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ASSESSMENT OF TARGET CAPITAL FOR GENERAL INSURANCE FIRMS

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ABSTRACT

Capital and cost of capital form a bridge between the insurance firm and the financial markets. The term capital is used in various ways. In current parlance, economic capital is frequently used to mean capital calculated using a risk-based measure which is independent of the regulatory requirements. In this paper we discuss the concept of target capital, where the firm takes account of three different approaches to risk appetite: regulatory capital plus a buffer; rating agency views; and the views of shareholders, where they make commitments to customers and wish to protect franchise value. We describe how, when blending these views, the firm needs to understand the trade-offs between too high and too low amounts of capital, with reference to the double taxation burden, insurance gearing (leverage of premiums to capital ratio), and the impact of the firm's credit rating on maximising franchise value. We then discuss the main drivers of the cost of capital, which we define as the required total return on the market value of the firm, as determined by reference to the opportunity cost of alternative investments of equivalent risk. We explain that, because the stock market value of the firm is not the same as the capital held inside the firm, the cost of capital derived from external studies cannot be directly applied to internal measures of target return such as return on equity (ROE); it is necessary to translate between the two measures. We separate the risk of the firm between the investment risk and the insurance risk. We describe the frictional costs of investing in an insurance firm, and explain the role of parameter and model risk arising from the uncertainty of the future claim costs of the firm. We describe the findings of two studies of the actual historical stock market returns of United States P&C companies. One of them suggests that applying the Fama-French model produces higher and more accurate cost of capital estimates than the capital asset pricing model (CAPM) method. This is explained by linking the price to book ratio to the costs of financial distress, which are particularly important for general insurance firms, given the influence of insurance strength ratings from the rating agencies. Finally, we attempt to estimate the risk load required in premiums to compensate investors for the elements of cost of capital which we have described, in a way that combines the financial economic approaches to insurance target returns with the traditional actuarial approaches to assessing the risks in the insurance business.

KEYWORDS

Economic Capital; Cost Of Capital; Risk Appetite; Regulatory Capital; Rating Agency Views; Franchise Value; Market Consistent Valuation; Frictional Costs; Costs of Financial Distress; Agency Costs; Parameter Risk; Risk Discount Rate; Return on Equity (ROE); Total Shareholder Return (TSR); Return on Risk-Adjusted Capital (RORAC)

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1. Introduction

1.1 *Aims of this Paper*

1.1.1 Over the past few years, many general insurance firms in the United Kingdom have developed dynamic financial analysis (DFA) models to assist with assessing their regulatory capital requirements under the Individual Capital Adequacy Standards (ICAS) regime of the FSA. Suppose that you are an actuary at one of those firms, and you have been asked to extend your DFA model to address the issue of the capital which should be used in running the business. In particular, suppose you have been asked to assist the senior management of the firm in their discussions with capital providers on the following three questions:

(1) How much capital should the firm hold, given its risk profile and the requirements of investors?
(2) What rate of return should be required on this capital?
(3) How should the firm assess performance targets and premium loadings in the light of (1) and (2)?

1.1.2 To answer these questions requires a blend of insurance risk considerations and financial market views of risk:

(1) The insurance view of risk comprises the traditional actuarial approaches to modelling and forecasting. It attempts to consider all sources of risk in the firm, both systematic and non-systematic, and to include the impact of correlations and diversifications.
(2) The financial markets view of risk comprises the approach of portfolio investors, who want to obtain a satisfactory total return by balancing risk and return over a broad spread of investments in insurance and many other industries. They are concerned with the extent to which a specific investment is correlated with general market and economy risks, and the extent to which it acts as a diversifier to other investments in their portfolio.

1.2 *Definition of Terms used in this Paper*

1.2.1 We use the words 'insurance firm' instead of 'insurance company' where it is useful to include other insurance entities, such as Lloyd's vehicles.

1.2.2 When we use the term 'capital', we mean capital assessed on a basis consistent with the shareholders' requirements:

(1) The target capital is the amount of capital required to be held in the firm, given the shareholders' risk appetites and return requirements, blended with the constraints of regulatory requirements and rating agency views. Some commentators define economic capital as the amount required to satisfy shareholders' risk appetites independent of, for example, regulatory constraints, but we regard these external views as an integral part of the insurance business.

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(2) We define the fair value capital actually held (the economic net assets) to be the market value of the assets less the (notional) market value of the liabilities. The market value of the liabilities will be the notional price required to transfer them to a third party, and so should include a market value margin, or MVM. The MVM is not necessarily the same as any risk margin in technical provisions required in future by regulators, as the regulators may specify a market-wide basis or an arbitrary basis, for example if they use a percentile approach, or an arbitrary cost of capital.

1.2.3 We use the terms 'equity' or 'surplus' to mean the accounting net assets of the firm. It is helpful to break shareholder value down into three components, these being the required amount of target capital, headroom and franchise value:

(1) Target capital required is as defined in ¶1.2.2. Note that target capital does not reflect other reasons for holding capital, for example to finance organic or inorganic growth.
(2) Headroom is the accounting net assets minus the calculated target capital. The net assets, or equity, on a firm's balance sheet are the result of an accounting assessment of assets and liabilities. The net assets also form the denominator against which accounting return on equity is measured. The headroom number is usually positive, as most firms wish to demonstrate financial strength by holding more capital than is strictly required on a risk basis. This is the category which covers the potential to finance organic or inorganic growth.
(3) Franchise value is normally defined to be the market capitalisation of a firm minus its accounting net assets. The franchise value is that part of a firm's market value which is not recognised in financial statements. This includes elements of value related to future business, as well as the limited liability put option.

1.2.4 As regards available investments, we use the terms:

(1) 'gilts' to mean government-backed bonds, and hence assume that these are suitable proxies for so-called 'risk-free' assets;
(2) 'bonds' to mean debt securities issued by ordinary trading companies, and hence subject to credit default ratings, such as AA or BBB; and
(3) for equity shares in ordinary companies, we normally use the word 'shares', in order to avoid overlap with the word 'equity', which is used to mean the accounting net assets. We could have used the word surplus to describe equity, but we wanted to retain the use of the popular phrase ROE for return on equity. Sometimes we use the word equities for shares when we believe that the context makes the usage unambiguous, for example in the phrase 'equity risk premium'.

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1.2.5 We use the phrase 'cost of capital' to mean the required total return on the market value of the firm, to be determined by reference to the opportunity cost of alternative investments of equivalent risk.

1.2.6 In this paper, we are only looking at cost of equity capital. We do not examine the issues relating to the cost of debt and/or the weighted average cost of capital (WACC).

1.2.7 We use the phrase 'frictional capital cost' to mean the before tax return on capital from underwriting (present value of current period underwriting income, plus gain/loss on present value reserve development, plus interest on risk-free investment of technical reserves) divided by capital set to produce the target cost of capital when earnings are adjusted to a market consistent basis, as described in Section 5. Equivalently, it is the ratio of income (excluding the income from the investment of capital) required to achieve the target cost of capital when earnings are adjusted to a market consistent basis.

1.3 *Layout of this Paper*

1.3.1 This paper contains what the authors believe to be the issues which the actuary should discuss when answering the questions raised in Section 1.1.

1.3.2 In Section 2 we discuss the considerations which a firm should make when deciding on the level of capital to hold:

(1) the viewpoints of regulatory capital plus a buffer, and of rating agency capital requirements;
(2) the strategic requirements of the business regarding positioning in the market and the risk appetite of shareholders; and
(3) recognising that there is no single right amount of capital, we discuss the costs and benefits of holding higher or lower capital amounts, and how the firm could articulate where in an optimum band it wishes to position itself, having regard to risk/reward ratios and the desire to maximise franchise value.

1.3.3 In Section 3 we discuss the many roles of the cost of capital, and link them together in the context of a general insurance firm (the terms introduced in this section are explained later at the appropriate places in the text), and we describe:

(1) the opportunity cost of alternative investments;
(2) the need for market consistent/risk neutral discount rates;
(3) separating investment risk from insurance risk by means of the so-called replicating portfolio;
(4) viewing the total cost of capital as the combination of the investment cost of capital plus the insurance cost of capital;
(5) the frictional capital costs of holding capital inside an insurance firm:

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(a) double taxation;
(b) the costs of financial distress, including the impact of the firm's insurance credit rating;
(c) agency costs;
(d) the role of uncertainty in some insurance returns; and
(e) the cost of illiquidity due to regulatory restrictions on capital;

(6) the impact of diversifiable versus non-diversifiable risks; and
(7) the need to reconcile different types of return: TSR (total shareholder return), ROE (return on equity), RORAC (return on risk adjusted capital) and RAROC (risk adjusted return on capital), and IRR (internal rate of return targets for managers).

1.3.4 In Section 4 we describe the empirical evidence from two studies of long-term stock market returns on what variables can be observed to be linked to the expected returns and/or the cost of capital. One by Swiss Re *sigma* No3/2005 examines the link between price/book ratio and the volatility of underwriting returns, and the link between price/book ratio and the volatility of investment returns. It concludes that:
(1) underwriting volatility has little effect on cost of capital; and
(2) investing in riskier assets, such as shares, does not increase franchise value.

The other, by Cummins & Phillips (2005), as part of the Casualty Actuarial Society (CAS) Risk Premium Project, concludes that:
(1) Using a capital asset pricing model (CAPM) approach significantly under-estimates the cost of capital, because of failure to adjust for the effects of firm size and financial distress. The Fama-French three-factor (FF3F) method provides better estimates of the cost of capital.
(2) The cost of capital can vary significantly with the solvency ratio/leverage of the firm.
(3) Both of these factors should be taken into account when assessing the value of future income streams or when setting insurance prices, i.e. premiums.
(4) The paper further describes and demonstrates an approach to the estimation of the cost of capital by line of business, called the full information beta approach, and shows that the cost of capital can vary significantly by line of insurance.

1.3.5 In Section 5 we explain that, because the stock market value of the firm is not the same as the capital held inside the firm, the cost of capital derived from external studies cannot be applied directly as an internal measure of target returns; it is necessary to translate between the two measures. We show a lengthy worked example which builds a model from the bottom up of the separate components of cost of capital described in Section 3. We attempt to estimate the contributions from the firm's investment policy, the cost of double taxation, the costs of financial distress, including the impact of the firm's insurance credit rating, agency costs, and the cost of illiquidity due to regulatory restrictions on capital. We do this in a way which attempts to combine the financial economic approaches to insurance target returns with the traditional actuarial approaches to assessing the risks in the insurance business.

1.3.6 In Section 6 we summarise our key findings and conclusions.

1.3.7 In Appendix A we include a worked example, containing calculations related to the principles discussed in Section 2 on the amounts of capital required for a hypothetical firm whose claims costs vary as a lognormal curve with different coefficients of variation.

1.3.8 In Appendix B we analyse the circumstances under which the statement that 'insurance risk is diversifiable and requires no financial reward' is valid.

2. Amount of Capital

2.1 *Three Different Approaches*

2.1.1 In this section we discuss the considerations which a firm should make when deciding on the level of capital to hold. Management is likely to want to consider various measures of capital when estimating the optimum amount of capital for its business:

(1) *Regulatory capital.* It will pay close attention to the capital requirements as stipulated by the regulator. This is the level at which the regulator can intervene in the affairs of the firm. Management will want to avoid this, so will want to operate with some sort of 'buffer' in excess of this level.

(2) *Rating agency capital.* Management will also be concerned about the credit rating of its firm. As such, it should also consider the views of rating agencies and the rating agencies' capital expectations for a firm of a given credit rating. This will also impact on the customers' views of the firm, and may be an influence on the market share and the quality of business which the firm can access.

(3) *Target capital.* By this we mean the estimated optimum amount of capital for a firm to hold from the point of view of a shareholder. This includes taking account of the strategic requirements of the business in its market place, regulatory constraints and the risk appetite of the shareholders. We note that this definition may be different to some of the other commonly used definitions which may ignore regulatory constraints.

2.1.2 The final choice will be a blend of all three of the above. It is then helpful to break shareholder value down into three components, these being target capital, headroom and franchise, as defined in Section 1.2. When considering an optimum blend of the three types of capital, the firm will also want to have a view on the protection of franchise value, and maximising shareholder value.

2.1.3 We assume that the firm has a full DFA model, and that it is able to estimate both VaR (value at risk) and TVaR (tail value at risk) with a one-year time horizon and for suitable multi-year horizons. We also assume that the firm's liabilities are valued at an amount consistent with the value at which they could be passed on to a third party, and we define the economic net assets of the firm as the market value of the assets less the market value of the liabilities.

2.1.4 Many years ago, rules of thumb were often used to gauge the amount of capital which a firm should hold. These rules of thumb were almost invariably factor based, and were related to the level of premiums written, sometimes historic premiums and sometimes forward looking. Although some industry observers would adapt the rules of thumb according to the business segment in which the firm operated, little consideration was given to the individual risk profile of the business — they were, after all, rules of thumb. European regulations broadly required insurers to hold capital of at least 18% of premium, or, if greater, a percentage of recent incurred losses, according to the required minimum margin (RMM) requirements. In reality, the insurance industry expected firms to hold significantly higher capital. For a large U.K. writer of personal and commercial business, observers expected the firm to hold capital of at least twice the RMM, roughly 40% to 45% of written premium. Medium sized firms writing long-tailed and/or commercial business would have been expected to hold, perhaps, 60% of written premium, whilst London Market specialist/reinsurance firms may have been expected to hold capital of at least 75% of written premium. There was no specific source for these rules of thumb, and in this paper we want to examine the replacements which reflect some of the changes in regulation and new thinking behind efficient capital management.

2.2 *Regulatory Capital plus a Buffer*

2.2.1 Under the ICAS regime in the U.K., a firm is required by the regulator to undertake regular assessments of the amount and quality of capital which, in its view, is adequate for the size and nature of its business, in order to meet the liabilities as they fall due. The FSA specifies that the ICA should be calibrated to a 99.5% VaR over a one-year time horizon. The absolute minimum or 'floor' level of capital which a firm should operate at is the ICG (individual capital guidance), as specified by the FSA following their review of the specific risks inherent in an insurer's business.

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Many firms will, however, look to hold a buffer of capital above the ICG, some by a considerable margin, in order to avoid the likelihood of regulatory intervention.

2.2.2 The firm's DFA model, based on total insurance risk, is used to assess a capital requirement. This capital requirement is a cost of entry to the insurance industry.

2.2.3 In deciding the level of capital to hold, it is important that a firm considers, not only the regulatory minimum (ICG) of capital, but also the chance of the actual amount of capital held by the firm falling below the regulatory minimum within the chosen time frame. Holding a buffer of capital above the ICG avoids minor shocks triggering regulatory action or the need to raise fresh capital immediately. Given that there can be considerable costs involved in raising new capital, a firm is likely to want to consider the probability of the capital falling to the regulatory minimum over a certain time period. For example, a firm may specify that the maximum probability that it is willing to accept of needing to raise fresh capital over the next year is, say, 10% or 20%. In this case management may want to hold capital equivalent to an 80% or 90% VaR above that of the ICG. This capital buffer could be thought of as protecting the firm from regulatory intervention against loss scenarios with a five to ten-year return period, a time period which may be similar to the length of the next insurance cycle (say ten years), or half a cycle (say five years).

2.2.4 In Appendix A we show the hypothetical example of a firm whose overall risk profile is a lognormal with varying coefficients of variation. As shown in Table A.2, if this firm has a solvency ratio of 67% and invests its capital in gilts, the ECR percentage would be 45% of premium. If we take the example of the coefficient of variation being 17.5%, the ICA would be 46% of the premium. If we assume that its ICG is set at the level of its ICA, if the firm wishes to avoid regulatory intervention or the need to raise fresh capital over the next year with a probability of one in five, its capital needs to rise to 55% of the premium, i.e. an additional buffer of 18% of the capital over and above the regulatory minimum capital, and if it wishes a probability of one in ten, its capital needs to rise to 63% of the premium, an increase of 36%.

2.2.5 A firm which has either strong acquisition plans or wants to significantly grow its share of the market may wish to hold additional capital on top of this buffer to finance such activity. The desired level of this additional capital will vary considerably from firm to firm, depending on each individual insurer's specific plans and strategy together with the management's risk appetite.

2.3 *Rating Agency Capital*

2.3.1 In deciding the amount of capital to hold, a firm is also likely to pay close attention to the views of rating agencies. For example, the firm

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may believe that operating at an A or an AA level will improve the firm's market share and customer retention rates, hence reducing marketing costs, and may give it access to better rated business, i.e. reduce loss ratios. A higher level of capital would also reduce the firm's 'mortality rate' (potential default rate). As long as the higher amount of capital is not excessive, this will lower the cost of capital (see Sections 2.7, 4.3 and 5.9) and thereby increase the NPV of future profit streams. The question which needs to be addressed is how to quantify the extra capital needed to achieve these benefits.

2.3.2 At the time of writing, it is commonly quoted that a one-year 99.5% VaR risk measure is equivalent to a BBB security rating. This may be partly the result of the FSA's consultation paper CP190 saying: "It is necessary to make the assumption which equates a BBB rating to a particular confidence level ... for the purposes of this paper we have selected a 99.5% confidence level.'' However, it should be noted that in the same consultation paper the FSA went on to ask: "whether this does indeed equate to a BBB rating.'' In practice, there is not a one-to-one mapping from VaR to credit rating, and rating agencies rarely publish forward looking survival probabilities for each credit rating. As a result, different sources, over the years, have attempted to quantify the level of security provided by each credit rating, and this has lead to a range of different calibrations being published.

2.3.3 The authors are aware that credit ratings for bond defaults and insurance strength ratings for claims payment ability are not the same thing. However, the two approaches treat similar sorts of events, and both are produced by similar organisations. Even though the connection between the two is a somewhat loose one, we believe that it is useful to see what lessons can be learned from studying the parallels. In particular, the credit spreads give a market consistent price in terms of risk discount rate for the rare events which are the failures of firms with a specified default probability.

2.3.4 Table 2.1 is based on research carried out by Bank of America. These calibrations, in Table 2.1, of VaR to credit ratings have been in common usage for several years. According to their research, a BBB rating is equivalent to a 99.7% VaR.

Table 2.1. Bank of America — calibration of survival probabilities to credit rating

Rating	Default probability	Survival probability
AAA	0.01%	99.99%
AA	0.03%	99.97%
A	0.11%	99.89%
BBB	0.30%	99.70%

The original research leading to the formation of this table was done by Bank of America. The table was later reproduced by the Wharton School, University of Pennsylvania in http://fic.wharton.upenn.edu/fic/papers/96/p9640.html

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2.3.5 An indication of the strength of each credit rating can be gained by analysing historical default probabilities, which are widely available from credit rating agencies over various time horizons. Table 2.2 is based on an S&P study which looked at the historical default probabilities for all industries over the period of 1981 to 2005. It can be seen that the implied one-year survival probability for a BBB rated firm is 99.73%.

Table 2.2. S&P historical survival probabilities — all industries based on 1981 to 2005

S&P historical survival probabilities (%)

		Timeframe (years)									
		1	2	3	4	5	6	7	8	9	10
Rating	AAA	100.000	100.000	99.970	99.940	99.900	99.830	99.760	99.640	99.600	99.560
	AA	99.990	99.960	99.910	99.810	99.710	99.600	99.480	99.380	99.290	99.190
	A	99.960	99.880	99.770	99.620	99.410	99.190	98.940	98.710	98.450	98.170
	BBB	99.730	99.240	98.680	97.940	97.170	96.440	95.850	95.240	94.730	94.180
	BB	98.880	96.670	94.040	91.550	89.350	87.230	85.550	84.100	82.740	81.710
	B	94.620	88.200	82.860	78.760	75.840	73.550	71.630	70.090	68.850	67.620

The table is based on S&P cumulative average default rates 1981 to 2005 from source:
http://www2.standardandpoors.com/spf/pdf/fixedincome/AnnualDefaultStudy_2005.pdf

2.3.6 It should be noted that historical default statistics themselves are highly volatile, particularly for high credit ratings, where the estimates are based on a very limited number of defaults. A previous study by Standard & Poor's (S&P) (2006), which covered the time period of 1981 to 2003, estimated the historical one-year survival probability for BBB at 99.63%, 0.1% lower than the same study two years later, which covered 1981 to 2005. Although this is only a relatively small change in the survival probability, it is a 25% reduction in default probability, from 0.4% to 0.3%, based on only two years of additional information, 25 years rather than 23 years, and it does demonstrate the volatility in the estimates of survival probability and the dependency on the historical economic environment. The fall in the estimated default rate from 2003 (increase in survival probability) was driven by a period of low corporate defaults.

2.3.7 The variability with time is also demonstrated by Figure 2.1, which shows data from S&P of historical corporate default rates for the period 1981 to 2005.

2.3.8 Fitch Ratings (Fitch) (2006) have recently published an Exposure Draft on Prism (Exposure Draft: Prism — Insurance Rating Calibration Measures), their new global economic capital model. In the exposure draft they present the proposed calibration of credit rating to VaR and TVaR confidence levels. Although the model is just one input to their rating process and not a rating tool in itself, it is still useful to look at their calibrations.

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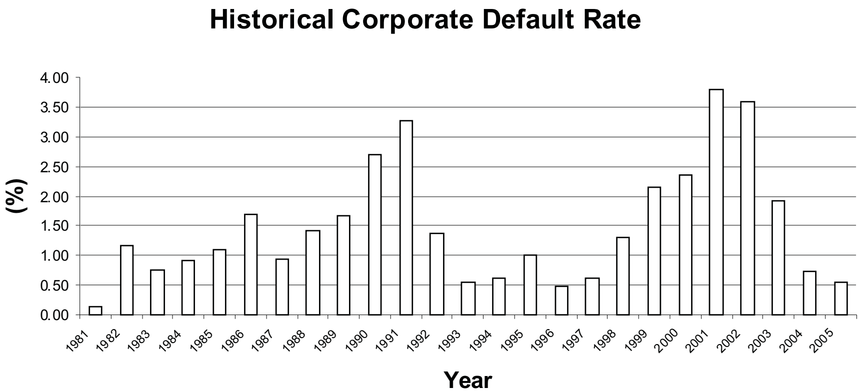

Figure 2.1. History of corporate default rates

Table 2.3. Fitch; insurance rating calibration measures for VaR

Fitch: idealised probability of survival (%)

		Timeframe (years)									
		1	2	3	4	5	6	7	8	9	10
Rating	AAA	99.995	99.983	99.967	99.946	99.922	99.894	99.862	99.828	99.790	99.749
	AA	99.985	99.954	99.912	99.861	99.800	99.733	99.658	99.576	99.488	99.393
	A	99.966	99.896	99.801	99.685	99.550	99.398	99.231	99.049	98.853	98.644
	BBB	99.721	99.302	98.809	98.260	97.669	97.041	96.383	95.698	94.990	94.261
	BB	99.263	98.205	96.988	95.661	94.253	92.782	91.262	89.704	88.115	86.504
	B	94.036	88.750	83.869	79.323	75.068	71.076	67.323	63.789	60.458	57.316

Source: http://www.fitchratings.com/corporate/help/about_insurance_model.cfm

Table 2.3 is an extract from Fitch's exposure draft. It shows the relationship between confidence level or estimate of survival probability and each credit rating over time periods of one to ten years. The full table in the exposure draft gives a calibration of survival/default probabilities up to 30 years, although modelling of the longer time horizons is usually reserved for life insurers.

