The Actuarial Profession
making financial sense of the future

August 2012

Reinsurance Structure and Shareholder Value

James Karim

Introduction 1

Evaluating financing alternatives for an insurance company in a simplified model 2

Equity capital 2

Combination of equity and debt capital 3

Combination of equity capital and reinsurance 5

Illustration of the effect of reinsurance on equityholders' return profile 7

Discussion and extensions to theoretical framework 15

Taxation 15

Bankruptcy costs 15

Multi-period insurance cashflows 16

Quantifying the effect of reinsurance structure on shareholder value 17

Appendix 1: Debt-to-equity and price-to-book ratios of selection of US P&C companies 19

Appendix 2: Financial data by company 20

References 21

ABSTRACT

This article uses traditional corporate finance techniques to develop a methodology for the economic valuation of reinsurance purchase. The issues are illustrated from the perspective of a public company wishing solely to maximise the market value of its outstanding shares. The company can do this by maximising the net present value ("NPV") of operations at its weighted average cost of capital ("WACC"). We demonstrate below that reinsurance may affect not just operational cashflows, but also the WACC itself. Previously, the latter effect has been accorded little attention, but as we show in this article, it may well form the primary motivation for some reinsurance hedging. The NPV framework unifies valuation issues surrounding earnings stability and capital relief and is naturally suited to both short-and-long-tailed insurance lines of business. Using empirical data, we show how the theory can be applied directly to infer the effects of reinsurance purchase on company share valuations.

Introduction

The value that an insurer's decision to purchase reinsurance brings to a company can only be measured on the scale of that company's individual objectives. Whilst this might seem like an obvious statement on the face of it, in fact many companies struggle to be explicit about potentially contradictory corporate objectives. In this article, we consider the position of a company that is purely seeking to maximise the market value of its outstanding shares. This is a commercial goal that is fundamental for most public companies.

At any given time, the value of a company's shares will represent the expected NPV of its dividend stream, evaluated at a discount rate reflecting the perceived riskiness of the cashflows. The value of the dividend stream can in turn be maximised by maximising the NPV of the firm's corporate activities. This evaluation is our focus below.

Questions relating to the amount of capital an insurer should hold are not addressed in this article. In practice, this is a complex decision that will need to allow for pricing implications of the company's financial strength, regulatory and rating agency considerations, as well as the potential costs of raising additional capital in a post-loss environment - see Froot (2007).

In this article, we therefore take the decision as to capital quantum as a given, with our analysis focussed upon a consideration of the relative merits of reinsurance and traditional capital sources (i.e. debt and equity) for meeting the target funding level. While reinsurance involves paying upfront for a promise of loss-contingent funding – the opposite of equity and debt, where financing is given upfront and it is the return that is contingent – it is a genuine capital substitute and can be incorporated within conventional finance frameworks.

Evaluating financing alternatives for an insurance company in a simplified model

Equity capital

Let us assume a simplified world, in which a new insurance company, initially funded with 100% equity capital, is characterised by the following cashflows:

Time	Description	Cashflow
0	Initial equity injection	– K
0	Receipt of premiums	+ P
0	Establishment of claim reserves	– P
		– K
1	Payment of claims	– C
1	Release of claim reserves	+ P
1	Release of tied up equity	+ K
		P + K – C

We have omitted expenses, investment income and frictional costs such as taxation for simplicity. The highly stylised nature of this example helps to draw out the key insights, with practical extensions discussed further below. The expected net present value of this company's operations is given by the following expression[1].

$$NPV_0 = -K + \frac{E(P - C + K)}{1 + i_0} \qquad (1)$$

The parameter i_0 above is the company's cost of capital. In this example, with 100% equity financing, i_0 is also the company's cost of equity and thus the parameter via which we take account of the riskiness of the cashflows. The more uncertain the insurance profit at time 1, the greater the discount we apply to it. A zero NPV would imply that the expected profitability was just sufficient to compensate shareholders for the risks assumed. A positive NPV would be indicative of the creation of shareholder value.

In well-functioning capital markets, investors' buying and selling actions influence the share price so that the NPV of share purchase at the appropriate discount rate is zero in equilibrium. Consequently, no sooner is shareholder value created, than the share price is correspondingly bid upwards. This instant recognition of the value operates to return the NPV of share purchase to zero.

In the context of this example, if the firm's prospects are seen to offer exceptional value, the second term on the right hand side of (1) will grow beyond K and the market value of the firm's shares will exceed the book value of K. We set out below empirical backup for the notion that insurers generating returns in excess of the cost of capital are valued more highly by equity markets.

For the illustration of the basic theory, we assume that initial equilibrium for the model company sees prospective returns equal to the cost of capital: In other words, the market value of the firm equals its book value and NPV_0 above is zero.

We are assuming in this example that equityholders are risk averse and demand a risk premium for assuming insurance risk. This could come about in a Capital-Asset-Pricing-Model ("CAPM") compliant world if insurance companies' risks were to some extent non-diversifiable from broader equity market risks - i.e. if insurance companies have "β" parameters greater than zero. We will demonstrate below that CAPM estimates of the cost of equity for insurance companies show risk premiums, with associated β parameters being significantly positive.

1 Strictly, we should cap the cashflow at time 1 at a minimum of zero, reflecting the shareholders' limited liability. We ignore this for simplicity, without prejudicing the conclusions

This may occur because insurance companies themselves invest premiums and surplus funds in positive β assets, or because their liabilities share a correlation with market risk. For example underwriters of trade credit insurance may experience higher claims during recessions or Financial Institutions underwriters may find a correlation between lawsuits and dislocations in financial markets.

However, we do not need to assume a world where CAPM assumptions apply. Looking at the coupons received by investors on catastrophe bonds or the returns demanded on sidecar investments, it would appear that investors in these instruments require returns in excess of risk free rates. This is observed despite the fact that the underlying insurance risk is generally catastrophe related and broadly uncorrelated with market risk (zero β). Either way, there is clear support for the assumption of risk aversion amongst investors in insurance-linked assets.

Combination of equity and debt capital

Whilst debt capital is not the primary focus of this article, we develop some concepts below that provide a foundation for an assessment of reinsurance value.

Our company above may decide to consider financing its operations in part by the issuance of debt, which can be directly substituted for equity. The debt would be subordinate to the obligations to policyholders. In this example, the company still purchases no reinsurance.

Let us assume that an amount $K_D = K - K_E$ is raised as debt, where K_E remains to be financed as equity. The interest payable on the debt is at a promised rate of r. Since debt interest is a fixed cost, the equityholders here are "gearing" their returns, amplifying their returns in good times and their losses in bad times.

