“Does your hedge do what it says on the tin?”

Hedging strategies for insurers: effectiveness in recent conditions and regulatory treatment

Report of the Risk and Investment Working Party

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Authors:
Scott Eason
William Diffey
Ross Evans
Paul Fulcher
Tim Wilkins

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1. Introduction

1.1 Over the current decade it has become popular practice for UK Life Insurance companies to manage their asset risk exposures, relative to their liabilities, using derivatives. In most cases, this has involved finding derivatives ("hedging assets") whose values move in the opposite direction to the assets held, net of liabilities, and to vary the mix of the two to create the required risk exposure.

1.2 Market conditions were fairly benign over the period to the middle of 2007 and it was typically perceived that the hedging assets performed well in tracking the opposite movement of the assets held. It was also common to assume in financial modelling and reporting that such hedges are perfect and to ignore any potential differences in movements in values between the assets held and the hedging assets.

1.3 The so called "credit crunch" or "global financial crisis", which started in the middle of 2007 and is still apparent into 2010, led to extreme volatility in most financial markets and highlighted the importance of hedging market risks.

1.4 However, the same crisis also created extremely stressed conditions in derivatives markets with unanticipated dislocations. This has raised the issue of whether the hedges taken out by insurers proved to be effective during the times when they were most needed – in other words did derivatives hedges, in practice, "do what they said on the tin".

1.5 Our working party was formed to address this question under the sponsorship of the Finance and Investment Practice Executive Committee. We presented our initial findings at the 2009 Risk and Investment Conference, and subsequently the 2009 Life Convention, and this paper represents our final output.

Hedge effectiveness and "basis risk"

1.6 When considering whether a hedge has been effective, one needs to consider what the hedge was actually trying to achieve.

1.7 In economic terms, as discussed above, hedges are typically trying to offset the risks in respect of an asset, or asset-liability, exposure.

1.8 This leads to consideration of "basis risk" which is typically defined as the risk that changes in the value of the hedging instrument do not exactly offset those of the position being hedged.

1.9 When considering the economic effectiveness of a hedge, the insurer may be concerned with whether the hedge produces a payoff at maturity that matches the gain or loss on the hedged position. This is essentially a cashflow

perspective.

1.10 However, an insurer may also be concerned as to whether changes in the market value of the hedge offset changes in the market value of the hedged positions, assessed at interim positions prior to maturity. This perspective has becoming increasingly relevant due to the trend in regulation and accounting towards a short-term mark-to-market perspective (e.g. under Solvency II).

1.11 During the global financial crisis, as our analysis in Section 3 to 5 shows, hedges that may still have been expected to be effective if held to maturity nevertheless showed considerable basis risk on a mark-to-market basis.

1.12 Hedges are often also taken out by insurers with regard to the regulatory and accounting consequences – for example in order to stabilise the capital position, to achieve up front capital relief, or to ensure profit stability. In this case, the effectiveness will depend on the treatment of the hedge under the particular regulatory or accounting metrics that are relevant – in many cases a hedge effective under one metric may be ineffective under another.

1.13 In addition, effectiveness can be impacted by counterparty risk – is the counterparty to the hedge actually able to pay when the hedge is required – and other practical issues such as liquidity strains.

1.14 More broadly, therefore, basis risk may be defined as the residual risk that remains with the insurer in respect of the risks covered by the hedging strategy. In this regard, we follow the definition of the Securitisation of Non-Life Insurance Working Party (2008).

Contents and scope of paper

1.15 This paper looks at some of the most popular hedges for with-profits and annuity funds within UK life insurance companies. We report on regulatory requirements and current treatments before comparing performance of underlying assets and the hedging assets over both the benign period from 1 January 2004 to 30 June 2007 and the stressed period since 1 July 2007.

1.16 We then look at some of the practical issues in using the hedges that have become apparent during the recent stressed conditions before drawing our conclusions on the appropriateness of the hedges examined and common regulatory practices.

1.17 The hedges we have examined are:

- Equity puts to provide a cap on equity losses.
- Credit default swaps to reduce credit risk from corporate bonds.
- Interest rate swaps to reduce interest rate risk from mis-matches of assets and liabilities.

- Interest rate swaptions used to manage losses from guaranteed annuity rates.

- Inflation swaps used to match index-linked liabilities.

- Currency swaps to reduce currency risk from mis-matches of assets and liabilities.

1.18 The authors are aware that there are a number of practical issues regarding hedging with-profits contracts such as:

- Asset shares are generally backed by a basket of assets and true economic hedges would be based on the basket. However, liquid hedging assets do not typically exist for such baskets of assets.

- Most with-profits funds include a material exposure to commercial property. The property derivative market is still not a deep, liquid market.

- Asset shares typically absorb a significant part of the risk of the underlying assets, so the net exposure to shareholders and/or the estate from the underlying assets can be relatively complex and non-linear.

- The assets and liabilities (and hence required hedges) alter with management actions, potentially requiring a dynamic hedging policy.

- There is often a conflict as to whether to hedge guaranteed or expected benefits, especially if the durations of asset shares and guaranteed liabilities differ.

- These issues are outside the scope of this paper. We refer the reader to Hibbert & Turnbull (2003) and Muir et al (2004) for more details on hedging with profits liabilities. Nevertheless, the comments and analysis in this paper are highly relevant to with-profits funds.

1.19 We have also not considered the detailed issues associated with hedging variable annuities business, which are discussed in Ledlie et al (2008).

1.20 This paper focuses on life insurance companies and their regulatory and accounting frameworks. However, the observations concerning the market basis risk on hedges will equally apply to pension funds.

2. Regulatory background and current treatments

2.1 Insurers face a wide range of regulatory and accounting frameworks which measure their liabilities and capital requirements in a variety of ways.

2.2 Risk based capital regulatory regimes such as the individual capital assessment (ICA) and the emerging Solvency II framework demand articulation and demonstration of internal controls and risk management systems. In this context ERM becomes a regulatory resource and a source of inspiration for principles-based oversight frameworks. Hedging strategies often have to be considered within and optimised across both these ERM based frameworks and older more rules based or formulaic regulatory approaches (such as Solvency I).

2.3 Below we look at some of the regulatory and accounting measures relevant to UK insurers in more detail and consider how the rules affect hedge effectiveness. We also contrast these with the corresponding US regulatory (risk-based capital) and accounting (US GAAP) regimes. We have commented on the likely treatment of the relatively simple hedges listed above, but even for these the actual effect would depend on the way the hedge is structured.

2.4 The initial impact of hedging can be to change capital requirements or the value of liabilities. The effect on capital requirements depends on the risks that are included in the capital calculation (so hedging these risks will tend to reduce capital requirements) and the treatment of residual risks (which may offset or even outweigh the capital benefit).

2.5 The ongoing effectiveness of hedging naturally depends on what metric is being hedged. For this Section we have assumed that hedging is on an economic basis. The current UK prudential regime is probably the furthest from an economic view so we comment on this in some detail.

UK prudential framework

2.6 The prudential framework for UK insurers is set out in the FSA's Handbook of Rules and Guidance, in particular the Prudential Sourcebook for Insurers (INSPRU). This includes both the "Pillar 1" requirements, subdivided into the regulatory "peak 1" basis and the realistic "peak 2" basis, and "Pillar 2" requirements, usually referred to as the Individual Capital Assessment ("ICA").

<u>Peak 1 – valuation of liabilities</u>

2.7 Although its significance has been reduced for many firms by the introduction of realistic balance sheets, the ICA regime and changes introduced in PS06/14 (eg allowing lapse rates and negative reserves), insurers still need to report the value of their liabilities on this basis.

2.8 The peak 1 framework combines a predominantly deterministic valuation of liabilities, including margins for prudence, with a non-risk-based solvency margin. For material options there is guidance indicating that a stochastic approach is appropriate, which should be benchmarked to relevant market asset prices. Thus there is an element of market-consistent valuation in the peak 1 basis, albeit subject to the overall requirement for prudence.

2.9 The discount rate for liabilities is based on the yield on hypothecated assets, so hedging can have a direct effect on the value of liabilities if the hedging assets are used in the calculation of the valuation yield. This may sometimes produce results that are out of line with an economic view. The deterministic valuation approach effectively writes off the time value of purchased options, but may give limited or no credit for the protection they provide.

2.10 Muir et al (2004) discuss examples of the effect of hedging with-profit liabilities using various derivative strategies. In particular, they demonstrate why short-dated equity "zero-cost collars" (an equity call is sold to fund purchase of an equity put) are a more efficient peak 1 hedging strategy than the longer-dated equity puts which would better economically match the nature of the guarantees in with-profits contracts.

2.11 The peak 1 discount rate is adjusted for credit default risk, but for corporate bonds the adjustment is typically less than the full yield credit spread. This gives corporate bonds a yield advantage over gilts and makes them more attractive for backing long duration liabilities in particular. As discussed in Telford et al (2010) this may have contributed to the high proportion of corporate bonds held by many companies with significant annuity liabilities.

2.12 The argument for a credit risk deduction that is less than the total credit spread is typically linked to a discussion regarding the appropriate allowance for liquidity premia. There are currently a wide range of views regarding the appropriate level of the liquidity premia in the light of the credit crunch with companies seeking allowance for often very significant liquidity premia within their regulatory returns. Including a liquidity premium in the discount rate acts as a partial hedge against the impact of variations in credit spreads on available capital. The remaining exposure to credit risk, and so the effectiveness of hedging credit risk with CDS, depends on what proportion of the credit spread is assumed to be liquidity premium.

2.13 The effect of CDS on the valuation interest rate is unclear. The valuation interest rate could be taken as the internal rate of return on a combined portfolio of CDS and bonds. The premium paid for the CDS is mainly time value, and would therefore be written off, but the CDS could be assumed to offset the assumed default losses on the portfolio. Therefore the impact of CDS will typically depend on the assumed default assumptions in the valuation interest rate versus the CDS premium.

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2.14 Where interest rate swaps are used for hedging, they will generally be combined with the actual bonds held to synthesise cashflows that are a better match for liabilities. The peak 1 valuation interest rate will be determined by the internal rate of return on the synthetic cashflows. The initial impact of

hedging on the value of liabilities may be quite limited (unless the synthetic cashflows have a very different profile from the unhedged cashflows) but the hedging should be effective at stabilising surplus over time if the synthesised cashflows are a good match for the liabilities. However the duration of liabilities is often different on a peak 1 basis from a best estimate basis because of prudent assumptions (eg lapse, mortality), so a hedge that is optimised on an economic basis may be less effective at hedging peak 1 liabilities.

2.15 Finally we consider swaption hedging of Guaranteed Annuity Options ("GAOs"). GAOs are usually treated as options with a material impact and hence valued on a (broadly) market-consistent basis. This is helpful for hedge effectiveness as assets and liabilities are valued using comparable methods. On the other hand the valuation basis still contains elements of prudence, for example a conservative GAO take-up rate is required. Firms can design their hedging to reflect these assumptions but may then find they are over hedged if their actual experience is less adverse than assumed.

Resilience capital requirement and matching rules

2.16 Regulatory basis only firms (ie those not subject to realistic balance sheet requirements) have to calculate a resilience capital requirement (RCR). This is based on a single market risk scenario, which combines a fall in equity and real estate values with the more onerous of a fall or rise in fixed interest yields by a specified amount (ie a parallel shift).

2.17 Hedging that reduces broad equity exposure or reduces any mismatch of duration between assets and liabilities is likely to reduce RCR. However there is no requirement to consider basis risk or other residual risks and so more refined hedge strategies may have little initial impact. For example, if a sold index future is used to reduce equity exposure then both the index and the firm's equity portfolio would be subjected to the same stress, ie the hedge is treated as fully effective.

2.18 The RCR does not cover credit, currency or inflation risk. Credit risks are partly addressed by deductions from the valuation interest rate (discussed above). Asset risks are also mitigated to some extent by rules governing how assets are invested. Assets must be of appropriate safety, yield, marketability, currency and term to meet expected cash outflows (INSPRU 1.1.34) and admissibility rules restrict the amounts of each class of asset that can be used to cover capital requirements. Firms must also limit counterparty exposures to prudent levels; loss mitigation techniques (including credit derivatives) can be taken into account. Thus effective hedging may allow investments to satisfy the rules rather than reducing liabilities or capital requirements.

2.19 Index-linked and unit-linked liabilities are subject to close matching rules. For index-linked liabilities this requires the liabilities to be covered by assets that closely represent the index or an index-linked approved derivative. Where liabilities cannot be exactly matched, firms should seek to match assets that at least cover the liabilities, eg RPI-linked assets to cover LPI-linked liabilities. These rules suggest that inflation derivatives used to hedge

inflation risk would need to be highly effective and residual mismatches should be over-hedged.

2.20 There are additional rules on the use of derivatives in insurance companies which are relevant to hedging as we will now describe.

Rules on use of derivatives

2.21 The specific rules on the use of derivatives, contained in INSPRU 3.2, require derivatives to be covered and set out conditions for a derivative to be admissible (and approved in relation to the treatment of permitted links).

2.22 Any obligations to transfer assets or money arising from derivatives must be covered. One purpose of this test is to ensure that firms have assets of the right type to meet their obligations when they fall due. Interpreting this test is not always straightforward; for example, is cover actually required for cash-settled options, where the purchaser receives the net value of the option and is not required to transfer any assets?

2.23 For the example of a FTSE100 put option, the logical cover is assets representing "a reasonable approximation" (INSPRU 3.2.16) to the assets underlying the index. However no guidance is given as to how good the approximation needs to be. Similarly, the obvious cover for a purchased index CDS would be a holding of the bonds underlying the index, but it is not clear how much name basis risk would be acceptable.

2.24 Cover can be provided by assets, liabilities, provisions or offsetting transactions so there are a number of ways to meet this test. It has been interpreted quite flexibly and does not generally seem to present a significant barrier to derivative use. However, it can cause practical issues in times of volatile markets – for example, all or part of hedge may become inadmissible, if the size or nature of the risk being hedged changes unexpectedly (such as with asset-share linked guaranteed annuity options, where market values fall sharply).

2.25 In addition to the cover requirement, a derivative can only be admissible if it satisfies further rules, in particular it must be held for the purposes of efficient portfolio management or reduction in investment risks.

2.26 In the context of hedging instruments it is usually the reduction in investment risks test that will be relevant. This is satisfied if the derivative reduces any aspect of investment risk without significantly increasing any other aspect of that risk. This requires an assessment of introduced risks such as counterparty and basis risk, although in practice this requirement has not acted as a barrier to use of the derivatives discussed in this paper.

2.27 Overall, these rules on the use of derivatives can act as a practical barrier to effective hedging. However there is some flexibility in the interpretation of the rules and it is often possible to find a satisfactory solution.

2.28 It is worth noting that hedge instruments are subject to the general stress testing and scenario analysis requirements contained in GENPRU 1.2.42.

Peak 2 – realistic balance sheet

2.29 The peak 2 basis applies to larger (over £500m) with profits funds. Assets are broadly valued at market value and most liabilities are measured on a market-consistent basis. Hedging does not have a direct impact on the initial valuation of liabilities unless the hedge affects the amounts paid to policyholders, for example by allocating the hedge assets to asset shares. However it will have an effect on the risk capital margin (RCM).

2.30 The RCM is based on specified stresses to equity, interest rates, credit and lapse rates. As for the RCR, the equity stress is expressed as a single percentage fall in all equities and basis risk is usually ignored. Similarly the interest rate stress is a simple parallel shift.

2.31 The credit stress is a bit more complex. It is specified in terms of an increase in credit spread on bonds that depends on both a bond's rating and its initial credit spread. For other exposures, including derivatives, firms have to calculate a change in the value of the exposure consistent with the specified changes in credit spreads. For index CDS this would theoretically require an analysis of the rating and spread of all the bonds underlying the index, although in practice a simpler approach would probably be used. If either the average rating or spread of the index is different from the actual bond portfolio held then the hedge may not be fully effective in reducing RCM.

