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ARIA Paper by Stewart C. Myers and James R. Read, Jr.

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The CAS must thank Doctors Myers and Read for their intriguing article. They have developed a practical algorithm for a previously subjective problem. Regulators often require a way to measure at least the indirect cost of an insurer's Surplus in ratemaking. This article offers a well-defined solution, together with a theoretical and philosophical explanation. There are practical problems with any approach to pricing administration in a largely free economy and with the most common theoretical context for administered rate regulation. But these issues are outside of the author's scope.

The Authors' Proposal

Profit targets or premium levels for regulated insurance products often reflect the amount of Surplus that an insurer commits to support the business under review and the cost of committing that Surplus. The authors suggest the following algorithm to appropriately reflect the cost of committing Surplus to a particular insurance product:

1. Compute the total expected default value of an insurer or of a group of insurers. This would be for the entire industry in an administered pricing state, such as Massachusetts.
2. Compute the insurers' marginal default value in respect of each product segment (the partial derivatives of the overall default value with respect to an increase in the amount of expected losses for each product.)

The authors show the novel and intriguing result that when the quantity of (expected losses x marginal default value) for each product is summed over all products, the result is equal to the overall expected default value. This is a surprising result. There are diversification benefits in combining risky but partly uncorrelated ventures, so the marginal cost of adding more of a product is generally less than the average cost. The by-line costs usually do not "add up." (This is the financial root of all insurance.) The new contribution here is to multiply these marginal values by the current amount of expected losses in each product category. Since these results do "add up", they can be used as an allocation base.

3. Allocate the overall Surplus among products in proportion to (marginal default value x expected losses.)

In the Myers-Cohn pricing approach commonly used in Massachusetts, regulators recognize that the allocated Surplus earns investment profits in addition to operating returns and that these investment profits are currently subject to two rounds of taxation: once paid by insurers corporately, and then paid again by the owners of the insurers. Regulated rates must allow a provision for the cost of this second taxation, or else they are confiscatory.

4. Load the premiums by a pre-tax provision of (Allocated Surplus x Return on Assets x Time Factor x Tax Rate). A sample calculation is shown on page two of the following exhibit, assuming a one-year maturity and that the authors' algorithm provided a 50% surplus-to-expected-loss ratio.

Application

Massachusetts rate regulation has been a very fertile ground for analyzing the capital structure and profit requirements for insurance companies. This paper is another important contribution to that history. The authors give an objective and consistent measure of the amount of Surplus which is subject to this double taxation. The authors show that marginal default values **can** be an allocation base for Surplus in rate regulation calculations. They argue that it **should** be, for well-founded reasons. But they do not, and cannot, show that it **must** be.

The authors provide two strong arguments for using their marginal default values. First, marginal default values have the high merit that they "add up". However, allocations based on premiums, losses, expenses, historic profit provisions, aggregate amount of limits provided, or policy counts also add up and have some plausible arguments as allocation bases. Second, and what is more important, the authors consider an environment where all insurance is sold on a "retail" base, subject to guarantee funds. Regulators can view the marginal contribution to default risk as the true cost to society of providing coverage, and thus a gauge of the fair price to charge to insureds. Not argued by the authors, but in a simpler view, regulators might also feel that committing more Surplus to a product provides a higher quality of insurance protection and therefore merits a proportionally higher profit.

Reassuringly, marginal default risks and capital commitments certainly move together. Products that contribute more to the potential default of a company, or to a larger default if it should happen, are greater commitments of insurers, and do merit higher rewards from regulators. While other allocation bases are possible, this reviewer feels that the approach suggested by the authors is a very reasonable one, and one that regulators should strongly consider, when an allocation is required.

A recent trend among U.S and other insurers has been the movement to off-shore domiciles. In these situations, many insurers are exempt from income tax. They are, instead, subject to excise tax which can be as little as 1% of premiums for the risk-bearer, when exposure is sent off-shore in the form of reinsurance. Understanding the cost of an off-shore company's commitments does not require a Surplus allocation.

But at least today, most primary insurance provided in the United Sates is written by U.S.-based companies who are subject to income tax on their investment returns. Moreover, regardless of tax status and domicile, insurers' Surplus has other costs. For example, insurers cannot freely invest in the asset mix which they view as optimal. They also find difficulty in moving capital in and out of their companies without regulatory approval and delay and rating penalties.

Critique

The authors are concerned that inefficient allocations of capital will result in inaccurate regulated prices, and thus insurers will "push the wrong product". However there are many other factors which assuredly do results in regulated insurers "pushing the wrong product".

For example, insurers use different distribution systems which have very different costs. For some products, there are companies that have operating costs differences of more than 10% of premiums. This is a multiple of the difference regulators would find between various product lines from the cost of double taxation on different amounts of allocated capital.

