The Impact of IFRS and Solvency II on Asset-Liability Management and Asset Management in Insurance Companies

November 2006
The purpose of this study is to review the risk management techniques that are applicable to asset and asset-liability management, in particular with regard to the implementation of the IFRS and the future prudential regulations, Solvency II, as well as the challenges facing managers in the scope of this implementation procedure.

The work presented herein is the result of academic research and, as such, it is important to note that:

• the opinions expressed in this study are those of the authors and do not engage the responsibility of either EDHEC Business School or AXA Investment Managers;

• the conclusions reached in this study in no way engage operational decisions and are in no way linked to the positions that the AXA Group has adopted or will adopt with regard to the structure of the IFRS and Solvency II in the future.
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## Partners

- About the EDHEC Risk and Asset Management Research Centre
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This new study that we are pleased to present was co-produced by the EDHEC Financial Analysis and Accounting Research Centre and the EDHEC Risk and Asset Management Research Centre, with the aim of combining the research centres’ expertise in complementary areas in order to address this complex subject, which involves several disciplines.

The EDHEC Financial Analysis and Accounting Research Centre deals with financial analysis issues: valuation of firms; the impact of IFRS on the management of companies and risk pricing; due diligence; and reform of the status of independent financial experts. The research centre aims notably to use state-of-the-art academic expertise to question certain financial paradigms, particularly that which ignores idiosyncratic risks in the calculation of the risk premium on the basis that such risks are diversifiable. We can thereby reject the notion that changes in the accounting framework are neutral with regard to how risks are perceived by showing that they have an impact either on the financial aggregates used by analysts or on the strategy used by companies to neutralise the accounting impact. We should also stress that the research centre decided to become involved in this study on Solvency II because we believe that the methods for valuing insurance companies will base themselves on these prudential regulations in the future, notably to determine the capital allocation per activity.

The EDHEC Risk and Asset Management Research Centre has made a point of conducting research that is both independent and pragmatic since it was set up in 2001. The concern to render its research work relevant and operational has led us over the past few years to publish a number of studies and surveys that look specifically at the application of research advances and the state of the art in financial theory to the improvement of investment management practices in the industry.

EDHEC’s ALM and Asset Management research programme concentrates on the application of recent research in the area of asset-liability management for pension plans and insurance companies. The research centre is working on the idea that improving asset management techniques and particularly strategic allocation techniques has a positive impact on the performance of Asset-Liability Management programmes. The programme includes research on the benefits of alternative investments, such as hedge funds, in long-term portfolio management. Particular attention is given to the institutional context of ALM and notably, as in the case of the present study, the integration of the impact of the IFRS standards and the Solvency II directive project.
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The first part of the current report provides an analysis of the IFRS and the Solvency II provisions in light of the asset management and ALM issues facing insurance companies. The second part examines state-of-the-art techniques in these areas, with particular focus on their suitability and relevance with regard to the requirements for insurance companies to manage their risks better. The third and final section goes on to provide details of the limits placed by the new IFRS environment on insurance companies in terms of asset management solutions in the presence of liabilities, thereby highlighting the additional volatility constraints on income statements and shareholders’ equity brought about by these new accounting standards.

We hope that the analyses, conclusions and recommendations that we are presenting in this report will help to stimulate and nourish discussions between institutional investors, managers and regulatory authorities, in a mutual concern to optimise the framework within which insurance companies operate.

We would like to extend our warmest thanks to AXA Investment Managers, without whose support and attention this report would not have been possible.
About the Authors

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Philippe Foulquier PhD heads EDHEC’s Financial Analysis and Accounting Research Centre and is an associate professor with the EDHEC group. He has a PhD in economic science and is a graduate of the SFAF (the French Financial Analysts’ Society). He joined EDHEC after an extensive professional career as a sell-side financial analyst specialised in the insurance sector. In 2005, Philippe was named “best French financial analyst in the insurance sector” in the reference international ranking established by Extel/Thomson Financial.

Samuel Sender founded MC2 Finance, an independent consulting firm for life and mutual insurance companies, before joining FINALYSE, a consultancy specialised in risk and performance measurement, as a senior insurance consultant and ALM specialist. Formerly with the Economics, Strategy and Quantitative Research unit at HSBC Asset Management Europe, and then head of Asset-Liability Management at Erisa, the French life insurance subsidiary of HSBC, he is a graduate in Statistics and Economics from ENSAE (Ecole Nationale de la Statistique et de l’Administration Economique) in Paris.
In recent years, the increasing amount and heightened complexity of risks have caused a necessary transformation in the environment of insurance companies. This development has led to a genuine desire to adapt accounting (IFRS) and prudential rules (Solvency II), with the aim of providing a better perception of all companies, notably with regard to the risks being run. We feel that we are therefore on the verge of a major evolution with far-reaching implications for the practices of asset management (AM) and asset-liability management (ALM) in this sector.

The first step in this change has been operational since 2005 and for the moment only concerns groups that invite savings from the general public: this is phase I of the IFRS. In the overall scheme, this phase is the least unsettling, because it mainly involves implementing the concept of fair value for most assets. This practice was already widely employed by financial markets, since they already reasoned in terms of the market value of assets. We will see however that the side effects are considerable and that the new volatility generated in the income statement and/or in equity will represent new constraints for insurance companies, notably with regard to the implementation of modern asset management and ALM techniques.

The second step, phase II of the IFRS, is planned for 2008 and will broaden the integration of risks to liabilities. At that stage, the funding methods, the explicit integration of options and guarantees (this problem was already brought up in phase I through the Liability Adequacy Test — LAT) and the adoption by around twenty insurance companies of European Embedded Value, will have to be totally rethought. The highlighting of the liabilities should thereby provide a large amount of information to the markets and introduce new management constraints for the insurance companies.

Finally, the third phase, Solvency II, is planned for around 2010. However, the ongoing work and involvement of insurance companies in this project show that the impact on asset management, ALM and, more generally, the integration of risks, will be visible very shortly, probably as soon as the outline of the standard capital formula has been drawn up (planned for July 2007). Unlike the IFRS, Solvency II will concern all European insurance companies. It also reinforces and generalises the requirements for evaluating and managing risks. The notion of risk is enlarged in terms of the field of application (financial market, ALM, credit, underwriting and operational risks), modelling (the distribution law, correlation, and the study of extreme risks), evaluation, and risk management (derivatives, reinsurance, securitisation and diversification).

Therefore, in view of the progressive implementation of the IFRS and Solvency II, the increasing ‘financialisation’ and sophistication of asset management and ALM techniques over the last few years should continue to grow. It should lead to an optimisation of the management of economic capital, through better asset-liability adequacy, more dynamic management of the differentials in
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interest risk exposure between the assets and liabilities (through more structured and sophisticated interest rate products, caps, floors, swaptions, CDS, etc.), a transfer of some of the risks of mass insurance (securitisation of automobile and residential portfolios) and large risks (natural catastrophe, mortality and life-expectancy bonds) towards the financial markets, better management of the extreme risks of financial assets and optimisation of diversification (even though it is still early to evaluate the degree to which it could boost and broaden asset allocation towards alternative investments, private equity, structured credits, etc.; this will depend on how those assets are treated in the standard formula).

The present report limits the analysis of these changes in the financial management of insurance companies. On the basis of a thorough analysis of the accounting (IFRS) and prudential constraints (Solvency II) and their limitations (part I), and of a presentation of the state-of-the-art in modern AM and ALM techniques (part II), solutions are proposed for risk and asset management in the presence of insurance liabilities in this new IFRS-Solvency II referential landscape (part III).

This report shows notably that the cumbersome systems implemented by the IFRS (provisional creation of new asset categories, hedge accounting, shadow accounting, fair value option, etc.) to handle the lack of harmonisation in phase I of the accounting methods between assets (mostly in fair value) and liabilities (at cost) are not only sometimes inefficient (those that are accompanied by overly constraining measures are used parsimoniously or not at all by the insurance companies), but above all can work against their objective of better risk management.

