Market Value, Economic Capital and Reinsurance: A Status Report

It is well known that economic capital requirements and reinsurance are closely related. Capital and reinsurance are essentially substitutes, chiefly secured in order to back up insurers' promises to their customers. Less well known, however, is whether insurer financial stability actually generates value, and, if so, how much. Knowing the value of financial stability is crucial for determining the valuation consequences of a change in economic capital held or reinsurance ceded.

This paper is a status report on our ongoing studies on capital market responses to changes in insurer capital and perceived financial volatility. Because other authors have contributed to this topic, we also survey selectively that work. Our emerging results indicate that company value is enhanced by having strong finances, but also suggest that there is a limit beyond which further financial strength is not worth the extra cost.

Before getting into the details of the studies, some background financial theory is covered, and the findings of other studies are summarized.

What financial theory says about risk aversion

Two paradigms of risk analysis dominated 20th century thinking about risk. For the individual, utility theory served as the basis, and for corporations beta – derived from portfolio theory -- was the key

Utility theory provides a mathematical way to express individuals preference for certainty over uncertainty. The utility to you of an amount of money represents how much you would like to have it. A million dollars is worth something, and two million is even better, but if you are risk averse, it's not twice as good. So if you win a lottery for a million, and have a chance at a coin flip for two million or zero, you would keep the million. Utility theory gets to this conclusion because the expected utility of taking the chance is less than the utility of one million certain, as the utility of two million certainty is less than twice the utility of one million certain.

This logic is compelling, but it doesn't apply to corporations. In classical financial theory, corporations do not have their own preferences toward risk, relying instead on shareholder value to communicate what they should like or dislike. If shareholders invested all their wealth in only a single company, then market value would exactly reflect shareholders' dislike of any and all risk. However, since shareowners can diversify their holdings across many companies, they care only about the component of company risk that is pervasive across their portfolio – systematic risk. Any risk due to idiosyncratic fluctuation of cashflow is diversified away, and so shareholders and market value are indifferent to it. So the extent to which a corporation's cashflows move with the overall market becomes a risk measure – indeed *the* risk measure – and this is what is measured by beta.

Problems with historical view - summary

The corporate story is logically coherent but clearly problematic. Companies buy insurance to protect against losses, such as damage to facilities and lawsuits. They don't seem to buy it for beta. Either the whole corporate attitude toward risk is tremendously naïve, as some academics believe even today, or the theory has problems. In the late 20th century a number of such problems did come to light, and now a different picture is emerging.

One line of attack on the classical view was to find material flaws in the assumptions of the original theory. One of these was that tapping capital markets and returning funds to them could be done at the same price. A company could pay out all its profits because if it ever needed funds it could raise them again at the same cost. After going public, companies rarely go back to the capital markets for more equity, and usually then only when distressed in some way. Retained earnings effectively come at a better price than new capital. This leads to the conclusion that companies with more growth opportunities will value retained capital more and will benefit from protecting it through risk management, even at a cost to current earnings. Several analytic and empirical studies discussed below have supported this idea.

Another approach was to look at ways that risk reduction could actually enhance earnings. If it costs something to reduce risk, but higher earnings result, then risk management adds to value. This is not inconsistent with the premises of financial theory, but is not contemplated in beta.

Taxation is one example – stable average earnings can be taxed at a lower average cost than wildly fluctuating earnings that average the same. The costs of financial distress are another. There are two kinds of things that happen if a firm falls into distress. The first relates to costs and the second to funding.

As to costs, if a firm falls into financial distress, a fair amount of value can be wasted on lawsuits, regulation, and on the bankruptcy process itself. Estimates are that approximately 2% of pre-distress value can be lost due to these 'frictional' costs [citation – Gilson?]. More important than frictional costs, however, are the distress costs of employees spending their energy floating their resumes, suppliers cutting back on their dependence, and even customers contemplating their use of the product. Management may also have no choice but to focus on the immediate issues of distress, taking time and energy away from pursuing strategic value. These broader costs of financial distress are estimated to be an order of magnitude greater than the frictional costs. [citation – Andrade]. Indeed, these broader costs start to impact the firm well before insolvency. Even the mere prospect of insolvency or financial weakness may trigger employees, suppliers and customers to begin looking elsewhere.

Second, distress unambiguously impacts funding. Once in distress firms find it hard to raise outside funds, and virtually impossible to raise external equity capital. After all, why would an investor provide equity capital to a firm in distress, thereby "throwing good money after bad." The money would go directly to pay creditors, instead of funding new growth to support the equity value. As a result, distressed firms cannot sell new equity for anything near its fair market value. For all practical purposes, external finance has become some expensive that they cannot afford to use it when it is most needed.

These two features of distress – higher costs and reduced financing opportunities -- make it a kind of death spiral from which exit is very difficult. As a result, the prospect of distress, even the distant prospect of distress, is imbedded negatively in security values every day. And risk management can raise value by reducing the chance of distress or near-distress states.

For insurers, customers might be considered to be extremely sensitive to the prospect of financial distress. After all, the only thing a customer "buys" from an insurer is the firm's future financial payments should he experience a loss. These payments are readily threatened if there is a prospect of future financial distress. Other companies experience these issues, though often to a lesser extent. As supply chain management becomes more critical, risk managers are increasingly looking at the risks to their suppliers. Would you buy a car from a company that might not be there to supply parts?

Even the individual story – utility theory – has its problems. While it makes sense in the abstract, psychological studies of risk attitudes have found it incomplete. For one thing, typically risk adverse people are often willing to make bets at less than even odds when the cost is small and the potential payout is significant. As the advertisement for the New York state lottery goes, "Hey – you never know." More critically here, risk aversion at the extreme end of the scale is more extreme than most utility functions would project. Known as the "certainty effect," the desire to remove the last vestiges of a major risk tend to be great. Psychological studies have found, for instance, that when the risk is life altering, like losing your home, putting in a risk of insurer failure of as little as 0.1% is of concern. Homeowners seem to want a premium credit of 1% – 2% to accept such as risk, which is 10 to 20 times the expected value. [citation] Because of these customer attitudes toward risk, insurers may be even more vulnerable to financial instability and possibility of financial distress.

