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The Economics of Insurance Securitizations

The practice of risk management has evolved significantly over the last 20 years and the development of derivative securities has played an important role. Insurers use derivatives to hedge against interest-rate risk, foreign exchange risk, and other risks.

Insurers can hedge the risk that interest rates will change. Without hedging, the company's surplus bears the risk and the firm must collect additional premiums from policyholders to compensate the capital providers for such an unhedged risk. Entering into a futures contract to hedge this exposure is substantially less costly than bearing the risk with shareholder capital.

Today insurers have a better understanding of options implicit in life insurance, annuities, and other insurance products. They value the risks explicitly and decide whether to hedge or to retain these risks. Hedging increases the demand for derivatives.

An example of a property/casualty insurance risk security is a catastrophe risk bond. Financial engineers have created even more complex instruments such as double-trigger puts, in which the payoff of the derivative is contingent upon an "insurance" event, such as a catastrophe and a "financial" event, such as rising interest rates. In the case of the catastrophe risk bond, the transaction is straightforward, representing either an alternative to a layer of traditional catastrophe reinsurance or catastrophe coverage.

The expanding role of risk management has not solved the problem of insufficient insurance capacity for certain lines of business. In the case of traditional insurance, shareholders of insurance firms bear these risks and expect a return on their capital that is commensurate with the degree of risk assumed. However, if alternative solutions to risk management problems (such as securitization) are more efficient in that the risk manager can hedge risk at lower cost than under traditional insurance methods and produce adequate returns to the risk-bearers, then these alternative methods will replace the traditional ones.

This is the basis of the economic argument in favor of securitization and derivatives in general. Specifically, securitization results in a more efficient distribution of risk throughout the economy through both lower insurance costs and increased capacity. Additionally, due to market imperfections, insurance securitizations increase investment opportunities. Here's how the process works.

Securitization of Catastrophe Risk

The following model is a simple illustrative idealization of catastrophe risk bonds—customarily referred to as cat bonds. USAA, Swiss Re, Winterthur, St.Paul Re and others (about 25 in all) successfully issued catastrophe risk bonds during 1997, 1998 and 1999.

Our example is a two-period catastrophe risk bond. For simplicity, there's no interest rate risk. The face amount is 100 and only coupons are at risk. The principal of 100 will be paid to the bondholder at the end of period 2 with certainty. A coupon of 12 is paid at the end of periods 1 and 2, provided no catastrophe occurs during the corresponding period.

Further, the market interest rate on risk-free securities is a constant 8 percent per year. The probability of a catastrophe, which triggers a default on the coupon payment, is a constant 3 percent per year.

The catastrophe states and probabilities, along with the corresponding cat bond cash flows, are shown in Figure 1.

The value of the cat bond at the time of issue, given the above assumptions, is \$106.49.

Now consider a bond that has the

FIGURE 1.
The Catastrophe Risk Bond Cash Flows

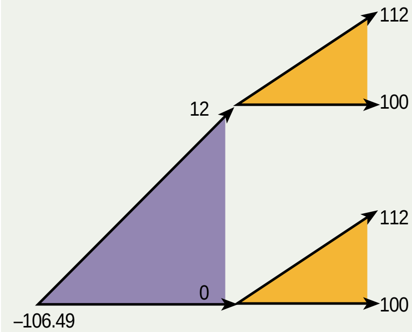

FIGURE 2.
Straight Bond Cash Flow

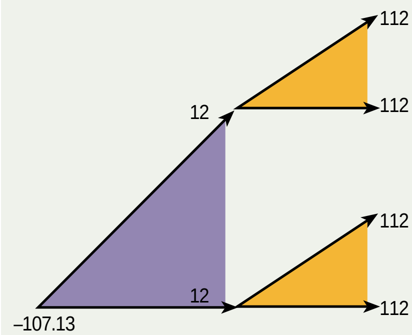

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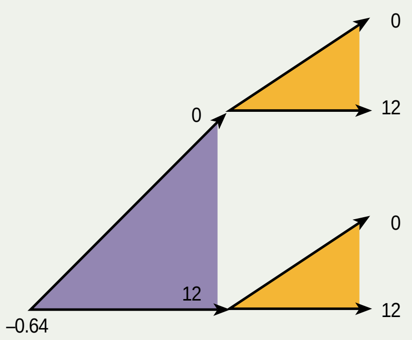
FIGURE 3.
Long Straight Bond and Short Cat Bond



same prospective cash flow (i.e., 12 percent coupons), but no possibility of coupon default. This is called a straight bond. The cash flows of the straight bond are illustrated in Figure 2.

