EDUCATION COMMITTEE

OF THE

SOCIETY OF ACTUARIES

FOUNDATIONS OF CORPORATE FINANCE AND ERM STUDY NOTE

DEMYSTIFYING THE RISK MARGIN

THEORY, PRACTICE AND REGULATION

by

Anthony Brown

The Education Committee provides study notes to persons preparing for the examinations of the Society of Actuaries. They are intended to acquaint candidates with some of the theoretical and practical considerations involved in the various subjects. While varying opinions are presented where appropriate, limits on the length of the material and other considerations sometimes prevent the inclusion of all possible opinions. These study notes do not, however, represent any official opinion, interpretations or endorsement of the Society of Actuaries or its Education Committee. The Society is grateful to the authors for their contributions in preparing the study notes.

F-152-20 **Printed in the USA**

Demystifying the Risk Margin: Theory, Practice and Regulation[1]

Anthony Brown

Presented to the Staple Inn Actuarial Society
May 2012

[1] Thanks to Daniel Curtis, Ross Gardiner and Alex Summers for their suggestions and comments in the development of this paper.

The risk margin is one of the most complicated features of the 'new' market-consistent actuarial world embodied by Solvency II, IFRS 4 Phase II and other regimes.

Much high quality work has been performed on the subject of the risk margin in the last few years, this paper aims to complement that with a comprehensive, straightforward, jargon-free and, above all, practical overview of the topic.

We will explore the theoretical justification for the risk margin concept. We will then look in some depth at the practicalities of calculation of the risk margin addressing issues such as appropriate allowance for diversification, costs of capital, allocation of capital, simplifications, and so on. Finally we will look at the policy choices made in various regimes, and review the regulatory guidance around its calculation.

Whilst this paper has a bias towards the place of the risk margin within Solvency II, we hope that much of what is contained is transferable to the similar concepts embedded in other regimes.

The paper has been designed to be read as a whole, but we hope that the sections can be dipped into by those performing the calculations, to provide stage-by-stage guidance to the practitioner on the ground.

Contents

1. The Theory

1.1. Why is the risk margin needed in a market consistent framework?

One of the fundamental principles of market consistent valuation is to value the insurance liabilities of an undertaking at the 'fair value' i.e. that which would be paid by a knowledgeable, willing party in an arms length transaction. We value our business at the amount it would be worth in a market where the buyers and sellers are acting in a rational fashion.

Using this principle, we can apply financial economics, to get a market consistent 'risk-neutral' value by assuming that we can discount the best estimate of our liability cashflows at the risk free rate, and therefore reach a 'fair' value which a putative buyer would pay to buy our liabilities from us.

However using just this approach would miss a key risk for our hypothetical buyer: they are buying *insurance* liabilities, which are uncertain by nature. Therefore, as well as holding assets to meet the best estimate of the present value of the liabilities, they will need to hold assets to address the risk that their best estimate was too low. Holding these additional assets engenders a cost, and so when the third party comes to buy the liabilities, they will require compensation for the fact that they have to raise and hold the capital.

This compensation will be manifested by the buyer charging an extra amount over and above the simple best estimate present value of the liabilities, and we call this amount the *risk margin*[2].

As the purpose of the risk margin is to set the liability value to equal a transfer value, it is not, and cannot be seen as a substitute for other elements of the valuation or capital framework. In particular the presence of a risk margin cannot be used as an argument for lower capital requirements or capital stresses on relevant risks. This is because the capital requirements and the risk margin are doing different jobs. The capital requirement is designed to protect the undertaking against adverse changes in

[2] Throughout the paper we will refer to the *risk margin*, some regimes have different names for the risk margin concept such as 'market value margin' or 'risk adjustment'. We will only use these alternative names when explicitly discussing these regimes.

risk factors at a specified level, the risk margin to set the value of liabilities to a transfer value. The risk margin is not a 'capital requirement', it is part of the market consistent valuation on the balance sheet.

1.2. What risks should the risk margin cover?

A risk margin only needs to be held in respect of risks which cannot be hedged away at low or zero cost: if a buyer can transfer a risk associated with the liability into the market, he would not have to hold capital to support it, so would not have to hold a risk margin with respect to that risk.

Where the buyer is just passing the risk on to a third party insurer (for example by a reinsurance arrangement), the third party would need to hold capital to support the risk, and so themselves would require a risk margin. For such risks then, the buyer is going to have to pay a risk margin one way or another, either to support the risks himself, or to compensate the third party buyer for the cost of them supporting the risks. Any seller, therefore needs to value their liabilities with a risk margin for these risks.

However where the risk can be transferred into a deep and liquid market, the buyer can hedge the risk at low or zero cost, and so will not have to hold capital to support the risk, or compensate others due to their requirement to hold such capital. As the buyer doesn't require compensation to eliminate the risk, the seller doesn't have to add a risk margin to the valuation of their liabilities in respect of these risks.

To summarise, a risk margin need be included only for non-hedgeable risks, where the concept of 'hedgeability' encompasses any risks which can be eliminated by trades into a deep, and liquid market.

Some risks are clearly hedgeable – pure interest rate risk in the UK for terms of less than 30 years can be easily hedged with interest rate swaps for relatively little cost. These risks do not need to be supported by a risk margin.

Some risks are clearly non-hedgeable – there does not currently exist a market to hedge operational risk for an insurance company. These risks therefore need to be supported by a risk margin.

Other risks fall closer to the border line – FTSE 100 equity positions can be relatively easily hedged, however exposures to specific stocks may not be hedgeable without either significant cost or significant basis risk.
Section 2.3.5 discusses this challenge in further detail.

1.3. Conclusion

The above discussion gives five key learning points:

- The risk margin is a widely used concept in market consistent frameworks.
- It represents an addition to the best estimate valuation of liabilities to set the total liability value to a market consistent transfer value.
- It performs a different purpose to the capital requirement, and is in no way a substitute for the capital requirements.
- It should be calculated with respect of non-hedgeable risks only, excluding risks for which the cost of hedging or transfer in negligible.
- It is not easy to demarcate which risks are non-hedgeable.

2. The Practice

2.1. How material is the risk margin?

The size of the risk margin principally depends on three factors; the calculation method, assumptions and parameters chosen, the magnitude of non-hedgeable risks the business is running, and the duration of risk carrying liabilities.

For business with long term non-hedgeable liabilities, such as annuities, the risk margin can be an extremely material balance sheet item. Under Solvency II it can be estimated[3] that in the UK the risk margin is approximately 2.5% of the total value of insurance liabilities for generally longer term life business (rising to as high as 8% for some business types), and 7% of the total value of insurance liabilities for generally shorter term non-life liabilities. Across the European industry the risk margin has been calculated to sum to over €120bn for solo firms, and an additional €80bn for groups.

2.2. How is the risk margin calculated?

Having expressed a theoretical need for the risk margin, the debate shifts to the most theoretically (and practically) appropriate way to calculate the risk margin.

The IASB (IASB 2007) identify eight high level approaches for risk margin calculation, and the International Actuarial Association (IAA 2009), summarise them into the following four high level methods to calculate a risk margin:

2.2.1. Quantile methods

Quantile methods describe the risk margin as the difference between liabilities valued at a set percentile and at their best estimate. For example, the risk margin could be defined as the 75% percentile of the discounted value of liabilities less the best estimate.