In addition to distribution channels, insurers have differences in time horizons, growth plans, product offerings and their ownerships' risk perspectives that result in different plans and aspirations. These companies will not view the same product in the same way. On a practical level, may a regulator take legal notice of the diversification benefits of exposures outside of the state or country?

Another concern with the authors' algorithm is that companies with different product mixes or levels of investment risk generally have different marginal default values for the same product. This can cause a destructive incentive. For example, using the authors' algorithm, if a company finds Automobile insurance to be insufficiently attractive at the approved pricing, by writing a much larger amount of credit derivatives, Catastrophe reinsurance or excess D&O or by investing in Iraqi bonds, the marginal default value for Automobile falls and it becomes more attractive.

A final concern with the authors' algorithm is circularity. Marginal default values depend on the current mix of business. But a company using this approach to choose the business they write does not yet know its mix of business. Thus, the profit depends on the allocation, which depends on the mix of business, which depends on the profit. (See Dan Gogol's review of Rodney Kreps' article in PCAS LXXVII.) Including a history of regulation, at times misdirected regulation, results in a knottier problem. A regulator cannot develop appropriate pricing in the future, unless we know that the regulated prices in the past resulted in the "appropriate" mix of business

Requiring the same rate for all companies for all risks guarantees that most companies face at best inefficient incentives. This is especially true when regulation also distorts price-setting to meet unrelated social objectives, as in Massachusetts Automobile insurance.

CAPM in Insurance

The key underlying assumption in applying a Surplus allocation in rate regulation is not the authors'. The regulatory model in Massachusetts and other states is that insurers should only earn profits consistent with those earned on other investments of comparable risk. This is based on the U.S. Supreme Court's Hope Natural Gas decision, which is usually interpreted to mean the profit margins which would be calculated using the Capital Asset Pricing Model (CAPM) method. That is, only the systematic, non-diversifiable risks within an insurance portfolio will (and should) earn a return above Treasuries, and that return is the same as a stock with equal correlation to the overall market would earn. MBA students are traditionally taught that a dynamite factory is a systematically less risky investment than a diversified, but leveraged, stock portfolio.

CAPM argues that the capital market cannot allow the dynamite factory to earn a higher return than an investment with a comparable beta factor.

A recent empirical challenge to the use of CAPM in insurance pricing is the market for Catastrophe bonds. These bonds earn significant excess returns on their total risk, even though that risk is seen as diversifiable. Catastrophe bonds have a low beta: some authors (example: Kenneth Froot) suggest that catastrophe insurance risk has a zero beta. However, Catastrophe bonds actually earn returns very significantly above equivalent Treasury bonds (see the recent work of Morton Lane). Contradicting the dynamite factory analogy, investors require an extra reward for the clear, but diversifiable, chance of a catastrophic loss of their investments.

We see that the CAPM results do not currently hold for insurance investments. This is only possible in the long term if the essential assumptions of CAPM do not apply to insurance investments. Do they? Insurers may not borrow or short sell without limit. Capital does not move freely into and out of insurance companies. Insureds and insurers and their investors and regulators all have different time horizons. Insurance contracts are not transferable or divisible. Several of the key assumptions underlying CAPM rate regulation clearly do not apply, although regulators persist in applying them out of respect for precedent or for lack of a practical alternative.

One alternative possible now for regulators is to model a notional portfolio representing a mix of Catastrophe bonds and Treasury bonds that matches the degree of total risk of an insurance product. The excess return on this notional portfolio would be an appropriate profit provisions to include in rates. This provides an objective measure of return without relying on the CAPM's assumptions, which we can see are violated both in theory and by market results. The alternative would however provide a non-confiscatory return "of equivalent risk" as required by Hope. A sample calculation is shown on page three of the exhibit.

A more direct analysis, that was also impossible in the past, is to look at the long-term loss ratio for the same product in the many states that now have vibrant and effective competitive market. This would provide a direct benchmark of the relationship between price and risk that Hope says insurers should earn. This comparison would also allow regulators to ignore differences of expense and product mix that insureds do not care about. Insureds only value what they receive as expected loss recoveries, defense and cost containment expenses, loss control services (and perhaps premium taxes, as a surrogate for sales tax that they might pay to replace their damaged property). This different approach could be viewed as "demand side" regulation.

The Author's Derivations

The key result - - that marginal default values "add up" - - is nicely proven for the case of two products and a fixed asset return. The authors generalize to multiple products and variable assets. This would be a stronger development with two additions. First, it would also be nice to see that the "adding up" works going from two products to three. Then, by "nesting" the definition of products as A, A+B, A+B+C, etc. we could induce that the conclusion holds for any number and ordering of products. Second, the authors briefly move from an unknown asset return to all asset returns. An illustration or two would make this more persuasive, for example, two products with respectively positive and negative correlation with assets.

