Chief Risk Officer Forum

July 2008

Market Value of Liabilities for Insurance Firms

Implementing elements for Solvency II

The Chief Risk Officer Forum (CRO Forum) comprises risk officers of the major European insurance companies and financial conglomerates. It is a professional group that was formed to develop and promote industry best practices by working jointly to address key risk-related issues facing the industry. The membership is shown below.

MEMBER COMPANY	REPRESENTATIVE	EMAIL ADDRESS
Aegon NV	Tom Grondin	tom.grondin@aegon.com
AIG, Inc	Robert Lewis	robert.lewis@aig.com
Allianz AG	Tom Wilson	tom.wilson@allianz.com
Aviva PLC	Jim Webber	Jim.webber@aviva.com
AXA Group	Jean-Christophe Menioux	Jeanchristophe.menioux@axa.com
Chubb*	Joel Aronchick	jaronchick@chubb.com
Eureko	Margreet Haandrikman	margreet.haandrikman@achmea.nl
Fortis	Olav Jones	olav.jones@fortis.com
Generali	Paul Caprez	paul_caprez@generali.com
Groupama	Rene Cado	rene.cado@groupama.com
Hannover Re	Eberhard Mueller	eberhard.mueller@hannover-re.com
HBOS*	Roger Dix	rogerdix@hbosplc.com
ING Group	Jeroen Potjes	jeroen.potjes@ing.com
Insurance Australia Group*	Tony Coleman	tony.coleman@iag.com.au
MetLife*	Henry Essert	hessert@metlife.com
Munich Re	Jo Oechslin	joechslin@munichre.com
Old Mutual plc*	Daniel Bruce	daniel.bruce@omg.co.uk
Prudential plc	Philip Long	philip.long@prudential.co.uk
Royal & SunAlliance*	Neil Macmillan	neil.macmillan@gcc.royalsun.com
Swiss Re	Raj Singh	raj_singh@swissre.com
Zurich Financial Services	Axel Lehman	axel.lehmann@zurichna.com

*** Associate members that participated in the preparation of this paper**

Chief Risk Officer Forum Contact Details:
Via E-mail: secretariat@croforum.org chairperson@croforum.org

The CRO Forum has already made significant contributions to the debate on valuation of insurance liabilities. Building on its previous position papers, the CRO Forum is now pleased to present this discussion paper, *"Market Value of Liabilities for Insurance Firms - Implementing elements for Solvency II"*. The paper addresses some core principles and the practical issues regarding the calculation of the market value of liabilities. In addition, given the inter-linkages between the issues, the CRO Forum has also incorporated the perspectives of the CFO Forum in formulating this paper.

The CRO Forum member companies have discussed and agreed on the principles and practical approaches described herein. The CRO Forum would also like to thank Dr. Philipp Keller of Ernst & Young and Professors Shaun Wang and Richard Phillips of Georgia State University for providing research regarding the calibration of the cost of capital rate; and Oliver Wyman for assisting in the preparation of this paper.

Contents

1. Executive Summary and General Principles 4
   1.1. Objectives and key considerations 4
   1.2. Definition of the Market Value of Liabilities 5
   1.3. General principles for calculation of the MVL 5
   1.4. Specific implementation proposals 6
2. Objectives and Key Considerations 9
   2.1. Objectives 9
   2.2. Distinction between solvency and accounting standards 9
   2.3. Distinction between market-consistent valuation and pricing practices 11
3. Specific Implementation Proposals 12
   3.1. Use of entity-specific and non-entity specific assumptions 12
   3.2. Swap rates as the definition of risk-free 13
   3.3. Projection of SCR required capital 14
   3.4. Context to determination of the Cost of Capital Rate 15
   3.5. Calibration of the Cost of Capital Rate 16
   3.6. Realistic best estimate basis 18
   3.7. Pillar 3 as Mechanism for Harmonisation 18

Appendix A. Examples of hedgeable and non-hedgeable risk 21
Appendix B. Summary of Research Findings 22
Appendix C. Frictional Cost of Capital 24
Appendix D. Weighted Average Cost of Capital 37
Appendix E. Market Price of Risk Method 43
Appendix F. CAPM and FF2F Method 49
Appendix G. Companies included in FIIB analysis 63
Appendix H. References 71

1. Executive Summary and General Principles

Over the past 3-4 years a tremendous amount of positive energy and resource has been expended in the name of improving the efficiency and effectiveness of the oversight of insurance entities, globally, by regulatory and supervisory bodies, industry associations and commentators alike. The CRO Forum is pleased at the pace and direction of the changes under consideration. However it has also become clear that in the course of the wider dialogue, confusion has sometimes arisen about the intended meaning about certain principles and elements of suggested implementation frameworks. Moreover, parallel discussions in the field of financial accounting have meant some terminology has dual meanings.

The aim of this paper is to explain in more detail the CRO Forum's position on the topic of the Market Value of Liabilities (MVL) of insurance firms, particularly on how it should be defined and parameterised. For those who have followed our past position papers on this and related topics, you will find that while the positions described herein are entirely consistent with those described in each of our earlier publications, we have adapted some of the terminology used previously with the aim of establishing a clear and unambiguous position.

1.1. Objectives and key considerations

- The CRO Forum is primarily concerned with ensuring that the Market Value Balance Sheet provides the appropriate basis for assessment of the economic solvency of insurance companies. The MVL is a key component of this balance sheet

- The CRO Forum would like to ensure that the construction of the MVL is consistent with regulators' views and is also consistent with sound risk management principles followed by leading insurers. From a risk management perspective, it is important to note that the basis for solvency assessment using MVL will be complemented by the requirements of supervisory review and external disclosures under Pillar 2 and Pillar 3 of the Solvency II framework, respectively

- One aspect of this is to ensure that the MVL provides a genuinely economic valuation of the technical liabilities, in the sense that it does not contain margins for prudence; these are contained exclusively in the required capital

- The CRO Forum believes that the requirements of a solvency framework, while complementary to, may not necessarily be the same as, the needs of financial accounting frameworks. In particular, the solvency framework should present a fair reflection of the economic value of liabilities through the MVL and should not be influenced by considerations relating to the timing and certainty of profit recognition

    - This position is consistent with the view adopted by the European CFO Forum that states that any allowance for accounting considerations should be explicitly introduced as an additional balance sheet item

- The CRO Forum emphasises that market-consistency refers to values that are consistent with those observed in deep and liquid financial markets and therefore draws a distinction between market-consistent valuation and observed pricing practices in the insurance markets. Insurance premium rates and prices are not considered an adequate basis for the valuation of insurance liabilities because primary insurance markets are illiquid and inefficient and because pricing practices in the primary insurance markets are driven by a range of considerations beyond the economic value of the liabilities generated

1.2. Definition of the Market Value of Liabilities

The CRO Forum defines the MVL as the market-consistent fulfilment cost to the insurer to meet its obligations to policyholders over time in the ordinary course of business. The MVL, therefore, represents the present value of the financial costs to an insurer that is obliged to meet those liability cash flows. The costs are comprised, inter alia, of policyholder benefits, expenses, tax payments and capital costs, net of expected future premiums and fees from the existing contracts. Whenever such obligations, or some component thereof, can be hedged through the financial markets, a valuation approach that is consistent with those markets should be applied. For risks that cannot be hedged, a margin for the cost of risk, which we refer to as the "Market Value Margin", should be included.

1.3. General principles for calculation of the MVL

The CRO Forum believes that the market valuation of liabilities should adhere to the following general principles:

- The CRO Forum continues to advocate the principles stated in its joint submission with the CEA in January 2006[1]. In summary, they state that all cash flows should be separated into hedgeable and non-hedgeable components and valued using either mark-to-market or mark-to-model approaches:[2]
    - Components of the cash flow for which hedging instruments are available in the financial markets should be valued with reference to the prices of those instruments or using the same option pricing techniques and parameters that are used in valuing the hedge portfolio in the financial markets. This is consistent with contingent pricing methodologies that have been used by major banks and financial institutions since the 1970s and consistent with current practices in the financial services industry
    - For components of the cash flow that are subject to non-hedgeable risks (both financial and non-financial) a mark-to-model adjustment (referred to as the Market Value Margin) should be added to the best estimate value of the cash flow
        - The CRO Forum position is that the Cost of Capital approach to calculate risk margins provides a theoretically sound approach for valuing such cash flows while maintaining transparency and pragmatism[3]
- The valuation approach should ensure transparency and comparability of the valuation across insurers and be based on the set of assumptions that characterize the liability that is being valued. Entity-specific assumptions should be made when projecting future cash flows so that the valuation reflects the particular characteristics of the portfolio in question
    - In the ordinary course of business, insurance companies will normally retain insurance liabilities and will not transfer them to a third party. Therefore, the CRO Forum believes it to be more economically sound to value insurance liabilities on the basis that they are kept in the company's own portfolio, including the company's existing servicing platform and cost structure, rather than to base the

[1] *"Solutions to major issues for Solvency II"*, Joint submission by the CEA and the CRO Forum, January 2006
[2] Examples of types of cash flow that fall into each of these categories can be found in Appendix A
[3] If sufficiently deep and liquid financial markets were to develop for certain insurance risks, then the market should be used to calibrate insurance risk prices in the insurer's MVL for these risks

valuation on a hypothetical transfer

- Absent observable markets, it is appropriate and practical to use "own company" experience, underwriting and servicing costs for the estimation of certain liability cash flows. This is because in most cases the risks are specific to the portfolio of the insurer and there is no observable market to gauge these risks and costs against. In reality, any such transfer would be based on the same assumptions as the transferee equally needs to fulfil the obligations to policyholders

- We note that the draft directive wording utilises the 'transfer' concept as the basis of valuation of technical provisions and subsequently defines how the calculation should be carried out. We believe that our approach is equally consistent with this basis when it is assumed that the whole entity is being transferred into an empty reference company. Both approaches can lead to similar conclusions when determining market consistent value for insurance liabilities. The Level 2 implementing measures will provide the opportunity to achieve consistency between the two approaches

- Where the value of liabilities can not be determined by reference prices in the financial markets, liability cash flows should be discounted with the risk-free yield curve without reference to the expected earned rate on the assets backing liabilities or to the insurer's own credit risk

- The appropriate risk-free yield curve should be derived from the swap curve and this curve should be used for both best estimate liability valuation and the market value margin valuation. Where the swap market is non-existent, illiquid or otherwise impaired a suitably liquid, equivalent risk-free yield curve may be used

1.4. Specific implementation proposals

The CRO Forum proposes that insurance undertakings follow certain specific approaches when implementing the abovementioned principles. These are:

- To ensure comparability of the valuation between insurers, all parameters and observable market prices that can be objectively determined in the financial markets and cash flows that do not depend on particular features of the firm should be based on non-entity specific assumptions. Key assumptions are identified in the following table:

Non entity-specific parameter	**Rationale**
▪ Confidence level interval (99.5% over 1 year) for determining required capital, together with the Cost of capital rate, on which the MVM is based	▪ Not a driver of cash flow profile. Constant cost of capital rate can be applied across all cash flows (see Appendices for rationale)
▪ Assumptions about risk factors that are identical for all insurers (e.g. correlations, volatilities, distributional assumptions)	▪ Assumptions about risk factors that are identical across companies (e.g. correlations between major equity indices and interest rates) should be harmonised to improve comparability across insurers
▪ Risk-free yield curve and other financial markets assumptions that determine option valuation	▪ Financial markets hedging costs for a given liability are identical across all insurance companies

- We do not believe it is feasible to set non-entity specific assumptions for liability cash flows that are determined by factors which are specific to the insurer holding those liabilities:

    - Even within the same product category, the profile of the insurance liability outflows can differ significantly from one company to another. This can be due to variations in the servicing platform and hence the expense structure. It can also be driven by variations in the underwriting characteristics of the insured peril or population and by the underwriting practices of the (re)insurer. Given the heterogeneity of potential variations in these assumptions, it is not feasible to pre-determine, in a centralized fashion, a uniform set of specific assumptions around such items as underwriting results, expenses and persistency. Hence, in cases where the significant drivers of cash flow are specific to the insurance firm concerned, entity-specific assumptions should be used. Key assumptions are identified in the following table:

Entity-specific parameter	**Rationale**
▪ Quantum and composition of required capital in respect of non-hedgeable risks	▪ The evaluation of the financial cost of meeting liabilities should be assessed in the context of the insurance company's own portfolio of risks
▪ Expenses	▪ Expenses are driven by entity specific cost structure
▪ Lapses	▪ Behaviour specific to liabilities being valued
▪ Underwriting results (expected frequency and severity of P&C claims, timing of cash flows, mortality and morbidity assumptions)	▪ Underwriting results specific to the risks in the liabilities being valued

- The approach described here recognises the fact that some information can be objectively observed, like prices of traded financial instruments or earthquake activity, whereas other information is firm-specific, like salary levels, claims management ability or a particular exposure to some risks

- The Market Value Margin should be calculated using the "Cost of Capital approach", which involves the following three steps:[4]

    1. Projecting the Solvency Capital Requirement (SCR)[5] in respect of non-hedgeable risks for the full lifetime of the business being valued
    2. Calculating a cost of capital charge in each period by applying a cost of capital rate to the SCR in that period
    3. Discounting the cost of capital charges using the swap curve

- The projection of the SCR in respect of non-hedgeable risks should be carried out as follows:

[4] See also *"A market cost of capital approach to market value margins – Discussion paper"*, Chief Risk Officer Forum (17 March 2006)
[5] The SCR is as envisaged by the Solvency II Draft Framework Directive

- Using a confidence level of 99.5% over a 1-year time horizon, in line with the Solvency II standard

- Using either the standard approach SCR or the internal model-based SCR

- Allowing for (net of) diversification benefits between non-hedgeable risks up to group level (allowing for any constraints on capital fungibility) and assuming that the insurer's risk profile evolves according to realistic best estimate assumptions

- Using a set of volume drivers such as those previously suggested by the CRO Forum as reasonable proxies for the level of risk, unless a more sophisticated method is available[6]

- Research commissioned by the CRO Forum suggests that a suitable range for the cost of capital rate is 2.5% - 4.5% per annum. This rate is intended to be applied to an SCR calibrated to a 99.5% confidence interval over a 1-year time horizon.

    - The range was arrived at after considering multiple approaches and it assumes a typical capital structure (mix of debt and equity) that is non-entity specific

    - The CRO Forum recognizes that the appropriate cost of capital rate may vary with the confidence interval at which capital requirements have been calculated. However, our research indicates that the product of the quantum of capital and the rate is relatively stable, which supports the use of a constant confidence interval (99.5%) and a constant rate, for Solvency II purposes. This is discussed further in the appendices

    - The cost of capital rate need not depend on whether a standard or internal model approach is used as long as both models are calibrated to the 99.5% confidence interval

    - We recommend that this range be re-considered periodically, e.g. every three to five years

- The entity-specific assumptions (e.g. persistency, expenses, crediting strategies etc.) used in the quantification of MVL should be on a realistic best estimate basis

- External disclosure is likely to lead to greater commonality as the market imposes penalties on those that do not adopt what are seen as reasonable assumptions. Therefore, the CRO Forum proposes that Pillar 3 of the Solvency II framework should be the vehicle for harmonization of the assumptions regarding:

    - The definition of deep and liquid markets for the purpose of identifying hedgeable risks

    - The parameterisation of assumptions regarding non-hedgeable financial risks (e.g. when the observed yield curve has been extended)

[6] See the CRO Forum paper cited in footnote 3, Appendix C – "Proxy measures for projecting capital"

2. Objectives and Key Considerations

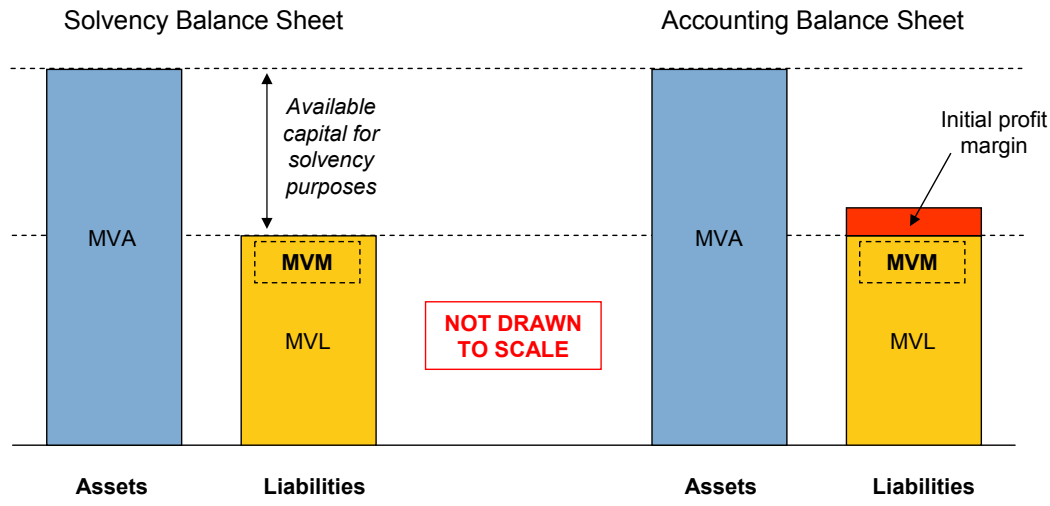
There were several objectives and key considerations that were critical in informing the position of the CRO Forum members. Although these do not form the CRO Forum's actual proposals, they are set out here in order to provide context to the proposals contained in this paper.

2.1. Objectives

- The CRO Forum is primarily concerned with ensuring that the Market Value Balance Sheet (of which the MVL is a key component) does the following:
    - Provides the appropriate basis for assessing the economic solvency of insurance companies; and
    - Aligns the economic balance sheet with the risk management levers available to company management
- The CRO Forum recognizes that insurance companies actively use the financial markets for risk management. Therefore, to ensure an alignment between the quantification of the MVL and risk management levers, the CRO Forum believes that the quantification of the *market-consistent* value of liabilities ought to be *consistent*, wherever possible, with observed pricing in deep and liquid *financial markets*

2.2. Distinction between solvency and accounting standards

- Recent discussions on accounting standards for insurance liabilities, including the IFRS insurance contracts Phase 2 discussion paper, has supported the Cost of Capital approach for the determination of a market value margin
- However, a key difference between the requirements of statutory and financial accounting is the prominence that will be given within the accounting framework to the question of profit recognition over the life of the contract (the timing and certainty of that profit); in contrast to regulators' relative focus on solvency
- The CRO Forum believes that it is not the purpose of the MVL to underpin any specific policy of recognition of profit emergence such as targeting zero profit at policy inception or recognising profit at inception. Instead, our position is that accounting considerations around profit recognition should be *explicitly* dealt with by means of an additional balance sheet item outside of the MVL. This is illustrated in the figure below



The solvency balance sheet does not contain a "profit margin reserve" so the initial profit margin forms part of available capital for solvency assessment

The pattern of profit emergence over the contract lifetime will be partially determined by the rules regarding amortisation of the "initial profit margin" reserve

- The difference between the (initial) policy premium (after deduction of relevant acquisition costs) and the MVL generated by that policy represents the profit expected to be generated by the contract over its lifetime. The Chief Financial Officer Forum (CFO Forum) refers to this as the "initial profit margin"[7]. Our position is that this amount must be treated as available capital for regulatory solvency purposes since it will not be paid to fulfil policyholder obligations

- The CFO Forum has already considered viable options for how this initial profit margin could be presented in the financial accounts. Since the initial profit margin is akin to deferred income, the CFO Forum proposal for accounting purposes is that it is presented separately in the liability section of the balance sheet but distinct from the insurance liabilities. This 'initial profit margin' does not form part of the MVL

- Our position is that any attempt to incorporate *implicitly* a certain policy around profit recognition in the quantification of MVL (via calibration of the parameters of the Market Value Margin or otherwise) would be detrimental to the transparency and usefulness of the balance sheet for solvency assessment

- The determination of the policy premium is driven by numerous considerations (see next section 2.3), including *inter alia* a target shareholder profit margin over and above the expected cost of capital for non-hedgeable risks. In assessing solvency, these expected margins represent tangible value to the shareholder and should be treated as part of the available capital rather than as a liability that is expected to be paid to the policyholders

[7] CFO Forum / CEA Response Letter to the IASB Discussion Paper 'Preliminary Views on Insurance Contracts', dated 30th November 2007.

2.3. Distinction between market-consistent valuation and pricing practices

It has been proposed that the parameters used for the quantification of the cost of capital be linked to market prices (premiums) for insurance risks. One potential consequence of this link is zero profit recognition at inception.