So what is the emerging consensus? Utility theory is not exactly right for individual risk attitudes, especially in getting to the value of the last bit of uncertainty. This clearly has implications for the value of insurer financial strength. Beta theory is not complete either. Besides not being the sole determinate of market risk – a feature not discussed here – beta ignores corporate risk that is specific to the individual company. However this does not say that corporations are people after all – it does not suggest that utility functions will work for company risk management. Beta is still a risk that has to be addressed – it is just not the only risk. Company value from risk management depends on specific issues, like how close distress might be, and what needs there might be for future capital. In essence these all boil down to assessing the improved profit opportunities that come from risk management, which is quite different from saying that a firm prefers certainty to uncertainty in general. A particularly strong motivator when the company is selling insurance is the risk concerns of its customers, especially the certainty effect for personal lines customers.

Problems with historical view - empirical findings

Works that bear on these issues include studies of individual attitudes toward risk, corporate risk management, and insurance market impacts.

Individual attitudes towards risk

The classical psychological study in this area is "Probabilistic Insurance" by Wakker, Thaler, and Tversky, which was published in 1997 in the *Journal of Risk and Uncertainty*. It tests people's reactions to insurance policies that are subject to a fairly small probability of default, using methods that get people to reveal their risk attitudes. The finding is that a reduction in premium of over 20 times the expected value of default is needed for people to feel this is equivalent to a no-default cover. They use the result to show that utility theory has difficulty explaining this, but that an alternative form of risk analysis called prospect theory explains it very well.

A growing number of studies supports prospect theory in general. A paper that discusses implications for insurance companies, including the resulting need for strong financials, is "The Loss Of The Certainty Effect" by Stewart & Stewart, in *Risk Management and Insurance Review*, 2001.

Corporate Risk Management

The effect, derived by Froot and others (as in Froot,. Scharfstein, and Stein, 1993, "Risk Management: Coordinating Investment and Financing Policies," *Journal of Finance* 48, 1629-1658), that retained earnings is a more economical source of capital than is external financing implies that, all else equal, firms with greater capital needs will gain more from risk management. Testing this requires a publicly available proxy for risk management activities, and engaging in hedging transactions is often used for this, even though it is typically only a small part of most companies' risk management activities. Firms with greater capital needs are generally those with better growth prospects, which might be indicated by a higher market-to-book ratio or by higher research and development expenditures. Higher liquidity constraints would also indicate potential capital needs. Several studies have found differences in the use of hedging among firms in the directions predicted. These include:

- Geczy, C., B.A. Minton, and C. Schrand, "Why Firms Use Currency Derivatives," *Journal of Finance* Vol. 52, 1997, pp. 1323-1354.
- Nance, Smith, and Smithson., "On the Determinants of Corporate Hedging*," Journal of Finance*, Vol. 48, 1993, pp. 267-284.
- He and Ng, "The Foreign Exchange Exposure of Japanese Multinational Corporations," *Journal of Finance*, Vol. 53, 1998, pp. 733-753.
- Dolde, "Hedging, Leverage, and Primitive Risk," *Journal of Financial Engineering*, Vol. 4, 1995, pp. 187-216.

These studies are part of a growing body of support for the existence of value in risk management that relates to external financing costs.

Other aspects of the value of hedging specific risk are also finding support. The Dolde study above reports a positive relationship between tax loss carry forwards and the use of risk management instruments, indicating that taxes provide an incentive for risk management. It also finds a significantly positive relationship between the use of risk management and leverage, as suggested by the expected frictional costs of financial distress, which would usually be higher for more leveraged firms. A similar outcome is found by the He and Ng study, as well as by Samant, "An Empirical Study of Interest Rate Swap Usage by Nonfinancial Corporate Business," *Journal of Financial Services Research*, Vol. 10, 1996, pp. 43-57.

Thus tax effects and financial distress, in addition to capital costs, appear to influence corporate risk management behavior, shown by the findings that corporations will spend money on risk management when doing so increases profit opportunities.

Insurance specific studies

Finance researchers see the insurance industry a good field for studying corporate risk management, as the extent of reinsurance purchases is available. An initial paper from this perspective is Mayers and Smith "On the Corporate Demand for Insurance: Evidence from the Reinsurance Market," *Journal of Business*, Vol. 63 (1) 1990 pp. 19-40. They find tax effects and financial distress costs to be important drivers of reinsurance purchases. Corporate form is also important, with closely held corporations and mutuals buying more reinsurance than do widely traded stock companies. The costs of financial distress can be great for insurance companies, leading to loss of business well before solvency is threatened. Another paper that finds that avoiding financial distress is an important motivator for insurer hedging is Cummins, Phillips and Smith "Derivatives and Corporate Risk Management: Participation and Volume Decisions in the Insurance Industry," Federal Reserve Bank of Atlanta Working Paper 97-12, 1997. They also find that reinsurance and financial hedges are to some extent replacements for each other, and identify other determinants of insurer hedging. An increase in market value from using risk management to avoid financial distress is reported by Staking and Babbel, "The Relationship between Capital Structure, Interest Rate Sensitivity, and Market Value in the Property-Liability Insurance Industry," *The Journal of Risk and Insurance* Vol. 62 No. 4, 1995 pp. 670-718.

Several studies have found pricing and growth benefits from insurer financial strength:

Phillips, Cummins and Allen "Financial Pricing of Insurance in the Multiple-Line Insurance Company," *The Journal of Risk and Insurance*, vol. 65 no. 4, 1998 pp. 597-636, estimate the price discount that insureds demand for accepting a higher probability of insurer default. They find the discount is about 10 times the economic value of the default probability for long-tailed lines and 20 times for short-tailed lines. This is roughly consistent with the predictions of prospect theory and the certainty effect. Cummins, Lin and Phillips have found even stronger effects in a study announced preliminarily but not yet published.

