The M Curve: Concepts and Applications

Basic Definition

The M curve is the market value of a company as a function of its capital, with an initial book of liabilities as a given. The level of the curve is affected by the growth opportunities and pricing power the company has, and the shape of the curve reflects how those opportunities are affected by changes in capital. How the market views the adequacy of loss reserves must also impact a company's M curve in practice, but initially we assume that capital is surplus which is accurate as stated.

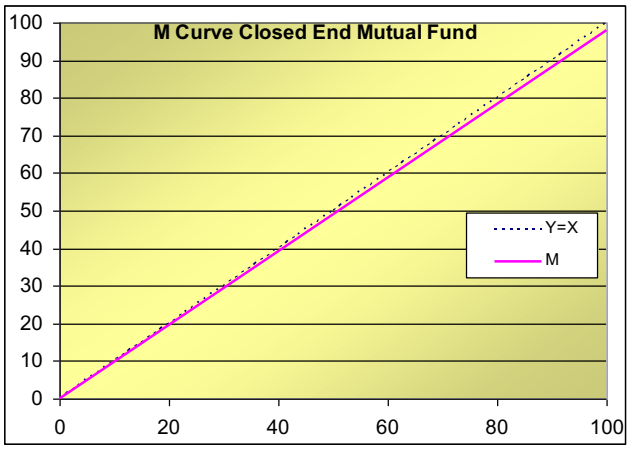
Basic Use

When an insurer with a given level of capital writes a book of business there is a distribution of possible results, each leading to a new level of capital, and through the M curve to a new market value. The expected value of the market value is called EM and it depends on the distribution of the business written. Also if the capital M were different there would be a different value of EM, so there is an EM curve that can be derived from the M curve and the distribution of business.

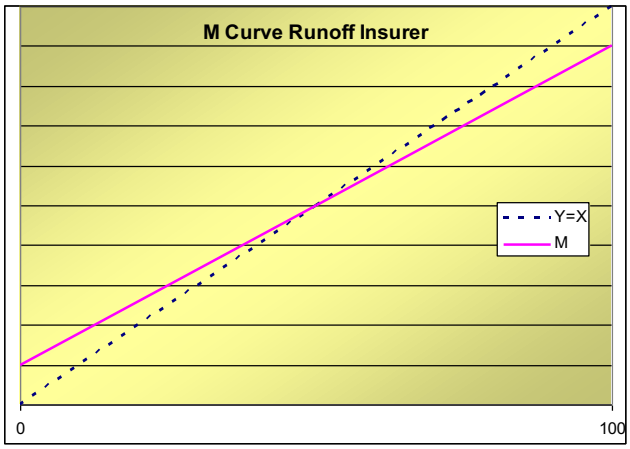
The value of various business decisions can be evaluated by their impacts on the expected market value. How much exposure to take on, pricing levels, reinsurance purchases, and capital raising and dispersing can all be evaluated in a consistent framework based on the impact on EM.

Shape of the M curve

First take the case of a close-end mutual fund. It is investing in a book of assets and is not taxed on its profits. However it trades at a slight discount to the value of its assets, possibly due to agency costs (the reluctance of investors to let someone else control their money). Adding capital to the firm increases value proportionally, as illustrated.