The price of the straight bond at the time the cat bond is issued is $107.13.

Suppose an insurer issues the cat bond and simultaneously buys the straight bond. The straight bond is more expensive. The insurer's net cost is 0.64 per 100 of face value. What does the insurer get in return? In each of the two future periods, if there's no catastrophe, the insurer's net cash flow is zero because it receives the straight bond coupon and pays the cat bond coupon.

If there's a catastrophe in either period, however, it still receives the straight bond coupon (12), but doesn't pay it. In effect, the insurer has purchased a two-year catastrophe reinsurance contract that pays 12 in case a catastrophe occurs during period 1 or 2. This increases the insurers capacity to sell insurance over the next two years by 12, at a cost of 0.64 per 100 of face value. The net cash flow is shown in Figure 3.

The line of insurance is immaterial to the capital market; it doesn't have to be catastrophe risk. Investors prefer these bonds because their returns have low correlation with stock returns. There may be many kinds of insurance risks that have low covariance with the stock market. An insurer could, for instance, issue bonds that would transfer mortality risk to bondholders. Clearly, mortality risk has low covariance with the stock market, making these bonds attractive to investors. Many insurers have issued long-term pension policies and face the risk of unexpected improvements in pension beneficiary mortality. A security with bondholder cash flows tied to a mortality index could provide long-term coverage not available in the traditional reinsurance market.

Structure of Securitization

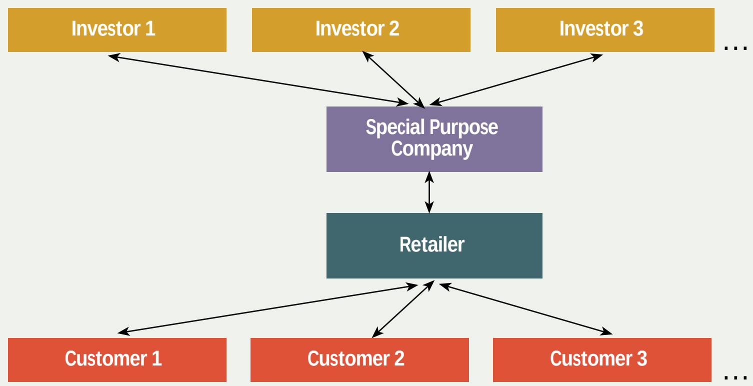
The securitization technology applies to many kinds of risk, in addition to insurance risk. In asset and liability securitizations, the common structure typically involves four entities: retail customers, a retail contract issuer, a special purpose company, and investors. In the case of insurance risk bonds, the four entities are as follows:

- Individuals or firms who buy policies from an insurer;
- The insurance company that issues the individual policies (retail contracts) and buys reinsurance from a special-purpose reinsurer (the special purpose company);
- The special-purpose reinsurer that issues the reinsurance and sells bonds;
- Investors who buy the bonds.

Figure 4 illustrates the direction and timing of cash flows to and from each entity involved in or related to an insurance risk securitization. Each of the arrows represents an exchange of cash corresponding to a contract. The timing varies with the application. In the case of homeowners insurance, for example, the customers pay a cash premium to the insurer and receive a contract (the homeowners policy) in exchange. Later, cash flows the other way for those customers who suffer losses and receive insurance benefits. The insurer pays a premium initially to the special-purpose reinsurer and receives a reinsurance policy in exchange.

The investors initially pay cash to the special-purpose company and receive bonds in exchange. Subsequently, they

FIGURE 4.
Securitization Components



receive coupons and principal, provided the insured event does not occur. If an insured event does occur, the special purpose reinsurer reimburses the insurer and the investors forfeit a portion of the coupon or principal depending on the bond contract.

The transactions are structured so that the price of the bonds (paid by the investors) and the reinsurance premium (paid by the retailer) are adequate to cover the insured loss with certainty. Under such arrangements, the special purpose reinsurer cannot default on its insurance

Derivatives greatly reduce the cost of certain financial transactions.

obligations. Therefore, there is no counterparty risk. (This implicitly assumes the instruments purchased with the proceeds of the bond issue are default-free.) The ability to eliminate counter-party risk is a major distinction between securitization and traditional reinsurance.