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, holding obligations constant, leads to almost a 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 uncertain and possible delay involved still place a premium on insurer financial strength.

Grace, Klein and Kleindorfer "The Demand for Homeowners Insurance with Bundled Catastrophe Coverages," Wharton Project on Managing Catastrophic Risks, 2001, find indications that

higher rated homeowners insurers get higher premiums, but with state variations having to do with insolvency funds.

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 was worth about 3% additional growth in the following two years, with a slightly stronger affect for initially lower rated insurers. A ratings downgrade cost lower rated insurers in the range of 20% loss of business over two years, but only about a 5% loss for higher rated insurers becoming less highly rated.

All of these results support the conclusion that having a strong balance sheet, with capital strength and earnings stability, adds value to the insurer, increasing both current earnings and the value of future earnings.

Our current studies

New analytic work by Froot (forthcoming, Journal of Risk and Insurance) has extended his previous studies on industries in general to consider for insurers in particular the added effect of customer risk aversion. He finds an explicit expression for the marginal financial value of additional capital for an insurer with a given risk profile. Changing the risk profile will also affect the value of the firm, so these findings provide a coherent integrated framework for addressing the value consequences of insurer underwriting, financing, investment and reinsurance decisions. In essence he shows that the insurance market effect – added pricing and growth from financial strength – combines with the capital market effect – differential internal and external financing costs – to further increase the value of risk management in particular and financial strength in general. However these effects are difficult to estimate separately, so the empirical studies emphasize estimation of their combined impact.

Volatility Study

Earnings volatility presents a risk of capital depletion, so it would be expected to have a negative impact on insurer value. One study we did was to explore the effects of earnings volatility on stock market valuation. However this is tricky for a number of reasons. First of all, there are numerous factors that go into a stock price, including earnings trends, growth prospects, etc., all of which make it difficult to establish a benchmark value. So we looked instead on the effect of earnings volatility during a period on the change in market value for the period.

This is to some extent a marginal effect: if a company has had stable earnings, and that fact indeed does improve its value, then continuing to show stable earnings would just be a confirmation of what the market already had priced in. The confirmation is worth something, but presumably only a fraction of the value of stability already built in to the market price. On the other hand, if during the period observed a company is much more or much less stable than the market had anticipated, the change in value would be closer to the full impact of the degree of stability it demonstrates. Our results found that the market value did respond as anticipated to the

volatility in the period. The volatility was then a proxy for the change in volatility, as these could be expected to be correlated. However the degree of change would then be an average effect across firms, some of which were confirming market anticipations and some of which were surprises. Thus the impact found would represent less than the full value of stability on market prices.

Current theory of change in market value of equities includes several factors that the market responds to, such as correlation of the price with the overall market. The model of Fama and French is representative of current thinking on what the key factors are. So any impact of earnings volatility should be measured with respect to the changes that would already be anticipated from that model. In addition, growth in earnings would be anticipated to have a positive effect on market price. Thus the impact of volatility on market price can be reliably measured only after these known effects are all accounted for. This leads to a multiple regression approach, where all the known factors are included, as is the effect of volatility. The regression setup we use measures excess return (return less the risk free rate) as a function of the Fama-French factors, earnings-to-capital (ROE), and the standard deviation of ROE. The best exact form for this regression – logs vs. levels, etc. – is still under investigation.

In one trial, separate log/log regressions were run on different mixes of types of insurance companies and firm sizes. There was a fairly consistent effect of stability on return indicated. Roughly speaking, a reduction of 10% in the standard deviation of quarterly earnings translated into an increase in market value in the range of 1/5 to 1/3 of a percent, with the smaller companies having the greater impact. As discussed above, this change is presumed to be an average impact of the extra information provided by the stability demonstrated in the period, and so is probably less than the total long-term impact of stability on the market price.

This is less than the results of Sommer, who found a 1/3 % increase in pricing from a 1% decrease in standard deviation. Presumedly the pricing increase would increase earnings and therefore value, but would be more leveraged. If earnings are 15% of premium, then a 1/3 % increase in premium would produce (1/3 %)/.15 = 2.2 % increase in earnings, which could be assumed to translate into a similar value increase. The problem in our regression is that the earnings are already in the formulation as an explanatory variable. This is correlated with lower standard deviation in the data, but the regression is picking up a separate effect of stability on value over and above its effect on earnings.

In any case, as an example consider a firm with a market cap of $10B which takes steps to reduce its standard deviation of quarterly earnings from 2.0% to 1.8%, or 10%. By our results that would translate into an increase in market value around 0.25%, or $25M, and probably a fair amount more over time if the stability is maintained. If the stability is produced by reinsurance, the increase in market value would be compared to the margin ceded, that is to the long-term expected excess of cost over recovery. This gives one estimate of the value of reinsurance, but probably understates the true value, both because of the averaging over previously stable and newly stable firms and not taking into account the effect of stability on higher earnings.

It could be argued that the relationship with earnings and stability is spurious, in that the companies with an earnings hit in the time period studied would automatically show a higher standard

deviation. However, the major loss drivers, such as catastrophes, loss level surprises, and rate adequacy tend to hit the whole industry simultaneously. The firms that do not spend money on risk management might be expected to have higher average earnings and a higher standard deviation, but the opposite is found.

Capital Adequacy

A standard measure of the capital strength of an insurer in comparison with its obligations is AM Best's BCAR score – Best's Capital Adequacy Ratio. BCAR generalizes the simple premium-to-surplus and reserve-to-surplus ratios into a combined score of capital relative to total obligations, and it includes an adjustment for loss reserve adequacy.

If policyholders indeed demand premium concessions for less secure coverage, then you would expect to see the companies with higher BCAR scores showing better results. Exhibit 1 illustrates this relationship for companies in the A rated range.