[3] As the regime is nascent, and firm specific data not yet published (and in some cases not even yet calculated), we cannot have definitive views on the size of the risk margin. We therefore use data from the 2010 Quantitative Impact Study (QIS5) as published in EIOPA (2011) and FSA (2011).

Such a method was used in the Australian regime for non life insurers as described in APRA standard GPS 310 (APRA 2010)
This has the effect of setting the total value of liabilities to be equal to the liability value at a value at risk (VaR) of e.g. 75%. Opinions vary as to what level the percentile should be set, and it should be noted that for liabilities with highly skewed (fat-tailed) risks, even a relatively high percentile may result in the value including risk margin of liabilities being lower than the best estimate.

Refinements to the method include calculating a quantile using a tail VaR (tVaR, also known as a conditional tail expectation - CTE) as opposed to a VaR. Again, opinions vary as to what the tVaR level should be.

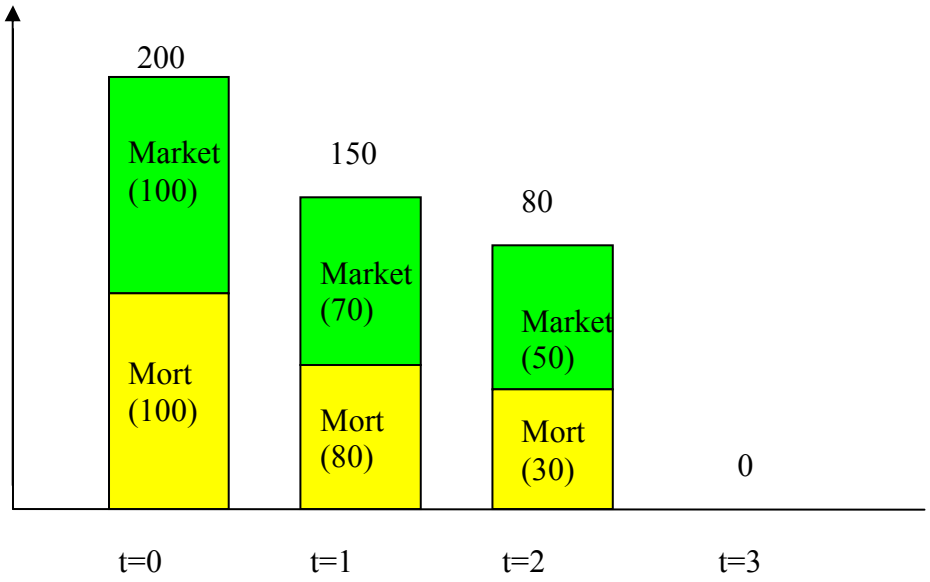
2.2.2. Cost of Capital methods

Cost of capital approaches describe the risk margin as equivalent to the cost required to set up and maintain capital to support the (non-hedgeable) risks to which a firm is exposed. Such methods require projecting the relevant capital required to support risks forward for the lifetime of the existing business, and then multiplying this by the cost to the firm of raising this capital, before discounting to get a present value.

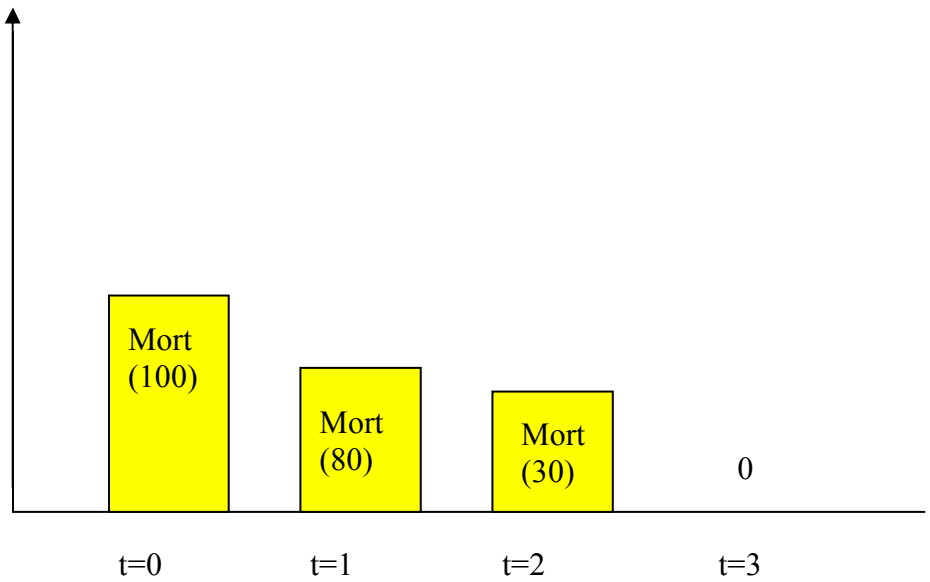
We give a stylised example:

> *A company writes 1000 three-year term assurance products. It measures its economic capital at VaR 99.5%.*
> *At present (t=0), its economic capital requirement is 200, made up of 100 for the mortality risk, and 100 for the market risk associated with holding the reserves (which it invests in government bonds). Tthere are no other risks.*
> *In 1 year's time there are 980 policies left. Its economic capital requirement on this business is now 150. This is made up of 80 of mortality risk and 70 of market risk.*
> *In 2 years' time there are 950 policies left. Its capital requirement is now down to 80, made up of 30 of mortality risk and 50 of market risk.*
> *In 3 years' time, all policies have matured, there are no policies left, and there is no economic capital requirement.*

We can represent this diagrammatically:



As the market risk is only related to the short dated government bonds the firm holds, it can be hedged out in the market for very low cost using CDSs and interest rate swaps, leaving the mortality risk as the only non-hedgeable risk. We therefore have the following capital requirements with respect to non-hedgeable risks:



The prospective buyer will need to hold these capital amounts at t=0, t=1 and t=2 to support the business.

*There is a cost of raising and holding this capital. If we assume that cost to be 5%, the cost of supporting the capital requirements will be 5%*100 = 5 at t=1, 5%*80 = 4 at t=2 and 5%*30=1.5 at t=3*[4].

These costs need to be discounted at the risk free rate to give a present value. For the sake of simplicity, we assume a constant 4% risk free rate to give a total risk margin calculated using the cost of capital method of $5 / (1.04)^1 + 4 / (1.04)^2 + 1.5 / (1.04)^3 = 4.8 + 3.7 + 1.3 =$ ***9.8***.

The cost of capital method is actuarially complex. It requires detailed projections of capital requirements for each risk, a demarcation between hedgeable and non-hedgeable risks, and a reliable assessment of the cost of raising and holding capital.

2.2.3. Modified assumptions

Modified assumption related approaches describe a range of approaches with a consistent aim of using prudent assumptions to produce a higher than best estimate value of liabilities to reflect the uncertainty within those liabilities. Such assumptions could include: modifications to the risk-free-rate used to discount the liabilities (including no discounting at all), prudent development ratios, prudent underwriting and product assumptions, etc.

The IAA (IAA 2009) discriminates between 'explicit' and 'implicit' risk margins derived from modified assumptions, with explicit methods requiring a best estimate calculation and a 'prudent' calculation, the difference between the two disclosed as the risk margin, and implicit methods requiring one calculation of liability values using prudent assumptions with the total value being equal to the best estimate of liabilities plus the risk margin.

2.2.4. Discount related methods

Discount related methods cover a variety of methods which involve reducing the discount rate of the liabilities (the risk-free rate) in order to provide a higher than best estimate value of liabilities. They can be seen as a special case of the modified

[4] A decision will have to be made as to whether the capital is raised at the beginning, middle or end of the year. In the above we have assumed capital raised and held at the end of the year in which the risk arises.

assumptions methods, focussing just on discount rates. At the extreme the liabilities could be valued undiscounted.