Aside from any accounting considerations around timing of profit recognition, the CRO Forum believes that there is no reason to link the market consistent valuation of insurance liabilities to premiums in the insurance markets:

- **Insurance prices are set by management and reflect multiple objectives, which vary between insurers and over time:** In most cases, insurers expect to make a profit and will include this in the price. But the nature of the profit loading will be distorted by such factors as:
  - Risk aversion in times of stress
  - Opportunity costs of not deploying capital elsewhere
  - A return on the insurer's prior investment in "franchise" (sunk costs involved in building distribution capabilities etc.)
  - An insurer's intention to grow market share for strategic reasons and therefore sell insurance policies at a marginal loss

- **Insurance markets are not sufficiently deep and liquid:** Insurance premiums can not be considered to provide market-consistent values for insurance risk since the market (between insurers and policyholders) is not sufficiently deep, liquid and efficient. In fact, the lack of liquidity and observable market prices in the insurance industry often leads to a situation where two insurers can command different prices for the same contract given their brand name, control of distribution and "shelf space" and numerous other considerations. Similarly a single insurer might be able to command two different premiums under multi-year policies for assuming an identical set of risks (and associated cash flows) across two different channels. In this instance, the product with the lower premium should have a higher MVL, given the lower cash inflows resulting from future premiums. However, calibrating the MVL to the observed pricing in the market will produce exactly the *opposite* result, producing a lower MVL in the case where the insurer was able to command the lower price

- **Insurers continue to use very different approaches to pricing:** Many insurers continue to price their products using techniques that are not based on market-consistent valuation principles. For example, many insurers continue to deploy measures that incorporate an expected return on a target asset portfolio (net of expected defaults) in the pricing of the liabilities, which may implicitly subsidize the origination of liabilities. Additionally, the pricing (and asset-liability management) of many insurance products is often constructed to optimise the pattern of emergence of the accounting profit

Given the above considerations, it is our position that using premium pricing in the insurance marketplace will reduce the comparability of liability valuation across insurance companies to the point where MVLs, at best, allow comparison of insurers' pricing strategies and/or their relative pricing power in the marketplace.

3. Specific Implementation Proposals

The CRO Forum proposes that insurance undertakings follow certain specific approaches when implementing the abovementioned principles. These are described in this section.

3.1. Use of entity-specific and non-entity specific assumptions

- To ensure comparability of the valuation between insurers, all parameters that can be objectively determined in the financial markets and cash flows that do not depend on particular features of the firm should be based on non-entity specific assumptions. Key parameters are listed in the table below

Non entity-specific parameter	**Rationale**
▪ Confidence level interval (99.5% over 1 year) for determining required capital, together with the Cost of capital rate, on which the MVM is based	▪ Not a driver of cash flow profile. Constant cost of capital rate can be applied across all cash flows (see Appendix for rationale)
▪ Assumptions about risk factors that are identical for all insurers (e.g. correlations, volatilities, distributional assumptions)	▪ Assumptions about risk factors that are identical across companies (e.g. correlations between major equity indices and interest rates) should be harmonised to improve comparability across insurers
▪ Risk-free yield curve and other financial markets assumptions that determine option valuation	▪ Financial markets hedging costs for a given liability are identical across all insurance companies

- The primary consideration is that the valuation standard should apply a uniform approach across different insurance entities. However, we also recognise that applying a uniform approach does not necessarily mean applying an identical set of requirements or assumptions across all cash flow projections

  - Even within the same product category, the profile of the insurance liability outflows can differ significantly from one company to another. This can be due to variations in the servicing platform and hence the expense structure. It can also be driven by variations in the underwriting characteristics of the insured peril or population and by the underwriting practices of the insurer. Given the heterogeneity of potential variations in these assumptions, it is not feasible to pre-determine, in a centralized fashion, a uniform set of specific assumptions around such items as underwriting results, expenses and persistency

  - Instead, the MVL should allow companies to use their own best estimate assumptions in the projection of the cash flows. Naturally, these assumptions need to be validated against experience studies

  - Similarly, each company will have a unique composition of risks, which will determine the level of diversification benefit to be taken into account in the capital requirements

- For these reasons, entity-specific assumptions about future cash flows should be made in cases when the drivers of a cash flow are specific to that entity. In other cases, non entity-specific assumptions should be made

- Key entity-specific assumptions are listed in the table below

Entity-specific parameter	Rationale
▪ Quantum and composition of capital requirements in respect of non-hedgeable risks	▪ The evaluation of the financial cost of meeting liabilities should be assessed in the context of the insurance company's own portfolio of risks
▪ Expenses	▪ Expenses are driven by entity specific cost structure
▪ Lapses	▪ Behaviour specific to liabilities being valued
▪ Underwriting results (expected frequency and severity of P&C claims, timing of cash flows, mortality and morbidity assumptions)	▪ Underwriting results specific to the risks in the liabilities being valued

3.2. Swap rates as the definition of risk-free

The "risk-free" yield curve for both best estimate liability valuation (discounting expected liability cash flows) and the market value margin valuation (discounting projected cost of capital figures) should be the derived from the swap yield curve observed in the market.

Where the swap market is non-existent, illiquid or otherwise impaired a suitable, liquid, equivalent risk-free yield curve may be used.

As discussed in the CRO Forum's papers on the market cost of capital approach (March 2006) and the admissibility of internal models (June 2005), swap rates are appropriate for use in the MVL calculation for the following reasons:[8]

In many countries, the market for swaps is deeper, longer and more liquid than the market for government bonds. In addition, there are often technical supply and demand factors which drive government bond yields such as issuance levels, indebtedness levels, currency reserves and collateral/margin market activity. This can be evidenced by the large variance in swap spreads between sovereign borrowers that would be considered "risk free"

- Swap rates have evolved from their foundation as a proxy AA curve to a near-risk free curve at which counterparties trade risk (interest rates, CDS, etc) in the financial markets

- The standard valuation rate for hedging instruments in the financial markets is the swap rate and therefore using government rates would provide in these cases an incorrect valuation and might discourage best risk management practice

The CRO Forum does not support the use of expected portfolio yields for discounting liability cash flows. This would provide a perverse incentive for taking more risk in order to reduce

[8] See *Principles for Regulatory Admissibility of Internal Models*, The Chief Risk Officer Forum (10 June 2005) and *A market cost of capital approach to market value margins*, The Chief Risk Officer Forum (17 March 2006)

liability values and liability-related capital requirements and, in our view, ought to be excluded from a market value of liabilities (MVL) standard.

This is also one reason why we do not support an "own credit risk" adjustment to the risk-free rate used to discount liability cash flows. Taking additional asset risk should not lead to a reduction in liability values.

3.3. Projection of SCR required capital

When calculating the MVL, the measure of capital to be used in the projection of future capital requirements is the SCR for non-hedgeable risks, calculated in accordance with the specifications outlined in the remainder of this section.

3.3.1. Confidence interval of 99.5%

The measure of capital should reflect a 99.5% confidence level over a 1-year time horizon for all insurance undertakings, in line with the Solvency II capital requirement. [9]

3.3.2. Standard model or internal model SCR

The SCR can be derived using either the standard approach or the internal model approach as defined by the Solvency II project.

3.3.3. Diversification benefits

The projected SCR in the MVM calculation should allow for (i.e. be net of) the impact of diversification benefits between all non-hedgeable risks. Any diversification benefit from hedgeable risk that the company chooses to take should not be captured for the purposes of calculating the MVM.

The diversification benefit may reflect available diversification right up to group level (i.e. across levels 1-4 as discussed in the CRO Forum's paper on the topic[10]), subject to there being no restrictions on that diversification as a result of limitations in the fungibility of the insurer's available capital.

The capital necessary to support non-hedgeable risk in future years will, in reality, depend on future new business written. The CRO Forum proposes that realistic best estimate assumptions are used to estimate the insurer's future risk profile for the purpose of allocating diversification benefits to projected SCR requirements. For example, in a mature P&C business with a stable business mix, we would assume that the composition of reserving risk across well developed underwriting years as well as more recent, less developed reserves remains broadly constant. Another example might be a life business that is still selling new business but whose mix of products is changing over time. In this case, the future mix of risks assumed in the diversification allocation will follow expected new business mix.

---

[9] The CRO Forum believes that the combination of holding capital for a single year and holding a provision for future capital costs addresses regulatory concerns adequately. Note that this approach inherently requires multi-year risk modeling. Alternative risk measures, involving a term longer than one year, are seen to provide valuable additional information for calibration of the one-year measure where the risk dynamic is one that clearly evolves over time (e.g. obesity trends in mortality, medical cost inflation or adverse claims development)

[10] See *"A framework for incorporating diversification in the solvency assessment of insurers"*, The Chief Risk Officer Forum (10 June 2005)

Finally, businesses that are closed to new business will base their diversification on the run-off mix of risks. Such an assumption is reasonable given that there is constant regulatory and management monitoring and intervention of the risk profile of an insurer. Under such a regime, it is reasonable to assume that no dramatic shift in the risk profile will arise in the ordinary course of business.

3.3.4. Volume drivers

To determine the risk margin, the expected capital necessary to support future non-hedgeable risk needs to be determined.

The CRO Forum proposes that the capital necessary to support non-hedgeable risk during future years should be projected by all insurers. Absent a more sophisticated approach[11], the approaches described in the earlier CRO Forum draft document on the market cost of capital approach can be used, i.e. using a simple method based on the nature of the liabilities and how they run off.[12] Any concerns about this simplification could be dealt with under Pillars 2 or 3. If companies opt to use their own internal models then they will need to explain the assumptions and calculation method used to their supervisors. In practice, for insurers adopting the standard approach, the SCR guidance will specify the drivers to be used to indicate the level of risk.

3.4. Context to determination of the Cost of Capital Rate

Under the cost of capital approach, the cost of capital charge in every period is calculated by multiplying the projected capital requirement in respect of non-hedgeable risk capital by a predefined cost of capital rate.

- The CRO Forum believes that the appropriate cost of capital rate for use in the MVM calculation is the rate of return an insurance company requires on the capital it deploys to support non-hedgeable risk over a given year. In other words, the quantification of MVM should capture only:

    - The quantum of capital that supports non-hedgeable risk; and
    - The component of the required return that represents the shareholder's reward for bearing that non-hedgeable risk

- It follows from this requirement that the cost of capital for MVM is not equivalent to the total return required by shareholders:

    - First, the expected return on franchise value (the difference between market capitalisation and economic net worth13) is excluded as it is not related to the in-force business but rather reflects expectations of the economic profits related to future business and general uncertainty as to the prospects of the company

[11] One example of such an approach is the use of complex, stochastic-on-stochastic calculations where the expected capital for non-hedgeable risk in each future year is determined as the probability-weighted average of the capital necessary in a large number of hypothetical states of the world and states of the company at that time. Sophisticated approaches such as these add significantly to the complication and make it very difficult to compare across companies that have used different projection techniques

[12] If insurance companies wish to project SCR requirements using more sophisticated approaches they should be allowed to do so. However, this should not be mandatory

[13] The economic net worth is the difference between the market consistent values of assets and liabilities

- Second, the required shareholder return is also driven by hedgeable risks in the business. These will usually be driven by the insurer's asset/liability position. The required return on these risks is different from – and possibly higher than – the required return on non-hedgeable risk. Any estimate of the cost of capital rate that includes part or all of this required return on hedgeable risk is not appropriate for use in the MVM calculation. This is because the MVM captures neither the required capital, nor the required shareholder return, in respect of hedgeable risk

- In order to derive the SCR, the market-consistent value of liabilities must be valued in the base case, as well as in a number of stress scenarios. The CRO Forum proposes that the same cost of capital rate be used in the base case as well as for the stress scenarios. The cost of capital rate used should therefore be a long-term average, reflecting both periods of stability and periods of stress. The rationale for this is as follows:

    - The MVL, as defined in this document, requires the use of parameters that should be based on a realistic assessment of the current and future situation of the financial market and the company

    - This implies that all relevant parameters, (e.g. the cost of capital rate and the capital base, expenses, claims etc.) should be based on best estimate assumptions. These best estimate assumption would of course – appropriately probability weighted – contain also realizations in stressed circumstances

3.5. Calibration of the Cost of Capital Rate

- It is important to recognise that isolating the appropriate cost of capital rate using available market data and prices is an extremely difficult technical exercise with no single approach proving conclusive. Therefore a degree of pragmatism is required in examining the results of various approaches in order to determine a range in which the "correct" cost of capital rate might reasonably lie. The ultimate choice of rate to be used must necessarily be driven by the need for comparability and simplicity, as well as theoretical rigour

- Given the challenges which are inherent in this calibration process, we believe that arriving at a reasonable estimation of the cost of capital rate will require a "triangulation" process that considers a variety of approaches

- The CRO Forum has commissioned research into the calibration of the cost of capital rate, carried out by Dr. Philipp Keller and Professors Shaun Wang and Rich Phillips. The researchers examined a range of approaches in their work, namely:

    - The Frictional Cost of Capital (FCoC) Approach,
    - The Market Price of Risk Approach, and
    - Estimates of the Equity Risk Premium derived from the Capital Asset Pricing Model (CAPM) and Fama-French 2-factor (FF2F) model

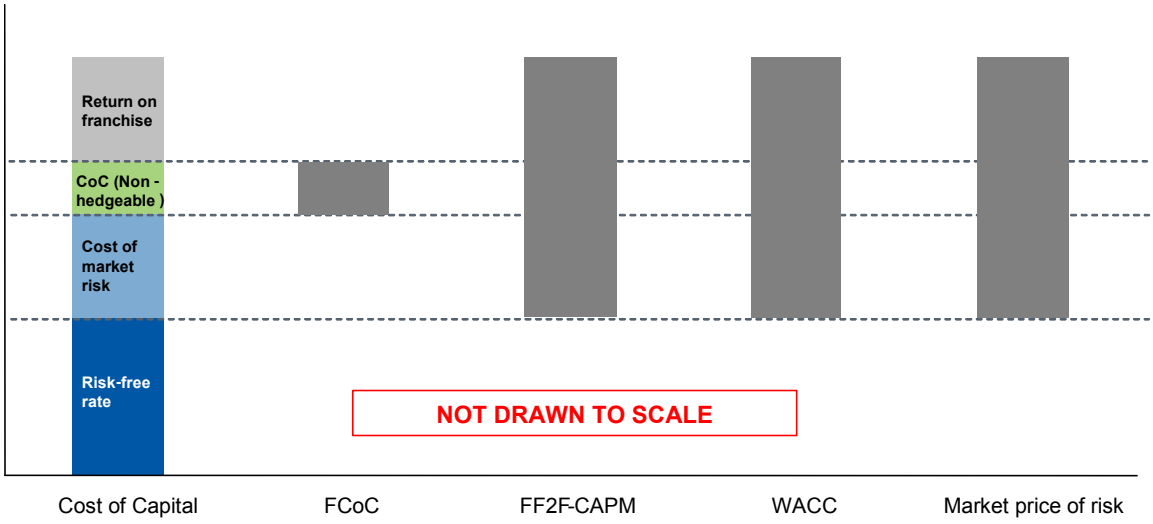
- The first of these approaches, the FCoC approach, does not contain any of the components described above as being out of the scope of the exercise (return on franchise value or base cost of capital)

- The latter two approaches are "total return" approaches, which means they provide an indication of the overall rate of return that might be demanded by an equity investor. They are therefore likely to contain at least one of the out-of-scope components

mentioned above and hence produce estimates that are above our central estimate of the appropriate cost of capital rate for MVMs.[14]

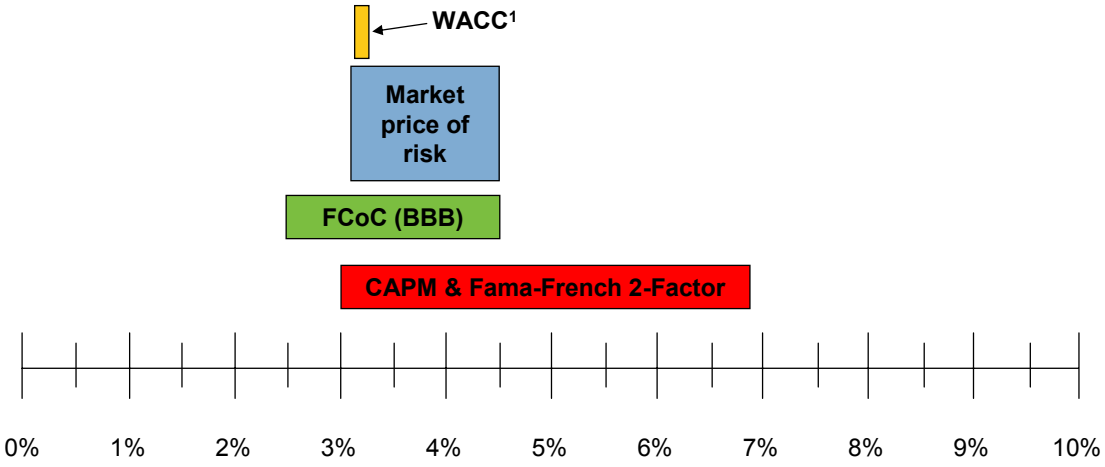
- For the latter two approaches, the researchers made use of the Weighted Average Cost of Capital (WACC) technique, covered in a separate appendix, to adjust the costs of equity for an assumed typical insurer capital structure, hence recognizing the potentially lower cost of debt funding. (The results also include a point estimate of the cost of capital based on the WACC approach and a set of illustrative assumptions)

- The components of the total cost of capital covered by each of the approaches is shown in the figure below



- The research into these methods is described in Appendices B-F. The range of potential values for the Cost of Capital Rate produced by each method is shown in the figure below

[14] The Fama-French 2-factor model and CAPM can both be described as "total return models", indicative of the total return that a shareholder might require on his investment in the business, assuming it was 100% equity funded



1. WACC is a point estimate of 3.2% based on an 80:20 split of equity:debt

2. Results are based in all cases on a risk-free rate of 4.0% and a corporate tax rate of 35%

- The CRO Forum has reviewed the results of the research and considered the scope of information covered and sensitivities of the results to parameter choices
- Based on this, we believe that a suitable range for the Cost of Capital Rate to be applied to an SCR calibrated to a 99.5% confidence interval over a 1-year time horizon is 2.5% - 4.5%
- The CRO Forum recommends that a single cost of capital rate is used by all insurance undertakings and is consistently applied to all lines of business in all geographies and in all time periods
- The cost of capital rate also need not depend on whether a standard or internal model approach is used.
- The CRO Forum recommends that this rate be re-calibrated periodically, e.g. every three to five years.

3.6. Realistic best estimate basis

When projecting expenses, lapses and capital costs for the calculation of the MVL (both for best estimate liability and projected capital purposes), realistic best estimate assumptions should be used. For example, if the company is a going concern and has reasonable expectations of remaining so, then going-concern assumptions will be used. Similarly, companies that are closed to new business will use run-off assumptions.

3.7. Pillar 3 as Mechanism for Harmonisation

Practical implementation of Pillar 3 could be accelerated by a technical dialogue between insurance firms, rating agencies, analysts and supervisors, especially where indirect inputs are used or valuations are based on models. The stakeholders would discuss how best to summarize the key assumptions that underpin the mark-to-model framework. The CRO Forum agrees with the Institute of International Finance when it says “The expectation is that

dialogue and improved disclosure will be the way to achieve greater convergence in valuation approaches and greater confidence in the results of the valuation process."[15]

External disclosure is likely to lead to greater commonality as the market imposes penalties on those that do not adopt what are seen as reasonable assumptions. Therefore, the CRO Forum proposes that Pillar 3 of the Solvency II framework should be the vehicle for harmonisation of the assumptions regarding:

- The definition of deep and liquid markets for the purpose of identifying hedgeable risks
- The parameterisation of assumptions regarding non-hedgeable financial risks (e.g. when the observed yield curve has been extended)

[15] *"Interim Report of the IIF Committee on Market Best Practices"*, Institute of International Finance (April 2008)

APPENDICES

Appendix A. Examples of hedgeable and non-hedgeable risk

The figure shows a categorisation of risks. The cells contain examples of each type of risk based on current levels of market development at the time of writing.

SOURCES OF EXPOSURE	TYPES OF RISK: Hedgeable	TYPES OF RISK: Non-hedgeable
Financial	▪ 10-year USD, EUR or Yen cash flow or interest rate option ▪ 10-year equity option	▪ 60-year USD, EUR or Yen cash flow or interest rate option ▪ 15-year emerging markets cash flow ▪ 30-year equity option
Non-financial	▪ Screen- or exchange-traded CAT risks ▪ Actively traded securitised risks	▪ Most insurance risks, e.g. mortality, property, casualty ▪ Policyholder behaviour

Appendix B. Summary of Research Findings

The CRO Forum commissioned Dr Philipp Keller[16] and Professors Shaun Wang[17] and Richard Phillips[18] to determine an appropriate cost of capital rate to be used in the determination of the Market Value of Liabilities. These appendices describe the work they carried out and the results obtained.

Isolating the appropriate cost of capital rate using available market data and prices is an extremely difficult technical exercise with no single approach proving conclusive. Therefore a degree of pragmatism is required in examining the results of various approaches in order to determine a range within which the "correct" cost of capital rate might reasonably lie. The ultimate choice of rate to be used must necessarily be driven by the need for comparability and simplicity, as well as by theoretical rigour.