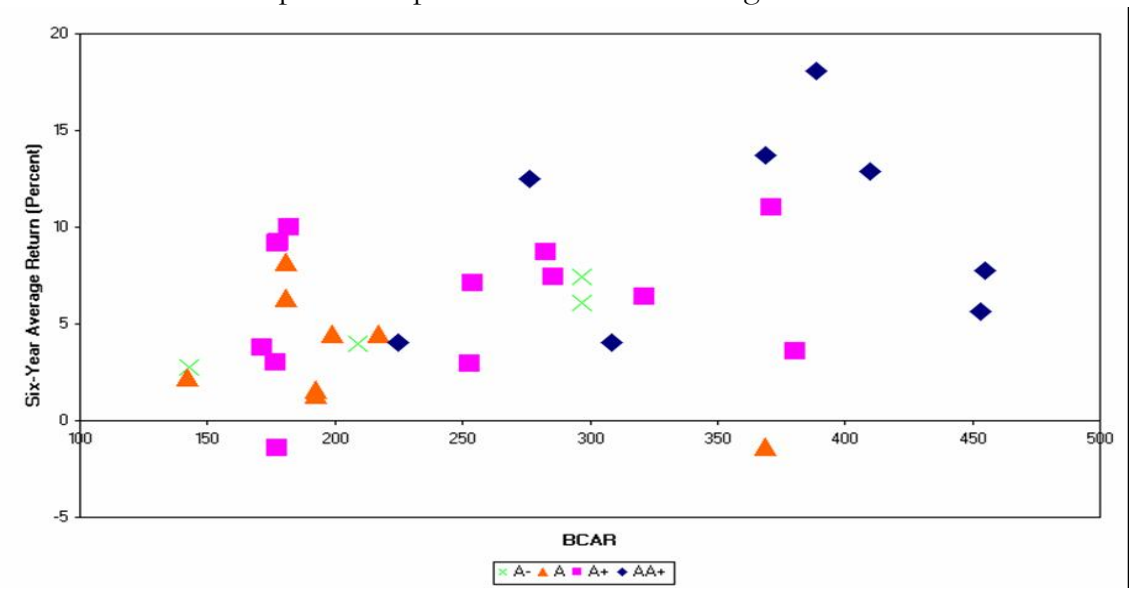

Exhibit 1 – Return as a Function of BCAR

The graph also indicates the Best ratings of the companies, which is established in view of both BCAR and earnings history, as well as Best's evaluation of company management, etc. The BCAR score itself appears to be significantly correlated with earnings even without considering the ratings achieved. Higher BCAR ratings seem to be associated with higher returns, but also with more of a spread across companies. One possibility for this spread could relate to differences between commercial and personal lines' buyers responses to financial strength, which the financial theory would expect, as discussed above.

Exhibits 2 and 3 illustrate the predicted relationship between capital adequacy and return given the results so far noted.

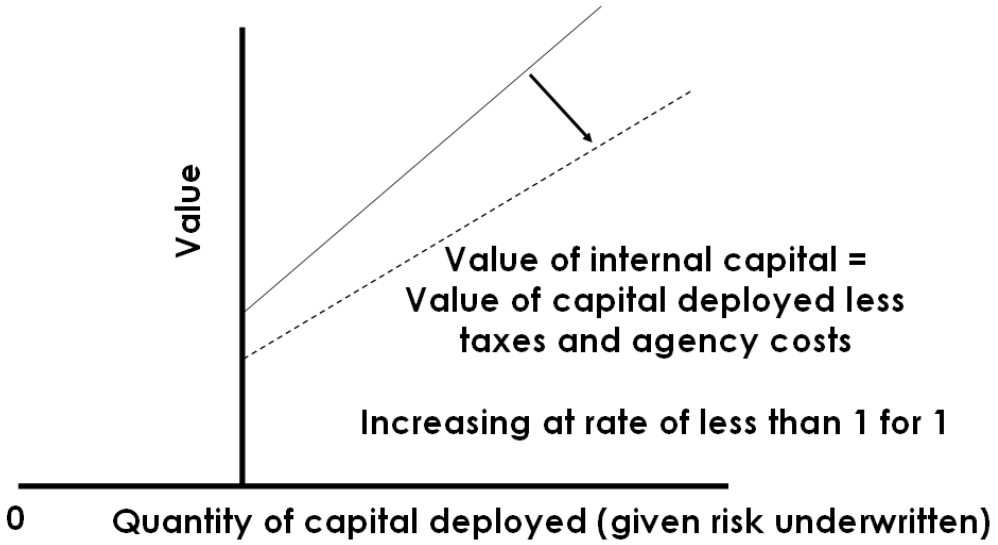

Exhibit 2 – Initial Model of Value vs. Capital

For a fixed degree of risk obligations, the original idealized financial theory would have firm value increasing 1 for 1 with capital. But recognition of the frictional carrying costs of capital, such as taxes on investment income and the reluctance of investors to let managers control a lot of money, would predict that value increases less than 1 for 1.