In the revised capital structure, claim liabilities will be paid firstly from policyholder premiums, secondly from equity capital and finally from debt capital.

As the equityholders have now taken a "first-loss" position, the debtholders are a step further removed from losses. This means that the equityholders are carrying more *risk* per unit of their investment. Consequently they will require a greater return.

Modigliani and Miller ("MM": see Modigliani and Miller, 1958) demonstrated that capital structure has no impact on the value of a firm in a world of seamless capital markets and devoid of frictional costs. Formally, they argued that individual shareholders could borrow or lend on their own accounts in a way that would generate or remove leverage as they desired. As such they could replicate or undo the effects of borrowing by the firm, meaning that no value would be created by the firm doing this on their behalf.

More intuitively, we can say that capital structure does not change the *activities* of the firm. For a given set of investment decisions – which for our company would be underwriting insurance contracts - changing capital structure is merely redefining the division of the spoils. The value is generated by the selection of insurance contracts written, rather than by how the resulting profits are divided among the parties who put up the finance. The division of these profits is a zero-sum game.

Looking specifically at the equityholders in the newly-levered firm, their expected NPV is given by:

$$NPV_E = -K_E + \frac{E(P - C - rK_D + K_E)}{1 + i_E} \qquad (2)$$

We described above how NPV_0 is zero in equilibrium, when the activities of the firm earn just enough margin to meet the cost of equity. But what would it take to make NPV_E positive, having modified the capital structure?

The right-hand-side will be positive and thus the equityholders will gain financially from the debt-for-equity swap if:

$$i_E < \frac{E\,(P - C - rK_D)}{K_E} \quad (3)$$

Intuitively, if the cost of equity is less than the expected return on equity, the equityholders gain. However, in efficient capital markets, the debtholders' required interest return will leave just enough of the pie remaining for equityholders to meet their necessary return - but no more. In other words:

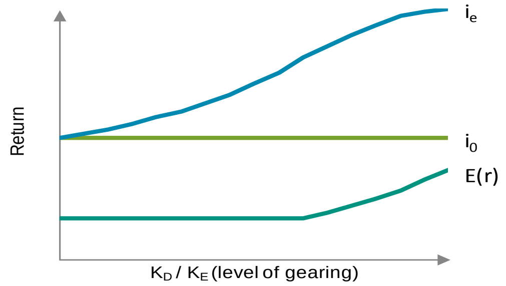
$$i_E = \frac{E\,(P - C - rK_D)}{K_E} \quad (4)$$

Observing that NPV_0 is zero in (1), we can rewrite this as the more conventional expression of MM's second proposition:

$$i_O = \frac{K_E}{K} i_E + \frac{K_D}{K} E\,(r) \quad (5)$$

The right hand side is usually termed the weighted average cost of capital ("WACC"). E(r) here is interpreted as the cost of debt or the expected return to debtholders. Where there is a risk of default on cashflows due to the debtholders, E(r) is lower than the promised rate of interest, r. MM's second proposition tells us that, absent capital market inefficiencies and frictional costs, the WACC is invariant to capital structure.

Increasing leverage gives the equityholders higher expected returns, but only by an amount that is sufficient to compensate them for the increased risk to which they are exposed by the geared returns. This is illustrated below:



The change in equity holder NPV resulting from a change in gearing is given by $NPV_E - NPV_0$ and can be broken down into two components, which will prove useful when considering reinsurance. Let us define:

$$\hat{NPV}_E = -K_E + \frac{E\,(P - C - rK_D + K_E)}{1 + i_O} \quad (6)$$

This would be the equityholders' expected NPV if the cost of equity remained at the initial cost of capital, namely i_0. We can label $\hat{NPV}_E - NPV_0$ as the "capital substitution effect", being the change in NPV that would occur from substituting debt for equity, were there to be no subsequent increase in the cost of equity.

The second component of the change in the equityholders' NPV, the "risk recalibration effect", is given by $NPV_E - \hat{NPV}_E$. This captures the fact that the cost of equity rises as gearing increases and vice versa. MM's second proposition tells us that these two effects offset one-another precisely. **The mix of debt and equity is thus irrelevant to the company's value.**

Combination of equity capital and reinsurance

The first question to be asked is whether, in a world free of capital market distortions and frictional costs, MM's propositions would negate the need to evaluate reinsurance strategy. Could we use the argument above that the parties' claims on the company's assets merely adjust themselves to reflect the relative risk positions assumed, such that the mix between equity and reinsurance is irrelevant? If so, we could move directly to the issue of how to consider adjusting MM's propositions in a world featuring the distortions we have assumed away.

The idea of MM irrelevance may be less intuitive in a reinsurance context. This is partly because of the reversal of the investment and return cashflows: with reinsurance, the investment (the recovery) is contingent and payable after the loss event, with the return (the reinsurance premium) payable upfront. However, this does not prevent us from calculating the amount of reinsurance capital sourced, nor its cost, as we show below.

Another sense in which reinsurance feels at odds with an equity/debt framework is that its location in the capital structure is hard to pinpoint. With the exception of whole account aggregate stop loss, which is rarely bought or available, reinsurance permeates the capital structure. It is everywhere, but nowhere that can be pinpointed precisely. Fortunately, many reinsurance structures act either to generate or to remove leverage, and so can be accommodated within the developed framework.

The key reason why we should not just assume that MM will apply in a reinsurance context is that reinsurance markets do not behave identically to the capital markets:-

- Unlike the equity and debt securities issued by large companies, reinsurance may be available from a small number of sellers and is untraded. For some classes and types of reinsurance, there may even only be a single seller, meaning that the mechanism by which the scrutiny of thousands of investors drives a price to its "fair" value is removed;
- Reinsurers are professional risk diversifiers. This opens up a possible asymmetry in the cost of a particular risk between cedant and reinsurer and thus an opportunity for mutual benefit from a reinsurance transaction. The zero-sum game described above between debt and equityholders may not be present here; and
- Reinsurance may be subject to pricing cycles ("soft" and "hard" markets), which means that short-run reinsurance economics fluctuate and are worthy of analysis

Given these important considerations, the Reinsurance Manager has a valuable role to play by incorporating reinsurance capital into the firm's financing structure in a manner that improves the economics to equityholders.

To illustrate this further, suppose that the ceded reinsurance premium is given by "X" and the reinsurance recoveries are given by "R". Let us assume further that the revised equity requirement with the reinsurance hedges in place is given by K_{RI}. K_{RI} may be calculated after value-at-risk type risk measures, more complex risk measures, rating agency requirements or regulatory factors have been taken into account.