More specifically, the dynamic asset management solutions that aim to reduce risk exposure while managing performance rely on different allocations to bonds, derivative instruments, structured products, mutual funds, or combinations of these. However, the accounting treatment by the IFRS of the variation in fair value of these assets (unrealised profits or losses) leads to considerable volatility in the income statement or shareholders’ equity, with no relation to the real exposure to the risks of the different strategies.

While IFRS and Solvency II should lead to a genuine evolution in the management of insurance companies, by empowering them with respect to their risks (identification, measurement and management), one is forced to observe today that the standards implemented often oppose their initial objectives: the adoption of modern asset management and ALM techniques with a view to reducing the exposure to risks is considerably penalised by the IFRS treatment by leading to additional purely accounting volatility, without any connection to the economic reality.
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The profound changes in the risk management of insurance companies, brought about by the increasing complexity and variety of risks over the last two decades, have made it necessary to revise prudential regulations (Solvency II) and to adapt the international accounting standards (IFRS).

The objective of the new accounting standards is to offer a better view of all companies, particularly with regard to the risks they run. However, our study shows that the definition of these regulations and their application to insurance companies are often at odds with their initial objectives: those who adopt good asset management or asset-liability management (ALM) practices in order to reduce their exposure to risk are often heavily penalised. These standards result in additional volatility in pure accounting terms, the extent of which does not correspond to economic reality.

With regard to Solvency II, we feel that the latest CEIOPS proposal, contained in the QIS 21, is inapplicable as it stands due to the inadequacy of its risk calibration. While Solvency II highlights the issue of taking extreme risks into account and aims to create an incentive for companies to measure and manage these risks, this calibration is an incentive to engage more in opportunistic arbitrage than in the improvement of risk management.

In an effort to demonstrate the inadequacy, and even contradictions, which one may find between certain IFRS definitions and Solvency II proposals on the one hand, and the aim to make insurance companies accountable for their risk management approaches on the other, EDHEC has published this major report. The first part of this report provides an analysis of the IFRS and the Solvency II provisions, in light of the asset management and ALM issues facing insurance companies. The second part examines state-of-the-art techniques in these areas, with particular focus on their suitability and relevance with regard to the requirements for insurance companies to better manage their risks. The third section goes on to provide details of the limits placed by the new IFRS environment on insurance companies in terms of asset management solutions in the presence of liabilities, thereby highlighting the additional volatility constraints on income statements and shareholders’ equity brought about by these new accounting standards.

The objectives of the IFRS and Solvency II require the implementation of more sophisticated risk management techniques

The first stage of the profound changes taking place in the risk management practices of insurance companies — phase I of the IFRS — has been

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1 - Quantitative Impact Studies 2, produced by the CEIOPS (Committee of European Insurance and Occupational Pensions Supervisors).
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operational since 2005 and for the moment only concerns companies that take savings from the general public. This is the phase that causes the least disruption, as it mainly involves the implementation of the ‘fair value’ principle for all assets, a practice that is already widely used by the financial markets. However, we will see that the secondary effects are far from negligible and that the volatility generated in income statements and/or shareholders’ equity is such that it will impose new constraints on insurance companies, particularly because of the need to implement advanced asset management and ALM techniques.

Phase II of the IFRS is expected for 2008 and will extend the integration of risk to liabilities. Provisioning calculations or even approaches and the explicit inclusion of options and guarantees will then have to be completely revised; this should bring about new constraints for insurance companies, which appear to be showing greater levels of interest than in phase I.

Finally, the third phase — Solvency II — which, unlike the IFRS, will concern all European insurance companies, is expected by around 2010. Our study shows, however, that the impact on asset management and ALM, and in particular the questions related to the integration of risk, will be visible as soon as the broad outline is given for the standard capital requirement formula (around 2007). Solvency II reinforces requirements for the evaluation and management of risk, the notion of which has been widened not only in terms of its scope (financial market risk, ALM, lending, underwriting and operational risk) but also its modelling (distribution law, correlation, study of extreme risks), evaluation and risk management (derivatives, reinsurance, securitisation and diversification). EDHEC believes that while the IFRS tend to add additional and unfortunate financial management constraints, Solvency II may bring about more structural changes to asset management and ALM.

Now, a major step in the development of Solvency II has just been completed with the publication of the QIS 2, which aims to use the responses given by insurance professionals to provide a quantitative estimate of the global impact of the new solvency system. On this particular point, EDHEC believes that while the initial proposals respond quite well to the required balance between sensitivity to the primary risk factors faced by insurance companies, on the one hand, and the complexity and soundness of the different approaches tested, on the other, the calibration of the proposed standard formula’s parameters is totally inadequate in light of the economic capital requirements it engenders. These requirements reach a level that is between two and four times that provided for by Solvency I, depending on the associated risks and activities.

2 - It should be noted that this problem is already raised in phase I by the LAT (Liability Adequacy Test) on the one hand, and by the development of European Embedded Value on the other.
while the regulatory authorities consider
insurance companies today to be well
capitalised. It would appear that the
CEIOPS suggests measuring risk using
a VaR of 99.5%, but that the calibration
of risk model factors has no bearing
on this figure. This report therefore
highlights certain errors in relation to
the treatment of the volatility of certain
risk factors in various areas:
• In general insurance, the historical
volatility of the combined ratio does not
appear to be an appropriate measure
of risk, as it supplants any optimal
management between the technical
result (insurance operations) and
financial result. It therefore constitutes
a hindrance to the implementation of
techniques for managing risks which in
order to be hedged involve a volatility
that will require additional capital.

• Stress scenarios require excessive
capital needs, in particular volatility of
40% for stock markets over one year,
which, as in the case of life insurance
companies in the US, could completely
discourage the holding of stocks. When
the stress scenarios are compared
in terms of historical data, it is also
interesting to note that the volatility
figure used for stocks has no bearing
on that used for the yield curve.

• The inclusion of the volatility of assets
in the capital requirements formula
leads to certain aberrations: for example,
a long-short strategy requires much less
capital than a strategy which aims to
minimise the variance of a low beta
equity driven portfolio.

• The treatment of options and the
explicit absence of any consideration
for dynamic asset allocation or hedging
strategies are at odds with the objectives
of Solvency II3.

While the objective of Solvency II is
to create an incentive for insurance
companies to better measure and
manage their risks, the provisions
proposed for their calibration sometimes
contradict the objectives themselves.
It would appear that the applicable
regulations need to be revised; this
could be achieved in 2007.

To conclude our analysis of the new
prudential and accounting provisions,
we believe that the ‘financialisation’ and
sophistication of asset management
and ALM techniques over the last
few years should continue to grow.
It should lead to an optimisation of
the management of economic capital,
through better asset-liability adequacy
and more dynamic management of the
differentials in duration and convexity
between the assets and liabilities (more
structured and sophisticated interest
rate products, caps, floors, swaptions,
CDS, etc.). It will also result in a transfer
of some of the risks of mass insurance
(securitisation of automobile and
residential portfolios) and large risks
(natural catastrophe, mortality and
life expectancy bonds) towards the

3 – ”No consideration should be given to management actions or active trading strategies.” (QIS 2)
financial markets. Finally, it will privilege better management of the extreme risks of financial assets, as well as the optimisation of diversification, even though it is still early for evaluating the degree to which it could boost and broaden asset allocation towards alternative investments, private equity, structured credits, etc.; this will depend on how those assets are treated in the standard formula, which we hope will be different to that proposed by the QIS 2.