2.2.5. Pros and cons of each method

There are a number of recent papers and presentations enumerating the advantages and disadvantages of each method (IAA (2009), Gutterman and Bell (2009), Group Consultatif (2006)). Different authors have used different criteria to assess the relative merits of each approach, these include:

- Ease of calculation
- Stability of calculation
- Cross sectoral consistency (application to both life and non-life business)
- Market consistency
- Flexibility of application
- Coverage of all risks
- Objectivity
- Ease of communication

The main conclusions on the advantages and disadvantages of each method are noted in Annex A.

Different regulatory regimes allow for different high level calculation methods. The extent to which each calculation method is allowed in various regimes is discussed in greater detail in section 3.

Actuarial practice appears to be converging around the cost of capital approach, and this is the method mandated by Solvency II and the Swiss Solvency Test. For IFRS, the 2010 exposure draft indicates no mandate of methods, with a cost of capital and quantile level (using VaR or tVaR) approach both considered acceptable.

2.3. How to calculate the risk margin using the cost of capital approach

The calculation using the cost of capital is far from straightforward. There are a number of critical practical challenges with such an approach. In addition, there are a number of key theoretical questions which can have a huge impact on the final result.

We discuss below some of the key questions and challenges, together with some considerations as to how to overcome them.
In particular we look at:

- What risk metric should be used (in section 2.3.1)
- What the cost of capital rate should be (in section 2.3.2)
- How should diversification be allowed (in section 2.3.3)
- How the costs of capital should be discounted (in section 2.3.4)
- What risks should be included (in section 2.3.5)
- How the capital requirements can be calculated and projected (in section 2.3.6)
- How the risk margin can be allocated (in section 2.3.7)

2.3.1. Risk metric to calculate capital requirements

To calculate the risk margin using the cost of capital method, you need to calculate both the capital that the putative buyer of your liabilities is going to need to hold, and the cost to them of raising and holding it.
To calculate the capital the buyer will need to hold, you will need a risk metric. This risk metric is not the risk metric that you as an undertaking use to calculate your own capital requirements; rather it is the risk metric that your putative buyer would use to calculate their own capital requirements.
There are a number of methods which could be used to determine this metric. They typically either focus on the actual risk tolerances of firms that buy insurance liabilities (which may be deduced by credit rating reports, reported company data - such as company analysts presentations, solvency ratio coverage, etc), or from the regulatory constraints that the buying insurance company is likely to meet (i.e. 99.5% VaR within Solvency II). Miccolis and Heppen (2010) present a further approach which links the risk metric to the rate of return required on capital.
A method which looks at the actual risk tolerances of firms likely to buy insurance liabilities is probably the most theoretically sound, as this would allow us to deduce

the market price of supporting the risk. Such a method is likely to be extremely practically challenging, not least because much of the data is unknown, and that which is known will change over time.

Given this, approaches based on regulatory capital requirements would seem reasonable, and in fact are a feature of Solvency II. For example in Solvency II the risk metric for the risk margin is the same as the risk metric for the calculation of capital requirements: 99.5% VaR.

2.3.2. The Cost of Capital to use

Once the risk metric has been chosen, the next major assumption is the cost of capital rate. Theoretically the cost of capital should be equivalent to the cost, above the risk free rate, to the buying undertaking of raising and holding the extra capital that they would be required to hold to support the new risks they are running as a result of buying your business. In practice the cost of capital factor is extremely difficult to calculate. We discuss some of the questions and challenges in calculating the rate.

Should the cost of capital vary?

The cost of capital should not vary between undertakings, as we are interested only in the notional buyer of liabilities, and it is expected that this buyer will have the same cost of capital regardless of which insurance liability he is buying. In the regulation, Solvency II is very clear that the "cost of capital shall be the same for…all undertakings" (EC (2009): Art 77(5)). This contention is reasonably uncontroversial, and is echoed by the opinion of the CRO Forum (CRO 2008). In practice it is possible that capital raising may be cheaper for insurers acquiring certain types of business, but such an impact is extremely difficult to model, and any assumptions would likely be too spurious to build into our calculations.

The CRO Forum also contend that the cost of capital rate should be reasonably constant, reflecting a 'through the cycle' estimation of the cost of raising capital, rather than one varying by time, and in this matter the European regulators (CEIOPS 2009) agree. The technical rationale for this could be challenged, a market consistent valuation of liabilities should reflect the market price as at today of the liabilities, and so the current market cost of raising capital: as capital markets tighten and loosen, the cost of capital rate should change. However implementing a varying cost of capital

rate would provide practical challenges, and possibly have pro-cyclical macro-economic effects.

How credit worthy is the buying firm?

The rate should be the rate that our buying firm needs to earn on the capital it deploys to support a non-hedgeable risk. We are assuming that this is constant through the cycle, so we take an average rate for stressed and benign markets, and we are assuming that the rate does not change according to the *type* of insurance business the buying firm is acquiring. However the rate will certainly vary depending on the credit worthiness of the buying firm. A solid well capitalised buying firm will need to pay less to raise capital than an undercapitalised firm. An assumption has to be made as to what the credit worthiness of the buying firm is.

To an extent this assumption can be tied to the assumption made as to the risk metric the buying firm would use: if the capital requirements are calculated using a high risk metric such as a 99.9% tVaR, we might assume that the buying firm is well capitalised, and so would be able to borrow cheaply, if a lower metric is used, such as a 95% VaR, we might assume a buying firm which has much lower capital standards, and so would find raising capital more expensive. It is important to have consistency of assumption between the risk metric used, and the creditworthiness of the buying entity.

For example, if the risk metric is set to be the regulatory minimum (such as 99.5% VaR in Solvency II), it is appropriate to assume the buying firm would have a credit worthiness at the regulatory minimum. 99.5% VaR translates to a BBB credit rating so the cost of capital if we are calculating capital requirements at a 99.5% VaR should be the cost for a BBB firm to raise capital. FinMa (2006) gives an analysis of how the cost of capital would vary according to the credit quality of the firm.

What is included in the rate?

As the assets covering the balance sheet liabilities, including the risk margin, are assumed to be marketable securities, the rate should be the spread over the risk free rate. It should not include the risk free rate.

The rate should not be equivalent to the total shareholder return. Particularly it should not include the 'return on franchise', which captures the return on a going concern due to expected profits arising from new business (as discussed in CRO (2008)). It

should also not capture the return that a firm would have to earn to support its hedgeable risks.

Instead, it should comprise just the cost of supporting non-hedgeable risks, and also, arguably, the frictional costs associated with raising and carrying capital, which would include underwriting fees, manager's incentives etc.

What should the rate be?

Below we summarise research taken to date on the appropriate rate. The interested reader could turn to CRO 2008, CEIOPS 2009, IAA 2009, Hitchcox 2006, FinMa 2006 and Swiss Re 2005 for further details.

There are a variety of competing methods to calculate the cost of capital for an undertaking. These methods rarely produce the same results, and often rely heavily on somewhat subjective assumptions.