The NPV for equityholders in a firm that partially finances with reinsurance is:

$$NPV_{RI} = -K_{RI} + \frac{E(P - X - C + R + K_{RI})}{1 + i_{RI}} \quad (7)$$

Here, i_{RI} represents the cost of equity with the reinsurance programme in place. If $NPV_{RI} - NPV_0$ is positive, changing the financing structure to incorporate reinsurance will have a positive payoff to the equityholders. By way of analogy to (6) above, we can define:

$$N\hat{P}V_{RI} = -K_{RI} + \frac{E(P - X - C + R + K_{RI})}{1 + i_0} \quad (8)$$

The capital substitution effect resulting from a reinsurance purchase is given by $N\hat{P}V_{RI} - NPV_0$ and will be positive if:

$$\frac{E(X-R)}{K - K_{RI}} < i_0 \quad (9)$$

The expression on the left of (8) measures the expected cost of reinsurance per unit of equity capital saved and is akin to what is sometimes termed “Ceded RoE”. This is the first part of our analysis of the increase in equityholders’ value from the purchase of reinsurance.

Where the reinsurance purchase leaves the equityholders’ risk profile unchanged - i.e. where the risk recalibration effect is zero and $i_0 = i_{RI}$ - this provides a complete picture of the changes in NPV. In all other cases, we need a means of trying to assess the impact of reinsurance changes on the cost of equity itself. This is a problem which we address below.

Intuitively, reinsurance can change shareholder value by reducing the overall cost of financing the company’s operations. It does not directly influence the insurance contracts written, but may allow them to be written more efficiently. We discuss this notion of efficiency further, but an important observation at this stage is that the right hand side of (7) will be positive and the reinsurance will add shareholder value if:

$$\frac{E(X-R)}{K-K_{RI}} * \frac{K-K_{RI}}{K} + i_{RI} \frac{K_{RI}}{K} < i_0 \quad (10)$$

The left hand side of (10) is an expression for the WACC when capital is provided by a mixture of reinsurance and equity. The first term can be thought of as the cost of reinsurance capital. The reinsurance structure will add value if it reduces the WACC from its initial starting value of i_0. There is a one-to-one link between increasing NPV and reducing WACC. They are flipsides of the same coin.

Illustration of the effect of reinsurance on equityholders' return profile

Overleaf, we illustrate equityholder return profiles for different financing alternatives. A model insurance company weighing up its funding options is modelled as having a combined ratio with mean 85% and standard deviation 27.5% and seeks to capitalise itself to the 1 in 500 value at risk (net of any reinsurance). In the gross case, this requires capital of 100% of gross written premium. Figure 1 shows the density function of the equityholders' internal rate of return, where all cashflows are modelled as realised within the first year for simplicity. Equityholders have an expected return of 15%, which we assume just sufficient.

In Figure 2, we can see the effect on the equityholders' return profile of refinancing 50% of the equity with debt. The debt interest rate here is set at 8%, with a probability of attachment of 2.6%. This generates an expected return to the debtholders of 6.8%. The gearing effect increases the equityholders' expected IRR, but the spread of returns is now considerably greater. Note the probability mass at a minus 100% return, when all the equity is burned through, and the debtholders start paying claims. The chance of losing the entire equity investment has increased by a factor of 15.

As explained above, if the MM result is taken as broadly applicable – we set out more below on how reasonable this is – and on the assumption that the debt cost is fair, the equityholders are *indifferent* between these two investment profiles. The increase in expected return from 15% to 23% compensates them just sufficiently, but not excessively, for the increase in risk assumed. The change in capital structure has left their value position unchanged.

In Figures 3 and 4, we consider the purchase of stop loss reinsurance. The stop loss in Figure 3 attaches at a combined ratio of 146% and exhausts at 200% for a premium of 4% (or 7.4% rate on line). Since the premium of 4% is payable upfront (unlike a debt interest payment, which may be defaulted upon), the capital relief provided by this contract is 50% of gross premium. Another way of saying this is that equity of 50% of gross premium must be raised to pay the stop loss premium and cover the risk of the combined ratio being realised between 100% and 146%. This will ensure the 1 in 500 downside is just covered.

The remaining equity investment in Figure 3 has an identical payoff structure to that of the levered equity position shown in Figure 2. The stop loss mirrors the subordinated debt precisely. As such, the value of purchasing this stop loss must be the same as the value of the refinancing carried out with debt in Figure 2.

If MM is applicable, both have zero value. Looking solely at the cost of the stop loss per unit of equity capital saved is in isolation an insufficient value metric. Whilst it is below the WACC of 15%, this merely represents its greater subordination in the capital structure. We cannot judge value without considering the knock-on effect on the post-reinsurance cost of equity. To do so would be to accept implicitly that a company can increase its value merely by issuing more debt, a conclusion that few CFOs would accept and which we show later has no empirical support.

On first glance, it can seem counter-intuitive to think of reinsurance as potentially *increasing* the cost of equity. Surely reinsurance is about risk reduction? Isn't risk always lower with reinsurance?

In fact, a more accurate way to think about reinsurance is as a risk *transfer* mechanism. If we transfer the least risky parts of the capital structure and retain the riskiest, then the risk per unit of the remaining investment actually increases. We have already illustrated this above with debt, where we transferred the most remote risk to debtholders, thus leaving behind a more volatile risk.

Figure 4 shows an alternative stop loss, representing a layer of 62.5% excess of 87.5% in combined ratio terms. The stop loss premium here is 12.5% of gross premium (or 20% rate on line). The equityholders in this example have effectively taken the claims-paying position of the debtholders in Figure 2. However, they receive all the upside profit from the business. Their return is maintained and their risk reduced. In the terminology developed above, both capital substitution and risk recalibration effects are positive. As such, this contract would deliver tremendous value to the company. Yet if we measure value solely based on cost per unit of equity capital relieved, it looks no different to the prior stop loss we considered.

The final graphs (Figures 5 and 6) show the effects of two different types of quota share reinsurance. Figure 5 illustrates a traditional quota share without override commission. There is no leverage effect here; rather, we are really just selling a (one-year) equity stake in the company to a reinsurer. The equityholders have the same return distribution on a smaller investment. Their cost of equity remains unchanged.

Conversely, the structured quota share to the right has a long sliding scale commission, such that the reinsurer starts losing money at a remote combined ratio. We have designed this contract so that the reinsurer faces a loss-making position beyond a 150% combined ratio.