To respond to these issues, part II of the EDHEC study provides a look at the state-of-the-art asset management techniques in the presence of insurance liabilities, as developed over the last thirty years, both in the academic and professional spheres. In particular, we show how techniques for dynamic asset management in the presence of such liabilities can be implemented using different supports (long-term bonds, derivatives, mutual funds, structures or a combination of these supports), with the dual objective of managing liability risk exposure (‘liability-matching portfolio’) and effectively managing asset performance. However, part III shows that depending on the strategy used, the accounting methods for treating the variation of the ‘fair value’ of each asset, as well as hedging operations, lead to greater or lesser volatility in the income statement and in shareholders’ equity and therefore result in an accounting bias in terms of strategic financial choices that we feel is completely at odds with the reality of economic volatility.

The IFRS bring about an additional volatility constraint (which clouds actual risk exposure) both with regard to hedging solutions for liability risk...

The hedging of liability risks can generally be done using three strategies: by constituting a bond portfolio, by using derivatives or by a combination of these two approaches.

The use of a bond portfolio to hedge liability risks immediately involves several challenges in purely financial terms: one must find bonds with appropriate maturity in relation to that of the liabilities, manage the hidden options in the insurance liabilities (which is almost impossible with bonds) and endure insufficient financial profitability. From now on, the accounting treatment of bonds and insurance contract liabilities where the risk is placed on the insurance company will generate volatility in the income statement (particularly with regard to immunisation techniques that require dynamic management of the bond portfolio) or in shareholders’ equity (and therefore in the solvency margin). While much of the bond portfolio is acquired with a view to

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4 - The authors of the study present a general analysis of the separation theorem from modern portfolio theory in the context of asset-liability management, as formalised by L. Martellini in ‘The Theory of Liability Driven Investments’, Life & Pensions Magazine, 2, 5, pp.39–44, 2006. This general analysis places LDI solutions in an innovative and consistent theoretical context.
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securing returns paid to policyholders, as well as insurance liabilities, and as a result is generally held until maturity, the IFRS demand that the variations in quarterly or half-yearly unrealised bond profits (classified as AFS) be included in shareholders’ equity, while the corresponding entry in liabilities remains part of historical costs. This volatility is completely artificial and in no way reflects either the value of an insurance company (dissymmetry in the treatment of the impact of an interest rate variation on assets and on liabilities) or the actual risk being run by an insurance company. The IFRS thereby reduce the financial management of liability risk hedging over several years, or even decades, to a scenario whereby assets are immediately liquidated (with no adjustment of liabilities).

Mindful of the excessive nature of this approach, the IASB suggested the implementation of a new asset category during the transition phase – HTM (held-to-maturity) – so as to correct this accounting mismatch (assets being valued at historical cost as with insurance liabilities). However, the accounting consequences for a HTM bond that is sold are so harsh as to have effectively dissuaded most insurance companies from using this asset category⁵ (in fact, some have no asset classified as HTM).

The second solution for hedging liabilities, involving the use of derivative instruments (swaps, swaptions, etc.) should allow the establishment of improved financial management solutions by allowing customisation through on the one hand the implementation of better cash flow matching and, on the other, the management of non-linear risks that are included in the liabilities’ hidden options. However, the appropriate treatment of derivatives requires either an overhaul of the IFRS or profound changes in the culture of financial markets. Today, the variation in value of the hedge performed using derivatives is fully included in the income statement, while, as we have seen, its corresponding entry, which is constituted by the change in value of the liabilities, has no accounting status.

This mismatch can result in such volatility in the income statement that the IASB established exceedingly cumbersome concepts referred to as ‘hedge accounting’, ‘shadow accounting’ and the ‘fair value option’. Again, however, the conditions required for the application of hedge accounting are so demanding (in particular proof of the effectiveness of the hedge) that insurance companies have made little use of it. The second problem for which, unlike in the banking world, there is no favourable and simple solution⁶ is that of macro hedging. In practice, the last half-yearly publications of 2006 have shown that these two issues alone are sufficient to bring about very high

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⁵ - More generally, the HTM category makes both dynamic management of interest rate risk and active management of credit risk impossible, which in turn means that the bond portfolio cannot be well managed in financial terms.

⁶ - The report provides an analysis of the limits and inadequacy of the shadow accounting solution proposed in phase I of the implementation of the IFRS.
The third solution for hedging liabilities is the creation of a bond portfolio that is complemented by derivative instruments (fixed-to-floated swaps, forward-start swaps) which, depending on the strategy used, make it possible to shorten or extend the duration of the bond portfolio. From an accounting point of view, this solution naturally combines the two mismatches mentioned for each of the last two strategies.

In practice, insurance companies maintain their mixed (bond-derivative) strategy at the cost of major efforts in communication (not without certain incidents, as seen with the last half-yearly publications): the financial community is not always inclined to delve into the depths of derivatives accounting and prefers to penalise those companies whose high volatility is accompanied by an explanation that is too complex or too opaque.

As developed in our analysis of state-of-the-art asset management techniques, the second component of good financial management practices in an insurance company, based on the separation theorem, is the search for high-quality performance from the asset portfolio. EDHEC suggest the use of the core-satellite approach to manage performance. The issue of optimising management and defining the asset risks is tackled in the core portfolio. A company can go about this in two ways: by employing risk diversification techniques to determine the optimal asset allocation decisions, on the one hand, and, on the other, by employing insurance portfolio techniques whereby risk hedging is performed using derivative instruments or, equally, dynamic asset allocation strategies, generating non-linear returns (convex payoffs) that will ensure tight control of the risk of loss or underperformance.

The first strategy, consisting of risk management on the basis of an optimal asset allocation decision (for example, where a certain percentage of stocks and bonds is defined as the optimal reference), requires frequent transactions as prices fluctuate to ensure that the asset portfolio is constantly adjusted so as to match the reference percentages at least. Using simulations, we demonstrate the superiority of this strategy when compared to a buy-and-hold strategy, in terms of its capacity to reduce the volatility and/or the (C)VaR (extreme risks) of the portfolio performance. Generally, this strategy used to be implemented by mutual

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7 - Fixed mix strategy. One can also adjust in line with variations in the risk parameters, leading to rebalancing in order to preserve optimal allocation with respect to the new estimated values of these parameters.
funds, which had the advantage of not being consolidated, meaning they caused no volatility in the income statement. Now, with the IFRS, major mutual fund holdings are usually consolidated. Furthermore, variations in minority mutual fund shareholdings are considered to be variations in liabilities and are recognised in the income statement. Such accounting constraints penalise this optimal allocation strategy, which is particularly effective in financial terms, bring about high volatility in the income statement and/or shareholders’ equity and necessarily impact heavily on the solvency margin.

The second risk management strategy is to consider optimal hedging with a view to generating non-linear returns as a protection against the risk of losses or underperformance. This strategy can be put in place using derivative instruments (an out-of-the-money put option, for example), structured products or even a dynamic asset allocation strategy (for which we have already mentioned the associated accounting problems). From an IFRS standpoint, the harsh constraint in derivatives handling of having to demonstrate and document the effectiveness of the hedge means that insurance companies must endure high volatility in the income statement, linked to the variation in the derivatives position with no corresponding variation in the underlyings. With regard to the treatment of structured products, the IFRS consider them as hybrid instruments made up of a host contract (the underlying) and one or more derivatives. Generally, the accounting treatment of these two components is done separately, which brings us back to the volatility and mismatch problems that are specific to derivatives.

Concrete numeric example of accounting volatility in risk management based on optimal asset allocation

Various numeric simulations were performed throughout this study to support our findings. One of the simplest, but no less informative, is a comparison between the accounting results of a buy-and-hold strategy, which consists of a direct investment in the global DJ Euro Stoxx index where the position then remains unchanged, and those of a strategy designed to determine the optimal allocation of the different sector indices that make up the DJ Euro Stoxx (with dynamic readjustments making it possible to return at regular intervals to the defined optimal allocation level) so as to minimise the portfolio’s extreme risk (CVaR) with no expected constraint on profitability. This simulation was performed for a period of 13 years (January 1993 to December 2005).