The *Frictional Cost of Capital* method (FCoC) attempts to define the cost of capital with reference to the frictional costs of, e.g. double taxation, costs associated with being eventually in financial distress, and costs associated with lack of alignment between managers and shareholders (agency costs), it does not include the return on franchise or risk free elements of the cost of capital. Each of these components is difficult to reliably assess, however work has been done to model the FCoC, and the CRO forum has produced analysis to show results for a BBB firm varying between 2%-6% depending on prevailing tax regimes, risk free rates etc, with a central estimate of 4.4%. This analysis set agency costs to zero.

Weighted average cost of capital (WACC) methods calculate the cost of capital as the weighted cost of raising debt and equity. The cost of raising debt is fairly straightforward to calculate as it can be assessed by examining corporate bond spreads for e.g. BBB bonds in the financial sector. The cost of raising equity is less straightforward to calculate, and various methods such as the Capital Asset Pricing Model (CAPM) and the Fama-French 2 Factor Model (FF2F) attempt to calculate this. The CRO forum calculated a cost of capital rate using this method, and produced results in the range 3%-7% depending on assumptions. The final figure is very dependent on two assumptions, firstly the split between debt and equity in the capital profile of the firm, and secondly the value of the cost of raising equity (the equity risk premium). It should be noted that both of these assumptions, as well as the cost of raising debt will vary significantly through the market cycle. WACC methods

do not capture the risk free element of the cost of capital, but do capture the franchise value so may overestimate the relevant cost of capital. However they could miss the costs associated with information asymmetries, frictional costs of raising capital, etc.
CEIOPS (2009) adds an overlay to the above analysis, considering that in order to stay true to the fundamental principle of the risk margin in Solvency II - which is to set the total value of liabilities to a transfer value - an adjustment to the total rate should be considered, with the aim of ensuring the value of liabilities is *consistent with market prices*. Unfortunately CEIOPS provides no guidance as to how this might be achieved, and it would seem that a sufficiently rich source of data of insurance liability transfers is unlikely to exist.

Conclusion

There has been significant research to inform the calculation of the cost of capital rate, and the basic principles and components seem to be agreed by most parties. That is that the rate should not include the franchise value or the risk-free component, that the cost should be constant throughout the cycle (even if this is theoretically questionable), and not specific to the undertaking, and it should be specific to the credit worthiness of the buying undertaking and so consistent with the risk metric used to calculate capital requirements.
However even with these principles, various calculation methodologies provide significantly different results. For a BBB rated buying undertaking, these vary from 2.5% up to 10%. This material uncertainty around such an important assumption does not make life easy for the practitioner on the ground, who is likely to have his own opinion as to where on the range the appropriate figure should sit. Fortunately, or perhaps unfortunately, some regulatory regimes mandate for the practitioner what cost should actually be used (see section 3).

2.3.3. Allowance for diversification

In the cost of capital method diversification is important, as it is the diversified capital required to support the business which is used to calculate the risk margin. Diversification benefits can reduce capital requirements by over a third (as outlined in

EIOPA (2011) so the difference between no allowance for diversification and full allowance could amount to more than 30% of the total risk margin.

At what level should diversification benefit be allowed?

Some diversification benefits should be allowed for. For example, the buyer of liabilities is unlikely to buy an individual contract, so allowing for diversification between contracts reflects the reality of how insurance business is sold. However, the question arises: 'how much diversification should be allowed for?' Is the buyer likely to buy the entire business of the insurer? For example for an international group would the full advantage of the international diversification benefit be gained by the buyer?

CEIOPS (2009) considers that diversification benefit can be included only within lines of business, however its justification is relatively weak - it argues primarily on the grounds of practicability and consistency with reporting requirements. The CEA (2009) consider that diversification benefit should be taken up to the level of the entire undertaking, and the CRO forum (2008) explicitly argues that the risk margin should be allowed for up to the level of the entire group. Neither industry body gives a particularly convincing rationale as to their position, both arguing the theoretical point that transfers of very large blocks of business could take place.

There is no obviously correct answer to this question. Theoretically diversification benefits should be allowed up to the level of business which would be transferred in a sale. As there is not a standard market in the sale of insurance business, it is difficult to hypothesise what amount of any particular business would be transferred to one buyer.

Recent notable M&A activity (International Insurance News 2010) shows a mixed bag of trades, with buy-outs of small and mid size insurance groups not uncommon, but larger insurance groups tending to be bought on line of business or solo basis. Sales of large conglomerates in more distressed circumstances have tended to see solo entity by solo entity sales, although again purchases of entire groups are not unheard of.

In the absence of reliable market data, practitioners must again either look to the regulatory constraints, or be prepared to back their assumptions on diversification up with what market data there is.

How should diversification benefit be allowed for between existing and new business?

The other complication is regarding whether diversification synergies should be allowed for between the business the putative buyer already has, and the new business it is requiring. In the market, many buyers of insurance liabilities buy them because they believe that they can exploit diversification benefit between the business they are buying and that they already hold. In this case, the risk margin may be smaller than the cost of capital the selling firm itself requires to meet the liabilities, as the would-be buyer would benefit from further diversification between new and old business.

In practice, if all of a firms liabilities are bought by a third party insurer, the buyer is likely to gain more diversification benefit than the seller had, as they will be diversifying some of the risk with their existing business. If only part of the firms liabilities are bought, for example just one line of business, the buyer may gain more or less diversification benefit than the firm currently has, the amount gained would depend on the diversification between lines of business within the firm at present.

The principle in Solvency II is for the insurance liabilities to be notionally transferred into a 'shell' undertaking which contains no other insurance liabilities, thus giving no diversification benefit between old and newly transferred business. IAA (2009) considers the concept of a 'large, multi-line, diversified entity' as the buying undertaking, which would give a certain amount of diversification. In the case of a firm with little current diversification benefit, for example a mono-liner insurer, the extra diversification benefit under the 'large, diversified' concept could be very significant. This brings some practical considerations: what would the management actions in the shell company be, could they reduce their capital requirements by reducing policyholder payouts, would their investment strategy differ, etc. For these considerations, the principle would usually be that the empty shell company would be run in the most efficient, risk minimising way possible given regulatory and legal constraints.

The 'large, diversified' definition is more realistic than the 'empty shell': insurance liabilities are most commonly bought by other insurers, not by empty companies. However the definition brings with it a number of practical challenges: the make up of the buying company would need to be determined, and a calculation then needed to be made regarding the extra new diversification benefit gained by the buyer. For the definition to work, some standardised guidance would need to be given by regulators

or accountancy bodies. A pragmatic alternative could be for a certain amount of diversification to be assumed as a haircut to the risk margin, with firms falling into buckets, small monoliners getting the most diversification benefit, and large composite firms getting the least (if any). Of course, any assessment of diversification benefit needs to consider that diversification may change over the course of the run-off of the business, and the calculation method should reflect that if appropriate (see also section 2.3.6).

Conclusion

The diversification benefit assumed in the risk margin should depend on the amount of your business could be transferred and the type of undertaking you expect to buy it.

Regarding the amount of business transferred, market analysis does not give us a convincing picture, and the situation will vary according to economic circumstance, nature of business of the firm, etc. Given these uncertainties, the Solvency II approach of transferring business units, but not entire groups does not seem unreasonable. However practitioners may seek to find relevant market data on under-stress transfers of business similar to their own, to understand the capacity of the market.

Regarding the level of diversification benefit gained by the buyer, theoretically some diversification benefit should be assumed as any buyer is likely to have some existing insurance business. Such diversification could be taken account of by applying a haircut to the risk margin. Calculating the size of the haircut in the current absence of a standardised buying entity is practically extremely challenging. The Solvency II method of assuming an empty reference portfolio as a buyer has the advantages of simplicity and transparency, but the cost of these strong advantages is a possible excess of prudence.