2.32 Under peak 2, all derivatives are taken into account, even when inadmissible under peak 1. This is a specific exemption for derivatives, rather than other inadmissible assets, and assists insurers wishing to put in place hedges for peak 2 to avoid any artificial restrictions from the admissibility rules discussed above.

Pillar 2 –Individual Capital Assessment

2.33 ICA capital requirements are based on principles rather than detailed rules. Firms are required to consider all the material risks that may arise before policyholder liabilities are paid.

2.34 Since the ICA will generally include capital for all significant risks, any reasonable hedging programme would be expected to have some benefit in reducing capital requirements but the effectiveness will depend on how ICA is implemented. Companies must calculate capital on a basis comparable with a 99.5% confidence level over one year but no specific approach is specified and companies can use a method that incorporates their hedging programmes if they wish.

2.35 There is also no specific guidance on the treatment of hedge effectiveness or basis risk. Firms need to identify any material shortcomings in their hedging programmes and hold additional capital where appropriate.

2.36 In practice the approach to basis risk varies. Some firms include a stress to the spread between swaps and gilts. This can be a risk factor where firms hold derivative assets valued using a swap-based yield curve but discount their insurance liabilities using gilt-based yields. Firms may consider tracking error between index-based hedges and the actual portfolios they are protecting. Some include additional stresses to yield curves that consider changes in slope and shape as well as level.

2.37 The risks included in an ICA assessment may depend on what hedging or risk mitigation is in place. One reason is that hedging may introduce new risks, such as credit exposure to the counterparty. Another reason is that, once hedging has removed a material risk, a residual risk that was previously neglected as second-order may become material relative to the remaining risks.

Insurance Groups Directive

2.38 For firms that are part of an insurance group, the Insurance Groups Directive (IGD) requires an assessment of capital resources and capital resource requirements at a group level.

2.39 During the financial crisis there was an increased focus on insurers' capital strength and risk management. For listed insurance groups this meant analysts focused on regulatory capital and IGD capital emerged as the measure of choice for the overall strength of a Group. In response companies increased their disclosure of IGD capital, often shown as a headline figure in their financial results. Many disclosures included sensitivities of IGD capital to equity, interest rate and credit stresses as well as information on de-risking. Hedging activity was often focused on short-term protection of IGD capital strength.

2.40 More recently, as financial markets have recovered, capital strength no longer receives as much attention and it seems less likely that companies will focus on IGD as their principal hedging measure.

2.41 The IGD parent undertaking solvency calculation is built on the solo solvency (i.e. pillar 1) adjusted to remove double-counting of assets and liabilities in subsidiaries. Funds that are not freely available to other areas of the group, such as surplus in long-term funds, are excluded from group capital resources. Hedging carried out in long-term funds may therefore have limited effect on group IGD surplus.

2.42 The group-level IGD surplus covers all subsidiaries but liabilities are not necessarily measured on the same basis. For some overseas territories ("designated territories" - EEA states plus a few others, including the USA), capital can be calculated using local prudential rules but for others a proxy capital calculation is required. This can be an issue for hedge effectiveness as the consolidated exposure to market risk is not measured on a consistent basis.

Solvency II

2.43 The Solvency II regime is due to come into force across the EU in October 2012, replacing the existing Solvency 1 regime. The Level 1 Framework Directive has now been adopted by the European Parliament and CEIOPS has issued its final advice on Level 2 implementing measures. However, at the time of writing the European Commission is still drafting the actual implementing measures and CEIOPS is starting work on Level 3 guidance so much of the detail of the regime is yet to emerge.

2.44 The overall philosophy of Solvency II is based on Value-at-Risk ("VaR") over a one-year time horizon. Solvency II essentially requires that sufficient capital be held so that, at a 99.5% confidence level, liabilities can at any point over the next year be transferred to a third party who will switch assets into a matching risk-free portfolio. Solvency II therefore places an emphasis on mark-to-market risk versus this risk-free replicating portfolio and this influences the way in which hedges may be treated.

2.45 The Solvency II framework also requires a valuation of liabilities on a market consistent basis plus an allowance for a risk margin (through a cost of capital calculation).

2.46 One contentious area is the possible inclusion of a liquidity premium within the discount rate. A combined CEIOPS and insurance industry (represented by bodies such as the CRO and CFO Forums and the CEA) Task Force produced a Report on the Liquidity Premium in March 2010 recommending that a liquidity premium could be included in certain circumstances. However many aspects are still unclear, such as which liabilities this would apply to, how the liquidity premium would be calculated in practice and the consequent impact on the SCR and risk margin.

2.47 Many insurance companies would welcome an allowance for a liquidity premium as it would decrease technical provisions and would probably act to mitigate some of the impact of increases in credit spreads. However, its inclusion would add complexity to the calculation of technical provisions and capital requirements, which would increase the challenge of risk management and hedging. This is discussed further at the end of Section 4.

2.48 Solvency II capital requirements (Solvency Capital Requirement, SCR) can be calculated using a standard formula or companies can apply for approval to use an internal model. CEIOPS has issued advice on the allowance for financial mitigation techniques in the standard formula (DOC 26/09, former CP31).

2.49 The advice contains a number of principles that risk mitigation instruments should satisfy. One principle is that only risk mitigation instruments are allowable for reducing the standard formula SCR, not processes and controls. An implication is that firms using dynamic hedging would only be able to allow for hedging instruments held at the valuation date. Although this is consistent with the instantaneous stress test approach of the standard formula, the credit given to hedging programmes would depend on assets held at a

particular date which may be rebalanced a few weeks or days afterwards. This may act as an incentive for firms to develop internal models.

2.50 Principle 2 covers legal certainty, effectiveness and enforceability. To avoid the risk of "window-dressing" with too short-term hedges, there is a requirement that hedges in force for less than twelve months should only be taken into account pro-rata (i.e. only 50% credit given for a six month hedge). If a programme of rolling short term hedges is in place, full credit is only given if the conditions for renewing the hedges are fully committed.

2.51 Principle 2 also covers basis risk, and states that where the underlying reference of the risk mitigation instrument does not perfectly match the risk exposure, then credit should only be allowed if the basis risk is not material compared to the mitigation effect. This seems to set quite a high standard – particularly in the light of our findings in Sections 3 to 6 - and may be difficult to demonstrate in practice.

2.52 Examples are given of hedges that are considered to involve material basis risk:

- "Equity derivatives whose underlying equities or indexes have not a correlation nearby 1 with the hedged asset or liability, especially in case of stressed situations.

- Credit default swaps referred to names different than the hedged name, or with a correlation not nearby 1, with a different tenor or a different nominal".

2.53 The advice requires that if insurers envisage using financial mitigation techniques with material basis risk, then they will need to develop partial internal models to capture these risks.

2.54 In either case, standard or internal model, the requirement is that capital should be held against basis risks with a confidence level and time horizon consistent with the Solvency II framework – i.e. at a 99.5% one-year VaR.

2.55 The design of the SCR standard formula is an important factor for hedging, in particular the market risk module. This includes stresses for interest rate (non-parallel upward and downward shocks), equity, property, spread, concentration and currency risk. The equity and interest rate stresses incorporate changes in the corresponding implied volatilities.

2.56 The equity sub-module includes a symmetric adjustment mechanism which increases or decreases the size of the stress depending on how the MSCI Developed index level compares with its one-year average. The intention of this mechanism is to reduce the required capital for equities in periods when equity markets have fallen rapidly and so hopefully avoid mass selling of equities in distressed markets. It remains to be seen whether a simple formula is sufficient to cope with all market conditions.

2.57 Inevitably the standard formula calibrations will not be consistent across all modules for all possible risks and at first sight there may appear to be hedging strategies that would reduce the SCR by arbitraging the rules, e.g. by moving an exposure from one module to another. However, this is unlikely to be effective in practice as regulators can require companies to move to an internal model if the standard formula does not properly reflect their risks.

2.58 A further requirement of Solvency II is an Own Risk Self Assessment (ORSA). This should encompass all material risks that may have an impact on the undertaking's ability to meet its obligations under insurance contracts. Basis risk will therefore need to be assessed in the ORSA, although this will not necessarily lead to additional capital requirements.

Risk based capital requirements for US variable annuities

2.59 So far we have looked at UK and European regulatory capital frameworks. In this section we compare these with US regulatory capital for insurers writing variable annuities. The contrast shows how different interpretations of risk based capital have been used in the different markets, driven partly by the different products and hedging practices.

2.60 Statutory risk based capital (RBC) is governed by rules and guidance adopted by the National Association of Insurance Commissioners (NAIC). In 2000 a scenario-based approach was adopted for the C-3 (market risk) component but only covering interest rate risk (C-3, Phase 1). More recently a principles-based regime has been developed (C-3, Phase 2 or C3P2) that will require companies to determine a total asset requirement (TAR), ie the sum of reserves and RBC.

2.61 One basic difference between RBC C3P2 and Solvency II is that the use of a conditional tail expectation (CTE) measure. TAR is based on the average of the worst 10% of the present value of projected surplus deficiencies, ie CTE90. Solvency II is based on a VaR measure, ie the 99.5^{th} percentile loss. One consequence for hedging is that the different measures consider different parts of the loss distribution, but in practice many hedging programmes will narrow the whole loss distribution so this distinction may not be very significant for hedge effectiveness.

2.62 A more fundamental difference is that C3P2 uses a run-off approach, compared with a 1 year standard for Solvency II (which may be approximated by instantaneous stress tests). This allows companies to take credit for dynamic hedging programmes in their RBC calculations.

2.63 There is a considerable amount of detailed guidance on hedging and hedge effectiveness in RBC. Credit can only be given to a Clearly Defined Hedging Strategy, which must identify both hedged and unhedged risks and the metric(s) and criteria used to measure hedge effectiveness, amongst other things. The TAR should include an adjustment for unhedged risks, hedge costs and any uncertainty over the effectiveness of the hedging strategy.

Accounting frameworks

2.64 Many insurers publish supplementary embedded value information in addition to their normal accounts. Here we look at some of the more commonly-used accounting bases: general accounting standards produced by the International Accounting Standards Board (IASB), EEV/MCEV principles published by the CFO Forum and US GAAP.

International Financial Reporting Standards

2.65 Accounting standards are published by IASB in the form of IFRS, gradually updating the older International Accounting Standards (IAS). Two of the standards that are particularly relevant to insurance companies and have implications for hedging are IFRS 4 (insurance contracts) and IAS 39 (financial instruments).

2.66 The accounting treatment differs depending on which standard applies to a particular asset or liability, and individual standards allow a variety of approaches. IFRS 4 allows existing accounting policies to be used, subject to some restrictions, or contracts can be remeasured to reflect current market interest rates. IAS 39 divides instruments into different categories which are measured using either fair value or amortised cost. The measurement of assets and liabilities, and hence the effectiveness of any hedging, is therefore heavily dependent on the choice of accounting policies.

2.67 The variety of different valuation methods can create mismatches between assets and liabilities. In response, IAS39 introduces the concept of hedge accounting. This allows companies to designate certain assets or liabilities, generally derivatives, as hedging instruments with corresponding hedged items. Hedging instruments and hedged items are subsequently measured on a consistent basis which should reduce P&L and balance sheet volatility.

2.68 As an example, suppose CDS are used to hedge corporate bonds designated as held-to-maturity investments. If hedge accounting is not applied then the CDS would be measured at fair value while the bonds are measured at amortised cost. Changes in the mark-to-market value of the CDS would appear in the P&L but unrealised gains on the bonds would only be recognised on an accrual basis.

2.69 However there are a number of relatively onerous conditions that need to be met in order to apply hedge accounting. One is that the hedge is "highly effective", which requires that the actual results of the hedge are within the range 80-125%. This puts a specific limit on the amount of basis risk that is allowed.

2.70 The "highly effective" test and the complexity of the other requirements, including the level of documentation required, mean that companies may not always seek to apply hedge accounting. In some cases potential P&L volatility may be considered preferable to the uncertainty of whether a hedge will pass the effectiveness test. Failing the test means assets and liabilities

may have to be re-designated and re-valued.

2.71 The IASB has a current project to replace IAS39 with a new standard IFRS9. This project is in progress at the time of writing this paper – a revised standard on hedge accounting was originally planned for Q1 2010 but it now appears that a more fundamental review of hedge accounting is to take place.

2.72 The IASB is also currently developing phase 2 of its insurance contracts project to replace IFRS 4. This is expected to produce some form of fair valuation calibrated to market values but this is not guaranteed. Many aspects are still under consultation, including fundamental decisions such as the discount rate, the cashflows to be valued and the liability measurement attribute. One contentious point is whether profits can be recognised at policy inception. If not then the value of liabilities could depart from a market-consistent valuation and be benchmarked against the premiums charged instead.

2.73 This phase 2 project is making slow progress with agreement on the outstanding issues proving hard to reach. The IASB currently state that they aim to publish an Exposure Draft in 2010 and a final standard in 2011 but this timetable appears ambitious.

EEV/MCEV

2.74 The CFO Forum has published European Embedded Value (EEV) principles covering embedded value disclosures by its members. Two key features are a discount rate for liabilities based on swaps and the inclusion of a time value of financial options and guarantees (TVFOG), although this does not have to be on a market-consistent basis.

2.75 Using a swap-based discount rate can be helpful for hedge effectiveness because it removes some potential basis risk between liabilities and the values of derivatives based on swap rates.

2.76 However, if TVFOG is calculated on a non-market-consistent basis then this may reduce the effectiveness of any hedging of options and guarantees. The asset will be measured at market value and there may be a mismatch with the valuation of the corresponding liability.

2.77 Principle 9 makes explicit provision for a deduction from EEV in respect of residual non-hedgeable risks. This deduction is intended to allow for asymmetries in non-hedgeable risks and risks that are not included in the TVFOG. This Principle tends to be applied in the context of demographic risks. It is possible that the development of the market in demographic hedge instruments, such as longevity swaps, will act to allow EEV reporters to reduce the deduction for non-hedgeable risks where these hedge instruments are available.

2.78 In June 2008, the CFO Forum published Market Consistent Embedded Value (MCEV) principles to replace EEV. These specify that the allowance for risk should be calibrated to market prices, and in particular options and guarantees

should be valued in line with the price of similar cashflows traded in capital markets. This should increase consistency between liability measurement and the value of hedging instruments.

2.79 However, in December 2008, the CFO Forum announced a review of the Principles to consider their application in more turbulent market conditions. In October 2009, the CFO Forum announced a change to their principles to permit the inclusion of a liquidity premium where appropriate. The CFO Forum are still considering how TVFOG should be calibrated in dislocated markets, but at year end 2008 most insurers publishing market consistent EEV or MCEV results used volatilities that did not reflect year end 2008 conditions (e.g. average volatilities over 2008). At year end 2009 most had reverted to using 31 December market volatilities.

2.80 These potential changes to the principles may help to smooth MCEV's sensitivity to market fluctuations, but would introduce potential inconsistencies with the value of hedging instruments.

2.81 As for IFRS phase 2, there is uncertainty over the future direction of MCEV. The CFO Forum has announced a delay in mandatory MCEV reporting from 2009 to 2011 to allow further work to finalise their review of the Principles.

US GAAP

2.82 The Financial Accounting Standards Board (FASB) has established various accounting standards to underpin the treatment of derivative instruments and financial hedges under US GAAP. The main standards are introduced in Statement of Financial Accounting Standards (SFAS) 133 published June 1998.

2.83 SFAS 133 allows for hedge accounting, along similar lines to IAS39. Financial hedges are split into three distinct categories: fair value hedges which are used to hedge changes in fair value; cashflow hedges or foreign currency hedges.

2.84 Movements in the value of derivative instruments may be recognised as earnings under SFAS 133 if they clearly fall into one of the categories listed above, and if this categorisation meets specific criteria and is documented as part of the derivative transaction. Strict disclosure standards are required. US GAAP standards are typically focused on earnings stability and SFAS 133 presents a route for achieving this for specific tightly controlled derivative transactions.