As shown in the table below, dynamic management (PF Min CVaR) makes it
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possible to considerably reduce volatility and extreme risks in relation to the buy-and-hold strategy, i.e. where one invests in the DJ Euro Stoxx and waits 13 years without making a single transaction.

However, the accounting treatment under the IFRS favours the buy-and-hold strategy, because it is possible to classify stock portfolios as AFS (Available For Sale). Quarterly or half-yearly variation in the market value of the DJ Euro Stoxx index will have no impact on the income statement but will only affect shareholders’ equity.

By contrast, with the dynamic asset allocation strategy, which makes it possible to reduce financial volatility and extreme risks, the quarterly and half-yearly variations in the market value of the portfolio made up of stocks from the DJ Euro Stoxx sector indices will be directly visible in the income statement. The volatility of the income statement under this management approach will be almost 17% (as against 0% under the buy-and-hold strategy, even though the latter results in greater financial volatility), with a maximum drawdown of 48% (as against 0% under the buy-and-hold strategy, which in reality results in a maximum drawdown of 63%). Finally, it is worth mentioning that this accounting impact on the income statement is in no way a reflection of shareholders’ equity (after integrating the results), as this equity varies as shown in the above table, with greater volatility, maximum drawdown, VaR and CVaR under the buy-and-hold strategy.

The IFRS represent a harsh restriction on good financial management practices in European insurance companies

With regard to the application of the IFRS to insurance companies, EDHEC believes that neither the method chosen (two-phase approach) nor the adaptational decisions made are satisfactory; above all, they are at odds with the intentions of the body for international accounting standards:

- While the concept of fair value is at the heart of the IFRS structure, and in view of the importance of defining a consistent representation of a company’s financial situation, the exclusion, on the one hand, of an insurance company’s liabilities on the pretext that they are too difficult to evaluate because they are not traded on the market is not consistent with the decision, on the other, to treat derivatives and structured products at fair value, even though they may be just as untradable and difficult to value. This inconsistency is one of the principal sources of volatility in

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**Table: Average Return, Maximum Drawdown, Volatility, VaR, CVaR**

<table>
<thead>
<tr>
<th>From Jan 1993 through Dec 2005</th>
<th>Average Return</th>
<th>Maximum Drawdown</th>
<th>Volatility Weekly 5%</th>
<th>VaR Weekly 5%</th>
<th>CVaR Weekly 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>DJ EURO STOXX</td>
<td>11.62%</td>
<td>62.99%</td>
<td>19.13%</td>
<td>4.36%</td>
<td>7.10%</td>
</tr>
<tr>
<td>PF MinCVaR</td>
<td>13.82%</td>
<td>48.33%</td>
<td>16.76%</td>
<td>3.81%</td>
<td>6.39%</td>
</tr>
</tbody>
</table>

*Source: EDHEC (2006)*

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8 - According to the company’s chosen frequency for accounting publications.
the income statements of insurance companies. At a time when prudential regulators — mainly through Solvency II — and the body for international accounting standards (via the IASB) are promoting internal models for the evaluation of asset-liability adequacy, the idea of excluding the majority of an insurance company’s liabilities from an actuarial analysis appears to be contradictory.

- EDHEC feels that the implementation of the IFRS undermines the very notion that financial accounts are a reflection of the value and risks of an insurance company. They impose constraints in terms of the volatility of the income statement and shareholders’ equity that appear to be completely at odds with the objective of the IFRS to make insurance companies accountable for the management of their risks. While Solvency II encourages insurance companies to improve the measurement of the extreme risks of their assets and liabilities so as to better manage them, the accounting result of good practice in the management of extreme risks is most often a financial situation that appears to be more risky than if the insurance company had done nothing at all.

- Finally, a more conceptual and fundamental contradiction comes of this analysis. While insurance companies strive to improve the management of their long-term risks (liabilities often have a lifetime of several decades), this management approach is handled in accounting terms by an analysis of the quarterly or half-yearly variation in the market value (which generally reflects short-term risk premia) of assets, liabilities and their associated hedges. Such an approach leads to insurance companies being considered as liquidating their assets and liabilities on an ongoing basis, whereas, in fact, they employ long-term management techniques to protect their liabilities, an approach which justifies a policy of allocating to risky assets that are partly non-liquid.

The idea of using the fair value principle for assets and liabilities by including all of their risk factors is clearly a significant step forward for financial management in insurance companies. However, this new, more ‘financial’ approach to accounting must not replace financial analysis, which in our opinion must remain independent from the chosen accounting approach. It is up to financial analysts, investors and regulators to understand an insurance company’s asset allocation and risk management policy by examining its balance sheet. Under no circumstances should the mathematical result that is reached by comparing and contrasting more or less sophisticated accounting figures, even if they are termed ‘fair value’, play the primary role in the evaluation of a company’s risks, consisting of an analysis of the consistency between
Executive Summary

its asset allocation and management policy and the assessment of its liability risks.

It is likely that the failure to sufficiently distinguish between the role of accounting and that of financial analysis, a phenomenon that has been heightened in recent years by the prominence in accounting of the true and fair view principle, has led to the inconsistencies highlighted in this study.

Instead of simply recording a company’s operations and possibly providing a discounted value of its worth, the IFRS, by also claiming to provide a consistent and universal framework for the analysis of a company’s value and its risks, reveal an ambition that is in our opinion disproportionate and dangerous.

Conclusion: From a Fair Value-based to an ALM-based approach to the evaluation of risks and solvency of insurance companies

While nobody would dispute the value of having a real view of the impact of the primary financial and actuarial risk factors on an insurance company’s accounts, we feel it is regrettable not only for the insurance sector but for the economy as a whole that the fair value of assets and liabilities be a basis for analysing the financial soundness and solvency of insurance companies. For most of their activities, insurance companies have long-term or even very long-term liabilities that in turn justify long-term allocation. Measuring their solvency on the basis of short-term values is not only incompatible with the need for investment in assets that, while risky, yield very positive average long-term returns, but also means that any genuine asset-liability management is an illusion, even though the regulators actually hope to promote ALM.

Similarly, EDHEC feels it is contradictory to favour the implementation of internal risk analysis models within the scope of the new prudential provisions (Solvency II), while at the same time basing the ultimate assessment of a company’s solvency on ratios taken from accounting values.

EDHEC believes that the only basis for analysts and regulatory authorities to assess the financial soundness and durability of an insurance company should be an analysis of the consistency between the liability risks and asset risks and an evaluation of the consistency and robustness of the asset-liability management models used.

This ALM-based approach to financial analysis presupposes that there is precise documentation of the company’s ALM allocation policy and the robustness tests that have been performed. This information should serve to support
the LAT tests, which are planned for the transitory phase of the application of the IFRS to the insurance sector.

EDHEC believes that neither the solutions put forward by the IASB to circumvent or diminish the short-term nature of the IFRS nor the transitory provisions are satisfactory. They ultimately render accounts more complex, arbitrary and unclear, and they increase accounting risk without offering any real solutions to facilitate good financial ALM management practices in insurance companies. On the contrary, we have shown in this study that good ALM, risk and asset management practices remain heavily penalised by the accounting provisions.

EDHEC hopes that European regulators and financial analysts will take full stock of the consequences of the new ‘financial’ approach to prudential regulation, Solvency II. This means abandoning all references to external and accounting approaches to solvency evaluation in favour of an evaluation of risk measurement and risk management procedures, internal models and the choice of risk parameters that underpin asset allocation and liability management decisions. In light of this, EDHEC regrets the approach chosen by the CEIOPS, as put forward in the QIS 2. Not only does it not correspond to the state of the art in global and optimal management of risk and insurance capital, but furthermore, and more importantly, in cases such as the treatment of options or the explicit absence of consideration for dynamic allocation strategies, it is at odds with the objective set out by Solvency II to control financial risks.