While such an arrangement may raise eyebrows, we have assumed for the purpose of illustrating the theory that full capital relief is available at the rate of cession. The reinsurer here is putting itself in the position of the debt investors in Figure 2. The equityholders' IRR distribution is halfway (representing 50% cession) between the cases shown in pictures 1 and 2. As the cession rate increases to 100%, the distribution converges to that seen in Figures 2 and 3.

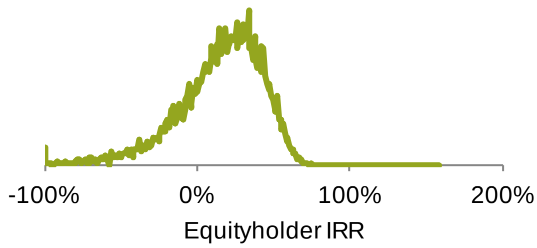
Using the same argument as before, if MM conditions hold, this quota share generates no value, even though the cost per unit of released equity is low. There is a negative risk recalibration effect to be taken into account: the cost of equity will go up as a result of the leverage introduced.

Structured quota shares are common, but are often valued simplistically in the same way as traditional quota shares. This can lead to misleading decision rules.

These examples have been designed to highlight the key insights from above, rather than to illustrate the most common reinsurance structures placed. In the next section, we look at some real world case studies.

Figure. 1

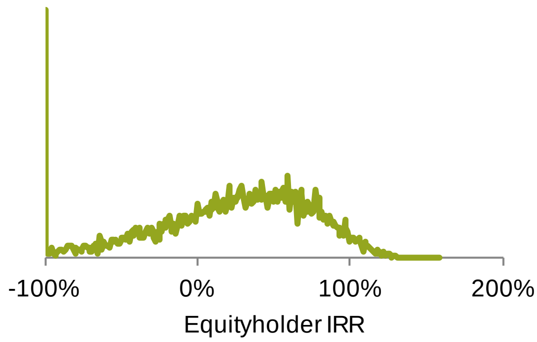
100% Equity financing



Mean	15.13%
E(Return | Return < 0)	-22.35%
75th %ile	0.09%
90th %ile	-20.75%
95th %ile	-36.51%
Prob(-100%)	0.21%
Equity Capital Saving	N/A
E(Ceded Profit)	N/A
Cost per Unit Equity Saved	N/A

Figure. 2

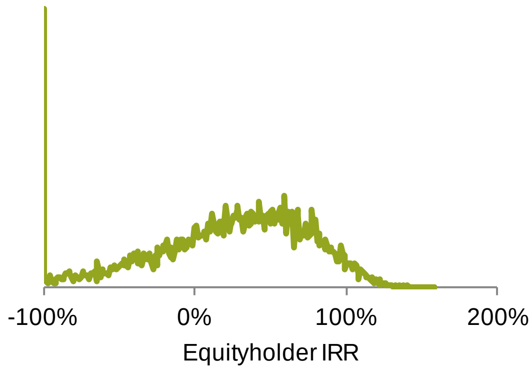
50% Equity + 50% debt



Mean	23.48%
E(Return | Return < 0)	-41.62%
75th %ile	-7.82%
90th %ile	-49.50%
95th %ile	-81.03%
Prob(-100%)	3.16%
Equity Capital Saving	50
E(Ceded Profit)	3.40
Cost per Unit Equity Saved	6.8%

Figure. 3

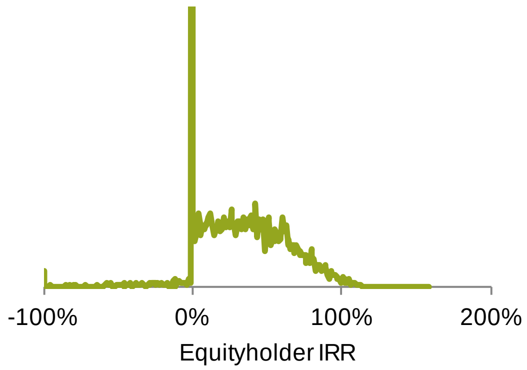
50% Equity + 50% stop loss (54% XS 146% combined ratio for premium of 4.00)



Mean	23.48%
E(Return | Return < 0)	-41.62%
75th %ile	-7.82%
90th %ile	-49.50%
95th %ile	-81.03%
Prob(-100%)	3.16%
Equity Capital Saving	50
E(Ceded Profit)	3.40
Cost per Unit Equity Saved	6.8%

Figure. 4

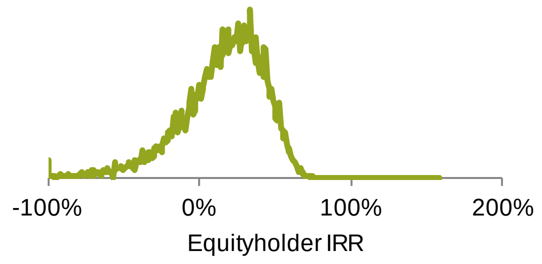
50% Equity + 50% stop loss (62.5% XS 87.5% combined ratio for premium of 12.50)



Mean	23.42%
E(Return | Return < 0)	-37.92%
75th %ile	0.00%
90th %ile	0.00%
95th %ile	0.00%
Prob(-100%)	0.21%
Equity Capital Saving	50
E(Ceded Profit)	3.42
Cost per Unit Equity Saved	6.8%

Figure. 5

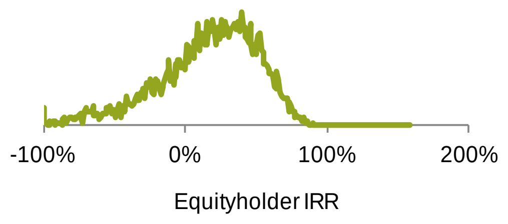
50% equity + 50% traditional quota share



Mean	15.13%
E(Return | Return < 0)	-22.35%
75th %ile	0.09%
90th %ile	-20.75%
95th %ile	-36.51%
Prob(-100%)	0.21%
Equity Capital Saving	50.00
E(Ceded Profit)	7.57
Cost per Unit Equity Saved	15.1%

Figure. 6

50% equity + 50% structured quota share



Mean	17.91%
E(Return | Return < 0)	-28.73%
75th %ile	-2.55%
90th %ile	-30.34%
95th %ile	-51.35%
Prob(-100%)	0.21%
Equity Capital Saving	25.00
E(Ceded Profit)	1.70
Cost per Unit Equity Saved	6.8%

Case Study 1

Reinsurance Programme Of Lloyd's Syndicate

This Lloyd's Syndicate has a variety of reinsurance structures that protect its gross account. Reinsurance reduces its 1 in 200 net loss - which we are using as a proxy for the capital requirement, ignoring the "Lloyd's Uplift" and non-underwriting risk for simplicity - from 86.5m to 31.1m. The gross return on equity would be 19.1% and we assume for simplicity that this equals its cost. Effectively we are assuming for illustration purposes that the book value of the company equals its market capitalisation.