The researchers examined the following approaches:

- Frictional Cost of Capital;
- Market Price of Risk Approach; and
- An estimation of the Equity Risk Premium using the CAPM and the Fama French 2 Factor (FF2F) Asset Pricing Model

The frictional cost of capital (FCoC) method explicitly models double-taxation and financial distress costs. It does not model agency costs. The rationale for this is discussed further in the section dedicated to the FCoC method.

Depending on the assumptions made, the FCoC method yields a reasonable range for the CoC rate of 2.5 – 4.5% using a capital base for the MVL calculations in line with the Solvency II capital requirements. Under this method, the CoC rate depends mainly on the risk-free rate, the tax rate and the loss-carry forward period.

Unlike the FCoC approach, the latter two approaches are "total return" approaches, which means they provide an indication of the overall rate of return that might be demanded by an equity investor. They include components that are not part of a cost of capital rate for valuation purposes, namely return on franchise value and return on hedgeable risk (predominantly ALM-type risk). To arrive at an unbiased estimate for the CoC rate for the purpose of valuation, such components would ideally be stripped out of the calculations. However, this is not possible with existing market data.

For the latter two approaches, the researchers made use of the Weighted Average Cost of Capital (WACC) technique, covered in a separate appendix, to adjust the costs of equity for an assumed typical insurer capital structure, hence recognizing the potentially lower cost of debt funding.

The weighted average cost of capital approach, using a long-term equity risk premium of 4.0%, a debt premium of 2.1%, a risk-free rate of 4.0% and a tax rate of 35% yields an estimate of the CoC rate of approximately 3.2%.

---

[16] Dr Philipp Keller is a Partner in Global Financial Services Risk Management at Ernst & Young and formerly of the Swiss Federal Office of Private Insurance (FOPI)

[17] Professor Shaun Wang holds the Robert W. Batten Chair of Actuarial Science at Georgia State University

[18] Professor Richard Phillips is the Chair of the Department of Risk Management and Insurance at Georgia State University and is also the Bruce A. Palmer Professor of Risk Management and Insurance.

The Market Price of Risk Approach resulted in an estimated range for the CoC rate of 3.1% - 4.5%, as shown in the following table:

	Cost of equity	WACC
Low end	3.9%	3.1%
High end	5.6%	4.5%

Lastly, using the Full Information Industry Beta (FIIB) methodology applied to CAPM and FF2F asset pricing models, the cost of capital rate has been estimated for life and non-life insurance companies, as shown in the following table:

		Equity risk premium	WACC
CAPM	**Life**	5.06%	4.0%
	Non-life	3.81%	3.0%
FF2F	**Life**	8.63%	6.9%
	Non-life	8.36%	6.7%

After reviewing the evidence presented above, the CRO Forum has concluded that a reasonable range for the CoC rate for valuation purposes runs from 2.5% to 4.5%. The CRO Forum proposes that a single rate from within this range be chosen and applied across the industry for MVL calculations under Solvency II.

Appendix C. Frictional Cost of Capital

This appendix describes the work carried out using the Frictional Cost of Capital (FCoC) approach and the resulting findings. It is arranged in the following sub-sections

- Overview
- Methodology
- Base Case Results
- Sensitivities
- Model limitations
- Validation
- Conclusions

C.1. Overview

Investors expect to be compensated when they supply capital. Under the FCoC approach, the total return required by shareholders may be thought of as consisting of

- The base cost of capital (for hedgeable risks, including the risk-free rate)
- Frictional costs
- Expected economic profit

The above components of the annual required return by shareholders are not all relevant in determining the cost of capital rate to be used for calculation of MVMs.

- **Base cost of capital:** Since hedgeable risks are excluded from the capital used in the calculation of MVMs, they should also be excluded from the cost of capital rate. Therefore, for the purposes of market consistent valuation, the base cost of capital, which is associated with hedgeable financial risks, is not relevant to the cost of capital rate

- **Expected economic profit:** Since capital is associated with an existing book of business, the cost of capital rate should only reflect risks associated with the current liabilities, not those associated with future business that has not been written. However, the expected economic profit reflects the expected return on franchise value, which is a measure based on the market's perception of ability to create value through future new business. As such, the return on franchise (and consequently, expected economic profit) should be priced for in new business pricing, but not in determining the value of existing business under a fair value approach

Therefore, for the purposes of the MVM calculation, investors only need to be compensated for frictional costs.

Frictional costs, in turn, can be decomposed into:

- **Double-taxation costs,** which are incurred since insurers' profits are taxed in most jurisdictions, leading to additional costs for shareholders

- **Financial distress costs** - are direct and indirect costs which arise when an insurer has difficulty meeting its financial obligations to policyholders or debtholders. These costs may arise because the insurer is regulated and has to satisfy solvency requirements or for a variety of other reasons including managerial time spent mitigating the distress

event and not growing the business, loss of ability to contract with suppliers, employees or customers from a position of strength in negotiations, etc.

- **Agency costs** - which are associated with the misalignment of the interests of management with the interests of the shareholders or between policyholders and shareholders. In addition, we consider lack of transparency and informational asymmetry to be part of agency costs

Some argue that insurers should also not be expected to provision for at least part of frictional costs since they are a cost to investors only. For example the cost of double-taxation can differ from jurisdiction to jurisdiction and rightly has to be borne by investors and not by insurers. Given that frictional costs and in particular the cost of double-taxation are explicitly taken into account in European Market Consistent Embedded Value disclosures and that they are expected by analysts and investors, the CRO Forum believes that for the purpose of setting the cost of capital rate, these costs should be included.

Agency costs, i.e. the costs due to misalignment of the interests of senior management and shareholders, have not been modelled. The CRO Forum believes this is appropriate due to the level of supervisor scrutiny likely under Solvency II and because any residual agency costs are less likely to be related to non-hedgeable risk on the in-force business and are more likely to be associated with management efforts to grow the franchise.

It is often conjectured that the misalignment of senior management interests with shareholder interests should be reflected in a higher cost of capital rate. The CRO Forum is aware that investors and analysts may apply their own agency cost discounts when evaluating insurance companies from a shareholder value perspective. However, we have not included agency costs in the FCoC method for solvency purposes for several reasons:

- In situations of financial distress, a reduction in solvency levels towards the minimum allowed by regulators will reduce or eliminate surplus capital, which is most often seen as a source of agency costs if it is used sub-optimally
- Under these conditions, regulatory oversight is likely to increase, helping to ensure that management is more focused on meeting obligations to current policyholders rather than engaging in expansive or strategically ambitious activities that might lead to a leakage of value
- It can also be argued that agency costs are already included in the calibration of the parameters lambda and k from catastrophe and corporate bonds and used in the calculations described later in this appendix

Defining the cost of capital rate to be the return required to compensate an investor for the frictional costs associated with the insurance undertakings has a number of implications

- The cost of capital rate depends on the company's economic solvency. This is due to the expected financial distress costs which are inversely related to the level to which the insurer is capitalized. As a result the higher the level of the default probability of the company, the higher the cost of capital rate will be
- The cost of capital rate depends on the jurisdiction in which the insurer is situated. Both financial distress costs and – likely to a larger degree – the taxation system have an effect on the Cost of Capital Rate. The lower the cost of double taxation is, the lower the Cost of Capital Rate

- The cost of capital rate to be used for valuation and solvency purposes is based on the cost of capital of the insurer, not on a given line of business[19]. This reflects the fact that the MVM should be determined at portfolio level, not by line of business. Determining the cost of capital rate by line of business would be inconsistent since there are no frictional costs directly attributable to a given line of business

C.2. Methodology

In this section, we present the simple model that was used to estimate the appropriate range for the cost of capital rate based on a simplified FCoC approach.

As explained in the previous sub-section, we estimated frictional costs due to double taxation and financial distress, but not due to agency costs.

C.2.1. Key assumptions and notation

- We assume that the cost of capital rate depends on the company's capitalisation level and we adopt the following notation
    - α denotes the confidence level to which a company is capitalized
    - EC(α) is then the actual capital of the firm
    - The Cost of capital rate is then denoted by CoC(EC(α))
- The minimum required capitalisation level is denoted as SCR (Solvency Capital Requirement). Under Solvency II, SCR=EC(αmin), where αmin =0.995
- We assume that the annual economic profit and loss (P&L) of a company is Normally distributed, although this is not essential to the arguments
    - We assume that the capital EC(α) supporting non-hedgeable risks is invested in risk-free assets generating a risk-free return of rf in all cases
    - We further assume that the mean impact of non-hedgeable risk outcomes on the P&L is zero
    - The overall mean of the distribution of annual P&L is therefore (EC(α) · rf)
    - The annual P&L is subject to the same volatility, σ, that was assumed in the calculation of the SCR and EC(α)
    - The distribution of annual P&L is therefore P&L ~ N(EC(α) · rf, σ)
- We assumed the tax rate to be τ = 0.35 and the risk-free rate to be rf = 4.0%

C.2.2. Double Taxation Costs

Under this model, we take a single-period approach and write the expected cost of double taxation over one year as

[19] If different lines of business were to have different cost of capital rates, this would mean that the market would view the associated capital bases as not reflecting risk and uncertainty appropriately. It would then, methodologically, be more correct to adjust the capital bases of the different lines of business in such a way that the cost of capital rates would be identical.

$$\tau \cdot \int_0^{\infty} x \cdot \varphi_{t_{tax}*EC(\alpha)*rf,\sigma/\sqrt{t_{tax}}}(x)dx = \frac{\tau}{t_{tax}} \cdot \int_0^{\infty} x \cdot \varphi_{t_{tax}*EC(\alpha)*rf,\sigma*\sqrt{t_{tax}}}(x)dx$$

where

x	takes on all possible values of the annual P&L in the range [0, ∞)
τ	is the corporate tax rate
$\varphi_{\mu,\sigma}$	is the Normal probability density function with mean μ and volatility σ
t_{tax}	is the tax carry-forward period in years

This approach makes the simplifying assumption that the cost of double taxation is not influenced by the company's existing deferred tax situation.

It also assumes that the impact of tax losses generated in the single period under study on the tax to be paid in future years can be captured via a compression of the P&L distribution for the period being studied. If the annual P&L has a Normal distribution with mean EC(α) · rf and volatility σ, then the relevant P&L for taxes with a carry forward of t_{tax} years has a Normal distribution with mean EC(α) · rf and volatility $\sigma/\sqrt{t_{tax}}$. This is believed to be an acceptable approximation in circumstances where annual profits from one year to the next are independent of each other.

Note that

- We used the physical probability measure rather than the risk-neutral one since taxes are payable based on actual realized profit
- In the ensuing calculations, we will assume a loss carry-forward period of 7 years which is a conservative assumption for most tax jurisdictions. For example, the UK has unlimited loss carry-forwards

C.2.3. Financial Distress Costs

Under this model, the expected cost of financial distress is given by

$$CoC(SCR) = \int_{-\infty}^{SCR} (SCR - x) \bullet f^{*}_{EC(\alpha)}(x)\,dx$$

where the economic position of the firm at the end of a year is given by a probability density function f(x). To proceed with the calculation, we make the following assumptions:

- The firm's economic position follows a Normal distribution with mean of EC(α) and volatility σ
- The losses are continuous, while the total yearly loss follows a Normal distribution
- If the firm's equity C drops below SCR, the company needs to obtain new capital of (SCR-C)

We further assume that any new capital to be raised incurs a cost of CoC(SCR), which is also the cost of capital rate for non-hedgeable risk in the MVM calculation that we are ultimately attempting to derive. This is believed to be acceptable because under the conditions of distress that would lead to additional capital being raised, it is likely that an insurance firm would engage in significant de-risking, leaving it with predominantly non-hedgeable risks in its existing business. Any new capital to be raised would be used to support this kind of risk

only; so that the return investors would require on that capital is the same as the CoC rate for the MVM.

Then, given a total loss X, the cost of capital for the company will then be

$$\begin{cases} 0, & \text{if } X \le EC(\alpha) - SCR, \\ CoC(SCR) \cdot (X - (EC(\alpha) - SCR)). & \text{if } X > EC(\alpha) - SCR. \end{cases}$$

In the first case, for small losses, the company incurs no financial distress cost since its capital is always above the minimal required.

In the second case the company has to obtain new capital in the amount of X-(EC(α)-SCR). Since the loss is assumed to emerge in a continuous way, the firm can always be capitalized to the level of SCR and has a cost of capital rate of CoC(SCR).

In the model, the company is therefore assumed to always be capitalized at least up to the level of the SCR.

For any given initial capitalisation EC(α), the expected cost due to financial distress can be calculated by averaging over all possible losses which gives us the following

$$CoC(SCR) = \int_{-\infty}^{SCR} (SCR - x) \bullet f^{*}_{EC(\alpha)}(x)\, dx$$

where $f^{*}_{EC(\alpha)}(x)$ is the risk-neutral probability density function of the annual P&L.

C.2.4. Calculation of CoC(SCR)

Combining the double taxation and financial distress costs produces

$$CoC(EC(\alpha)) \cdot EC(\alpha) = \tau \cdot \frac{1}{t_{tax}} \int_{0}^{\infty} x \cdot \varphi_{t_{tax} * EC(\alpha) * rf, \sigma * \sqrt{t_{tax}}}(x)\ dx + CoC(SCR) \cdot \int_{-\infty}^{SCR} (SCR - x) \cdot f^{*}_{EC(\alpha)}(x) dx$$

In case of minimum capitalisation, i.e. when the available capital of an insurer equals its SCR, the equation above is

$$CoC(SCR) \cdot SCR = \tau \cdot \frac{1}{t_{tax}} \int_{0}^{\infty} x \cdot \varphi_{t_{tax} * SCR(\alpha) * rf, \sigma * \sqrt{t_{tax}}}(x)\, dx + CoC(SCR) \cdot \int_{-\infty}^{SCR} (SCR - x) \cdot f^{*}_{SCR}(x) dx$$

Then, CoC(SCR) can be written explicitly as

$$CoC(SCR) = \frac{\frac{\tau}{t_{tax}} \int_{0}^{\infty} x \cdot \varphi_{t_{tax} * SCR(\alpha) * rf, \sigma * \sqrt{t_{tax}}}(x) dx}{SCR - \int_{-\infty}^{SCR} (SCR - x) \cdot f^{*}_{SCR}(x) dx}$$

C.2.5. Calculation of CoC(EC(α))

The general Cost of Capital rate as a function of a company's economic capital EC(α) can now be calculated explicitly by numerically or analytically solving the above equation.

Note that in this mode, the cost of capital rate CoC(EC(α)) does not depend on the volatility of the company's P&L. The volatility is captured in the economic capital, while the CoC rate only depends on α.

If taxes could not be smoothed, this property would be lost and the cost of capital rate would be higher for companies with volatile results.

The cost of capital rate depends linearly on the tax rate τ. Jurisdictions with higher tax rates will have higher cost of capital rates. For example, the US corporate tax rate is 35% while that of the UK is 28%, so the FCoC method would suggest a higher cost of capital rate for US insurers than for UK ones, *ceteris paribus*.

C.2.6. Numerical Calculations

We assumed for the numerical calculations that the economic profit and loss is Normally distributed with mean 0 and volatility σ.

This implies that economic capital for a given confidence level can be calculated explicitly as $EC(\alpha) = \Phi^{-1}(\alpha) \cdot \sigma$.

We used the Wang 2-factor transform to translate a real-world probability measure to a risk-neutral one.[20] A given observed probability distribution X is transformed to Y via

$$F_Y(t) = Q\left|\Phi^{-1}(F_X(t)) + \lambda\right|$$

where *Q* has a Student's t distribution with k degrees of freedom and where lambda (λ) is a parameter that – for Normally distributed risks – corresponds to the Sharpe ratio.

In the following calculations, we assume that λ=0.75 and k=6. These parameters have been calibrated to observed spreads of catastrophe bonds after Hurricane Katrina[21]. We also performed all the calculations based on a pre-Katrina calibration of λ=0.45 and k=5 and obtained slightly lower cost of capital rates. While the effect of Katrina likely leads to an overstatement of the long-term cost of capital rate, given the inherent limitations of the model, the more conservative calibration has been chosen as a base case.

[20] See Shaun Wang, *"A Universal Framework for Pricing Financial and Insurance Risks"*, ASTIN Bulletin: Journal of the International Actuarial Association, 32 (November 2002): 213-234

[21] Based on unpublished research carried out by a research team at Georgia State University in 2007

C.3. Base Case Results

For the base case results, the following parameters have been chosen

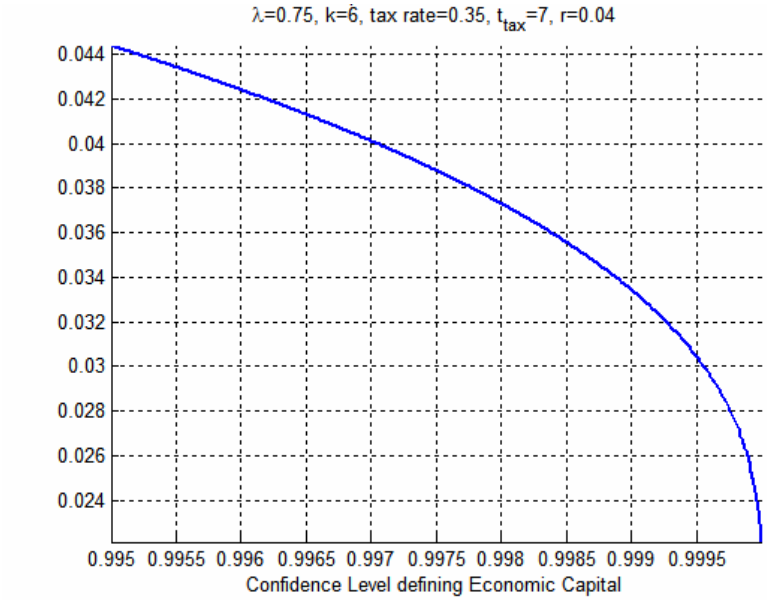
- A risk-free rate of 4.0%
- A tax rate of 35%
- A tax loss carry-forward period of 7 years

The risk-free rate and tax rate are believed to be broadly representative of conditions in many European and North American countries at the time of writing. The tax loss carry-forward period of 7 years is believed to be shorter than what might be achievable in practice in many jurisdictions (e.g. unlimited carry-forward in the UK) and is therefore considered to be somewhat conservative.

For the baseline parameters and assumptions described above, the cost of capital rate for a BBB-rated company is 4.4%, i.e. CoC(SCR) = 4.4%. This is the central estimate produced by the FCoC method.

The following chart shows how the cost of capital rate varies with capitalisation level.

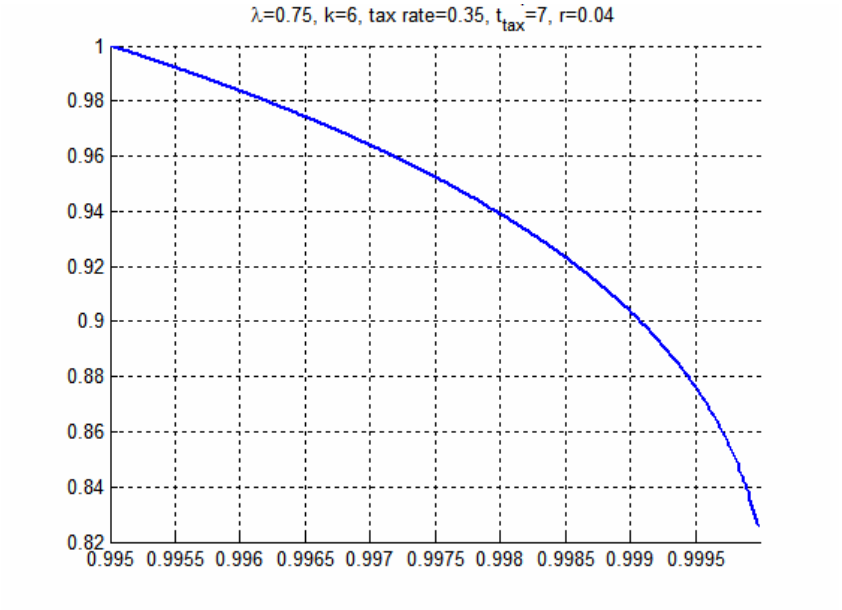
Figure 1 – Cost of Capital rate as a function of confidence level (base case)



It can be seen that the CoC rate reduces as the level of capitalisation increases, reaching a level of CoC(99.99%) = 2.6% for AAA-rated companies.

It is interesting to calculate the MVM as a function of the confidence level. We have already seen that the cost of capital rate decreases for rising confidence levels. Of course, the absolute amount of required capital increases. The MVM is the product of these two quantities. The following graph shows the MVM as a function of the confidence level, normalized so that the MVM for a BBB-rated company is 1.0.

Figure 2 – Market Value Margin as a function of confidence level (base case)



We see that the absolute MVM of a AAA-rated insurer is approximately 15% lower than that of a BBB insurer. This difference in absolute MVM levels is well within the overall margins of uncertainty in the calculation arising from approximations in

- The methodology used to estimate the CoC Rate
- Parameterization of the CoC Rate
- Projection of future SCR capital requirements
- Diversification benefits allocated to future SCR requirements

The CRO Forum therefore considers that, for solvency purposes, it would be acceptable to require all companies to calculate their MVMs based on a minimum regulatory capital requirement (SCR) and the corresponding Cost of Capital Rate, regardless of their internal target or actual levels of capitalisation.