2.3.4. The correct rate to discount the calculated costs of capital

The costs of capital are calculated at each future period, and then discounted to give a present value.

The correct discount rate to use depends on what risks are being included in the risk margin. In the framework described above the risk margin excludes all non-hedgeable risks and liabilities are discounted at a risk-free rate. Under an alternative

framework, the liabilities can be discounted at a rate which includes corporate bond default risk, with the risk margin then being increased to include this default risk. This framework is little used, and is outlined in (Keller 2010).

It is far more commonly observed that the risk margin is calculated assuming total hedgeability of spread risk, and as such the appropriate discount rate is the relevant risk free rate.

2.3.5. Assessing which risks are non hedgeable

Risks to be included in the calculation of the risk margin must be not hedgeable in the markets at negligible cost.

As discussed in section 1.2, whilst some risks are clearly straightforwardly hedgeable at a reasonably low cost (such as short term interest rate risk, which can be hedged with swaps), and others are clearly not presently hedgeable in the capital markets such as the risk of a certain natural catastrophe taking place, there are many that fall somewhere between these categories.

The following table gives some examples of risks for which it is unclear whether they are hedgeable:

Risk	**Why might it not be hedgeable?**
50 year Euro interest rate risk	Would normally hedge with swaps, but there may be no deep and liquid swap market for 50 years.
30 year FTSE equity volatility	FTSE derivatives available, but possibly not to that term.
Longevity risk on UK annuity portfolio	Longevity derivatives available, but possible basis risk, and lack of deep and liquid market.
Credit risk from bond in mid size company	CDS available, but maybe not for that particular company.
10 year interest rate risk for UK WP business	Interest rate may be hedgeable, but consideration needs to be given to dynamic policyholder behaviour.
Currency risk between SEK and small emerging market currency	No deep and liquid market in transactions between these currencies.

Faced with this uncertainty pragmatic decisions need to be made. The IAA suggest a starting point to be that all risks other than market risk and credit risk be included as non hedgeable risks, and for that position to then be refined by examining in more depth the true hedgeability of the relevant risks. The simplifying assumptions

suggested by EIOPA (EIOPA 2010) were for market and spread type credit risks not to be included, except interest rate risks which are of a longer duration than the longest available swap instrument.

Notwithstanding regulatory constraints (see section 3), in considering which risks are to be included in the risk margin, the practitioner should consider the basic principle, which is that any risk which cannot be hedged in a deep and liquid market should be included in the risk margin. Generally this will mean that insurance type risks are included, and financial type risks are not, but there will be nuances to this division, and practitioners may wish to disaggregate risks.

For example, if the secondary market in longevity risk is considered deep and liquid, a practitioner may consider it appropriate to consider a proportion of the longevity risk as hedgeable, and the residual basis risk to be not hedgeable. Alternatively a practitioner may consider all of his currency risk hedgeable, but then enter a new trade with a developing nation where there is little or no market in currency trades, he may therefore consider only this new currency risk as non-hedgeable for the purposes of the risk margin.

What risks are eventually included in the risk margin calculation will therefore be a result of a view reached between the relevant parties as to what risks are hedgeable (and perhaps what risks are practicable to model as part of the risk margin). These parties will include some or all of: firms, industry bodies, regulators, analysts, and accounting standards bodies. Simplifying assumptions and broad brush approaches to what risks are assumed to be hedgeable are likely to be required. The practitioner may follow regulatory advice, or if he has more discretion will have to make his own assessment as to the hedgeability or partial hedgeability of the risks he is subject to.

2.3.6. Calculating and projecting the capital requirement

Under the cost of capital method, the capital requirements need to be calculated at the date of calculation (t=0), and projected forwards for the run off of the business. The calculation of the capital requirement at t=0 is not always straightforward, and the calculation of the capital requirement as the business runs off can be extremely complicated.

Calculation at t=0

The calculation at t=0 should be consistent with the risk metric used. Assuming a VaR or tVaR risk metric, this will often be computed using stochastic simulations with a risk distribution defined for each risk which is then mapped onto a loss function for the business.

Simplifying the calculation of the capital requirement at t=0

Depending on the risk metric chosen, calculation of the capital requirement at t=0 may be technically challenging. There are a number of standard methods for simplifying or making more practical the calculation at t=0 such as the use of replicating portfolios, standardised stresses and so on. This paper does not intend to summarise the various methods for applying simplifications to this calculation as this a favourite actuarial topic, and consequentially there is a strong body of work related to this question.

Of course if the risk metric and risk distribution used for the risk margin calculation is the same as the risk metric used for internal economic or regulatory capital requirements, further simplifications at t=0 are less likely to be necessary.

Projecting the calculation forwards

For the cost of capital method, a capital requirement in respect of the non-hedgeable risks is required for each year for the full run off of the business. A thorough method for this would involve stochastically projecting forward the business until run off, then, for each simulation, and at each time point, calculating the capital requirement (possibly itself stochastically), before discounting to get a final number.

This nested stochastic approach, provides a potentially very high calculation burden: depending on the modelling method chosen, the need to require a number of model points over a large number of scenarios, with path dependency and possible nested calculations at a number of different points in the future can combine to require many millions or even billions of individual model runs per model point. Such an approach is therefore impracticable for all but the simplest business, and simplifications are almost always required.

Simplifications of the projection

We consider three broad families of simplifications:

- ‘Technical simplifications’ – aimed at reducing the number of model runs required through advanced actuarial and mathematical techniques
- ‘Run-off simplifications’ – aimed at providing an approximation for how to run-off the capital requirement over the course of the business.
- ‘Rough and ready approximations’ – aimed at providing rough and high level approximations.

Technical simplifications

Technical simplifications could involve the use of replicating portfolios to reduce the number of runs required, or other methods to get a closed form approximation of a full stochastic run. They may also involve methods to ‘pick’ scenario which are likely to bite in the capital requirement tail scenarios, and to discard other simplifications in the model run, again to reduce the number of scenarios required. Such simplifications are being developed continually, and there is a good and continuously increasing body of research on individual methods.

This family of simplifications have a strong advantage in that they most closely protect the underlying economic justification for the risk margin – particularly they should well capture the changing nature of the risk if the business is modelled as running off, particularly capturing changes in the relative importance of risks as the business develops, and changes in diversification benefit. They may include new risks not present at t=0, which emerge as the business runs off, and they should capture risks associated with options etc. If they are used, they should be thoroughly tested and validated, and it is critical that the practitioner truly understands them, and particularly any shortfalls they have. These simplifications may be designed to be used to facilitate frequent and easy calculation, with a ‘full’ calculation being run from time to time to check their validity.

Run off simplifications

Projecting the balance sheet as it runs off in the way described above can be difficult. You need to have an assumption regarding how the business reserves will run off, and from that, what the capital requirement at each stage of run off might be. This requires you to calculate the extant risks at each stage of the run-off.

The run off simplifications family of simplifications uses techniques to more simply model how the capital requirement develops as the business runs off. We consider four families:

i) Simple fixed proportion of the extant best estimate as the best estimate runs off.

For example, we may have a best estimate of liabilities of 100, and a capital requirement at 10 at t=0. We know at t=1 the best estimate of liabilities will be 50, so we approximate that the capital requirement changes by the same ratio, and therefore will be 5. The value of the best estimate at each time point is likely to be known, as it will be an input into the current present value of liabilities if a cashflow model is used, and so this method is reasonably straightforward.