2.3.9 It can be seen that there is a fairly good correspondence between the S&P historical defaults table and Fitch's forward looking calibration. In particular, Fitch calibrate a BBB rating as a one-year 99.7% VaR, which, to one decimal place, is the same as that estimated from S&P's historical default study. This close correspondence is particularly interesting, given the different criteria for assigning each rating used by Fitch and S&P.

2.3.10 Table 2.4 summarises some the results of various different

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Table 2.4. Capital for hypothetical firm with lognormal CoV of 17.5% for various survival probabilities measures

Source	One-year VaR confidence level for BBB	Capital for BBB rating	One-year VaR confidence level for A	Capital for A rating
Commonly quoted	99.50%	464	N/A	N/A
Bank of America	99.70%	508	99.89%	593
S&P average default rates 1981 to 2005	99.73%	517	99.96%	675
Fitch-Prism calibration	99.72%	514	99.97%	688

Note: CoV is the coefficient of variation.

calibrations of VaR confidence level to credit rating, as applied to the hypothetical lognormal firm in Appendix A. Small differences between these different measures are not surprising, because of the different time periods used for calibration and the different ways in which they have been derived. The range of estimates is greater for the higher credit ratings, which is hardly surprising, given the lower number of defaults, making estimates increasingly uncertain and volatile. The S&P survival probabilities are based solely on historical defaults and cover all industries between 1981 and 2005. In their calibration, Fitch have used default data back to the early 1900s. The Fitch rating thresholds have been made public to provide transparency to the rating process. A major difference is that these thresholds are forward looking. According to Fitch, a 99.5% VaR measure: "would land between a BBB− and a BB+."

2.3.11 From Table 2.4 it would appear to be reasonable to take a 99.7% confidence level VaR as being broadly equivalent to a BBB rating. A firm which calibrated its DFA to 99.7% rather than to 99.5% would come up with a greater capital figure than a firm which calibrates its estimate to 99.5%. Take a simplified hypothetical example of a firm whose overall risk distribution is lognormal with a coefficient of variation of 17.5%, as illustrated by the worked example in Appendix A. Calibrating to 99.7% rather than to 99.5% will increase the capital estimate by approximately 10%.

2.3.12 We explained in ¶2.3.3 that the connection between credit ratings for bond defaults and insurance strength ratings is somewhat loose. For example, consider the comparison between calibrating a DFA model to 99.5% and a one-year survival rate of 99.7% for rating agency capital. The DFA model will generally consider the variability of claim payments to ultimate when calculating the capital required. The 99.7% rating agency definition will generally only include insolvencies occurring in the following year. Thus, the rating agency definition might exclude companies which may be insolvent, but whose reserves have not increased to recognise this

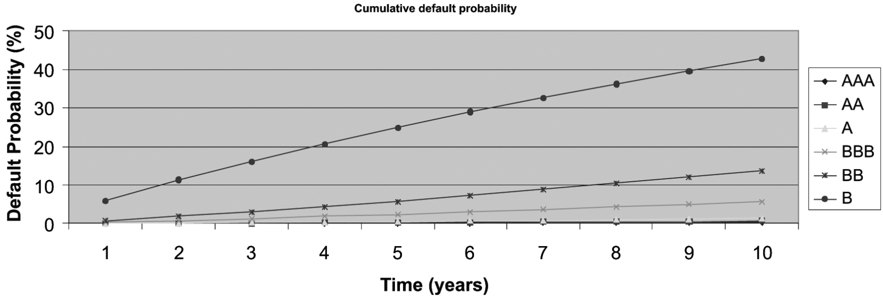

Figure 2.2. Based on data from Fitch ratings — exposure draft: Prism — insurance rating calibration measures

fact. Thus, the 99.5% may be consistent with the 99.7%, as the underlying definitions of insolvency are different.

2.3.13 The graph in Figure 2.2 shows the calibration of the cumulative default experience to credit rating. As would be expected over increasing time horizons, the different probabilities of default for the range of credit ratings becomes very significant.

2.3.14 Fitch is one of a number of rating agencies which are increasingly focusing on TVaR as a risk measure for rating. In fact, TVaR will be the primary risk measure used in Prism. TVaR looks at the entire loss distribution above a stated threshold, rather than just the single point on the curve which is captured by VaR. TVaR is the average loss incurred above the stated threshold. For example, a 99.5% TVaR gives the average of the highest 0.5% of losses. For this reason TVaR will be higher than the VaR estimate for the same percentile.

2.3.15 TVaR is often seen as a better measure of risk than VaR. Reasons cited include:

(1) VaR estimates do not give any indication as to how bad the default is when it does happen. TVaR, on the other hand, considers the size of the losses when default occurs. In particular, TVaR will also reflect low probability, but high severity, events.

(2) Certain statistical properties of TVaR are more desirable than those of VaR. In particular TVaR is a coherent measure of risk (see Artzner *et al.*, 1999). On the other hand, the mathematical treatment of TVaR for multiple time periods is complex.

2.3.16 Table 2.5, again an extract from the Fitch exposure draft, gives the calibration of the TVaR confidence levels to the credit rating. The calibration table suggests that a 99.2% TVaR over a one-year time horizon is broadly equivalent to a BBB rating. It is of interest to note that, in

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Table 2.5. Fitch ratings; insurance rating calibration measures for TVaR

Fitch tail VaR confidence level (%)

		Timeframe (years)									
		1	2	3	4	5	6	7	8	9	10
Rating	AAA	99.984	99.949	99.904	99.845	99.777	99.696	99.609	99.510	99.404	99.292
	AA	99.953	99.863	99.740	99.589	99.415	99.217	98.999	98.760	98.505	98.231
	A	99.897	99.689	99.411	99.071	98.679	98.233	97.744	97.210	96.635	96.021
	BBB	99.213	98.042	96.665	95.142	93.501	91.767	89.952	88.068	86.126	84.133
	BB	98.182	95.604	92.662	89.486	86.137	82.670	79.113	75.494	71.837	68.156
	B	85.812	73.627	62.668	52.721	43.670	35.431	27.947	21.173	15.081	9.655

Source:http://www.fitchratings.com/corporate/reports/report_frame.cfm?rpt_id=282264

discussions related to the Solvency Capital Requirement (SCR) for Solvency II, CEIOPS (2006) make the following comment in paragraph 1.9 of their 'Quantitative Impact Study 2 — Technical Specification': "the 'target' standard is TVaR at an equivalent level of prudence to VaR 99.5%. A broad assumption has been made that TVaR 99% would meet this objective, and this is reflected in certain SCR parameters."

2.3.17 It is of interest to consider the relative levels of capital which may be required to attain each credit rating. Table 2.6 is based on the hypothetical firm in Appendix A with an overall risk profile as a lognormal distribution with a coefficient of variation of 17.5%. We have assumed that the premium is 1,000, the mean loss ratio is 95% and we have used the Fitch calibrations of VaR confidence level to each credit rating. We have also assumed that investment income exactly matches any expenses, so that we can ignore both these items. The table suggests that to increase credit rating from BBB to A may require approximately 35% more capital. To increase the credit rating to AAA may require around an additional 65% of capital.

2.3.18 For this hypothetical firm, the ICA calibrated to a one-year 99.5% VaR is very sensitive to the assumed CoV, as can be seen from Table A.2. When the CoV is 15% the ICA, as a percentage of ECR, is 84%; the ICA is 102% of ECR for a CoV of 17.5%; 122% for a CoV of 20%; and 163% for a CoV of 25%. In practice, the firm would have a much more complexly

Table 2.6. Hypothetical firm with lognormal CoV of 17.5%

Rating	VaR confidence level (%)	Capital	% of BBB capital
AAA	99.995	839	163%
AA	99.985	753	146%
A	99.966	688	134%
BBB	99.721	514	100%
BB	99.263	429	83%
B	94.036	227	44%

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structured probability curve for its DFA capital requirement than a lognormal, and should use that output to produce a table similar to Table 2.6 for discussions with management.

2.3.19 As mentioned above, using a TVaR measure for risk is often more appropriate than VaR for many applications to which capital models may be put. In Tables 2.7 to 2.9 we give the equivalent TVaR measure for many of the commonly used risk tolerance measures. We have again taken a simplified example of a firm which models its overall risk profile as a lognormal distribution and has a CoV of 17.5%.

2.3.20 In addition to stating the classically defined return period for each risk measure, we have also given the equivalent 'TVaR return period' or

Table 2.7. Hypothetical firm with lognormal CoV of 17.5%

	VaR and equivalent TVaR		TVaR and equivalent VaR	
Return period (years)	VaR	TVaR	TVaR	VaR
1,000	99.9%	99.7%	99.9%	100.0%
200	99.5%	98.7%	99.5%	99.8%
100	99.0%	97.4%	99.0%	99.6%

Table 2.8. The correspondence between confidence levels and return periods under VaR and TVaR risk measures for a hypothetical firm with lognormal CoV of 17.5%

Return period (years)	VaR	TVaR	TVaR return period (years)
10,000	99.99%	99.97%	3,694
3,333	99.97%	99.92%	1,233
1,000	99.90%	99.73%	375
200	99.50%	98.67%	75
100	99.00%	97.36%	38
10	90.00%	74.50%	4
5	80.00%	50.69%	2

Table 2.9. The correspondence between confidence levels and return periods under VaR and TVaR risk measures for a hypothetical firm with lognormal CoV of 17.5%

TVaR return period (years)	TVaR	VaR	Return period (years)
10,000	99.99%	100.00%	27,194
3,333	99.97%	99.99%	9,003
1,000	99.90%	99.96%	2,686
200	99.50%	99.81%	533
100	99.00%	99.63%	267
10	90.00%	96.18%	26
5	80.00%	92.18%	13

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'fully protected policyholder return period'. This measure of return period is important for a group which wishes to protect its franchise value by recapitalising after a loss. This example is discussed in more detail in ¶2.4.2.

2.3.21 The 'TVaR return period' is, in effect, the expected duration between loss scenarios which, on average, are of a magnitude sufficient to wipe out all of the subsidiary's capital. Take, for example, the 99.73% TVaR measure, which is broadly equivalent to a VaR of 99.90%. We would expect there to be a one in 1,000 chance of the firm being unable to meet all liabilities incurred within the next year, but the cost of replacing the deficit, and paying claims in full, is equivalent to replacing capital once every 370 years $(1/(1-0.9973))$.

2.3.22 Anecdotal evidence suggests that some rating agencies have expressed frustration at the market's lack of appreciation of the granularity of ratings, i.e. that AA ought to be worth more than A. In practice, it seems that the market sometimes does not view ratings as that important at the finer levels of detail; firms are not bonds. For insurance firms, three levels seem important:

(1) AAA (or AA+): these levels are needed for the largest and/or most specialised transactions.
(2) A− and above: these levels are needed to write commercial business, particularly long-tailed, and reinsurance.
(3) Below A−: at these levels the insurer security is often considered marginal, and customer relationships are considered at risk.

2.3.23 It is necessary to distinguish between sufficient capital to maintain a specified rating level (e.g. AA) and having a high degree of confidence that the rating will stay AA over some given time horizon. In Section 2.2 we talked about the need for a firm to maintain a buffer over the regulatory minimum amount of capital. A similarly argument can be made when considering rating agency capital. Here a firm may want to maintain a buffer over the minimum level of capital required to attain a given credit rating, with the aim of reducing the probability of being rated below a desired threshold rating to an acceptable level. For example, a firm may decide that it is prepared to accept no greater than a 10% chance of being rated lower than AA over the next five years. In this case, the firm will want to hold a buffer over the minimum level of capital which it believes is required to achieve a AA rating.

2.4 *Strategic Views of Capital Requirement, based upon Shareholder Risk Appetite*

2.4.1 While VaR remains a widely used measure, regulators are showing increasing interest in TVaR as a risk measure, as mentioned in ¶2.3.15. Moreover, the risk appetite of shareholders will likely extend beyond VaR, as they will want to know the cost of protecting their franchise value.

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2.4.2 Consider, for example, the situation of the parent firm of a large multinational group. Following a significant loss to a subsidiary, the parent may choose to pay all claims which the subsidiary is unable to meet, in order to protect its global franchise value. In other words, it will want its customers around the world see it honour its long-term commitment by supporting individual territory business units in times of financial difficulty. From another point of view, if the group believes in the long-term future of the territory, and still sees the subsidiary to be a profitable venture in the long term, it may choose to recapitalise the subsidiary following an adverse scenario in order to take advantage of 'payback' conditions after a major loss. Such a group will be interested, not only in the frequency of insolvency, but also in the magnitude of any losses. For such a group, the primary focus will be on the TVaR. As an example, suppose that the group asserts to customers and regulators that it will keep sufficient capital in the subsidiaries to meet a one-in-500 TVaR level. Using the hypothetical lognormal firm in Appendix A, with a coefficient of variation of 17.5% and its capital invested in gilts, this would correspond to holding capital at slightly less than an A rating level (62.5% of premium in Table A.2, compared to 68.8% for an A rating).

2.4.3 It is interesting to consider what the different rare probabilities actually mean in practice. A 99.5% VaR risk tolerance over a one-year time horizon needs to be sufficient to fully protect against all but the 0.5% highest annual aggregate loss scenarios, regardless of whether these loss scenarios are dominated by one particularly large loss or by a combination of several smaller losses. Consider, for example, a hypothetical situation where there are two independent loss scenarios, each of which has a one-in-300 probability of occurring within the next year. These independent loss scenarios could come from different risk types, e.g. insurance risk, market or operational risk. The probability of one or other of these occurring within the next year is roughly one in 150. As such, the actual capital held would need to be sufficient to withstand a loss scenario of this magnitude, as it will fall within the 99.5% VaR measures. Some firms may fall into the trap of ignoring all scenarios which are estimated to have a probability of occurring of less than one in 200.

2.4.4 In the following illustration, we again take the example of the hypothetical lognormal firm in Appendix A, and assume that the CoV is 17.5%:

(1) The 99.5% VaR claim amount is 1,464.
(2) The 98.7% TVaR claim amount is also 1,464, i.e. a 98.7% TVaR is equal to a 99.5% VaR (see Table 2.7).
(3) The 99.5% TVaR over a one-year time horizon is 1,548.
(4) Capital is held at the ICA 99.5% VaR level of 464 (99.5% VaR claims less premiums of 1,000).
(5) The volatility of ultimate claims has been recognised, not just the volatility of the claims recognised over the next year.

2.4.5 In the absence of any parental desire to recapitalise the firm, policyholders are protected against all but the worst 0.5% of loss scenarios. If a loss, or a combination of losses, of this magnitude or greater does occur, the average loss to the firm will be 1,548; the 99.5% TVaR. The capital held by the firm will partially protect policyholders against this unusual claims experience, but the insurer will not be able fully to meet its obligations. On average, the firm will not be able to meet 84 claims (1,548 less 1,464). This gives an expected policyholder deficit of 0.5% * 84 = 4.2.

2.4.6 Now suppose that the insurer has a parent which acknowledges the cost to the parent's franchise value of a subsidiary failing. The parent may decide to pay all policyholders' claims which the subsidiary has been unable to meet. As the firm holds capital equivalent to a 99.5% VaR, the probability of this occurring is 0.5%. The average amount which will need to be paid when called upon is 84. Thus, the annual expected cost to the parent of meeting these unpaid claims is 0.5% * 84 = 4.2. This is the same as the expected policyholder deficit. Policyholders in this second situation have received full protection against the subsidiary defaulting. This should be compared with the scenario of Barings, where the losses in one part of the world brought down the parent. If this can occur, then policyholders do not receive 'full protection', just close to it.

2.4.7 Regulators can be concerned, not only with the likelihood of insurers being unable to meet claims, but also with the expected loss to policyholders when default does occur. They are also likely to consider the protection given to policyholders by any market wide compensation scheme protecting policyholders in the event of financial failure. In the absence of a parent company meeting the cost of a subsidiary's default, what level of protection do the policyholders really have? As discussed above, the policyholders will not have their claims met in full with a 0.5% probability, and, in these situations, the total policyholder loss will be, on average, 84. The capital of 464 held is equivalent to the 98.7% TVaR claim level less the 1,000 of premiums. Therefore, the average of the worst 1.3% of the losses will use up the whole of the firm's capital. In an efficient market, and assuming that investors are risk neutral, it should be possible for the firm to enter into an agreement where, if the loss exceeds the 98.7%-ile, the firm will pay a counterparty 84 and the counterparty will fully pay all policyholder claims. The expected amount of each party's obligation in any given year is 4.2 ($0.5\% \times 84$). In effect, with this level of capital (i.e. 464) the firm expects to pay only 98.7% of policyholder claims in the long run, and this might be described as being sufficient to protect against a one-in-75 loss scenario, significantly less than may be thought when looking at the 99.5% VaR — this is what we referred to as a 'TVaR return period' in Section 2.3. In practice, the regulator is likely to set the target so that the overall capital for the industry is about the same, but switching to TVaR is likely to produce higher capital requirements for insurers writing more volatile business.

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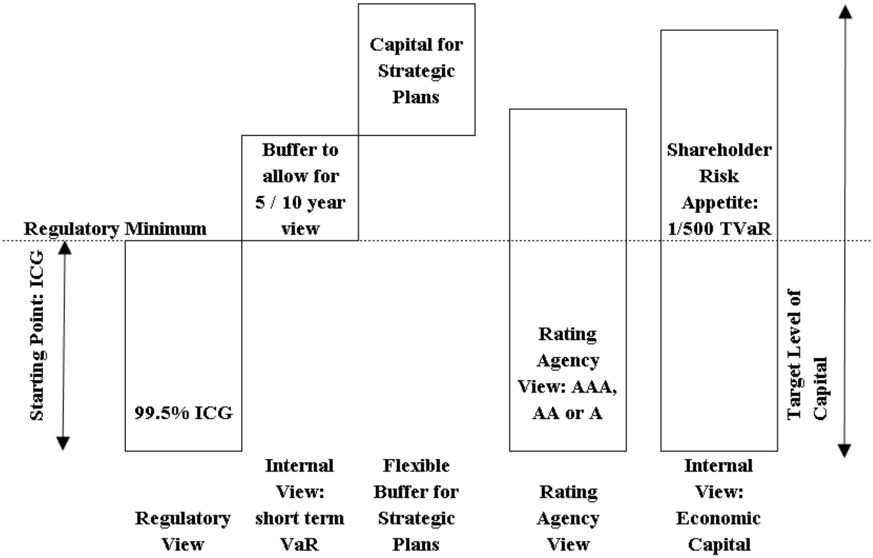

Figure 2.3. Comparison of capital options based upon three views of risk appetite

2.5 *Blending the Three Views of Capital Requirement*

2.5.1 There are many considerations for a firm to make when deciding on the level of capital to hold, and a trade off has to be made between some of the benefits gained from holding more capital against the increased cost of so doing.

2.5.2 The starting point is to consider, alongside each other, the views based upon the three different approaches to risk appetite discussed in Sections 2.2 to 2.4, i.e. regulatory capital plus a buffer, rating agency views, and the strategic/shareholders' view of risk appetite. These are summarised in Figure 2.3.

2.5.3 When deciding between holding higher and lower amounts of capital, the shareholders will also have regard to:

(1) risk reward trade offs; and
(2) the potential to maximise franchise value, and hence shareholder value.

2.6 *Communicating Risk Reward Trade Offs*

2.6.1 Figure 2.4 shows the trade off between increasing the security of the firm against the financial profitability, measured by the ROE, based on the example lognormal firm shown in Table A.4 of Appendix A. Increasing the capital in the firm increases the security, but reduces the ROE. This can

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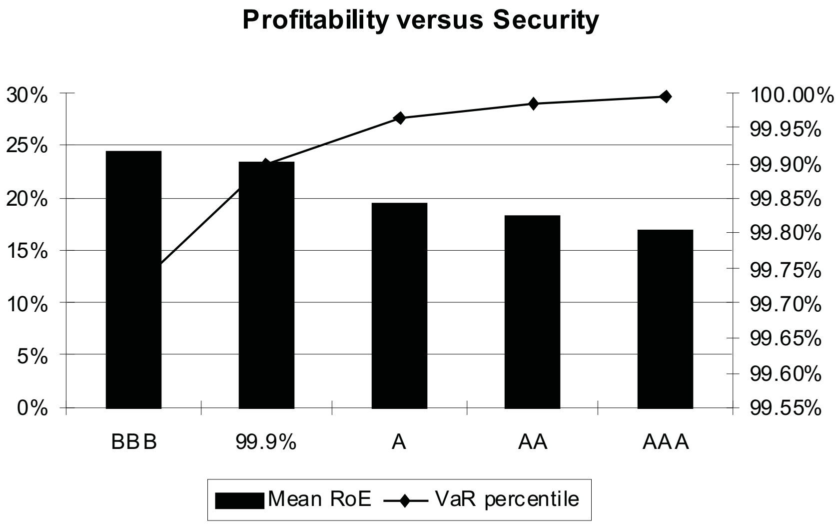

Figure 2.4. The trade off between capital and profitability of a firm

be thought of as the traditional actuarial approach to managing an insurance firm. Under this approach, the goal of management is likely to be to hold capital at a level which reduces the risk of default to an acceptable level and to maximise the expected return on equity, subject to the risk appetite of shareholders. In this example calculation, we have assumed that a higher rated firm has the same access to business, and can only charge the same prices, as a lower rated firm. If it were possible for market leaders to enjoy better policy terms, this should be factored in as well.

2.6.2 As we discuss in more detail in Section 3.9, the return achieved by a shareholder may be significantly different to the ROE, as the franchise value of the firm may result in the market value being different to the net asset value. Setting a target based on the ROE can be inappropriate unless the ROE target is calibrated to the required TSR target.

2.7 *Impact of Capital Ratios on the Cost of Capital*

2.7.1 When considering the impact on franchise value of different capital ratios, the firm needs to consider the consequences which follow from achieving a given credit rating.

2.7.2 A firm which increases its capital ratio may be able to achieve a higher credit rating. This may, in turn, give it access to more profitable markets and lucrative sources of business, including more complex deals or larger risks to which only firms of high credit ratings will be offered. This

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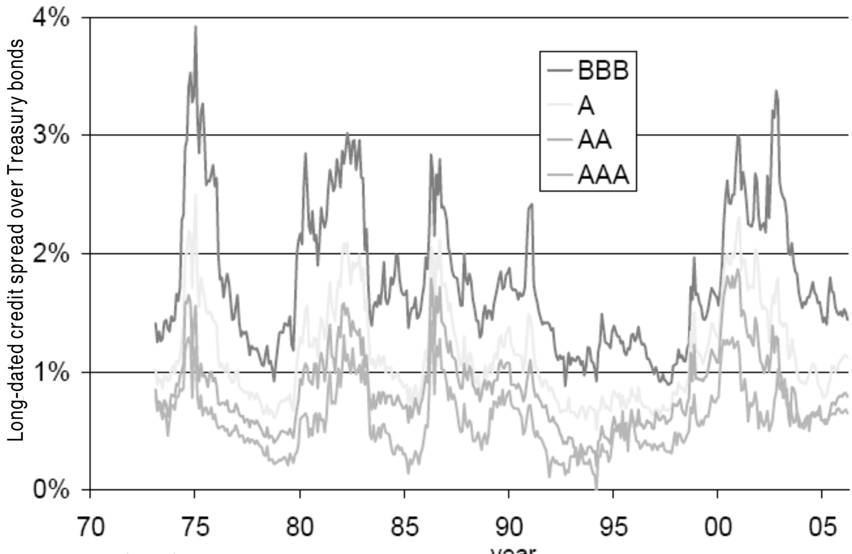
could potentially lead to the firm being able to increase its market share (but not so much as to reduce the rating again), and generate further profit. Furthermore, shareholders are likely to value the expected profit flows using a lower risk discount rate, as this is consistent with a firm which has a higher survival probability. This will, in turn, lead to a further increase in the net present value (NPV) (and therefore market value) of the firm, reflecting the reduced likelihood of an impairment of franchise value.