C.4. Sensitivities

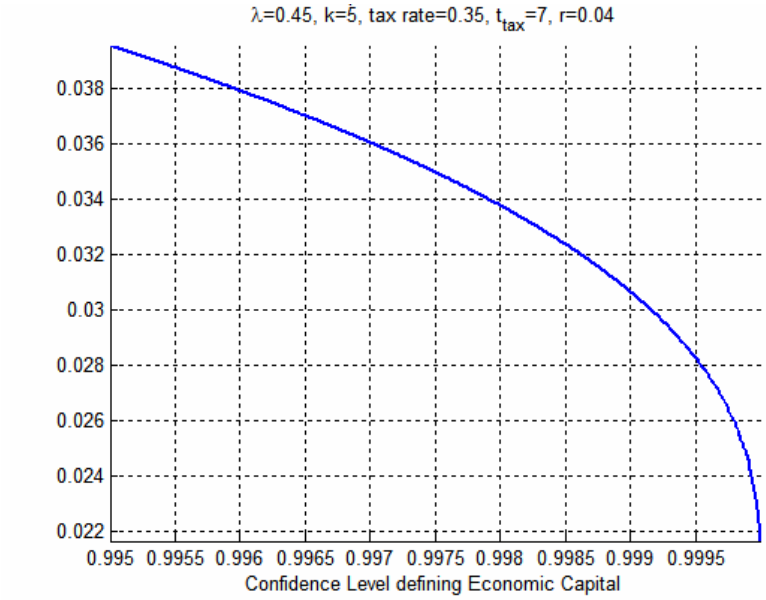
This section shows how the results of the FCoC vary according to the values of the most important parameters, namely

- Lambda and k used in the Wang transform
- Loss carry-forward period
- Risk-free rate
- Regulatory minimum requirement

C.4.1. Sensitivity to Sharpe Ratio (Lambda) and degrees of freedom (k)

We performed the calculations a second time, under the assumption that lambda=0.45 and k=5 but retaining the base case assumptions for tax rates (35%), tax carry-forward period (7 years) and risk-free rate (4.0%). These values for lambda and k are based on a pre-Katrina calibration to corporate bonds performed by Shaun Wang. The chart below shows the cost of capital rate across varying levels of capitalisation.

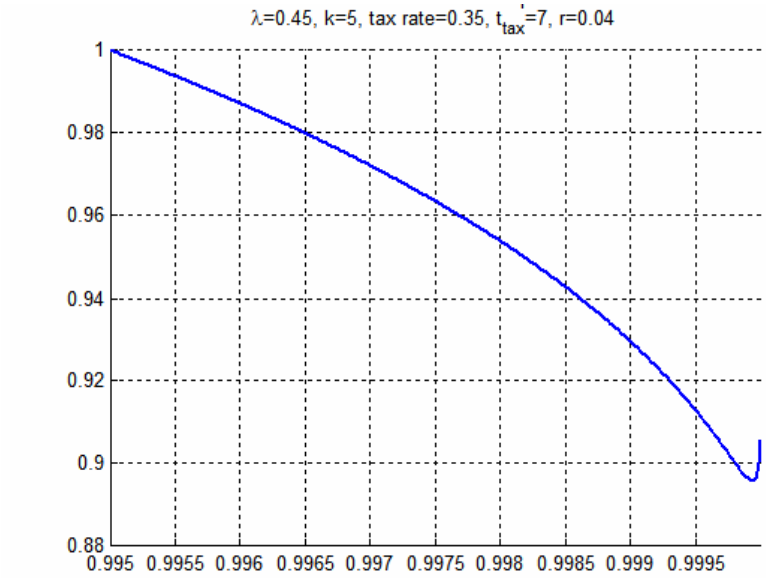
Figure 3 – Cost of Capital Rate as a function of confidence level (λ and k sensitivity)



In this case the cost of capital rate for a BBB-rated company is CoC(SCR) = 4.0%, as compared to the 4.4% obtained using post-Katrina parameters.

As in the base case, we show below the absolute value of the MVM across capitalisation levels, normalised so that the value for BBB-rated insurers is 1.0.

Figure 4 – Market Value Margin as a function of confidence level (λ and k sensitivity)

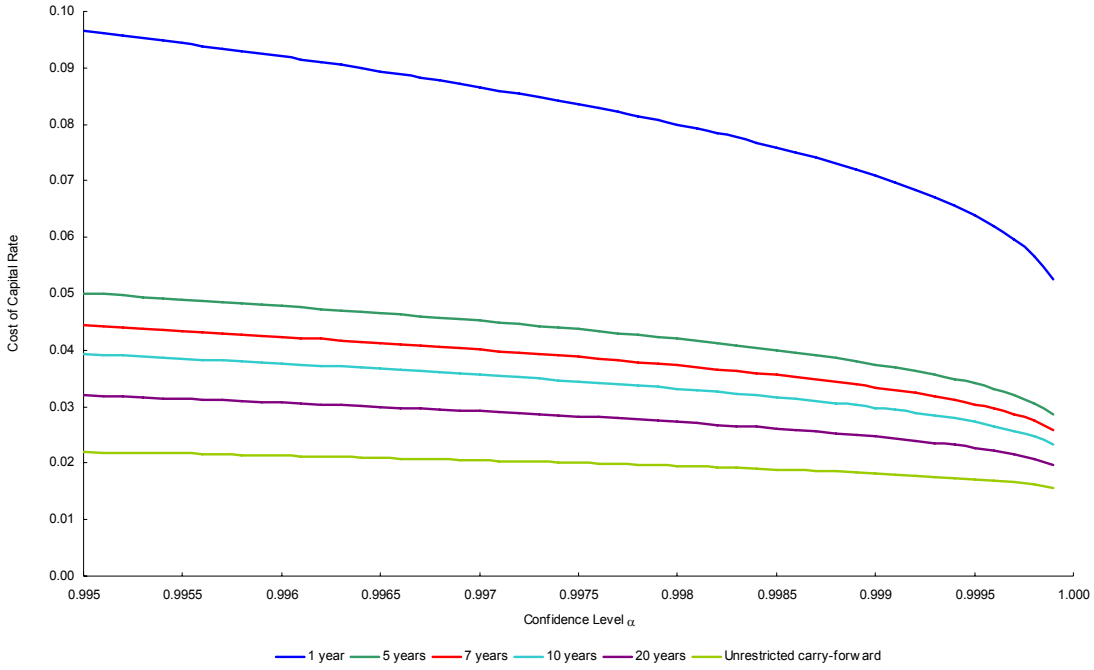


In the above chart we see that when using the pre-Katrina parameters, the MVM of a AAA-rated company is about 10% lower than that of a BBB company.

C.4.2. Sensitivity to Loss Carry-Forward Period

The figure below shows the effect of different carry forward periods on the cost of capital rate. These results are produced using a risk-free rate of 4.0% (r = 0.04), a tax rate of 35%, λ = 0.75 and k=6.

Figure 5 - Cost of Capital Rate as a function of confidence level (loss carry-forward sensitivity)

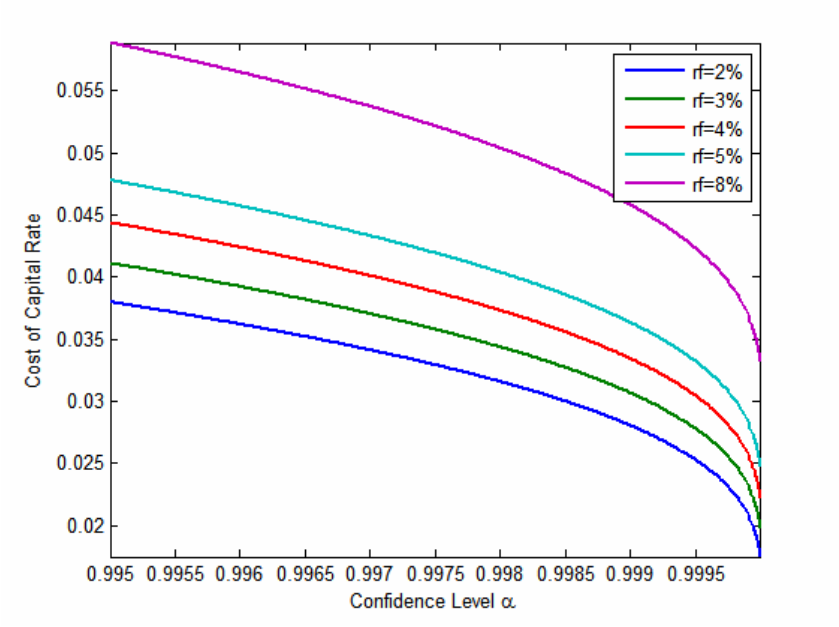


It can be seen that in the case where there is only one year carry-forward of losses, the CoC rate for a BBB company is approximately 9.7%. For carry forwards of 5 years, 7 years, 10 years and 20 years, the CoC rates for a BBB company are 5.0%, 4.4%, 3.9% and 3.2% respectively. For unrestricted carry forwards, the CoC rate is 2.1%.

C.4.3. Sensitivity to the risk-free rate

The graph below shows the different CoC Rate curves for varying risk-free rates (0%, 4%, 8% and 12%).

Figure 6 – Cost of capital rate as a function of confidence level for a range of risk-free rates



It can be seen that the CoC Rate is sensitive to the level of risk-free rates. For the range of values considered here, it can be seen that the relationship is approximately linear, with the CoC Rate for a BBB-rated insurer increasing by 0.3% - 0.4% for every 1.0% increase in the risk-free rate.

C.5. Model Limitations

As was noted earlier, the above-described model does not explicitly take into account agency costs. Since agency costs are smallest for minimally capitalized companies, the fact that the CRO Forum proposes to use a cost of capital rate calibrated to BBB companies minimizes the effect of this omission. If a company-specific cost of capital rate were chosen depending on the firm's target rating, agency costs would need to be taken into account in particular for highly rated firms.

C.6. Check on reasonableness of results

We compared the simple model predictions of cost of financial distress with empirical data. Based on *The risk-adjusted cost of financial distress* by Heitor Almeida and Thomas Philippon, the risk-adjusted costs of financial distress, as a percentage of firm value, are 1.34% for BBB bonds and 0.24% for AAA bonds. This compares – for λ=0.75 and k=6 in our simple model – to 1.6% for BBB insurers and 0.34% for AAA insurers. Given the data limitations, this is certainly within generally accepted tolerance levels.

C.7. Conclusions

- The cost of capital rate does not depend on a company's volatility of profit and loss (P&L) but it does depend on its capitalisation level

- The absolute value of the MVM is relatively insensitive to the confidence level to which the company is capitalised. That means that the MVM can be determined, for example, by defining the CoC rate for a BBB rated company (i.e. a confidence level α of 0.995) with the capital base for the MVM calculation defined by the Solvency II SCR. This would correspond to the way the MVM is defined by Solvency II and the Swiss Solvency Test (SST)

- The Cost of Capital Rate depends linearly on a jurisdiction's tax rate for all confidence levels. This means that the cost of capital rate (and therefore the MVM) in a jurisdiction with a tax rate of 10% is only half of that in a jurisdiction with a tax rate of 20%

- The cost of capital rate does not depend on the business written, i.e. the cost of capital rate should be the same for life insurers, P&C insurers, monolines, reinsurers etc., as long as they are capitalized to the same confidence level

- For highly capitalized companies, the cost of capital rate is determined mainly by the cost of double taxation and the cost of financial distress is negligible

- The Cost of Capital rate is quite sensitive to the period over which losses can be carried forward for tax purposes. The results for a BBB rated company (i.e. a confidence level α of 0.995) vary from 2.1% to more than 5%. The base assumption of a 7 year carry-forward period corresponds to a Cost of Capital rate of 4.4%.

- The Cost of Capital rate is sensitive to changes in the level of risk-free rate, increasing by 0.3% to 0.4% for every 1% increase in the risk-free rate

- The Cost of Capital rate is not very sensitive to the number of degrees of freedom chosen for the Student's t distribution used in the numerical calculations. For k > 3, the Cost of Capital Rate does not change particularly significantly and ranges from 4.4% for a BBB company to 2.6% for a AAA company

- The Cost of Capital rate is more sensitive to combined changes in λ and k. The Cost of Capital rate for a BBB company λ=0.45 and k=5 is approximately 4.0%, whereas for λ=0.75 and k=6, it is about 4.4%

The CRO Forum concludes that an appropriate Cost of Capital rate based on the FCoC method with reasonable parameter estimates would lie broadly in the range 2.5% - 4.5%.

Appendix D. Weighted Average Cost of Capital

D.1. WACC Summary

In the standard corporate finance literature, the Cost of Capital Rate for a firm is often defined as a weighted average of the cost of equity capital and cost of debt capital with an adjustment for tax relief on interest payments made to service the debt. This is known as the Weighted Average Cost of Capital (WACC) approach.

The cost of equity capital is a key input into the WACC. The cost of equity for a firm can be derived using the Capital Asset Pricing Model (CAPM) and estimates of the equity risk premium (ERP) of the stock market.

Historical ERPs based on empirical realized returns on the stock market in excess of the government bond yields require an extended time period to ensure stability of results.

A comprehensive study of equity risk premia (Dimson, Marsh and Staunton, 2003) concluded: "A plausible, forward-looking risk premium for the world's major markets would be on the order of 3% on a geometric mean basis, while the corresponding arithmetic mean risk premium would be around 5%."

Based on research of reported empirical studies, we select the best point estimate of equity risk premium to be 3.5%, while a plausible range would be (2.5% to 4.5%).

Assuming that a firm's surplus is made up of 80% equity capital and 20% from debt; and using a conservative estimate for the cost of equity capital of 4.0%, a cost of debt capital of 2.1% and a tax rate of 35% (which causes an adjustment for tax deduction of interest payment on the debt), we obtain an estimate of the CoC Rate of approximately 3.2%.

D.2. Weighted Average Cost of Capital Approach

In the standard corporate finance literature, the Cost of Capital Rate, R_{COC}, for a firm is often defined as the weighted average of the cost of equity capital, R_e, and the cost of debt capital, R_d, with an adjustment for the tax relief on interest payments made to service the debt:

$$R_{COC} = R_e \frac{E}{E+D} + R_d(1-\tau)\frac{D}{E+D}$$

where

E: is the market capitalisation,
D: is the market value of debt, and
τ: is the effective tax rate.

D.3. Capital Asset Pricing Model

The most widely used approach to derive the cost of equity capital is the Capital Asset Pricing Model (CAPM). The cost of equity capital for a firm "j", written $R_{e;j}$ can be derived from the equity risk premium (ERP) of the stock market using the following relationship:

$$R_{e;j} = \beta_j \cdot R_m ,$$

where R_m is the long-run equity risk premium over the risk free rate, r_f, and the firm's Beta, $\beta_j = \left(\rho_{jm} \cdot \frac{\sigma_j}{\sigma_m} \right)$ reflects the correlation of the firm's returns with those of the equity market overall.

It can therefore be seen that the equity risk premium is a key determinant of the cost of equity capital.

D.4. Equity Risk Premium Estimates

D.4.1. Historical Studies

ERP analysis based on historical realized returns on the stock market in excess of the government bond yield requires data over an extended time period to ensure stability of estimation.

Here we cite a paper "*Global Evidence on the Equity Risk Premium*" by Dimson, Marsh and Staunton (Fall, 2003), Journal of Applied Corporate Finance. The authors conducted a comprehensive study of equity risk premia and concluded that

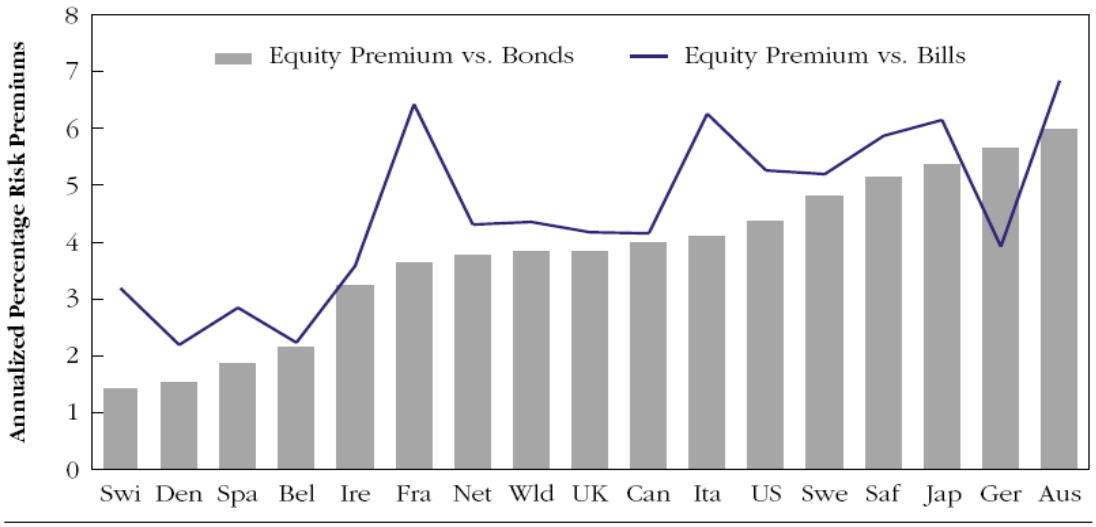
> "A plausible, forward-looking risk premium for the world's major markets would be on the order of 3% on a geometric mean basis, while the corresponding arithmetic mean risk premium would be around 5%."

Table 3.1 International Equity Risk Premia 1900-2002

	Equity Risk Premiums (Percent per Year)					
	Relative to Bills			Relative to Bonds		
	Geometric Mean	Arithmetic Mean	SD	Geometric Mean	Arithmetic Mean	SD
Australia	6.8	8.3	17.2	6.0	7.6	19.0
Belgium	2.2	4.4	23.1	2.1	3.9	20.2
Canada	4.2	5.5	16.8	4.0	5.5	18.2
Denmark	2.2	3.8	19.6	1.5	2.7	16.0
France	6.4	8.9	24.0	3.6	5.8	22.1
Germany	3.9	9.4	35.5	5.7	9.0	28.8
Ireland	3.6	5.5	20.4	3.2	4.8	18.5
Italy	6.3	10.3	32.5	4.1	7.6	30.2
Japan	6.1	9.3	28.0	5.4	9.5	33.3
The Netherlands	4.3	6.4	22.6	3.8	5.9	21.9
South Africa	5.9	7.9	22.2	5.2	6.8	19.4
Spain	2.8	4.9	21.5	1.9	3.8	20.3
Sweden	5.2	7.5	22.2	4.8	7.2	22.5
Switzerland	3.2	4.8	18.8	1.4	2.9	17.5
United Kingdom	4.2	5.9	20.1	3.8	5.1	17.0
United States	5.3	7.2	19.8	4.4	6.4	20.3
Average	4.5	6.9	22.8	3.8	5.9	21.6
World	4.4	5.7	16.5	3.8	4.9	15.0

*The equity risk premium is measured here as 1 + equity rate of return divided by 1 + risk-free return, minus 1. The statistics reported in this table are based on 103 annual observations for each country, except Germany which excludes 1922–23, when bill and bondholders experienced returns of –100% due to hyperinflation. The row labeled "Average" is a simple, unweighted average of the statistics for the 16 individual countries. The row marked "World" is for the World index (see text).
Source: E. Dimson, P. Marsh, and M. Staunton, *Triumph of the Optimists: 101 Years of Global Investment Returns* (New Jersey: Princeton University Press, 2002), and *Global Investment Returns Yearbook* (ABN AMRO/London Business School, 2003).

Figure 3.1 Worldwide Annualized Equity Risk Premiums 1900-2002



Germany excludes 1922–23.
Source: Dimson, Marsh, and Staunton, *Triumph of the Optimists: 101 Years of Global Investment Returns* (Princeton University Press, 2002) and *Global Investment Returns Yearbook* (ABN AMRO/London Business School, 2003).

Douglas J. Lamdin, in his 2003 article *"Corporate bond yield spreads in recent decades: an examination of trends, changes, and stock market linkages"*, discussed two different measurements of the ERP, namely, historical versus forward-looking. Recent research has lead to two primary conclusions: (1) realized historic returns on the stock market likely overestimate the true ERP during that time and overestimate the current ERP as well, and (2) "implied" forwarding-looking ERP estimates are below historic realized rates and also may have fallen over time.

Measurement of the ERP using realized returns on the stock market may seriously overestimate the ERP. Basic models of share valuation imply that stock values equal the present value of expected future cash flows to shareholders. As the expected growth rate in future cash flows rises or falls, share values will move in the same direction. If the required return on equity rises or falls, share values will move in the opposite direction. Thus, if "surprises" regarding growth are positive on average and/or the required rate of return is falling, stock prices will be higher than expected, as will realized returns. Ex post realized returns will therefore exceed the ex ante required return of investors. If this has been the case, as Fama and French (2002)
and others claim, ERP estimates based on realized returns will not provide
accurate estimates.