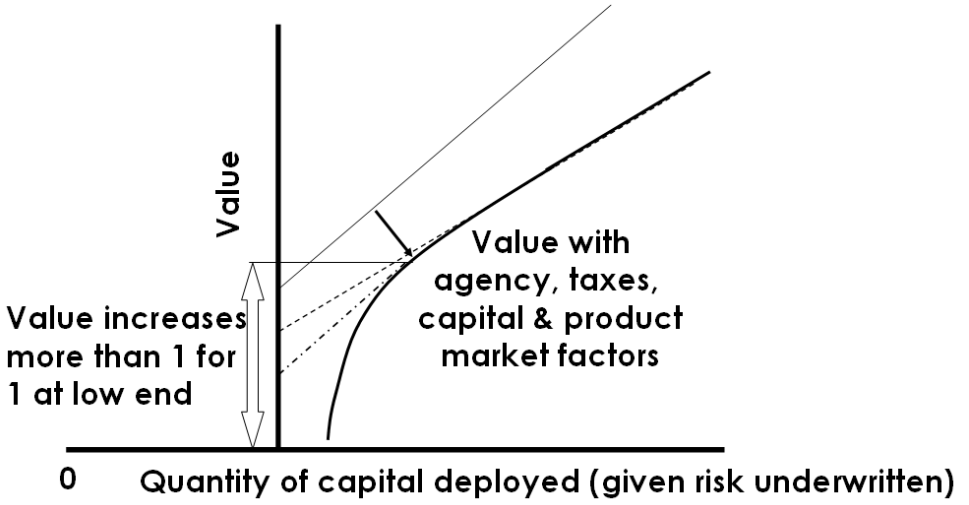

Exhibit 3 – Refined Model of Value vs. Capital

Adding in capital market effects – the value of retained earnings – and insurance market effects – the risk aversion of policyholders – gives a different picture for lower levels of capital strength. In that region adding capital increases value at a rate of more than 1 for 1, as growth and profitability potential are both enhanced. At the upper end, however, the picture remains the same as before, in that once a very strong capital position is attained, there is not much additional value in more, and the frictional costs dominate.

Effect of capital adequacy on value

The mathematical form of the curve at the low end of Exhibit 3 would be useful for valuing capital adequacy, including the value of reinsurance. To study this we looked at the loss of capital suffered by insurers in the September 11, 2001 attacks, as initially estimated, in comparison to their loss in market cap during that month. Exhibit 3 would anticipate that the firms with lower

capital adequacy would experience a much sharper drop in value than would the stronger firms. Taking BCAR as the measure of capital adequacy, the following preliminary version of this model was found to fit reasonably well to the data:

$$\text{Change in market value / Change in surplus} = \beta + \gamma \text{BCAR} + \text{random term}$$

Here β was found to be 9.25 for personal lines companies and 4.64 for commercial lines writers, with a value of -2.02% for γ. For a base BCAR score of 100 (capital = required capital), this would lead to a market loss of 7.2 times the capital loss for a personal lines writer, and 2.6 times for commercial lines. Paying anything up to these multiples of expected losses would thus be cost effective for reinsurance.

For a commercial writer, a BCAR of about 180 would bring the loss to the level of 1 for 1, while this wouldn't happen until somewhat over a BCAR of 400 in personal lines. These could then be considered optimum levels of capital. The model of Exhibit 3 would predict that the market loss would even be less than the capital loss for insurers above these levels, but the model as stated would not be expected to hold for too much higher BCAR levels, as the market loss would eventually become too low. Our model imposes a line with a slope of 95% above these levels.

The difference between personal and commercial lines is what would be anticipated from postulated financial theory. While the corporate insurance buyer is risk averse, it is less so and for different reasons than the individual policyholder. Beta is still important for commercial enterprises, even though some degree of aversion to specific risk is now seen to be rational.

Companies with a given BCAR score can have quite a wide range of market values. This can reflect, among other things, perceptions of growth prospects and reserve adequacy. To illustrate the data for this study in comparison to the model, it is useful to look at the ratio of market value to the level of surplus required to produce a BCAR score of 100. Exhibit 4 shows this for personal lines and commercial lines companies before and after the 9/11 event. The BCAR scores and market values before the event are labeled P for personal lines and C for commercial lines companies, and the implied post-event values are the other end of each line segment.

The predicted movements in these points for a company at any starting point in this space are given by the curves shown in Exhibits 5 and 6, for personal and commercial lines writers. The actual lines from Exhibit 4 are superimposed on the curves on Exhibits 7 and 8. As with any regression model there is not perfect agreement between model and data, as reflected in the random term. but as can be seen in the exhibits, the greatest disagreement is for companies that had very minor losses in the event.