2.7.3 As can be seen from Figure 2.5, the historical spreads of each credit rating over Treasury bonds are very volatile. The credit spread at the time of valuation should be considered when choosing the discount rate to value future profit streams. The volatility of credit spreads may, therefore, lead to a volatile NPV (and hence market value) of a firm.

2.7.4 However, holding excess capital inside an insurance firm can be inefficient. Capital will generate tax liabilities to the insurer from the investment income generated from the capital itself, and to the shareholder from the dividends which the insurer distributes. This is known as the cost of double taxation. Increasing the capital base will also reduce the amount of leverage of the pure insurance activities of the firm, diluting the insurance earnings per unit of capital and leading to a lower ROE. Increasing the capital within the firm may also lead to an increase in agency costs. These factors will tend to cause investors to reduce the expected future earnings,



Source: Bloomberg

Figure 2.5. History of the long-dated credit spread over Treasury bonds

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and hence to reduce the NPV of the future profitability of the firm (and therefore reduce the market value).

2.7.5 Reducing a firm's capital has the reverse effect. That is, agency costs and the double taxation penalty are reduced, but this is offset against potentially more restricted underwriting and shareholders valuing the future profits expected to emerge less strongly, reflecting the firm's reduced survival probability.

2.7.6 Where capital held by a firm is excessive, a further increase in capital will not be beneficial. This is because the increased expense due to double taxation and agency costs will tend to exceed the benefits brought by holding the extra capital. In this case, for each extra £1 which shareholders put into the firm, the value of the firm is likely to increase by less than £1.

2.7.7 Where there is a shortfall of capital, a further reduction in capital, for example by increasing dividend payments or a share buyback, will also be detrimental to the shareholders. Loss of market share and the increased costs, because of the increase in the probability of financial distress and a risk of regulator intervention, will outweigh the benefits of reduced agency costs and double taxation penalties. In this case, withdrawing £1 of shareholders' equity from the firm would be expected to result in the market value of the firm falling by more than £1.

2.7.8 Increasing the capital of a firm will increase the financial strength of the firm, giving the policyholder additional security. The degree to which policyholders are willing to pay for this additional security will depend on the risk appetite of the policyholders and the degree of protection given by any compensation scheme protecting policyholders in the event of financial failure of the insurer. Where capital becomes excessive, the increase in frictional costs outweighs the additional benefits for which the policyholders are prepared to pay, together with the additional benefits recognised by the shareholders. Clearly, the optimum level of this capital will vary considerably from firm to firm, and will depend on many things, including the individual insurer's specific plans and strategy, together with the management's risk appetite and the market circumstances. In reality, it is unlikely that there will be a single optimum level of capital, but rather there is a band of appropriate capital levels for a firm to operate within. Within this band the frictional costs of raising additional, or distributing excess, capital are likely to exceed any benefit of so doing.

2.8 *Impact of Capital Ratios on Franchise Value*

2.8.1 Under the financial economics approach of maximising franchise value, the price of risk must be taken into account. In some circumstances it is important to consider the value of the limited liability put option of the firm — that is the option which the firm has to default on its liabilities in a situation in which the liabilities are greater than the assets. The value of this option becomes more significant at lower levels of capital, as the option is

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increasingly likely to be exercised as capital is reduced. However, if we assume that the firm is well managed and that regulatory minimum capital levels are set at an appropriate level, the value of this option is likely to be small (or negligible) when capital held is close to the optimal level of capital.

2.8.2 In Section 5 of Exley & Smith (2006), the authors give a detailed discussion of the sensitivity of franchise value to changes in tax, expenses and agency costs. A reduction in expenses, tax and agency costs will increase the optimal level of capital.

2.8.3 Figure 2.6 illustrates how the franchise value of a firm may change as the level of capital is varied. The optimal level of capital is that which maximises the shareholder value. At moderate to high levels of capital the value of the limited liability put option of the firm is likely to be negligible. However, at very low levels of capital the value of this option may become significant. Where capital is 'negative' and the firm is technically insolvent, the option is 'in the money', and its value can be become very significant. Where capital held is excessive, high frictional costs lead to a reduction in the franchise value.

2.8.4 Franchise value is maximised when the marginal cost of holding additional capital equals the marginal increase in benefits given by the additional capital. In practice, it can be difficult to determine this point with any level of precision.

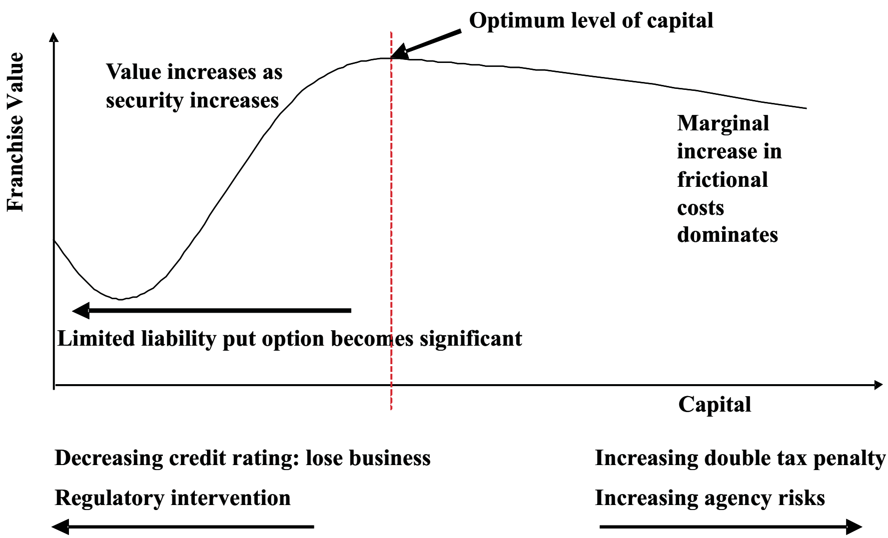

Figure 2.6. Effect of capital levels on franchise value

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2.9 *The Impact of the Insurance Underwriting Cycle*

2.9.1 In deciding on the optimum level of capital, management should consider the effects of the insurance cycle and possible changes in the cost of raising capital throughout the cycle. It may be that capital can be raised most cheaply when the capital base is already strong and is least needed. The optimum level of capital which a firm chooses to hold is therefore likely to vary through the insurance cycle. Some firms may be prepared to make an underwriting loss at a low point in the cycle, in the hope that, over the whole cycle, underwriting will be profitable. Low barriers to entry to the insurance market accentuate the cycle, resulting in greater fluctuation in the loss-ratio experience. In the past, following periods of poor loss experience for the market as a whole, capital bases have become tight, insurers have become more selective of risks which they write and premium rates have risen. As the premium rates harden, capital bases should again strengthen, and the cost of raising new capital is likely to fall.

2.9.2 Some firms may be prepared to write business at loss making rates during a soft market, accepting that this will temporally weaken their capital base. In so doing, they hope that they will retain their customer base, and that, over the whole cycle, underwriting will be profitable.

2.10 *Summary and Conclusions for setting the Amount of Target Capital*

2.10.1 Whatever level of capital the firm elects to hold, it is important that it is able to articulate this decision to shareholders, regulators and rating agencies. Management should also have an appreciation of the optimum band for their firm. Presenting the options to management using diagrams similar to Figures 2.3 to 2.5 may help to communicate the trade off which has to be made between the benefits of extra capital against the increased costs.

2.10.2 To a financial economist, the goal for management is likely to be to maximise the franchise value of the firm, and, in so doing, to maximise the share price. This contrasts with the traditional actuarial approach, where the goal of management is often seen as maximising the expected return, subject to an acceptable level of risk. These two different approaches need to be blended when determining the optimal level of capital.

2.10.3 Today many firms are relying much less on the factor-based rules of thumb mentioned in ¶2.1.4. Management is likely to consider carefully the appropriate risk measure for its firm, regulatory requirements, the views of rating agencies, its strategic objectives and, increasingly, target capital, before deciding on the appropriate level of capital for its firm, which will depend on the specific risk profile of its business.

3. Cost of Capital — Framing the Question

3.1 *What do we Mean by Cost of Capital?*

3.1.1 The logic goes something like this: we need to have a target,

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perhaps one of many, by which to manage the business, and opportunity cost makes good economic sense for this purpose. How might we assess what this opportunity cost is? A popular approach is to use past achieved returns in analogous situations as a guide.

3.1.2 We cannot regard cost of capital as a fact in the same way as we can regard a return on, say, a government stock as a fact. It should be regarded more as a guide and a judgement, based upon the available market data.

3.1.3 There is always great danger in assuming that past history, such as achieved returns on investment, can be projected into the future. In particular, observers should be aware that a large part of returns on shares over recent years may be attributable to a change in price level from the start to the end of the period being considered.

3.2 *The Many Tasks of Cost of Capital*

The cost of capital can be asked to do many things at once:

(1) represent both an opportunity cost and a hurdle rate;
(2) be used in an NPV calculation to discount future earnings streams, in a way which reflects the degree of risk involved;
(3) reflect expected outcomes and potential variability in a manner which is 'market consistent' and/or 'risk neutral' (these terms will be explained at the appropriate parts of Section 3); and
(4) bear an appropriate relationship to the ROE, the RORAC and the IRR.

In this section we discuss all of the above potential functions, and link them together in the context of a general insurance firm.

3.3 *Opportunity Cost of Alternative Investments*

3.3.1 The investor putting his capital into the general insurance firm expects a return commensurate with the risk to which the capital is exposed. He will have regard to:

(1) the relative risks and returns on alternative investments, such as gilts, bonds or shares in businesses other than general insurance; and
(2) the impact which the insurance firm has on the rest of his portfolio, i.e. the extent to which it correlates with, or diversifies against, a broad spread of other investments.

3.3.2 The traditional CAPM hypothesis is that market prices are such that:

$$\text{Expected return on an asset} = \text{Risk-free rate} + \text{beta} * (\text{Market return} - \text{Risk free rate})$$

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and from this is deduced:

Cost of capital = Risk-free rate + beta * (Market return − Risk free rate).

3.3.3 We should note that there is a distinction between what we might call the external return and the internal return. The rate of return to an investor in a firm over a period, being a function of its market prices at the beginning and the end of the period and cash distributed during the period, is not the same as the rate of return generated within the firm. In normal conditions, the return to the investor (even before taking account of the investor's own tax position) will be the lower of the two by virtue of the tax suffered within the firm. Also, if the firm is able to earn high rates of return on invested capital, the stock market value of the firm may be bid up to be higher than the invested capital, which would lower the expected external return.

3.3.4 Generally, in this paper, when we discuss returns, our starting point is that of someone who is valuing the firm's internal flow of future earnings. His choice of parameters must be consistent, in some way, with the external returns expected by investors in the external markets. Our discussion attempts to explain this relationship.

3.3.5 The underlying rationale for the CAPM is that expected rates of return on assets traded in frictionless and informationally efficient capital markets are sufficient to compensate investors for the time value of money at the default-risk-free rate of interest plus a risk premium to compensate investors for bearing systematic market risk. It is important to understand the financial economics theory of systematic market risk and the rewards for taking it. Technically it is a one-year model, but it is often extrapolated to multi-year periods; for the purposes of this paper, it is the spirit behind the model which is important.

3.3.6 The core of the problem is the fundamental uncertainty in returns from shares over time. Markets generally rise and fall together, sometimes dramatically, and whilst there have been long periods of high returns compared to the risk-free rate, it is quite conceivable that there will be long periods of low or negative returns in the future. Periods of good economic performance can lead to high share price levels, and an ever-present fear for investors is of entry into the market at a high price level, which is then followed by a period of falling profits and share prices. Furthermore, a time of falling profits and share prices is precisely the time at which an investor is more likely to be a distressed seller.

3.3.7 The longer the investor's timescale, the less he will fear periods of poor share performance. An example of an investor with a long timescale might be a university foundation which only spends half the dividends which it receives; the important point is not to need to realise the investments at any time in the near future. However, most investors are not in this position,

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and the fear of losing money in the short to medium term is the conventional reason why share prices are generally such as to give a significantly higher expected return than risk-free investments.

3.3.8 The next stage in the theory about how markets perform is to realise that there are some companies which have a more than average exposure to the general state of the economy and some which have less. For example, we would expect companies producing capital goods to be more risky in this sense and utilities less so. The original CAPM assumed that this continuum of risk exists, and is demonstrated by the extent to which each firm's share price tends to move in line with, or is correlated with, share prices generally. This correlation is typically measured over relatively short time scales, but the conclusions are typically assumed to apply to the market's expectations for the return on each share over the longer term.

3.3.9 The Fama-French three-factor model (hereinafter called the FF3F model) was developed in response to the criticism that the CAPM tends to give inaccurate estimates of the cost of capital (or expected return) because it omits important financial risk factors. The FF3F model retains the CAPM's single factor for systematic market risk, and adds factors to capture the effects of firm size (defined in terms of total market capitalisation) and the ratio of the book value of equity (BV) to the market value of equity (MV). The former factor controls for the 'small firm effect,' i.e. the observation that the cost of capital is inversely related to firm size. Some commentators explain that the BV to MV ratio reflects financial distress, with financially vulnerable firms having higher values of this ratio than stronger firms. This factor controls for the tendency of investors to require higher expected returns on shares in financially vulnerable firms, since these firms will perform particularly poorly exactly when individual investors' portfolios are experiencing overall losses. The paper 'New facts in finance' by Cochrane (1999) explains this in more detail, and justifies it by calibration against U.S. stock market data, quoting a variety of studies undertaken in the mid 1990s.

3.3.10 The financial economist approach to the world is to try to understand what 'is' in terms of how markets perform. They look for measures to be 'market consistent'. The traditional actuarial approach to the world is to try to think about what 'will be' when deciding how to tackle long-term financial decisions. Since prices in markets are the combined effect of different people's different needs and preferences, it is entirely plausible that each sector of the market will be priced attractively to some people and unattractively to others. So, for an investor who has a very long time scale, and who is simply concerned with maximising wealth at some distant point, buying shares would normally seem to be a sensible decision. For an investor concerned with retirement five years hence, the potential for shares to give a poor or disastrous performance over a five to ten-year period will render them less attractive, and will push up the relative price which he will be prepared to pay for medium-term fixed interest stocks. The financial economist will say: "Yes, I agree, and this all helps to explain prices today." He will not disagree that the long-horizon investor is doing the right thing, but he will remind the investor that his expected return will accrue over time, and will be subject to considerable risks over that period.

3.3.11 All of this might then lead on to the question: "What should the management of an insurer be trying to achieve in terms of shareholders' returns?" The traditional investor's view would be to get the best return from the opportunities available, bearing in mind the opportunity costs to the investors. This will lead to a heavy emphasis on building franchise value, which is very closely linked to the ability to employ capital profitably in the future. The actuary advising the firm needs to ensure that, when valuing different future flows of earnings, he puts a price on the risk in those earnings which is consistent with market prices.

3.4 *Market Consistent/Risk Neutral Discount Rates*

3.4.1 Consider an investor with £2bn to invest, who is choosing whether to invest in gilts, bonds or shares. For simplicity sake, suppose that each option offers an income in perpetuity, with a variety of running yields, as shown in Table 3.1. Remembering that the value of a perpetuity is $(1/(1+i) + 1/(1+i)^2 + 1/(1+i)^3 + \text{to infinity}) = 1/i$, the investor will value each stream of income as in Table 3.1 (the value of the asset is equal to the value of the annual income multiplied by the 'value of perpetuity' or the perpetuity factor).

3.4.2 Each income stream has a different amount of financial market risk, and, in order to arrive at the market price of the asset, the investor has to discount each stream at a different rate. The term 'risk-neutral' means adjusted for risk, as reflected in market prices, as shown in Table 3.2.

3.4.3 Suppose that the investor now puts £2bn worth of gilts as capital into an insurance firm. In this section we make the simplifying assumption that this is done at a price/book value (PBV) of 1.0. Later, in Section 3.9, we examine the case of a price/book value greater than 1.0.

3.4.4 Remembering the principles discussed above, we have two possible ways of thinking about the value generated by an insurance business and how

Table 3.1. Invest £2bn in the stock market

Asset	Yield	Income p.a.	Value of perpetuity	Value of asset
Gilts	5%	£100m	100/5% = 20.0	£2,000m
AAA bonds	5.5%	£110m	100/5.5% = 18.2	£2,000m
AA bonds	5.75%	£115m	100/5.75% = 17.4	£2,000m
A bonds	6.25%	£125m	100/6.25% = 16.0	£2,000m
BBB bonds	6.75%	£135m	100/6.75% = 14.8	£2,000m
Shares	9%	£180m	100/9% = 11.1	£2,000m

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Table 3.2. Market price for risk discount rates

	Risk free rate				Risk discount rate
Risk free rate	5%	+	0%	=	5%
AAA: (1/10,000 default)	5%	+	0.5%	=	5.5%
AA: (1/3,000 default)	5%	+	0.75%	=	5.75%
A: (1/1,000 default)	5%	+	1.25%	=	6.25%
BBB: (1/200 default)	5%	+	1.75%	=	6.75%
Basket of shares	5%	+	4%	=	9%

it should be managed. We can consider the market consistent price today of the firm and of its component parts, or we can consider the total future return. In either case we have to start with the investor's opportunity costs.

3.4.5 The opportunity cost relates to what the investor would otherwise have done with the money. As an investor will view an insurance firm as an equity share, it is reasonable to assume that he will want to compare the firm with other shares in his portfolio on a like-for-like basis. We should remember how easy it is to lose capital quickly in the insurance business; the investor will want to be compensated for this risk.

3.4.6 The next question is how the shareholders' funds in the insurance firm are to be invested. Investment in shares produces higher expected returns than investment in gilts, but exposes the investor to greater risks. Moreover, to give policyholders sufficient protection, investment in shares rather than in gilts means that the level of capital in the firm has to be higher in relation to business volumes. So, a more prudent investment strategy than 100% in shares will have to be followed.

3.4.7 Remember also that, as well as investing shareholders' funds, one can think of an insurance firm as a geared investment trust, investing money 'borrowed' from policyholders in return for paying their contingent claims. So, if all shareholders' funds were invested in shares, then, even if investments are also held to broadly match the term and type of the policyholder liabilities, the shareholders would still seek an overall return in excess of that on their underlying funds. This is due to double taxation, agency costs and parameter uncertainty risk, which can make insolvency, and hence loss of franchise value, have a higher probability. Some insurance risk is also correlated to investment markets, and so 'diversifiability' arguments are weakened. In summary, totally diversifiable risks do not receive an additional return, but they are rare in practice.

3.4.8 We will therefore assume that the opportunity cost to the investor is the general market return on shares, and will start with our firm investing its shareholder capital entirely in risk-free investments, i.e. gilts. Will the reduction in investment return on the subscribed capital be made up elsewhere?

3.4.9 Suppose that the insurance firm has a solvency ratio of 67% and

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Table 3.3. Invest £2bn in an insurance firm (PBV = 1.0)

	Earnings from investment of capital	Earnings from insurance operations	Total net income
Option 1: invest £2bn in gilts (yield 5%)			
Investment income	£100m		
Income tax	(£30m)		
Net income	£70m		£70m
Option 2: invest £2bn in shares (yield 9%)			
Investment income	£180m		
Income tax	(£54m)		
Net income	£126m		£126m
Option 3: invest £2bn of gilts in insurance firm capital (PBV = 1.0) Solvency ratio 67%, premiums £3bn, profit margin 7.5%			
Income/profit	£100m	£225m	
Corporation tax (30%)	(£30m)	(£68m)	
Firm net	£70m	£158m	
Dividend tax (30%)	(£21m)	(£47m)	
Net income	£49m	£110m	£159m

writes £3bn of premium, by taking a 7.5% market share of a £40bn market which returns pre-tax insurance profits after expenses of 7.5% of premium. Then the value equation is as set out in Table 3.3.

3.4.10 The investor will ask whether the exercise has been worthwhile. He has exposed his capital to insurance risk, effectively paid tax twice on the investment income on the capital held in the insurance firm, but gained extra income from the insurance operations. The risk from these income streams must be compared on a market consistent basis, and we now discuss the general principles to consider.

3.5 *Separating Investment Risk from Insurance Risk; the Replicating Portfolio*

3.5.1 It is very convenient to separate the balance sheet of an insurance firm between the investment and insurance operations, by introducing the use of the so-called replicating portfolio. This is described extensively in Swiss Re *sigma* No3/2005, and is shown in Figure 3.1.

3.5.2 The replicating portfolio represents the portfolio of assets which most closely matches the cash flows of the insurance liabilities in terms of type and term:

(1) For those liabilities whose cash flows are closely related to returns on financial market risks, e.g. claims awards linked directly to RPI, the replicating portfolio is a set of index-link gilts matched against the date of the expected claim payments.

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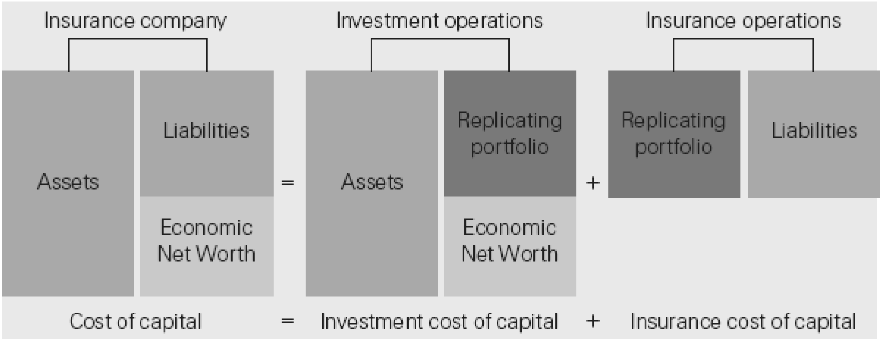

Figure 3.1. Breakdown of an insurance balance sheet
(reproduced from Swiss Re *sigma* No3/2005)

(2) For those liabilities whose cash flows are largely independent of financial market risks, e.g. hurricane claims, the ideal replicating portfolio is the traditional 'immunisation'/'matching' portfolio, i.e. a bundle of zero coupon government instruments which mature with the same expected profile over future years and have the same currency mix as the liabilities.

(3) For those liabilities whose cash flows are partially linked to financial market risks, the replicating portfolio is inevitably a compromise. For example, for a portfolio of motor insurance claims, with claims linked to social inflation plus earnings inflation, it may only be possible to match partially with index-linked gilts. In addition, given the redemption profile of the index-linked gilts in issue, it may not be easy to construct a portfolio with a mean term appropriate to the liability cash flows. This problem is made harder by the potential impact of the Courts Act, and is harder, yet again, for excess of loss reinsurers.

(4) If a set of assets with the exact payment profile needed is not available, it may be necessary to 'mark to model'. For example, if the liability cash flows have a term much longer than the government bonds in issue, it may be necessary to extrapolate the yield curve to estimate the value of the equivalent matching asset.