In conclusion, EDHEC feels that the particular nature of long-term investors’ liabilities, be they insurance companies or pension funds, is such that both regulators and financial analysts need to attach greater importance to the ongoing concern principle (which is an accounting principle), rather than suppose that the notion of fair value will transcend the whole of the accounting doctrine. It is only by finding this necessary balance that the invaluable contribution of the IFRS to the transparency of risk, particularly market risk, will not be undermined by the legitimate aim of allowing institutional investors, and insurance companies in particular, to continue to operate as long-term investors and perform their invaluable role of constant liquidity providers for the market and the economy at large.
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La profonde mutation de la gestion des sociétés d’assurance engendrée par la complexification et la multiplication des risques au cours des deux dernières décennies a suscité une nécessaire refonte des règles prudentielles (Solvency II) en complément de l’adaptation des normes comptables internationales (IFRS).

L’objectif des nouvelles normes comptables est d’offrir une meilleure perception de toute société, notamment au regard des risques qu’elle encourt. Toutefois, notre étude montre que la définition et l’application de ces règles aux assureurs va souvent à l’encontre de leurs objectifs initiaux : l’adoption de bonnes pratiques de gestion d’actifs et d’actif-passif (ALM) pour réduire l’exposition aux risques est souvent fortement pénalisée. Ces normes engendrent en effet une volatilité additionnelle, d’ordre purement comptable, sans commune mesure avec la réalité économique.

Pour ce qui concerne Solvency II, la dernière proposition du CEIOPS issue du QIS 2 nous apparaît inapplicable en l’état, tant la calibration des risques nous semble inadéquate. En effet, alors que Solvency II met en avant la problématique de prise en compte des risques extrêmes et vise à créer une incitation pour les sociétés à les mesurer et à les gérer, cette calibration incite plus à réaliser des arbitrages opportunistes plutôt qu’à améliorer la gestion des risques.

Pour montrer l’inadéquation, voire la contradiction qui peut ressortir entre certaines définitions des normes IFRS et propositions de Solvency II d’une part, et les objectifs de responsabilisation des sociétés d’assurance quant à la gestion de leurs risques d’autre part, l’EDHEC a publié cet important rapport. Dans une première partie de notre étude nous avons analysé les normes IFRS et les dispositions de Solvency II, au regard des problématiques de gestion d’actifs et d’ALM des sociétés d’assurance. La seconde partie dresse un état de l’art des techniques de gestion d’actifs et d’ALM, et notamment leur adéquation et leur pertinence, par rapport aux exigences d’une meilleure maîtrise des risques des sociétés d’assurance. Sur la base de ces deux parties, une troisième détaille les limites dans le nouvel environnement IFRS, des solutions de gestion d’actifs en présence de passifs de sociétés d’assurance. Sont ainsi mises en exergue les contraintes additionnelles de volatilité du compte de résultat et des capitaux propres que ce nouveau référentiel comptable engendre.

Les objectifs des IFRS et de Solvency II incitent la mise en œuvre de techniques de gestion des risques plus sophistiquées

La première étape de cette profonde mutation dans la gestion des sociétés d’assurance que constitue la phase I des IFRS est opérationnelle depuis

1 : Quantitative Impact Studies 2 élaborée par le CEIOPS (Committee of European Insurance and Occupational Pensions Supervisors).
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2006 et ne concerne pour l’instant que les sociétés faisant appel à l’épargne publique. Schématiquement, cette phase est la moins bouleversante puisqu’il s’agit principalement de mettre en place le concept de la « juste valeur » pour l’ensemble des actifs, pratique déjà largement utilisée par les marchés financiers. Nous verrons toutefois que les effets secondaires sont loin d’être négligeables et que la nouvelle volatilité générée dans le compte de résultat et/ou dans les capitaux propres est de nature à constituer de nouvelles contraintes pour les sociétés d’assurance, notamment dans la mise en œuvre de techniques avancées de gestion d’actifs et d’ALM.

La seconde étape, la phase II des IFRS, est prévue pour 2008 et élargira l’intégration des risques aux passifs. Devraient alors être totalement repensées les méthodes de provisionnement, l’intégration explicite des options et garanties, ce qui devrait engendrer de nouvelles contraintes de gestion pour les sociétés d’assurance, qui semblent d’ailleurs plus mobilisées que pour la phase I².

Enfin, la troisième phase, Solvency II, qui à la différence des IFRS concernera l’ensemble des sociétés d’assurance européennes, est prévue autour de 2010. Toutefois, cette étude montre que les impacts sur la gestion d’actifs et l’ALM, avec en particulier les questions relatives à la prise en compte des risques, pourraient être visibles dès que les contours de la formule standard du capital requis seront dessinés (courant 2007). En effet, Solvency II renforce les exigences d’appréciation et de gestion des risques dont la notion est élargie tant au niveau de son champ d’application (risques de marchés financiers, ALM, crédit, souscription et opérationnels), que de sa modélisation (loi de distribution, corrélation, études des risques extrêmes), de son évaluation et de sa gestion (dérivés, réassurance, titrisation, diversification). Selon l’EDHEC, si les IFRS ont été de nature à ajouter des contraintes additionnelles et malencontreuses de gestion financière, Solvency II pourrait engendrer des évolutions plus structurelles dans la gestion d’actifs et ALM.

Or, une étape importante dans l’élaboration de Solvency II vient d’être franchie avec la publication du QIS 2 visant à donner, sur la base des réponses des professionnels de l’assurance, une estimation quantitative de l’impact global du nouveau système de solvabilité. Sur ce point particulier, l’EDHEC estime que si les premières propositions répondent assez bien à l’équilibre recherché entre d’une part la sensibilité aux principaux facteurs de risques encourus par les assureurs, et d’autre part la complexité et le bien fondé des différentes approches testées, la calibration des paramètres de la formule standard proposée est en revanche totalement inadéquate compte tenu des exigences de capital.

² - A noter que le problème est déjà soulevé d’une part, en phase I à travers le test d’adéquation des passifs – LAT – et d’autre part, par le développement de l’European Embedded Value.
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économique qu’elle engendre. Ces exigences sélévent en effet à un niveau compris entre deux et quatre fois plus que celui prévu par Solvency I selon les risques et activités, et ce alors que les autorités de contrôle estiment aujourd’hui que les sociétés d’assurance sont bien capitalisées. Il semblerait que le CEIOPS suggère une mesure des risques en référence à une VaR à 99,5%, mais que la calibration des facteurs des modèles de risques en ait été totalement déconnectée. Ainsi, le présent rapport met en exergue certaines aberrations quant aux traitements de la volatilité de certains facteurs de risques dans différents domaines :

• En assurance dommages, la volatilité historique du ratio combiné ne nous paraît pas être une mesure pertinente du risque, car elle évince toute gestion optimale entre le résultat technique (opérationnel assurance) et le résultat financier. Elle constitue ainsi un frein à la mise en place de techniques de gestion des risques, dont la volatilité de la couverture exigerait des capitaux additionnels.

• Les stress scenarii requièrent des besoins de capitaux excessifs. Soulignons notamment la volatilité de 40% des marchés actions sur une année, qui comme pour les sociétés d’assurance vie aux États-Unis, pourrait complètement décourager la détention d’actions. Lorsque l’on compare les stress scenarii par rapport aux données historiques, il est d’ailleurs intéressant de constater que la volatilité retenue pour les actions est sans commune mesure avec celle retenue pour la courbe des taux d’intérêt.

• La formulation concernant l’intégration de la volatilité des actifs dans la formule d’exigence de capitaux conduit à certaines aberrations : par exemple, une stratégie « long-short » requiert beaucoup moins de capital qu’une stratégie visant à minimiser la variance d’un portefeuille (« low beta equity driven »).

• Le traitement des options et l’absence explicite de considération pour les stratégies dynamiques d’allocation d’actifs ou de couverture sont en contradiction avec les objectifs de Solvency II.