This method may be materially inaccurate if the risk profile of the business changes as the liabilities run off. For example a 30 year endowment assurance with a term assurance element for the first five years of the product will see an evolving risk profile with mortality risk at the outset potentially leading to a high SCR relative to the best estimate at t=0, with a lower SCR relative to the best estimate after t=5. Using this simplification in this case would therefore overstate the risk margin.

ii) Proportion of best estimate multiplied by duration.

An additional simplification to method i is to simply multiply the current proportion of the best estimate that is the capital requirement by the duration of the best estimate liabilities. This simplification has the advantage of being even easier than simplification i, however it may further lose accuracy. As for simplification i if the riskiness of the business changes in a non proportional way as the business runs off the simplification may be materially inaccurate. In addition, if the business runs off in a non linear pattern, the duration approach may not accurately capture the changing nature of the best estimate.

Additional complexities for simplification i and ii may arise if the business has reinsurance or other risk transfer which changes as the business runs off, in this case the simplifications may well not be appropriate, a similar case arises

if the nature of the diversification benefit between risks changes as the business runs off.

iii) Stochastic run off of best estimate

Simplification i could be used either on a deterministic run off of the best estimate, or on a stochastic projection of the best estimate. For simplification i, you could model a number of patterns of best estimate run off in a Monte Carlo model, and then multiply each of the best estimates at each time, and for each scenario by the capital requirement to best estimate ratio at t=0

This may be reasonably easy in practice, as for many firms the cash flow model used to calculate the best estimate will already include stochastic projection. As described below, this method can then be nuanced, with the capital requirement to best estimate ratio varying according to scenario.

iv) Expert judgement of the run off pattern.

Simplications i, ii and iii are more or less mechanistic simplifications which allow the practitioner to apply a defined methodology to aid them to calculate the risk margin. An alternative to this type of approach is to apply a more flexible methodology to give an estimate of the run off pattern of the capital requirements.

For example, a practitioner may use method i above, and then 'correct' the run off pattern mandated by holding a fixed proportion of the best estimate. They could do this by altering the capital requirement figures at some time points to allow for known changes in the risk profile of the business, e.g. when risk transfers or product features change.

They could use method iii, and apply different capital requirement to best estimate ratios depending on the scenario, so scenarios under e.g. low inflation have different multipliers than scenarios under higher inflation.

An even more flexible approach could be taken, with the practitioner applying a combination of expert judgement to provide an estimate of the run off pattern related to some risks only, with those risks being combined with capital requirements for other risks which are calculated in a more mechanistic fashion.

Options i, ii and iii produce a challenge in that there is a risk of a 'black box' approach being followed, where a method is used with little consideration as to its validity. To address this, the practitioner will need to be aware of the limitations of their method, and perhaps stress test or use more advanced methods from time to time to ensure that the calculated results are correct. If material discrepancies are found they can either adjust the formula, or use a different method. Depending on the nature of the risks the firm is running, material discrepancies may be extremely likely.

Option iv does not have this challenge, but provides a separate difficulty in that the expert judgement may be hard to apply and hard to justify to regulators and auditors. As such assumptions should be documented, reviewed and well understood, and revisited from time to time.

Rough and ready simplifications

For some business, practitioners may considerate it appropriate to employ more rough and ready simplifications.

These could involve adding a set percentage on to the best estimate of liabilities to reflect the size of a risk margin. Such a set percentage may be derived by, from time to time, performing a more accurate calculation on the business. Alternatively it may be derived from an industry average of all businesses with similar risk profiles, either set by regulators or industry bodies. Any such set percentage should be calculated with a solid and defensible rationale which pertains to the nature of the business.

These simplifications should be used with extreme caution, generally only when the risk is relatively straightforward, and the nature of the risk unchanging. It may be less inappropriate when the risks are of a shorter term, and the total size of the risk margin is small relative to the size of the undertaking (and possibly in absolute terms).

Conclusion

The ultimate choice of simplification will be a matter of expert judgement on behalf of the practitioner performing the calculation. The practitioner needs to take into account the complexity of the risks they are running, with particular emphasis on whether the risk is likely to develop a changing nature as the business develops, and any non-linearities or inter-dependencies between the risks. They will need to take into account a principle of proportionality, assessing the marginal benefits of

increased complexity against the costs of running the calculation. Many practitioners may desire to stress their simplification to determine whether it is reasonable, or perhaps to perform a more accurate calculation from time to time to reassess the validity of simplifications which are run on a much more frequent timescales.

On a practical basis, it is almost certainly useful to consider the risk margin when setting up the cash-flow model which will be used to value the best estimate, since the results gained from that model can help in the calculation of the risk margin, and may allow the practitioner to use a more accurate simplification.

Simplifications should always be proportionate to the nature, scale and complexity of the business, and proportionate to the purpose to which the data will be put.

2.3.7. Allocating the risk margin

For reasons of external and internal reporting and for facilitation of risk management, it can be useful to allocate the total risk margin calculated for the firm to individual products, risks, lines of business etc.

This can present a serious practical challenge: the risk margin may be calculated at an entity level, assuming diversification between capital requirements in the entity, therefore to allocate requires portioning that diversification benefit from line of business to line of business, or from risk to risk.

The problem is similar to the problem of allocating economic capital, and similar approaches to the economic capital allocation problem (as outlined in SOA 2006 and others), could be adopted. We recap four possible types of approach for capital and risk allocation in Annex B.

The method used will depend on the modelling abilities of the firm, the use to which the numbers will be put, and the nature of the risk. Whichever method is used, the practitioner should be aware of the limitations, and where possible perform stress tests to understand them. In the case of a pro-rata method, serious consideration should be given to how appropriate the pro-rata reference is in determining the contribution of the risk margin. For example if one is allocating the risk margin in proportion to risk capital requirements, and the risks have very different run-off patterns, considering only the t=0 capital requirement is unlikely to be appropriate. The practitioner should also be careful to consider whether the same approach being used to allocate SCR

capital and the risk margin is appropriate, in many cases it won't be as the SCR allocation will refer to a wider set of risks, possibly on a going concern as opposed to run off basis.

2.4. Conclusion

This section gives five key learning points:

- The risk margin is extremely material, making up around €200bn across Europe.
- It can be calculated in a wide number of ways. The choice of calculation will be a trade off between theoretical accuracy and practicality
- The Cost of Capital method is arguably the method most true to the theoretical concept, but it brings with it several extremely tough practical obstacles as well as some difficult to answer theoretical questions.
- If using the Cost of Capital method, the practitioner will need to overcome the practical obstacles, and a variety of simplifications may be required to facilitate this. The simplifications should be used with caution, and their limitations well understood.
- Whilst there has been significant debate on the theoretical questions such as the correct cost of capital rate, there are still divergent views in the financial community and the practitioner will need to either follow the approach mandated in regulation if appropriate, or come to his own justified view.

3. The Regulation

3.1. Introduction

Future inclusion of the risk margin onto the balance sheet is inevitable for UK firms. Under current drafting in the two major in-development regimes of IFRS 4 phase II and Solvency II UK insurers will have to consider the risk margin in both their regulatory balance sheets, and their accounting balance sheets. Firms outside of the European Union may also have to consider the risk margin in their regulatory balance sheet. For example the Australian and Swiss regulators currently have a risk margin concept.