2.85 SFAS 133 was amended by SFAS 138 (June 2000) and SFAS 149 (April 2003). The US GAAP reporting standards contained in SFAS133, 138 and 149 were developed partly in the context of the US markets for variable annuities and guaranteed investment contracts. SFAS 133 covered interest rate hedges and intra-group hedges. SFAS 149 contained certain amendments related to the definition of a derivative and the treatment of hybrid investments in life insurance policies.

2.86 As for IFRS, US GAAP contains separate standards for insurance contracts, SOP03-1. For variable annuities, some guarantees are covered by this standard but others are treated as embedded guarantees subject to SFAS 133. This can lead to inconsistent measurement of guarantees within the same product, which presents significant challenges for companies that base their hedging on US GAAP earnings.

Conclusion

2.87 Accounting and regulatory metrics can have a significant impact on hedge effectiveness and even the choice of appropriate hedging strategy. This is particularly true for measures that are relatively far from an economic view of value and risk.

2.88 The historic peak 1 is such a measure and potentially leads to distortions in hedging strategies, for example:

- Shorter-dated equity collars are favoured over longer-dated puts that better match nature of guarantees
- Hedging of credit risk is not incentivised
- Hedging of regulatory interest-rate risk would be relative to a prudent rather than economic assessment of expected liability cashflows (e.g. mortality rates, take-up rates of options)
- Derivatives are subject to specific rules that can cause practical issues.
- Basis risk on hedges is typically not taken into account (this also applies under peak 2).

2.89 Current IFRS accounting also leads to distortions since, in some cases, the value of assets, liabilities, and hedging instruments are accounted for differently even where the economic form is consistent.

2.90 The move to a more economic form of regulation has reduced some of these regulatory distortions, although firms still need to comply with the peak 1 test. In particular, the Individual Capital Assessment represents a more principles-based and economic approach to assessing the impact of hedges.

2.91 When the Working Party was constituted, initial discussions were held with the FSA who were interested in whether we would define a “hedge effectiveness” standard that could be used to determine whether credit should be allowed for hedges in Pillar 1 reporting.

2.92 The Working Party’s view was that it was difficult to define such a standard in an objective fashion and indeed that defining too fixed a standard with a pass/fail test might be incompatible with a principles-based approach to regulation. However, it may be appropriate to require firms to develop their own standards on hedge effectiveness – as with the requirements for a Clearly

Defined Hedging Strategy in the United States RBC regime.

2.93 In subsequent correspondence the FSA stated they would expect a firm to assess whether a hedge substantially mitigates the risks it is assumed to mitigate, and to consider what risks remain or arise due to the introduction of the hedge. Specifically:

- For Pillar 1, derivatives must be approved (i.e. satisfy the admissibility requirements such as removing more risk than they introduce).

- For Pillar 2, insurers should consider any capital required to mitigate other risks introduced by the hedge.

2.94 Solvency II will also introduce a more market-consistent approach to regulation. However, the requirements for hedge recognition may render many current hedging strategies ineffective for insurers using the Standard Model SCR.

2.95 Overall the trend across both regulatory and accounting frameworks towards market-consistent measurement (Solvency II, IFRS 4 phase 2, MCEV), generally brings the valuation of liabilities and hedging assets closer together. However the financial crisis has raised some theoretical and practical issues with this approach and there are a number of open issues still to be agreed in each of these frameworks.

2.96 We also expect this increased trend to market-based frameworks to increase emphasis on hedge performance in short-term mark-to-market terms rather than just on their performance at maturity. Hence when we consider the performance of hedges below we focus on mark-to-market basis risk.

3. Equity puts and collars

3.1 A large number of UK insurance companies have used equity puts and collars to protect against equity value falls. A put is an option to sell equities at a fixed price in a future and hence is designed to guarantee that your portfolio doesn't fall more than a certain amount. A collar also sells some of the potential upside from equity returns to pay for the put option. Zero-cost collars can be designed and have been popular. These are designed to collar equity value returns between maximum and minimum levels.

3.2 The options used to implement these strategies are generally based on the FTSE 100. However, not all equity mandates are based on the FTSE 100. A lot of companies widen their base to the FTSE All Share which includes a number of small and mid-cap stocks and is more UK focussed than the FTSE 100 which contains more global companies. In addition, a lot of equity investment is carried out on an active basis and so returns on the actual portfolio won't necessarily follow those of the index.

3.3 As explained in Section 2, it is generally assumed in pillar 1 capital calculations that equity hedges are perfect.

3.4 In this section, we look at the historic impact of the first of these issues by comparing the returns over the past five years of the FTSE 100 relative to the FTSE All Share. This gives an indication of the likely effectiveness of FTSE 100 puts and collars on a FTSE All Share tracking portfolio.

3.5 Equity hedges can be designed to be either short-term (one year or less) or longer-term. For longer-term hedges, the mark-to-market movements of the hedge values compared to the movement of the market values of the equity portfolio will be important. However, this is also driven by the level of equity volatility at the valuation date and so we have not explored this in this paper.

3.6 To consider the effectiveness of the hedges and appropriate treatment of the hedges for statutory reporting measures, we looked at the mean and standard deviation of the FTSE All Share monthly index price movements against those of the difference in price movements between the two indices for the five years to 31 December 2009. We also looked at the mean and standard deviation of the absolute differences and calculated separate figures for pre- and during credit crunch (taken to be pre- and post 30 June 2007). The hedge could be considered effective if the mean and standard deviation of the differences are small compared to those of the FTSE alone as this would imply the two move together.

3.7 The results for the three sets of indices are shown below in Fig 3.1.

Fig 3.1 Monthly price movement statistics

FTA vs FT100

1 month		Full	Pre crunch	During crunch
Mean	FTA	0.33%	1.03	-0.36%
Mean	FTA – FT100	0.03%	0.09	-0.04%
StDev	FTA	4.42%	2.36	5.76%
StDev	FTA – FT100	0.50%	0.36	0.60%
Mean	abs(FTA)	3.40%	2.21	4.58%
Mean	abs(FTA-FT100)	0.37%	0.28	0.45%
StDev	abs(FTA)	2.82%	1.25	3.42%
StDev	abs(FTA-FT100)	0.33%	0.23	0.39%

3.8 It can be seen that the impact of the hedge is material and that, although the crunch did see slightly wider price differences between the indices, the hedges remained fairly effective during the crunch. However, it is clearly also the case that the hedges are not perfect and over a month, the average difference in the indices is about 10% of the average index movements.

3.9 Data becomes increasingly scarce given that we are looking at only a 5 year period if we try to look over longer hedge terms but we have repeated the above analyses for both 3 and 6 month periods. The results are shown below in Figs 3.2 and 3.3 respectively.

Fig 3.2 Quarterly price movement statistics

FTA vs FT100

3 month		Full	Pre-crunch	During crunch
Mean	FTA	0.89%	3.55%	-1.77%
Mean	FTA – FT100	0.10%	0.30%	-0.10%
StDev	FTA	8.02%	2.88%	10.57%
StDev	FTA – FT100	0.87%	0.74%	0.98%
Mean	abs(FTA)	6.27%	4.07%	8.46%
Mean	abs(FTA-FT100)	0.75%	0.66%	0.84%
StDev	abs(FTA)	4.88%	1.96%	5.98%
StDev	abs(FTA-FT100)	0.41%	0.39%	0.43%

Fig 3.3 Half-Yearly price movement statistics

FTA vs FT100

6 month		Full	Pre crunch	During crunch
Mean	FTA	2.41%	7.73%	-2.91%
Mean	FTA – FT100	0.29%	1.00%	-0.41%
StDev	FTA	15.23%	4.62%	20.74%
StDev	FTA – FT100	1.16%	1.01%	0.89%
Mean	abs(FTA)	11.81%	7.73%	4.62%
Mean	abs(FTA-FT100)	0.89%	1.07%	0.71%
StDev	abs(FTA)	9.14%	4.62%	11.17%
StDev	abs(FTA-FT100)	0.75%	0.90%	0.60%

3.10 The 3 month figures show very similar characteristics to the 1 month figures. The 6 month figures show improved impact of hedging although still not perfect. The 6 month figures also show a slight improvement during the crunch. This is not surprising as during the crunch, it was perceived that the correlation of all assets increased.

3.11 A large number of equity hedges are put on for a 1 year period. 1 year hedges are also of interest for solvency calculations, such as Solvency II and typical ICA calculations, where a 1 year period is generally used.

3.12 Given that it appears that the credit crunch did not have a big impact on the effectiveness of these hedges, we looked into the annual figures going back 25 years. These are shown in the table below. It could be argued that it is only the effectiveness of the hedge in adverse scenarios that is of importance. During the last 25 years, there were 4 when the FTA fell more than 10%. We have also shown the statistics for those 4 years.

Fig 3.4 Annual price movement statistics (1984-2009)

FTA vs FT100

Annual		Full data	Down 10% only
Mean	FTA	7.6%	-21.9%
Mean	FTA – FT100	0.3%	-1.0%
StDev	FTA	16.2%	8.7%
StDev	FTA – FT100	2.6%	1.5%
Mean	abs(FTA)	16.0%	21.9%
Mean	abs(FTA-FT100)	2.2%	1.4%
StDev	abs(FTA)	7.5%	8.7%
StDev	abs(FTA-FT100)	1.4%	1.0%

3.13 On an annual basis, a FTSE 100 hedge against a FT All Share portfolio can be seen to have been quite effective although not perfect in removing the risk over the past 25 years. Although based on limited observations, it appears that the hedge works best in the times when it is needed most.

3.14 FT All Share based options can be bought which will reduce the observed element of basis risk but this has to be weighed up against the greater cost and lower liquidity of FT All Share options.

3.15 It needs to be remembered that even if the benchmark and option index are aligned, basis risk will still exist for active equity mandates because the portfolio performance will not track the index.

3.16 Most insurance companies diversify their equity holdings by including overseas equities. Using a FTSE 100 hedge for these overseas equities will introduce further basis risk. However, equity options are available on most major equity indices.

3.17 Equity options are also typically traded on a price return basis, rather than a total return basis, which leaves the insurer exposed to dividend risk. Total return options are available but are generally less liquid. A better option for companies concerned about this risk is often to also enter a dividend swap.

4. Credit Default Swaps

Introduction

4.1 The last decade has seen increased use by UK Life Insurance companies of corporate bonds to back with-profits and annuity business in particular. Using corporate bonds introduces credit risk into the portfolio (interest rate and currency rate risks can also be introduced, or managed, by using corporate bonds and these are covered in Section 5). The credit risk is often managed by using credit default swaps and this section looks at the effectiveness of doing so.

4.2 A detailed introduction into credit default swaps can be found in Muir et al (2007). This paper explains the fundamental differences in credit exposure between bonds and CDS (for example that CDS are company-specific and not bond-specific) and why using a CDS is not a perfect hedge for any one corporate bond. However, on a hold to maturity or default basis, good protection can be achieved in a lot of cases.

4.3 The paper also explains the number of technical reasons why the spreads on a corporate bond and a credit default swap for the same single issuer may behave differently. Given that it is unusual to hold a hedging CDS to maturity (you would usually just sell the bond) and that default levels are generally low on investment grade bonds, the biggest issue with any hedge is often the mark-to-market risk caused by differences in the movements of these spreads whilst the hedging CDS is in place.

4.4 Typically, a bond mandate will require a bond manager to hold a large number of diversified corporate bonds and to out-perform a corporate bond index through individual name screening and from taking positions on credit spreads. If a manager is negative on an individual name, they may well sell that issue rather than take out an individual CDS. However, if a manager believes that in the short term, general credit conditions are likely to worsen before improving again, then they are more likely to use credit default swaps to hedge their credit risk rather than embark on a costly large-scale sale and re-purchase exercise.

4.5 This paper therefore focuses on mark-to-market risk by looking at the relationship between corporate bond and CDS indices and the relative historic spread movements of each over various time periods.

4.6 A very large number of corporate bond indices exist. For example, Markit iBoxx have indices covering each of the major currencies (including sterling) and have sub-indices by maturity, rating and sector. It is therefore possible to create benchmarks using corporate bond indices that closely reflect the nature of a given portfolio.

4.7 In contrast, there are a more limited number of CDS indices. For example, there are no sterling-only indices (the European indices cover both Euro-zone and UK issuers), no rating sub-indices and a highest term of 10 years.

4.8 A common CDS index, the Markit iTraxx Europe, covers 125 equally-weighted European investment grade entities. As well as suffering from the same technical issues as for single-name CDS hedges, using CDS indices will inevitably introduce a further fundamental risk in that the underlying names and weightings in the portfolio and the hedging asset will be different.

Historical Analysis

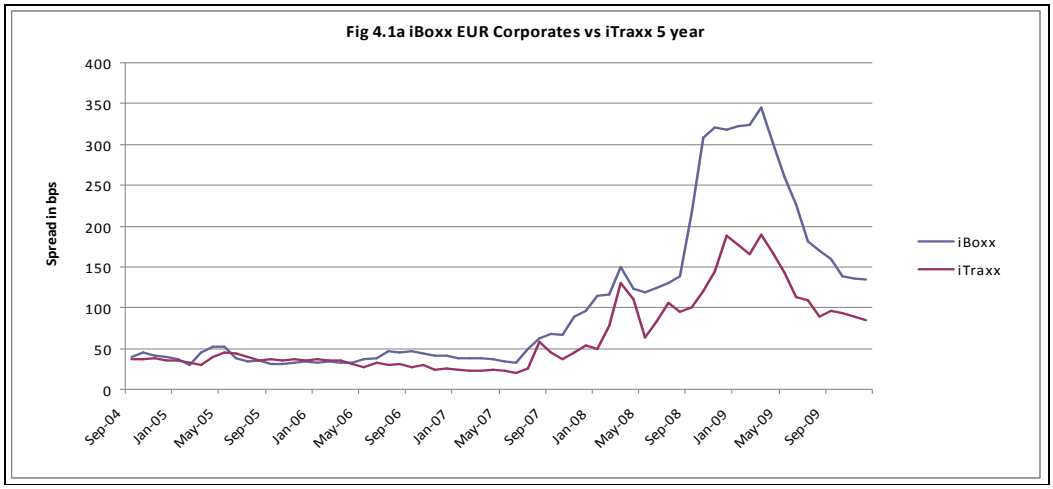
4.9 In the rest of this section we look first at the historical effectiveness of three CDS index hedges on selected corporate bond index holdings where we would expect the hedge to be particularly effective. We then look at the effectiveness of index hedges when holding a sterling-only bond portfolio, which would be more typical for a UK life insurer.

4.10 The first bond index is the iBoxx EUR Corporates index. At 31/12/08, this covered 1058 investment grade bonds issued in Euros (includes many UK companies) and had an average term to maturity of 5.35 years. We have chosen to compare this with the iTraxx Europe 5 Year CDS index which covers the most liquid 125 single name CDS in the European market (including UK companies).

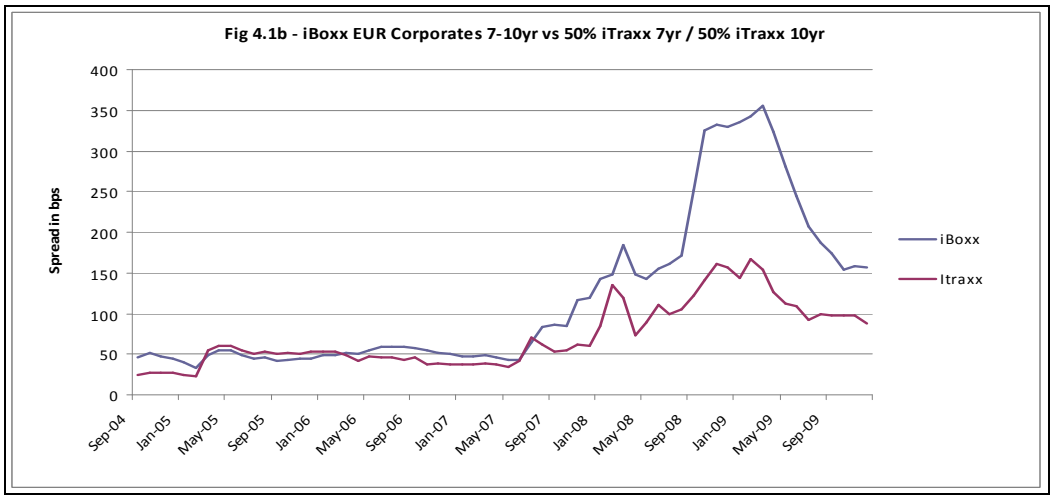
4.11 We also looked at the iBoxx EUR Corporates 7-10 year index to see if the effectiveness was greater for longer duration hedges. At 31/12/08, this covered 212 investment grade bonds issued in Euros and had an average term to maturity of 8.33 years. We have chosen to compare this with a 50/50 holding of iTraxx Europe 7 Year CDS index and iTraxx Europe 10 Year CDS index. The CDS indices cover the same names and using the combination brings the maturity in line with that of the bond index.