The ERP measured in a forward-looking manner uses a model of stock value (returns) based on the present value of future cash flows to investors. In a constant growth model, this implies that the expected dividend yield plus the expected capital gains return provide an estimate of the required return of investors. Subtracting the current government bond rate provides the implied ex ante ERP estimate.

Note that these empirical findings were conducted by eminent researchers in the field of finance and published in leading finance journals. Given that reliable estimates can only be derived from very long-term observations, we do not expect that repeating the analysis after adding one or two additional years of observations would change the results materially.

Key results of estimates of ERP

Authors	Article	Range

		(low to high)	
Lamdin (2002)	"New Estimates of the Equity Risk Premium and Why We Need Them." Business Economics. Vol. 37. No. 4. Pp. 54-60.	3.30%	4.70%
Claus and Thomas (2001)	"Equity Premia as Low as Three Percent? Evidence from Analysts' Earnings Forecasts for Domestic and International Stock Markets." Journal of Finance. Vol. 56. Pp. 1629-1666.	3.00%	4.00%
Fama and French (2002)	"The Equity Premium." Journal of Finance. Vol. 57. Pp. 637-659.	2.50%	4.30%

D.4.2. Recent studies by Barrie & Hibbert

Barrie & Hibbert have conducted extensive analysis of world stock market volatilities and target risk premiums and we are grateful to them for sharing their study results with us. At the end of 2007, Barrie & Hibbert recommended a target long-term global equity market equity arithmetic premium of 4%. Long-term volatility for individual equity markets ranges between 17% (UK, US) and 62% (Argentina).

Based on reported empirical studies, we select the best point estimate of equity risk premium to be 3.5%, while a plausible range would be (2.5% to 4.7%).

D.5. Corporate Bond Spreads

Here we present the findings of Douglas and Lamdin's (2003) article. The Federal Reserve Board (www.federalreserve.gov) (Lamdin (2003)) analyzed monthly data of current promised yield on Aaa and Baa corporate bonds and 10-year Treasury bonds from February 1970 to May 2003. The following is a summary of relevant empirical results:

1. During this period, the monthly promised yield on the Treasury bonds (T) averaged 7.93% with a standard deviation of 2.38%
2. For Aaa bonds, these values were 8.87% and 2.08%
3. For Baa bonds these values were 9.98% and 2.40%
4. The (Aaa –T) yield spread averaged 0.95% during this period, with a standard deviation of 0.48%
5. The (Baa –T) yield spread averaged 2.05% with a standard deviation of 0.58%

D.6. An Illustrative Example

Suppose that a firm's surplus arises from 80% equity capital and 20% from debt.
We have selected a risk-free rate of r_f = 4%. We have used a cost of equity capital (in excess of risk-free) of R_e^* = 4.0%, which is towards the upper end of the range of (2.5% - 4.7%) discussed in section D.4. Based on the findings in section D.5, we have used a cost of debt capital (in excess of risk-free) of R_d^* = 2.1%. Lastly, we have used a tax rate of τ : = 35%.

Applying the WACC approach produces a cost of capital (in excess of risk-free of):

$$R^*_{COC} = (R^*_e + r_f)\frac{E}{E+D} + (R^*_d + r_f)(1-\tau)\frac{D}{E+D} - r_f$$

= (4.0% + 4.0%) * 0.8 + (2.1% + 4.0%) * (1 - 0.35) * 0.2 – 4.0%

= 3.19%.

D.7. WACC Applied to Market Price of Risk

Here we repeat the calculation shown in the example in section D.6, using the range of estimates for the cost of equity derived using the Market Price of Risk approach, which is described in detail in Appendix E.

The results are shown in the following table:

	Cost of equity	WACC
Low end	3.9%	3.11%
High end	5.6%	4.47%

Under the assumptions used here, the Market Price of Risk approach generates a range for the Cost of Capital rate of 3.1% to 4.5%.

D.8. WACC Applied to ERP from CAPM and FF2F

Here we repeat the calculation shown in the example in section D.6, using the range of estimates for the equity risk premium (ERP) derived using the CAPM and FF2F approach, which are described in detail in Appendix F.

The results are shown in the following table:

		ERP	WACC
CAPM	**Life**	5.06%	4.04%
	Non-life	3.81%	3.04%
FF2F	**Life**	8.63%	6.90%
	Non-life	8.36%	6.68%

Under the assumptions used here, the two approaches generate a range for the Cost of Capital Rate of 3.0% to 6.9%.

Appendix E. Market Price of Risk Method

E.1. Market Price of Risk Summary

In a Solvency II context, the minimum required capital is prescribed as the 99.5th percentile. Assuming a Gaussian (Normal) distribution for the profit/loss distribution with volatility σ, required capital (SCR) can be calculated easily as SCR = 2.58 σ.

The Sharpe Ratio λ is the expected excess return over the risk-free rate in units of volatility, hence λ quantifies the market price of risk. For our purpose we can interpret the MVM as expected excess return over the risk-free rate. Provided we know the value of the Sharpe Ratio, we then have MVM = λ σ.

The CoC Rate can be expressed simply as

$$\text{CoC Rate} = \frac{\text{MVM}}{\text{Required Capital}} = \frac{\lambda}{2.58}$$

In other words, if we know the market price of risk for insurance liabilities, we will be able to derive a COC Rate, and vice versa.

The market price of risk for insurance liabilities can be estimated using historical data and leads to a value of approximately 0.15 and consequently to an estimate of the CoC Rate of 5.5%.

E.2. Application of Market Price Of Risk in Calculating MVMs

We first establish a market price of risk, λ, on a per annum basis, which can be calibrated from studies of market risk premium per unit of volatility.

Portfolio CAPM: For a firm's own insurance portfolio, M, and its segment of business, j, we have

$$\lambda_j = \rho_{jM}\lambda_M ,$$

where ρ_{jM} is the correlation between segment *j* and the firm portfolio.

- Let X(0) >0 be the total "nominal" value of insurance liability evaluated at current time t=0.
- Let X(t) be the total "nominal" total value of insurance liability evaluated at time t.
- Let $X^p(t)$ denote the cumulative paid losses up to time t.
- Let $X^u(t)$ denote the cumulative unpaid losses at time t.

We have

$$X(t) = X^p(t) + X^u(t), \quad t > 0.$$

Assume that $X^u(t)$ eventually decreases to 0 by time T: $X^u(T) = 0$.

Let ΔX(t) represent the sum of payments during time period (t, t+Δt) plus changes in the nominal technical provisions for future payments.

Note that at any point in time, "cushion" capital is only needed to support unpaid losses $X^u(t)$.

Assume an expected instantaneous volatility term structure σ(t) of unhedged residual risks in the value $X^u(t)$.

$$\frac{dX^u(t)}{X^u(t)} = -\mu(t)dt + \sigma(t)dW_t,$$

where $\mu(t)$ represents the payment rate during the time interval (t, t+dt), and dW_t represents a Brownian motion. Note that the payment rate $\mu(t)$ represents a negative growth rate for the unpaid insurance liabilities.

Let $\lambda_j(t)$ be an instantaneous market price of risk (per annum) at time t.
For any time interval, (t, t+dt), we have an implied capital commitment:

$$\frac{X^u(t)\cdot\lambda_j(t)\cdot\sigma(t)\cdot dt}{COC_j}.$$

Thus, the total present value of capital commitment is

$$\frac{\int_0^T X^u(t)\cdot\lambda_j(t)\cdot\sigma(t)\cdot v_t\cdot dt}{COC_j},$$

where v_t is the present value function using the risk-free yield curve.

The MVM for the insurance liability is thus

$$\int_0^T X^u(t)\cdot\lambda_j(t)\cdot\sigma(t)\cdot v_t\cdot dt.$$

The market-consistent value of the insurance liability is calculated by:

$$E^*(X) = \int_0^T \cdot v_t \cdot dX^p(t) + \int_0^T X^u(t)\cdot\lambda_j(t)\cdot\sigma(t)\cdot v_t\cdot dt.$$

E.3. Calibration of Market Risk Premium and Sharpe Ratio for EU Countries

Using the result by Dimson, Marsh and Staunton (2003), we have the following estimates for ten EU countries:

Table 2 Historical differential return of the stock market over fixed income, Time Period 1900-2002; Annualized Returns; Over long-term bond yields

EU countries	Geometric average	Standard deviation	Lambda_g
Germany	3.70%	28.80%	0.128
Sweden	4.80%	22.50%	0.213
Italy	4.10%	30.20%	0.136
Holland	3.80%	21.90%	0.174
UK	3.80%	17.00%	0.224
France	3.60%	22.10%	0.163
Ireland	3.20%	18.50%	0.173
Belgium	2.10%	20.20%	0.104
Spain	1.90%	20.30%	0.094
Denmark	1.50%	16.00%	0.094
Switzerland	1.40%	17.50%	0.080
Average of EU countries	3.08%	21.36%	0.144

Using a per annum market price of risk of λ=0.144, we can derive the implied cost of capital rate for any chosen capitalization level (solvency standard) and under a range of distributional assumptions for the annual P&L. The two tables below do this for a Normal and a Student's t distribution.

Normal P/L distribution		
Solvency Standard	99.50%	99.95%
Solvency Capital (as multiple of sigma)	2.58	3.29
Market Price of Risk (risk load as multiple of sigma)	0.144	0.144
Implied CoC Rate (100% Equity)	5.6%	4.4%

Student's t P/L distribution (deg. of freedom = 6)		
Solvency Standard	99.50%	99.95%
Solvency Capital (as multiple of sigma)	3.71	5.96
Market Price of Risk (risk load as multiple of sigma)	0.144	0.144
Implied CoC Rate (100% Equity)	3.9%	2.4%

Note that for a higher solvency standard, e.g., AA or 99.95% threshold, we have a lower CoC Rate corresponding to the same market price of risk, λ=0.144.

Also, for a given market price of risk, and solvency threshold, we get a lower CoC Rate by assuming a Student's t distribution rather than a Normal distribution.

Remark: using arithmetic premiums would give higher risk premiums and thus higher Sharpe ratios. For instance, if we were using Barrie & Hibbert's selection of target long-term global equity market equity *arithmetic* premium of 4%, and a long-term volatility of 25.5%, we would get a Sharpe Ratio of 0.157. This is slightly higher than our above selections.

E.4. An Example of Calculating fair value of insurance liabilities

For this example, we chose the global parameters shown in the table below.

Lambda	0.15
COC rate	5.50%
Interest rate	4.50%

Consider a non-life insurance liability portfolio. We assume that the outstanding reserves have a run-off period of 20 years, following some expected actuarial/statistical payout patterns. We also assume that the year-over-year loss reserve developments have a constant annualized volatility of 10%. With a selected per annum lambda=0.15, we can calibrate risk margins in each development year as a multiple (lambda) of the annualized volatilities. Furthermore, we can calculate the present value to derive a "market value" for the reserve liability portfolio.

Year	Expected unpaid amount (1)	Volatility term structure (2)	Risk load (3) = (1).(2).(0.15)	Implied capital (4) = (3)/5.5%	PV v_t
1	$1,000.0	10.0%	$15.00	$272.73	0.956938
2	$800.0	10.0%	$12.00	$218.18	0.915730
3	$640.0	10.0%	$9.60	$174.55	0.876297
4	$512.0	10.0%	$7.68	$139.64	0.838561
5	$409.6	10.0%	$6.14	$111.71	0.802451
6	$327.7	10.0%	$4.92	$89.37	0.767896
7	$262.1	10.0%	$3.93	$71.49	0.734828
8	$209.7	10.0%	$3.15	$57.20	0.703185
9	$167.8	10.0%	$2.52	$45.76	0.672904
10	$134.2	10.0%	$2.01	$36.60	0.643928
11	$107.4	10.0%	$1.61	$29.28	0.616199
12	$85.9	10.0%	$1.29	$23.43	0.589664
13	$68.7	10.0%	$1.03	$18.74	0.564272
14	$55.0	10.0%	$0.82	$14.99	0.539973
15	$44.0	10.0%	$0.66	$11.99	0.516720
16	$35.2	10.0%	$0.53	$9.60	0.494469
17	$28.1	10.0%	$0.42	$7.68	0.473176
18	$22.5	10.0%	$0.34	$6.14	0.452800
19	$18.0	10.0%	$0.27	$4.91	0.433302
20	$14.4	10.0%	$0.22	$3.93	0.414643
Total PV		**15.7%**	**$60.93**	**$1,107.85**	

Note that this methodology helps to reflect the time diversification effect. In this example, the ultimate CV is 15.7%, however, thanks to time diversification, the per annum CV is only 10%.

E.5. Links from Solvency Capital to Market Price of Risk and Cost of Capital

In a Solvency II context, the minimum required capital SCR is prescribed as the 99.5th percentile.

We assume a Gaussian (normal) distribution for the profit / loss distribution:

At the SCR solvency threshold, we have

$$\text{Required Capital} = \Phi^{-1}(0.995) = 2.58\sigma,$$

where Φ is the Gaussian distribution function.

Remark: If we were assuming a Student's t distribution for the profit / loss distribution (with 6 degrees of freedom), then at the SCR solvency threshold,
$\text{Required Capital} = t_6^{-1}(0.995) = 3.71\sigma$, where t_6^{-1} is the inverse t-distribution with 6 degrees of freedom.

In financial economics, a key concept of MVM for risky financial assets is the market price of risk, or Sharpe Ratio:

$$\lambda = \frac{E(R_M) - r_f}{\sigma(R_M)}.$$

In other words, the market price of risk, λ, is the MVM (or expected excess return over risk-free rate) per unit of volatility.

Here we view the market price of risk as the bridge to link 1) Solvency Capital, 2) the CoC rate, and 3) the MVM for insurance liabilities.

Assume that the MVM is specified using a firm-level market price of risk, we have

$$\text{Risk Margin} = \lambda\sigma,$$

which is a multiple of the standard deviation. Then we have for the CoC Rate:

$$\text{CoC Rate} = \frac{\text{Risk Margin}}{\text{Required Capital}} = \frac{\lambda}{2.58}.$$

In other words, if we know the market price of risk for insurance liabilities, we will be able to derive a CoC Rate, and vice versa.

Indeed, it is advantageous to specify a fixed market price of risk, since firms with different ratings may have different CoC rates, but nevertheless the same market price of risk on the liabilities.

As an alternatively formulation, the CAPM can be expressed in terms of the market price of risk:

$$R_{e;j} = \lambda_j \cdot \sigma_j, \text{ with } \lambda_j = \rho_{jm} \cdot \lambda_m.$$

We can derive the CoC Rate from estimates of either 1) the market risk premium, or 2) the market price of risk.

In the context of evaluating MVMs for insurance liabilities, we will have the following information:

1. The volatility of the insurance liabilities by lines of business, and their correlation coefficients or even other correlation structures, from which we can derive the overall volatility (or probability distributions) for the liability portfolio.
2. The term structure of volatilities for insurance liabilities (sometimes we can assume an overall volatility for the whole lifetime of insurance liabilities, and implicitly assume a constant coefficient of variation).

In light of the relationships between the CoC Rate, the market risk premium and the market price of risk, we can calculate the CoC rate in the following steps:

Step 1. Estimation of the Cost of Equity Capital and Market Price of Risk
Step 2. Estimation of the Cost of Debt Capital
Step 3. Estimation of firm's beta or correlation
Step 4. Estimation of relative portions of Equity Capital and Debt Capital
Step 5. Use weighted average formula to derive firm's CoC Rate (per Appendix D)

Appendix F. CAPM and FF2F Method

F.1. Summary of ERP Estimation Using CAPM and FF2F

This appendix describes two methods used to provide estimates of the equity risk premium, which is needed as an input into the WACC calculation discussed earlier.

The equity risk premium estimates are provided for two asset pricing models: the Capital Asset Pricing Model (CAPM) and the two-factor asset pricing model developed by Professors Eugene Fama and Kenneth French.

The CAPM is a traditional model from financial theory and is by far the most popular method used to estimate the cost of equity capital among large publicly traded companies. The CAPM cost of capital is equal to the rate of return on risk-free securities plus a market risk premium based upon the systematic market risk of the firm's stock estimated as the firm's market beta.

The second model used is an international version of the Fama-French multi-factor asset pricing model originally proposed in Fama and French. The model was developed because although the CAPM market systematic risk factor is statistically significant, this factor alone does not adequately explain stock returns.

The CAPM and FF2F asset pricing models produce estimates of the cost of equity capital for individual insurers. However, the task set forth here is to determine the cost of equity capital for a firm of average risk operating in the life insurance industry or in the non-life insurance industry. Unfortunately most insurers in our sample participate in both industries (and others) and therefore the estimated cost of equity capital for a specific firm should reflect the relative proportion of its entire portfolio of businesses.

Accordingly we utilized the *full-information industry beta (FIIB)* which allows us to decompose the individual company cost estimates into industry-specific cost estimates. The underlying insight is that the *observable* beta for the overall firm is a weighted average of the *unobservable* betas of the underlying lines of business.

The approach provides region-specific estimates for each industry and also provides industry-specific estimates of the cost of equity capital for the global insurance industry. The results can be interpreted as providing estimates of the cost of capital for insurers that are of average risk for the life and non-life insurance industries located in the major regions of the world and for the global insurance industry.

F.2. Introduction

This section provides estimates of the equity risk premium needed as an input for the WACC calculation. The estimates are produced using two different asset pricing models prominent in the academic finance literature for the life and the non-life insurance industries based on return data of publicly traded companies headquartered in the United States, Europe and Asia. We provide region-specific estimates for each industry and also provide industry-specific estimates of the cost of equity capital for the global insurance industry. Collectively the companies in the data set underwrote $1.4 trillion in net premiums written in 2005 and therefore make up a substantial portion of the $3.4 trillion in worldwide premium volume that transacted in 2005 (Source: Swiss Re 2006). Thus, the results shown here can be interpreted as providing estimates of the cost of capital for insurers that are of average risk for

the life and non-life insurance industries located in the major regions of the world and for the global insurance industry.

The equity risk premium estimates are provided for two asset pricing models: the Capital Asset Pricing Model (CAPM) from Sharpe (1964) and Linter (1965) and the two-factor asset pricing model developed by Professors Eugene Fama and Kenneth French (Fama and French 1998). The CAPM is the traditional model from financial theory and is by far the most popular method used to estimate the cost of equity capital among large publicly traded companies (Graham and Harvey 2001). The CAPM cost of capital is equal to the rate of return on risk-free securities plus a market risk premium based upon the systematic market risk of the firm's stock estimated as the firm's market beta.

The second model we use is an international version of the Fama-French multi-factor asset pricing model originally proposed in Fama and French (1992, 1993). The model was developed because although the CAPM market systematic risk factor is statistically significant, this factor alone does not adequately explain stock returns. In the international setting Fama and French (1998) have shown that adding a second factor related to the ratio of the book value of equity (BV) relative to the market value (MV) of equity to the CAPM significantly increases the explanatory power of the model. The BV-to-MV risk factor reflects the tendency of investors to require higher expected returns on individual stocks that tend to perform poorly when a portfolio of high BV-MV firms also tend do perform poorly (relative to a portfolio of low BV-MV firms) as research has shown these firms perform particularly poorly exactly when individual investors' portfolios are also experiencing overall losses. The ratio of the BV of equity to the MV of equity is sometimes referred to as the value factor because analysts view firms with high BV-to-MV ratios as value stocks and firms with low ratios of BV-to-MV as growth stocks.

The CAPM and FF2F asset pricing models produce estimates of the cost of equity capital for individual insurers. However, the task set forth in this exercise is to determine the cost of equity capital for a firm of average risk operating in the life insurance industry or in the non-life insurance industry. Unfortunately most insurers in our sample participate in both industries (and others) and therefore the estimated cost of equity capital for a specific firm should reflect the relative proportion of their entire portfolio of businesses. Accordingly we utilize the *full-information industry beta (FIIB)* which allows us to decompose the individual company cost estimates into industry specific cost estimates. The underlying insight is that the *observable* beta for the overall firm is a weighted average of the *unobservable* betas of the underlying lines of business. The FIIB approach was first developed in the context of the CAPM by Ehrhardt and Bhagwar (1991) and significantly modified by Kaplan and Peterson (1998). Cummins and Phillips (2005) extended the FIIB method to the Fama-French multifactor setting and then used the method to produce cost of capital estimates for U.S. property-casualty insurers for individual lines of insurance. The authors' work suggested that over the time period of the late 1990s, the cost of equity capital calculated using the more robust Fama-French model was significantly higher than the corresponding estimates developed using the CAPM.