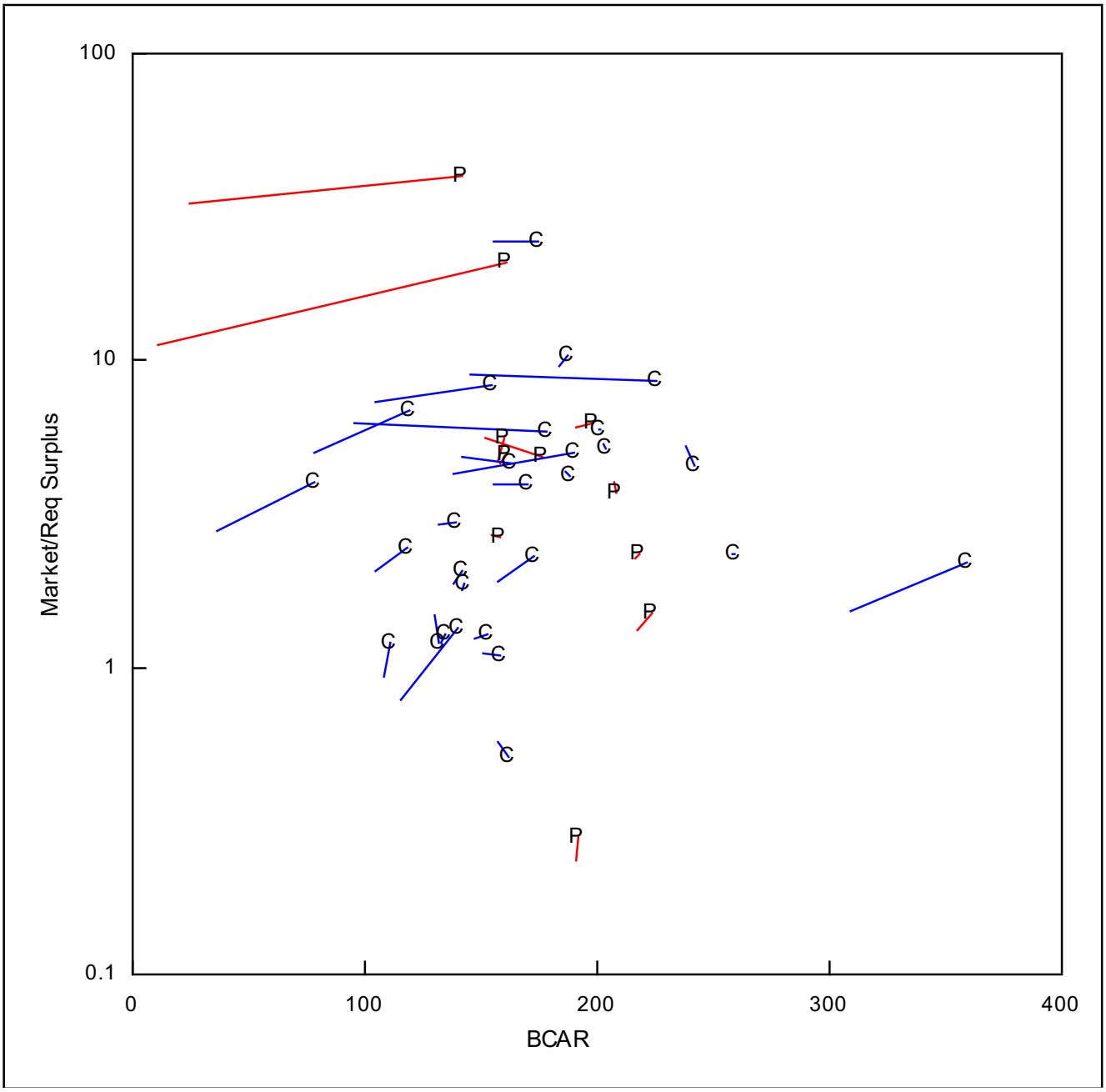

Exhibit 4 – BCAR and Market Values Before and After

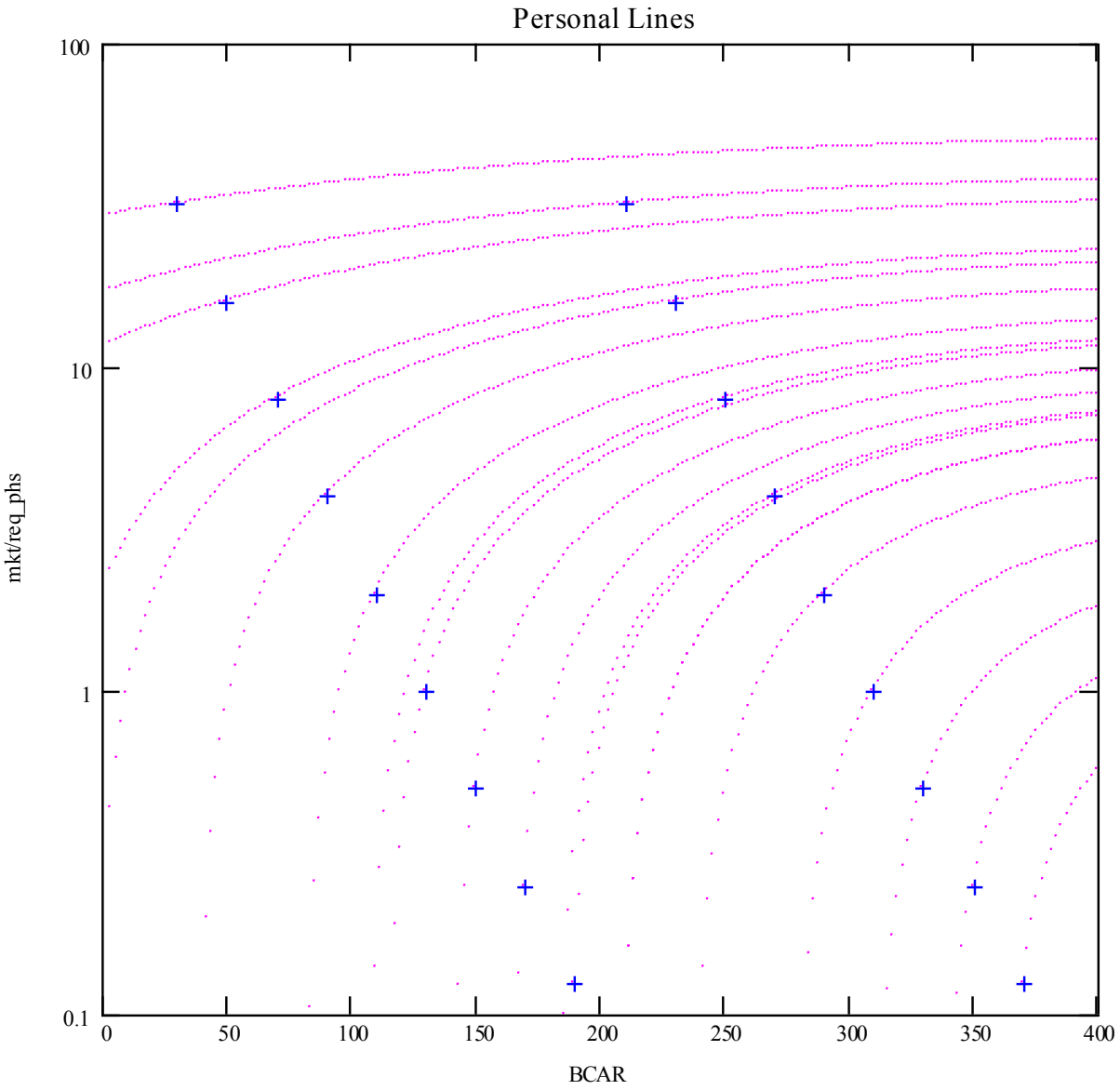

Exhibit 5 – Model Changes in BCAR and Market Value – Personal Lines

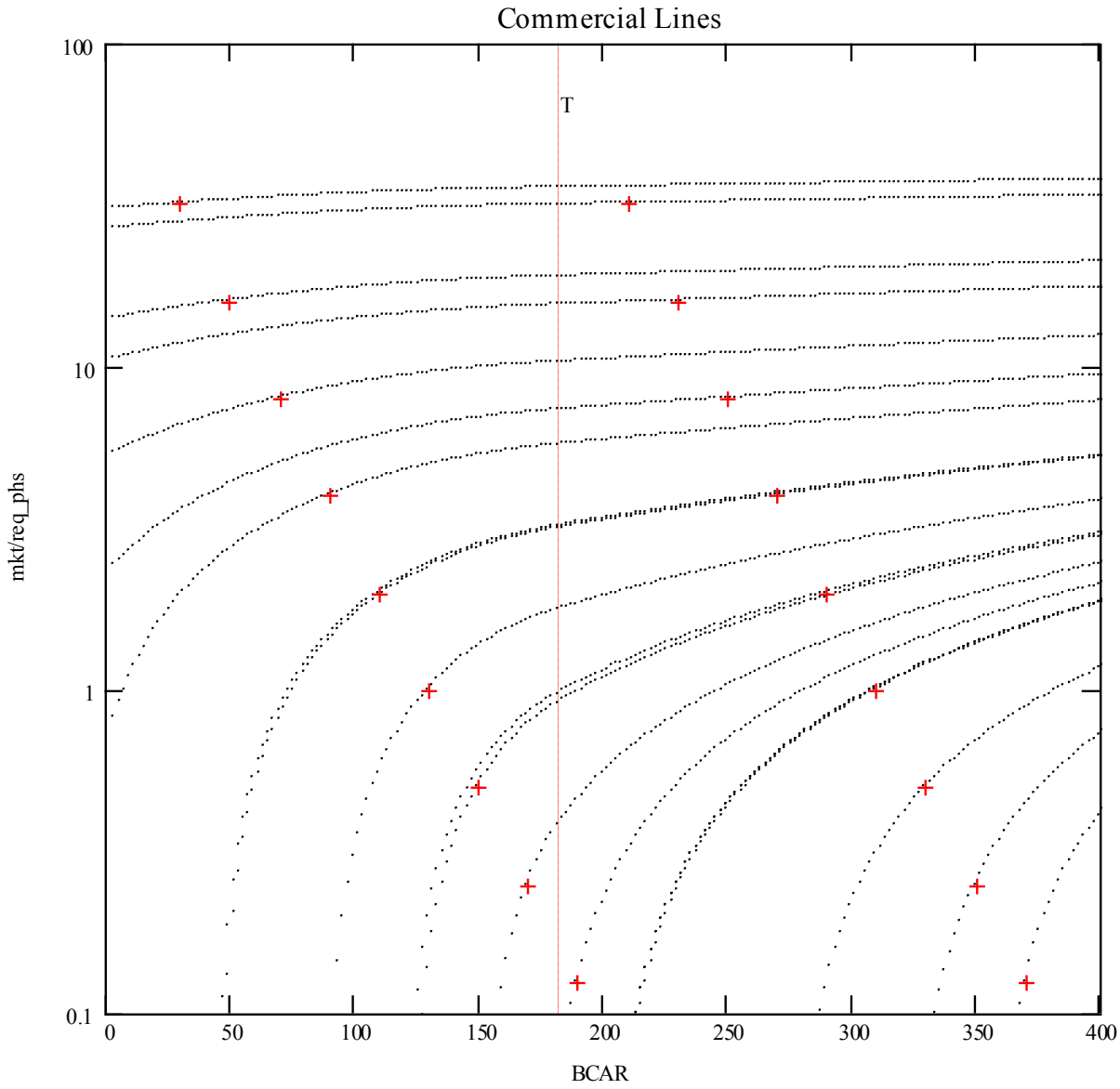

Exhibit 6 – Model Changes in BCAR and Market Value – Commercial Lines

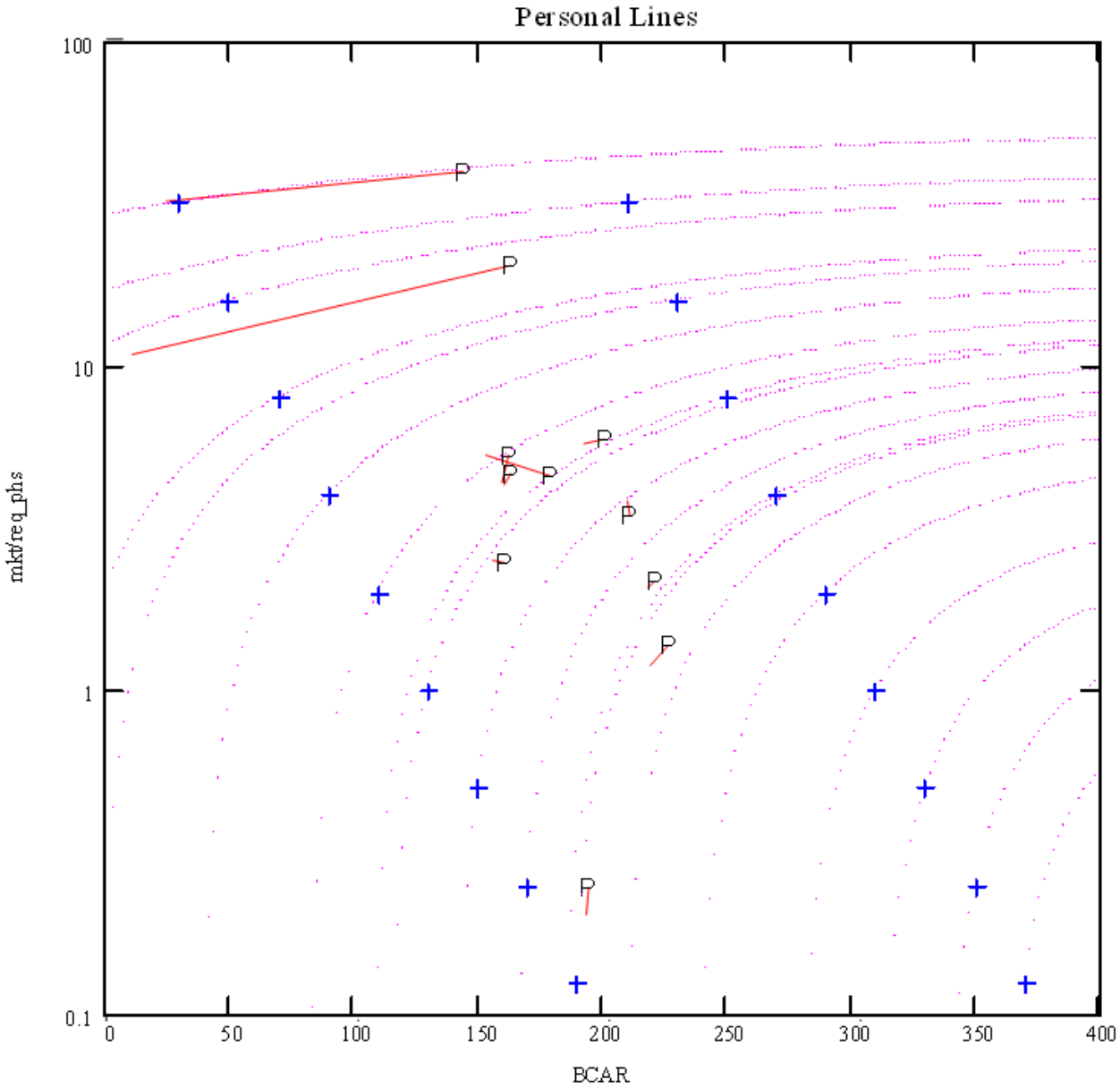

Exhibit 7 – Model vs. Actual Changes in BCAR and Market Value – Personal Lines