Now consider an insurer in runoff. It has a

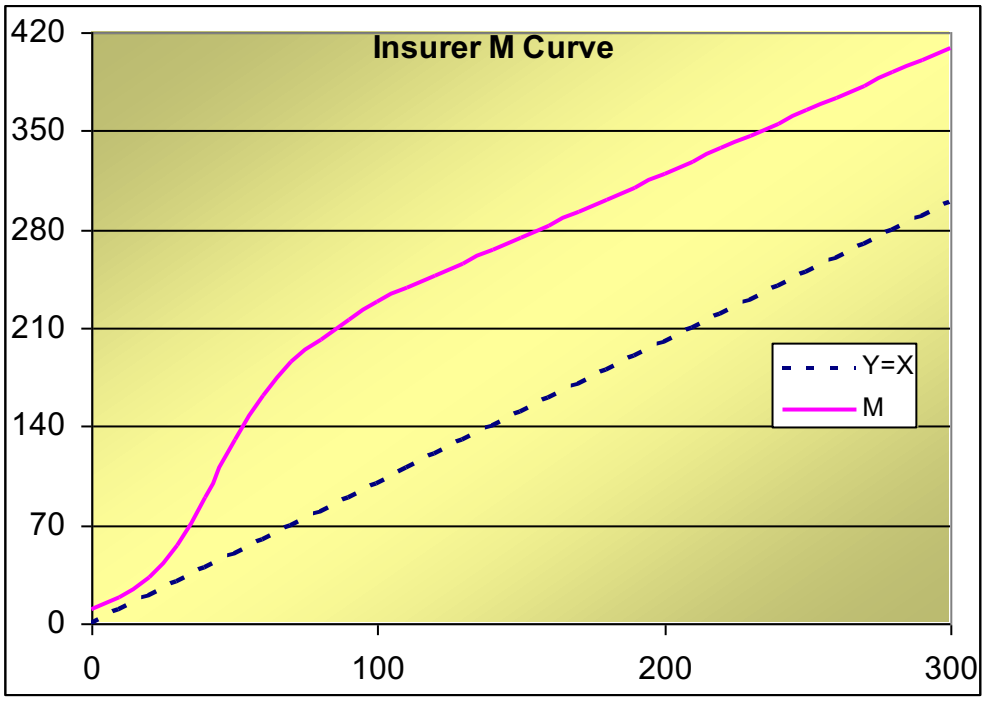


book of assets and liabilities it is managing but is not writing new business. In addition, it is taxed on its profits. We are assuming liabilities are reserved adequately, but there is risk that they will deviate from their expected values. Adding capital would not be likely to add value and the capital owners would like to take out as much as they could. Reducing surplus to zero would still leave a positive market value, however, due to the value of the default put option. (Adverse reserve development is borne by the insureds and favorable development goes to the capital owners.) The M curve would thus start at a positive value and increase with a slope somewhat below unity, and market could be less than capital due to the frictional costs of taxes and agency costs. If the default put is considered part of capital, as in some accounting proposals, then the M curve would be somewhat different than shown here.

An ongoing insurer can be considered to be a combination of a runoff book, current underwriting, and future opportunities. There is a growing body of evidence that higher capital creates opportunities for more and better insurance business and better pricing. The current outstanding business is actually a form of runoff, but of the unearned premium reserve not the loss reserves. The real impact of adding capital is its effects on growth and profitability of business yet to be written. The M curve should be higher than in the runoff case due to the value of these opportunities.

Near the level of zero capital, adding a small amount will have little impact, as the company could not attract much business. But as the amount added increases, the insurer becomes increasingly viable in the market, and market value would then exceed surplus by more than the default put. Thus at some point the M curve would have to rise faster than one for one. Eventually however a high enough level of capital could be reached that the insurer would not get any more growth and profitability benefits from adding more. Then adding more capital would increase market value by less than one for one, due to frictional costs.

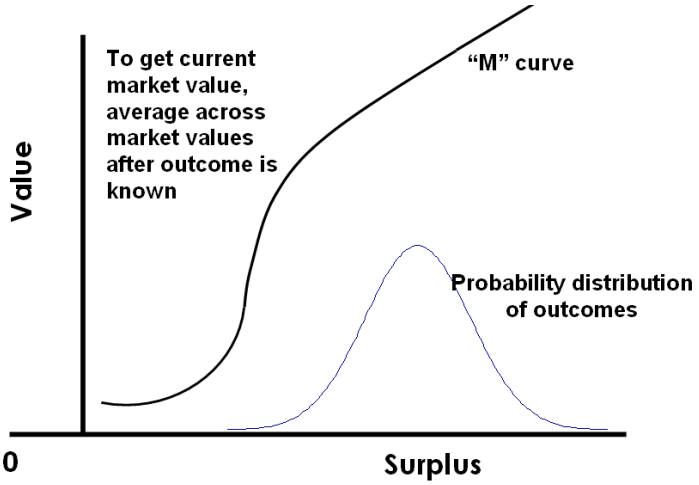
It is the part of the curve that is upward rising but concave downward that lends value to risk man-