The expected cost of the reinsurance capital, given by the left hand side of the inequality marked (9) above (and sometimes termed "Ceded RoE") is 14.9%, which is below the cost of equity. Since the reinsurance capital costs less than the equity it replaces, this generates a positive capital substitution effect. However, the graph overleaf demonstrates clearly what has happened to the distribution of the equityholders' return. The green line shows how the equityholders' IRR distribution would look if the business were 100% equity funded. The dark blue line shows the distribution of equity returns after the purchase of the reinsurance programme. It can be seen that this has a higher mean, up from 19.1% to 26.5%, but with a much greater spread. The risk profile of the equity has therefore increased, and we need to assess what this has done to the cost of equity. If we accept that these equityholders are risk averse, the cost of equity must have risen from 19.1%.

Estimating the increase in the cost of equity is a tough proposition. In the situations above, we were able to precisely replicate reinsurance structures with debt alternatives. Generally speaking, in the absence of aggregate stop loss or contracts which operate in the same way (such as some structured quota shares), we will need to make the best possible approximation. This is likely to be more accurate than assuming no change in the cost of equity at all.

Suppose that the company could swap 55% of its equity for debt and that this debt, with a 2.2% chance of attachment, would typically be priced at 8% in the fixed income capital markets. If we apply MM's second proposition, the cost of equity would then rise to 34.1%, leaving the WACC unchanged at 19.1%. The return profile of the equityholders after this hypothetical refinancing is shown by the light blue line in the graph overleaf. Its variability is similar to that of the equityholders' return after reinsurance. The lines are not a perfect match: the light blue line is slightly tighter, but has a higher probability of total loss (i.e. -100% return). We are required to trade these two types of risk against one other using no more than intuition. But the light blue line is a less imperfect fit for the dark blue line than the green line.

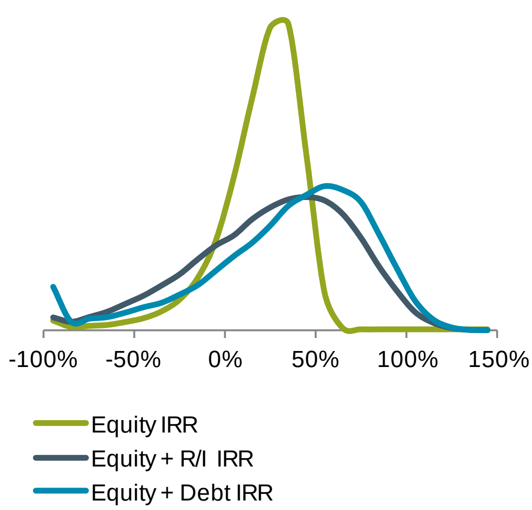
We can infer from this that the costs of equity under these two financing structures should be similar. If we use 34.1% as the revised cost of equity for the structure involving reinsurance purchase, we can see that the risk recalibration effect outweighs the capital substitution effect. The overall effect of the reinsurances purchased by this Syndicate is to increase the WACC and reduce shareholder value. Far from being disheartening, this invites a more granular analysis to ascertain which contracts are generating the leverage - and at what price.

Whereas a traditional reinsurance analysis looks at the marginal dollars of equity saved by different structures, here we need to look at the marginal effects of different structures on the cost of equity. By restructuring or removing the contracts leveraging equityholder returns without sufficient reward, we can improve this Syndicate's offering to shareholders.

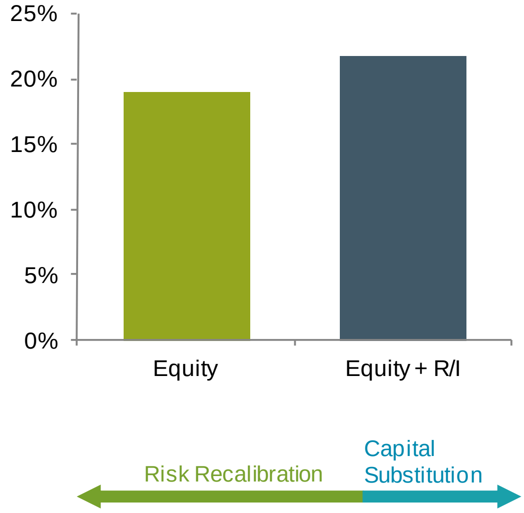
In attempting to mirror the effect of reinsurance on equity returns, we considered a 55% debt financing structure. The feasibility of such a high leverage ratio from a regulatory perspective is not something that we need to worry about *per se*: it is only an obstacle insofar as it renders the job of estimating a suitable debt interest rate more difficult. It is worth pointing out here that this example highlights the ability of reinsurance to generate leveraged returns when conventional methods may not be permissible.

	Equity	Equity + R/I	Equity + Debt
Written Premium	123,400,000	105,800,000	123,400,000
Expense Ratio	8.00%	9.33%	8.00%
Return Period Capitalisation	200	200	200
Capital Requirement	86,488,606	86,488,606	86,488,606
Equity Capital	86,488,606	31,068,148	38,919,873
Debt Capital	0	0	47,568,733
Reinsurance Capital	0	55,420,458	0
Expected Equity IRR	19.07%	26.51%	34.13%
Debt Interest Rate	0.00%	0.00%	8.00%
Cost of Equity	19.07%	34.13%	34.13%
Cost of Debt	0.00%	0.00%	6.74%
Cost of Reinsurance Capital	0.00%	14.89%	0.00%
WACC	**19.07%**	**21.80%**	**19.07%**
Capital Substitution Effect (1)	0	1,941,463	4,924,257
Risk Recalibration Effect (2)	0	-3,707,402	-4,924,257
NPV of Change in Capital Structure = (1) + (2)	**0**	**-1,765,939**	**0**
NPV Change as % Company Gross Book Value	**0.00%**	**-2.04%**	**0.00%**

Equityholder IRR



WACC



Case Study 2

Per risk reinsurance programme of direct US property insurer

This primary US Insurer ("ABC") is exposed to property risk and Cat perils and is considering the value of its risk excess of loss programme. Rather than looking at the effect of a combination of programmes, as we did above, in this case we are looking at one programme in isolation.