4.12 The third bond index we looked at was the iBoxx EUR Financials as we expected this to have been the sector most hit by the credit crunch. At 31/12/08, this covered 553 bonds with an average term to maturity of 5.11 years. We have chosen to compare this with the iTraxx Europe Senior Financials 5 Year CDS index.

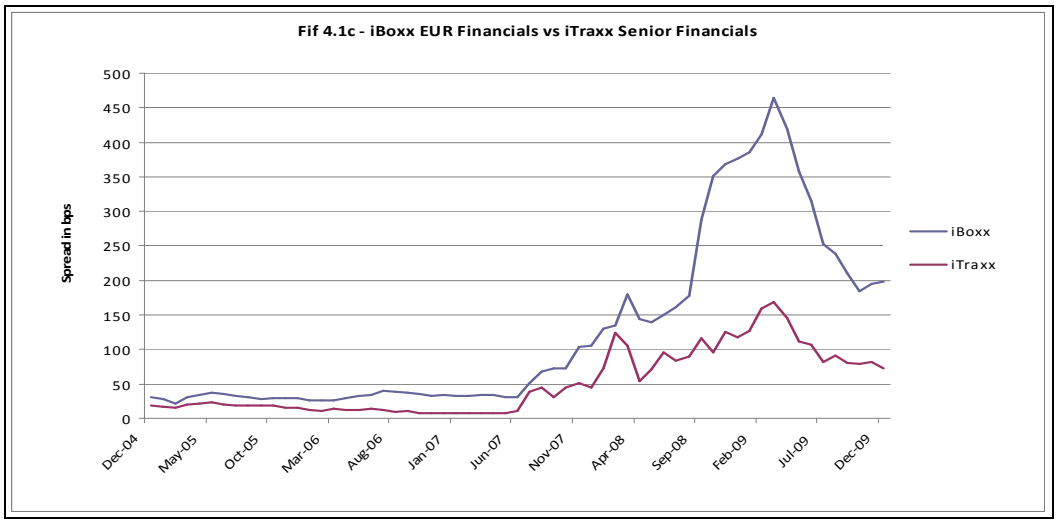
4.13 CDS index data is relatively sparse with the indices only having been started in either 2004 or 2005. Figs 4.1a – 4.1c show the comparison of asset swap spreads for the iBoxx indices and the quoted mid spreads for the iTraxx indices.



Sources: SG; MarkIt



Sources: SG; MarkIt



Sources: SG; MarkIt

4.14 It can be seen in all three cases that the differences in spread between the two indices were very close for most of the pre-crunch period (ie before 30 June 2007) but that these have widened considerably during the credit crunch.

4.15 To consider the effectiveness of the hedges and appropriate treatment of the hedges for statutory reporting measures, we looked at the mean and standard deviation of the bond index spread movements against those of the difference in spread movements between the bond index and the CDS index. We also looked at the mean and standard deviation of the absolute differences and calculated separate figures for pre- and during credit crunch (taken to be pre- and post 30 June 2007). The results for the three sets of indices are shown in Fig 4.2:

Fig 4.2 Monthly spread movement statistics

iBoxx EUR Corporates vs iTraxx 5 years

1month		Full	Pre crunch	During crunch
Mean	iBoxx	1.49	0.28	2.92
Mean	iBoxx-iTraxx	0.74	0.60	0.90
StDev	iBoxx	20.72	5.53	30.19
StDev	iBoxx-iTraxx	19.01	5.69	27.61
Mean	abs(iBoxx)	11.08	3.49	19.98
Mean	abs(iBoxx-iTraxx)	11.62	4.16	20.37
StDev	abs(iBoxx)	17.52	4.26	22.51
StDev	abs(iBoxx-iTraxx)	14.99	3.86	18.25

iBoxx EUR Corporates 7-10 vs 50% iTraxx 7 years 50% iTraxx 10 years

1 month		Full	Pre crunch	During crunch
Mean	iBoxx	1.74	0.54	3.15
Mean	iBoxx-iTraxx	0.74	-0.78	2.53
StDev	iBoxx	19.90	5.60	28.92
StDev	iBoxx-iTraxx	18.01	4.30	26.28
Mean	abs(iBoxx)	11.32	3.52	20.47
Mean	abs(iBoxx-iTraxx)	10.98	3.07	20.25
StDev	abs(iBoxx)	16.40	4.35	20.32
StDev	abs(iBoxx-iTraxx)	14.23	3.07	16.50

iBoxx EUR Financials vs iTraxx Senior Financials 5 years

1 month		Full	Pre crunch	During crunch
Mean	iBoxx	3.25	1.58	5.08
Mean	iBoxx-iTraxx	2.04	0.36	3.90
StDev	iBoxx	25.94	7.10	37.14
StDev	iBoxx-iTraxx	22.99	4.02	33.28
Mean	abs(iBoxx)	14.88	3.68	27.23
Mean	abs(iBoxx-iTraxx)	13.47	2.89	25.14
StDev	abs(iBoxx)	21.41	6.25	25.26
StDev	abs(iBoxx-iTraxx)	18.66	2.77	21.65

4.16 It can be seen that under any measure, and for all three pairs of indices, the impact of the hedge on the monthly statistics is minimal.

4.17 This would suggest that using index CDS over short periods to increase or decrease the credit risk of a corporate bond portfolio has not historically provided the intended results on a consistent basis. This is not to say that

investment managers have not been able to add value by correctly predicting the direction of index CDS spreads but more that it has proved difficult to reduce risk on the complete portfolio over short periods by using index CDS.

4.18 Data becomes increasingly scarce if we try to look over longer periods but we have repeated the above analyses on a 6 monthly basis. The results are shown below in Fig 4.3:

Fig 4.3 Half Yearly spread movement statistics

iBoxx EUR Corporates vs iTraxx 5 years

		Full	Pre crunch	During crunch
Mean	iBoxx	8.53	-1.21	20.22
Mean	iBoxx-iTraxx	4.14	1.44	7.37
StDev	iBoxx	76.29	5.07	119.19
StDev	iBoxx-iTraxx	36.54	7.44	56.96
Mean	abs(iBoxx)	44.74	3.96	93.68
Mean	abs(iBoxx-iTraxx)	21.41	5.96	39.96
StDev	abs(iBoxx)	60.81	2.95	61.20
StDev	abs(iBoxx-iTraxx)	29.14	3.90	36.28

iBoxx EUR Corporates 7-10 vs 50% iTraxx 7 years 50% iTraxx 10 years

		Full	Pre crunch	During crunch
Mean	iBoxx	11.14	-0.41	22.69
Mean	iBoxx-iTraxx	49.60	7.48	91.72
StDev	iBoxx	75.50	9.28	111.38
StDev	iBoxx-iTraxx	55.72	4.05	50.34
Mean	abs(iBoxx)	49.60	7.48	91.72
Mean	abs(iBoxx-iTraxx)	36.55	12.12	60.97
StDev	abs(iBoxx)	55.72	4.05	50.34
StDev	abs(iBoxx-iTraxx)	39.27	10.54	43.20

iBoxx EUR Financials vs iTraxx Senior Financials 5 years

		Full	Pre crunch	During crunch
Mean	iBoxx	16.64	-0.10	33.38
Mean	iBoxx-iTraxx	11.11	1.26	20.95
StDev	iBoxx	90.30	4.55	132.75
StDev	iBoxx-iTraxx	75.74	4.37	112.46
Mean	abs(iBoxx)	54.13	3.66	104.59
Mean	abs(iBoxx-iTraxx)	40.14	3.64	76.64
StDev	abs(iBoxx)	72.15	1.98	73.10
StDev	abs(iBoxx-iTraxx)	63.91	2.12	76.51

4.19 In most cases it can be seen that as the period gets longer, the impact of the hedge increases to reduce the size and volatility of spread movements. However, it should be noted that in the pre-crunch period a number of the hedges actually increased the spread risk, albeit on small numbers.

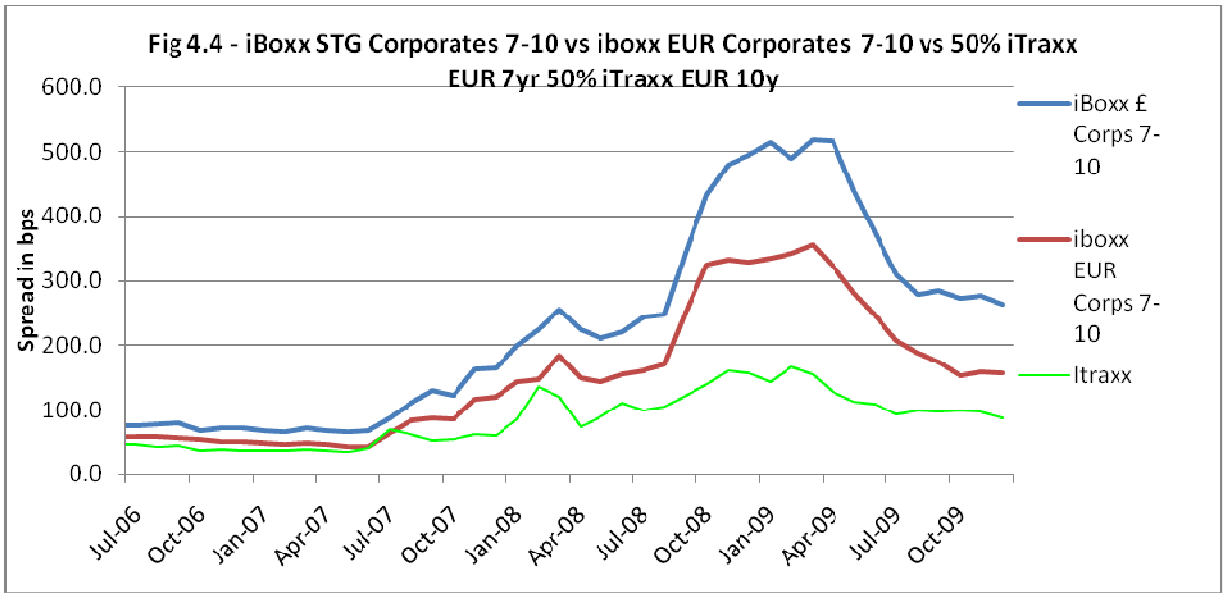
4.20 Also, it appears that the hedges generally worked best in the post-crunch period when movements were more pronounced.

4.21 However, it remains clear that the hedges looked at are still a very long way from the perfect hedges often assumed in financial modelling and this basis risk has grown more significant over the crunch period as spread movements have increased.

4.22 The bond indices that we have looked at so far have all been Euro-denominated to try and find pairs of indices that showed the lowest name and characteristics basis risk. However, it is much more typical for a UK life insurance company to hold a sterling only portfolio as this removes currency risk compared to its liabilities.

4.23 We have therefore repeated the analyses above for a sterling corporate bond index, the iBoxx Stg Corporates 7-10 year index. We would expect the best available hedge for this portfolio to be the 50% iTraxx EUR 7 year 50% iTraxx EUR 10 year hybrid we have already used.

4.24 We were only able to get the iBoxx Stg Corporate data from the Markit website from 1 July 2006. The results are shown below and compared against those found above for the iBoxx EUR Corporates 7-10.



Sources: SG; MarkIt

Fig 4.5 Spread movement distributions

iBoxx STG Corporates 7-10 vs 50% iTraxx 7 years 50% iTraxx 10 years					iBoxx EUR Corporates 7-10		
1 month		Full	Pre crunch	Crunch	Full	Pre crunch	Crunch
Mean	iBoxx	4.60	1.08	6.06	1.74	0.54	3.15
Mean	iBoxx-iTraxx	3.57	-0.91	5.43	0.74	-0.78	2.53
StDev	iBoxx	33.24	7.52	39.36	19.90	5.60	28.92
StDev	iBoxx-iTraxx	30.86	4.12	36.62	18.01	4.30	26.28
Mean	abs(iBoxx)	22.28	4.53	29.63	11.32	3.52	20.47
Mean	abs(iBoxx-iTraxx)	22.20	3.51	29.94	10.98	3.07	20.25
StDev	abs(iBoxx)	24.85	5.95	26.03	16.40	4.35	20.32
StDev	abs(iBoxx-iTraxx)	21.44	2.09	21.06	14.23	3.07	16.50

6 month		Full	Pre crunch	Crunch	Full	Pre crunch	Crunch
Mean	iBoxx	26.95	-4.02	39.34	11.14	-0.41	22.69
Mean	iBoxx-iTraxx	20.93	-1.58	29.94	49.60	7.48	91.72
StDev	iBoxx	135.59	0.70	164.02	75.50	9.28	111.38
StDev	iBoxx-iTraxx	107.93	9.63	130.75	55.72	4.05	50.34
Mean	abs(iBoxx)	95.47	4.02	132.05	49.60	7.48	91.72
Mean	abs(iBoxx-iTraxx)	70.16	6.81	95.50	36.55	12.12	60.97
StDev	abs(iBoxx)	92.72	0.70	83.91	55.72	4.05	50.34
StDev	abs(iBoxx-iTraxx)	80.11	2.24	82.56	39.27	10.54	43.20

4.25 It can be seen that the sterling index has been more volatile during the credit crunch mainly due to the higher concentration of financial stocks. It can also be seen that a hedge using the combined iTraxx CDS would not have materially protected such a sterling portfolio from mark-to-market losses.

4.26 Of course, most corporate bond portfolios are actively managed and so the bonds held will be different from those in the iBoxx indices. It could be that the bonds actually held do correspond better to a CDS index than those of the iBoxx index so we can make no stronger statement than to say that the effectiveness of the hedge on an actual portfolio will be different to that against the index and that companies should consider this in any analysis.

4.27 We do however feel that the results are conclusive enough to say that, especially during times of stress, whilst CDS offer significant default protection, using vanilla CDS index hedges does not materially reduce the inherent mark-to-market risk for a corporate bond portfolio.

4.28 It is perceived that the main cause of the lack of effectiveness is due to relative liquidity. Corporate bond spreads will include an element of compensation for illiquidity which can be zero but will increase at times of stress.

4.29 Under Solvency II, as discussed in Section 3, there is a current debate as to the inclusion of a liquidity premium in the discount rate for liabilities.

4.30 The CEIOPS Task Force Report on the Liquidity Premium identifies three main methods of calculation of a liquidity premium, namely

(a) The CDS Negative-Basis Method which compares the spread on a corporate bond with the spread of a CDS for the same issuing entity, same maturity, same seniority and same currency.

(b) The Covered Bond Method which involves choosing a pair of assets which, besides liquidity, are assumed to offer equivalent cashflows and equivalent credit risk. The primary example is an index of covered bonds versus swaps.