Implementing the FIIB methodology in the FF2F framework requires us to estimate two regressions where the dependent variables are the two Fama-French betas for the firms in the sample. One of the regression equations uses the Fama-French market systematic risk betas as the dependent variables and the second regression uses the Fama-French BV-to-MV beta coefficients. The independent variables for both regression equations are line of business participation variables based on the revenues that each firm obtains from the various industries in which it does business. In the CAPM framework, implementing the FIIB methodology requires us to only estimate one regression where the dependent variables are the estimated CAPM betas for each firm in the sample.

F.3. Methodology

The analysis proceeds as follows. First, for each firm in our data set, we estimate the CAPM market beta coefficients for each firm in the sample using the following time-series regression:

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + e_{it} \quad (1)$$

where r_{it} is the monthly return on the stock for firm i in month t, r_{ft} is the risk-free rate of interest at the beginning of the month, r_{mt} is the monthly return on the value-weighted market portfolio appropriate for the region in which the insurer is headquartered, e_{it} is the error term, and β_i is the estimated CAPM beta.

Second, we estimate the excess market risk and BV-MV risk factors for the Fama-French model where the time series regression estimated for the FF2F model for each firm is

$$r_{it} - r_{ft} = \alpha_i + \beta_{mi} (r_{mt} - r_{ft}) + \beta_{vi} \pi_{vt} + \eta_{it} \quad (2)$$

where π_{vt} is the additional factor included to capture financial distress risk in month t, β_{mi} and β_{vi} are the estimated market and value risk coefficients, and η_{it} is the error term. The financial distress factor π_{vt} is the difference between a portfolio of high BV-MV stocks and a portfolio of low BV-MV stocks specific to the region in which the insurer is located.[22]

Consistent with standard empirical implementation of the models, each time series regression is estimated annually through the end of June of each calendar year using the previous sixty months of return data. Any firm with less than 36 months of data and any firm with an estimated CAPM beta or estimated Fama-French market or BV-MV risk factor that has absolute value greater than 5 is eliminated from the sample.

The third step in the analysis is to produce full information industry betas for each industry by performing cross-sectional regressions with the estimated market betas as dependent variables and a series of weights proxying for the firm's participation in various lines of business as explanatory variables. In the case of the CAPM, the FIIB regression estimated is

$$\beta_i = \sum_{j=1}^{J} \beta_{fj} \, \omega_{ij} + \xi_i \quad (3)$$

where β_i = firm i's overall CAPM market systematic risk beta coefficient,
β_{fj} = the full-information CAPM market systematic risk beta for industry j,
ω_{ij} = firm i's industry participation weight for industry j, and
ξ_i = random error term for firm i.

The ω_{ij}, j = 1, 2, . . ., J, for firm i, which sum to 1.0, measure the firm's participation in each line of business. Following Kaplan and Peterson (1998) and Cummins and Phillips (2005), we use revenues by industry to calculate ω_{ij}, so that ω_{ij} = revenues of firm i in industry j divided by total revenues of firm i across all industries in which the firm participates.

Using the FIIB method for the FF2F model requires us to estimate two cross sectional regressions. The first, where we decompose the FF2F market systematic risk factor, is

[22] See Fama and French (1993) for a detailed discussion of the construction of the portfolios and the resulting factor.

exactly the same as the CAPM FIIB regression except we replace the CAPM beta β_i with the estimated FF2F market systematic risk factor β_{mi}. However, using an equation similar to equation (3) would not be appropriate for the Fama-French BV-to-MV beta coefficient because these betas tend to vary systematically with firm BV-to-MV ratios.[3] Specifically, the BV-to-MV betas tend to be directly related to firm BV-to-MV ratios. To address this problem, we conduct the following regression for the BV-to-MV beta:

$$\beta_{vi} = \sum_{j=1}^{J} \beta_{f1vj}\, \omega_{ij} + \beta_{f2v} \ln(BV_i / MV_i) + \xi_{vi} \qquad (4)$$

where β_{vi} = BV-to-MV beta estimate firm *i*,
β_{f1vj} = full-information BV-to-MV beta intercept coefficient for industry *j*,
β_{f2v} = full-information BV-to-MV beta slope coefficient,
BV_i, MV_i = book value of equity and market value of equity for firm *i*,
ω_{ij} = industry-participation weight for firm *i* in industry *j*, and
ξ_{vi} = random error term for firm *i*.

Equation (4) allows for different intercept coefficients for each industry and also controls for variation in the BV-to-MV ratio across the firms in the sample. The slope coefficient captures the systematic relationship between individual firm exposure to its own Fama-French value risk factor and the firm's own BV-to-MV ratio. Thus, controlling for the average book-to-market ratio, we get an estimate of the industry value risk factor. The full information industry beta estimate for the BV-to-MV factor is obtained using the estimated coefficients $\hat{\beta}_{f1hj}$ and $\hat{\beta}_{f2h}$ by inserting the industry participation weights (ω_{ij}) and ln(BV_i/MV_i) for each firm into equation (4). Equations (3) and (4) are estimated using ordinary least squares.

The coefficients of the line of business participation variables in the full-information beta regressions (3) and (4) are then interpreted as the full-information industry beta coefficients for the business lines. For example, the coefficients on the non-life line of business variable are interpreted as beta coefficients that isolate the market risk and BV-to-MV risk of conducting non-life insurance business. Thus, the regressions can be used to separately identify the contribution of writing non-life insurance to the traded firm's overall beta coefficient. A similar interpretation is given to the life insurance variable in equations (3) and (4).

F.4. Data Sources and Sample Selection

The data on stock returns for the European and Asian insurers used in this analysis were obtained from the Standard & Poor's Global Issues database which contains market value data on stocks traded on exchanges worldwide. The data on stock returns for the U.S. insurers comes from the CRSP database. To make the results comparable across regions, all individual company returns were converted to be in a common currency - U.S. dollar returns.

The market return indices needed to estimate the firm-specific CAPM beta and the Fama-French market systematic and BV-MV risk factors are specific to the region in which the company is headquartered. For U.S. domiciled insurers we used the value-weighted market return and BV-MV risk factor based upon all publicly traded stocks that trade on the NYSE,

[3] See Fama and French (1996), p. 59. There is no apparent pattern of market systematic risk factors in the Fama-French model by BV-to-MV ratio.

AMEX and Nasdaq exchanges. For companies headquartered in the European Union we used the dollar denominated value-weighted market return and BV-MV risk factor for all stocks that trade on European stock exchanges. The indices used for companies located in the Asian countries are country-specific and therefore based upon the stock market in each country. All of the region or country specific market return and BV-MV indices were obtained from Professor Kenneth French's data archive that is available online.[23] The risk-free rate used in the analysis is the 30 day Treasury bill rate also taken from Professor French's website.

The source we used to identify the set of publicly traded firms that underwrote insurance and to calculate the book values of equity and the revenues by industry was the Standard & Poor's Global Financial Services database for the European and Asian insurers and the Standard & Poor's Compustat database for U.S. insurers.[24] We identify the sample of insurance firms as any publicly traded firm that reports positive values for insurance net premiums written or positive values for technical reserves (i.e. insurance-related liabilities). The time period for our analysis was 1998 – 2006.

Table 1 below shows the number of insurer observations by country/region and by year included in the analysis. Companies domiciled in the United States make up approximately 60 percent of the observations in the data set followed by European companies that make up approximately 30 percent of the observations. There are relatively few Asian domiciled publicly traded insurers with the majority located in Japan and Australia. The list of individual firms included in the analysis is provided in Appendix G.

Summary statistics for the firms in the sample are reported in Table 2 by region. The largest average firms writing insurance are found in Europe where the average firm has total assets over this time period of $113 billion. The companies writing insurance from Asia or the United States are, on average, much smaller although the largest company in the dataset was a U.S. company (Citigroup) which had assets of almost $1.5 trillion in 2005. There are interesting differences in the average premium writings among the companies across regions. For example, the average publicly traded company from the U.S. wrote almost 70 percent of its net sales in non-life insurance and had very little business from outside the insurance business. The average European company, however, has a greater percentage of its revenue coming from outside the insurance industry (mostly banking) and a greater participation in life insurance than does the average Asian or U.S. company. The average estimated CAPM beta for the U.S., European and Asian companies are 0.72, 1.06, and 0.89, respectively. The average estimated loading on the Fama-French market risk factor is quite similar across regions and all quite close 0.90. The average estimated BV-MV Fama-French risk factor is similar for U.S. and European companies (0.89 and 0.70, respectively) but is much lower for the average Asian insurer (0.29).

[23] The website is: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
[24] We could have used the Global Financial Service database to identify the U.S. insurers but chose to use the S&P Compustat data base as it contains more detailed data regarding the sources of revenue by industry for U.S. firms only.

Table 1: Global Insurer Dataset
Number of Observations By Country By Year

Table shows the number of insurer observations by year by country used to estimate the cost of equity capital for U.S., European and Asian insurers. The final data set includes all publicly traded companies in the Compustat data base that report underwriting insurance and that have at least 36 months of return data prior to June for each year. Any observation with negative premiums, negative assets or negative book value equity are eliminated. Observations with estimated Fama-French market or BV-MV value coefficients greater than 5 or less than -5 are also eliminated.

	Year									
Region/Country	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
U.S.	**182**	**185**	**167**	**154**	**148**	**140**	**140**	**138**	**137**	**1391**
Europe	**80**	**83**	**79**	**77**	**71**	**78**	**81**	**86**	**47**	**682**
Austria	4	5	3	3	2	3	2	2	0	24
Belgium	0	3	2	2	1	2	2	2	2	16
Denmark	3	4	3	2	3	3	3	3	1	25
Finland	2	2	2	2	2	2	2	2	3	19
France	7	5	0	3	5	8	7	6	2	43
Germany	13	14	14	17	15	15	16	17	5	126
Greece	1	1	1	1	1	0	0	0	0	5
Ireland	3	2	2	2	2	1	2	2	2	18
Italy	13	13	14	10	10	9	11	11	10	101
Luxemburg	0	0	0	0	0	1	1	1	0	3
Netherlands	4	4	4	3	3	3	3	3	2	29
Norway	1	1	0	0	0	0	0	0	0	2
Portugal	2	3	2	0	0	0	0	0	0	7
Spain	0	1	2	3	2	2	2	2	2	16
Sweden	1	2	1	1	1	3	4	5	3	21
Switzerland	9	8	8	8	8	7	5	8	5	66
U.K.	17	15	21	20	16	19	21	22	10	161
Asia	**22**	**21**	**18**	**18**	**18**	**18**	**19**	**19**	**21**	**174**
Australia	6	5	2	5	8	6	7	6	6	51
Hong Kong	0	0	0	0	0	1	1	2	3	7
Japan	14	14	14	11	8	7	7	8	9	92
New Zealand	0	0	0	0	0	1	1	0	1	3
Singapore	2	2	2	2	2	3	3	3	2	21
Global	**284**	**289**	**264**	**249**	**237**	**236**	**240**	**243**	**205**	**2247**

Table 2: Summary Statistics of Global Insurer Dataset: 1998 - 2006

Table displays summary statistics for U.S., European and Asian firms underwriting insurance over the years 1998 - 2006. The market capitalization and the book equity-to-market equity ratio was calculated using the year-end closing price of the firm's stock times the number of shares outstanding. Several insurers have multiple issues of stock and some have stock that trade on multiple exchanges. The figures shown here were summed across all the firm's outstanding common and preferred equity. All monetary figures were converted to $US millions.

	United States			Europe			Asia		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Fama-French Market Risk Factor	0.953	-2.153	4.434	0.936	-2.735	3.127	0.851	-0.374	3.600
Fama-French BV-MV Risk Factor	0.886	-4.504	4.826	0.701	-2.237	4.282	0.293	-1.005	2.688
CAPM Beta	0.716	-1.246	3.634	1.060	-2.593	3.723	0.888	-0.342	2.661
NPW Total	2,946	0.161	92,490	7,809	0.01	280,700	3,347	1.06	15,122
NPW Non-life	2,245	0.000	45,174	3,073	0.00	51,894	2,726	-1.51	13,722
NPW Life	701	0.000	47,316	4,684	0.00	280,700	562	0.00	9,432
Net Sales	4,117	0.291	154,033	15,005	9.20	471,130	5,224	5.18	26,045
% Sales Non-Life Ins.	69.0%	0.000	104.6%	38.3%	0.0%	100.8%	52.1%	0.0%	92.8%
% Sales Life Ins.	16.5%	0.000	100.0%	25.6%	0.0%	104.1%	15.9%	0.0%	103.8%
% Sales Other	14.6%	-0.046	99.0%	36.1%	-9.7%	100.0%	32.0%	-4.9%	97.9%
Total Assets	22,942	2.594	1,484,101	113,736	63.51	1,366,941	29,397	63.43	322,328
Total Liabilities	19,907	0.839	1,374,810	108,211	28.62	1,321,608	25,711	14.48	299,002
Total Book Equity	3,168	0.330	121,743	4,931	30.27	61,178	3,518	9.15	26,005
Market Capitalization	6,021	2.548	385,883	10,570	14.38	404,569	4,649	7.61	37,986
Leverage: Liabilities/Assets	0.728	0.080	0.989	0.897	0.044	0.990	0.820	0.171	0.967
Book Equity/Market Capitalization	0.996	0.028	13.970	0.728	0.070	3.759	1.143	0.001	8.621

F.5. Equity Risk Premium Estimates

Table 3 displays the long-term average market returns and Fama-French BV-to-MV risk premia by region based upon the data archive maintained by Professor Kenneth French. The time period covered by the U.S. data is July 1926 – December 2006. The time period for the European and Asian markets is January 1975 – December 2006. In addition to the region-specific estimates, we also report the long-term average excess market return based upon largest stock exchanges from sixteen countries around the world including the U.S., Western Europe, Japan and Australia as reported in Dimson, Marsh and Staunton (2003). All returns are dollar denominated.

Table 3: Long Run Historical Returns on the Market Index and BV-MV Value Risk Premium by Region

Table displays the long run average historical return on the value weighted total return index and on the BV-MV value/financial distress risk by region. The excess market return for dollar-based returns is in excess of the 30 day T-bill rates. The table dispalys the monthly average of the historical returns multiplied by 12.

Region	Return Denomination	Time Period	Total Market Return	Excess Market Return	BV-MV (Value) Risk Premia
U.S.	Dollar	July 1926 - December 2006	11.47	7.81	4.92
Europe	Dollar	January 1975 - December 2006	15.10	9.24	3.80
Asia	Dollar	January 1975 - December 2006	12.70	6.85	9.99
World	Dollar	January 1900 - December 2002	-	5.7	-

All regional equity return and BV-MV value premia data are from Professor Kenneth French's data archive online at mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. The world historical excess risk premium is taken from Dimson, Marsh and Staunton (2003).

The average regional excess market risk premium was lowest in Asia at 6.85 percent and highest in Europe at 9.24 percent. The average market excess return for the world was 5.7 percent. The BV-to-MV risk premium is positive for all regions and was highest in Asia at 9.99 percent and lowest in Europe equal to 3.80 percent. The long term average BV-MV risk premium based upon U.S. stocks, which has the longest time series, is 4.92 percent. Unfortunately we are not aware of a long term world-wide estimate of the BV-MV risk premium.

Even though we present historical market return information earlier in this report, we show the historical long term averages in Table 3 for two reasons. First, it is instructive to compare the long term average risk premium for the excess market return and for the BV-MV risk factors across regions. The earlier table only shows the excess market return information. Second, determining the cost of equity capital requires us to estimate both an industry's exposure to market risk and/or BV-MV financial distress risk and also estimates of the expected return required to bear each risk. The FIIB regressions provide the industry specific factor loadings. Consistent with previous literature, we use the historical averages over long periods of time to estimate the expected excess market risk premium and the expected BV-MV risk premia. For illustration purposes, because all returns used in this portion of the study were converted to U.S. dollar, all cost of capital estimates displayed in the upcoming tables are calculated using the long term average risk premia based upon U.S. stocks. Thus, the expected risk premium for market returns net of the risk-free rate of interest and the expected BV-MV risk premium are 7.81 and 4.92 percent, respectively. In addition, for the cost of equity capital estimates based upon the entire industry world-wide, we separately report a global cost of equity capital estimate using the world excess market risk premium as reported in Dimson, Marsh and Staunton (2003) equal to 5.7 percent.

Table 4 shows the FIIB CAPM beta coefficients and the corresponding cost of equity capital estimates for the non-life and life insurance industries by region and for the global industry. The regional estimates were estimated by running the FIIB cross-sectional regression using the beta estimates only for firms domiciled in that region. The global estimates were calculated running the FIIB regressions including all insurer observations regardless of their location.

The average FIIB CAPM beta for the non-life insurance industry is generally less than one for each region and ranged from a low of 0.60 for companies headquartered in the United States and a high of 1.02 for European insurers. The CAPM beta for the global non-life insurance industry was 0.73 across all years of data and 0.67 over the most recent five years. Based upon the most recent five years and using the expected excess market risk premium based upon U.S. stocks, the cost of equity capital ranges from a low of 4.66 percent for U.S. insurers to a high of 7.97 percent for European insurers. The estimated cost of equity capital for the global non-life insurance industry is estimated to be 5.22 percent using the expected excess market risk premium calculated using U.S. stocks and is 3.81 percent based upon the world expected excess market risk premium.

Table 4: Full Information Beta CAPM Dollar Denominated Cost of Equity Capital Estimates for the U.S., European, Asian and Global Insurance Industry: 1998 - 2006

Table displays estimates of the CAPM cost of equity capital estimated using the Full Information Beta methodology on publicly traded insurers headquartered in the United States, Western Europe and Asia. The Asian countries include Japan, Hong Kong, New Zeland, Australia and Singapore. Company returns, used to estimated the first stage firm-specific CAPM betas, were converted to dollar denominated returns. The market index for the U.S. companies is the value-weighted market return on all stocks that trade on the NYSE, AMEX and Nasdaq stock exchanges in excess of the 30 day treasury bill rate. The market index for all European insurers is the value-weighted market dollar return for all Western European exchanges, including the United Kingdom, in excess of 30 day treasury bill rate. The market index for the Asian insurers are country specific. Each country's weighted market dollar denominated return in excess of the 30 day treasury bill rate. The expected market risk premium for each region and for the column labeled "Global US ERP" is the long run historical monthly average return in excess of the 30 day treasury bill rate on all U.S. stocks estimated on data from July 1926 - December 2006 times 12. The expected market risk premium based upon U.S. data is 7.81 percent. The expected market risk premium for the column labeled "Global World ERP" is the long run historical monthly average dollar denominated return in excess of the 30 day treasury bill rate on all stocks from sixteen countries including the U.S., Japan, Western European countries, and Australia estimated on data from January 1900 - December 2002 times 12 taken from Dimson, Marsh and Staunton (2003). The world expected excess market risk premium is 5.70 percent.

Panel A: Non-Life Insurance

	CAPM Beta				Dollar Denominated Cost of Equity Capital				
Year	U.S.	Europe	Asia	Global	U.S.	Europe	Asia	Global US ERP	Global World ERP
1998	0.96	0.61	0.81	0.95	7.53	4.76	6.36	7.39	5.39
1999	0.90	0.91	1.04	0.93	7.04	7.13	8.10	7.28	5.31
2000	0.79	1.02	0.72	0.82	6.20	7.93	5.63	6.40	4.67
2001	0.49	0.83	0.72	0.56	3.84	6.49	5.61	4.36	3.18
2002	0.44	0.72	0.58	0.49	3.46	5.66	4.52	3.85	2.81
2003	0.51	1.08	0.26	0.61	3.99	8.42	2.05	4.78	3.49
2004	0.55	0.95	0.50	0.62	4.32	7.41	3.91	4.83	3.52
2005	0.63	0.96	0.88	0.72	4.93	7.49	6.84	5.61	4.09
2006	0.84	1.39	0.98	0.90	6.58	10.86	7.62	7.04	5.13
Ave.	0.68	0.94	0.72	0.73	5.32	7.35	5.63	5.73	4.18
5 Year Ave.	0.60	1.02	0.64	0.67	4.66	7.97	4.99	5.22	3.81

Panel B: Life Insurance

	CAPM Beta				Dollar Denominated Cost of Equity Capital				
Year	U.S.	Europe	Asia	Global	U.S.	Europe	Asia	Global US ERP	Global World ERP
1998	0.99	1.55	1.27	1.09	7.76	12.14	9.95	8.52	6.21
1999	0.91	1.56	1.36	1.08	7.15	12.19	10.62	8.48	6.18
2000	0.73	1.39	0.78	0.92	5.72	10.85	6.10	7.18	5.24
2001	0.35	0.77	0.96	0.58	2.76	6.03	7.49	4.53	3.30
2002	0.37	0.71	0.99	0.60	2.90	5.53	7.76	4.71	3.43
2003	0.51	1.06	0.59	0.79	4.01	8.32	4.63	6.18	4.51
2004	0.63	1.27	0.62	0.85	4.91	9.93	4.84	6.62	4.83
2005	0.89	1.29	0.65	1.06	6.97	10.10	5.05	8.29	6.05
2006	1.08	1.94	0.48	1.14	8.42	15.16	3.77	8.89	6.49
Ave.	0.72	1.28	0.86	0.90	5.62	10.03	6.69	7.04	5.14
5 Year Ave.	0.70	1.26	0.67	0.89	5.44	9.81	5.21	6.94	5.06

Turning to the life insurance industry results we see the average FIIB CAPM beta is higher in each region of the world relative to the corresponding estimate for the non-life insurance industry. Over all years of data, the average CAPM life insurance industry beta was lowest in the U.S. equal to 0.72 and highest in Europe at 1.28. The CAPM beta for the global life insurance industry is 0.90 across all years of data and 0.89 over the most recent five years. The cost of equity capital across the regions, based upon the most five years of data and using the expected excess market risk premium based upon U.S. stocks, ranges from 5.44 to 9.81 percent and the global industry estimate equals 6.94 percent. The cost of equity capital for the global life insurance industry estimated using the worldwide expected excess market risk premium is 5.06 percent.