There is an obvious moral hazard problem associated with insurance risk securitizations. At least two methods that have been used to resolve this problem.

- The security can be written in terms of an independently determined loss ratio. This takes determination of the security's coverage out of the hands of the insurer, solving the problem, but introducing basis-risk — the contract covers industry losses, not the insurer's own risks.
- An independent firm is hired to provide claims services.

The Economic Basis of Insurance Risk Securitization

The basic argument in favor of insurance risk securitizations is the same argument in favor of all derivatives, namely, derivatives greatly reduce the cost of certain financial transactions. Furthermore, insurance risk securitization can:

- Increase insurance capacity;
- Allow insurers more efficient access to capital markets;
- Permit customized contracting for the hedging of risks.

As one example, suppose an insurance firm wishes to reduce its exposure to some price or index and increase exposure to some other price or index. One way to do this is to sell the existing long position and use the proceeds to purchase the appropriate instruments, producing the desired exposure profile. This can result in significant transaction costs, tax effects, and market impact. Using derivatives, such a transaction can be accomplished quickly and at a fraction of the cost and the insurer can focus more directly on the risks it wants.

To the extent that insurance risk securities continue to be attractive to investors, the potential for providing needed capacity for otherwise uncovered insurance exposures will continue to be exploited. In the same vein, development of more efficient risk transfer techniques will result in lower insurance prices, the elimination of some capacity-related pricing cycles, and cheaper substitutes to traditional reinsurance.

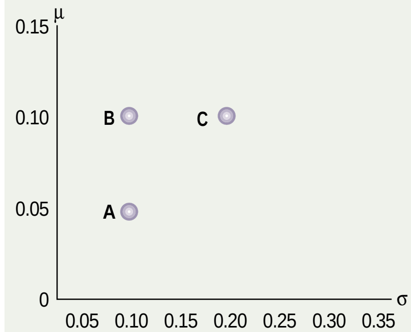
The Demand for Insurance Risk Securities

Why do investors buy insurance risk bonds? The demand for insurance risk securities can be examined within the Markowitz mean-variance model in which the total risk of an asset is measured by its variance over the planning period. In this one-period model, the focus is on the return random variable r, through the expected return $\mu = E[r]$ and the standard deviation $\sigma = \sqrt{\text{Var}(r)}$.

Suppose there's a total of *n* assets an investor can purchase. A *portfolio* is constructed from the *n* given assets by specifying the percentage of the value of the portfolio invested in each asset. It's assumed that the scale of investment doesn't affect the percentages; investors with the same risk-return preferences will select the same portfolios regardless of the size of their investments. To specify a portfolio, one need only specify the percentage invested in each security. Let the expected portfolio return and the portfolio return standard deviation be denoted as μ_p and σ_p, respectively.

An efficient portfolio is defined as one not dominated by another portfolio. It's a portfolio for which there's no other with lower standard deviation and an equal or higher expected return. Figure 5 illustrates the concept of efficiency and the associated notion of portfolio dominance.

FIGURE 5.
Risk and Return Relations



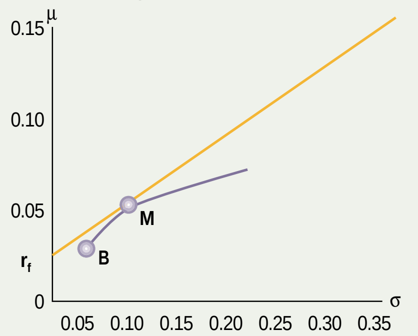
Note that portfolio B dominates portfolio A since it offers the same risk (standard deviation) but has a higher expected return. Similarly, portfolio B dominates portfolio C since it offers the same expected return but a lower level of risk. The basic problem is to find the maximum portfolio return for a given portfolio risk level or the minimum portfolio risk level for a given portfolio return. These optimal portfolios are said to be *mean-variance efficient* portfolios.

There are potentially different minimum variance portfolios for each target return. In fact, one can graph an entire set of efficient portfolios, plotting the points (μ,σ) by solving the portfolio problem for different values of σ, corresponding to a range of values of target expected returns, μ. This graph is called the efficient frontier.

