A Delicate Balance

How capital asset pricing models can improve insurance portfolios.

by Paul J. Kneuer

▶ **The Big Picture:** Some insurers use the capital asset pricing model (CAPM) to evaluate their reinsurance decisions.

▶ **The Significance:** Using CAPM to evaluate reinsurance purchases pinpoints an insurer's return on equity.

▶ **What Needs to Happen:** To attain balance, insurers must cover both undiversifiable catastrophe risk and diversifiable individual risk.

When insurers buy reinsurance to manage their insurance portfolios, they are addressing the same balance between risk and return that investment managers assess to manage performance. In fact, some insurers use a conceptual tool of finance, known as the capital asset pricing model, to fine-tune their reinsurance decisions.

Investment managers use CAPM to evaluate stocks and bonds for their portfolios, weighing the potential returns of each asset against its contribution to the overall risk of the portfolio. That increment is known as the investment's beta—the degree to which its risk is greater or lesser than the overall market.

Similarly, when insurers use a CAPM framework, they compare the risk reduction from potential reinsurance placements to their expected net costs, with a calculation of a ceded return on equity for each alternative. This calculation can compare reinsurance alternatives by showing the expected benefit (as a reduction in overall required capital) against the cost (as premium less expected loss recoveries). The lower the ceded ROE, the better.

The model focuses on the amount of corporate volatility. It neglects important internal uses of risk reduction in performance assessment, planning, compensation and pricing. Despite these drawbacks, there are times when CAPM does help reinsurance buyers quantify their risks and associated costs. But this framework must be used thoughtfully.

Buying in an Efficient Market

To use CAPM, a ceding company evaluates the expected net cost of each alternative reinsurance contract and weighs the protection provided against the ceding company's overall risk position.

Here is an illustration where property concentrations are the key driver of risk to the ceding insurer. Insurers' overall risk is not well correlated with investment market risks, so equity market betas are not significant factors for most insurers. However, because of the "stickiness" of regulated insurer capital, catastrophe risk should be considered as an undiversifiable risk, both within individual insurers and across the insurance and reinsurance markets. A contract's effect on major losses becomes its key relative risk measure, like the betas in CAPM. The buyer's decision process in this case would be to buy any reinsurance contracts that cost less than the value of the reductions in the company's catastrophe probable maximum loss.

The analysis results in efficient market risk margins that do not depend on the type of product: catastrophe excess, risk excess, aggregate or pro rata. Theoretically, risk margins should be efficient across different markets: direct, facultative or treaty. So the company also should sell any direct contracts that are priced above the value of its increase in PML. Most insurance contracts outside of industry peak catastrophe zones are "good writes." Companies can use the same math to evaluate reinsurance, manage their direct portfolio and price their original business.

The following is a plausible example where a buyer evaluates the trade-offs in terms of ceded ROE, the costs of potential contracts compared to the reduction in overall portfolio risk each offers.

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Five Possibilities

This chart reviews the information that a ceding company could use to choose between five potential reinsurance contracts. The treaty limit and premium are contractual terms. The expected loss and standard deviation might be the result of catastrophe simulation models. The change in PML and expected cost are calculations by the ceding company to consider the benefit and cost of each potential contract. The last column, Ceded ROE, is a comparison of the costs and benefits. Contracts with lower Ceded ROE's are more desirable.
($ Millions)

Alternative Treaty	Occurrence Treaty Limit	Treaty Premium	Expected Loss	Standard Deviation	Change in Ceded PML	Expected Cost	Ceded ROE
Florida Cat XL	$100M	$25M	$10M	$30M	$90M	$15M	16.70%
Idaho Cat XL	$100M	$6M	$3M	$17.1M	$12.8M	$3M	23.40%
Per Risk XL	$100M	$5M	$4M	$2.0M	$0.2M	$1M	50.00%
Working Property	$10M	$30M	$25M	$15.8M	$8.0M	$5M	62.50%
Umbrella QS	$5M	$25M	$15M	$8.7M	$0M	$10M	Undefined
Total Ceded	**Approx. $200M**	**$91M**	**$57M**	**$34.1M**	**$90.3M**	**$34.0M**	**37.60%**

CAPM Assumptions

This approach gives the ceding company the best net portfolio possible in the market, if:

- All buyers and sellers have the same (i.e., finite) time perspective;
- All buyers measure risk the same way, are risk-averse and are fully diversified;
- Leverage is free and unlimited;
- Insurance and reinsurance contracts are both fully divisible; and
- Market risk and price information are available equally to everyone.

If these axioms apply, reinsurance contracts have risk charges that only reflect the contracts' undiversifiable exposure to industry catastrophe events.

But these concepts do not apply very well to insurers, because of licenses, ratings, reputation, staff and producer relations that are expensive and slow to build.

Most of us in the industry benefit from the happy reality that insurance is not sold in an efficient market. If it were, individual insureds would be able to buy coverage at a price just equal to their expected losses, plus a risk charge (like the beta factors in CAPM) that reflects only their share of the industry's peak catastrophe event volatility. There would be no return to capital above that charge for undiversifiable risk.

Equally, the net cost of reinsurance protections (relative to expected market volatility) would be equivalent no matter how a cedent chose to buy: catastrophe, per risk, pro rata or aggregate. Reinsurance decisions would be simple.

Fortunately, the market is inefficient. Insureds mostly pay premiums that cover the costs of their own individual, diversifiable volatility. But, reinsurers charge a return just to cover the insurers' undiversifiable industry risks.