Table 4 displays the estimated Fama-French FIIB beta coefficients β_{mi} and β_{hi} for the non-life insurance industry as well as the estimated BV-MV slope adjustment coefficients. Similar to the estimates based upon the CAPM, the average Fama-French market systematic risk factors are all less than 1.0 and across regions they range from a low of 0.63 in Asia to a high of 0.77 in the U.S. using the five most recent years of data. The estimated market risk factor

based upon the global industry is 0.75. The average BV-MV risk factor in each region is positive suggesting investors require a risk premium to invest in non-life insurers based upon their exposure to the financial distress risk. The average BV-MV risk factor ranges from a low of 0.56 for Asian insurers to a high of 1.15 for the European insurers using the five most recent years of data. The BV-MV estimate for the global industry is 0.83.

The market and value risk premia shown in the lower panel of Table 5. The market systematic risk premium is obtained by multiplying the beta coefficient for a given region by the long-term average market risk premium $\beta_{mi}[E(r_m) - r_f]$. The BV-to-MV risk premium is obtained first by adjusting the BV-to-MV beta using the estimated slope adjustment to allow for variations in BV-to-MV ratios across companies (see equation (4)), i.e. the BV-to-MV risk premium is $ß_v[ß_{f1v} + \textit{slope adjustment}]$. We use the same book-to-market ratio across all regions to calculate the slope adjustment to focus the discussion on differences across the systematic risk differences rather than differences in the average book-to-market ratio for firms across regions. Accordingly, for illustration purposes, the book-to-market ratio was set equal to the average ratio for all insurers in the data base - 0.926. The total equity risk premium is obtained by adding the market systematic risk premium and the BV-to-MV risk premium.

Consistent with results previously published using data on U.S. insurers (Cummins and Phillips 2005), the equity risk premium estimates are higher for the FF2F model than are the corresponding estimates determined using the CAPM. This conclusion is similar regardless of region. For example, the estimated equity risk premium for non-life Asian insurers is 4.99 percent using the CAPM model and 7.67 percent using the FF2F model. For the global industry using the world-wide expected excess market risk premium, the CAPM and FF2F estimates are 3.81 and 8.36, respectively.

The largest source of the increase in the FF2F equity risk premium relative to the CAPM is the significant premium that investors appear to demand to allocate capital to non-life insurers. Note the five year average value risk premium is positive and ranges from a low of 2.72 percent for Asian insurers to a high of 5.66 for European insurers. The estimate for the global industry is 4.07 percent. Thus, failure to account for this financial distress risk will cause insurers to underestimate their cost of attracting equity capital which may lead to under-pricing and/or to not fully accounting for the cost of holding capital against their non-hedgable risks.

The FF2F estimated FIIB beta coefficients and corresponding equity risk premium estimates for the life insurance industry are shown in Table 6. The most notable conclusion is that the cost of equity capital for life insurance estimated using the FF2F model also appear significantly higher than those derived using the CAPM. Again, the primary source of the large increase is the positive loading on the value risk factor which leads, for example, to 3.38 percent risk premium for the global industry based upon the most five years of data. The final cost of equity capital estimates for the life insurance industry range from a low of 5.14 for Asian insurers to a high of 11.81 percent for U.S. insurers. The overall cost of equity capital estimate for the global life insurance industry is 10.58 using the U.S. expected excess market risk premium and 8.63 using the worldwide expected market risk premium.

Table 5: Full Information Beta International Fama French Two Factor Dollar Denominated Cost of Equity Capital Estimates for the U.S., European, Asian and Global Non-Life Insurance Industry: 1998 - 2006

Table displays coefficient estimates for the two factor international version of the Fama-French model for the non-life insurance industry estimated using the Full Information Beta methodology for publicly traded insurers headquartered in the United States, Western Europe and Asia. The table also displays the corresponding estimated cost of equity capital The Asian countries include Japan, Hong Kong, New Zeland, Australia and Singapore. Company returns, used to estimated the first stage firm-specific market and BV-MV financial distress factors were all converted to dollar denominated returns. The index used to estimate the market factor for the U.S. companies is the value-weighted return on all stocks that trade on the NYSE, AMEX and Nasdaq stock exchanges in excess of the 30 day treasury bill rate. The market index used for the European insurers is the value-weighted dollar return for all stocks that trade on Western European exchanges including the United Kingdom in excess of the 30 day treasury bill rate. The market index used to estimate the market factor loading for the Asian insurers is the country specific value-weighted dollar denominated index in excess of the 30 day Treasury bill rate. The expected market risk premium for each region and forthe co "Global US ERP" is the long run historical monthly average return in excess of the 30 day treasury bill rate on all U.S. stocks estimated on data from July 1926 - December 2006 times 12. The expected market risk premium based upon U.S. data is 7.81 percent. The expected market risk premium for the column labeled "Global World ERP" is the long run historical monthly average dollar denominated return in excess of the 30 day treasury bill rate on all stocks from sixteen countries including the U.S., Japan, Western European countries, and Australia estimated on data from January 1900 - December 2002 times 12 taken from Dimson, Marsh and Staunton (2003). The world expected excess market risk premium is 5.70 percent. The expected BV-MV financial distress risk premium is the historical average return based upon all publicly traded companies in the United States estimated from July 1926 - December 2006. The expected BV-MV value risk premium is 4.94 percent.

Panel A: Estimated Factor Coefficients

	Market Factor				BV-MV Factor				BV-MV Slope Adj. Coeff.			
Year	**U.S.**	**Europe**	**Asia**	**Global**	**U.S.**	**Europe**	**Asia**	**Global**	**U.S.**	**Europe**	**Asia**	**Global**
1998	1.04	0.28	0.80	0.97	0.95	1.39	-0.08	0.92	0.36	0.43	0.10	0.29
1999	0.98	0.75	1.16	0.96	0.91	1.48	0.04	0.87	0.30	0.37	0.14	0.18
2000	1.12	0.98	0.60	1.07	1.18	1.33	0.00	1.15	0.33	0.16	0.11	0.25
2001	1.07	0.83	0.62	1.00	1.15	1.32	0.37	1.13	0.09	-0.12	0.08	0.03
2002	0.94	0.66	0.47	0.88	1.13	1.21	0.51	1.12	0.07	0.16	0.09	0.10
2003	0.89	0.71	0.38	0.83	1.06	1.32	0.37	1.08	0.03	-0.06	0.17	0.07
2004	0.79	0.62	0.53	0.74	0.85	1.31	0.32	0.95	0.03	0.23	0.37	0.16
2005	0.58	0.60	0.84	0.60	0.55	1.17	0.65	0.73	-0.13	0.06	0.08	0.07
2006	0.66	1.06	0.96	0.72	0.13	0.75	0.96	0.29	-0.25	-0.34	-0.10	-0.11
Ave.	0.90	0.72	0.70	0.86	0.88	1.25	0.35	0.91	0.09	0.10	0.12	0.12
5 Year Ave.	0.77	0.73	0.63	0.75	0.74	1.15	0.56	0.83	-0.05	0.01	0.12	0.06

Panel B: Indvidual Risk Premia and Total Cost of Equity Capital

	Market Premia					Value Premia				Dollar Denominated Cost of Equity Capital				
Year	**U.S.**	**Europe**	**Asia**	**Global US ERP**	**Global World ERP**	**U.S.**	**Europe**	**Asia**	**Global**	**U.S.**	**Europe**	**Asia**	**Global US ERP**	**Global World ERP**
1998	8.11	2.21	6.24	7.58	5.53	4.54	6.67	-0.44	4.40	12.65	8.88	5.80	11.98	9.93
1999	7.65	5.82	9.08	7.51	5.48	4.35	7.12	0.16	4.21	12.00	12.94	9.23	11.72	9.69
2000	8.74	7.68	4.65	8.39	6.12	5.70	6.47	-0.06	5.54	14.44	14.15	4.59	13.93	11.66
2001	8.39	6.51	4.81	7.85	5.72	5.63	6.52	1.77	5.56	14.02	13.03	6.58	13.41	11.28
2002	7.36	5.14	3.68	6.86	5.00	5.51	5.88	2.48	5.47	12.87	11.02	6.16	12.33	10.47
2003	6.97	5.58	2.95	6.46	4.72	5.21	6.52	1.74	5.27	12.18	12.10	4.69	11.73	9.99
2004	6.15	4.81	4.14	5.79	4.22	4.18	6.36	1.44	4.60	10.33	11.17	5.58	10.39	8.82
2005	4.53	4.70	6.53	4.67	3.40	2.73	5.74	3.18	3.55	7.26	10.44	9.71	8.22	6.95
2006	5.18	8.30	7.49	5.59	4.08	0.72	3.81	4.74	1.48	5.90	12.11	12.23	7.06	5.55
Ave.	7.01	5.64	5.51	6.74	4.92	4.28	6.12	1.67	4.45	11.30	11.76	7.17	11.20	9.37
5 Year Ave	6.04	5.71	4.96	5.87	4.28	3.67	5.66	2.72	4.07	9.71	11.37	7.67	9.94	8.36

Table 6: Full Information Beta International Fama French Two Factor Dollar Denominated Cost of Equity Capital Estimates for the U.S., European, Asian and Global Life Insurance Industry: 1998 - 2006

Table displays coefficient estimates for the two factor international version of the Fama-French model for the life insurance industry estimated using the Full Information Beta methodology for publicly traded insurers headquartered in the United States, Western Europe and Asia. The table also displays the corresponding estimated cost of equity capital The Asian countries include Japan, Hong Kong, New Zeland, Australia and Singapore. Company returns, used to estimated the first stage firm-specific market and BV-MV financial distress factors were all converted to dollar denominated returns. The index used to estimate the market factor for the U.S. companies is the value-weighted return on all stocks that trade on the NYSE, AMEX and Nasdaq stock exchanges in excess of the 30 day treasury bill rate. The market index used for the European insurers is the value-weighted dollar return for all stocks that trade on Western European exchanges including the United Kingdom in excess of the 30 day treasury bill rate. The market index used to estimate the market factor loading for the Asian insurers is the country specific value-weighted dollar denominated index in excess of the 30 day Treasury bill rate. The expected market risk premium for each region and forthe co US ERP" is the long run historical monthly average return in excess of the 30 day treasury bill rate on all U.S. stocks estimated on data from July 1926 - December 2006 times 12. The expected market risk premium based upon U.S. data is 7.81 percent. The expected market risk premium for the column labeled "Global World ERP" is the long run historical monthly average dollar denominated return in excess of the 30 day treasury bill rate on all stocks from sixteen countries including the U.S., Japan, Western European countries, and Australia estimated on data from January 1900 - December 2002 times 12 taken from Dimson, Marsh and Staunton (2003). The world expected excess market risk premium is 5.70 percent. The expected BV-MV financial distress risk premium is the historical average return based upon all publicly traded companies in the United States estimated from July 1926 - December 2006. The expected BV-MV value risk premium is 4.94 percent.

Panel A: Estimated Factor Coefficients

	Market Factor				BV-MV Factor				BV-MV Slope Adj. Coeff.			
Year	**U.S.**	**Europe**	**Asia**	**Global**	**U.S.**	**Europe**	**Asia**	**Global**	**U.S.**	**Europe**	**Asia**	**Global**
1998	1.11	1.38	1.31	1.14	0.70	1.06	0.03	0.71	0.36	0.43	0.10	0.29
1999	1.10	1.37	1.27	1.15	1.13	1.72	-0.46	1.20	0.30	0.37	0.14	0.18
2000	1.13	1.31	0.82	1.13	1.08	1.37	-0.36	1.14	0.33	0.16	0.11	0.25
2001	0.92	0.73	0.91	0.82	1.05	0.59	0.57	0.93	0.09	-0.12	0.08	0.03
2002	0.84	0.66	0.93	0.74	0.98	0.63	0.33	0.80	0.07	0.16	0.09	0.10
2003	1.00	0.92	0.53	0.92	1.13	0.33	0.01	0.80	0.03	-0.06	0.17	0.07
2004	1.02	1.16	0.68	1.04	1.14	0.28	-0.06	0.83	0.03	0.23	0.37	0.16
2005	0.86	1.17	0.64	0.96	0.85	0.32	0.00	0.57	-0.13	0.06	0.08	0.07
2006	0.85	1.86	0.35	0.94	0.62	-0.07	0.03	0.47	-0.25	-0.34	-0.10	-0.11
Ave.	0.98	1.17	0.83	0.98	0.96	0.69	0.01	0.83	0.09	0.10	0.12	0.12
5 Year Ave.	0.92	1.16	0.62	0.92	0.94	0.30	0.06	0.69	-0.05	0.01	0.12	0.06

Panel B: Indvidual Risk Premia and Total Cost of Equity Capital

	Market Premia					Value Premia				Dollar Denominated Cost of Equity Capital				
Year	**U.S.**	**Europe**	**Asia**	**Global**	**Global World ERP**	**U.S.**	**Europe**	**Asia**	**Global**	**U.S.**	**Europe**	**Asia**	**Global US ERP**	**Global World ERP**
1998	8.71	10.77	10.26	8.90	6.49	3.31	5.03	0.12	3.39	12.02	15.80	10.38	12.29	9.88
1999	8.59	10.73	9.89	9.02	6.58	5.42	8.31	-2.29	5.85	14.01	19.04	7.59	14.87	12.43
2000	8.84	10.24	6.39	8.82	6.43	5.16	6.65	-1.79	5.53	14.00	16.89	4.60	14.35	11.96
2001	7.19	5.71	7.11	6.42	4.68	5.13	2.93	2.78	4.56	12.32	8.64	9.89	10.98	9.24
2002	6.59	5.19	7.25	5.78	4.22	4.78	3.03	1.57	3.88	11.37	8.22	8.82	9.66	8.10
2003	7.84	7.21	4.11	7.21	5.26	5.54	1.65	-0.01	3.89	13.38	8.86	4.10	11.09	9.14
2004	7.98	9.10	5.34	8.14	5.94	5.59	1.30	-0.43	4.04	13.57	10.40	4.91	12.18	9.97
2005	6.70	9.14	4.99	7.49	5.46	4.23	1.53	-0.02	2.76	10.93	10.68	4.98	10.24	8.22
2006	6.66	14.53	2.70	7.36	5.37	3.15	-0.21	0.20	2.36	9.81	14.32	2.90	9.72	7.73
Ave.	7.68	9.18	6.45	7.68	5.60	4.70	3.36	0.01	4.03	12.38	12.54	6.46	11.71	9.63
5 Year Ave.	7.15	9.03	4.88	7.20	5.25	4.66	1.46	0.26	3.38	11.81	10.49	5.14	10.58	8.63

In summary, based upon the analysis conducted here, the global insurance industry equity risk premium estimated using the FIIB methodology and assuming an excess expected market risk premium of 5.7 percent (based historical return data from the world's largest stocks over the 20th century) for the non-life insurance industry is 3.81 percent and 5.06 percent for the life insurance industry. The corresponding estimates calculated using the FF2F model (assuming a BV-MV expected risk premium of 4.92 percent) are 8.36 for the global non-life insurance industry and slightly higher at 8.63 percent for the global life insurance industry.

Appendix G. Companies included in FIIB analysis

Asian companies represented in Full Information Beta Analysis

Company name	Country
AMP LTD	Australia
ANZ-AUSTRALIA & NEW ZEALD BK	Australia
AXA ASIA PACIFIC HLDGS LTD	Australia
CALLIDEN GROUP LTD	Australia
CHALLENGER INTERNATIONAL LTD	Australia
COMMONWEALTH BANK AUSTRALIA	Australia
FAI INSURANCE LTD	Australia
FAI LIFE LTD	Australia
INSURANCE AUSTRALIA GROUP	Australia
MMI LTD	Australia
NATIONAL AUSTRALIA BK	Australia
QBE INSURANCE GROUP LTD	Australia
SGIO INSURANCE LTD	Australia
SUNCORP METWAY LTD	Australia
TYNDALL AUSTRALIA LTD	Australia
CHINA INSURANCE INTL HLDGS	Hong Kong
DAH SING FINANCIAL HOLDINGS	Hong Kong
PACIFIC CENTURY INS HOLDINGS	Hong Kong
AIOI INSURANCE CO LTD	Japan
CHIYODA FIRE & MARINE INSUR	Japan
FUJI FIRE & MARINE INSURANCE	Japan
KOA FIRE & MARINE INSURANCE	Japan
MILLEA HOLDINGS INC	Japan
MITSUI SUMITOMO INSURANCE CO	Japan
NICHIDO FIRE & MARINE INSUR	Japan
NIPPONKOA INSURANCE CO LTD	Japan
NISSAN FIRE & MARINE INS CO	Japan
NISSAY DOWA GENERAL INSURANC	Japan
NISSHIN FIRE & MARINE INS CO	Japan
SOMPO JAPAN INSURANCE INC	Japan
SUMITOMO MARINE & FIRE INSUR	Japan
T&D HLDGS INC	Japan
TAISEI FIRE & MARINE INS	Japan
TOWER LTD	New Zealand
GREAT EASTERN HOLDINGS LTD	Singapore
INSURANCE CORP OF SINGAPORE	Singapore
SINGAPORE REINSURANCE CORP	Singapore
UNITED OVERSEAS INSURANCE	Singapore

European companies represented in Full Information Beta Analysis

Company name	Country	Company name	Country
ALLIANZ ELEMENTAR VERSICH-AG	Austria	PREMAFIN FINANZIARIA SPA	Italy
GENERALI HLDG VIENNA AG	Austria	RAS HOLDINGS SPA	Italy
INTERUNFALL	Austria	SOC CATTOLICA ASSICURAZIONI	Italy
UNIQA VERSICHERUNGEN AG	Austria	TORO ASSICURAZIONE	Italy
WIENER STADTISCHE ALLG VERSI	Austria	UNIPOL	Italy
FORTIS	Belgium	VITTORIA ASSICURAZIONI	Italy
KBC GROUP SA	Belgium	ESPIRITO SANTO FINANCIAL GRP	Luxemburg
ALM BRAND A/S	Denmark	ABN-AMRO HOLDINGS NV	Netherlands
CODAN GROUP LTD	Denmark	AEGON NV	Netherlands
TOPDANMARK AS	Denmark	ASR VERZEKERINGSGROEP NV	Netherlands
TRYG-BALTICA FORSIKRING A/S	Denmark	ING GROEP NV	Netherlands
OKO OSUUSPANKKIEN KESKUSPANK	Finland	STOREBRAND ASA	Norway
POHJOLA GROUP	Finland	BANCO COMERCIAL PORTUGUES SA	Portugal
SAMPO OYJ	Finland	COMPANHIA SEGUROS IMPERIO SA	Portugal
ASSURANCE GEN DE FRANCE	France	MUNDIAL CONFIANCA SA	Portugal
AXA	France	SEGUROS TRANQUILIDADE SA	Portugal
CARDIF SA	France	BANCO SANTANDER CENTRAL HISP	Spain
CNP ASSURANCES SA	France	CORPORACION MAPFRE	Spain
COFACE SA	France	GRUPO CATALANA OCCIDENTE SA	Spain
COMPAGNIE BANCAIRE SA	France	MAPFRE VIDA SEGUROS REASEGUR	Spain
CRCAM NORD	France	FORENINGSSPARBANK (SWEDBANK)	Sweden
CREDIT AGRICOLE SA	France	NORDEA BANK AB	Sweden
CREDIT LYONNAIS SA	France	SKAND ENSKILDA BANKEN	Sweden
EULER HERMES	France	SKANDIA FORSAEKRING AB	Sweden
GENERALI FRANCE ASSURANCES	France	SVENSKA HANDELSBANKEN	Sweden
SCOR SA	France	BALOISE HOLDING	Switzerland
UNION ASSURANCES FEDERALES	France	BERNER VERSICHERUNG	Switzerland
AACHENER & MUENCH LEBEN	Germany	CONVERIUM HOLDING AG	Switzerland
AACHENER & MUNCHENER VERSICH	Germany	CREDIT SUISSE GROUP	Switzerland
ALBINGIA VERSICHERUNG AG	Germany	GENERALI (SCHWEIZ) HOLDING	Switzerland
ALLIANZ AG	Germany	HELVETIA PATRIA HOLDING	Switzerland
ALLIANZ LEBENSVERSICHERUNGS	Germany	SCHWEIZ NATL VERSICHRNG	Switzerland
AMB GENERALI HOLDING AKTIENG	Germany	SCHWEIZER RUCKVERSICHERUNGS	Switzerland
AXA KONZERN AG	Germany	SWISS LIFE HOLDING	Switzerland
AXA VERSICHERUNG AG	Germany	VAUDOISE ASSURANCES HLDG	Switzerland
BHW HOLDING AG	Germany	WINTERTHUR SCHWEIZ VERSICHER	Switzerland
DBV WINTERTHUR HOLDING AG	Germany	ZURICH VERSICH (ZURICH GRP)	Switzerland
DEUTSCHE BANK AG	Germany	ABBEY NATIONAL PLC	UK
ERGO VERSICHERUNGSGRUPPE AG	Germany	AMLIN PLC	UK
GERLING-KONZERN ALLG VERSICH	Germany	ARBUTHNOT BANKING GROUP PLC	UK
HANNOVER RUECKVERSICHERUNG	Germany	ATRIUM UNDERWRITING PLC	UK
KOLNISCHE RUCKVERSICHERUNG	Germany	AVIVA PLC	UK
MANNHEIMER AG HLDG	Germany	BERKELEY TECHNOLOGY LTD	UK
MLP AG	Germany	BRIT INSURANCE HOLDINGS PLC	UK