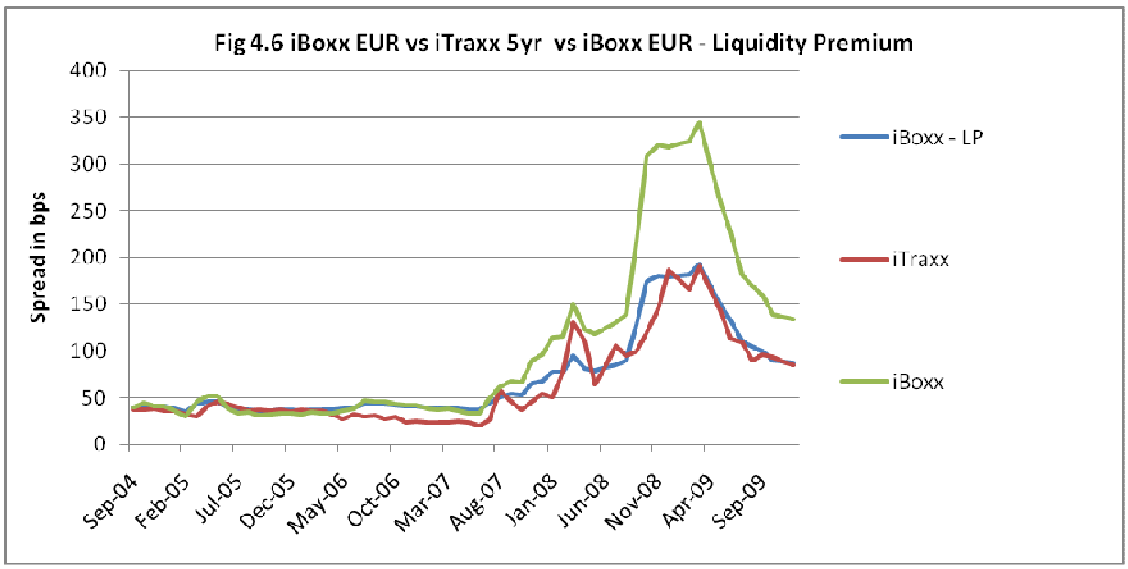
(c) The Structured Model Method which involves the use of option pricing techniques to calculate a theoretical credit spread which compensates only for credit (default and spread) risk. The difference between the theoretical spread and the actual market spread is typically taken to be the liquidity premium.

4.31 The Task Force report recognises that none of the approaches are perfect but identify a simple proxy method using a basic formula for the liquidity premium, LP = max (0, x*(Spread-y)), and show figures using x=50% and y=40bps.

4.32 If the only source of discrepancy seen in our investigations between mark-to-market of the CDS and corporate bond indices is changes in liquidity premium, and these changes can be reflected in liability calculations, then CDS will become very effective hedges.

4.33 By definition, the CDS Negative-Basis method for calculating the Liquidity Premium effectively says that the difference between CDS and Corporate Bonds is purely liquidity. However, it does require same names, maturity, seniority and currency for this to be the case. This is unlikely in practice and so some residual basis risk will still exist.

4.34 However, to give an indication of the potential impact on the effectiveness of a CDS hedge if a liquidity premium is included in the liability calculation, we show again graph 4.1a below but also plotting the iBoxx after deducting the proxy formula measure of the liquidity premium.



Sources: SG; MarkIt

4.35 It can be seen that using this approach increases significantly the effectiveness of the hedge and explains virtually all of the differences previously seen.

4.36 It remains to be seen whether a liquidity premium is to be allowed in the calculation of the liabilities under Solvency II, how it is to be calculated, what liabilities it would apply to (possibly only annuities) and whether it can be used for new as well as existing business.

4.37 It is clear from our analysis that the answers to these questions will impact the effectiveness of any index CDS hedging for a corporate bond portfolio.

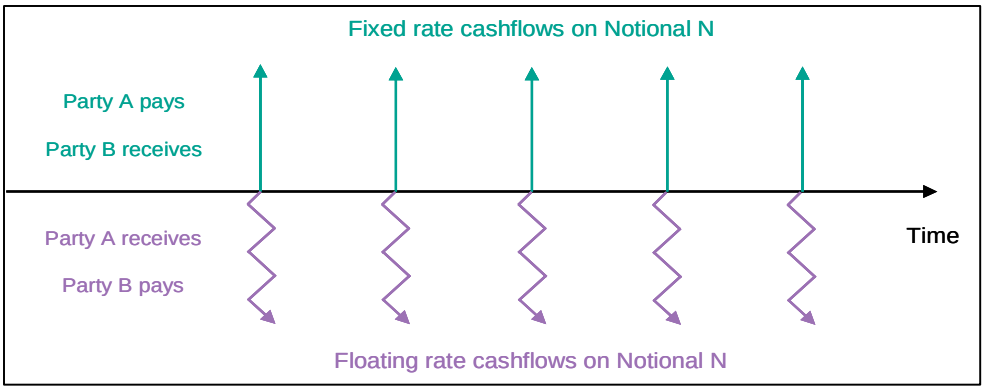
5. Interest rate, inflation and currency swaps

Interest Rate Swaps

Introduction

5.1 An interest rate swap is an agreement between two parties where one stream of future interest payments is exchanged for another based on an agreed notional amount. Interest rate swaps typically exchange a fixed payment for a floating payment that is linked to LIBOR (see paragraph 5.27).

Fig 5.1 Swap Agreement

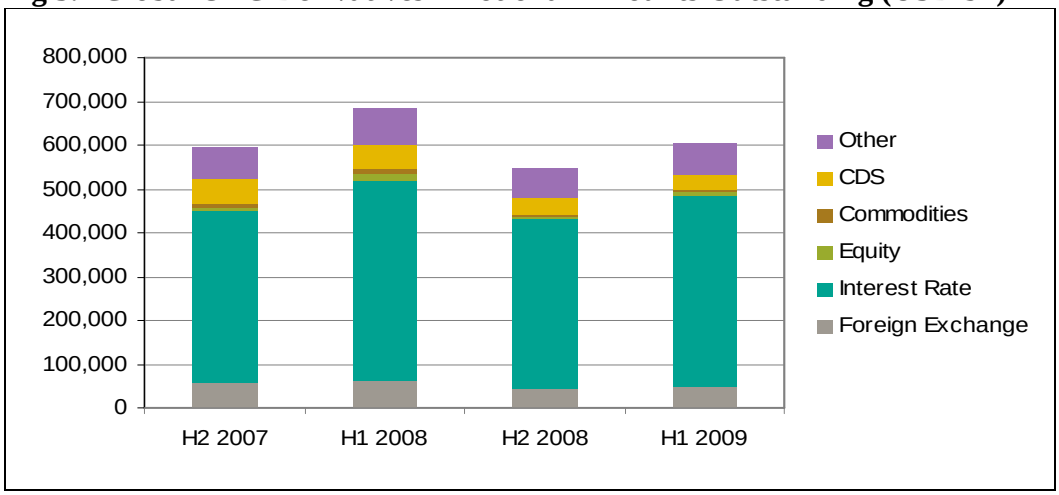


5.2 In order to fund the floating leg of the swap, the insurer may elect to hold a proportion of its assets in cash. The combination of cash and interest rate swap is broadly equivalent to holding a fixed income bond with the same notional, maturity and fixed rate as the swap.

5.3 Equally, we can think of a long-dated fixed income bond as equivalent to a shorter-dated bond plus forward starting interest rate swap. In this case the redemption proceeds from the shorter-dated bond would be used to fund the floating leg of the forward starting swap. The swap essentially hedges the rate at which the maturing shorter-dated bond can be reinvested.

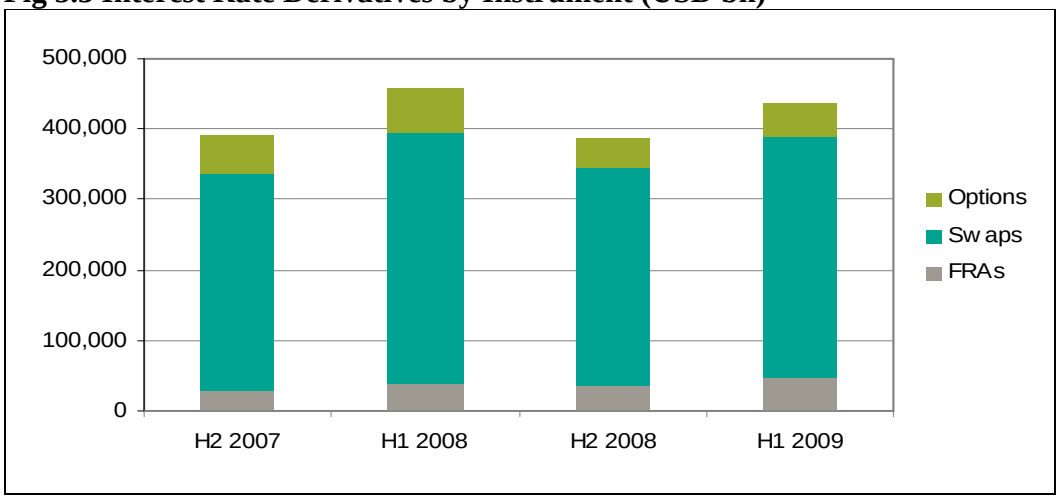
5.4 Interest rate swaps are the most commonly traded derivative, as illustrated by the Bank for International Settlements (2009) in their 2009 report on OTC derivatives market activity and shown below:

Fig 5.2 Global OTC Derivatives – Notional Amounts Outstanding (USD bn)



Sources: BIS

Fig 5.3 Interest Rate Derivatives by Instrument (USD bn)



Sources: BIS

5.5 Interest rate risk is often described as an "unrewarded risk". By this we mean that interest rate risk arises because of the nature of insurance liabilities rather than a decision being made to take risk in the expectation of enhanced returns (as would be the case with, for example, equities). This statement of course assumes that rates curves are not distorted; else investors may be incentivised to take interest rate risk in the expectation of gains when rates curves revert.

UK Life Insurance Applications

5.6 Interest rate swaps are used by the majority of UK life insurance companies, with the main drivers being:

- Duration matching of assets and liabilities for annuity funds – where there is a shortage of long-dated fixed income securities available in the market with which to match the longer dated liabilities;

- Matching guaranteed benefits under with-profits contracts – under this approach the insurer will employ separate yield generating strategies in

order to provide discretionary benefits to its policyholders;

- Immunising the fund as a whole from interest rate mismatches between assets and liabilities – for example strategic "buckets" of interest rate swaps may be used to improve the PV01 matching of the assets and liabilities (i.e. aligning the present values of changes in assets and liabilities due to a 1bp parallel shift in the yield curve); and

- Cashflow matching, especially where capital is scarce and cash inflow is limited (e.g. closed with-profits funds) – interest rate swaps permit exact cashflow matching which would otherwise not be possible using, for example, fixed income securities.

Regulatory Considerations

5.7 Admissibility follows from the fact that interest rate swaps are being used to reduce investment risk. In order to satisfy the cover test, insurers must hold sufficient assets (e.g. cash, floating rate assets, redemption proceeds from maturing bonds) to fund the LIBOR legs of the swaps.

5.8 Peak 1 of Pillar 1 encourages strong cashflow matching because of the penal reinvestment rate assumption and the need to hold capital against interest rate risk. The standard formula under Solvency II, on the other hand, is based on a 1 year time horizon and makes the implicit assumption that assets are transitioned to a risk-free portfolio at the end of the period – this is likely to focus insurers on sensitivities to interest rate curve shifts rather than close cashflow matching. These issues are explored in more detail in Telford et al (March 2010).

Robustness

5.9 When constructing a hedge using interest rate swaps, an insurer will typically assess its robustness to subsequent shifts, rotations and twists in rates curves. Clearly, the greater the number of "buckets" used to group the assets and liabilities (e.g. annual, 5 year, 10 year etc.) the more robust the hedge.

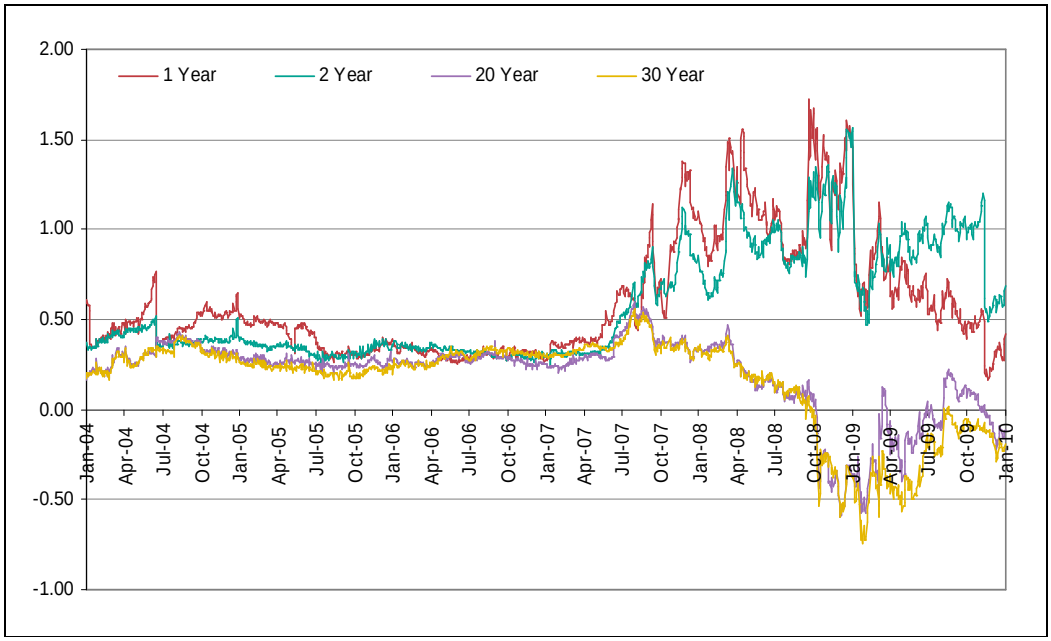
5.10 This sort of testing will continue at regular intervals throughout the lifetime of the hedge, helping to identify any rebalancing that needs to take place.

Exposure to Swap Spreads

5.11 Swap spreads represent the arithmetic difference between swap rates and gilt yields of similar maturity. Swap rates are traditionally higher than gilt yields, i.e. swap spreads are traditionally positive.

5.12 Since August 2007, swap spreads have become considerably more volatile and exhibit more curvature than has historically been the case, as shown in the chart below:

Fig 5.4 Swap Spreads (%) – Swap Rate minus Gilt Yield



Sources: RBS; Bloomberg

5.13 Historically, swap spreads were relatively stable with swaps trading around 30bps higher than gilts. In part this reflected an assumption that bank deposits were more risky than government debt.

5.14 The onset of the credit crunch resulted in severe dislocation to the LIBOR market, driving short-end swap rates higher (see paragraph 5.27) – hence we see short-end swap spreads increasing rapidly after August 2007.

5.15 In contrast, long-end swap spreads declined – becoming negative in the last quarter of 2008. The causes of negative spreads have been explored in detail by Deloitte (2008), with the primary ones being:

- Investors seeking to replace swap hedges previously transacted with failed banks, such as Lehman Brothers;
- Swaps are unfunded instruments, and funding costs increased significantly post the collapse of Lehman Brothers;
- Lack of capacity from hedge funds and bank proprietary trading desks to exploit swap spreads; and
- Concerns over governments' abilities to repay national debt and nationalisation of much of the banking sector – leading investors to question whether government bonds are much safer than banks.

5.16 Under peak 2 of Pillar 1 and for the ICA many life insurers discount their liabilities using the "risk-free rate" of gilts + [x]bps (e.g. 10bps addition for liquidity). At the same time, they may hold interest rate swaps on the balance sheet to hedge liabilities.

5.17 Where the insurer's assets and liabilities have different anchor points (in either "gilt land" or "swap land"), volatility in swap spreads will flow through to the balance sheet.