Here, the reinsurance structure actually *decreases* equityholder leverage slightly, rather than increasing it. This can be seen in the graph on the exhibits page overleaf and may be expected from a risk excess of loss structure. Noting this, we need to make subtle changes to the approach used above in order to compute the two value effects that we have developed.

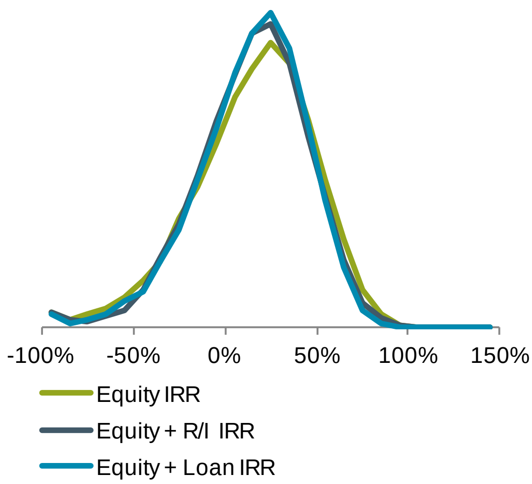
Rather than considering notionally swapping debt for equity, we now need to consider the opposite: ie notionally raising more equity capital than is required to run the insurance company and then lending the excess capital to a similar company seeking leverage (Company "XYZ"). It must be stressed that this is a purely conceptual exercise: we are merely considering this course of action to compare the distribution of returns achievable with those obtained from running ABC with its reinsurance programme.

If ABC raised an additional 12% capital, which it then proceeded to lend to XYZ in order to assist XYZ in its 12% debt for equity swap, ABC would be dampening down the overall risk of its investment portfolio. The return for this portfolio would be 14.2%, rather than the 15.1% receivable for pure investment in ABC's own activities. So it would be taking a lower return, but for a lower risk.

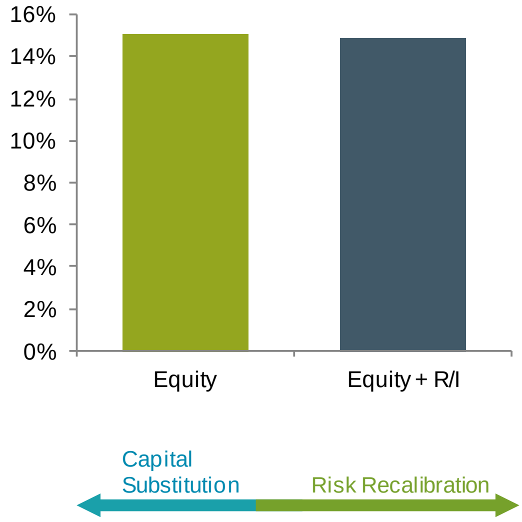
The return profile of this portfolio of two investments is comparable to the return for the equityholders in ABC after reinsurance, as can be seen in the graph overleaf. Hence, 14.2% is a reasonable starting point for ABC's post reinsurance cost of equity. We can see this in the top graph, where the equityholder return profiles have the same risk and return characteristics. Using this, we can see that, while the capital substitution effect is negative, it is outweighed by the positive risk recalibration effect. ABC is adding more value by reducing the volatility of equityholders' returns than it is removing by replacing equity with slightly more costly reinsurance. This highlights one of the key benefits of using a joined-up, NPV-based approach to reinsurance valuation: we are explicitly able to value reductions in earnings volatility. Under a more simplistic valuation framework, the programme might be written off in light of every dollar of equity saving costing 18 cents, a rate higher than the cost of capital.

	Equity	Equity + R/I	Equity + Loan
Written Premium	280,000,000	259,300,000	280,000,000
Expense Ratio	30.00%	32.39%	30.00%
Return Period Capitalisation	200	200	200
Capital Requirement for Investments	128,523,626	128,523,626	143,946,461
Investment in ABC	128,523,626	110,164,189	128,523,626
Capital Loaned to XYZ	0	0	15,422,835
Reinsurance Capital	0	18,359,438	0
Expected IRR on Equity Investment in ABC	15.06%	14.46%	15.06%
Interest rate on Loan to XYZ	0.00%	0.00%	8.00%
Cost of Equity Investment in ABC	15.06%	$\boxed{14.22\%}$	15.06%
Expected Return on Loan to XYZ	0.00%	0.00%	7.28%
Cost of Reinsurance Capital	0.00%	18.64%	0.00%
"WACC"	**15.06%**	**14.85%**	**$\boxed{14.22\%}$**
Capital Substitution Effect (1)	0	-571,747	-
Risk Recalibration Effect (2)	0	798,848	-
NPV of Change in Capital Structure = (1) + (2)	**0**	**227,101**	**-**
NPV Change as % Company Gross Book Value	**0.00%**	**0.18%**	**-**

Equityholder IRR



WACC



Discussion and extensions to theoretical framework

Taxation

In our description of MM's Proposition II, we summarised the idea that capital structure affects the division of returns between capital providers, but not the returns themselves. Hence, the WACC should not change with capital structure: one party's gain is another's loss.

In the real world, there may be third parties who have an interest in the company's cashflows. A notable example would be the tax authorities. It is typical that debt interest is tax deductible, meaning that the taxman gets a lower share of the company's revenue as the level of gearing rises: debt is more tax efficient than equity. Ceded reinsurance premiums are a tax deductible cost, meaning that reinsurance shares the tax efficiency of debt capital.

The simple framework used above can be generalised: in computing the NPV of a change in capital structure, we simply need to consider the NPV of changes in taxation payable, as well as the NPV of the other two effects upon which we have focussed primarily. In practice, we would need to take *all* forms of taxation into account, including the personal taxation of interest payments, dividend payments and capital gains. If capital gains are taxed at a lower rate or with more favourable allowances, the tax benefits of debt financing may be considerably reduced.

Bankruptcy costs

Were the tax efficiency of debt without opposing forces, the optimal capital structure would involve minimising equity capital. In practice, as the gearing of a firm increases, the probability of its bankruptcy increases.

This increase may be negligible or modest at first, but becomes overwhelming at very high levels of gearing.

Bankruptcy is a costly process. The direct costs of professional fees may be substantial, but a high probability of bankruptcy carries with it indirect costs, such as an inability to retain staff or a distortion of the activities that the firm takes on. Equityholders may take excessively risky ventures in the knowledge that they have minimal downside, but all the upside.