3.5.3 The replicating portfolio serves many purposes:

(1) It puts a value on the firm's liabilities which is consistent with market prices. Traditionally, actuaries would put a value on the firm's liabilities, and then work hard to value the firm's assets on a consistent basis. With the replicating portfolio approach, the actuary starts by marking the assets to market prices, and then ensures that the liabilities are valued consistently with the assets. This is equivalent to

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discounting at market consistent risk discount rates which take inflation and other market linked variables into account. However, there is still uncertainty remaining about the amount and timing of the nominal cash flows.

(2) It is well understood that, if assets are matched on a cash flow basis to the liabilities, and the liabilities are discounted, the risk of adverse impact on net asset values from movements in interest rates is much reduced. The replicating portfolio achieves the same for liabilities with significant financial market risk.

(3) Whether or not the assets actually are invested in the theoretical replicating portfolio, the concept effectively removes financial market risk from the assessment of the expected return on the liabilities.

(4) For items under (3) in ¶3.5.2, it is important to evaluate the residual amount of financial market risk in the liabilities after the application of the optimum matching replicating portfolio. Typically, these are long-tail liability claims, where reserves can amount to a multiple of surplus capital. If, for example, the residual (unmatched) financial market risk is, say, 20% of liabilities, and liabilities amount to three times capital, then this risk will be significant in relation to the capital, and will tend to correlate with the investment risk of the capital itself, i.e. it will gear up the firm's financial market risk.

(5) It is also convenient to allocate to the insurance operations the actual return on the replicating portfolio, as this is closely matched to the characteristics of the underlying insurance liabilities. The return on the replicating portfolio is the investment return which the firm would receive if it chose to minimise its investment risk, and then any extra return which the firm receives as a result of taking extra investment risks accrues to the investment operations of the firm.

3.6 *Cost of Capital equals Investment Cost of Capital plus Insurance Cost of Capital*

3.6.1 Having split the firm's balance sheet into two parts, as described in Section 3.5, it is easier to assess the cost of capital drivers for the two components separately.

3.6.2 The investment cost of capital depends on the riskiness of the investment portfolio selected, and shareholders can adjust their required return, or cost of capital, as a function of the investment risk assumed.

3.6.3 When a shareholder invests his capital in an insurance firm rather than directly in the investment markets, then, as well as tax costs, he takes on extra risks from the insurance operations. The opportunity costs which he assumes are known as frictional capital costs, which are shown in Figure 3.2.

(1) *Costs of financial distress. In extremis*, this refers to the costs of bankruptcy; less extreme, but still important, are the costs of lost customers or more difficult supplier relationships if the firm gets into

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Driver		Frictional capital cost
Corporation tax paid by the insurance firm	→	Double taxation penalty
Franchise value, capital adequacy	→	Costs of financial distress
Transparency, reputations, incentives	→	Agency, uncertainty costs
Regulatory restrictions on capital	→	Illiquidity costs

Figure 3.2. Drivers of frictional capital costs
(based upon a diagram from Swiss Re *sigma* No3/2005)

financial difficulties. The particular application for insurance firms is their insurance strength rating, as this can influence their market position, the views of customers and regulators, and their franchise value.

(2) *Agency costs.* Typically, these arise because of divergent management-shareholder objectives and information asymmetry. For example, managers have only one job, and they might prefer to diversify the firm's activities across many different business segments, whereas the shareholders might believe that they are better placed to diversify their own exposures themselves by buying shares in firms which are specialists in the different segments. Managers of the firm might know more detail than the shareholders about the core risks which the firm is bearing, such as the exact assumptions which they have made with regard to the future cost of catastrophe claims or court awards. Also, it is difficult for investors to judge the accuracy of loss reserve estimates, creating an information asymmetry which may raise the cost of capital.

(3) *Cost of illiquidity due to regulatory restrictions on capital.* Sometimes putting the investor's capital into an insurance firm exposes it to restrictions from regulators; for example, it may not be readily movable from one territory to another, or the level of capital may not be allowed to drop below a minimum, even when the firm believes that the true economic requirement has decreased. Once the capital is inside the insurance firm, it may be difficult for the investor to release it swiftly if he wishes to rearrange his investment portfolio, and there will be high transaction costs on selling. These are frictional costs for which the investor needs to be compensated.

We describe these in more detail and attempt to estimate their impact on the risk discount rate in Section 5.

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3.6.4 Sometimes the split:

$$\text{Cost of capital} = \text{Investment cost of capital} + \text{Insurance cost of capital}$$

is re-expressed as:

$$\text{Cost of capital} = \text{Base cost of capital} + \text{Frictional cost of capital}.$$

3.7 *Diversifiable versus Non-Diversifiable Risks*

3.7.1 We think of the market's current risk discount rate as the risk-free rate plus an uplift for uncertainty. It is important to distinguish between several sources of risk and/or uncertainty:

(1) variability about the mean, arising from volatility in the financial outcome which is correlated with other returns in financial markets;
(2) variability about the mean, arising from volatility in the financial outcome which is independent of other returns in the financial markets; and
(3) fundamental uncertainties which are special to the insurance business, such as the fact that we do not know the mean cost of natural catastrophe or future legally driven claims. As a result, there is an extra dimension of uncertainty, which we call parameter or model uncertainty.

3.7.2 The financial markets set the price for risks arising under item (1). In general, in an original CAPM world, any reward for pure process risk under item (2) would be competed away, and the financial markets give no long-term reward for bearing this risk. However, sometimes the process risk of insurance is so large (e.g. the cost of hurricanes and global warming, the cost of U.S. asbestos and environmental claims) that there is doubt in the investor's mind as to whether the forecast mean is correctly set, and he may need an increased risk discount rate for the parameter or model uncertainty. This is similar to some of the items generally included under the heading of agency costs, but we believe that it is so important to the valuation of insurance firms that it justifies a special heading. We discuss this in more detail in Section 5.

3.8 *Two Types of Risk Discount Rate — Realistic Balance Sheet versus Market Consistent Embedded Value*

3.8.1 In current parlance, the term 'risk discount rate' can have meanings apparently similar to 'cost of capital'. It is important to distinguish between two different potential usages of the term 'risk discount rate':

(1) One usage is to value liability cash flows at a point in time. If it is possible to find exactly hedging assets to put in the replicating portfolio, the value of the liabilities is assessed by 'marking to market' at the value of the corresponding assets. If it is only possible to find assets

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which approximately hedge the liabilities, it is necessary to value the liabilities by 'marking to model'. For example, if the liabilities have a longer duration than the available assets in that territory, it is necessary to extrapolate the known yield curve. The risk discount rate is the current market yield on the replicating portfolio, and will vary between different categories of liability, according as they have different financial market characteristics. This corresponds to the realistic balance sheet approach of life insurance practice.

(2) The other usage is to value a flow of future shareholder earnings. For example, suppose that the liabilities are stated in the balance sheet at a value higher than the best estimate discounted at the return on the optimum replicating portfolio. This can arise in U.S. GAAP if reserves are undiscounted, or in Solvency II and/or IFRS if there is a risk margin in the technical provisions, irrespective of whether it is based on a cost of capital or on a percentile approach. The release of the risk margin over future periods is valued according to the principles of a market consistent embedded value:
   (a) If liabilities are paid out exactly as forecast in the best estimate, the increase in the discounted value of the liabilities (the 'unwind of the discount') is exactly offset by investment income allocated from the replicating portfolio.
   (b) The contribution to the insurance technical result is therefore zero, and the result in the profit and loss account is the partial release of the risk margin, plus the investment return on the opening risk margin and the allocated capital.
   (c) This stream of earnings must be valued at the firm's appropriate cost of capital, i.e. reflecting the investment cost of capital of the surplus assets plus the frictional costs of capital arising from the insurance operations.

3.8.2 Thus, when you see the term 'risk discount rate', you need to determine which purpose it is being used for:

(1) When being used for discounting liabilities, it reflects only the financial market characteristics of the liabilities themselves. It is based on the most suitable hedging/matching assets for the liabilities in question. We suggest that it should include the use of risk-free rates to value liabilities which are completely independent of financial markets.

(2) When being used for valuing future streams of earnings, it reflects the financial circumstances of the whole firm. This includes the financial market characteristics of the surplus assets, the financial market characteristics of the technical assets if they are invested differently from the replicating portfolio, the frictional costs of the firm's insurance operations, and the firm's credit rating. This usage is consistent with the phrase 'cost of capital' which is being discussed in this paper.

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3.8.3 It should be noted that, when discounting liabilities in order to value them at a point in time, any allowance for risk will reduce the discount rate (not increase it), and hence increase the cost of the liabilities; but, when valuing a stream of future earnings, the allowance for risk will increase the discount rate, thus reducing the present value of the earnings from a riskier line of business. It is also interesting to note that the risk discount rate for valuing liabilities, apart from judgements required when marking to model, depends only on the liabilities being valued, and is therefore largely independent of the specific circumstances of the firm. This allows for consistency of reporting in financial statements.

3.9 *Internal versus External Rates of Return — ROE versus TSR*

3.9.1 It is necessary to take account of the fact that the shareholder's investment in the firm is not the same as the equity/surplus capital, because of the franchise value. The previous discussions have been based upon assessing a required cost of capital by comparison with alternative investments of comparable risk. This is an external rate of return, to be expressed as a percentage of TSR (total shareholder return). For operational purposes, such as setting performance targets or profit loads, it needs to be made consistent with an internal rate of return, such as IRR or ROE.

3.9.2 In Section 3.5 we discussed the investor putting £2bn into an insurance firm on a price/book ratio of 1.0. In practice, the shareholders own, not only the current net asset value of the firm, but also the future earnings, and the investor must pay a price for these. If he pays £2bn for his stake in the firm at a PBV of 1.25, his £2bn translates into being able to inject capital into the firm of £1.6bn, or else owning a proportion of the firm which translates into £1.6bn of capital in the firm. At a 67% solvency ratio, this allows the firm to write £2.4bn of premiums. This is shown in Table 3.4.

3.9.3 As before, the double taxation penalty is outweighed by the extra income from the insurance operations, but the income stream from the investment in gilts is risk free, the income from shares is subject to overall stock market risk, and the net income from the insurance firm is subject to the risks discussed in Sections 3.5 to 3.8. The risk from these income streams must be compared on a market consistent basis, and we consider this in detail in Section 5. This example assumes that all of the earnings are paid out in dividends, which means, therefore, that the maximum double taxation penalty is realised, i.e. the worst case situation is shown.

3.9.4 The total stock market value of firm (TMV) comprises two parts:

(1) *The net asset value* (*NAV*)

The stated accounting value of the liabilities might exceed the true (discounted) best estimate value, for example if using undiscounted reserves for U.S. GAAP, or if using an explicit risk margin/market value margin for Solvency II and/or IFRS. In this case, for the purposes

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Table 3.4. Invest £2bn in an insurance firm (PBV = 1.25)

	Earnings from investment of capital	Earnings from insurance operations	Total net income
Option 1: invest £2bn in gilts (yield 5%)			
Investment income	£100m		
Income tax (30%)	(£30m)		
Net income	£70m		£70m
Option 2: invest £2bn in shares (yield 9%)			
Investment income	£180m		
Income tax (30%)	(£54m)		
Net income	£126m		£126m
Option 3: invest £2bn of gilts in insurance firm capital (PBV = 1.25) Solvency ratio 67%, premiums £1.6bn, premiums £2.4bn, profit margin 7.5%			
Income/profit	£80m	£180m	
Corporation tax (30%)	(£24m)	(£54m)	
Firm net	£56m	£126m	
Dividend tax (30%)	(£16.8m)	(£37.8m)	
Net income	£39.2m	£88.2m	£127.4m

of assessing target capital, it is necessary to use the market consistent embedded value (MCEV). This includes the NPV of the release over time of the excess of carried book reserves over the true best estimate, using the appropriate cost of capital.

(2) *The franchise value* (*FV*)
This is the NPV of future profits, partly from the MCEV and partly generated by new business. It is obtained by subtraction: TMV less NAV.

3.9.5 The return definitions are expressed as:

$$\text{Return} = (\text{Value at end of period} - \text{Value at start of period} + \text{Cash flows}) / (\text{Starting investment}).$$

The TSR and the ROE definitions are then as follows:

(1) TSR = (ending share valuation − starting share valuation + dividends − rights issues)/(starting share valuation).
(2) ROE = (ending equity + dividends − starting equity)/(starting equity), where equity equals assets minus accounting liabilities.

Alternatively, the ROE can also be expressed as:

(3) ROE = (premiums − claims − expenses + investment income)/ starting equity.

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3.9.6 There is no mathematical or other reason why these two measures of return should produce the same number, even when averaged over long periods of time. For example, there is no theorem which says that maximising the ROE will necessarily maximise the TSR.

3.9.7 Businesses use many measures of return. Some are based on market values, others are based on accounting values. Traditionally, the ROE in the above formulae has been based on accounting regimes such as U.S. GAAP or IFRS (before or after fair value). To be consistent with target capital considerations, it needs to be defined in terms of economic values of liabilities and reinsurance recoverables, and market values for financial assets.

3.9.8 We have explained previously that return on capital and return on market value mean different things. In addition, there are two other phrases in common use where the numerator and the denominator need care in definition: RORAC (return on risk adjusted capital); and RAROC (risk adjusted return on capital):

(1) The capital item 'C' should be chosen after the considerations of target capital arising from the discussion in Section 2. It is then risk adjusted for the insurance risk circumstances of the firm.
(2) The return item 'R' should be chosen after the considerations of cost of capital arising from the discussions in Sections 3 and 5. It is then risk adjusted for the financial market risk circumstances of the firm.

3.10 *Setting Target Rates of Return*

3.10.1 When comparing profit targets with the cost of capital estimates in practice, we often see ROE targets more than ten percentage points greater than the cost of capital, for the following reasons:

(1) In the absence of capital constraints, each business unit has to earn at least its cost of capital at the margin (Swiss Re *sigma* 3/05, page 6).
(2) For value maximisation where available capital is limited, projects which are economically viable have to be rejected because the firm does not have enough capital to invest.
(3) Sometimes the accounting equity figure used for performance purposes may underestimate the economic measure of equity (market consistent value of assets less market consistent value of liabilities) on which the cost of capital is estimated.

3.10.2 Value-based management starts with a hypothesis that shareholder interests are represented by a target return, according to a particular return definition. Shareholder value is deemed to have been created if the target return is exceeded. The value created is the experienced return minus the target return. The target is sometimes called the cost of capital. In that case, the value created is the return experienced minus the cost of capital, and this is often called economic profit.

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3.10.3 Targets may sometimes be derived from the mean of a distribution of peer group companies. As the most complete historic data, and the largest literature, usually relate to total shareholder returns, these are often used as a starting point for targets, sometimes with adjustment to reflect different return definitions being used for performance measurement in future. Further adjustment may be required to historic data to include or to exclude failed companies. The target may be expressed as a function of contemporaneous market moves rather than as a number fixed at the start of a period. As with any performance target, capital providers may wish to stretch the target upwards to encourage greater effort, and managers could seek a lower target so as to improve their chance of beating it.

3.10.4 A final use of return calculations is the valuation, either of companies or of balance sheet items. Experienced returns depend on the initial valuations, so, conversely, we can consider what valuation allows for a specified future return to emerge.

3.11 *Multi-Year Views and the Role of the Insurance Cycle*

3.11.1 The underwriting cycle or insurance cycle is often debated: does it exist; should it exist; is it rational compared to stock market theories? If you assume that it will continue, there are two main views on factoring it into return targets and cost of capital:

(1) One approach tries to take the long-term point of view. It will estimate capital and return targets suitable for use across the average of the whole cycle. It will assess the individual performances of business segments as: economic value added at good parts of the cycle; and economic value destroyed at poor parts of the cycle. It will then assess 'projects', e.g. returns from specific product lines and territories, e.g. lifetime values of customer segments, on a longer-term basis than one year, but using a baseline which does not vary from year to year. It might steer its business in the shorter term by setting near term targets as, say, a higher than average rate of return target applied to the long-term capital requirement.

(2) The other approach would be to reassess both capital requirements and target returns from year to year, as external market circumstances change.

3.11.2 Each approach represents a way for the firm to take opportunistic advantage of imbalances in supply and demand.

4. Cost of Capital — Top Down Approaches and Empirical Evidence from Stock Market Studies

4.1 *Cost of Capital at Firm Total Level in Financial Economic Context*

In this section, we examine the evidence from actual stock market data.

Two recent papers which present cost of capital results for general insurance firms are Swiss Re s*igma* No3/2005 ('Insurers' cost of capital and economic value creation') and Cummins & Phillips (2005) ('Estimating the Cost of Equity Capital for Property-Liability Insurers'), in the *Journal of Risk and Insurance*, research which was conducted on behalf of the CAS Risk Premium Project.

4.2 *Key Findings — Swiss Re* sigma *No3/2005*

4.2.1 This study was based on an empirical analysis of a set of 27 traded U.S. P&C companies for the period 1997 to 2002. Their approach was to consider the ratio of market capitalisation to economic net assets, called an economic price/book ratio, and examine how it varies with risk factors, such as the companies' insurance riskiness and their investment riskiness. The price/book ratio is taken as a proxy for value creation potential (i.e. investors will pay more than economic net assets only if they think that the firm has good prospects). A firm which earns a return which is higher than the cost of its capital has a high price/book ratio, and vice versa for one which earns a return which is lower than its cost of capital. Economic net assets are defined as the market consistent value of assets less the market consistent value of liabilities.

4.2.2 One test which they ran was whether the volatility of underwriting results (a proxy for insurance riskiness) decreases the price/book ratio. This is a plausible assumption, since it is the uncertainty of insurance cash flows which gives rise to the frictional capital costs of insurance operations. Figure 9 of their paper shows that the regression line slopes downward, which suggests that, as underwriting volatility increases, so does the cost of capital. However, the R squared value is low, and the t-statistic indicates that the relationship is not significant.

4.2.3 Another test which they ran was on the relationship of the investment strategy and the investment return to the share valuation of insurers. The percentage of economic net assets invested in shares was taken as a proxy for the market risk taken by insurance companies. The empirical evidence supports the theoretical view that investing in shares does not increase franchise value. Even though investment in riskier assets might achieve a higher return, it is only sufficient to offset the extra risk being undertaken.

4.2.4 More details of their methods and the results are given in Sections 4.4 to 4.6.

4.3 *Key Findings — Cummins & Phillips (2005)*

4.3.1 This paper investigated the estimation of the cost of equity capital for property-liability insurers. (We use the phrase property-liability insurers in this section where discussing their work, which was based upon data from the U.S. stock market.) Their approach was to obtain the beta coefficients

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for a sample of insurance firms, using stock market trading data for 172 publicly traded firms writing property-liability insurance in the period 1997 to 2000, and then to perform a cross-sectional regression, where the dependent variable is the observable beta and the independent variables measure the firms' participation in various lines of non-life (P&C) insurance business. The coefficients of the line of business participation variables are then interpreted as the so-called full-information beta (FIB) coefficients for the different business lines.

4.3.2 One major conclusion was that the cost of capital estimates for insurers from the FF3F method are generally higher than the estimates based on the CAPM, because the CAPM approach does not adjust for the price/book ratio. Cummins & Phillips relate the price/book ratio to the costs of financial distress, which are particularly important for insurers, given the influence of insurance strength ratings from the rating agencies. Hence, using a CAPM approach could lead to significant under-estimation of the cost of capital for insurers.

4.3.3 Another major conclusion was that there are cost of capital differences by line of business and size of company which are statistically significant. Thus, it is important to use firm and line specific costs of capital in applications such as project selection and capital allocation.

4.3.4 Overall, their recommendation was that full-information betas can be used by insurers in a variety of contexts, including the allocation of capital by line of business, estimation of the RAROCs, insurance pricing, and decision making about entering or exiting lines of business. Full-information costs of capital could also be used to evaluate potential merger and acquisition transactions.

4.3.7 More details on their methods and the results are given in Sections 4.7 to 4.10.

4.4 *Methodology — Swiss Re* sigma *No3/2005*

Their study was based on an empirical analysis of a set of 27 traded U.S. P&C companies for the period 1997 to 2002. They considered the ratio of market capitalisation to economic net assets, called an economic price/book ratio, and examined how it varies with risk factors, such as the companies' insurance riskiness and their investment riskiness.

4.5 *Detailed Results — Swiss Re* sigma *No3/2005*

4.5.1 Underwriting volatility has little effect on the cost of capital. One test *sigma* ran was whether the volatility of underwriting results (a proxy for insurance riskiness) decreases the price/book ratio. This would be a plausible assumption, since it is the uncertainty of insurance cash flows which gives rise to the frictional capital costs of insurance operations. Figure 4.1 shows that the regression line slopes downward, which suggests that, as underwriting volatility increases, so does the cost of capital, which, in turn,

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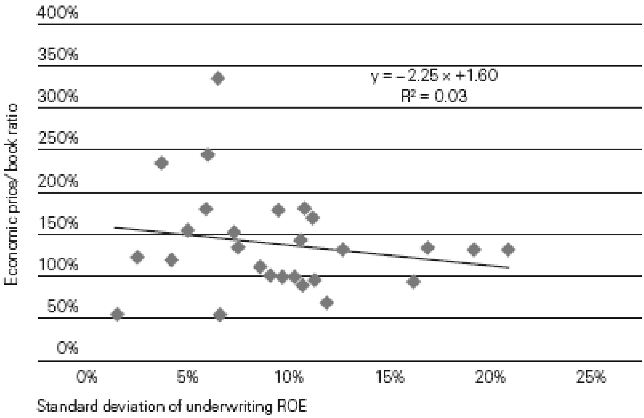

Figure 4.1. Economic price/book ratio against insurance riskiness (reproduced from Swiss Re *sigma* No3/2005 Figure 9)

has a negative impact on the price/book ratio. However, the *R* squared value is low, and the *t*-statistic indicates the relationship is not significant. There are various reasons why some companies have a lower underwriting volatility than others, for example, better risk diversification, risk selection and use of reinsurance.

4.5.2 Increased investment earnings, from increased share holdings or otherwise, does not increase the FV. The percentage of economic net assets invested in shares was taken as a proxy for the market risk taken by insurance companies. Figure 4.2 shows no apparent relation between the riskiness of the investment portfolio and the price/book ratio. If anything, a riskier investment portfolio is linked to a lower price/book ratio, but the result is not statistically significant. The empirical evidence supports the theoretical view that investing in shares does not increase the FV.