Finally, I very much enjoyed the authors' description of a U-shaped profitability curve reflecting the changing contribution of operating and capital costs as the number of different insurance products increases. An opposite conclusion has been drawn for other industries. Operating costs and relative pricing often move in opposite directions with unit volumes, but don't stabilize in the middle.

For example, McDonald's has the highest market share among restaurants and can spread its general costs over famously its billions and billions of transactions. Conversely, each reader's neighborhood favorite has a particular format that reflects local tastes and circumstances better than any national firm can. This allows effective product differentiation and prices much higher than McDonald's. A smaller national chain can hope for neither benefit and is typically less profitable than either extreme.

Insurance has a similar problem but, as the authors note, the correlation between risks adds a dimension. Insurers can pursue a competitive advantage in three ways, not just two:

1. High volume produces low per-unit operating expenses.
2. Specialization allows better customer responsiveness and higher pricing levels.

3. Diversification allows lower overall variability and a relatively lower cost of risk per unit.

Unfortunately, these tactics are essentially contradictory.

- High volume or a specialized focus prevents diversification of risk.
- Specialization or diversification prevents economies of scale
- High volume or diversification prevents customer responsiveness.

While a two-dimensional market space allows two stable and optimal solutions, a three-dimensional space allows three polar optima, and perhaps also three hybrids, each balancing two of the poles at a time. This is a much more challenging problem, and may help explain the instability seen in insurance markets.

"I liked white better," I said.

"White!" he sneered. "It serves as a beginning. White cloth may be dyed. The white page can be overwritten; and the white light can be broken."

"In which case it is no longer white," said I. "And he that breaks a thing to find out what it is has left the path of wisdom."

Gandolf, recounting a conversation with Saruman:

The Fellowship of the Ring, J.R.R. Tolkien, Book Two, Chapter 2.

Exhibit – Page One

Simplifying Assumptions

A. Cat Bond, Priced at Market

• Face amount:	$100,000,000 Limit
• Term:	One year
• Dividends:	None
• Current price:	$94,000,000
• Estimated frequency of loss:	0.001 per year
• All losses are total limits	
• Estimated beta:	0

B. Capital Market Results

• Expected return on total market	7%
• Risk-free interest rate (1-year Treasury):	2%

C. Regulated Automobile Liability Policies

• Limit:	$1,000,000
• Estimated frequency of loss:	0.01 per year per policy
• Average severity:	$100,000 (including ALAE)
• Standard deviation of severity:	$100,000
• Frequency and severity are independent	
• Estimated beta:	20%
• Average duration:	1 year

D. Industry Totals

• Number of cars:	5,000,000
• Expected losses:	$5,000,000,000
• Expected number of claims:	50,000
• Standard deviation of number of claim:	15,000
• Average costs (including Taxes, Commissions, ULAE):	30% of GWP
• Premium tax only:	5% of GWP

Exhibit – Page Two

CAPM Pricing Model

• Expected industry losses:	$5,000,000,000
• Beta of losses:	20%
• Risk-adjusted discount rate:	3% = 2% +20% x (7%-2%)
• Discounted losses:	$4,854,000,000 = (Losses/1.03)
• Allocated Surplus:	$2,427,000,000 (Assumed 50% per authors' model)
• Interest on Surplus:	$48,544,000 (2% risk-free rate)
• Tax on interest:	$16,019,000 (33%)
• Losses plus tax allowance:	$4,870,000,000 (Discounted losses + tax on interest)
• Gross Premiums:	$4,870,000,000 / (1-30%) = $6,957,000,000
• Rate per car:	$1,391.

Exhibit – Page Three

Pricing via Reference to Cat Bond Returns

Massachusetts Industry Totals

- Expected losses: $5,000,000,000
- Standard deviation of losses: $5,400,000,000 (simulation results)

Cat Bond Pricing

- Expected losses: $1,000,000 (1% of $100,000,000)
- Promised return: $6,000,000 ($100 Mn - $94 Mn)
- Expected return: $5,000,000 ($6 Mn - $5 Mn)
- Risk-free return: $1,880,000 (2% of $94 Mn current price)
- Excess return: $3,120,000
- Standard deviation of losses: $9,950,000 (via binomial model)
- Excess return / SD: 31.36%

Required Rates

- Expected losses: $5,000,000,000
- Discounted losses: $4,902,000,000 (discounted at 2% risk-free)
- Allowed return: $1,693,440,000 (31.36% of $5.4 Bn)
- Losses plus risk charge: $6,595,000,000 ($4.902 Bn + $1.639 Bn)
- Gross premiums (Supply side): $6,595,000,000 / (1-30%) = $9,422,000,000
- Rate per car: $1,884.
- Gross premiums (Demand side): $6,595,000,000 / (1-5%) = $6,942,000,000
- Rate per car: $1,388.