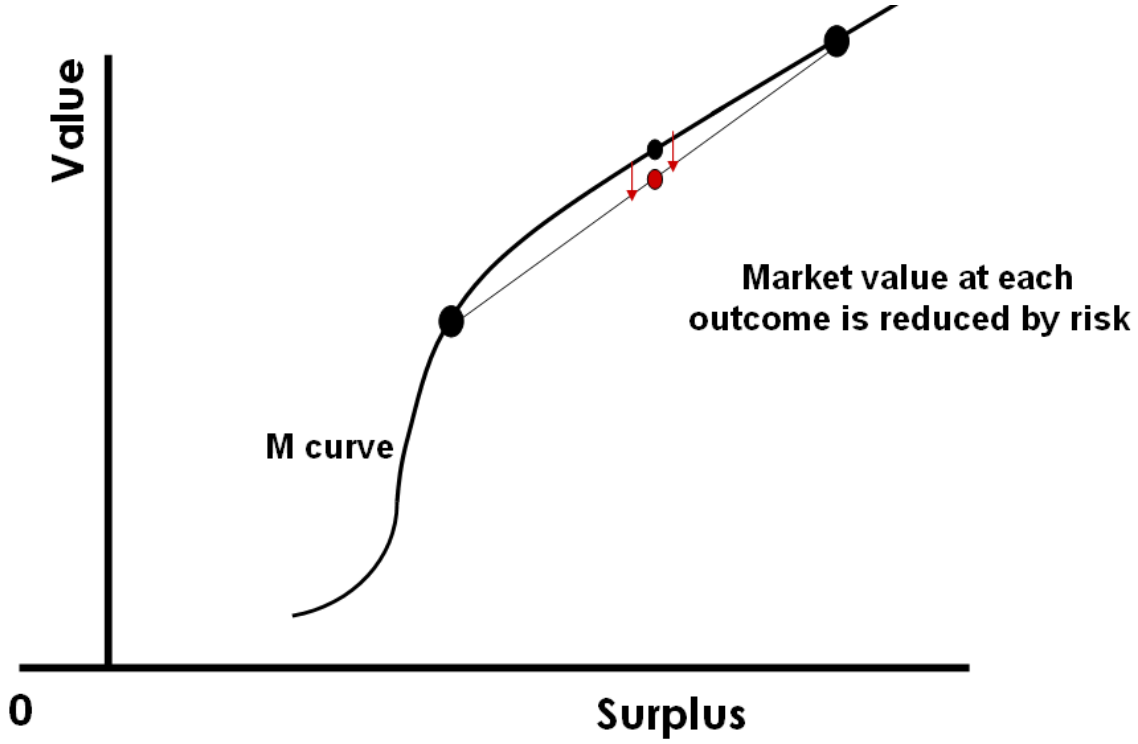


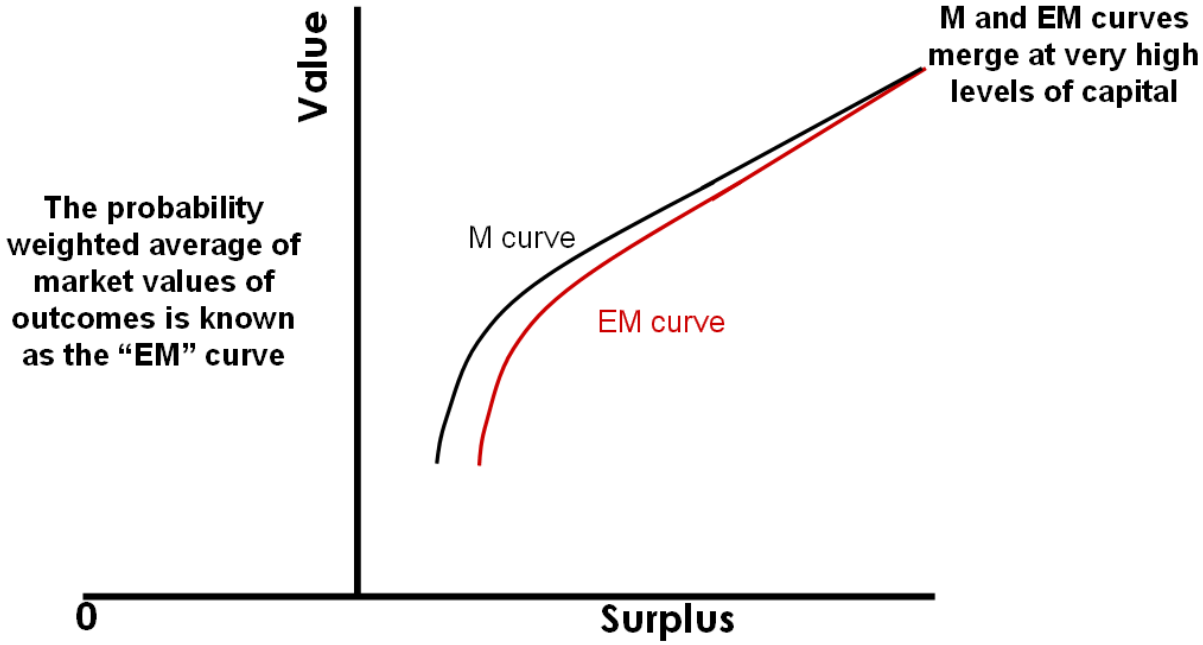
agement activities. Below that the curve is convex – curved upwards – which would make the company risk seeking, in that it would have more to gain than lose from taking risk. However the insurance buyers would not be likely to be very interested in accepting this security. Thus most insurers would be located in the concave downward portion of the curve.