Company name	Country	Company name	Country
MUENCHENER RUECKVERSICH	Germany	COUNTRYWIDE ASSURED GRP PLC	UK
NORDSTERN ALGEMEIN VERSICHER	Germany	COX INSURANCE HOLDINGS PLC	UK
NURNBERGER BETEILIGUNGS-AG	Germany	FRIENDS PROVIDENT PLC	UK
RHEINLAND HOLDING AG	Germany	GENERAL ACCIDENT PLC	UK
THURINGIA VERSICHERUNGS-AG	Germany	GOSHAWK INSURANCE HLDGS PLC	UK
VEREINTE VERSICHERUNG AG	Germany	GPG (UK) HOLDINGS PLC	UK
WUERTTEMBERGISCHE & BADISCHE	Germany	GUARDIAN ROYAL EXCHANGE PLC	UK
WUERTTEMBERGISCHE AG	Germany	HARDY UNDERWRITING GROUP PLC	UK
WUERTTEMBERGISCHE LEBENSVERS	Germany	HIGHWAY INSURANCE HOLDINGS	UK
WUESTENROT & WUERTTEMBERG AG	Germany	HISCOX PLC	UK
ETHNIKI GENERAL INSURANCE CO	Greece	INDEPENDENT INSURANCE GROUP	UK
FBD HOLDINGS	Ireland	KILN PLC	UK
HIBERNIAN GROUP PLC	Ireland	LEGAL & GEN GROUP PLC	UK
IRISH LIFE & PERMANENT PLC	Ireland	LLOYDS TSB GROUP	UK
IRISH LIFE PLC	Ireland	LONDON & MANCHESTER GROUP	UK
ALLEANZA ASSICURAZIONI	Italy	LONDON INS MARKET INVT TRUST	UK
ALLIANZ SUBALPINA SPA	Italy	OLD MUTUAL PLC	UK
ASSICURAZIONI GENERALI SPA	Italy	PROVIDENT FINL GROUP	UK
ASSITALIA-LE ASSIC D'ITALIA	Italy	PRUDENTIAL PLC	UK
BANCA CARIGE SPA GEN & IMPER	Italy	RESOLUTION PLC	UK
BANCA MONTE DEI PASCHI SIENA	Italy	ROYAL & SUN ALLIANCE INS GP	UK
ERGO PREVIDENZA SPA	Italy	ROYAL BANK OF SCOTLAND GROUP	UK
FONDIARIA SAI SPA	Italy	ST JAMES PLACE	UK
INA-ISTITUTO NAZ ASSICURAZ	Italy	SUN LIFE & PROVINCIAL HLDGS	UK
ITALIANA ASSICURAZIONI SPA	Italy	SVB HOLDINGS PLC	UK
LA FONDIARIA ASSICURAZIONI	Italy	UNITED ASSURANCE GROUP PLC	UK
MEDIOLANUM SPA	Italy	WELLINGTON UNDERWRITING PLC	UK
MILANO ASSICURAZIONI	Italy		

MUENCHENER RUECKVERSICH	Germany	COUNTRYWIDE ASSURED GRP PLC	UK
NORDSTERN ALGEMEIN VERSICHER	Germany	COX INSURANCE HOLDINGS PLC	UK
NURNBERGER BETEILIGUNGS-AG	Germany	FRIENDS PROVIDENT PLC	UK
RHEINLAND HOLDING AG	Germany	GENERAL ACCIDENT PLC	UK
THURINGIA VERSICHERUNGS-AG	Germany	GOSHAWK INSURANCE HLDGS PLC	UK
VEREINTE VERSICHERUNG AG	Germany	GPG (UK) HOLDINGS PLC	UK
WUERTTEMBERGISCHE & BADISCHE	Germany	GUARDIAN ROYAL EXCHANGE PLC	UK
WUERTTEMBERGISCHE AG	Germany	HARDY UNDERWRITING GROUP PLC	UK
WUERTTEMBERGISCHE LEBENSVERS	Germany	HIGHWAY INSURANCE HOLDINGS	UK
WUESTENROT & WUERTTEMBERG AG	Germany	HISCOX PLC	UK
ETHNIKI GENERAL INSURANCE CO	Greece	INDEPENDENT INSURANCE GROUP	UK
FBD HOLDINGS	Ireland	KILN PLC	UK
HIBERNIAN GROUP PLC	Ireland	LEGAL & GEN GROUP PLC	UK
IRISH LIFE & PERMANENT PLC	Ireland	LLOYDS TSB GROUP	UK
IRISH LIFE PLC	Ireland	LONDON & MANCHESTER GROUP	UK
ALLEANZA ASSICURAZIONI	Italy	LONDON INS MARKET INVT TRUST	UK
ALLIANZ SUBALPINA SPA	Italy	OLD MUTUAL PLC	UK
ASSICURAZIONI GENERALI SPA	Italy	PROVIDENT FINL GROUP	UK
ASSITALIA-LE ASSIC D'ITALIA	Italy	PRUDENTIAL PLC	UK
BANCA CARIGE SPA GEN & IMPER	Italy	RESOLUTION PLC	UK
BANCA MONTE DEI PASCHI SIENA	Italy	ROYAL & SUN ALLIANCE INS GP	UK
ERGO PREVIDENZA SPA	Italy	ROYAL BANK OF SCOTLAND GROUP	UK
FONDIARIA SAI SPA	Italy	ST JAMES PLACE	UK
INA-ISTITUTO NAZ ASSICURAZ	Italy	SUN LIFE & PROVINCIAL HLDGS	UK
ITALIANA ASSICURAZIONI SPA	Italy	SVB HOLDINGS PLC	UK
LA FONDIARIA ASSICURAZIONI	Italy	UNITED ASSURANCE GROUP PLC	UK
MEDIOLANUM SPA	Italy	WELLINGTON UNDERWRITING PLC	UK
MILANO ASSICURAZIONI	Italy		

United States companies represented in Full Information Beta Analysis

Company name	Company name
21ST CENTURY HOLDING CO	KAYE GROUP INC
21ST CENTURY INS GROUP	KINGSWAY FINANCIAL SVCS INC
ACCEL INTL CORP	LANDAMERICA FINANCIAL GP
ACCEPTANCE INSURANCE COS INC	LANDSTAR SYSTEM INC
ACE LTD	LASALLE RE HOLDINGS LTD
ACMAT CORP -CL A	LEUCADIA NATIONAL CORP
AETNA INC	LIBERTY CORP
AETNA INC	LIBERTY FINANCIAL COS INC
AFLAC INC	LIFE RE CORP
ALDERWOODS GROUP INC	LIFE USA HOLDING INC
ALDERWOODS GROUP INC	LIFEMARK CORP
ALFA CORP	LINCOLN NATIONAL CORP
ALLCITY INSURANCE CO	LOEWS CORP
ALLEGHANY CORP	MANULIFE FINANCIAL CORP
ALLIED GROUP INC	MARKEL CORP
ALLIED LIFE FINANCIAL CORP	MAX RE CAPITAL LTD
ALLSTATE CORP	MBIA INC
ALPHASTAR INSURANCE GRP LTD	MCM CORP
AMBAC FINANCIAL GP	MEADOWBROOK INS GROUP INC
AMBASSADORS INTERNATIONL INC	MEEMIC HOLDINGS INC
AMER COUNTRY HOLDINGS INC	MERCHANTS GROUP INC
AMERCO	MERCURY GENERAL CORP
AMERICAN BANKERS INS GROUP	MERIDIAN INS GROUP INC
AMERICAN FINANCIAL GROUP INC	METLIFE INC
AMERICAN GENERAL CORP	METRIS COMPANIES INC
AMERICAN HERITAGE LIFE INVS	MGIC INVESTMENT CORP/WI
AMERICAN INDEPENDENCE CORP	MID ATLANTIC MEDICAL SVCS
AMERICAN INDTY FINL CORP	MID OCEAN LIMITED
AMERICAN INTERNATIONAL GROUP	MIDLAND CO
AMERICAN MEDICAL SECURITY GP	MIIX GROUP INC
AMERICAN NATIONAL INSURANCE	MMI COMPANIES INC
AMERICAN PHYSICIANS CAPITAL	MOLINA HEALTHCARE INC
AMERICAN SAFETY INS HLDG LTD	MONTPELIER RE HOLDINGS
AMERIGROUP CORP	MONY GROUP INC
AMERIN CORP	MORGAN GROUP INC -CL A
AMERUS GROUP CO -CL A	MOUNTBATTEN INC
AMWEST INSURANCE GROUP INC	MUTUAL RISK MANAGEMENT LTD
ANFI INC	NAC RE CORP
ANNUITY AND LIFE RE HOLDINGS	NATIONAL INFORMATION GROUP
AON CORP	NATIONAL SEC GROUP INC
ARCH CAPITAL GROUP LTD	NATIONAL WESTERN LIFE -CL A
ARGONAUT GROUP INC	NATIONWIDE FINL SVCS -CL A

Company name	Company name
ARISTA INVESTORS CORP	NAVIGATORS GROUP INC
ATLANTIC AMERICAN CORP	NCRIC GROUP INC
AVATAR HOLDINGS INC	NOBEL INSURANCE LTD
AVIDYN INC	NORTH EAST INSURANCE CO
AXA FINANCIAL INC	NYMAGIC INC
AXIS CAPITAL HOLDINGS	OAKWOOD HOMES CORP
BALDWIN & LYONS	ODYSSEY RE HOLDINGS CORP
BANCINSURANCE CORP	OHIO CASUALTY CORP
BERKLEY (W R) CORP	OLD GUARD GROUP INC
BERKSHIRE HATHAWAY	OLD REPUBLIC INTL CORP
CAPITAL RE CORP	ORION CAPITAL CORP
CAPITOL TRANSAMERICA CORP	OXFORD HEALTH PLANS INC
CBIZ INC	PARTNERRE LTD
CENTENE CORP	PAULA FINANCIAL/DE
CENTRIS GROUP INC	PENN TREATY AMERN CORP
CERES GROUP INC	PENN-AMERICA GROUP INC
CHANDLER INSURANCE LTD	PENNEY (J C) CO
CHARTWELL RE CORP	PHILADELPHIA CONS HLDG CORP
CHUBB CORP	PHOENIX COMPANIES INC
CIGNA CORP	PHP HEALTHCARE CORP
CINCINNATI FINANCIAL CORP	PICO HOLDINGS INC
CITIGROUP INC	PLATINUM UNDERWRITERS HLDG
CITIZENS CORP	PMA CAPITAL CORP
CITIZENS FINANCIAL CORP/KY	PMI GROUP INC
CITIZENS INC	PREPAID LEGAL SERVICES INC
CNA FINANCIAL CORP	PRESERVER GROUP INC
CNA SURETY CORP	PRESIDENTIAL LIFE CORP
COBALT CORP	PRINCIPAL FINANCIAL GRP INC
COMMERCE GROUP INC/MA	PROASSURANCE CORP
COMPDENT CORP	PROFESSIONALS GROUP INC
CONSECO INC	PROGRESSIVE CORP-OHIO
COTTON STATES LIFE INSURANCE	PROTECTIVE LIFE CORP
COUNTRYWIDE FINANCIAL CORP	PROVIDENT COS INC
COVANTA HOLDING CORP	PRUDENTIAL FINANCIAL INC
COVENTRY HEALTH CARE INC	PXRE GROUP LTD
CUMBERLAND TECHNOLOGIES INC	RADIAN GROUP INC
DEERE & CO	REINSURANCE GROUP AMER INC
DELPHI FINANCIAL GRP -CL A	RELIABLE LIFE INS CO -CL A
DONEGAL GROUP INC	RELIASTAR FINANCIAL CORP
DONEGAL GROUP INC	RENAISSANCERE HOLDINGS LTD
EMC INSURANCE GROUP INC	RENT A WRECK OF AMERICA INC
ENDURANCE SPECIALTY HOLDINGS	RESOURCE BANCSHARES MTG GRP
ENHANCE FINANCIAL SVCS GRP	RIGHTCHOICE MGD CARE

Company name	Company name
ERIE INDEMNITY CO -CL A	RLI CORP
ESG RE LTD	RTW INC
EVEREST RE GROUP LTD	SAFECO CORP
EXECUTIVE RISK INC	SAFEGUARD HEALTH ENTERPRISES
FARM FAMILY HOLDINGS INC	SAFETY INSURANCE GROUP INC
FBL FINANCIAL GROUP INC-CL A	SCOTTISH RE GROUP LTD
FIDELITY NATIONAL FINL INC	SCPIE HOLDINGS INC
FINANCIAL INDUSTRIES CORP	SECURITY NATL FINL CP -CL A
FINANCIAL SEC ASSURANCE HLDG	SEIBELS BRUCE GROUP INC
FIRST ACCEPTANCE CORP	SELECTIVE INS GROUP INC
FIRST AMERICAN CORP/CA	SERVICE CORP INTERNATIONAL
FIRST COMMONWEALTH INC	SIERRA HEALTH SERVICES
FLORIDA PROGRESS CORP	SOUTHERN SECURITY LIFE INS
FOREMOST CORP OF AMERICA	SOUTHWESTERN LIFE HLDGS INC
FORTUNE FINANCIAL INC	ST PAUL COS
FPIC INSURANCE GROUP INC	ST PAUL TRAVELERS COS INC
FREMONT GENERAL CORP	STANCORP FINL GROUP INC
FRONTIER INSURANCE GROUP INC	STANDARD MANAGEMENT CORP
GAINSCO INC	STATE AUTO FINANCIAL CORP
GENERAL ELECTRIC CO	STEWART INFORMATION SERVICES
GENERAL RE CORP	SUN LIFE FINANCIAL INC
GORAN CAPITAL INC	SUNAMERICA INC
GREAT AMERN FINL RESOURCES	SUNSTAR HEALTHCARE INC
GRYPHON HOLDINGS INC	SUPERIOR NATL INS GROUP INC
GUARANTEE LIFE COS INC	TERRA NOVA BERMUDA -CL A
HALLMARK FINANCIAL SERVICES	TIG HOLDINGS INC
HANCOCK JOHN FINL SVCS INC	TORCHMARK CORP
HANOVER INSURANCE GROUP INC	TRANSAMERICA CORP
HARLEYSVILLE GROUP INC	TRANSATLANTIC HOLDINGS INC
HARTFORD FINANCIAL SERVICES	TRENWICK GROUP LTD
HARTFORD LIFE INC -CL A	TRIAD GUARANTY INC
HCC INSURANCE HOLDINGS INC	TRIGON HEALTHCARE INC
HEALTH NET INC	UICI
HEALTH POWER INC	UNICO AMERICAN CORP
HEALTHAXIS INC	UNITED FIRE & CAS CO
HEALTHPLEX INC	UNITED HEALTH GROUP INC
HIGHLANDS INSURANCE GRP INC	UNITRIN INC
HORACE MANN EDUCATORS CORP	UNIVERSAL AMERICAN FINL CP
HSB GROUP INC	UNUMPROVIDENT CORP
HSBC FINANCE CORP	UTG INC
INDEPENDENCE HOLDING CO	VESTA INSURANCE GROUP INC
INFINITY PROPERTY & CAS CORP	WALSHIRE ASSURN CO
INTERCARGO CORP	WELLPOINT HEALTH NETWRKS INC

Company name	Company name
INTERCONTINENTAL LIFE CORP	WELLPOINT INC
INVESTORS TITLE CO	WESCO FINANCIAL CORP
IPC HOLDINGS LTD	WHITE MTNS INS GROUP LTD
JEFFERSON-PILOT CORP	XL CAPITAL LTD
JOHN ALDEN FINANCIAL CORP	ZENITH NATIONAL INSURANCE CP
KANSAS CITY LIFE INS CO	

Appendix H. References

Almeida, H. and Philippon, T., 2007, “The risk-adjusted cost of financial distress,” Journal of Finance. Vol. 62. No. 6. Pp. 2557-2586.

CEA and the CRO Forum (Joint Submission), 2005,“Solutions to major issues for Solvency II.”

CEA and the European Insurance CFO Forum, 2007, “Response to IASB Discussion Paper - Preliminary Views on Insurance Contracts,”

Claus, J. and Thomas, J., 2001, "Equity Premia as Low as Three Percent? Evidence from Analysts' Earnings Forecasts for Domestic and International Stock Markets." Journal of Finance. Vol. 56. Pp. 1629-1666.

CRO Forum, 2006, “A market cost of capital approach to market value margins – Discussion paper.”

CRO Forum, 2005, “A framework for incorporating diversification in the solvency assessment of insurers.”

CRO Forum, 2005, “Principles for Regulatory Admissibility of Internal Models.”

Cummins, D.J. and Phillips, R.D., 2005, “Estimating the Costs of Equity Capital for Property-Liability Insurers,” Journal of Risk and Insurance. Vol. 72. Pp. 441-478.

Dimson, E., Marsh, P. and Staunton, M., 2003, “Global Evidence on the Equity Risk Premium,” Journal of Applied Corporate Finance. Vol. 15. No. 4, Pp. 27-38.

Ehrhardt, M.C. and Bhagwar, Y.N., 1991, “A Full-Information Approach for Estimating Divisional Betas,” Financial Management. Vol. 20. Pp. 60-69.

European Commission, 2007, “Proposal for a Directive of the European Parliament and of the Council on the taking-up and pursuit of the business of Insurance and Reinsurance – Solvency II.”

Fama, E.F. and French, K.R., 2002, "The Equity Premium", Journal of Finance. Vol. 57. Pp. 637-659.

Fama, E.F. and French, K.R., 1998, “Value versus growth: The international evidence”, Journal of Finance. Vol. 53. Pp. 1975-1999.

Fama, E.F. and French, K.R., 1996, “Multifactor explanations of asset pricing anomalies”, Journal of Finance. Vol. 51. Pp. 55-84.

Fama, E.F. and French, K.R., 1993, “Common risk factors in the returns on stocks and bonds”, Journal of Financial Economics. Vol. 33. Pp. 3-56.

Fama, E.F. and French, K.R., 1992, “The cross-section of expected stock returns”, Journal of Finance. Vol. 57. Pp. 427-465.

French, K.R., Data Library, Accessible from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Graham, J.R. and Harvey. C.R., 2001, “The theory and practice of corporate finance: evidence from the field,” Journal of Financial Economics. Vol. 60. Pp. 187-243.

International Accounting Standards Board, 2007, “Discussion Paper – Preliminary Views on Insurance Contracts.”

Institute of International Finance, 2008, “Interim Report of the IIF Committee on Market Best Practices.”

Kaplan, P.D. and Peterson J.D.,1998, “Full-Information Industry Betas,” Financial Management. Vol. 23. Pp. 64-70.

Lamdin, D.J., 2003, “Corporate bond yield spreads in recent decades: an examination of trends, changes, and stock market linkages,” Business Economics. Vol. 39. Pp. 28-35.

Lamdin, D.J.. 2002. “New Estimates of the Equity Risk Premium and Why We Need Them,” Business Economics. Vol. 37. No. 4. Pp. 54-60.

Linter, J., 1965, “The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets,” Review of Economics and Statistics. Vol. 47:1. Pp. 13-37.

Sharpe, W.F., 1964, “Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk,” Journal of Finance. Vol. 19:3. Pp. 425-445.

Standard & Poor’s, Compustat database

Standard & Poor’s, Global Financial Services database

Wang, S., 2004, “Cat Bond Pricing Using Probability Transforms,” Geneva Papers: Etudes et Dossiers, special issue on “Insurance and the State of the Art in Cat Bond Pricing”, No. 27.

Wang, S., 2002, “A Universal Framework for Pricing Financial and Insurance Risks”, ASTIN Bulletin: Journal of the International Actuarial Association, Vol. 32. Pp. 213-234.