The choice of optimal capital structure may be described as finding the optimal balance between these two effects. Estimating bankruptcy costs is, regrettably, more difficult.

It is important to stress that the framework above does not rely on the acceptance of MM. As long as we can value changes in debt / equity policy and can mirror the payoffs expected under different reinsurance structures, we can place a value on those structures.

We show in Appendix 1 that there is significant variability of debt-to-equity ratios among insurers and reinsurers. Were capital structure to be crucial, one would expect a greater degree of clustering around the perceived optimum.

The regression line fitted in the left-hand box of Appendix 1 shows a positive relationship between the price-to-book ratio and the degree of leverage. However, this is entirely driven by the outlying Amtrust. There is good reason to believe that Amtrust is valued highly because its returns exceed its cost of capital, rather than because shareholders are attaching value to its high debt-to-equity ratio. Without Amtrust, there is no significant relationship and an R-squared of below 2%.

This is evidence to suggest that debt-to-equity policies have little obvious and consistent effect on value. Hence, reinsurance valuation metrics should not routinely ascribe value to capital structures that are replicable via, and cost equivalent to, the use of traditional capital sources.

This notion is not currently widely considered by industry practitioners. We have shown above that this can lead to potentially misleading value decisions.

The full dataset is shown in Appendix 2.

Multi-period insurance cashflows

Our model of the insurance company was considerably simplified in that we assumed all cashflows happened at time zero or time 1. If we have long-tailed lines of business, our formula for the NPV of the company's operations (using equity financing) can be rewritten as:

$$NPV_0 = -K_0 + \sum_t \frac{E(P_t - C_t + K_t)}{(1 + i_0)^t} \qquad (11)$$

K_0 here is the initial capital injection, with K_t denoting the capital flow at time t, C_t the claims paid at time t and P_t the premiums received at time t. The other formulas can be adjusted analogously. This is a considerable advantage of using an NPV methodology over a ratio-based approach, where allowing for the tying up of capital over a multi-period horizon is more challenging. Note that we are not discounting any cashflows at the risk free rate.

Quantifying the effect of reinsurance structure on shareholder value

The approach outlined above advocates analysing the effect of reinsurance purchase on the NPV of the company or, equivalently, the WACC. The case studies showed how we can put this into practice. We now consider whether we can go one step further and assess the implication for the company's share price of an improvement in its financing efficiency.

One way of doing this would be purely theoretical: we could calculate a theoretical share price based on a simple discounted dividend model. The standard formula would be:

$$P = \frac{D}{i - g} \quad (12)$$

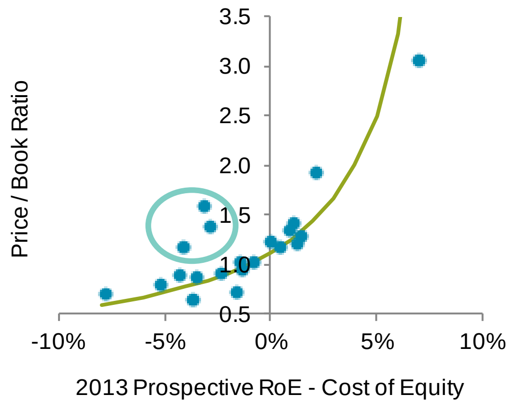
Here, P is the price of a share, D is the dividend due next period, g the growth rate of those dividends and i the cost of equity. Using the techniques developed, we can assess the impact on i of the reinsurance purchase. We would also need to factor in the change in D that may result in a greater or lesser number of shares being in circulation, as a result of the change in financing structure.

However, this remains very theoretical and it is difficult to apply sense-checking to any proposed change in share price. An alternative way of looking at the problem is to look at a cross-section of company valuations and see if the assumptions and implications of the framework developed are supported. We would expect to find that:

- Those companies with future return prospects in excess of their costs of equity will trade above book value (and vice-versa); and
- The greater the excess of the expected return over the cost of equity, the higher the valuation

It is difficult to estimate objectively all the future returns expected and to discount them. Over a shorter horizon, however, we can look at Analysts' estimates for the 2013 return on equity. Clearly this is a shorter term view of value than would be ideal, but it is a useful starting point.

In estimating each company's cost of equity, we have used the CAPM methodology described above: we estimate each company's β based on its correlation with broader (stock) market risk and add this proportion of the market's risk premium to the risk free rate of return. The resulting relationship for US insurance companies is shown below, with the full dataset summarised in Appendix 2.



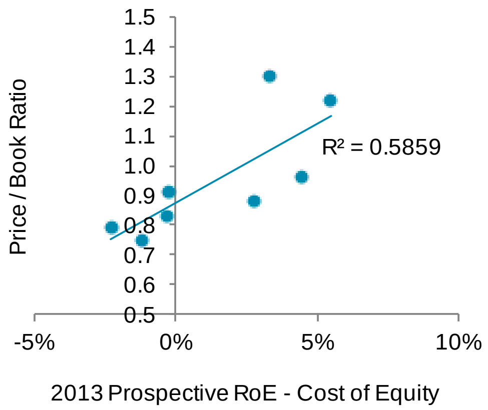
The relationship is broadly as we would expect to see. There are only 3 points in an unexpected quadrant (circled in the graph), where the price-book ratio is above 1, despite a 2013 return that is expected to be below the estimated cost of equity. There are many possible reasons for this, but differences in accounting methodologies, expectations of merger activity and expectations of high returns after 2013 are all possibilities.

The concave nature of the curve is what we would expect to see if differential costs of equity were the primary driver of different valuations. In this case, we would expect the rate of descent of the curve to decline at low valuations, as the company could always go into run-off, placing a lower bound on the discount to book value that could reasonably apply. Here, the curve crosses at about 1.1, close to the theoretical expectation of 1.

We demonstrate above how a change in reinsurance structure may increase or decrease the expected return on equity, depending on whether the reinsurance adds or removes leverage. We showed how to estimate this change in the cost of equity, and hence how to calculate the difference between expected ROE and cost of equity before and after changes in reinsurance structure. We can thereby identify reinsurance structures that move us North-Eastwards along the valuation curve from our starting position, towards higher share prices.