Ainsi, alors que l’objectif de Solvency II est de créer une incitation pour que les sociétés d’assurance mesurent et gèrent mieux leurs risques, les dispositions proposées pour leur calibration sont parfois en contradiction avec les objectifs. Une reformulation des règles applicables sur le sujet apparaît dès lors nécessaire et pourrait avoir lieu dans le courant de 2007.

En conclusion de notre analyse du nouveau dispositif prudentiel et comptable, nous estimons que, la « financierisation » et la sophistication des techniques de gestion d’actifs et d’ALM qui s’est amorcée au cours...
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de ces dernières années devraient s’amplifier. Elle devrait se traduire par une optimisation de la gestion du capital économique, via une meilleure adéquation actif-passif, et une gestion plus dynamique des écarts de duration et de convexité entre les actifs et passifs (produits de taux plus structurés et sophistiqués, caps, floors, swaptions, CDS...). Elle entraînera également un transfert vers les marchés financiers d’une partie des risques d’assurance de masse (titrisation de portefeuilles automobiles, habitations) et de pointe (obligations catastrophes naturelles, mortalité, longévité). Enfin, elle favorisera une meilleure gestion des risques extrêmes et une optimisation de la diversification même s’il est encore tôt pour apprécier dans quelle proportion Solvency II pourrait dynamiser et élargir l’allocation d’actifs aux investissements alternatifs, private equity, crédits structurés..., cela sera fonction du traitement de ces actifs dans la formule standard que nous souhaitions différente de celle proposée dans le QIS 2.

Pour répondre à cette problématique, la partie II de l’étude EDHEC dresse un état de l’art des différentes techniques de gestion d’actifs en présence de passifs d’assurance, qui ont été développées au cours de ces 30 dernières années, tant dans le monde académique que professionnel. Nous montrons en particulier que des techniques de gestion dynamique d’actifs en présence de passifs d’assurance peuvent être mises en œuvre, à partir de différents supports (obligations long terme, dérivés, OPCVM, structurés ou une combinaison de ces supports), avec le double objectif de gérer l’exposition aux risques de passifs (« liability-matching portfolio ») tout en gérant efficacement la performance des actifs. Toutefois, la partie III montre que selon la stratégie retenue, les traitements comptables de la variation de la « juste valeur » de chacun de ces actifs et des opérations de couverture conduisent à une plus ou moins forte volatilité du compte de résultat et des capitaux propres et donc engendrent un biais comptable dans les choix stratégiques financiers qui nous paraît totalement déconnecté de la réalité de la volatilité économique.

Les IFRS engendrent une contrainte additionnelle de volatilité (qui opacifient la réelle exposition aux risques) tant sur les solutions de couverture de risques de passifs ...

La couverture des risques de passifs peut généralement s’opérer selon trois types de stratégies : constituer un portefeuille obligataire, recourir aux dérivés ou retenir une combinaison de ces deux approches.

Le recours à un portefeuille obligataire pour couvrir des risques de passifs comporte déjà de nombreux défis sur

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le plan purement financier : trouver des obligations avec des maturités adéquates par rapport à celles des passifs, gérer les options cachées des passifs d’assurance (ce qui est quasiment impossible avec des obligations) et souffrir d’une rentabilité financière insuffisante. Désormais, la classification comptable des obligations et le traitement des passifs des contrats d’assurance dont le risque est supporté par l’assureur, génèrent un accroissement de la volatilité dans le compte de résultat (notamment dans le cadre de techniques d’immunisation nécessitant une gestion dynamique du portefeuille obligataire) ou des capitaux propres (et donc par répercussion sur la marge de solvabilité).

Ainsi, alors qu’une large part du portefeuille obligataire est acquise en vue de sécuriser le rendement versé aux assurés et les passifs d’assurance, et de ce fait, conservée en général jusqu’à maturité, les IFRS imposent que les variations des plus-values latentes obligataires (classification en AFS) trimestrielles ou semestrielles soient inscrites dans les capitaux propres, alors que la contrepartie aux passifs reste en coût historique. Cette volatilité est totalement artificielle et ne reflète en aucun cas, ni la valeur d’une société d’assurance (asymétrie du traitement de l’impact d’une variation des taux d’intérêt sur les actifs et sur les passifs), ni le risque réel encouru par un assureur. Les IFRS réduisent ainsi la gestion financière de couverture des risques de passifs sur plusieurs années, voire décennies, à un scénario de liquidation immédiate des actifs (sans d’ailleurs ajuster les passifs).

Conscient des excès de cette approche, l’IASB a proposé de mettre en place une nouvelle classe d’actifs pendant la phase transitoire, appelée HTM (« held-to-maturity »), afin de corriger cette distorsion (« mismatch ») comptable (actif évalué au coût historique comme pour les passifs d’assurance). Toutefois, les conséquences comptables liées à la cession d’une obligation classée en HTM sont si pénalisantes qu’elles ont en pratique dissuadé la plupart des assureurs de recourir à cette classe5 (certains n’ont d’ailleurs aucun actif classé en HTM).

La deuxième solution de couverture des passifs qui consiste à recourir aux instruments dérivés (swaps, swaptions, etc.) autoriserait a priori la mise en œuvre de meilleures solutions de gestion financière puisqu’elle permet de réaliser du « sur-mesure » avec d’une part, la mise en place d’un meilleur « cash flow matching », et d’autre part de la gestion de risques non linéaires qui figurent dans les options cachées des passifs. Cependant, le traitement pertinent des dérivés nécessite, soit une refonte de la norme IFRS, soit une profonde évolution de la culture des marchés financiers. En effet, aujourd’hui la variation de la valeur de la couverture effectuée à partir de dérivés est

5 - Plus globalement la classification HTM ne permet ni de gérer dynamiquement le risque de taux ni d’effectuer une gestion active du risque de crédit et rend donc impossible une bonne gestion financière d’un portefeuille obligataire.
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totalement inscrite dans le compte de résultat, alors que nous avons vu que sa contrepartie, constituée par le changement de valeurs des passifs n’existe pas comptablement.

Cette distorsion peut engendrer une telle volatilité dans le compte de résultat que l’IASB a mis en place des « usines à gaz », appelées « hedge accounting », « shadow accounting » et « fair value option ». Toutefois, là encore, les conditions requises pour l’application du « hedge accounting » sont si exigeantes (notamment la démonstration de l’efficacité de la couverture) que les assureurs n’ont eu peu recours. Le second problème qui, contrairement au monde bancaire, n’a pas trouvé de solution favorable et simple est celui de la macro couverture. Dans la pratique, les dernières publications semestrielles 2006 ont montré que ces deux problématiques suffisent à elles seules à engendrer une très forte volatilité dans le compte de résultat, d’ailleurs pas toujours comprise par les marchés financiers qui dans ce cas, n’hésitent pas à sanctionner le titre de la société concernée.

La troisième solution de couverture des passifs repose sur la constitution d’un portefeuille obligataire, complété par des instruments dérivés (« fixed-to-floated swaps », « forward-start swaps ») qui permettent selon la stratégie retenue, de raccourcir ou d’allonger la duration du portefeuille obligataire. D’un point de vue comptable, on retrouve naturellement le cumul des deux distorsions comptables mentionnées pour chacune des deux précédentes stratégies.

Dans la pratique, les assureurs maintiennent leur stratégie mixte (obligataires-dérivés) au prix de grands renforts de communication (avec toutefois certains accidents comme on l’a vu aux dernières publications semestrielles) : la communauté financière n’est pas toujours enclin à entrer dans les méandres de la comptabilité des dérivés et préfère sanctionner la société lorsque la forte volatilité est assortie d’un discours trop complexe ou trop opaque.

