Evaluating Individual Unit Profitability via Value Impact

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One of the key problems for insurance company management is evaluating the profitability of individual units, such as lines of business, states, departments, and even contracts. Capital allocation, pricing theory, and other approaches have been proposed to do this. An alternative proposal is explored here, based on the units' contributions to a measure of company value.

Background

Merton and Perold (1993) propose a profitability target for a unit based on the cost of risk capital. For the unit this is the value of the financial guarantee the company provides to the customers of the unit. That is, if losses for the unit exceed its premium and the investment income on it, the customers have access to the full value of the company's capital to cover their losses. The value of their contingent claim then becomes the cost of risk capital for the unit, and thus is the minimum target profitability. Presumably this can be evaluated by standard financial methods, i.e., by using a risk-neutral valuation of the policyholders' option. This would involve transforming the loss probabilities into a heavier distribution so that the market value of a loss transfer would be the expected value of the deal under the transformed probabilities, including such transactions as this policyholder option.

Mango (2003) calls this approach capital consumption – the unit uses up capital of the firm. He proposes pricing the policyholders' option by mapping each loss event into a larger loss, and then pricing by the mean of the transformed loss. This mapping is equivalent to the risk-neutral valuation, as the transformed losses could be considered a new loss distribution whose mean is used to evaluate deals. It is also equivalent to the riskiness aversion function of Kreps (2003), which is a factor by size of loss applied to the loss size. Kreps uses these transforms to create co-measures for any risk measure that can be expressed as a transformed expected value. There is an analogy to utility theory here, as larger losses are less desirable and so are penalized more. Thus Mango calls the mapping function a utility function. However this is misleading terminology in that the mapping is applied to the loss itself, whereas in utility theory the transform is applied to the value of surplus before and after the loss. In any case, so far this approach is equivalent to Merton-Perold.

Mango carries this forward with a method of incorporating the time frame aspect. Some contracts pay out quickly, while others pay over many years. Mango discounts the adjusted losses at the risk-free rate to get a present value pricing of the option, which is similar to what is typically done under a risk-neutral valuation. In the Merton-Perold framework this would be expressed as evaluating a more complex op-

tion – an option which is exposed when losses from the unit exceed its premium plus investment income, and then continues to pay all claims after that. Merton-Perold did not explicitly consider this type of option, but it is a natural extension of their framework.

In a private conversation, Ken Froot pointed out that the mean profitability is not the right value to compare to the risk capital so defined, in that the profit is also a contingent claim – all the profit goes to the company, if it is positive. This claim could be evaluated by the risk-neutral valuation as well, and the values of the profit and guarantee compared. However Froot points out that the sum of the two claims is an ordinary forward contract – not a contingent claim at all. It represents the total position of the company in the unit's contracts. The present value of all the cash flows in the risk-neutral measure is the value of this position. This is a variation of the discounted cash flow (dcf) methodology. It discounts the transformed cash flows to get the economic value of the unit. The two separate options could be presented, however, to show the positive and negative components of this value.

Some Remaining Issues

The value of the unit so far has been considered with respect to the market as a whole, but this value could be different within a company. For instance, it might cost more for the company than the overall market to provide the financial guarantee, especially if the unit losses have a high correlation with the company's other losses. This relies on the fact that company specific risk does have a value impact, especially for insurers. See Major-Venter (2000) for a summary of literature on this issue.

Of course the actual form of the loss or probability transform is important, and that needs to be determined. Typically, proposed transforms are tested against known prices to find one that at works in some specific known realms. E.g., see Wang (2002). But there is a delicate issue here – the discounted cash flow method uses transforms of the specific loss payments, but the value impact of a given loss is really its entire present value, so that is what should be transformed. In Krep's framework, the leverage multiplier g(x) for a loss payment should depend on the whole loss x, not each payment.

Unit Contribution to Company Value

A way to address both of these issues is to look at the unit's contribution to overall company value. For this, company value can be measured by the transformed dcf method, where the transform is applied to the present values of the total company losses for each event. This is most clearly expressed in the riskiness-leverage function approach, where the x used in the g(x) function is the total company loss for the event. This will typically give a bigger percentage penalty to events that are large for the entire company,

so if the unit losses are high in those events, they will get a greater hit than would the same sized unit loss in an event that is less significant overall. The ratio of transformed value to present value can then be applied to each payment of each claim for each unit that had a loss in that event. Thus each unit's loss transforms are based on the contributions of the unit's losses to the overall value of the company, and not just to the size of the individual payment for the unit itself. This is essentially a co-measure approach, where the measure is the value of the company under the transformed dcf methodology.

Some More Remaining Issues

One big detail: how do loss reserves get into this calculation? The simplest approach is to exclude them – take the value measure to be the transformed dcf for the company for a policy year. Then each unit's contribution to that year can be evaluated. The problem is that the company still has exposure to events that cause loss reserve increases, and the units that correlate most strongly with these increases essentially use more capital, and so their value would be overstated by just looking at individual policy years.

An alternative would be to model the events that cause reserve increases, such as increases in price levels, adverse court rulings, unintended coverage being extended back for several years, change in reserving philosophy, etc. The costs of such events could be modeled and transformed just like new loss events, but the modeling to do this gets more complex. The individual unit losses in these reserve-change events would have to be modeled to apply the loss transform. And since a reserve event can affect several years, the growth of the company and risks to that growth, as well as risks to the composition of the future company would also have to be modeled.

Another issue is what about other measures of company value? A more sophisticated value measurement would include systematic and non-systematic risk, and then measure the unit's contribution to these. The systematic-risk component itself can be evaluated with a transformed dcf approach, but the transform would measure the market impacts of an event, not just company impacts. The co-measure with the market would work for this value metric, but again the modeling would be more difficult.

Conclusion

Measuring unit profitability by the contribution to the economic value of the firm addresses many of the outstanding business unit management issues. However, doing it right appears to involve fairly intricate modeling of the company and even the market as a whole.

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