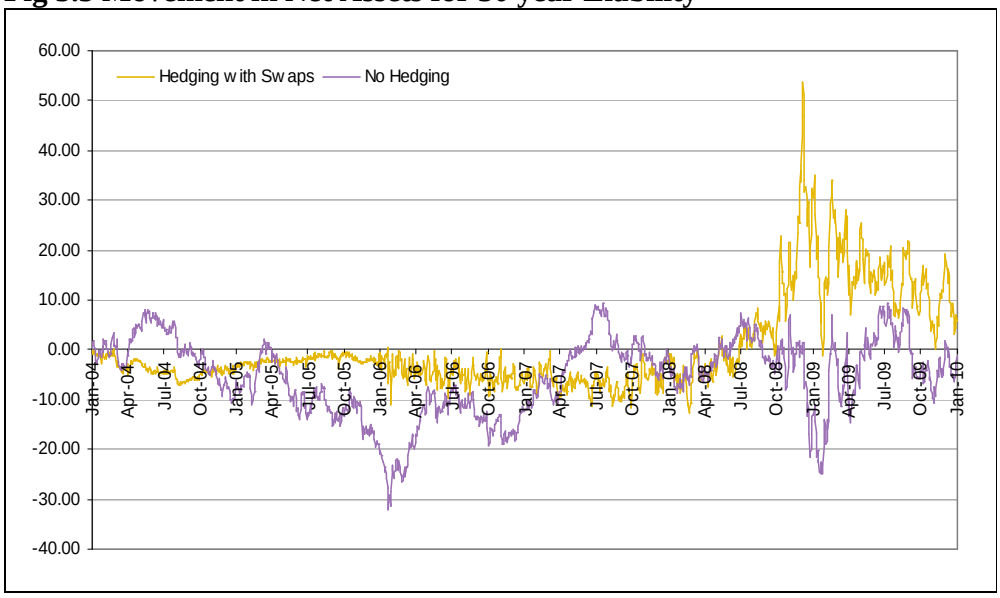
5.18 To illustrate the potential balance sheet impact, we consider the example of a rolling 30 year liability, valued using the 30 year gilt yield.

5.19 The chart below shows the change in net assets over the period 2004-2009 for two different investment strategies:

- Liability backed with cash
  exposing insurer to movements in the 30 year gilt yield

- Liability hedged with 30 year zero coupon interest rate swap
  exposing insurer to movements in the 30 year swap spread

Fig 5.5 Movement in Net Assets for 30 year Liability



Sources: RBS; Bloomberg

Hedging with Swaps	**2004-2009**	**Pre August 2007**	**Post August 2007**
Mean	0.3	-4.0	**6.6**
Std Dev	9.2	2.2	**11.6**
No Hedging	**2004-2009**	**Pre August 2007**	**Post August 2007**
Mean	-5.3	**-7.3**	-2.2
Std Dev	7.8	**8.2**	5.9

5.20 30 year swap spreads were relatively stable up to August 2007. As a result, we see noticeable improvements in both the mean net asset position and the volatility of the net asset position as a result of hedging.

5.21 From August 2007 onwards, swap spreads were considerably more volatile than gilt yields. Consequently, hedging was a higher risk strategy versus liabilities, valued using gilt yields, than simply holding cash.

5.22 One way of looking at this is that we witnessed something akin to a "one in two hundred year event" in swap spreads during the credit crunch. However we did not see anything as extreme in gilt yields. Therefore we come to the seemingly perverse conclusion that hedging actually increased risk during this period.

5.23 It is possible to hedge the variability in swap spreads. Consider the case where swap spreads widen. A life insurance company that values its liabilities using a gilts benchmark and receives fixed through swaps will suffer negative balance sheet impacts. This risk can be hedged by:

- entering a contract to purchase a gilt one year from now – the price would be the one year forward price of the gilt; and

- simultaneously entering a swap starting in one year – with the same maturity as the gilt – under which the insurer pays fixed and receives floating

5.24 This trade would be cash settled one year from now. If swap spreads widen over the next year then this hedging trade will deliver a profit which can be used to (partly) offset the loss experienced on the insurer's balance sheet.

5.25 This has been a common trade for UK life insurers and their asset managers over 2009 – not only for hedging purposes but also when taking the view that swap spreads will revert to more "normal" levels within the next 12 months.

5.26 These "spread-lock" trades are one of the reasons why there has been a contraction in swap spreads over the latter part of 2009.

<u>Dislocations in the LIBOR Market</u>

5.27 The London Interbank Offered Rate ("LIBOR") is an average of the rate at which banks can borrow unsecured funds in the inter-banks money market on a short term (e.g. 3 month or 6 month) unsecured basis.

5.28 LIBOR is not a risk-free rate. Firstly, it reflects the offered rate of the market and not the bid. Secondly, it contains credit and liquidity risk, which can become significant in times of financial stress. LIBOR is also a theoretical rate, since it is based on submissions from a panel of banks as to where they perceive that they could obtain funding.

5.29 Interest rate swaps exchange a fixed payment for a floating payment that is linked to LIBOR. The insurer must therefore generate at least this floating rate of return in order to meet its obligations under the swap.

5.30 One option is to invest in assets that pay a coupon linked to LIBOR, however this can mean taking credit and/or liquidity risk as explained above.

5.31 An alternative is to invest in money market funds, however these will tend to pay the overnight rate rather than LIBOR – the difference between the two can be significant in times of financial distress. This can be seen in the chart

below, which shows the difference (in basis points) between 6 month LIBOR (the market standard for interest rate swaps) and SONIA ("Sterling Overnight Index Average"). SONIA is the weighted average of actual overnight deposit rates transacted in the market.

Fig 5.6 6 Month LIBOR *minus* SONIA

Sources: RBS; Bloomberg

	Jun 2005 – Dec 2009	Pre August 2007	Post August 2007
Mean (bps)	59	16	97
Std Dev	58	6	57

5.32 The gap between 6 month LIBOR and the overnight rate has historically been small (around 16bps), but increased significantly with the onset of the credit crunch, reaching over 300bps shortly after the collapse of Lehman Brothers.

5.33 Another alternative would be to structure swaps based on shorter-dated financing rates that are more easily generated by money market funds than LIBOR, such as SONIA. These swaps are not without issues, however:

- The market expectation for SONIA to be below LIBOR will be priced into the swap – i.e. the fixed leg on a SONIA swap will be lower than the fixed leg on a LIBOR swap;

- SONIA swap contracts are not the market standard, so they are significantly less liquid and have higher transaction costs than their LIBOR equivalents; and

- In practice, long-end SONIA swaps are priced off LIBOR swaps – hence they would have been subject to many of the same market dislocations, particularly at the long-end.

Solvency II

5.34 The CEIOPS Task Force Report on the Liquidity Premium also addresses the key issue of the basic reference risk-free rate for the valuation of insurance liabilities.

5.35 In CP40, CEIOPS proposed the use of a AAA government bond curve for the basic reference risk-free rate. As requested by the Commission, the Task Force have reconsidered this and looked at using a swap curve as a starting point instead.

5.36 A swaps-based discount rate will create exposure to swap spreads for any insurer holding government bonds – we may therefore expect continued use of spread-locks, albeit in the reverse direction.

5.37 The Task Force do not regard interbank i.e. LIBOR/EURIBOR swaps as exempt from credit risk, in particular due to the 3-month or 6-month bank risk required to earn the floating leg. Therefore the swap curve would need to be adjusted to be used as a risk-free rate.

5.38 Although the Task Force do not reach a firm view, a potential theoretical solution, endorsed by the CRO/CFO Forum, is the use of overnight i.e. SONIA/EONIA swaps, where the floating leg is based on overnight deposit rates.

5.39 The main practical issue with the use of SONIA/EONIA swaps is the lack of liquidity compared to LIBOR/EURIBOR swaps – in particular they are significantly less liquid at other than very short durations.

5.40 For long-dated trades, which would be crucial for life insurers, there is currently no liquid or readily tradable solution in SONIA.

5.41 As at 10th March 2010, the SONIA curve at the long end was some 40bps below LIBOR - so there would be a significant increase in liabilities with the move to a SONIA flat curve. Large demand from insurers would have potentially negative price implications, worsening capital positions.

Interest Rate Swaptions

Introduction

5.42 An interest rate swaption gives the holder the right, but not the obligation, to enter into an interest rate swap at some future date. The terms of the contract (such as the fixed rate under the swap and whether the contract will be cash settled at the expiry of the option) are agreed at the outset.

5.43 There are two types of interest rate swaption contracts:

- Receiver swaptions give the holder the right to enter into an interest rate swap where they receive fixed and pay floating

- Payer swaptions give the holder the right to enter into an interest rate swap where they pay fixed and receive floating

5.44 To this end, a swaption builds optionality into a forward starting interest rate swap – a premium is charged in respect of this optionality.

5.45 Interest rate swaptions can be used to hedge against interest rates falling/rising over the term of the option. For example, an insurer wishing to hedge against interest rates falling over the next year could purchase a one year receiver swaption:

- If interest rates fall over the year, the swap will be in-the-money to the insurer – so the insurer will exercise the option and either (a) enter the swap; or (b) receive the positive mark-to-market as cash

- If interest rates rise over the year, the swap will be out-of-the-money to the insurer – so the option will not be exercised

Guaranteed Annuity Options

5.46 A guaranteed annuity option (or "GAO") is the right to convert the sum assured under a life assurance policy into a life annuity at the better of:

- the market rate prevailing at the time of conversion; and

- a guaranteed rate.

5.47 During the 70s and 80s, many UK life insurers issued with-profits pensions contracts containing GAOs – interest rates were very high at the time and so the guarantees were deeply out-of-the-money.

5.48 Interest rates have since dropped significantly and expected longevity has increased, increasing the value of the guaranteed annuity and creating significant additional liabilities for insurers.

5.49 For a given longevity assumption, the liability under a GAO is very much like the payoff under a receiver swaption:

- As interest rates fall, the cost of purchasing an annuity on the open market increases – hence the policyholder receives less income each year for each unit of sum assured. Once interest rates drop below a certain level, the guarantee will be exercised.

- A receiver swaption gives an insurer the option to enter into a swap under which it pays fixed and receives floating. Broadly speaking, once interest rates drop below the fixed rate of the swap, the option will be exercised.

5.50 For this reason (and as evident from FSA Returns), most UK life insurers use swaptions to hedge their GAO liabilities. This can be done using either:

- receiver swaptions; or
- payer swaptions and receiver swaps

These two methods are equivalent via the principle of put-call parity.

5.51 Traditional hedge portfolios were constructed using at-the-money receiver swaptions (e.g. with 4%-5% strikes).

5.52 More recently, insurers have hedged using portfolios of payer swaptions and receiver swaps.

The strike on the payer swaptions is set equal to the effective strikes on the GAOs, which are typically well above current forward market rates due to improving longevity. The insurer will typically use at-the-money receiver swaps (zero cost) rather than swaps that are in-the-money.

Under this strategy, the insurer hedges just the time value of the GAO. The intrinsic value (reserved for by the insurer) must be invested to earn at least LIBOR in order to fund the floating leg of the swaps.

Hedge Effectiveness

5.53 One issue with using interest rate swaptions is the exposure to swap spreads when using a gilts benchmark to value liabilities. Options can not be traded easily on government bonds, so insurers have found it difficult to hedge against this risk in the same way as for interest rate swaps.

5.54 The "option" part of interest rate swaptions does not normally give rise to basis risk relative to the liabilities being hedged – this is because the liabilities are marked to the volatility of traded swaptions under peak 2 of Pillar 1 and for the ICA.

Inflation Swaps

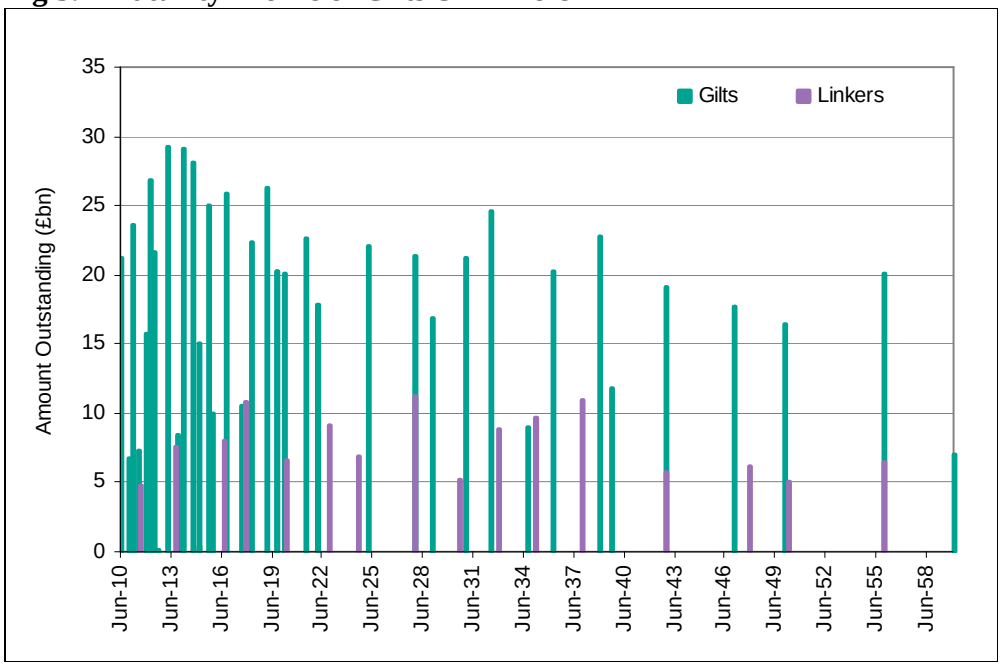
Introduction

5.55 For life insurance companies with inflation-linked liabilities, matching assets can take the form of either:

- inflation-linked government bonds ("linkers);
- inflation-linked corporate bonds ("corporate linkers"); or
- inflation swaps ("RPI swaps")

5.56 The chart below shows the maturity profile of linkers and conventional gilts in issue – this illustrates the relatively small sizes and limited tenors of available linkers:

Fig 5.7 Maturity Profile of Gilts & Linkers



Sources: RBS; Bloomberg

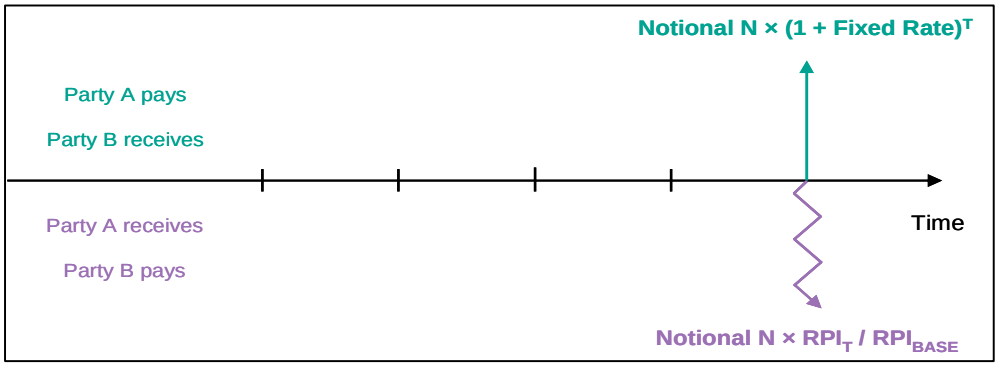
There is a similar dearth of corporate linkers.

5.57 Consequently, most life insurers with material volumes of inflation-linked liabilities (e.g. bulk purchase annuity market) use inflation swaps to protect themselves against higher than expected inflation.

5.58 An inflation swap is an agreement between two parties where one stream of future payments is exchanged for another based on an agreed notional amount. Inflation swaps typically exchange a fixed payment for a variable payment that is linked to the Retail Prices Index ("RPI").

5.59 The most regularly traded structure in the inflation-linked swaps market is the zero coupon inflation swap. One counterparty agrees to pay the cumulative percentage increase in RPI over the tenor of the swap (maybe with some lag), and the other pays a compounded fixed rate. There are no exchanges until the maturity of the swap, i.e. it is a zero coupon transaction.

Fig 5.8 Swap Agreement



Limited Price Indexation

5.60 In practice, a material proportion of an insurer's index-linked liabilities may have caps (e.g. 5%) and floors (e.g. 0%) on annual indexation – this is referred to as limited price indexation (or "LPI").

RPI collared between 0% and 5% corresponds to typical UK pensions in payment increases – this is typically designated LPI (0.5).