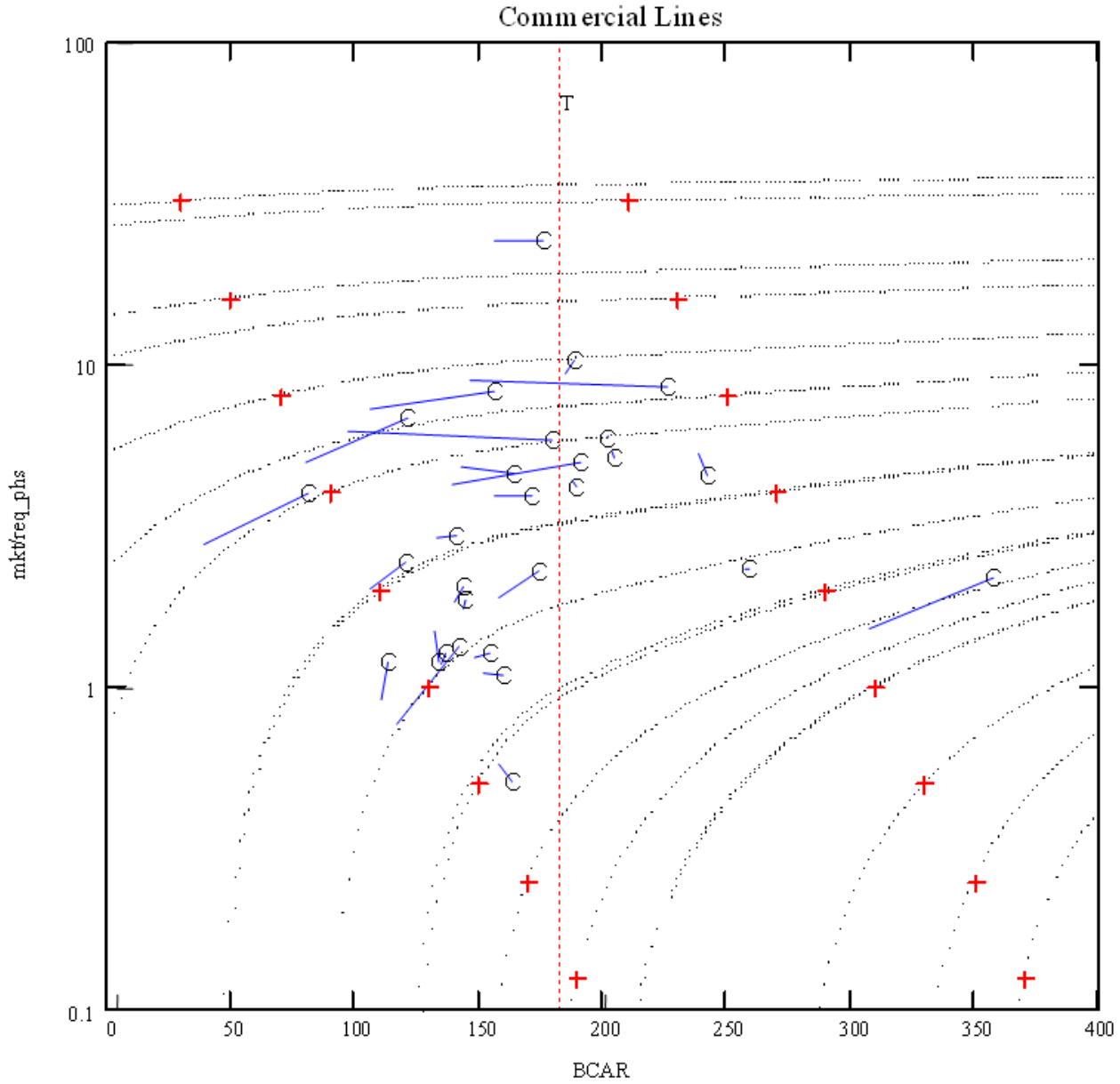

Exhibit 8 – Model vs. Actual Changes in BCAR and Market Value – Commercial Lines

Using the findings for reinsurance management

Finding the optimal level of reinsurance has been regarded as a judgment trade-off between the marginal cost of the program (premium less expected recovery) and the stability gained. The results of our studies, as well as those of some of the previous studies cited, point to another methodology. By quantifying the value of stability and financial strength, the marginal cost of the reinsurance can be compared directly to the expected added firm value. There are a few studies with slightly different findings, but together they can provide a hopefully narrow range of answers to the fundamental question "What is the value of reinsurance?"