Before portfolio theories were used in ceded ROE analyses, most reinsurance dollars went to protect individual policy volatility and very little to undiversifiable industry risks. That may not be the case now, but it is still not optimal to spend all reinsurance dollars on just the undiversifiable perspective.

Value in Per-Policy Protections

Reinsurance provides other important benefits:

- Long-term measure of the cost of low-frequency claims to use in short-term performance assessments (such as by product, class, territory or producer);
- Objective charges for compensation systems, including producer profit shares;
- Objective expense factors for rate filings;
- Price validation for low-credibility books;
- Validation of contract forms, risk selection, producer management and growth strategies; and
- Access to broader technical experience base for claims, loss control and actuarial teams.

In this decision framework, a buyer first would evaluate the expected net margin of each reinsurance alternative

Development of CAPM

William Sharpe won the 1990 Nobel Prize in Economics for defining the CAPM approach. CAPM measures the movement of a stock in a portfolio relative to the overall movement of the market (measured as beta).

Franco Modigliani, 1985 Nobel Prize winner for Economics, and Merton Miller (1990 co-winner with Sharpe) wrote a paper applying similar concepts to create a theory of corporate capital structure. They showed a firm's value is unaffected by its financing decisions. This approach is essential to understanding corporate investment and risk decisions. American economist Eugene Fama argued that CAPM is overly simple: some risky stocks outperform others for reasons unrelated to market performance, such as small capitalization and high book-value-to-price ratios. We believe his conclusion applies to insurance policies that are riskier for reasons unrelated to industry loss events. Recently, Nassim Taleb, author of *Fooled by Randomness*, has noted that limitations to historical data prevent the development of key information used in CAPM. CAPM is often used to regulate insurance and public utility rates, despite the noted limitations.

against the price for the direct volatility assumed, measured as it is sold in the direct insurance market.

The buyer would then purchase any reinsurance contracts that cost less than the price of the risk in the policy limits ceded. Just as important, he or she sells any direct contracts that charge more than the cost of their reinsurance protection.

The next table shows how this approach might be applied to the same group of contracts.

Insurers that use CAPM to focus entirely on protecting against undiversifiable catastrophe risk can end up missing profit opportunities by undercharging their individually volatile customers, such as the ones with high policy limits.

Alternatively, insurers that focus entirely on the diversifiable "individual risk" end up concentrated in the industry's peak risk zones. Our suggestion is to balance the two outcomes by explicitly recognizing these two parallel objectives. They are different, but not in conflict.

ranking reinsurance alternatives by comparing net costs to the resulting reduction in net volatility.

> To use CAPM, a ceding company evaluates the expected net cost of each alternative reinsurance contract and weighs the protection provided against the ceding company's overall risk position.

For the corporate, undiversifiable PML perspective, the best gauge is PML reduction. For individual policy

ance and reinsurance, that do not cross-trade efficiently.

Considerations in choosing between the two approaches can include:

- Ratio of policy limits to surplus
- Design of compensation and underwriting authority systems
- Value of market intelligence
- Strategies of competitors and rating peers.

There are many reinsurance contracts that give buyers benefits in both markets: for example, high level per risk excess coverage in Florida.

Companies can test these alternatives to see if they add value to either the systematic or undiversified perspective.

Or, they can build an internal "shadow cost" system that trades off the value of their catastrophe- and individual-policy risks.

For example, a buyer could evaluate the expected margin of each reinsurance alternative by comparing it to:

- 80% of the reduction in Catastrophe PML, plus

Individual Approach

This chart considers the same potential contracts and terms. Here, the ceding company also calculated the policy limits in its direct portfolio of business that expose each potential reinsurance contract by itself—the individual policy perspective. Another calculated figure is the direct policy premiums that the company charges for those exposed policy limits.

($ Millions and Billions)

Alternative Treaty	Occurrence Treaty Limit	Treaty Premium	Expected Loss	Standard Deviation	Net Exposed Policy Limits Ceded	Direct Premiums on Exposed Limits Ceded	Expected Cost	Evaluation
Florida Cat XL	$100M	$25M	$10M	$30.0M	$0	$0	$15M	Bad
Idaho Cat XL	$100M	$6M	$3M	$17.1M	$0	$0	$3M	Bad
Per Risk XL	$100M	$5M	$4M	$2.0M	$15B	$15M	$1M	Best
Working Property	$10M	$30M	$25M	$15.8M	$20B	$50M	$5M	Good
Umbrella QS	$5M	$25M	$15M	$8.7M	$25B	$25M	$10M	Good
Total Ceded	**Approx. $200M**	**$91M**	**$57M**	**$34.1M**	**$60B**	**$76M**	**$34M**	

Most insurers have (at least) two separate risk-protection budgets: overall exposure to their peak catastrophe events, and protection of individually risky policies.

Because we operate in an inefficient market, the optimal allocation between those two budgets is beyond CAPM assumptions. Buyers must subjectively choose how to invest their risk protection dollars: 50%-50%, or 90%-10% or even 99%-1%. But once they make that call, buyers can use the same analysis in either framework

protections, buyers can measure the total direct volatility sold in the insurance market, and compare it to the expected net cost of reinsurance. The second, "individual policy" view is not comparable to the corporate, undiversifiable PML view because they examine different types because they consider different markets, i.e., insur-

- 20% of the price of the direct volatility sold to the market.

Specific scales and weights must be subjective judgments for each ceding company, based on its capital, risk, product knowledge, competition and internal processes. BR