It may be hoped by the practitioner that many of the rules currently in development will help them in addressing the practical challenges discussed in section 2 above, and indeed that the regimes will offer some guidance in these matters.

In this section of the paper we give a recap of the place of the risk margin in various developing and developed regimes, and offer a quick reference guide as to what the regimes tell us about how to calculate the risk margin in practice.

Much of the regulation is in development, and so whilst we give the best view of where the regulation is heading this section will be in need of update as the rules become finalised.

3.2. Solvency II

At the time of writing, the Solvency II rules are still in the process of being finalised, however it is certain that the risk margin will form a key part of the Solvency II balance sheet. The Solvency II risk margin is defined as 'such [as] to ensure the value of the [liabilities] is equivalent to the amount that insurance…undertakings would be expected to require in order to take over and meet the insurance … obligations' (EC 2009).

The exact implementation of the risk margin has gone through a number of different iterations during the development of Solvency II as various decision making bodies have given their view as to the details which should be included in the regulation. This means that although there is still some uncertainty as to the final make up of the

rules, it is clear that the mandated method is expected to be the cost of capital method, and that simplifications will be permitted for the calculation. In October 2011 a latest iteration of the rules was produced, but not formally published.

The more detailed requirements are still in development, and in our comparison table in section 3.4 we reference the October 2011 version of these. It is important to note that some of the details may change ahead of Solvency II implementation, and that the rules in respect of the risk margin are unlikely to be finalised until at least the end of 2012.

QIS5

During 2010 in a Europe wide QIS exercise (QIS5) EIOPA tested a possible iteration of the risk margin.

In the exercise the vast majority (over 80%) of participants used a simplification when calculating and projecting their balance sheets. Unavoidable market risk was included in the risk margin, with most choosing to interpret this as any interest rate risk stemming from liabilities with a longer maturity than the last active asset, although there was little consistency amongst participants, and it tended to have a low impact when used.

3.3. IFRS

In their 'insurance contracts' work, the IASB are aiming to provide a single source of principle-based guidance to account for all types of insurance contracts. They plan to replace the current accounting standard IFRS 4 with a new accounting standard (IFRS 4 'Phase II') which would be underpinned by a market consistent framework. This standard is expected to come into force no earlier than 2015.

In 2010 an 'exposure draft' (IASB 2010) which provided a formal consultation on the implementation of IFRS 4 was released. Since then the concepts in the exposure draft have been debated, and further tentative decisions have been released (IASB 2012).

Under the most recent proposals, IFRS includes a risk margin type concept in the framework, called a 'risk adjustment'. The risk adjustment was defined in the exposure draft as 'the maximum amount an insurer would rationally pay to be relieved of the risk that the ultimate fulfilment cash flows exceed those expected'. This definition has been recently altered to tentatively define the risk margin as 'the compensation the insurer requires for bearing the uncertainty inherent in the cash

flows arising as the insurer fulfils the contract'. This is conceptually similar to the Solvency II definition, although it should be noted that the concept is based on a 'fulfilment', not a 'transfer value'. The standard also contains a number of differences with respect to the developing Solvency II requirements.

In particular, the exposure draft allowed for quantile type approaches as well as cost of capital approaches when calculating the risk adjustment, and the latest developments appear to be even broader in what calculation methods they allow. The exposure draft also restricted diversification benefit to the portfolio of business, although again it appears that the latest developments at IASB are moving towards relaxing the restriction on diversification.

A new formal draft of the standard is currently expected in the second half of 2012.

3.4. The two regimes compared

While both regimes are still in development it is impossible to make a final comparison between the two.

This table sets out certain practical areas, and gives the current best estimate of the requirements under Solvency II and IFRS 4 Phase II. As the regimes become finalised it may be in need of updating.

	Solvency II	**IFRS 4 Phase II**
Risk margin concept	'Risk margin' is 'such [as] to ensure the value of the [liabilities] is equivalent to the amount that insurance…undertakings would be expected to require in order to take over and meet the … obligations'. Definition unlikely to change.	'Risk adjustment' defined in Exposure Draft (ED), as 'the maximum amount an insurer would rationally pay to be relieved of the risk that the ultimate fulfilment cash flows exceed those expected'. Definition expected to be slightly changed for next release.
Method of calculation permissible.	Cost of Capital is only method allowed.	Exposure Draft (ED) allows quantile methods using VaR or tVaR, and Cost of Capital method. Latest indications are that the next release will allow any reasonable method.
Details of method	Cost of Capital method: - Risks captured at a 99.5%	Cost of Capital: - VaR level to be

	VaR confidence level - 6% capital rate rate - CoC rate and VaR level same for all business. - Non-hedgeable risks projected for full run off of business. - Discounted at basic risk free rate	'sufficiently high to capture almost the entire tail'. - Capital rate to not include mismatch risk born by insurer, uncertainty about future business, or risk free rate. - Possible to have different VaR level and CoC rates for different business. VaR: - Judgement required to set the appropriate VaR level. Tail VaR: - Judgement required to set the level. - Recommended for skewed distributions.
Risks included	Non-hedgeable risks include all underwriting and operational risks, 'residual' market risk (not including interest rate risk), certain credit risk.	Risks which arise from the insurance contract. Insurance risk, and investment risk, operational risk etc just when that affects the amount of payment to policyholders.
Diversification allowed	Diversification allowed up to undertaking level, but not to group level.	ED allowed diversification only up to portfolio level. Latest developments indicating diversification allowed 'to the extent considered by the insurer in assessing the compensation it requires for bearing risk'.
Simplifications permissible	A set of reasonably tightly defined suggested simplifications for projecting the balance sheet expected to form 'comply or explain' guidance. Simplifications likely to range from restricted simplifications in calculating the capital requirement to more major 'run off' style simplifications. 'Rough and ready' simplifications may be allowed under restricted circumstances. Other justifiable simplifications likely to be allowed.	Not specified in the ED.
Allocation	Allocation to standard lines of business required.	Allocation may be required for reporting purposes,

		although if risk adjustment is calculated at portfolio level, additional allocation is possibly not needed.
Disclosure	Reporting likely to show separate 'risk margin' and 'best estimate' components per line of business.	Must be calculated separately from the estimates of future cashflows. For comparability, disclosure must include a 'confidence level equivalent', regardless of method used.
How to choose method and approach	No choice of method. Simplifications used need to be appropriate to the nature, scale and complexity of the risks of the business.	Method needs to meet various principles including: Higher adjustment for: - low frequency high severity risks - Longer duration business - Wide probability distribution of risk - Risks which are less well understood. Risk adjustment can change if emerging experience indicates it should. The ED (Para B94 to B102) gives explicit consideration as to which method may be more suitable. Technique must be implementable and auditable.

3.5. Other regimes

Whilst Solvency II and IFRS are the regimes likely to be of most interest to UK insurers, other regimes also include a risk margin concept.

The Australian prudential regime for insurers includes a risk margin concept for general insurers, the risk margin is underpinned by a quantile type approach, with the total value of the 'central estimate', and the 'risk margin' expected to be at a 75% VaR level.

The Swiss Solvency Test (SST), which is the prudential regime for insurers in Switzerland, includes a risk margin concept for all insurers called the 'market value margin'. The methodology mandated is extremely similar to the cost of capital method used in Solvency II. As in Solvency II, the SST uses a 6% cost of capital rate,

and as in Solvency II, the SST include possible simplifications for projecting forward the balance sheet. Unlike in Solvency II, the SST includes non-hedgeable market risks.