... que sur la gestion efficace de la performance

Comme nous le développons dans l’état de l’art sur les techniques de gestion d’actifs, la seconde composante d’une bonne gestion financière d’un assureur, assise sur le théorème de séparation, consiste en la quête de performance des portefeuilles d’actifs. L’organisation proposée par l’EDHEC pour gérer la performance est celle dite du « core-satellite ». Dans le portefeuille « core » se situent les enjeux de définition des risques de l’actif et d’optimisation de leur gestion. Celle-ci peut être réalisée selon deux approches : d’une part, par l’application des techniques de diversification des risques qui

6 - Dans leur rapport les auteurs analysent les limites et insuffisances de la solution proposée dans la Phase I de la mise en œuvre des normes IFRS constituée par le « shadow accounting ». 
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déterminent des décisions d'allocation d'actifs optimales, et d'autre part selon des approches issues des techniques d'assurance de portefeuille qui proposent des couvertures des risques via le recours à des instruments dérivés ou, de façon équivalente, des stratégies d'allocation d'actifs dynamique, avec une génération de rendements non linéaires (« convex payoffs ») qui assure la gestion stricte du risque de pertes ou de sous performance.

La première stratégie qui consiste à gérer le risque sur la base d'une décision d'allocation optimale d'actifs (par exemple un certain pourcentage d'actions et d'obligations est défini comme une référence optimale) nécessite de fréquentes transactions au fur et à mesure que les cours varient, afin d'ajuster en permanence le portefeuille d'actifs pour être à minima en harmonie avec les pourcentages de référence. A travers des simulations, nous démontrons la supériorité de cette stratégie par rapport à une stratégie « buy-and-hold » quant à la capacité à réduire la volatilité et/ou la (C)VaR (risques extrêmes) de la performance du portefeuille. Cette stratégie était jusqu'alors généralement mise en œuvre via des OPCVM qui présentaient l'avantage de ne pas être consolidés et ainsi n'engendraient pas de volatilité au compte de résultat. Désormais, avec les IFRS, les détentions significatives d'OPCVM sont considérées comme des variations de passifs comme des variations de passifs, avec leur reconnaissance dans le compte de résultat. Ces contraintes comptables pénalisent cette stratégie d'allocation optimale particulièrement efficace sur le plan financier et se traduisent par une forte volatilité du compte de résultat et/ou des capitaux propres et nécessairement par un fort impact sur la marge de solvabilité.

La seconde stratégie de gestion des risques consiste à considérer une décision de couverture optimale en vue de générer des rendements non linéaires pour se protéger contre le risque de pertes ou de sous performance. Cette stratégie peut être mise en place en utilisant des instruments dérivés (par exemple une option de vente en dehors de la monnaie), des produits structurés ou encore via une stratégie d'allocation dynamique d'actifs (dont on a mentionné dans la stratégie précédente les problèmes comptables associés). D'un point de vue IFRS, pour le traitement des dérivés, la forte contrainte de démonstration et de documentation de l'efficacité de la couverture conduit les assureurs à vivre avec une forte volatilité au compte de résultat, liée à la variation de la position en dérivés sans contrepartie des sous-jacents. Concernant le traitement des produits structurés, les IFRS les considèrent comme des instruments hybrides composés d'un contrat hôte.
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(le sous-jacent) et d’un ou plusieurs dérivés. Généralement la comptabilité de ces deux composantes est séparée et l’on revient donc sur les problèmes de volatilité et de « mismatch » comptables propres aux dérivés.

Un exemple concret chiffré de volatilité comptable d’une gestion du risque basée sur une allocation optimale d’actifs

Pour étayer notre démonstration, différentes simulations numériques ont été réalisées à travers cette étude. L’une des plus simples, mais non moins démonstratives, consiste à comparer la traduction comptable de la performance d’une stratégie « buy-and-hold » consistant à investir directement dans l’indice global du DJ Euro Stoxx tout en conservant cette position, à celle d’une stratégie visant à déterminer l’allocation optimale des différents indices sectoriels qui composent le DJ Euro Stoxx (avec des réajustements dynamiques permettant de revenir régulièrement au niveau de l’allocation définie comme optimale), afin de minimiser les risques extrêmes du portefeuille (CVaR), sans contrainte de rentabilité attendue. La simulation est réalisée sur une période de 13 ans (de janvier 1993 à décembre 2005).

Comme le montre le tableau ci-dessus, la gestion dynamique (PF Min CVaR) permet de réduire sensiblement la volatilité et les risques extrêmes par rapport à la stratégie « buy-and-hold », c’est-à-dire celle consisant à investir dans le DJ Euro Stoxx et patienter 13 ans sans réaliser la moindre transaction.

En revanche, le traitement comptable des IFRS est favorable à la stratégie « buy-and-hold », puisqu’il est alors possible de classifier le portefeuille d’actions en AFS. La variation trimestrielle ou semestrielle de la valeur de marché de l’indice DJ Euro Stoxx, n’aura aucun impact sur le compte de résultat mais affectera uniquement les capitaux propres.

A contrario, pour la stratégie dynamique d’allocations d’actifs qui permet de réduire la volatilité financière et les risques extrêmes, la variation trimestrielle ou semestrielle de la valeur de marché du portefeuille d’actions composé des indices sectoriels DJ Euro Stoxx, sera visible directement dans le compte de résultat. La volatilité du compte de résultat liée à cette gestion sera de près de 17% (versus 0% pour la stratégie « buy-and-hold » alors que cette stratégie engendre une plus forte volatilité financière) avec un « maximum drawdown » de 48% (versus 0% pour la stratégie « buy-and-hold » alors qu’en réalité cette stratégie engendre un « maximum drawdown » de la performance financière de 63%).

Mentionnons enfin, que cet impact comptable sur le compte de résultat n’est en aucun cas le reflet de la

<table>
<thead>
<tr>
<th>From Jan 1993 through Dec 2005</th>
<th>Average Return</th>
<th>Maximum Drawdown</th>
<th>Volatility</th>
<th>Weekly 5% VaR</th>
<th>Weekly 5% CVaR</th>
</tr>
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<tbody>
<tr>
<td>DJ EURO STOXX</td>
<td>11.62%</td>
<td>62.99%</td>
<td>19.13%</td>
<td>4.36%</td>
<td>7.10%</td>
</tr>
<tr>
<td>PF MinCVaR</td>
<td>13.82%</td>
<td>48.33%</td>
<td>16.76%</td>
<td>3.81%</td>
<td>6.39%</td>
</tr>
</tbody>
</table>

Source: EDHEC (2006)

* Selon la fréquence de publication comptable choisie par la société.
Résumé

situation des capitaux propres (après réintégration du résultat), puisqu'ils varient selon le tableau ci-dessus, avec une volatilité, un « maximum drawdown », une VaR et une CVaR des capitaux propres plus importante avec la stratégie « buy-and-hold ».

Les normes IFRS sont une contrainte forte à la bonne gestion financières des sociétés d’assurance européennes

Pour l’EDHEC l’application des normes IFRS aux sociétés d’assurance, tant dans l’approche retenue en deux phases que pour les décisions d’adaptations prises, ne sont pas satisfaisantes et surtout sont contradictoires avec les intentions du normalisateur comptable international :

- Alors que le concept de « fair value » est au cœur de l’architecture des IFRS et au regard des enjeux que représente la définition d’un cadre homogène de présentation des états financiers, il existe une incohérence dans la justification, d’une part à exclure les passifs des sociétés d’assurance sous prétexte qu’ils sont difficiles à évaluer parce que non négociés sur un marché et, d’autre part, à traiter dès la phase I, les dérivés et structurés à leur juste valeur alors que ceux-ci peuvent être tout aussi peu négociables et complexes à évaluer. Or, cette incohérence est l’une des plus grandes sources de volatilité des comptes de résultat des sociétés d’assurance. A l’heure où les régulateurs prudentiels, notamment au travers de Solvency II, et le normalisateur comptable international (par l’intermédiaire du LAT « Liability Adequacy Test ») promeuvent les modèles internes pour l’évaluation de l’adéquation actif-passif, l’idée de soustraire la majeure partie des passifs d’un assureur à une analyse actuarielle nous paraît être contradictoire.