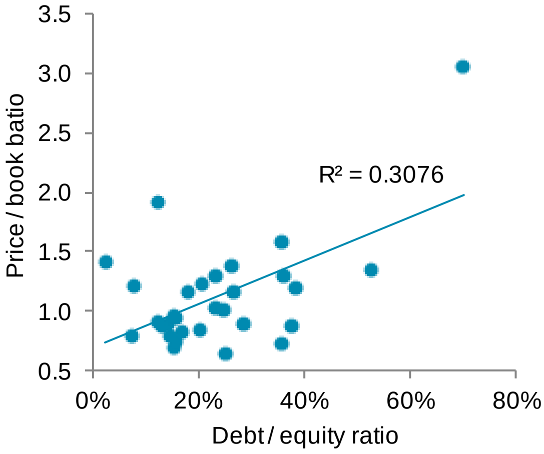
It is quite notable how relatively small movements appear to offer the potential of materially higher valuations. Looking at a company with one of the lowest valuations, XL Group, the valuation is severely impacted by the high cost of equity. This may be reduced by identifying and removing reinsurances that are adding gearing, but for little return, and by implementing reinsurances that reduce earnings volatility (see Case Study 2).

The relationship is less strong for the reinsurers (see graph to right), where there is a smaller sample and less variability. However, the relationship is directionally as one would expect. This adds support to the idea that, if reinsurance can be used to increase the spread between expected return and cost of equity, equity valuations can be increased.

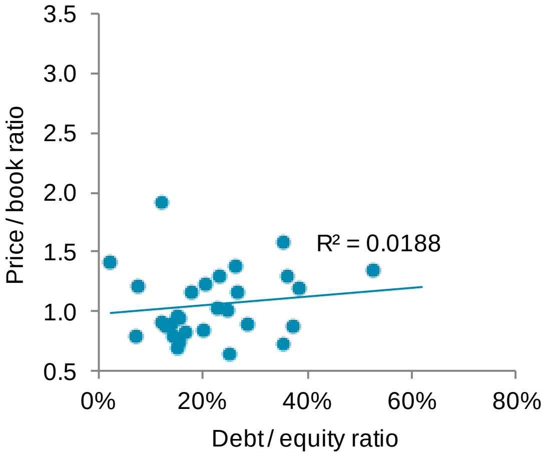


Appendix 1: Debt-to-equity and price-to-book ratios of selection of US P&C companies

Including Amtrust



Excluding Amtrust



	Debt / Equity Ratio
Mean	24.60%
Standard Deviation	14.18%
Minimum	2.30%
Lower Quartile	15.15%
Median	23.00%
Upper Quartile	30.90%
Maximum	70.00%

	Debt / Equity Ratio
Mean	23.41%
Standard Deviation	12.22%
Minimum	2.30%
Lower Quartile	15.13%
Median	21.70%
Upper Quartile	29.30%
Maximum	62.10%

Appendix 2: Financial data by company

	Debt-to-Equity	Price / Book	Cost of Equity	Prospective 2013 RoE	Excess RoE	Insurer / Reinsurer
Ace	20.40%	1.23	9.60%	9.65%	0.05%	Insurer
Alleghany	23.00%	1.02	7.60%	6.80%	-0.80%	Insurer
Allied World	24.60%	1.01	8.80%	7.39%	-1.41%	Insurer
American Financial Group	20.30%	0.84	9.40%			Insurer
Amtrust	70.00%	3.06	9.80%	16.84%	7.04%	Insurer
Arch	13.20%		7.20%	8.20%	1.00%	Insurer
Argo	25.00%	0.64	8.20%	4.50%	-3.70%	Insurer
Chubb	23.10%	1.29	8.50%	10.00%	1.50%	Insurer
Cincinnati	18.00%	1.17	9.20%	5.07%	-4.13%	Insurer
Employers *	26.20%	1.38	10.90%	8.04%	-2.86%	Insurer
Hanover Insurance Group	35.60%	0.72	8.80%	7.22%	-1.58%	Insurer
Loews	37.50%	0.87	10.40%	6.92%	-3.48%	Insurer
Markel	35.50%	1.58	8.00%	4.92%	-3.08%	Insurer
Navigators	14.00%	0.89	9.20%	4.95%	-4.25%	Insurer
Old Republic	24.10%		10.70%	12.46%		Insurer
ProAssurance	2.30%	1.41	7.90%	9.00%	1.10%	Insurer
RLI Corp	12.10%	1.92	8.30%	10.50%	2.20%	Insurer
Selective	28.40%	0.9	9.70%	7.41%	-2.29%	Insurer
Tower	38.40%	1.2	8.60%	9.85%	1.25%	Insurer
Travelers	26.60%	1.17	9.00%	9.48%	0.48%	Insurer
United Fire	7.30%	0.79	9.90%	4.75%	-5.15%	Insurer
White Mountains **	15.70%	0.95	7.50%	6.17%	-1.33%	Insurer
WR Berkley	52.40%	1.34	8.30%	9.20%	0.90%	Insurer
XL Group	15.10%	0.69	14.50%	6.70%	-7.80%	Insurer
Alterra	15.40%		9.40%			Reinsurer
Aspen	15.50%	0.75	8.60%	7.39%	-1.21%	Reinsurer
Axis	16.90%	0.83	8.80%	8.49%	-0.31%	Reinsurer
Bershire Hathaway	34.30%		9.10%			Reinsurer
Endurance	19.60%		7.80%			Reinsurer
Everest	12.90%	0.88	7.60%	10.40%	2.80%	Reinsurer
Fairfax	36.00%	1.3	5.40%	8.70%	3.30%	Reinsurer
Flagstone	29.60%		11.00%			Reinsurer
Hannover Rueck	32.20%		12.60%			Reinsurer
Muenchener Rueck	26.60%		11.90%			Reinsurer
Partner Re	12.10%	0.91	8.30%	8.03%	-0.27%	Reinsurer
Platinum	14.60%	0.79	9.10%	6.80%	-2.30%	Reinsurer
Ren Re	7.70%	1.22	7.90%	13.40%	5.50%	Reinsurer
Swiss Re	62.10%		12.50%			Reinsurer
Validus	15.20%	0.96	8.10%	12.53%	4.43%	Reinsurer

* Analyst Estimates on different basis - subjective adjustment of 2012 estimates to reflect appropriate basis of comparison

** Only one Analyst estimating an RoE that exceeds any attained since 2002 and more than 3 x average of last 5 years
Have replaced with average of last 5 years

Source: Bloomberg, July 2012

References

Froot, K.A, 2007, Risk Management, Capital Budgeting, and Capital Structure Policy for Insurers and Reinsurers, Journal of Risk and Insurance, 74: 273-299

Modigliani, F.; Miller, M. (1958). "The Cost of Capital, Corporation Finance and the Theory of Investment". American Economic Review 48 (3): 261–297