4.5.3 Figure 4.3 examines the relation between the historical average investment return and the price/book ratios. Investment return is calculated as the actual mark to market return on investments less the return on the replicating portfolio. Return on the replicating portfolio equals the actual investment return which the firm would receive if it chose to minimise its investment risk. Again, there is a slight indication that a higher investment return is linked to a lower price/book ratio, but the result is not statistically significant. Thus, it is difficult, in practice, for insurers to earn excess returns through investment strategies simply involving more market risk. Taking investment risk does not hurt share valuations either. Strong liquidity and tax arguments are reasons why insurers could invest in corporate bonds and shares. Riskier investment strategies are expected to generate higher

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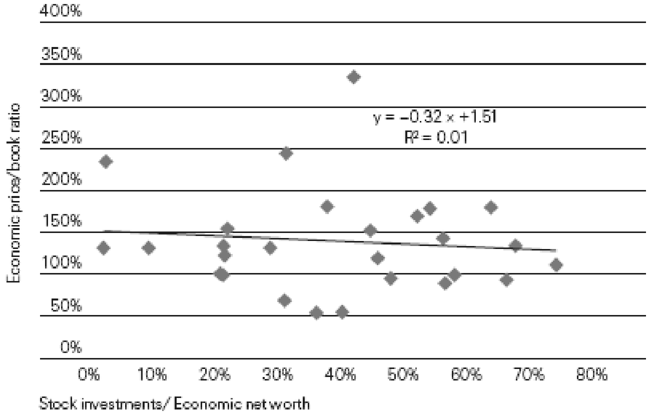

Figure 4.2. Economic price / book ratio against investment riskiness
(reproduced from Swiss Re *sigma* No3 / 2005 Figure 6)

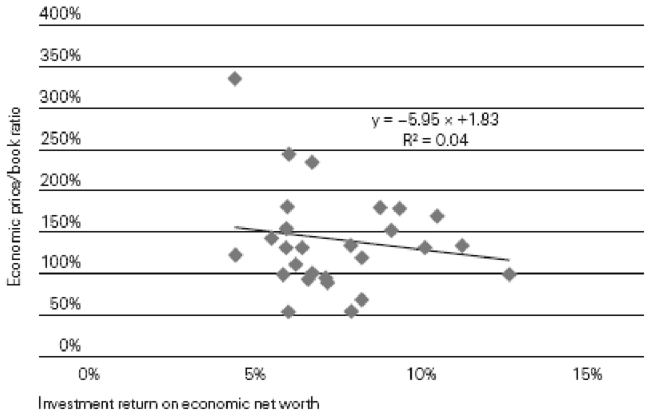

Figure 4.3. Economic price / book ratio against investment return
(reproduced from Swiss Re *sigma* No3 / 2005 Figure 7)

investment income and ROE (all else being equal), and some shareholders may prefer this option, accepting the higher risk. Insurers can choose their investment portfolio based on their financial market risk appetite, which is affected, not only by the firm's own risk tolerance overall, but also by restrictions imposed by solvency, rating and financial analysts' requirements.

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In addition, riskier investment strategies (e.g. more shares) lead to a higher capital requirement as an output from the DFA model, i.e. less insurance leverage.

4.6 *Cost of Capital Estimates provided in Swiss Re* sigma *No3/2005*

4.6.1 *Sigma* 3/05 used the following methods for estimating the cost of capital:

(1) *CAPM*; a one-factor model which uses regression to solve for beta in the formula:

$$\text{Firm return}_{\text{year i}} = \text{Risk-free rate}_{\text{year i}} + \text{beta} * (\text{Market return}_{\text{year i}} - \text{Risk-free rate}_{\text{year i}})$$

where the equity risk premium (equal to the market return less the risk-free rate) is determined from broader-based studies. The current cost of capital is the risk-free rate plus beta (determined from the regression) times the current equity risk premium.

(2) *MCPM (market consistent pricing method)*, where the cost of capital is determined as the sum of: (a) investment cost of capital; plus (b) insurance cost of capital:
   (a) Investment cost of capital equals risk-free rate plus investment risk premium, and investment risk premium is (equity risk premium * equity gearing + credit risk premium * bond leverage).
   (b) Insurance cost of capital equals frictional capital costs.

4.6.2 Method (2) in ¶4.6.1 yields a return on accounting equity (ROE), and the other approach yields a return on market value (TSR). However, the MCPM, as applied by Swiss Re *sigma* 3/05, mixes some ROE measures in a mostly TSR format.

4.6.3 Swiss Re *sigma* 3/05 applied CAPM and MCPM to 1993 to 2002 results, across a sample of 27 companies. They use a 'long-term' beta of 1.03 against the market excluding the TMT (Technology, Media and Telecoms) sector, based on 1999 to 2002 data. They produced the following range of costs of capital by firm:

(1) CAPM result: 5.1% to 11%.
(2) MCPM result: 7.4% to 10%.

Currently (2005) they project the cost of capital at 7% to 8%, based on a risk-free rate of 3% and an equity risk premium of 4%. They observe that the cost of capital in the 1980s was 15%, the major source of the difference being the higher risk-free rate.

4.7 *Methodology — Cummins & Phillips (2005)*

4.7.1 The Cummins & Phillips paper identifies essentially the same methods for estimating the cost of capital as those identified by *sigma*:

discounted cash flow (DCF), CAPM, FF3F, and APT (arbitrage pricing theory). APT considers separate risk factors, each with its own multipliers, and the sum of parts and MCPM methods described by *sigma* appear to be applications of APT.

4.7.2 Cummins & Phillips show results based on CAPM and FF3F, and express a preference for FF3F. Cummins & Phillips suggest that APT might use too many factors and then be too data intensive to be useable, especially in the context of attempting to analyse the data by line of business. Cummins & Phillips prefer FF3F to CAPM, because they conclude that failure to recognise sources other than the CAPM systematic risk factor can lead to significant under-estimation of insurance firms' cost of capital. This mirrors the views expressed in Cochrane (1999).

4.8 *CAPM as applied by Cummins & Phillips*

Cummins & Phillips describe the CAPM approach as a commonly used method for estimating the cost of capital assuming that investors are only rewarded for taking risk if the risk is linked to the overall performance of the economy. That linked risk is often called 'systematic risk', and the linked risk is often assumed to be the same as the variability observed in equity markets. They highlight that the normal CAPM model does not account for the belief that investors may require a larger return for investing in either:

(1) a smaller firm (lower market capitalisation); or
(2) a firm which is more likely to suffer financial distress (lower market to book value ratio).

4.9 *FF3F as applied by Cummins & Phillips*

4.9.1 They adopt a two-stage approach:

(1) Returns on specific shares in the sample are regressed on a market risk factor or factors to obtain separate beta coefficients for each firm. The beta coefficients are inserted into appropriate equations along with the estimated market risk premia, to obtain cost of capital estimates for each firm. They use 1926 to 2000 data for risk premia (equity risk premium, size premium and BV/MV premium) and 1992 to 2000 data for estimation.
(2) They perform a cross-sectional regression, where the dependent variable is the observable beta and the independent variables measure the firms' participation in various lines of property-liability business. They utilise data from the National Association of Insurance Commissioners to break down the revenues of property-liability insurers by line of insurance.

4.9.2 The coefficients of the line of business participation variables are then interpreted as the so-called full-information beta (FIB) coefficients for the business lines.

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4.10 *Detailed Results — Cummins & Phillips*

4.10.1 At total industry level, FF3F costs of capital are substantially larger than the CAPM costs of capital for property-liability insurers. Based on the value weighted results, the comparison is a cost of capital of 19% for the FF3F method versus a cost of capital of 12% for the CAPM method. The following points should be noted:

(1) The FF3F systematic market risk betas are larger than the comparable CAPM betas.
(2) The FF3F model imposes a positive cost of capital premium for financial distress, which is not present under the CAPM.

Controlling for factors other than systematic market risk makes a significant difference, suggesting that property-liability insurers relying on the CAPM may be significantly under-estimating the cost of capital. The values of 19% and 12% are derived from a period when the risk-free rate and equity risk premium were much higher than 2006 values — see ¶4.11.2.

4.10.2 The FF3F results suggest that, compared to All Industry averages, property-liability insurance shares are about average in terms of their sensitivity to systematic market risk and firm size, but property-liability stock returns are much more sensitive to financial distress than shares in general. Financial distress carries a significant cost of capital penalty for property-liability insurers.

4.10.3 The share prices of larger insurers are less sensitive to financial distress than those of smaller insurers, as expected if larger firms are more diversified and have better access to capital.

4.10.4 For All Industries, the cost of capital is much higher for small firms than for large ones. The size effect is less pronounced for property-liability insurers than for the stock market in general, and Cummins & Phillips suggest that that might be the case because the size difference between the average large and small property-liability insurers is not as high as for large and small shares in general.

4.10.5 The FF3F cost of capital estimates for property-liability insurers tend to be somewhat higher than All Industries, and Cummins & Phillips suggest that that might be the case because insurers tend to be smaller than average firms in other industries, and because they tend to have more sensitivity to the price/book ratio financial distress factor.

4.10.6 When comparing personal lines firms with commercial lines firms, the equally weighted results show a cost of capital for the average insurer which is slightly higher for personal lines, but the value weighted results show for the market as a whole that the cost of capital is higher for commercial lines. The authors suggest that this may indicate that the types of commercial business written by larger insurers (e.g. national and multi-national accounts) are more risky than those written by smaller insurers, which tend to focus on local or regional risks. In addition, they suggest that it

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may reflect the superior ability of larger insurers to cover catastrophic personal lines property risks because of their better capitalisation.

4.10.7 The paper examined a segmentation of lines of business between automobile insurance, workers' compensation, and all other lines. This breakdown was intended so that they could examine the two most highly price-regulated lines. They found results which varied by line of business, and they also found that the market wide (value weighted) cost of capital was lower than the cost of capital for the average firm (equally weighted). They concluded that failure to recognise sources of risk other than the CAPM systematic risk could lead to significant underpricing in regulated lines, and that the industry-wide cost of capital is significantly lower than the average firm cost of capital, especially for automobile insurance. Thus, basing prices on industry wide costs of capital is likely to be penalising for the average firm in the industry.

4.10.8 A previous paper by Cummins & Lamm-Tennant (1994) carried out a similar study, using stock market data for the period 1982 to 1989. They reached the following conclusions (quoted directly from page 199 in that article):

"(1) Both the insurance and the financial leverage variables are statistically significant and positively related to the Value Line equity beta in all of the equations shown in Table 4. This is an interesting finding in view of the tendency of financial analysts to focus on financial leverage and the tendency of regulators and insurance analysts to focus primarily on insurance leverage. Our results suggest that both types of leverage are important and thus should be recognised by insurers for project selection and by regulators in setting regulated prices and testing insurer solvency.

(2) The commercial long-tail specialisation variable is also significant and positively related to the equity beta. This is as expected if long-tail lines such as liability are more risky and/or exacerbate information asymmetries. This result suggests that securities markets require a higher cost of equity capital for insurers with relatively high proportions of commercial long-tail business, providing strong evidence that the cost of capital is not constant across lines of insurance.

(3) The overall conclusion is that leverage and line of business specialisation have a strong effect on the cost of equity capital for insurance."

4.11 *Comparing Cost of Capital Estimates between Swiss Re* sigma *3/05 and Cummins & Phillips*

4.11.1 The two papers by Swiss Re *sigma* and Cummins & Phillips produce different results, partly because they use different periods and different points in time. Also, they use different approaches: *sigma* is trying to estimate today's prospective values; whereas Cummins & Phillips are looking historically for average parameters to put into regression equations to examine splits by line of business. We include a comparison of their approaches in Table 4.1.

4.11.2 The extra cost of capital of 3.7% in the Cummins & Phillips paper arising from the costs of financial distress was derived from a period

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Table 4.1. Comparison of Swiss Re *sigma* 3/05 and Cummins & Phillips

Source/authors	Swiss Re *sigma* 3/05	Cummins & Phillips
Risk-free rate (RFR)	3.0% used	4.9% used
About the RFR assumption	Notes that short-term *t*-bill rate has ranged from 1.0% in June 2003 to 16.7% in Aug 1981, with average 6.7%; 3% chosen as close to recent one-year rate	30-day *t*-bill over the period 1997 to 2000; nominal, not real
Equity return in excess of the RFR	Assumed to be 4.0% going forward	Historical value 8.4%
About the equity excess return	Noted that it has declined over the last 50 years	Average over period 1926 to 2000
CAPM estimate for cost of capital	Forward looking 7% (and note a very wide spread between firms)	Historical value 12.0%
Other method used	MCPM = market consistent pricing method	Uses FF3F model as enhancement to original single factor CAPM, plus regression analysis on lines of business
Results of other method	7.6%, split as to 5.6% investment cost of capital plus 2% frictional costs	Historical value 18.5%, of which 3.7% comes from costs of financial distress

when the average equity risk premium was 8.4%. If you use an equity risk premium of 4% going forward, it may be appropriate to consider a lower average future value for the costs of financial distress, perhaps 2%. The value of 3.7% was also an average across many firms, with different capital structures and business mixes, and an individual firm might prefer to have regard to the credit default spreads described in Section 2.

5. Cost of Capital — Bottom Up Approaches

5.1 *Aim of the Bottom Up Approach*

5.1.1 A common approach to converting the cost of capital into insurance business targets, such as the ROC or the TSR is to undertake an exercise of preparing pro-forma future financial statements which produce the desired cost of capital as the bottom line return. The internal insurance targets from such analyses, sometimes 10% or less, appear low compared to our intuition or compared to targets observed in practice.

5.1.2 This section proposes that the process of producing earnings' estimates which are consistent with the cost of capital data used by financial economics is more complex than usually recognised. To demonstrate this point, we will illustrate a more detailed view of the process and discuss the factors which should be considered.

5.1.3 Our process builds a ‘market consistent’ earnings model, based on the firm’s asset policy and on the separate components of frictional costs used in financial economics, as follows: cost of double taxation, costs of financial distress, agency costs and costs of regulatory restrictions on capital. Our process looks separately at how costs affect the accounting statements (income statement and balance sheet) and the franchise value (market value minus accounting book value).

5.1.4 The results of this work suggest that the apparent gap between proforma ROC targets and realistic targets may really be the result of inadequacies in the earnings models. The discussion also provides an opportunity to demonstrate that the actuarial ideas of risk margin and contingencies are not necessarily that far from the financial economics ideas of frictional costs related to agency-principal issues, lack of transparency and market pricing of risk.

5.1.5 For the purposes of this section, we use a risk-free rate of 5% for gilts with durations appropriate for our examples, and an expected return on shares of 9% (a 4% equity risk premium), as we have in prior sections of the paper.

5.1.6 In the remainder of this section we proceed as follows:

(1) Consider an insurance entity with zero expected growth, and book value equal to market value (so the TSR and the ROC have the same denominator), and none of the ‘frictional costs’ which are added in (2) to (6). For that insurance entity, we consider it first as if it were a leveraged fund.
(2) Add the cost of double taxation.
(3) Discuss franchise value and implications if market value is greater than book value.
(4) Consider the effect of financial distress costs on both accounting income and franchise value.
(5) Consider the effect of agency costs on accounting income and franchise value.
(6) Consider the effects of regulatory restrictions on accounting income and franchise value.
(7) Finally, we consider the effect of growth.

We consider each of the elements sequentially, and we recommend that the reader goes through Section 5 once, to appreciate the narrative flow, before re-reading to absorb the details. Table 5.10 (in Section 5.17) consolidates all of the points made in that sequential development.

5.1.7 In our worked examples, we present ideas and results in tables with a single-year view. We appreciate that the risks do not materialise this way, it is meant to be the ‘annualised average view’ of the costs of the risks involved. We are also aware that some capital costs need to be evaluated across several calendar years, for example, liability reserving risk needs to be modelled over the long-tail run-off of the future claims development patterns. We have avoided the complexity of these calculations, in order to be able to focus on the principles of the economic risk issues.

5.2 *Insurance Firm Target Returns*

5.2.1 In Sections 3 and 4 we discussed how financial economics derives a cost of capital by looking at the TSR achieved by the investors. We call this 'outside the firm results'. In particular, the CAPM and FF3F models look at after-the-fact (*ex-post*) market returns from insurers and the market as a whole, over long enough time periods that they can assume that the observed results reflect the investor's before-the-event (*ex-ante*) expectations. We observe that the data yielding cost of capital results include market value effects, if any, of random variations from expectations, and poor results from 'agency costs', financial distress and regulatory restrictions.

5.2.2 If our business plan is to support the target 'cost of capital' *to investors*, our 'inside the firm' earnings plan must consider a similar range of earnings outcomes and evaluate earnings from the investors' perspective. For example, in a trivial way, our earnings plan begins with pre-tax earnings, but, in preparing a business plan for investors, we include the effect of corporate taxes, in order to demonstrate the impact of double taxation. In the same way, there are other factors to be considered in converting the earnings plan 'inside the firm' to the perspective of the investor 'outside the firm'.

5.3 *Financial Economics View of Insurance*

5.3.1 From a financial economics perspective, an insurance firm is a leveraged fund with frictional costs.

5.3.2 To understand what this means, recall how one might build up the cost of capital and related insurance returns from basic principles, as described in Section 3:

(1) The base cost of capital is defined as: "the return they [shareholders] would have otherwise achieved by investing in a leveraged fund. It depends on the investment strategy of the insurer. For example, a U.K. insurer that closely matched its insurance liabilities and used the FTSE 100 index as a benchmark for excess capital, the base cost of capital would be equal to the return on the FTSE 100 index." (Hancock *et al.*, 2001).
(2) "Investing capital in financial markets through an insurance firm gives rise to frictional costs which do not arise when investing the same capital more directly through an investment fund. These costs include compensation for lack of transparency and control, for the additional costs related to potential financial distress, for regulatory restrictions, and additional taxes." (Hancock *et al.*, 2001).
(3) "Underwriting risks are diversifiable and insurers cannot expect to earn higher returns by taking those risks. But insurers must earn risk

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margins because they operate in regulated markets with double taxation and other costs of holding capital. These margins are based on financial theory, not on the actuarial risk load literature." (Feldblum, 2006).

5.3.3 In the rest of Section 5 we consider the technical earnings which an insurance firm needs to achieve to give the investor a return which is commensurate with risks which they accept and frictional costs which they incur. We look at two hypothetical cases: the first where the insurance firm invests all of its capital in shares; and the second where the insurance firm invests its capital entirely in gilts. As the investor could place their money directly in shares or gilts themselves, the insurance firm must achieve technical earnings sufficient to give a return which leaves the investor no worse off after allowing for the frictional costs and appropriate treatment of the additional risks. Thus, for the insurance firm investing its capital in shares, we estimate the technical earnings required to give the investor a 9% return after allowing for frictional costs and appropriate treatment of the additional risks. Similarly, for a firm investing its capital in gilts, we estimate the return from technical earnings required to give the investor a 5% return, again after allowing for frictional costs and the appropriate treatment of additional risks.

5.4 *Insurance Entity as a Fund*

5.4.1 To begin our exercise, consider a hypothetical leveraged financial fund (actually impossible in practice) in which the capital is invested in an insurance firm where there are no frictional costs. It is subject to no regulation, and there is no taxation of income within the firm, the owners are only subject to taxation when they receive income from the fund. Furthermore, the investors in the fund can withdraw their capital at any time without restriction, and finally, the fund cannot go bankrupt.

5.4.2 To begin, as discussed in Section 3, a pure leveraged fund would look like Table 5.1.

5.4.3 The return is 12%. The investor expectation, e.g. the cost of capital for an investment with this leveraged risk, must be 12%. If the cost of capital were over 12%, no one would invest in it. If the cost of capital were less than 12%, then investors would buy so much of the fund that they would bid down the returns on shares and or bonds until prices reached the correct equilibrium.

Table 5.1. Pure leveraged fund

Capital	100	Earning	9%	=	9
Debt raised at risk free rates + 1%	(100)	Costing	6%	=	(6)
Investments in shares	100	Earning	9%	=	9
Total	100	Earning	12%	=	12

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Table 5.2. Insurance leveraged fund

Capital	100	Earning	9%	=	9
Technical reserves*	(200)	Costing	x%	=	($2x$)
Investments of technical reserves in gilts	200	Earning	5%	=	10
Total	100	Earning ($19 - 2x$)%		=	$19 - 2x$

*Assuming technical reserves equal $2x$ capital. The value of the ratio does not affect the following discussion.

5.4.4 A detailed model supporting the 12% cost of capital would depend on the variability of each investment in the fund and the correlations between those investments. Since we have market prices, however, the detailed model is not necessary.

5.4.5 For our hypothetical insurance enterprise, the leveraged fund looks like Table 5.2.

5.4.6 The observed return/cost of 'x%' on technical reserves is the net present value profit/loss on new business and gain/loss on development of discounted reserves. The market valuation of cash flows from the technical reserves, by analogy to the pure leveraged fund, depends on the characteristics of the cash flows from the technical reserves. Unlike the pure fund situation, we do not have a market value for the cash flows from the technical reserves. Therefore, we cannot use market prices to determine the value of 'x'. Instead, we need to value the insurance earnings with a model which produces values consistent with the values which the market assigns to earnings on other investments.

5.4.7 We will now proceed to do that in the context of developing the frictional cost structure for the insurance entity. For that purpose, we will assume that 'x' covers frictional costs only, and would be zero if there were no frictional costs. The reader can better assess those assumptions after considering the rest of Section 5 and the discussion in Appendix B.

5.4.8 In these examples, we further assume that capital in the insurance entity is provided by shareholder funds and not by debt. We recognise that tax effects would be different if capital were provided partly by debt and partly by shareholder funds. However, assuming that capital is provided solely by shareholder funds simplifies the analysis, so that we can better explain the issues which we want to concentrate on in our paper. The assumptions also reflect the fact that shareholders could choose to use debt to leverage their investment in the insurance enterprise, and, according to some financial economic theories (e.g. Modigliani and Miller), produce the same effect as leverage in the insurance enterprise (except for frictional costs).

5.5 *Double Taxation — Frictional Cost*

5.5.1 The first frictional cost component which we consider is taxation. Tax rules vary by jurisdiction and by type of business. For general insurance,

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Table 5.3. Impact of double tax only; shares & risk free capital – PBV = 1.0

	Item		Capital invested in shares Amount in £000	%	Capital invested in gilts Amount in £000	%
1	Insurance premium	(selected)	2,500		2,500	
2	Technical earnings	(backsolve)	78	3.1%	42.5	1.7%
3	Capital: in shares	(selected)	2,000	100%	0	0%
4	Capital: in gilts	(selected)	0	0%	2,000	100%
5	Capital total	= (3) + (4)	2,000	100%	2,000	100%
6	Earning on capital: shares	= (3)*9%	180	9%	0	9%
7	Earning on capital: gilts	= (4)*5%	0	5%	100	5%
8	Earning on capital: total	= (6) + (7)	180	9%	100	5%
9	Total earnings	= (2) + (8)	258		143	
10	Taxes	= (9)*30%	−77	30%	−43	30%
11	After tax earnings	= (9) + (10)	180		100	
12	ROC	= (11)/(5)	9.0%		5.0%	
13	Market value	(selected)	2,000	100%	2,000	100%
14	TSR	= (11)/(13)	9.0%		5.0%	
15	Frictional capital cost TSR	= (2)/(13)	3.9%		2.1%	
16	Frictional capital cost ROC	= (2)/(5)	3.9%		2.1%	

Notes: (1) The column labelled '%' gives percentages related to capital, except that the value in line 2 relates to premium, and the value in line 10 is the tax rate applicable to total earnings. This is true for all subsequent tables in Section 5.

(2) Line 2, technical earnings mean UW profit/(loss) plus 'risk free' investment income on technical reserves.

(3) Line 2 is determined by back-solving so that line 14 is the targeted amount.

(4) Line 10, tax rates on share investments are sometimes different in amount and timing (taxed when realised, for example). Therefore there may be differential tax rates between the share investment strategy and the risk free investment strategy. This illustration does not address that issue.