5.61 The market for LPI swaps is becoming more liquid – in particular an active two-way market in LPI(0,5) has developed out to 50 years – but remains less liquid than the RPI swap market. More complex inflation exposures – for example related to deferred pensions – are more difficult to hedge precisely with liquid instruments.

Inflation Break-evens

5.62 Break-even inflation is the difference between the nominal yield on a fixed-rate bond and the real yield on an inflation-linked bond of similar maturity and credit quality.

5.63 If inflation averages more than the break-even rate, then the inflation-linked bond will outperform the fixed-rate bond to maturity. Conversely, if inflation averages below the break-even rate, then the fixed-rate bond will outperform the inflation-linked bond.

Regulatory Considerations

5.64 Directive 2002/83/EC of the Solvency I regime requires insurers to match index-linked liabilities "as closely as possible … by assets of appropriate security and marketability which correspond as closely as possible" to the index on which the liabilities are based. A similar requirement appears to be imposed by the Solvency II Framework Directive.

5.65 Admissibility of inflation swaps follows from the fact that they are being used to reduce investment risk. The cover test is satisfied by holding conventional bonds which provide for the fixed legs under the swaps.

5.66 The treatment of real rate risk under Solvency II will be addressed at Level 3, as stated in CEIOPS final advice for the calibration of the market risk module (formerly Consultation Paper 70).

Hedge Effectiveness

5.67 In the absence of credit risk, inflation-linked bonds and inflation swaps may be regarded as equally good instruments for cashflow matching purposes.

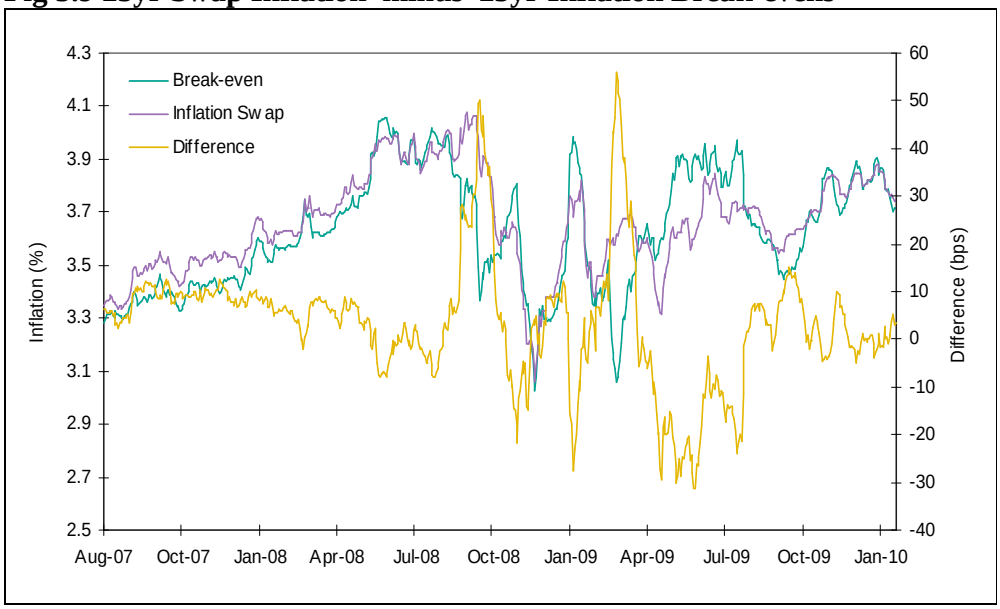
5.68 For example, suppose that an insurer has a liability in N years time which will grow with inflation between now and the end of the N years. Suppose also that there is a zero coupon inflation-linked bond available in the market which matures in N years. Both the bond and an N year zero coupon inflation

swap can be used to provide for the liability exactly – there is no cashflow basis risk.

5.69 However we must also consider the extent to which the value of the hedging instrument changes in line with that of the liability over the lifetime of the hedge, i.e. mark-to-market risk. For example, an insurer may value inflation-linked liabilities using inflation break-even rates derived from government bonds, but hedge these liabilities using inflation swaps (or vice versa).

5.70 We can do this by comparing inflation break-evens on government bonds with inflation swap rates:

Fig 5.9 25yr Swap Inflation minus 25yr Inflation Break-evens



Sources: RBS; Bank of England

5.71 Prior to the credit crunch, movements in swap rates and break-evens showed a high degree of correlation, with swap rates c.10bps higher on average.

5.72 Swap rates and inflation break-evens have been considerably more volatile since the collapse of Lehman Brothers, and there have been several periods where the two markets have not moved in tandem. Some of the reasons for this behaviour are discussed in the March 2009 BIS Quarterly Review:

- Flight to liquidity, meaning high demand for nominal government bonds – putting downward pressure on break-evens;
- Leveraged investors unwinding inflation linked bond positions during the market turmoil – pushing real yields up, which in turn pushed break-evens down;
- Expectations of lower inflation and investors hedging break-even positions in bond markets – pulling swap rates down; and

- Investors seeking to exploit perceived lows in break-evens – acting to reverse some of the observed declines in break-evens.

5.73 As the gap between swap inflation and break-even inflation changes over time, so too will the insurer's net assets (all other things being equal). For example, if inflation swap rates stay flat over the next year but break-evens rise, then net assets will improve for an insurer which hedges using swaps but values with reference to linker break-evens.

Currency Forwards

Introduction

5.74 A currency forward contract (or "Fx forward") is a binding obligation to buy or sell a certain amount of foreign currency at a pre-agreed rate of exchange, on a certain future date. The most liquid Fx forwards are 1, 2, 3 and 6 months.

5.75 Fx forwards, in conjunction with interest rate swaps, are used by UK life insurance companies to hedge the foreign exchange risk arising from:

- assets denominated in foreign currencies (e.g. USD-denominated corporate bonds);
- contracts of insurance under which claims are payable in foreign currencies (e.g. German term assurance policies); and
- surplus capital within and dividends payable from foreign subsidiaries

5.76 The diagram below illustrates how a Fx forward is used to hedge the foreign exchange risk on a USD-denominated bond:

5.77 The interest rate swaps protect the insurer from rising USD rates and falling GBP rates. The Fx forward hedges the foreign exchange risk over the period and embeds a basis swap.

5.78 Because Fx forwards are short term, they need to be "rolled" to maintain the hedge (i.e. cash settled at maturity and then a new contract is taken out). This exposes the insurer to movements in spot Fx rates and basis swap spreads.

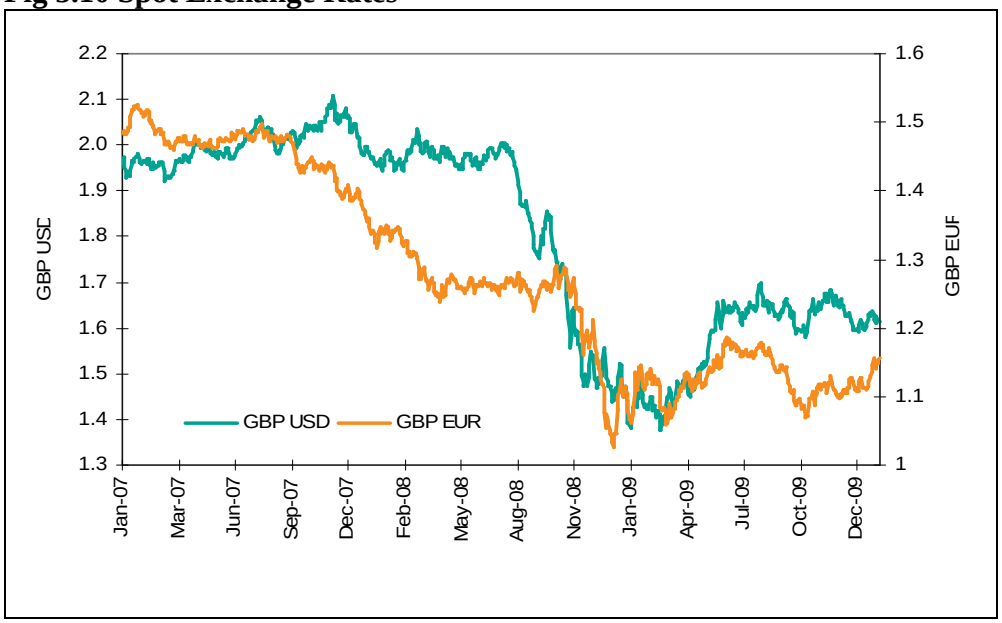
Spot Exchange Rates

5.79 Spot exchange rates have been very volatile over the past two years, with Sterling showing considerable weakness vs. Dollars and Euros.

5.80 Because the Fx forwards are cash settled at maturity, this exposes the insurer to disinvestment/reinvestment risk – assets may need to be sold to fund the settlement amount, or conversely proceeds will need to be invested.

5.81 Over 2009, for example, movements in the GBP/USD and GBP/EUR spot exchange rates alone could have resulted in collateral cash calls of as much as 13% of the value of the assets/liabilities being hedged. Insurers using these instruments would therefore have needed sufficient liquid assets to post as collateral.

Fig 5.10 Spot Exchange Rates



Sources: Bloomberg

	Dec 08	March 09	June 09	Sep 09	Dec 09
GBP/USD	1.44	1.43	1.65	1.60	1.62
Value USD Portfolio	10,000	10,100	8,755	9,016	8,911
MTM		100	-1,345	261	-105
		1%	-13%	3%	-1%
GBP/EUR	1.03	1.08	1.17	1.09	1.13
Value EUR Portfolio	10,000	9,483	8,739	9,389	9,091
MTM		-517	-744	650	-298
		-5%	-8%	7%	-3%

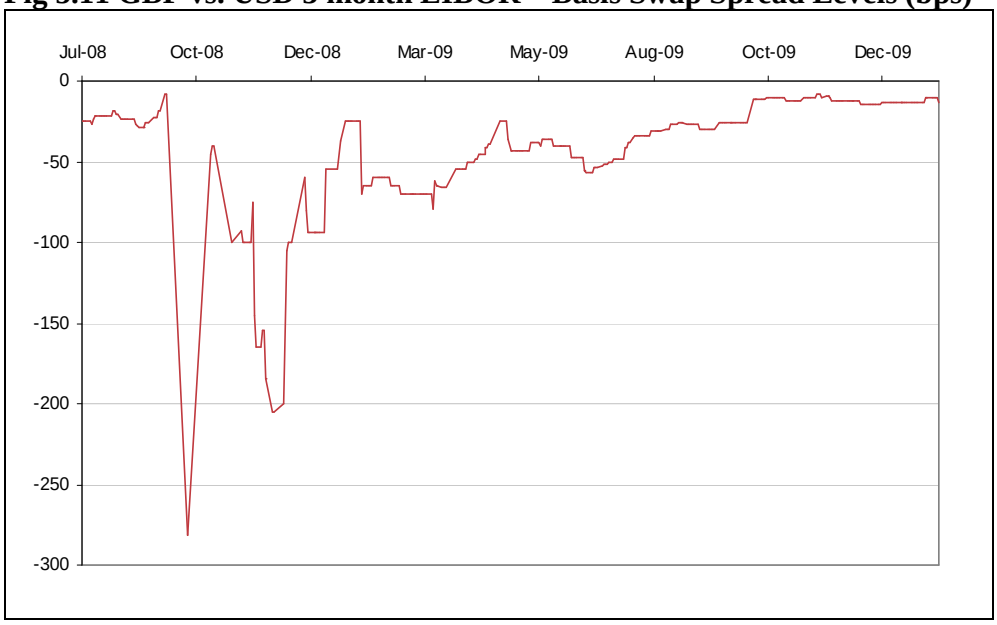
Basis Swap Spreads

5.82 A basis swap is an interest rate swap which involves the exchange of two floating rate instruments (e.g. USD LIBOR swapped for GBP LIBOR).

5.83 Basis swaps are quoted as a spread over one of the floating rates, with the other floating rate paid "flat." Generally, if 3 month GBP LIBOR is one of the floating rates, the spread is added to the other side.

5.84 The chart below shows how basis swap spreads have changed over the past few years for GBP vs. USD 3 month LIBOR. A spread of -10bps, for example, indicates that an investor would receive 3 month GBP LIBOR in exchange for paying 3 month USD LIBOR + 10bps.

Fig 5.11 GBP vs. USD 3 month LIBOR – Basis Swap Spread Levels (bps)



Sources: Bloomberg

5.85 Historically, basis swap spreads were very tight and stable.

5.86 The global demand for Dollars from the end of Q3 2008 forced basis swap spreads very wide. Non-US banks had run out of short term Dollars because of the large impairments they had been forced to make on USD-denominated assets. Struggling to obtain funding in unsecured cash markets, they turned to the collateralised foreign exchange swap markets.

5.87 Any insurer with a rolling 3 month strategy over this period would have been exposed to the wide and volatile basis levels – making rolls very expensive.

Regulatory Considerations

5.88 INSPRU requires insurers to "hold admissible assets in each currency of an amount equal to at least 80% of the amount of its liabilities in that currency". This "localisation" provision limits the amount of foreign exchange risk that insurers are allowed to take under the Solvency I regime.

5.89 Article 132 of the Solvency II Framework Directive, on the other hand, does not appear to require insurers to match their liabilities by currency:

"*With respect to insurance risks situated in the Community, Member States shall not require that the assets held to cover the technical provisions related to those risks are localised within the Community or in any particular Member States.*"

5.90 Additionally, Solvency II is based on a one year time horizon and assumes that assets are transitioned to a risk-free portfolio at the end of the year – therefore a one year Fx hedge appears optimal.

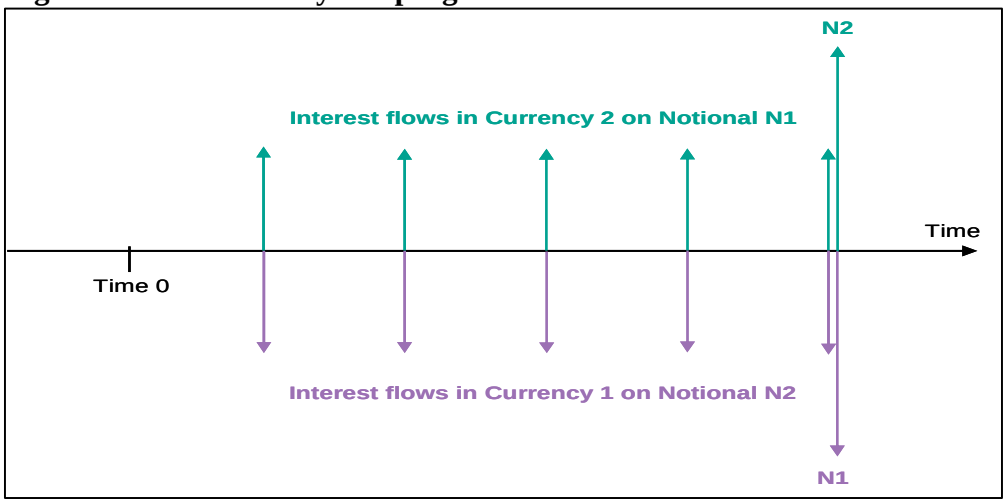
5.91 Insurers that hedge for longer than this will be exposed in capital terms to the risk of unwind (despite being better placed in terms of cashflow matching).

Currency Swaps

Introduction

5.92 A cross currency swap is an agreement between two counterparties to exchange interest and principal payments in different currencies:

Fig 5.12 Cross Currency Swap Agreement



5.93 At inception, the notional amounts in the two currencies are usually set to be equal given the spot foreign exchange rate X (i.e. N1 = X × N2).

Hedge Effectiveness

5.94 Unlike a strategy of rolling short-dated Fx forward contracts, cross currency swaps lock into spot Fx rates and basis swap spreads for the life of the hedge, thus removing cashflow basis risk. However this typically makes them more expensive in terms of bid/offer spread.