As international insurance regulation develops, it appears likely that more financial regulators will include a risk margin concept into their regimes.

3.6. Conclusion

The divergence in international regulation and standards will provide a challenge to practitioners and their employers. For practitioners, the burden of performing two different potentially complicated calculations should not be underestimated – indeed they may wish to take advantage of the flexibility in IFRS to use a method which has synergies with the less flexible Solvency II. Firms and practitioners will also face a communication challenge – if they deem it appropriate to use different methodologies or standards this will have to be justified, both to the senior management of the firm, and perhaps more importantly to the investment community. Transparency of method, and strong and clear communication of the rationale behind the approach used will be critical.

The developing regimes give an answer to many of the practical challenges outlined in section 2. Some regimes allow more discretion than others, for example, under the current drafting, practitioners preparing IFRS reports will have to consider what method they think is most appropriate for their business, and once they have settled on the method will have to consider and justify some of they key assumptions that they use. Even in regimes like Solvency II which allow less discretion, practitioners will still face a challenge in applying the mandated methods in a proportionate and simple fashion.

4. Bibliography

APRA (2010) – GPS310 *Audit and Actuarial Reporting and valuation*

APRA (2008) General Insurance Risk Margins Industry Report

CEA (2009) CEA Key messages in Level 2 Implementing Measures

CEIOPS (2009). Advice for Level 2 Implementing Measures of Solvency II – *Calculation of the risk margin.*

CRO (2008). Market value of liabilities for insurance firms - *Implementing elements for Solvency II*

JD Cummins (2000): Allocation of Capital in the Insurance Industry *Risk Management and Insurance Review*

EC (2009) Directive 2009/138/EC - *On the taking up and pursuit of insurance and reinsurance (Solvency II).*

EIOPA (2010) QIS5 Technical Specifications

EIOPA (2011) EIOPA report on the 5th QIS for Solvency II

Ernst and Young (2010). IFRS Phase 4 and Solvency II – Bridging the gap

FinMa (2006). The Swiss experience with market consistent technical provisions – *the cost of capital approach.*

FinMa (2007). Technical Document on the Swiss Solvency Test

FSA (2011) FSA UK Country Report: QIS5 for Solvency II

Group Consultatif (2006) Solvency II Risk margin Comparison, Published in open letter to CEIOPS:

Gutterman and Bell (2009) Risk margins – providing perspective, *Presentiation to FASB*

Hitchcox et al (2006) Assessment of target capital for general insurance firms, *Discussion paper to Institute and Faculty of Actuaries*

IAA (2009). Measurement of Liabilities for Insurance Contracts: Current Estimates and Risk Margins

IASB (2007) Discussion Paper - *Preliminary views on insurance contracts*

IASB (2012) Staff Paper: Effect of board redeliberations on ED Insurance Contracts

International Insurance News (2010) The Insurance Industry: Mergers and Acquisitions 2010. *http://www.globalinsurance.com/blog/the-insurance-industry-mergers-and-acquisitions-2010-273920.html*

Keller (2006). A primer for calculating the Swiss Solvency Test "Cost of Capital" for a Market Value Margin

Keller (2010). Some comments on the illiquidity premium, *Association Suisse des Actuaries*

Miccolis and Heppen (2010) A practical approach to risk margins in the measurement of insurance liabilities for property and casualty (general insurance) under developing international financial reporting standards, *International Congress of Actuaries*

Milliman (2011) Comparison of the standard formulae for life insurers under the Swiss Solvency Test and Solvency II

SOA (2006) Speciality guide on Economic Capital

Swiss Re (2005) Insurers' cost of capital and economic value creation: principles and practical implications

5. Annex A: The main calculation methods for the risk margin

	Ease of calculation	Theoretical soundness	Subjectivity and transparency	Flexibility	Coverage of risks	Stability of calculation	Ease of Comms	Cross-Sectoral consistency
Quantile methods	Reasonably straight-forward if liabilities valued on a cashflow model.	Not obviously market consistent. Particularly inappropriate if using VaR and heavy tailed risks.	Exists only in the choice of quantile. Transparent and potentially comparable across firms.	Fixed methodology, although implementation may vary.	Risks may all be considered, but may not include tail risk	Fairly stable, although depends on quantile.	Simple to communicate	Can be made consistent.
Cost of capital methods	Actuarially extremely complex	The most in line with market consistency, although to an extent this depends on the implementation decisions.	Lots of areas of discretion, especially in choosing unhedgeable risks.	Reasonably inflexible, although some area for flexibility in calculation method chosen.	All non-hedgeable risks should be explicitly covered.	Fairly stable, and volatility likely to be transparent.	Requires specialist knowledge or very careful comms.	Consistent if underlying assumptions (e.g. on CoC rate and VaR levels are).
Discount related approaches	Reasonably straightforward	Not market consistent.	High, in choice of discount rate	Fixed methodology	No clear link	Depends on dynamic updating of discount rate	Prima facie simple but confusing when considered in more depth	Possibly consistent, although different business has different susceptibility to discounting.
Assumption based	Reasonably straightforward	Not market consistent.	Very high level of subjectivity.	Very flexible as any assumption can be modified.	Depends on choice of assumptions modified.	Depends on whether the firm chooses to update assumptions.	Simple	Difficult to make consistent as different business has different assumptions.

6. Annex B: Methods for risk margin allocation

Euler capital allocation is typically done in stochastic modelling by examining the scenario at which the capital requirement is calculated, and looking to determine the contribution of each risk/product/etc to the capital requirement calculated in that scenario. Smoothing may be applied to the figure so derived by using information from nearby scenarios. Such an approach could be adapted for risk margin allocation only if the risk margin is calculated at the granularity at which you want to apply the allocation, and the risk margin is calculated stochastically. Various simplifications can be applied, however the calculation burden for an Euler based approach is likely to be very high for all firms but those with the simplest risk profile and/or the most sophisticated modelling.

The Pro-rata approach seeks to allocate the risk margin in proportion to a suitable allocation proxy. If allocation is to be done by line of business or product, this could be by total best estimate of liability or by t=0 capital requirement for each line of business (if that figure is calculated). If the allocation is to be done risk by risk the allocation could be done by t=0 capital requirement for the risk. In both cases the results are likely to be somewhat unreliable as the measure by which the risk margin is allocated is unlikely to capture the full complexity of the risk margin calculation: an allocation in proportion to capital requirement at t=0 does not capture the running off of the risk, allocating in proportion to best estimate of liabilities does not capture the different risk characteristics of different products. The pro-rata approach should then be accompanied by an assessment of whether it has valid underlying assumptions.

The Marginal approach calculates the entire risk margin, and then recalculates with each business unit or product removed one by one, the fall in risk margin between each calculation reflects the contribution of the business unit to the risk margin. The order in which the business units are removed may have an impact on the allocation of the risk margin, so the exercise may be performed a number of times, with the business units being removed in different orders. The results from the different runs would then be used to create a single allocation, either by straight averaging, or a more complicated method (for example Myers Read).

Of possible use for some reporting is to not allocate the diversification benefit to the line of business or risk, and instead to allocate it to the entity as a whole. This means the risk margins would be calculated separately for each business unit/product/etc, and the difference between this figure and the total risk margin, the diversification benefit, is just allocated at corporate level. This method does not reflect the diversification benefits inherent in some lines of business, and may not be appropriate for all reporting regimes. It is however reasonably simple, and while arguably excessively prudent clearly doesn't 'over-analyse' the problem.