(5) Line 16 is the frictional cost of capital equal to $-2x$ in Table 5.2. It is negative because Table 5.2 deals with costs, but the returns are positive.

taxation is generally based on total income, albeit sometimes with differences in treatment between underwriting income, investment income, realised capital gains and unrealised capital gains. For simplicity, we assume a tax rate of 30% on total income, including unrealised capital gains. Then the required return on technical earnings (the inside cost of capital) to produce 9% and 5%, respectively, to the investor are 3.9% and 2.1% of capital. These returns on technical earnings cover the cost of the tax payments, giving the shareholder an after tax return of 9% and 5%, respectively, where the capital is invested in shares and in gilts. For consistency with the more complex examples later in Section 5, we have shown all of the details of this calculation in Table 5.3. However, in this case, line 15, the frictional capital cost TSR, can be found easily by grossing up the TSR for tax and subtracting the return on capital. Where the capital is invested in

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Table 5.3A. Impact of double tax and varying premium to capital ratios; shares & risk free capital — PBV = 1.0

			Capital invested in shares		Capital invested in gilts	
	Item		Amount in £000	%	Amount in £000	%
1	Insurance premium	(selected)	2,500		3,000	
2	Technical earnings	(backsolve)	78	3.1%	43	1.4%
3	Capital: in shares	(selected)	2,000	100%	0	0%
4	Capital: in gilts	(selected)	0	0%	2,000	100%
5	Capital total	= (3) + (4)	2,000	100%	2,000	100%
6	Earning on capital: shares	= (3)*9%	180	9%	0	9%
7	Earning on capital: gilts	= (4)*5%	0	5%	100	5%
8	Earning on capital: total	= (6) + (7)	180	9%	100	5%
9	Total earnings	= (2) + (8)	258		143	
10	Taxes	= (9)*30%	−77	30%	−43	30%
11	After tax earnings	= (9) + (10)	180		100	
12	ROC	= (11)/(5)	9.0%		5.0%	
13	Market value	(selected)	2,000	100%	2,000	100%
14	TSR	= (11)/(13)	9.0%		5.0%	
15	Frictional capital cost TSR	= (2)/(13)	3.9%		2.1%	
16	Frictional capital cost ROC	= (2)/(5)	3.9%		2.1%	

See notes with Table 5.3.

shares, the frictional capital cost TSR is therefore 9%/(1 − tax rate) less 9% = 9%/(1 − 30%) less 9% = 3.9%.

5.5.2 For greater realism, we note that a firm with its capital invested in shares will have a higher capital to premium requirement than one with its capital invested in gilts, as described in Section 2. For example, based on the examples shown in Appendix A.1.3 and A.1.4, a firm with an 80% solvency ratio (capital/premium) investing capital in shares and a firm with a 67% solvency ratio investing capital in gilts would both have a risk profile equivalent to an A rating. In the latter case, the firm can write more premiums for the same amount of capital, so that the required return on technical earnings becomes 1.4% of premium, as shown in Table 5.3A (compared with 1.7% in Table 5.3).

5.5.3 The effect of more premium is to reduce the policyholder cost (line 2: technical earnings of 1.4% in Table 5.3A rather than 1.7% in Table 5.3), but leaves the frictional capital cost unchanged.

5.6 *Franchise Value*

5.6.1 Before considering the three other frictional costs, we will make the analysis more realistic by recognising that market value is not necessarily equal to accounting book value. Until Section 5.15, we will continue to consider a firm with no growth in earnings from year to year.

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5.6.2 For most insurers market value is greater than book value (PBV > 1.0), and we describe the difference as franchise value. From a balance sheet perspective, franchise value is the market value of assets, either tangible or intangible, which is not recorded in accounting statements or is recorded at values below their market value, and of liabilities which are reported at values above their market value. General insurance customer relationships, for example, are not recorded as assets in accounting statements, but do affect franchise value. Unpaid claim reserves are often reported at nominal rather than at discounted values for financial reporting purposes. By definition, those and other assets and liabilities are included at market value in the insurer stock price.

5.6.3 From an income perspective, if the firm's total shareholder returns are expected (by investors) to exceed the cost of capital, then the market value will increase until cost of capital times market value equals expected earnings plus growth in value per share (i.e. TSR).

5.6.4 Table 5.4 shows the effect on Table 5.3A if we assume that the market value is 150% of the book value. This is somewhat lower than the value from the sample of companies observed in the *sigma* 3/05 study cited earlier, although the actual value does not affect the logic underlying the illustration.

5.6.5 Thus, we need an internal before-tax profit margin of 10.3% of capital in order to achieve the shareholder return of 9% if the firm invests in shares, and 5.7% of capital to achieve 5% if the firm invests in gilts.

Table 5.4. Impact of double tax shares and risk free capital — PBV = 1.5

			Capital invested in shares		Capital invested in gilts	
	Item		Amount in £000	%	Amount in £000	%
1	Insurance premium	(selected)	2,500		3,000	
2	Technical earnings	(backsolve)	205	8.2%	114	3.8%
3	Capital: in shares	(selected)	2,000	100%	0	0%
4	Capital: in gilts	(selected)	0	0%	2,000	100%
5	Capital total	= (3) + (4)	2,000	100%	2,000	100%
6	Earning on capital: shares	= (3)*9%	180	9%	0	9%
7	Earning on capital: gilts	= (4)*5%	0	5%	100	5%
8	Earning on capital: total	= (6) + (7)	180	9%	100	5%
9	Total earnings	= (2) + (8)	385		214	
10	Taxes	= (9)*30%	−116	30%	−64	30%
11	After tax earnings	= (9) + (10)	270		150	
12	ROC	= (11)/(5)	13.5%		7.5%	
13	Market value	(selected)	3,000	150%	3,000	150%
14	TSR	= (11)/(13)	9.0%		5.0%	
15	Frictional capital cost TSR	= (2)/(13)	6.8%		3.8%	
16	Frictional capital cost ROC	= (2)/(5)	10.3%		5.7%	

See notes with Table 5.3.

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5.6.6 It appears that the ROC hurdle has become nearly three times tougher, 10.3% rather than 3.9%, just because the market value is greater than the book value. However, it would be more accurate to recognise that franchise value is greater than zero (market value > book value) because there have been increases in assets which support future income, but which are not reflected in the accounting capital. Therefore a 10.3% ROC target is appropriate, and as attainable as a 3.9% target would be if there was no franchise value. A 3.9% ROC earnings target is too low, and achieving only 3.9% would lead to a falling market value. The same rationale applies to the firm investing in gilts.

5.7 *Financial Distress Cost*

5.7.1 The risk of financial distress applies to companies in any industry. Companies manage that risk using hedging, insurance (reinsurance in case of the insurance industry), diversification, etc. From the shareholder perspective, the purpose of these risk management strategies is not to reduce variability as an end in itself, because shareholders might want to manage variability themselves, especially if it is diversifiable. Instead, the intention is to seek ways of improving the mean value of the firm. As explained in Coleman (2005) (page 18), as firms approach bankruptcy they suffer diminution in reputation as a supplier, customer and employer; management is distracted; and the value of assets steadily erodes. Consider Figure 5.1, which we

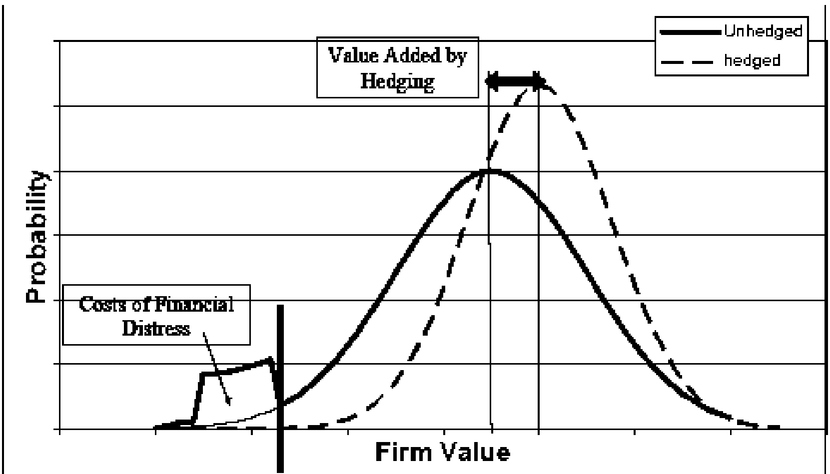

Figure 5.1. Value of avoiding financial distress
(reproduced from Coleman, 2005)

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reproduce from that paper, which shows the probability distribution of the firm value under two different risk profiles. With high volatility, the solid distribution has a thick left tail due to the costs associated with financial distress; the narrower dashed distribution, however, is of lower risk and the firm is less likely to go into bankruptcy. By reducing volatility in income and thus the possibility of financial distress, the firm's expected value may be increased, depending on the level of the associated expense of hedging.

5.7.2 For an insurance firm, the costs of distress include expenses in raising capital, legal fees and loss of value from distressed sales and indirect costs in reputation and associated franchise value (s*igma* 3/05, page 13). We first look at the 'mortality' or failure components of this risk, and then consider the total risk.

5.7.3 As noted in Section 4.10 and consistent with our intuition, Cummins (2005) shows that financial distress has a greater impact on market value of insurers than on companies in other industries.

5.8 *'Mortality' or Failure Risk*

5.8.1 When the investor puts capital into the insurance firm, it is exposed to the risk of default from the insurance operations, and this is often expressed in probability terms as 'one in 200 over a one-year horizon' or some other level, and then re-expressed as 'BBB', or 'single A'. Although the standard rating agency ratings for insurance firms are not the same as default rates for corporate debt, they have many similar features. In particular, the spreads over the risk-free rate of differently rated bonds may be used as a measure of the market price for different failure rates.

5.8.2 Therefore, we can look at the failure component of insurance frictional cost by studying investor response to default risk. The long-term ten-year default rate for A-rated corporate bonds is 0.19% per year (Table 2.2 ten-year default rate annualised). Moreover, the recovery rate on senior debt exceeds 50%, so that the expected cost of defaults is about 0.1% (0.18%/2). The market price for this default risk in mid-August 2006 was 0.95% per year above U.S. Treasury ten-year bonds 5.78% for corporate A's versus 4.83% for U.S. Treasury ten-year bonds). This is a risk premium equal to 85 basis points above the long-term expected default cost of ten basis points.

5.8.3 It might be tempting to explain this spread in excess of the expected value of default as a risk margin. The financial economist will observe that it is not calculated, but determined by the market. Moreover, the financial economist will observe that the difference is explained partly by the fact that the risk is not completely diversifiable, since defaults are correlated with stock market results (systematic risk); it is partly explained by the potential for adverse selection, as the financial arrangements are never perfectly transparent to the investor (or even to the rating agency), and the issuer has more knowledge of the risks than the purchasers (called agency risk or asymmetric information by financial economists, and called adverse selection by actuaries). One financial economic explanation given for the spread is that historic default rates do not contain sufficient extreme events, i.e. large numbers of well rated companies becoming insolvent at the same time, as happened, for example, in the 1929 Great Depression.

5.8.4 The spread might be considered as an additional 0.85% chance of a total loss of principal, a 1.7% chance of a 50% loss, or some other combination of 'frequency' and 'severity'.

5.8.5 We also note that the FF3F analysis for general insurance firms, discussed in Section 4, estimates that the additional cost of capital is 3.18%. As discussed in ¶4.11.2, this was derived from a period when the equity risk premium was much higher, and, looking forward, it is possible that market distress charges are currently also lower. Therefore, a forward looking rate might be, say, 2%. Since the FF3F analysis includes investor perceived 'distress' costs arising from problems which do not produce complete failure, it is consistent that the FF3F cost would be higher.

5.8.6 To examine the impact of distress cost on our earnings model, we need to consider the following:

(1) The distress costs have at least three components:
  (a) normal costs of reinsurance, compliance, risk management, etc., aimed at preventing financial distress;
  (b) the impact of the probability of financial distress on expense and earnings projections; and
  (c) the impact on franchise value of the market spread for financial distress (above the expected values of loss from financial distress).

(2) Each of those costs may be already reflected, in part or in whole, in earnings projections (items (1)(a) and (1)(b)), or the measured cost of capital (item (1)(c)).

5.8.7 The earnings adjustments depend on a careful consideration of point (2) of ¶5.8.6. For our modelling we assume the following:

(1) Normal costs of reinsurance, compliance, etc. are fully reflected in the earnings projections.
(2) The earnings projections include adverse claim scenarios. However, the projections do not fully include either the expenses of managing through financial distress or the loss of premium and earnings which would result if financial distress caused a down-grading of the firm's financial rating. We assume that the additional cost not reflected in the earnings projections has an expected value equal to 0.5% of capital.
(3) We assume that the cost of capital does not include provision for the market impact of financial distress. This assumption seems completely correct if the cost of capital is based on capital invested in gilts which have no default risk. For the firm which invests capital in shares, it depends on how the cost of capital analysis was prepared. Assuming

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that it was done with CAPM and not FF3F, and was based on a relatively short period of time which did not necessarily include the full impact of defaults, then an adjustment for missing default risk is appropriate.

5.8.8 We assume that the cost of the risks not reflected in the cost of capital is 2% of the market value of the firm. This is based on the 0.85% to 1.7% market spread for default risk on bonds for A-rated firms. It is higher than that, because the risk of loss of market value from distress is greater than the risk of failure to pay claims due to financial distress. It is also higher than that because the probability of financial distress is greater than the probability of default. It is lower than that because there may be some financial distress risk included in the 9% cost of capital. Finally, it is tested for reasonableness against the 3.2% financial distress cost of capital element measured by Cummins & Phillips (2005).

5.8.9 Table 5.5 shows the resulting cost of capital.

5.8.10 Thus, based on the effects of double taxation, using market value as the denominator, and reflecting the market cost of financial distress, the frictional capital cost measured as a percentage of capital, in addition to the return on surplus, is 15.0% for the firm investing in shares and 10.5% for the firm investing in gilts.

5.9 *Cost of Capital varies for Firms with Different Ratings*

5.9.1 The analysis above suggests that the cost of capital can be calibrated to the insurer's financial rating, which is convenient, as the Cummins & Phillips result is for insurers of all credit ratings combined. Consider two firms with identical insurance risks. One firm operates with a premium to capital ratio of 1.25:1 and has an A-rating. The other firm operates with a premium to capital ratio 28% higher, or 1.60:1. This increase in premium to capital ratio would give the second firm a BBB rating, not because of any extra inherent riskiness in its operations, but because it is writing more premiums for the same amount of capital.

5.9.2 The increase has four effects, some of which move in opposite directions. Firstly, on the favourable side, the firm earns more profit per unit of capital. If nothing else changed, that would result in an increase in market value. Secondly, the increase in leverage increases the expected value of costs from financial distress, and that reduces the market adjusted earnings (lines 2.1 and 2.2). Thirdly, there is either an adjustment in mortality risk effect on franchise value (lines 14 and 14.1), or an equal and opposite adjustment in the cost of capital. The second and third effects would act to reduce franchise value. Finally, the firm may need to decrease premium rates, reducing technical earnings, in order to attract business, given its lower credit rating. Data to measure any of those factors are not readily available. Nonetheless, to demonstrate the concepts we make several

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Table 5.5. Impact of double tax and financial distress costs — A-rated insurer, shares and risk free capital — PBV = 1.5

	Item		Capital invested in shares: Amount in £000	Capital invested in shares: %	Capital invested in gilts: Amount in £000	Capital invested in gilts: %
1	Insurance premium	(selected)	2,500		3,000	
2	Technical earnings	(backsolve)	300	12.0%	210	7.0%
	2.1 Earnings adj — financial distress costs		−10	−0.5%	−10	−0.5%
	2.2 Adjusted tech earnings	= (2) + (2.1)	290		200	
3	Capital: in shares	(selected)	2,000	100%	0	0%
4	Capital: in gilts	(selected)	0	0%	2,000	100%
5	Capital total	= (3) + (4)	2,000	100%	2,000	100%
6	Earning on capital: shares	= (3)*9%	180	9%	0	9%
7	Earning on capital: gilts	= (4)*5%	0	5%	100	5%
8	Earning on capital: total	= (6) + (7)	180	9%	100	5%
9	Total earnings	= (2) + (8)	470		300	
10	Taxes	= (9)*30%	−141	30%	−90	30%
11	After tax earnings	= (9) + (10)	329		210	
12	ROC	= (11)/(5)	16.5%		10.5%	
13	Market value	(selected)	3,000	150%	3,000	150%
14	TSR — survivor firms	= (11)/(13)	11.0%		7.0%	
	14.1 Mortality risk	(selected)		2.0%		2.0%
	14.2 TSR — mortality adjusted	(14) − (14.1%)	9.0%		5.0%	
15	Frictional capital cost TSR	= (2.2)/(13)	10.0%		7.0%	
16	Frictional capital cost ROC	= (2.2)/(5)	15.0%		10.5%	

Notes: (1) See notes with Table 5.3.
(2) 0.5% times capital in line 5.
(3) Line 14 is the earnings for firms not driven to financial distress.
(4) Line 14.1 is the market value of financial distress and (as with corporate bonds) subtracted from the 'return given survival' to obtain the market return.
(5) In line 14.2, the reference (14.1%) means the percentage value shown in the % column (rather than the amount column) of line 14.1.

assumptions and show the results in Table 5.6. We assume that the expected cost of financial distress increases from 0.5% to 1.0% (line 2.1). We assume that the market cost of financial distress risk in excess of the expected value increases from 2.0% to 3.0% (line 14.2). This is instead of, and equivalent to, assuming a 1% increase in cost of capital, which is not unlike the market spread between BBB and A bonds. Finally, we assume that insurance premium rates are decreased to the extent that technical earnings fall from 12.0% to 11.1% (line 2). Table 5.6 shows the results using these assumptions. The firm has the same market value because its expected total shareholder return adjusted for financial distress (line 14.2) is not changed. However, it is now a riskier investment which earns more in years when there are no

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Table 5.6. Single A and BBB rated firms impact of double tax and financial distress costs

			Single A rated firm		BBB rated firm	
	Item		Amount in £000	%	Amount in £000	%
1	Insurance premium	(selected)	2,500		3,200	
2	Technical earnings	(backsolve)	300	12.0%	352	11.1%
	2.1 Earnings adj — financial distress costs		−10	−0.5%	−20	−1.0%
	2.2 Adjusted tech earnings	=(2)+(2.1)	290		332	
3	Capital: in shares	(selected)	2,000	100%	2,000	100%
4	Capital: in gilts	(selected)	0	0%	0	0%
5	Capital total	=(3)+(4)	2,000	100%	2,000	100%
6	Earning on capital: shares	=(3)*9%	180	9%	180	9%
7	Earning on capital: gilts	=(4)*5%	0	5%	0	5%
8	Earning on capital: total	=(6)+(7)	180	9%	180	9%
9	Total earnings	=(2.2)+(8)	470		512	
10	Taxes	=(9)*30%	−141	30%	−154	30%
11	After tax earnings	=(9)+(10)	329		358	
12	ROC	=(11)/(5)	16.5%		17.9%	
13	Market value	(selected)	3,000	150%	3,000	150%
14	TSR — survivor firms	=(11)/(13)	11.0%		11.9%	
	14.1 Mortality risk	(selected)		2.0%		3.0%
	14.2 TSR — mortality adjusted	(14) − (14.1%)	9.0%		9.0%	
15	Frictional capital cost TSR	=(2.2)/(13)	10.0%		11.8%	
16	Frictional capital cost ROC	=(2.2)/(5)	15.0%		17.7%	

Notes: (1) See Table 5.5 notes for A-rated firm.

(2) Line 13: market to book ratio kept fixed and technical earnings is back-solved so that TSR-mortality adjusted is the same for both firms. This is not a unique solution. If technical earnings were lower and other assumptions were unchanged, then market value would decrease.

financial distress costs (lines 2.1 and 14.1), but would produce large investor losses if there were financial distress.

5.10 *Agency Risk in Insurance Enterprises*

5.10.1 Agency risk is described in various ways. One description of agency risk is that, by placing funds in the hands of the insurance entity rather than in a fund from which the investor can remove assets at will, the investor accepts the risk that the management will take actions which are not optimal for the investors. From a somewhat different perspective, *sigma* 3/05 (page 13) identifies the drivers of agency risk as transparency, reputation and incentives. In an insurance context, this agency risk includes:

(1) transparency of pricing and reserving aspects of the business; and

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(2) the extent to which management is making the best decisions for the investors, or modifying the decisions to reflect managements' interests.

5.10.2 Insurance has a particular set of characteristics. It sets a price in advance for certain contingencies which are particularly difficult to forecast, and generally cannot be hedged. Examples include man-made events, such as the cost of court awards for motor and liability business, man-made events such as terrorist acts, and the cost of natural disaster from hurricanes, floods and other weather events for property business.

5.10.3 The financial results depend on the accuracy of pricing and reserving models, which have parameter and model uncertainty which cannot be diversified by increasing size, and can be only partly diversified across multiple lines of business. Some of the cost drivers, inflation for example, are correlated with the market results. The business is subject to extreme events, such as natural and man-made disasters, as listed above. The variability associated with the costs relating to these events may be diversifiable against the totality of the risks in the capital markets, but uncertainty still remains in respect of the mean results. All of this contributes to a lack of transparency, as investors cannot be familiar with the characteristics of the models, and agency-principal risk in whether management is applying the models and other tools in the best interests of shareholders. There is also operational risk in whether management can execute its intended use of models and tools. The potential outcomes include, for example, under-pricing and under-reserving for catastrophe and extreme liability risks.

5.10.4 The markets are well aware of these issues. The industry has, at times in the past, missed earnings forecasts as a result of unexpected outcomes, and has, at times, suffered reserving deficits, for example in respect of U.S. tort claims. Hurricane Katrina claims demonstrated, as Hurricane Andrew claims had done a decade ago, weaknesses in catastrophe modelling tools for both pricing, reinsurance strategy and capital adequacy. Investors would logically be concerned about the degree of parameter and model risk and whether the mean level of future earnings is correctly stated, although they may not express it in those terms.

5.10.5 The top-down returns (the source data for CAPM and FF3F results) already reflect these issues. From a bottom-up perspective, a complete market consistent model should address three issues. Firstly, market consistent earnings projections need to include the expected value for these extreme events, including model failure. Secondly, the market pricing for extreme events may be higher than just the expected value of those events, for example as we have seen in the analysis of default risk. Market consistent earnings forecasts must reflect the market value of the risks associated with those events, not just the expected value. Finally, an investor analysis of earnings projections would need to include a provision for the lack of transparency and asymmetry in information, as he attempts to determine the extent to which these 'tail' issues are considered in the reported earnings projections.

5.11 *Sources of Earnings Projections and Adjustments to Market Consistent Basis*

5.11.1 Consider several types of earnings projections:

(1) *Case 1.* The earnings projection for our hypothetical insurer might be a projection which assumes the continuation of earnings patterns observed over several underwriting cycles. In that case, the projected earnings might be considered to be market consistent with perhaps very little adjustment.
(2) *Case 2.* We have a long-term history, but, for example, management has changed, and the new management projects earnings improvements from specific business changes. For the purposes of assessing its investment value, an investor might give some credit to the management projections, but also might give some weight to less favourable outcomes. This weighted average earnings projection would be lower than the management's projection. While the effect of the investor's viewpoint is sometimes treated by increasing the discount rate, we think that that confounds several different issues. The cost of capital has not changed because management's forecasts focus on the positive. Rather, the investor does not fully believe any single forecast.
(3) *Case 3*; a new firm, or a firm so changed that it is effectively a new firm. The earnings projection from an investor's perspective might be reduced below the management's projection, as was the situation in Case 2, but the reduction would likely be larger.

5.11.2 The difference between these situations can be described in normal actuarial language as a matter of uncertainty, or in financial economics language as increasing agency risk costs due to increasing reliance on management expectations and decreasing reliance on actual data, and thus reduced transparency for the investor.