5.95 A cross currency swap can be easily wound up – the close out amount will be the mark-to-market position of the swap. Circumstances under which the insurer might want to unwind include:

- default of the foreign asset; and
- domestic liability due earlier than expected/modelled

5.96 In such circumstances, the cross currency swap is still in existence and typically with a non-zero mark to market position – therefore exposing the insurer to potentially significant cash calls.

5.97 Two ways of managing this "unwind risk" are:

- offload the default risk to a bank (e.g. swap that automatically cancels in the event of default) – however charges for this can often be significant; and

- assume a certain percentage of the assets (liabilities) will default (claim early) and have the same percentage of the currency swap portfolio in cancellable format – therefore keeping the cost of the cancellable option small in relation to the overall portfolio

Regulatory Considerations

5.98 Since a one year hedge is optimal from a Solvency II perspective, the unwind risk on a full term cross currency swap may push insurers towards a strategy of rolling Fx forwards, even though this increases risk on a long-term cashflow matching basis.

6. Practical issues

Counterparty risk

6.1 Exchange traded derivatives (ETD) are standardised contracts publically traded on, typically specialised, exchanges similar to stock market exchanges. The exchange acts as intermediary to the trade, and ultimately an insurer's counterparty is the exchange.

6.2 The financial crisis is expected to lead to an increase in the share of exchange traded derivatives, in part due to pressure from the authorities in the United States to reduce systemic risks from the banking sector.

6.3 However, most of the hedges discussed in this paper are currently traded on the "Over the Counter" (OTC) market – and therefore represent private, and potentially bespoke, trades directly between two parties. In this case the insurer's counterparty will normally be an investment bank.

6.4 The bankruptcy of Lehman Brothers on 15 September 2008 highlighted the risks to insurers of the failure of hedging counterparties.

6.5 Insurers should take into account a number of issues when assessing how to measure and manage counterparty risk:

- Selection and diversification of counterparties

  Insurers will need to form a view of the creditworthiness of counterparties using, inter alia, rating agencies views, market information (e.g. spread on their bonds and the price of CDS protection) but also the insurer's own assessment of risk.

  Diversification of counterparties provides one important risk mitigant. However, as seen in the financial crisis, systemic risk from the banking sector leads to a simultaneous decline in the creditworthiness of all banks. Correlation benefits between banking counterparties should therefore not be overestimated.

- The correlation of counterparty exposure with the hedged risk

  The main risk will tend to lie with hedges that are correlated with systemic financial risks events that will lead to counterparty insolvency. For example, insurers may have concerns about buying CDS protection on the German government from a German bank.

  There may also be concern in markets where banks appear to be taking a one-way bet – i.e. it is unclear how they are themselves laying-off the risk assumed. A topical example here was banks writing large volumes of super-senior protection against extreme losses on portfolios of sub-prime

mortgages, which they typically retained on their books.

- Netting arrangements

  Some counterparties had issues with Lehman Brothers failure where they had some contracts where they owed Lehman Brothers money, and others where Lehman Brothers owed them money. In the former, they were required to settle the contract immediately and in full, but their recovery under the latter was delayed and limited. Insurers will typically wish to ensure they have legally robust netting arrangements in place to avoid this risk.

- Risk mitigation measures. These can include

- Diversification – as discussed above.

- Credit trigger agreement – where derivatives are terminated and settled on pre-defined events such as a ratings downgrade of the counterparty below a certain level.

- Credit intermediation – where a stronger counterparty sits between the insurer and the original bank counterparty.

- Hedges on counterparty risks – e.g. using credit default swaps or credit insurance – although these hedges will themselves have counterparty risk.

- Collateralisation arrangements – see below.

- The economic capital required to be held against exposures

- Ultimately, insurers will need to hold adequate economic capital to protect against residual risks once the measures above are taken into account.

Collateralisation

6.6 A key method of mitigating counterparty exposure is the use of collateral.

6.7 Most insurers will establish collateral arrangements with their hedging counterparties. This has been less common for non-financial users of derivatives, such as corporates, who indeed typically prefer not to receive and post collateral (see below).

6.8 Typically, at periodic intervals (e.g. daily or weekly), a derivative position is marked-to-market. If the mark-to-market is in favour of the insurer, then the investment bank posts collateral – typically in the form of high quality assets such as cash or government bonds – to the insurer as security against the insurer's exposure to the bank.

6.9 Issues for insurers to consider, highlighted by the financial crisis, include:

- Frequency of collateral posting, and close-out risk

  On insolvency of the counterparty, the insurer is exposed to movements in the value of the derivative hedge between the date collateral was last posted, and the insolvency date. This risk can be mitigated, but not eliminated, by more frequent posting of collateral – and daily collateralisation has become common practice.

  Insurers, even with daily collateral, should reflect this "jump-to-default" risk in assessing counterparty exposures, particularly if taking capital relief against regulatory stress tests for the value of a hedge.

  The Standard Model SCR under Solvency II requires insurers to hold counterparty risk capital against the difference between the value of the hedge taken into account in the stressed SCR scenario and a stressed value of the collateral which has actually been posted (i.e. pre-stress). Essentially the Standard Model assumes that the 99.5% stress event will occur overnight and that counterparty failure may occur before additional collateral can be posted. This is a rather prudent approach and doesn't actually incentivise insurers to improve the quality of collateral arrangements.

- Acceptable collateral quality

  Collateral agreements will specify the range of assets that are "eligible" to be posted as collateral. Typically, lower quality collateral (e.g. corporate rather than government bonds) will, if accepted, be subject to a haircut in value – i.e. will require over-collateralisation versus the exposure. Collateral may also be required to be replaced if, for example, it is downgraded.

  On insolvency of the counterparty, the insurer may need to sell the collateral assets to cover their exposure. Collateral which is illiquid or whose value is correlated with the hedged exposure is therefore less attractive. Taking our example above of buying CDS protection on the German Government from a German bank, the counterparty risk would not be materially reduced if German government bonds were posted as collateral.

  A recent trend has been for banks to offer improved terms to counterparties if the bank is allowed to post less liquid assets as collateral (e.g. unrated loans, or asset-backed securities).

- Replacement cost

  The insurer will usually also need to replace the derivative with another counterparty. This can be difficult at a time of market distress associated with a bank failure. In the case of Lehman Brothers default, this issue was seen in the inflation swap market where the volume of trades that

needed to be replaced had a material impact on market liquidity.

Practical issues with collateralisation

6.10 Insurers will need to ensure that they have appropriate systems and procedures in place to cope with the management of collateral.

6.11 Collateralisation is typically a two-way process – i.e. insurers will normally be required to post collateral if the mark-to-market value of the hedge moves in the banks favour.

6.12 This can cause practical issues for insurers. Insurers may be forced to post collateral even though the underlying hedged positions are illiquid – for example an insurer holding corporate bonds plus interest-rate swaps against annuity liabilities may, if rates rises, be forced to liquidate the corporate bonds to be able to post cash or government bonds as collateral.

6.13 This issue was highlighted by the FSA (2008) in the context of asset-backed securities. They observed "where insurers are receiving a fixed rate in swap transactions and investing in floating rate instruments (such as ABS) as part of their ALM strategy they should consider the liquidity impact of collateral calls when interest rates rise. It is possible that, in an environment of increasing interest rates, they could face margin calls at the same time as seeing the value of their investments fall".

6.14 Insurers will therefore need to stress test potential collateral calls to assess the volume of liquid (or 'eligible') securities that they will need to hold

6.15 As shown in our analysis in Sections 3 to 5, derivative positions have been highly volatile in the financial crisis, leading to insurers facing collateral strains greater than they may have anticipated. One response from insurers has been to agree a wider range of eligible collateral that they can post to banks, e.g. corporate bonds.

6.16 This concern with needing to post collateral is a key reason why non-financial firms have been lobbying in the US against being included in any requirements to use exchange traded derivatives. They are concerned about the need to hold liquid assets to post as collateral on hedges, when the underlying hedged position (e.g. swapping debt from floating to fixed) is illiquid.

6.17 Posting of collateral also has an opportunity cost – for example, government bonds posted as collateral would not then be available e.g. for stock lending.

6.18 Liquidity issues also arose in some cases where hedges were uncollateralised. Some hedge funds who owed Lehman money under uncollateralised derivatives found themselves facing unexpected cash calls when Lehman failed and the administrator required them to settle the contract.

Clearing houses

6.19 Another trend likely to result from the financial crisis, is increased regulatory pressure for banks to use centralised clearing houses for OTC derivatives.

6.20 An initial derivative trade is made between two counterparties on the OTC market – e.g. Bank A and Bank B. However, the trades are then "novated" to the clearing house, so that both Banks then ultimately face the clearing house as their legal counterparty, rather than each other.

6.21 The clearing house will typically collect both initial and variation (i.e. mark to market) margin from its counterparties, usually in the form of cash.

6.22 This has the following advantages

- Reduces counterparty risks on settlement.
- Increased standardisation of contract terms.
- Netting of offsetting positions.
- Independent valuation of trades and collateral.
- The clearing house may offer a "guarantee fund" that covers losses in excess of a firm's collateral on default of a member firm.

6.23 The increased use of centralised clearing house by banks should act to reduce systemic risks in the banking sector, and therefore reduce counterparty risk for insurers, even if the insurers themselves continue to deal direct with banks.

6.24 One current debate is whether other financial firms, such as insurers, should also make use of clearing houses directly, i.e. become members of the clearing house. However, clearing houses typically require all variation margin to be posted in cash, with no flexibility to widen collateral terms, and for insurers this would intensify the liquidity issues identified above.

6.25 Clearing houses are themselves not free of counterparty risk. Indeed the Standard Model SCR does not appear to recognise the benefit of using clearing houses and may even penalise this, since it would be seen as a reduction in the number of counterparties and because many clearing houses do not have explicit credit ratings.

Liquidity and transaction costs

6.26 In many cases, derivative markets actually remained more liquid than the corresponding physical asset markets during the financial crisis – for example the interest swap market remained relatively liquid and the credit default swap market was typically more liquid than the physical corporate bond market.

6.27 Nevertheless, liquidity did reduce and transactions costs widened materially in the months following the failure of Lehman Brothers.

6.28 Insurers should consider the potential risks of a reduction in liquidity, and increase in transactions costs, on hedging strategies, particularly where a dynamic hedging programme is being used.

Valuation

6.29 Insurers will need to place a value on hedges for financial reporting purposes. Although counterparties will normally provide a valuation, best practice would be for insurers to form their own independent view, for example from their own models or from other price sources.

6.30 In some cases, where markets are illiquid or not functioning, a mark-to-model approach may be required. Although outside the scope of this paper, longevity swap hedges are an example where this is needed, and during the worst period of the financial crisis, valuations in many markets, physical as well as derivatives, became unreliable.

6.31 Being able to place an independent value on derivatives held is also important for monitoring collateral arrangements.

6.32 One practical issue that has arisen is the appropriate discount rate that should be used for valuing derivative cashflows. As discussed in Risk Magazine (2010), prior to the financial crisis, the standard assumption was to use the Libor swap curve. However, post the financial crisis there is a recognition that this may not be appropriate as material gaps have opened up between the cost at which banks can fund themselves, Libor, and overnight interest rates. Generally accepted practice in this area is still emerging, but a view appears to be forming that:

- Uncollateralised derivatives, where the bank owes money to a counterparty, should be valued at a discount rate that reflects the cost of funding to the bank, which is typically materially higher than Libor swap rates and will differ between banks.

- Collateralised derivatives should be valued using overnight SONIA swap rates, as discussed in Section 5, since this is the rate that is paid on cash collateral.

7. Conclusions

Summary of findings

7.1 Our aim was to assess whether derivative hedges did what they said on the tin, particularly during the recent financial crisis.

7.2 The severe dislocation in financial markets caused by the crisis highlighted a number of issues and risks with hedging strategies, including many that were not previously foreseen.

7.3 In particular, for a number of popular hedging strategies, such as CDS, the basis risk between the hedge and the hedged exposure during the financial crisis was material, particularly when assessed on a mark-to-market basis. Indeed in some cases – e.g. swap rates vs. gilt rates – the residual basis risk actually exceeded the volatility of the un-hedged exposure. On a cashflow basis, however, many of these hedges should still perform as expected.

7.4 The effectiveness of a hedge depends crucially on how the hedge performance is measured – and what the hedge was expected to do.

- The appropriate mark-to-market hedge for interest-rate risk on liabilities will depend on the choice of discount rate. Swaps represent a "perfect" hedge for liabilities discounted using swap rates and, in contrast, government bonds are no longer a risk-free asset in mark-to-market terms. But volatility will arise with swaps if a government bond based discount rate is used.

- The basis between bond and CDS contracts arguably represents mainly a funding or liquidity premium. A portfolio of bonds hedged by a matching index CDS (if available) is largely hedged for default risk, but contains considerable illiquidity. If liabilities are also illiquid, e.g. annuities, and valued using a discount rate including a liquidity premium (as may apply under MCEV and Solvency II) then the CDS could be an effective hedge.

7.5 Equity hedging strategies tended to perform well – since in this financial crisis, correlations between different equity markets actually increased significantly. However, we are aware that some variable annuity providers suffered material losses in cases where the funds and indices on which guarantees were offered proved significantly more volatile than available indices in the hedging market. And basis risk on equity hedges even for typically UK equity portfolios should not be neglected.

7.6 From a regulatory perspective, the historic Pillar 1 measures (peak 1 and peak 2) may have proven generous in their treatment of hedge effectiveness, with basis risk not taken into account. Basis risk was typically picked up in Pillar 2 although the level of sophistication of approaches has varied considerably in practice.

7.7 In contrast, under Solvency II, the Standard Model SCR may actually set too high a standard for hedge recognition. If interpreted rigorously the proposed requirements may render most current hedging strategies ineffective and so disincentivise insurers using the Standard Model from hedging market risks or from establishing appropriate collateral arrangements. A more optimistic perspective would be to say that Solvency II will incentivise insurers to more thoroughly document and model the residual risks in hedges.

7.8 The financial crisis also highlighted the importance of managing counterparty exposures. The use of collateralisation is a key part of this risk management, but as we have shown collateralisation may also present insurers with some significant practical issues.

What should insurers do?

7.9 Based on our findings, we would suggest that insurers should:

- Analyse their hedging strategies in detail to understand basis and other residual risks.
- Establish appropriate economic capital for basis risks.
- Reflect in new business pricing the costs associated with basis risks between guarantees offered to customers and available hedging instruments.
- Consider the construction of more refined hedges that address basis risks. Insurers will also need to carefully consider the trade off between hedges with lower basis risk and the lower transaction costs and greater liquidity of more commonly traded hedges.
- Review their selection of counterparties and their collateral, and other counterparty risk mitigation, arrangements.
- Perform stress tests of hedging strategies and collateral arrangements against extreme events including, but not limited to, a repeat of the financial crisis.
- Document hedging strategies and the tests and standards applied to hedge effectiveness. In particular under Solvency II, insurers will need to either provide a robust justification of hedge effectiveness under the Standard Model, or develop partial internal models for their hedge programmes.
- Ensure that the issues associated with basis risk are properly communicated to all key stakeholders (e.g. the Board).

7.10 Derivative hedges will remain an important part of risk management for insurance companies and the financial crisis has only heightened the importance of hedging financial risks.

7.11 However, insurers need to read the instructions on the tin carefully and take care when applying these products.

8. Acknowledgements

8.1 The opinions expressed in this paper are the authors' personal views, rather than those of our employers.

8.2 We would like to acknowledge the many helpful comments received from both colleagues and peers. However any errors or omissions remain the authors own.

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Details of the regulatory and accounting frameworks in Section 2 can be found at:

- EEV / MCEV principles – published by CFO Forum at http://www.cfoforum.nl/embedded_value.html

- International accounting standards – published by International Accounting Standards Board at http://www.iasb.org/Home.htm

- Solvency II – CEIOPS consultation papers and advice http://www.ceiops.eu/

- UK regulatory regime – FSA Handbook http://www.fsa.gov.uk/Pages/handbook/

- United States risk-based capital requirements for Variable Annuities
  http://www.naic.org/