The efficient frontier can be completely defined in terms of two efficient portfolios. This is called a "mutual fund" theorem. It states that investors will be indifferent between holding a combination of two mutual funds (efficient portfolios) on the efficient frontier or a combination of the underlying *n* assets. This result is independent of the wealth or preferences of the individual investors.

Now add two new securities to the investment opportunity set. The first is a risk-free bond. It has return r_f and zero variance. Every investor is better off (or

FIGURE 6.
Capital Market Line



no worse off) as a result of this expanded investment opportunity set. This can be illustrated by use of a mutual fund theorem: an efficient portfolio of risky assets, *M*, can be combined with the risk-free asset, the combination of which dominates all other portfolios on the previously defined efficient frontier. This is shown graphically below in Figure 6.

Hence, in this economy of *n* risky assets and one risk-free asset, all investors will hold a combination of the mutual fund, *M*, and the risk-free asset.

As before, this result is independent of individual investor preferences or wealth. The straight line in Figure 6 is called the *capital market line*, and portfolio *M* is termed the *market portfolio*. The efficient frontier, before introducing the risk-free bond, is the curved line. Any point on the capital market line can be obtained by investing in the risk-free bond and the fund *M*. The capital market line lies above the original efficient frontier, except at *M* where they're equal. All investors will demand a portfolio on the capital market line, given the investment opportunity set composed of the $n + 1$ assets.

Next, introduce a new security with relatively large expected return, correspondingly high standard deviation, but little correlation with other risky assets. This security can be considered an insurance risk security, such as a catastrophe risk bond. The set of investment opportunities has been expanded and investors can add this new (risky) security to their portfolio. Because this security's return is uncorrelated with the other *n* risky securities, a portfolio containing it will dominate portfolios that don't. (See Figure 7.)

All investors will now demand portfolios that are on the new capital market line.

The new security pushes the frontier up and to the left, so the slope of the capital market line increases when it's redrawn as a tangent to the new frontier. The new securities added can be any security with relatively low covariance with the market. Long-term bonds with coupons based upon a mortality index, for example, would also improve investment opportunities. (More details on this argument can be found in the authors' paper: *ASTIN Bulletin*, May 2000, Volume 30 number 1, "Economic Aspects of Securitization of Risk," pages 157–193.)

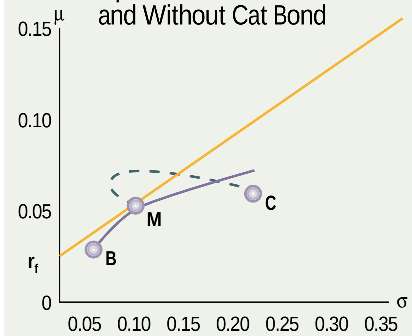
One criticism of this analysis is that the insurance risk security should be attainable from pre-existing capital market assets. However, because of market imperfections the introduction of insurance risk securities does produce changes in risk securities does produce changes in capital market conditions because the insurance risk security reduces transaction costs in an imperfect market. Therefore, the type of shift in the capital market line described above does occur.

Life Insurance Securitization

There are potentially two ways securitization can be applied to life insurance. First, a long-term bond based on mortality could cover the risk that annuity beneficiaries live longer than anticipated, perhaps based on a countrywide mortality index. A reinsurer issuing such a bond would have increased capacity to issue contracts to direct writers and pension plans in the given country.

A second example might be a bond designed to cover a specific portfolio of lives. Large amounts of term life insurance are written with very selective underwriting.

FIGURE 7.
Capital Market Line With and Without Cat Bond



There's little experience for this business, so the projected mortality has relatively high variance. A 5- to 10-year bond could be designed to cover this risk and provide coverage that's hard to find or expensive in traditional reinsurance markets.

Conclusion

The economic justification for insurance risk securitization is that insurance risks are repackaged and sold to the capital market so investors can distribute their capital over these risks more efficiently than they could when the risks were contained in the original risky securities. This holds regardless of individual investor risk preferences or wealth. As long as this increase in efficiency is possible, insurance risk securities should continue to proliferate in the capital markets.

The effects of more efficient risk transfer and risk sharing will manifest themselves in the form of more insurance coverage of assets, better insurance pricing, and lower capital costs for insurers and reinsurers. ●