The EM Curve

The M curve shows the market value given the surplus and business opportunities, but if surplus is a random variable then the market value is the expected value of M over the distribution. For companies in the concave portion of the M curve, the EM curve is below the M curve, as uncertainty reduces value.



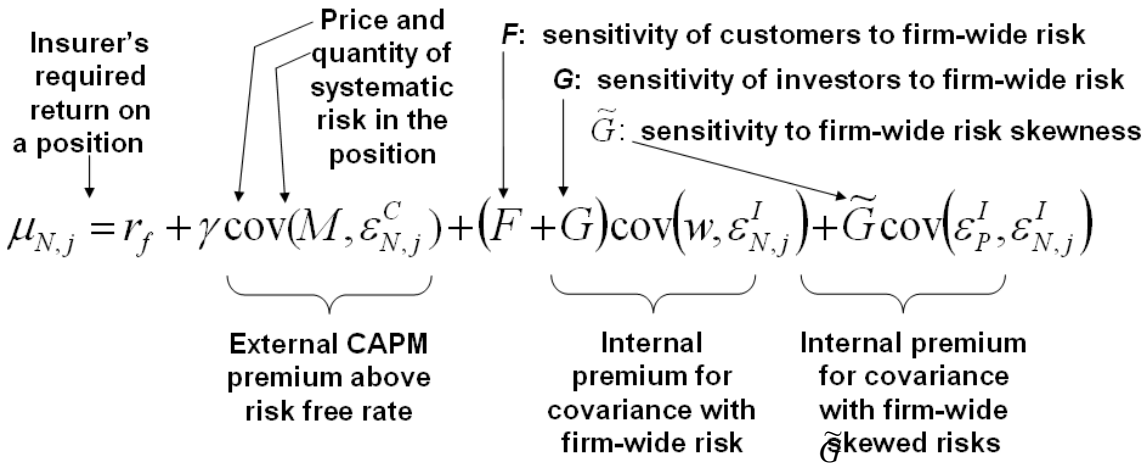




Business decisions like volume written and reinsurance affect the probabilities of outcomes so they affect the value of the company, which lies on the EM curve. Changing capital moves you along that curve.

Pricing Formula (What happened to CAPM?)

This is the pricing formula Ken derived for this study.



With just CAPM you only had the first two terms. Companies from all industries also have the G term, which was shown by Froot-Stein. Insurance companies additionally have the F and G tilde terms, which arise from the fact that customers prefer insurance contracts that will pay to insurance contracts that might pay, and from the asymmetric distribution of outcomes, respectively. These together are called "insurance market effects," while the F term, which is due to differing costs of internal and external capital, is called the "capital market effect."

Why is this important? We are not able to measure the F and G terms separately so we are just looking for the effects of insurance company specific risk on value in general. So we could just study these effects themselves without reference to the formula. However this could look like we are working outside of the framework of financial theory, which would seem unsound to financial officers who are trained in capital market theory. This equation makes it clear that our work is done within the framework of capital market theory, not ignoring CAPM but refining it.

