know, through modern finance valuation principles, how the stochastic nature of interest rates impacts value, it is a natural extension to incorporate. It also provides more meaningful value estimates of liabilities than those that ignore this source of randomness. The resulting present value estimates have, in essence, stripped out any insurer-specific C-1 risk (asset default) and C-3 risk (interest rate risk). Because the valuation lattices or simulation paths are calibrated to Treasury securities before applying them to insurance policies, we can be

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[6] A good example of this approach is given by M. Asay, P. Bouyoucos, and T. Marciano, "On the Economic Approach to the Valuation of Single Premium Deferred Annuities," *Financial Optimization,* Stavros Zenios, editor, Cambridge University Press, 1993, pp. 132-135.

[7] These valuation models are discussed in Section III of this book. A thorough discussion of the models is available in D. Babbel and C. Merrill, *Valuation of Interest-Sensitive Financial Instruments*, Society of Actuaries, Frank J. Fabozzi Associates, 1996; and "Economic Valuation Models for Insurers," *North American Actuarial Journal,* 1999 (forthcoming).

assured that the resulting liability estimate can be satisfied, on an expectation basis and, in principle, along all interest rate paths, with a properly engineered portfolio of Treasury securities and derivatives on Treasury securities. C-2 risk (mispricing of mortality/morbidity risk or of other pure risks) and C-4 risk (qualitative management issues) remain and are accounted for at their expected present values.

Now, if an insurer were to set aside reserves equal to the present value of liabilities, would this be adequate under most circumstances to satisfy the liabilities? The answer is a resounding "no." This is easy to demonstrate with an example. To be concrete, consider an insurer with a closed block of business. If assets were set aside in an amount equal to the present value of that closed block of liabilities, and the block were left in a run-off mode, these assets would usually be inadequate to fund them. This is true whether the assets are duration and convexity matched to the liabilities or mismatched, because there can always be a deviation in the timing of a claim from what is expected. More often than not, the insurer would run out of assets before the final dollar of liabilities is paid, even though the assets were equal to the expected present value of the liabilities at the outset.[8] However, if the insurer were able to dip into surplus during those periods of shortfalls and reimburse with interest the surplus during periods of excess asset values, by the time the final dollar of liabilities is due, the insurer would have 50-50 odds of retaining sufficient assets remaining in the closed block to satisfy the final liability payment.

Clearly, a prudent insurer would need to set reserves greater than the present value of liabilities in order to have hopes of survival. Reserves, as usually computed, have a conservative bias is them designed to increase the probability of insurer solvency over time. Additionally, surplus is required in order to cushion against any shortfalls should the reserves prove to be inadequate.

In an economic sense, we need not focus on accounting concepts such as reserves, surplus, and risk-based capital. From a managerial viewpoint, these are best viewed as merely regulatory constraints. What is needed to cushion the liabilities against inadequate assets is actual money, as measured by the net tangible value — the excess market value of tangible assets over the present value of liabilities. The amount of net tangible value needed to provide an adequate cushion will depend on the amount and behavior of the present value of liabilities. A certain amount will be needed to handle actuarial risk, *i.e.,* deviations from expected claims. More will be needed if there is model risk, *i.e.,* the risk that experience will deviate from the functional relationships expressed as assumptions (*e.g.,* interest-sensitive lapse functions) in our valuation models. If the insurer retains asset default risk, asset liquidity risk, and interest rate risk, additional net tangible value will be needed. Yet all of these calculations will depend on

[8] The reason that the probability of having enough assets is not simply 50-50 is that the expectation concept used in defining the present value of liabilities does not take into account the paths that the asset and liability values follow over time. Therefore, there will be many paths that would generate adequate asset returns by the final payment date to satisfy the remaining liabilities, yet inadequate returns over many paths prior to that final date.

the amount and riskiness of the present value of liabilities and the desired level of insolvency risk.

Occasionally, an objection is raised against our notion of the present value of liabilities by comparing it to readily observed market values of certain insurance liabilities. This objection is handled by keeping in mind that the present value should be formulated in a context of keeping the insurance business on the primary carrier's books, and for some good reasons.

Consider a situation in which an insurer has tangible assets worth $105 and a present value of liabilities of $100. Suppose that the net value of its put option to default together with its franchise value is $2, and while not carried explicitly on its balance sheet, this value enhances the market value of its assets and equity.

Now, suppose that the insurer's liabilities are all GICs, and that it can repurchase and retire them in the open market for only $98. Alternatively, if it leaves them outstanding, it will require $100, in present value, to satisfy them ultimately. If one looks only at the cash price to retire the GICs, it looks like an attractive deal. But the *full* cost includes not only the $98 cash price but also the lost value of options ($2) associated with dropping that business.