5.11.3 Case 1 requires the smallest adjustment. The adjustment should not be zero, because there are favourable and unfavourable tails of the distribution which may not have been observed in actual experience. The earnings projection needs to include adverse experience, including the expected level of financial distress and default costs, which have not been included in the observed experience. These might be offset by very favourable experiences which have also not been observed in the experience period. However, as we expect insurance distributions to be skewed, the net effect of the two adjustments should be a charge against earnings. It should be noted that including the expected level of defaults in the earnings projection does not eliminate the need for the mortality adjustment, since the

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mortality adjustment is for the market price of default in excess of the expected value.

5.11.4 Cases 2 and 3 require increasing agency charges, sufficient to reflect the full range of outcomes and the increasing charges for lack of transparency in forecast results.

5.11.5 Lest the reader thinks that these issues relate only to insurance, we observe that financial analysts are reported to be marking down the earnings and prices of industrial companies with large pension plans, when the companies are not utilising life expectancies at the analyst's target levels or do not clearly specify their treatment of longevity risk.

5.12 *Estimates of Agency Costs*

5.12.1 *Sigma* 3/05 estimates that the insurance cost of capital (meaning frictional capital cost, as used in this paper) is 2% for all insurance risks other than double taxation. This seems low, considering the cost of distress estimated by the failure rate analysis in Sections 5.8 to 5.9 and the Cummins & Phillips FF3F work.

5.12.2 *Sigma* 3/05 based the 2% on the following:

(1) There is no way, from an external perspective, to determine elements of frictional cost separately (page 30).

(2) Therefore they looked at combined frictional cost in three ways:

   (a) *Historical underwriting returns*
   Sigma (page 33) discusses issues of competition, regulation, and time periods being good or bad. They reach no specific conclusions. For 1976 to 2002 they observe that the average return is 2.6%, recent returns are negative, and the range is +16.4% to −9.4%. Underwriting results are on the economic basis discussed earlier, so that they are not due to variations in interest rates.

   (b) *Market price of insurance risk based on insurance-linked securities (ILS)*
   Sigma shows cat examples (Japan EQ, multi-peril, U.S. wind, and Euro wind). The spread currently is 100 to 200 basis points over risk-free rate for most ILS types. The spread on U.S. wind is much higher (reaching 800 basis points at one time). This large spread is consistent with a lack of market comfort with loss predictions. *Sigma* provides a list of reasons why ILS margins might be high or low compared to real costs.

   (c) *Research on the percentage of premium devoted to underwriting risk*
   Derrig (1983), for a rate filing in Massachusetts, estimated that the cost of risk related to underwriting risk is 1% of premium or 2% of capital (using capital equal to 50% of premium).

Sigma seems to use the Derrig 2% value (also after considering the other indicators). None of the indicators supporting the 2% charge appear to relate

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to financial distress or regulatory restrictions. Therefore we will treat it as an estimate of agency frictional cost.

5.13 *Modelling with Agency Costs*

5.13.1 The discussion in the sections above showed that there is much that we do not know about the magnitude of agency risk costs. To examine the impact of agency risk cost on our earnings model, we need to consider the following:

(1) The agency risk costs have at least three components:
   (a) agency-principal costs which arise in the normal course of business;
   (b) the impact of agency costs on earnings; and
   (c) the impact of agency costs on franchise value.

(2) Each of those costs may be reflected already, in part or in whole, in earnings projections (items (1)(a) and (1)(b)), or in the measured cost of capital (item (1)(c)).

5.13.2 The earnings adjustments depend on a careful consideration of point (2) of ¶5.13.1. For our modelling we assume the following:

(1) Normal course of business effects are fully reflected in the earnings projections.
(2) The earnings projections do not include the expected value for all adverse claim scenarios or the expected cost of agency-principal issues costs which would arise in those extreme situations. We apply a 1% agency risk charge.
(3) The earnings projections have somewhat less transparency than assumed in the cost of capital source. We apply an additional 1% agency charge to the market value.

These assumptions give a cost of capital equal to 1% of capital plus 1% of market value, slightly less after taxes than 2%.

5.13.3 Table 5.7 shows the resulting cost of capital.

5.13.4 The effect of this agency risk provision is a 3.3% increase in the frictional cost of capital for the firm with capital invested in shares (18.3% minus 15.0% in Table 5.5), and 3.2% for the firm with capital invested in gilts.

5.14 *Regulatory Costs*

5.14.1 We will consider three elements of cost related to regulations.

5.14.2 Firstly, there is the cost of routine compliance. That is often part of the firm's normal expense, and so we make no additional adjustment.

5.14.3 Secondly, there are regulatory restrictions on the investment of assets. The effect of these restrictions is reflected in the earnings projections, and we make no additional adjustments. Moreover, Feldblum (pages 8 to 9)

Table 5.7. Shares & risk free capital – PBV = 1.5 impact of double tax, financial distress and agency costs for an A-rated firm

	Item		Capital invested in shares: Amount in £000	Capital invested in shares: %	Capital invested in gilts: Amount in £000	Capital invested in gilts: %
1	Insurance premium	(selected)	2,500		3,000	
2	Technical earnings	(backsolve)	365	14.6%	273	9.1%
	2.1 Earnings adj — financial distress costs	(selected)	−10	−0.5%	−10	−0.5%
	2.2 Earnings adj — agency costs	(selected)	−20	−1.0%	−20	−1.0%
	2.3 Adjusted tech earnings	= (2) + (2.1) + (2.2)	335		243	
3	Capital: in shares	(selected)	2,000	100%	0	0%
4	Capital: in gilts	(selected)	0	0%	2,000	100%
5	Capital total	= (3) + (4)	2,000	100%	2,000	100%
6	Earning on capital: shares	= (3)*9%	180	9%	0	9%
7	Earning on capital: gilts	= (4)*5%	0	5%	100	5%
8	Earning on capital: total	= (6) + (7)	180	9%	100	5%
9	Total earnings	= (2.3) + (8)	515		343	
10	Taxes	= (9)*30%	−155	30%	−103	30%
11	After tax earnings	= (9) + (10)	361		240	
12	ROC	= (11)/(5)	18.0%		12.0%	
13	Market value	(selected)	3,000	150%	3,000	150%
14	TSR — survivor firms	= (11)/(13)	12.0%		8.0%	
	14.1 Mortality risk	(selected)		2.0%		2.0%
	14.2 Agency risk — franchise adj	(selected)		1.0%		1.0%
	14.3 Total — franchise adj	= (14.1%) + (14.2%)	3.0%		3.0%	
	14.4 TSR — adjusted	= (14) − (14.3)	9.0%		5.0%	
15	Frictional capital cost TSR	= (2.3)/(13)	12.2%		9.1%	
16	Frictional capital cost ROC	= (2.3)/(5)	18.3%		13.7%	

Notes: See Table 5.5 notes.

believes that asset limitations do not matter, because the insurer earns a market rate of return on each asset class.

5.14.4 Thirdly, the insurer's ability to move capital from one territory to another in a multinational group or, more generally, to distribute dividends to shareholders is limited by regulators. *Sigma* 3/05 believes that the regulatory frictional cost is related to illiquidity, apparently referring to such limits on capital movement and dividend payments. They assign a liquidity risk cost of 0.5%, based on the market spread between similar liquid and illiquid investments.

5.14.5 We accept the 0.5% frictional cost adjustment and assign it to franchise value, because this cost will not affect earnings. The results of these

Table 5.8. Shares & risk free capital — PBV = 1.5 impact of double tax, financial distress agency costs, and regulatory costs for an A-rated firm

	Item		Capital invested in shares: Amount in £000	Capital invested in shares: %	Capital invested in gilts: Amount in £000	Capital invested in gilts: %
1	Insurance premium	(selected)	2,500		3,000	
2	Technical earnings	(backsolve)	385	15.4%	294	9.8%
	2.1 Earnings adj — financial distress costs		−10	−0.5%	−10	−0.5%
	2.2 Earnings adj — agency costs (selected)	= (2) + (2.1)	−20	−1.0%	−20	−1.0%
	2.3 Adjusted tech earnings	= (2) + (2.1) + (2.2)	355		264	
3	Capital: in shares	(selected)	2,000	100%	0	0%
4	Capital: in gilts	(selected)	0	0%	2,000	100%
5	Capital total	= (3) + (4)	2,000	100%	2,000	100%
6	Earning on capital: shares	= (3)*9%	180	9%	0	9%
7	Earning on capital: gilts	= (4)*5%	0	5%	100	5%
8	Earning on capital: total	= (6) + (7)	180	9%	100	5%
9	Total earnings	= (2.3) + (8)	535		364	
10	Taxes	= (9)*30%	−161	30%	−109	30%
11	After tax earnings	= (9) + (10)	375		255	
12	ROC	= (11)/(5)	18.7%		12.7%	
13	Market value	(selected)	3,000	150%	3,000	150%
14	TSR — survivor firms	= (11)/(13)	12.0%		8.5%	
	14.1 Mortality risk	(selected)		2.0%		2.0%
	14.2 Agency risk — franchise adj	(selected)		1.0%		1.0%
	14.3 Regulatory risk — franchise value	(selected)		0.5%		0.5%
	14.4 Total — franchise adj	= (14.1%) + (14.2%) + (14.3%)	3.5%		3.5%	
	14.5 TSR — adjusted	= (14) − (14.4)	9.0%		5.0%	
15	Frictional capital cost TSR	= (2.3)/(13)	12.8%		9.8%	
16	Frictional capital cost ROC	= (2.3)/(5)	19.3%		14.7%	

Notes: See Table 5.5 notes.

assumptions are in Table 5.8. Thus, we need an internal profit margin of 19.3% on capital before taxes in order to achieve the target TSR of 9%.

5.15 *Effect of Growth*

5.15.1 We consider three cases of how market value changes follow from growth or other changes in the firm's operations and related financial results.

5.15.2 *Case 1: permanent expense reduction*

Suppose that a firm reduced expenses and increased its margins. This

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might be due to cost reductions from automation or to a new distribution system with reduced acquisition expense. Then, if investors anticipate that the increase in margin was permanent, they would be willing to pay more for the firm's shares, and the market value would increase until the TSR with the reduced expense structure again equals the cost of capital. For example, suppose ROC was 15%, and increased to 16% with the expense reductions, and further suppose that ROC improvement produced a 5% increase in market value. The cost of capital remains unchanged, say at 9%. To retain the higher market value, the firm must continue to earn 16%. The 16% ROC target appears tougher than a 15% target, but with the automation and new distribution system, the 16% target is no tougher than 15% was pre-change. Case 1 also applies to any earnings growth which does not require increased capital. For example, ROC growth due to reduced capital requirements, e.g. diversification in risks, would have the same effect.

5.15.3 *Case 2: one-time earnings improvement*

A one-time earnings jump, say because there were fewer than expected catastrophes, might produce an increase in dividends, either immediately or over time, and a corresponding share price increase until the dividend is paid. It will not, however, produce a longer-term increase in the share price or a change in the cost of capital.

5.15.4 *Case 3: earnings grow with premium, but with no improvement in margins*

Consider an increase in earnings produced from more premiums, which requires a proportionate increase in capital and franchise value, for example the purchase of a company or a block of business. The market value of the firm would also grow proportionately, but it would not change the wealth of any of the investors. The increase in capital must come by deferring dividends or by raising capital from new or existing shareholders. The improvement has no value to shareholders, because they can achieve the same result by buying more shares of the same firm. As a second order effect, however, the cost of capital might increase to the extent indicated by the size effect in the FF3F model.

5.15.5 *Summary*

Investors prefer Case 1, a permanent increase in margins, because it produces a 10% increase in their wealth. Case 2, earnings 10% above the cost of capital on a one-off basis, produce only a 1% increase in wealth (11% minus 10%). Either of those cases is better than simply more of exactly the same business. In the real world it is difficult to distinguish clearly among these cases. Even Case 3 can be difficult to distinguish from other cases, as increases in premium without increases in margin do not necessarily immediately require additional capital. Nonetheless, in the longer run, we expect the underlying cause in earnings growth to drive the market value. This summary is aimed to consider the major strategic effects of growth. The impact on a particular firm will depend on timing issues and whether the growth triggers other effects. For example, share prices might rise in anticipation of a one-time increase in dividends; or a capital constrained firm with a Case 2 one-time earnings increase might be able to use the capital to improve its financial rating, allowing it to increase profitable business and reduce the market value effect of mortality risk.

5.15.6 As a reality check, note that ¶5.15.4 argues that premium growth without growth in margins does not increase franchise value. This seems to be inconsistent with the importance which management, boards and shareholders seem to place on growth. We think that the reasons for this include the following:

(1) Case 3 growth in earnings, which requires a proportionate increase in capital, is often expected to require a less than proportionate increase in human capital and IT resource. If so, the increase would not require a proportionate increase in capital and franchise value, and the situation is really Case 1, where we should be looking at premium growth as a source of improving margins ('economies of scale').
(2) The current value of the business assumes an ongoing profit stream. It may not be credible that a business with no growth will continue to earn its profit stream. Therefore, growth confirms that that existing profit stream is reliable. Lack of growth reduces the reliability of the profit stream and increases an additional agency (transparency) cost which reduces market value.
(3) Management is interested in growth as evidence of its success. If the forecasted growth is not achieved, the transparency of all of management's forecasts becomes questionable, and agency/transparency charges reduce franchise value.
(4) From management's perspective, growth reduces the chance of a take-over.

Thus, growth in size without increase in margins appears to be important, because lack of growth can damage the existing franchise value, rather than because it drives an increase in franchise value.

5.16 *Growth Example*

5.16.1 In this section we consider the impact of growth in margins on the frictional cost of capital and target technical earnings. For example, suppose that, starting from the situation described in Table 5.8, management plans to make investments which will permanently increase technical earnings (line 2) from 15.4% to 16.4% (a 6% increase). This percentage increase in margins produces an earnings increase of £25m (1% profit margin improvement times £2,500m in premium). Since the frictional capital cost

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Table 5.9. Effect of growth in margins shares & risk free capital – PBV = 1.5; impact of double tax, financial distress agency costs, and regulatory costs for an A-rated firm

			(A) Initial state	(B)	(C) After growth in margin	(D)	(E) During implementation	(F)
	Item		Amount in £000	%	Amount in £000	%	Amount in £000	%
1	Insurance premium	(selected)	2,500		2,500		2,500	
2	Technical earnings	(see notes)	385	15.4% (Note 1)	410	16.4% (Note 2)	200	8.0% (Note 1)
	2.1 Earnings adj — financial distress costs	(selected)	–10	–0.5%	–10	–0.5%	–10	–0.5%
	2.2 Earnings adj – agency costs (selected)	= (2) + (2.1)	–20	–1.0%	–20	–1.0%	–20	–1.0%
	2.3 Adjusted tech earnings	= (2) + (2.1) + (2.2)	355		380		170	
3	Capital: in shares	(selected)	2,000	100%	2,000	100%	2,000	100%
4	Capital: in gilts	(selected)	0	0%	0	0%	0	0%
5	Capital total	= (3) + (4)	2,000	100%	2,000	100%	2,000	100%
6	Earning on capital: shares	= (3)*9%	180	9%	180	9%	180	9%
7	Earning on capital: gilts	= (4)*5%	0	5%	0	5%	0	
8	Earning on capital: total	= (6) + (7)	180	9%	180	9%	180	9%
9	Total earnings	= (2.3) + (8)	535		560		350	
10	Taxes	= (9)*30%	–161	30%	–168	30%	–105	30%
11	After tax earnings	= (9) + (10)	375		392		245	
12	ROC	= (11)/(5)	18.7%		19.6%		12.3%	
13	Market value	(selected)	3,000	150%	3,140	157%	3,140	157%
14	TSR — survivor firms	= (11)/(13)	12.5%		12.5%		7.8%	
	14.1 Mortality risk	(selected)		2.0%		2.0%		2.0%
	14.2 Agency risk – franchise adj	(selected)		1.0%		1.0%		1.0%
	14.3 Regulatory risk – franchise value	(selected)		0.5%		0.5%		0.5%
	14.4 Total – franchise adj	= (14.1%) + (14.2%) + (14.3%)	3.5%		3.5%		3.5%	
	14.5 TSR – adjusted	= (14) – (14.4)	9.0%		9.0%		4.3%	

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Table 5.9. (continued).

	Item		(A) Initial state Amount in £000	(B) %	(C) After growth in margin Amount in £000	(D) %	(E) During implementation Amount in £000	(F) %
15	Frictional capital cost TSR	=(2.3)/(13)	12.8%		13.1%		6.4%	
16	Frictional capital cost ROC	=(2.3)/(5)	19.3%		20.5%		10.0%	
17	Growth – increase in margin	Selected				1.0%		
18	Growth in mkt adj earnings (info)	C2.3/A2.3				7.0%		
19	Capital gains per share	C13/A13				4.7%		
20	Total required shareholder return	A14.5 = C14.5				9.0%		
21	Shareholder return from earnings	D20 – D19				4.3%		

Notes: (1) Backsolved.
(2) Selected.

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(ROC basis) is 19.3% before taxes and $0.7 * 0.193 = 13.5\%$ after taxes, we would expect that, if nothing else changes, an investment equal to £25m/(1/0.135) = £185m would support the current cost of capital. An investment greater than £185m would reduce market value, and an investment of less than £185m would increase the market value. Table 5.9 shows that, as long as the changes do not affect the agency or the mortality risk factors, then the result is as expected. Table 5.9 also shows how the cost of capital is supported by both changes in market value (capital gains) and income.

5.16.2 Columns (A) and (B) repeat the information from Table 5.8.

5.16.3 Columns (C) and (D) show the intended situation after the investment is completed. Technical earnings of 16.4% (line 2, column D) support a PBV of 157% (line 13, column D), compared to 150% (line 13, column B) when technical earnings are 15.4%.

5.16.4 Columns (E) and (F) show the situation during the year of implementation. During the year of implementation, market value increases 4.7% (1.57/1.50 − 100%) without any earnings in the year. Since 4.7% of the 9% TSR will be achieved without earnings, the earnings/capital (ROC) in that year needs to be only 4.3% (9% cost of capital less the 4.7% return on share price) to support its share price. Line 2 shows that technical earnings of 8.0% will yield the required 4.3% earnings component of TSR.

5.16.5 The difference between 8% earnings in the implementation year and 15.4% earnings prior to implementation is £185m; the investment level which gives investors the target TSR.

5.16.6 This analysis assumes that the cost of implementing the changes required to support the improvement in operating margin is treated as an expense rather than as an investment for accounting and tax purposes. If some or all of the expense were capitalised, then, apart from tax effects, the increase in market value would be less than 4.7%, but the earnings would be offset by an equal amount. Tax effects would likely reduce the breakeven investment amount.

5.16.7 The analysis in Table 5.9 is unnecessarily complex if there are no changes in agency or mortality risks associated with implementing the changes. The framework is useful, however, to be sure that we consider whether those risks will affect the investor perspective on earnings, and also to separately consider the earnings and market value impact of the investments.

5.17 *Relative Importance of the Different Frictional Costs*

5.17.1 In order of importance, the elements that most significantly affect the internal cost of capital are as shown in Table 5.10. The change in cost of capital is the change in target investor return. The change from base in technical earnings is the decrease (increase) in premium required from policyholders to achieve the change in target return.

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Table 5.10. Assumptions that most significantly affect the internal cost of capital base case is capital in gilts – PBV = 1.5; impact of double tax, financial distress agency costs, and regulatory costs for an A-rated firm

	Item	Comment	Change from base Cost of capital	Change from base Tech. earn
0	Base	Capital in gilts — frictional capital cost = 14.7% (Table 5.8 line 16 gilts); technical earnings = 9.8% (line 2 gilts)	Base	Base
1		Capital in shares – frictional capital cost = 19.3% (Table 5.9 line 16 shares)	+4.6%	+5.6%
	Capital 100% in gilts for items below:			
2	Market value to book value	Decrease PBV (line 13) from 150% to 125%	−3.0%	−2.0%
3	Premium to surplus ratio	Increase the premium to surplus ratio to 100% (line 1 = £2.0m rather than £3.0m)	0.0%	+4.9%
4	Target cost of capital	A decrease in target cost of capital from 5% to 4% (gilts still earn 5%)	−2.1%	−1.4%
5	Tax rate	A decrease from 30% to 25%	−1.2%	−0.8%
6	Agency risk	A decrease in agency cost from 2% to 1% (0.5% in earnings and 0.5% in franchise value)	−1.5%	−1.0%
7	Mortality risk	Reducing the cost of financial distress by half, to 0.25% in earnings and 1.0% in franchise value	−2.4%	−1.6%
8	Combined	Changes 1 to 6 simultaneously	−8.1%	−5.4%
9	Zero tax	Tax rate 0% (low tax domicile)	−5.4%	−3.6%
10	Alternative combination	The effect of similar changes that increase the frictional capital cost and required technical earnings. See note below.	+11.1%	+3.1%

Note: The combined effect of changes that increase the frictional capital cost as follows: 175% PBV (up 25% rather than down 25%), premium up £1m to 4m with no change in capital, cost of capital for gilts at 6% (up 1%), tax rate up 5% to 35%, agency risk up 1.0% to 1.5% in earnings and 1.5% in franchise value, and mortality risk up 1.0% to 1.0% in earnings and 2.5% in franchise value. The result is an increase in friction capital cost of +11.1% to 25.8% and an increase of 3.1% in target technical earnings to 12.9%.

5.18 *Two Comments arising from Table 5.10*

5.18.1 *Policyholder perspective on investment strategy*

Firstly, we note that comparing case 1, investment of capital in shares, to the base case, investment of capital in gilts, it appears that gilts are better than shares from a policyholder perspective, because investment of capital in gilts produces a lower required premium than investment of capital in shares (5.6% higher premiums for the firm investing in shares). The primary sources of this difference are:

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(1) partly the effect of taxes; and
(2) partly the assumption that the premium to capital ratio can be higher for the insurance firm investing capital in gilts than for the firm investing capital in shares.

To the extent that these and other assumptions in the model are valid, and if all else were constant, competition would drive insurers towards heavy investment in gilts and there would be a security conscious shareholder group which accepted the returns associated with that strategy. In practice, investment strategies vary considerably, with some firms able to hold individual shares for long periods and avoid paying tax on unrealised appreciation — we do not conclude that there is a single 'right' strategy.

5.18.2 *Tax considerations*

The fact that some jurisdictions are more efficient places to hold insurance capital than others is a very topical one, with a number of London Market insurers moving capital and operations to Bermuda. Case 9 in Table 5.10, zero tax, compared to the base case 30% tax, shows a reduction of 5.4% in the cost of capital if the benefit flows to the investors, or a reduction of 3.6% if the benefit flows to the policyholders. Theory would suggest that, if all insurers had access to a zero-tax position, then competition would give the benefit to the policyholders. To the extent that not all insurers have access to the zero tax position, then at least some of the benefit would flow to the investors. Further, note that the cost of capital reduction would be achieved as an increase in the market value of the firm. The frictional capital cost as a percentage of market value would be reduced, but the internal frictional capital cost (ROC), which we see as driving internal management targets, would not be changed.

5.19 *So, what do these Examples tell us?*

(1) Looking at stock market returns for insurers, it is clear that investors do not require abnormally high returns for investing in insurance enterprises.
(2) On the other hand, frictional costs, a financial economics term, explain why insurance firms need to earn a non-zero return in excess of the investment earnings on capital.
(3) Of those frictional costs, some are 'purely frictional', like taxes. To the extent that firms can choose the jurisdiction for incorporation or operation, they may be able to seek better tax treatment.
(4) Some are closely related to 'risk margins' in normal actuarial terminology, because they are market charges above expected values for taking risk (mortality and agency risk, for example).
(5) We hope that we have helped to translate some financial economics terms into insurance and actuarial terms.