Examples – Picky Insurance Company (Very Selective)

Writing a book of business has risk so must produce a profit to not reduce value. The risk moves value from the M curve to the EM curve, but profit moves value along the EM curve, as illustrated in Figure A. In this example, a $6.6M profit on $515M premium is needed to break even on value. Reinsurance reduces risk so moves the EM curve upward, but the margin above expected losses in

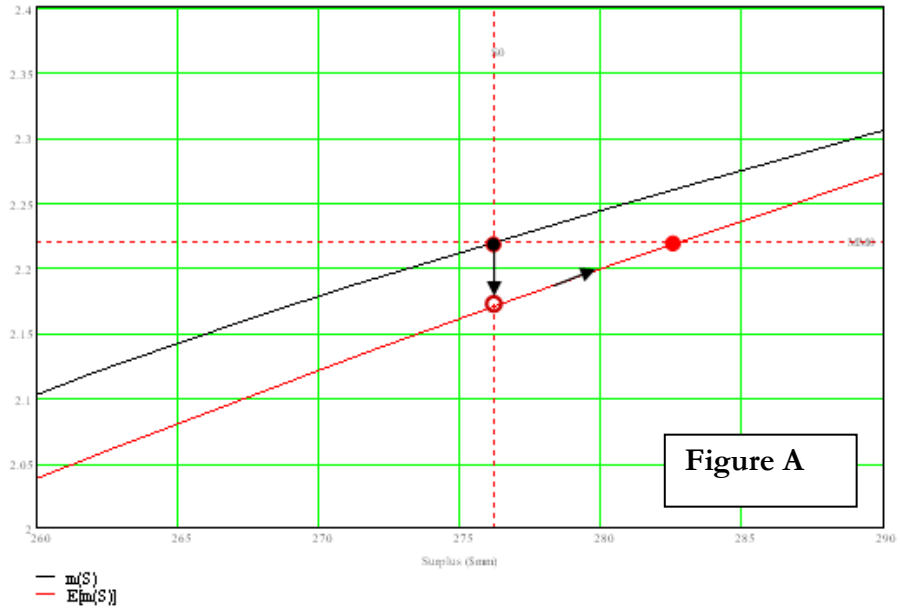


Figure A

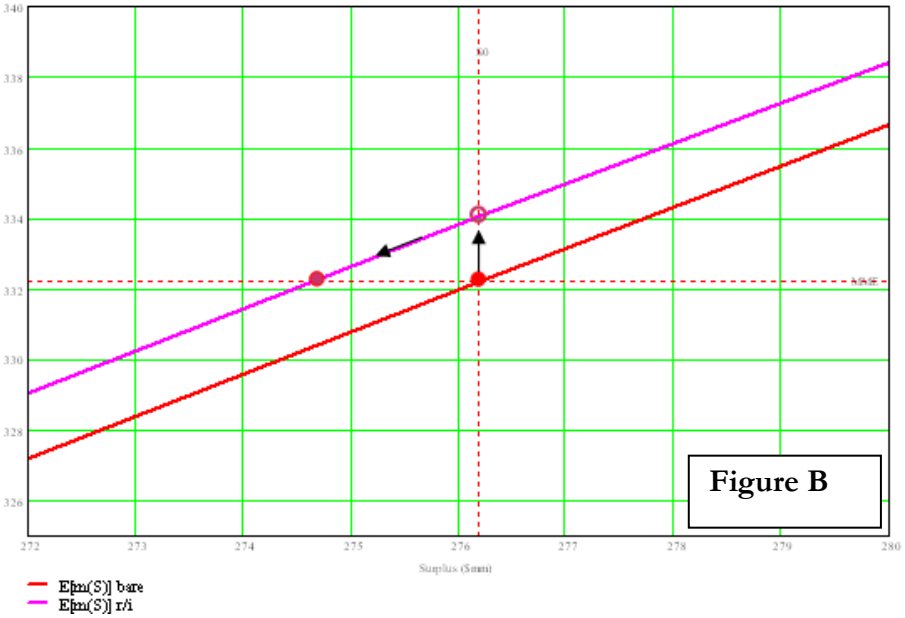


Figure B

the reinsurance moves value to the left along the new EM curve. Figure B illustrates this with a layer with 1.9% LOL which is placed with a 2.5% ROL. The layer still would add value up to a 4.4% ROL.

Other decisions that can be addressed within this framework include the value of a new capital issue or alternatively reducing capital through dividends or buy-backs, buying a new book of business, and increasing the investment risk and expected return. All work by calculating the EM curve based on the risk involved, and moving along it based on the expected level of capital.