Next, suppose that the insurer can transfer the liabilities to another insurer. Again, the true cost for the insurer is not only the value of tangible assets that must be transferred to the other insurer, but also the lost value of its options. The acceding insurer may require less than the $100 of present value needed to fully satisfy the liabilities but that does not mean that it costs less than $100 to fully satisfy them on an expectation basis. The acceding insurer may charge less because it gains the value of renewals or increases the value of its own default put option. After all, the transferred business will affect the acceding insurer's franchise and default put option values differently than that of the cedant. In fact, even the interest rate sensitivity (and therefore the value) of some of the liability cash flows may itself change when the business is transferred to a new carrier with a different kind of marketing force, crediting strategy, and financial strength. The acceding insurer may charge more simply because it can get more through negotiations. Yet these factors should not be misconstrued as impacting the present value of funds required for the primary carrier to satisfy fully, on an expectations basis, the retained liabilities.

Another objection against the present-value-of-liability concept is sometimes raised that the valuation models are fashioned to be arbitrage-free, yet the insurance liabilities, because of randomness surrounding claims and lapses, cannot be subject to the forces of arbitrage. But here we are reminded that it was not long ago when the mortgage-backed securities market emerged. Pricing was not subject to the forces of arbitrage due to the uncertainty surrounding the prepayment speeds, and there were no close comparables traded in the market. Nonetheless, satisfactory pricing algorithms were eventually developed based on two-factor, stochastic interest rate models.

Consequently, option-adjusted spreads,[9] correctly calculated, have narrowed considerably and all but disappeared in some segments of that market. This suggests that even though these valuation models cannot rely on the forces of riskless arbitrage, they can still approximate value closely.

It would appear that similar pricing algorithms should be used to value insurance liabilities. These liabilities are also subject to considerable uncertainty. Some of the uncertainty, such as the incidence of lapse and surrender, devolves from the vacillation of future interest rate levels and paths. This uncertainty can be modeled in a fashion similar to mortgage-backed security prepayments. Uncertainty stemming from mortality, morbidity, accident experience and some base levels of lapses and surrender may not be related directly to interest rates and can be reflected directly in the expected cash flows input into the valuation model.

In life insurance, there is a need to model the dividend and crediting rate practices of the insurer. These practices are often difficult to codify because a committee may declare a set of numbers to be used that is not related, through a simple formula, to the level and evolution of the stochastic Treasury rates used in the valuation models. Nonetheless, the decision process can usually be approximated by some formula tied to these interest rates. The actual process may rely more on realized portfolio yields and returns than on Treasury rates, yet on an *ex ante* basis, the stochastic Treasury rates may be used because they serve as certainty-equivalent rates of return on the portfolio subject to credit and liquidity risk. This should suffice for liability valuation purposes.

It is entirely another question, albeit an interesting one, to model the optimal dividend or crediting rate strategy. If a firm is not following such optimal strategies in certain lines of its business, it might be reflected in a higher spin-off value. Another separate question is whether the insurer is following sound asset/liability management practices. The present value of an insurance liability is not dependent on what assets the insurer holds nor on how its portfolio is structured. Rather, it depends simply on how much in default-free securities would be required today to meet its expected liability payments over time. Again, the present value must account for any interest rate sensitivities in the liabilities.

It is an important, but separate issue how much in reserves and surplus is needed to ensure, with an acceptable degree of probability, that a sufficient cushion of assets is in place to handle any adverse deviations in liability payments from those expected. The amount of reserves and surplus required will, of course, depend on the structure of the

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[9] An option-adjusted spread is a "fudge factor" of sorts to capture in the interest rate lattices or paths the mispricing of the security based on the model price versus the market price. (See D. Babbel and S. Zenios, "Pitfalls in the Analysis of Option-Adjusted Spreads," *Financial Analysts Journal,* July/August 1992, pp. 65-69.) It is common to calculate option-adjusted spreads based on some fixed level of volatility for purposes of historical charting, but when pricing the securities, the volatility assumed should relate to the future period over which the mortgages will be repaid.

investment portfolio and the probability distribution of state-contingent liability payments (where the states are defined by the levels and evolution of interest rates).

Our narrower definition of liability values, while unlikely to produce value estimates that precisely match those market values of liabilities which are actually traded in the marketplace, nonetheless has some merit. First, it is simpler to compute for most insurance liabilities than would be the case of a more expansive definition of market value, which would impound in some way the values of put options and franchise value. Second, it is subject to less controversy by relegating to the other side of the balance sheet some of the most troublesome areas of valuation. Third, it provides a useful number as a starting point to regulators and to the insurers themselves, who need to know how much it should take to fully defease the liabilities that the insurer has underwritten. Fourth, it provides a number that is more easily compared among insurers. Fifth, it is particularly helpful in firm risk assessment, particularly if the liabilities are valued using models that feature the same drivers of uncertainty as used on the asset side of the economic balance sheet. (See Section IV of this book.) Finally, it can serve as the basis for financial performance measurement. (See Chapter 3.)