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(6) Financial economics is an evolving story. We hope that an ongoing dialogue between the actuarial and financial economics approaches will result in increasing convergence of our understanding of the business.

6. Summary and Conclusions

6.1 *Assessing Target Capital*

6.1.1 When assessing target capital, the firm needs to consider three different approaches to risk appetite:

(1) regulatory capital plus a buffer;
(2) rating agency views; and
(3) shareholders' views, where they make commitments to customers and wish to protect franchise value.

When balancing and blending the three views above, the firm needs to understand the trade-offs between:

(4) double taxation burden;
(5) insurance gearing (leverage of premiums to capital ratio); and
(6) maximising franchise value.

6.1.2 At the core of the problem is a trade-off:

(1) Arguing for a higher level of capital for a given volume of business is:
    (a) a better credit rating which may attract better business and enable higher premiums to be charged; and
    (b) higher capital which reduces the risk of having to recapitalise (which would cause existing shareholders to suffer dilution on adverse terms), and also reduces the risk of losing business, reputation and consequent loss of franchise value.

(2) Against this, each additional unit of capital imposes a cost through:
    (a) tax inefficiency compared to the shareholder holding its investments directly and not through the insurance firm;
    (b) other 'frictional costs', such as the cost of financial distress and agency risk;
    (c) exposure to insurance risk, and, in particular, the considerable parameter uncertainty within projections; and
    (d) reduced investment freedom for the shareholder.

6.1.3 Target capital and the cost of capital form a bridge between the insurance firm and the financial markets, hence it is a balancing solution to the opposing forces of (1) to (3) and (4) to (6).

6.1.4 The 'target capital' to which we refer in this paper is what a firm chooses to hold as a result of a strategic evaluation. Capital held does not

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come directly from a computer model; it is a mixture of regulatory, rating agency and strategic requirements. As such, it is a choice within constraints.

6.2 *Market Consistent Management Targets*

6.2.1 We suggest that an appropriate target for managers should be established, considering the required total return on the market value of the firm, as determined by reference to the opportunity cost of alternative investments of equivalent risk. This is opportunity cost, often referred to as the 'cost of capital'.

6.2.2 This investor cost of capital is not the same as ROE or other internal measures of return. The internal targets must be calculated by determining the profits needed to cover the market value of frictional costs and achieve the market consistent earnings, as described in Section 5.

6.2.3 A common insurance pricing model formulates the pricing problem by looking at the cash flows to and from the owners of the insurance firm, i.e. the commitment of capital and the receipt of after-tax underwriting profits and after-tax investment income. We suggest that these models need to consider the additional frictional costs, identified in Section 5, in order to establish targets which are market consistent and which support the firm's market valuation.

6.2.4 Note that the external cost of capital must not be applied directly to the equity in ROE calculations to assess a required profit target. For example, suppose that you have derived a cost of capital which varies by line of business, using CAPM/FF3F studies looking at the return on TMV. When applying these to the firm, it is not appropriate to apply them directly in ROE calculations, instead the process should start from TSR and cascade down in order to assess required risk loads.

6.2.5 The risk load so calculated only covers the cost of capital, i.e. it produces a 'break even' result in economic value terms. It is necessary to add an additional profit load on top in order to create 'economic profit'.

6.3 *Traditional CAPM Methods may underestimate the Cost of Capital for General Insurance Firms*

6.3.1 This is not a criticism of CAPM. CAPM is a high level view, applied to the whole spectrum of all industries, and measures only the relationship between expected returns and beta or systematic risk. Alternative methods (such as the FF3F method) allow for systematic risk, and also for the size of the firm and its price/book ratio.

6.3.2 Cummins & Phillips (2005) apply the FF3F method to general insurance firms, and estimate a higher value for required returns than the CAPM method. They explain this by linking the price to book ratio to the costs of financial distress, which are particularly important for general insurance firms, given the influence of insurance strength ratings from the rating agencies.

6.4 *Target Risk-Based Returns for General Insurance Firms vary with Solvency Ratio/Leverage*

6.4.1 The probability of default should play some role in setting the required returns of investors from insurance firms, and should play some role when the firms are setting insurance prices.

6.4.2 For example, insurance purchased from a relatively safe insurance firm should be less risky, and thus command a higher price, than one from a firm with a higher probability of default.

6.4.3 It is an important result that the price for the rare events which cause the potential defaults of insurance firms can be judged by the investor by reference to the credit default spreads in the financial markets, thus producing a market consistent view.

6.5 *Target Risk-Based Returns for General Insurance Firms vary with Line of Business*

6.5.1 This is related to the 'riskiness' of the lines of business, but is not suggesting a reward for statistical process variability. Instead, it arises from the variation in frictional costs arising from the different insurance risks in the firm, together with the non-diversifiable systematic risk in the insurance liabilities.

6.5.2 Frictional costs are very important for insurers; these costs are internal to the insurance firm and are not relevant to CAPM, which deals with observed profits. The relationship between insurance volatility and franchise value is complex. Small levels of volatility due to process risk may have no impact on franchise value. However, unexpected extreme events (volatility) arising from parameter and model risk can affect uncertainty (actuarial language) and agency risk costs and financial distress costs (financial economics language). This parameter uncertainty also affects many firms at once in the sector. If you knew that your models were exactly right, then you could capitalise the firm exactly to the correct level. Investment markets seem to believe that insurance firms are not as safe as they say that they are, and hence require an extra return to cover that uncertainty.

6.6 *Increased Investment Risk in a General Insurance Firm does not Increase Shareholder Value*

Holding shareholder funds in shares does not appear to increase the franchise value; it marginally decreases it, according to a historical study by Swiss Re *sigma* 3/05. This is due to increased default risk and the market's fear of loss of franchise value.

6.7 *Market Consistent Earnings mean Best Estimate Cash Flows (including all Scenarios) and including the Cost of Insurer Default*

6.7.1 If you are discounting business plans, e.g. to calculate an NPV, the CAPM and FF3F methods assume that their derived yield is being applied to

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a true best estimate of the forecast earnings, i.e. the probability weighted average of all possible outcomes, including outcomes with failure of the firm. This is so that, when the investor is combining many different investments in a portfolio, the so-called diversifiable risks can be diversified away in a statistical manner.

6.7.2 Therefore, the forecast earnings should not be just a median or a mode, set without reference to the whole distribution. Nor should they be a stretching aspirational target.

6.7.3 When the investor calculates an NPV of the future mean earnings assessed in ¶6.7.1, he puts a price on those earnings which reflects the risks which are rewarded by the financial markets, including the cost of default, as demonstrated by Cummins & Phillips.

6.7.4 Note that it is not double counting to have the firm's credit risk appear in both ¶¶6.7.1 and 6.7.3. It is interesting to note the comparison of which risks appear in which parts of the firm's value equation:

(1) The mean earnings forecasts include all statistical risks, both diversifiable and non-diversifiable.
(2) The capital to support the business is assessed, partly using risk measures which include all insurance statistical risks, and partly by reference to credit default rates and the impact of other frictional costs on franchise value.
(3) The risk discount rate to combine the earnings and capital in an NPV calculation reflects only those risk elements which will attract a reward in the financial markets.

6.8 *Do Investors Require an Equity like Return from an Insurance Firm?*

Consider the following example: the risk-free rate is 5%, and the market average equity risk premium is 4%; what return would investors demand from a general insurance firm, if the firm invests its capital assets in gilts?

(1) Swiss Re *sigma* 3/05 would quote a target return which would be equivalent to 9.6%.
(2) Cummins & Phillips would quote a target return which would be equivalent to 11%.
(3) The Swiss Solvency Test quotes 6% over the risk-free rate for setting risk margins in technical provisions.

This suggests that current models do, indeed, require an equity-like return, and one which is greater than the market average, in line with the additional risks.

6.9 *Target Capital and Cost of Capital as Bridges between the Insurance Firm and the Financial Markets*

6.9.1 The ideas covered in this paper are not necessarily new, but we hope that they will help actuaries to understand and to make use of some of

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the ideas of financial economics. We have sought to explain that there is less difference between the actuarial and the financial economic approaches than there might appear to be, and that both are relevant to the problem of how much capital an insurer should hold, and the closely related question of what target return the shareholders should require or expect.

6.9.2 Considering all frictional costs, the return which the insurance business has to provide over the whole insurance cycle is surprisingly high if insurers are not to destroy value. In particular, the impact of double taxation puts the insurance industry at a significant disadvantage, particularly when compared to 'alternative risk transfer' mechanisms, which are becoming popular.

6.9.3 However, target returns vary, depending on the types of risk present in the business. Those lines of business which require high levels of capital relative to premium written also inevitably require considerably higher profit or risk loads in the premiums which they charge their customers.

6.9.4 Whilst there is no 'correct' answer to the target capital problem, which is essentially judgemental, we find that there is useful recent literature which helps us to make a start. There is most surely a 'wrong' answer, and we hope that this paper will help actuaries to avoid it. Our hope is that our work will lead others to consider these questions and to take our thinking forward.

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APPENDIX A

ILLUSTRATIVE CALCULATIONS OF ALTERNATIVE AMOUNTS OF CAPITAL TO HOLD

A.1 *Hypothetical Model of Liabilities*

A.1.1 We illustrate the principles discussed in Section 2 by means of a firm whose claims costs vary as a lognormal curve with different coefficients of variation. In practice, the firm could reproduce the Value at Risk and Tail Value at Risk measures from its own DFA model of its capital requirements.

A.1.2 In Table A.1, we show the expected premiums and the distribution of claims at various VaR and TVaR levels for a range of coefficients of variation (CoV) from 15% to 25%. We assume that the investment income covers expenses.

A.1.3 In Table A.2, we show different capital calculations for a firm which invests its capital in gilts. If the firm has a solvency ratio of 67%, and a ratio of liabilities to premium of 200%, its ECR would amount to 45% of premium. Suppose that its coefficient of variation were 17.5%, then its ICA would amount to 46% of premium. We then show the capital requirement for various alternative measures:

(1) regulatory capital plus a buffer at a one in five and a one in ten level;
(2) rating agency capital at A, AA and AAA levels; and
(3) capital based upon different TVaR levels.

What is of interest is, not only the absolute levels, but also the relative levels. For example, with a coefficient of variation of 17.5%, the increase for a one in five buffer is 18%, for a one in ten buffer is 36%; the uplift from BBB to A is 34%, to AA is 46%, and to AAA is 63%.

A.1.4 In Table A.3, we repeat the calculations in Table A.2 for a firm which invests its capital in shares. If the firm has a solvency ratio of 80%, and a ratio of liabilities to premium of 200%, its ECR would amount to 56% of premium. Suppose that its coefficient of variation were 20%, then its ICA would amount to 55% of premium. For a coefficient of variation of 20%, the increase for a one in five buffer is 18%, for a one in ten buffer is 36%; the uplift from BBB to A is 35%, to AA is 48%, and to AAA is 65%. If we assume that the difference in ECRs gives an approximate indication of the impact of the extra risk from the investment strategy, the higher CoV mimics this in the modelling of the firm. Then it can be seen that the uplifts over the ICA are similar for the two examples.

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Table A.1. Risk measures for example firm with lognormal risk profile

	Premiums	1,000	1,000	1,000	1,000	1,000
	Loss ratio	95%	95%	95%	95%	95%
	Claims					
	Best est	950	950	950	950	950
	CoV	15%	17.5%	20%	22.5%	25%
	Std Devn	143	166	190	214	238
	Lognormal					
	Mu	6.845	6.841	6.837	6.832	6.826
	Sigma	0.149	0.174	0.198	0.222	0.246
	VaR claim levels					
5	80.0%	1,065.2	1,083.1	1,100.5	1,117.4	1,133.9
10	90.0%	1,137.4	1,169.1	1,200.7	1,232.2	1,263.7
100	99.0%	1,329.2	1,401.7	1,476.7	1,554.3	1,634.3
200	99.5%	1,379.6	1,463.7	1,551.5	1,642.9	1,737.8
250	99.6%	1,395.4	1,483.3	1,575.1	1,670.9	1,770.7
500	99.8%	1,443.3	1,542.7	1,647.2	1,757.0	1,872.1
1,000	99.9%	1,489.6	1,600.5	1,717.9	1,841.8	1,972.4
3,333	99.97%	1,567.5	1,698.3	1,838.0	1,987.0	2,145.4
10,000	99.99%	1,636.1	1,785.2	1,945.7	2,118.0	2,302.7
	TVaR claim levels					
5	80.0%	1,160.5	1,197.4	1,234.6	1,272.2	1,310.0
10	90.0%	1,223.0	1,272.6	1,323.3	1,374.9	1,427.4
100	99.0%	1,399.7	1,488.9	1,582.3	1,680.0	1,781.9
200	99.5%	1,447.6	1,548.4	1,654.6	1,766.3	1,883.7
250	99.6%	1,462.8	1,567.2	1,677.5	1,793.8	1,916.0
500	99.8%	1,508.8	1,624.8	1,747.9	1,878.4	2,016.3
1,000	99.9%	1,553.7	1,681.1	1,817.2	1,962.1	2,116.1
3,333	99.97%	1,629.4	1,776.9	1,935.7	2,106.1	2,288.8
10,000	99.99%	1,696.6	1,862.5	2,042.3	2,236.8	2,446.6

Notes: (1) Mu = (4*LN(Mean) – LN(StdDev^2 + Mean^2))/2.
(2) Sigma = (LN(StdDev^2 + Mean^2) – 2*LN(Mean))^0.5.
(3) VaR = EXP(NORMINV(Percentile,Mu,Sigma)).
(4) TVaR = (Mean – Mean*NORMSDIST((LN(VaR) – Mu – Sigma^2)/Sigma))/(1 – Percentile).

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Table A.2. Choices of capital amount for lognormal firm with capital in gilts

	Premiums	1,000	1,000	1,000	1,000
	Loss ratio	95%	95%	95%	95%
	Claims				
	Best est	950	950	950	950
	CoV	15%	17.5%	20%	25.0%
	Std Devn	143	166	190	238
	Lognormal				
	Mu	6.845	6.841	6.837	6.826
	Sigma	0.149	0.174	0.198	0.246
	Capital: regulatory plus buffer				
	ICA/VaR 1/200	379.6	463.7	551.5	642.9
	ICA + VaR 1/5	444.8	546.8	652.0	760.3
	ICA + VaR 1/10	517.0	632.8	752.2	875.1
	Capital: rating agency level				
BBB	99.721%	420.5	514.3	612.8	823.6
A	99.966%	559.5	688.3	825.7	1,127.5
AA	99.985%	611.0	753.4	906.1	1,244.7
AAA	99.995%	678.5	839.2	1,012.9	1,402.1
	Capital: TVaR levels				
1/100	99.0%	399.7	488.9	582.3	781.9
1/200	99.5%	447.6	548.4	654.6	883.6
1/250	99.6%	462.8	567.2	677.5	916.0
1/500	99.8%	508.8	624.8	747.9	1,016.3
1/1,000	99.9%	553.7	681.1	817.2	1,116.1
	Balance sheet (capital in gilts)				
	Solvency ratio	67%	67%	67%	67%
	Premiums	1,000	1,000	1,000	1,000
	Liabilities	2,000	2,000	2,000	2,000
	Capital	670	670	670	670
	Assets	2,670	2,670	2,670	2,670
	ECR (capital in gilts)				
3.5%	Asset	93	93	93	93
12%	Premium	120	120	120	120
12%	Reserve	240	240	240	240
		453	453	453	453
	As % premium:	45%	45%	45%	45%
	ICA/ECR:	84%	102%	122%	163%

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Table A.3. Choices of capital amount for lognormal firm with capital in shares

	Premiums	1,000
	Loss ratio	95%
	Claims	
	Best est	950
	CoV	20%
	Std Devn	190
	Lognormal	
	Mu	6.837
	Sigma	0.198
	Capital: regulatory plus buffer	
	ICA/VaR 1/200	551.5
	ICA + VaR 1/5	652.0
	ICA + VaR 1/10	752.2
	Capital: rating agency level	
BBB	99.721%	612.8
A	99.966%	825.7
AA	99.985%	906.1
AAA	99.995%	1,012.9
	Capital: TVaR levels	
1/100	99.0%	582.3
1/200	99.5%	654.6
1/250	99.6%	677.5
1/500	99.8%	747.9
1/1,000	99.9%	817.2
	Balance sheet (capital in shares)	
	Solvency ratio	80%
	Premiums	1,000
	Liabilities	2,000
	Capital	800
	Assets	2,800
	ECR (capital in shares)	
16%	Asset (1)	198
12%	Premium	120
12%	Reserve	240
		558
	As % premium:	56%
	ICA/ECR:	99%

Note: (1) Asset component of ECR: 3.5%*2,000 + 16%*800 = 198.

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Table A.4. Mean RoE versus VaR percentile for lognormal firm with capital in gilts

	Premiums	1,000	1,000	1,000	1,000	1,000
	Loss ratio	95%	95%	95%	95%	95%
	Claims					
	Best est	950	950	950	950	950
	CoV	17.5%	17.5%	17.5%	17.5%	17.5%
	Std Devn	166	166	166	166	166
	Lognormal					
	Mu	6.841	6.841	6.841	6.841	6.841
	Sigma	0.174	0.174	0.174	0.174	0.174
	Capital: VaR levels					
BBB	99.721%	514.3				
	99.900%		542.7			
A	99.966%			688.3		
AA	99.985%				753.4	
AAA	99.995%					839.2
	Balance sheet (capital in gilts)					
	Solvency ratio	51.4%	54.3%	68.8%	75.3%	83.9%
	Premiums	1,000	1,000	1,000	1,000	1,000
	Liabilities	2,000	2,000	2,000	2,000	2,000
	Capital	514	543	688	753	839
	Assets	2,514	2,543	2,688	2,753	2,839
	Insurance result (capital in gilts)					
	Premiums	1,000	1,000	1,000	1,000	1,000
	Inv Inc	100	100	100	100	100
	Claims	(950)	(950)	(950)	(950)	(950)
	Expenses	(50)	(50)	(50)	(50)	(50)
	Technical result	100	100	100	100	100
	Investment profit	26	27	34	38	42
	Total profit	126	127	134	138	142
	Mean ROE	24.4%	23.4%	19.5%	18.3%	16.9%

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APPENDIX B

INSURANCE AS A LEVERAGED INVESTMENT FUND: EFFECT OF ADDING A FRICTIONLESS INSURANCE FEATURE

B.1 The issue which we consider here is the extent to which it is reasonable to assume that adding a frictionless insurance feature to a leveraged investment fund increases the cost of capital (i.e. 'is 'x' zero?').

B.2 Consider the insurance leveraged fund shown in Table 5.2 and repeated in Table B.1.

B.3 The pure risk-neutral perspective suggests that, in the leveraged fund context, the required return from insurance operations would be zero, because the insurance risk is a diversifiable risk, and investors can make the 9% required return related to the investment of capital from the return on shares. Others (*sigma* 3/05, page 12) say that the fund return needs to be 'at least' the 9% return from shares.

B.4 The insurance structure with the underlying technical reserves can be seen more clearly in Table B.2, shown in two cases, with capital invested in shares or gilts.

B.5 The risk neutral perspective argues that, if the fund invests in shares, the cost of capital would be exactly 9%, and if the fund invests only in long-term risk-free bonds, the cost of capital would be 5%, because the opportunity cost for an investor choosing that type of security is 9% and 5% respectively.

B.6 To support the pure risk-neutral claim that the target return can be exactly 9% (or 5%), we need to consider the following logic:

(1) The risk neutral view compares the combined insurance operation and the investment of shares to a leveraged fund.

(2) On that basis, 0% for insurance is appropriate if the risk parameters, let us simplify and say the standard deviation of returns, of the combined portfolio is the same as, or better than, the standard deviation of the equity returns.

(3) In addition, the risk neutral perspective assumes that the insurance result has zero correlation with the equity returns.

(4) Let us further assume that the insurance result varies solely due to process variation, which could be made as small as we chose by increasing the number of risks (for example, if we insured the outcome of fair dice games).

Table B.1. Insurance leveraged fund (copied from Table 5.2)

Capital	100	Earning	9%	=	9
Technical reserves	(200)	Costing	x%	=	($2x$)
Investments of technical reserves in gilts	200	Earning	5%	=	10
Total	100	Earning	($19 - 2x$)%	=	$19 - 2x$

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Table B.2. Fund structure (no frictional costs) — capital invested as shown

	Item		Capital invested in shares: Amount in £000	Capital invested in shares: %	Capital invested in gilts: Amount in £000	Capital invested in gilts: %
1	Insurance premium	(selected)	2,500		2,500	
2	Technical earnings	(backsolve)	0	0.0%	0	0.0%
3	Capital: in shares	(selected)	2,000	100%	0	0%
4	Capital: in gilts	(selected)	0	0%	2,000	100%
5	Capital total	=(3)+(4)	2,000	100%	2,000	100%
6	Earning on capital: shares	=(3)*9%	180	9%	0	9%
7	Earning on capital: gilts	=(4)*5%	0	5%	100	5%
8	Earning on capital: total	=(6)+(7)	180	9%	100	5%
9	Total earnings	=(2)+(8)	180		100	
10	Taxes	=(9)*0%	0	0%	0	0%
11	After tax earnings	=(9)+(10)	180		100	
12	ROC	=(11)/(5)	9.0%		5.0%	
13	Market value	(selected)	2,000	100%	2,000	100%
14	TSR	=(11)/(13)	9.0%		5.0%	
15	Frictional capital cost TSR	=(2)/(13)	0.0%		0.0%	
16	Frictional capital cost ROC	=(2)/(5)	0.0%		0.0%	

(5) Even with the restrictive assumptions above, the standard deviation of the combined equity portfolio and insurance operation is still larger than the standard deviation of the equity portfolio alone (combined standard deviation = SQRT (variance equity portfolio plus variance insurance result), assuming that they are independent).

(6) This can be evaluated in at least three ways:

(a) The additional risk of insurance risk can be made as small as we choose, so, asymptotically, there is no difference in risk.

(b) The price of purchasing the £2bn of capital (shares or gilts) could be increased by an arbitrarily small amount, providing some additional capital, to leave the variance per unit of capital unchanged when the insurance risk is combined with the risk of the investment in gilts or shares. While this reduces the return to something smaller than 12%, that reduction can be made arbitrarily small.

(c) An insurance return greater than 0% (e.g. even 0.001% if the standard deviation of the insurance results is small enough) will increase the overall return to more than 12%, and, with smooth enough investor risk/reward trade-offs, will be sufficient to make the total return large enough for the investor.

B.7 Thus, the pure risk neutral claim is not exactly correct, but it can be made as close to correct as we choose, with the additional assumption that

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the insurance risk can be made arbitrarily small by increasing the size of the portfolio.

B.8 Since real insurance risk includes model risk and parameter risk, which cannot be diversified by insuring more risks, it can be only partially diversified across lines of business, and may have some residual market-correlated risk (e.g. financial markets and insurance claims are correlated with inflation). These risks might be considered in assessing the frictional cost structure of the insurer, as we have tried to do in Section 5.

B.9 Note that, in this discussion, we are not claiming that totally diversifiable risk requires a financial reward; we are questioning the exact meaning of what constitutes diversifiable risk. The FF3F model, discussed above, illustrates how financial economics recognises that risks other than fluctuations in market values are considered in valuing investments.