Current Status

The results shown for Picky Insurance come from our study of the value impact of the capital lost from the 9/11 attacks (the "event study"). This study showed that for most insurers there was a decrease in value which was a significant multiple of the loss of capital. This indicates that most insurers are in the concave portion of the M curve. The actual results of our analysis so far do not justify typical market reinsurance purchases, however. Picky Insurance was postulated as a firm with a great

deal of risk, and the results of the event study show value in reinsurance for Picky, but not for more usual firms. The basic problem is that the margin in the reinsurance price also reduces capital so would reduce value by a large multiple of the margin. This makes it hard for the stability produced to show sufficient value enhancement.

Another study we are doing is the "volatility study." It looks at the market value of insurance companies as a function of their earnings volatility. By our theory a more stable insurer should have a higher market value. The problem is in formulating this effect properly. Should this higher value be a one-time effect, or should value in each period increase faster due to stability? The relationship to earnings is also an issue. Higher earnings should produce higher value, so we are looking at the effect of stability over and above the effect of earnings. However stability does appear to affect earnings as well, so this should also be reflected in the study. So far various formulations of the volatility study have produced a significant impact of volatility on value, but the effect of earnings on value have either been too weak to believe or so strong that the impact of the reinsurance margin overwhelms the value of stability.

Both the volatility study and the event study are ongoing. We are still looking for formulations that will work for real insurers.

Outside Studies

Insurance finance researchers have been studying related issues, and a number of these studies have bearing on the value of reinsurance. Even without our own studies we can use some of these studies for our client analyses. Some of the more suggestive studies we have uncovered are outlined below.

Epermanis and Harrington "Market Discipline and Reaction to Rating Changes in U.S. Property-Liability Insurance Markets," University of South Carolina, March 2001 find that growth rates are higher for higher rated insurers, and that the growth rate of a company moves up and down with rating changes. They found that a ratings upgrade is worth about 3% additional growth in the following two years, with a slightly stronger effect for initially lower rated insurers. A ratings downgrade costs lower rated insurers in the range of 20% loss of business over two years, but costs only about a 5% loss of business when higher rated insurers become less highly rated.

We could use this study in combination with the FIT work on ratings impact of reinsurance to estimate value impacts of reinsurance. The loss of business from being lower rated would affect near-term earnings but would also affect the franchise value of discounted future earnings and so the market-to-book ratio.

Sommer "The Impact of Firm Risk on Property-Liability Insurance Prices," *The Journal of Risk and Insurance*, vol. 63 no. 3, 1996, pp. 501-514 finds that the profit load insureds are willing to pay decreases as the ratio of capital to assets declines, and also decreases as the volatility of that ratio increases. This reinforces the impact of strong capitalization on pricing. Part of this is a response to stability of results, suggesting that stability itself can contribute to earnings. Numerically, he finds that at the mean levels of the variables, a 1% increase in capital, with obligations held constant, leads to an almost 1% increase in pricing achieved, and a 1% decrease in the portfolio standard deviation produces more than 1/3 of a percent increase in pricing. He concludes that there is an impact of guarantee funds on insurer choices, but the uncertainty and possible delay involved still place a premium on insurer financial strength.

The effect of standard deviation on pricing should translate directly into earnings. Preliminary analysis suggests that this will show a great deal of value of reinsurance. The main risk is that it will be unrealistically high. Application of this to actual and proposed treaties will help us evaluate its reasonability.

Cummins, Lin and Phillips, "Capital Allocation and Pricing Intermediated Risks: Preliminary Evidence from the Insurance Industry," which has been presented but not published, finds that reducing the insolvency put by a small factor increases the premium level attainable by approximately the same factor. The insolvency put is the financial value of the option of the insurer to default, which is closely related to the expected policyholder deficit. This tends to be a small number, like 0.1%, and is difficult to estimate. It might be somewhat beyond the 1-in-1000 return period annual aggregate loss for the company from Metarisk, for example. But if reinsurance changes this number from 0.1% to 0.099%, these results suggest there would be a 1% increase in pricing and therefore earnings, which could be significant. Thus it could well be worth trying to estimate this impact, as it

could show a decent value from the reinsurance.

Conclusion

The pricing formula Ken has produced makes this approach respectable from a financial theory viewpoint. The empirical studies we are doing may or may not provide adequate quantification of the value of reinsurance. So far the versions we have do not achieve this. Other empirical studies are showing strong effects, and could be useful within this framework.