- L’application des normes comptables telles quelles sont aujourd’hui établies remet en cause à notre avis l’idée même que des états financiers puissent refléter la valeur et les risques des sociétés d’assurance. Elles engendrent en effet des contraintes par rapport à la volatilité du compte de résultat et des capitaux propres qui nous paraissent totalement contradictoires avec les objectifs des IFRS de responsabilisation des sociétés d’assurance, quant à leur gestion des risques. Ainsi, alors que Solvency II incite les assureurs à mieux mesurer les risques extrêmes de leurs actifs et passifs pour mieux les gérer, la traduction comptable des bonnes pratiques de gestion des risques extrêmes conduit le plus souvent à des états financiers qui paraissent plus risqués que si l’assureur se contente de ne rien faire.

- Enfin, une contradiction plus conceptuelle et fondamentale apparaît. Alors que les sociétés d’assurance cherchent à améliorer leur gestion des risques long terme (la duration des passifs est parfois de plusieurs décennies), la traduction comptable de cette gestion se fait par une analyse de la variation trimestrielle ou semestrielle de la valeur de marché.
Résumé

(qui reflète généralement des primes de risque court terme) des actifs, passifs et leurs couvertures associées. Cela revient à considérer les assureurs sur la base d’une liquidation permanente de leurs actifs et passifs alors que leur gestion relève d’un processus de long terme de protection des passifs, ce qui justifie une politique d’allocation d’actifs risqués dont une part peu liquide.

L’idée de retenir la « juste valeur » pour les actifs et passifs en intégrant l’ensemble de leurs facteurs de risques est naturellement une avancée significative pour la gestion financière des sociétés d’assurance. Cependant, cette nouvelle approche plus « financière » de la comptabilité ne doit pas se substituer à l’analyse financière, qui, à notre avis, doit être indépendante du cadre comptable choisi. C’est aux investisseurs, régulateurs et analystes financiers à apprécier et comprendre la politique d’allocation d’actifs et de gestion des risques du bilan de l’assureur. En aucun cas, le résultat arithmétique issu de calculs comptables plus ou moins sophistiqués, quand bien même ils trouvent leurs justifications dans le terme de « juste valeur », ne doit primer dans l’évaluation des risques de la société par une analyse de sa cohérence entre la politique d’allocation et de gestion des actifs et son appréciation des risques de ses passifs.

Il est probable que l’insuffisante distinction entre le rôle de la comptabilité et celui de l’analyse financière, renforcée ces dernières années par la préméance dans la doctrine comptable du principe d’image fidèle, a conduit aux incohérences mises en exergue dans cette étude.

En ne se contentant pas d’enregistrer les opérations des entreprises et éventuellement d’en donner une valeur actualisée de leur patrimoine, mais en prétendant fournir également un cadre cohérent et universel d’analyse de leurs risques et de leurs valeurs, les normes IFRS, à notre avis, font preuve d’une ambition démesurée et dangereuse.

Conclusion : d’une approche « Fair Value-Based » à une démarche « ALM-Based » pour l’appréciation des risques et de la solvabilité des sociétés d’assurance.

Si nul ne conteste l’intérêt de pouvoir disposer d’une réelle vision de l’impact des principaux facteurs de risques financiers et actuariels sur les comptes des entreprises d’assurance, il nous paraît dommageable non seulement pour le secteur de l’assurance mais pour l’économie toute entière que la fair value des actifs et passifs servent de fondament à l’analyse de la solidité financière et de la solvabilité des assureurs.

En effet alors que pour l’essentiel de leurs activités les assureurs ont des passifs de long voir de très long terme qui justifient des allocations elle-même de long terme, mesurer la solvabilité sur des valeurs de court terme nous paraît
Résumé

non seulement incompatible avec le nécessaire investissement dans des actifs certes risqués mais dont la moyenne des rendements de long terme est très positive mais également rend illusoire toute véritable gestion actif-passif que par ailleurs les régulateurs souhaitent promouvoir.

Dans le même esprit, il nous parait contradictoire de favoriser la mise en œuvre de modèles internes d'analyse de risques dans le cadre du nouveau dispositif prudentiel Solvency II et par ailleurs faire dépendre l'appréciation finale de la solvabilité des entreprises de ratios fondés sur des valeurs comptables.

Nous considérons que seule une analyse de la cohérence entre les risques des passifs et des actifs et une évaluation de la cohérence et de la robustesse des modèles de gestion actif-passif doit servir de fondement aux jugements des analystes et autorités de tutelle pour apprécier la solidité et la pérennité financière de la société d’assurance.

Cette approche « ALM based » de l'analyse financière suppose que soient précisément documentées la politique d'allocation de gestion-passif ainsi que les tests de robustesse effectués. Cette information devrait servir à la qualification des LAT prévus dès la phase transitoire de l'application des normes IFRS au secteur de l’assurance.

Nous ne pensons pas que les solutions proposées par l'IASB pour contourner ou atténuer le « court termisme » des normes IFRS ainsi que les dispositions transitoires soient satisfaisantes. Elles conduisent au final à une complexification, à un arbitraire et à une illisibilité des comptes. Elles accroissent le risque comptable sans pour autant procurer de réelles solutions pour faciliter la bonne gestion financière des actifs et passifs financiers des assureurs. Au contraire, nous avons pu montrer à l’occasion de notre étude qu’au final les bonnes pratiques de gestion des risques d'ALM ou d’actifs restent fortement pénalisées par le dispositif comptable.

Pour l'EDHEC, les régulateurs européens tout comme les analystes financiers devraient tirer toutes les conséquences de la nouvelle approche « financière » du contrôle prudentiel que constitue Solvency II. Cela suppose que soit abandonner toute référence à des approches externes et comptables de l’appréciation de la solvabilité au profit d’une évaluation des procédures de mesure et de gestion des risques, des modèles internes et choix des paramètres de risques qui sous tendent les décisions d'allocation d'actifs et de gestion des passifs. En ce sens, l'EDHEC regrette l’approche choisie par le CEIOPS et proposée dans le QIS 2. Celle-ci, non seulement ne correspond pas à un état de l’art d’une gestion globale et optimale des risques et du capital des assureurs mais également et surtout, dans des cas comme celui des options et de l’absence explicite de considération pour les stratégies d’allocation dynamique,
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est contradictoire avec l'objectif de maîtrise des risques financiers affirmé par Solvency II.

Pour conclure, nous considérons que la spécificité des passifs des investisseurs de long terme qu'ils soient assureurs ou fonds de pension nécessite que tant les régulateurs que les analystes fassent plus cas du principe ( lui aussi comptable..) de continuité de l'exploitation sans considérer que l'idée de « fair value » transcenderait l'ensemble de la doctrine comptable. Ce n’est qu’au prix de cet équilibre que l’apport incontournable des IFRS dans l’information sur les risques notamment de marchés ne sera pas remis en cause par le souci légitime de permettre aux investisseurs institutionnels et particulièrement aux assureurs de continuer à exercer leur métier d’investisseur de long terme et à jouer le rôle indispensable d’apporteur constant de liquidité au marché et à l’économie.
I. The New IFRS and Solvency II Environment
The New IFRS and Solvency II Environment

Since January 1st, 2005, listed insurance companies have had to report their consolidated financial statements according to the International Financial Reporting Standards (IFRS). The objective is to draw up an accounting system that corresponds to the acceptance of economic cash flows. Beyond this objective, we believe that the IFRS constitute the first step in a strong incentive change in asset management and asset-liability management (ALM) that will be ratified by the implementation of Solvency II.

In the first part of this document, through a presentation of the key standards for asset management and ALM, and the Solvency II environment, we analyse how this new framework will accelerate the trend of “financialisation” in ALM, notably by introducing the concept of “fair value”, which removes a large number of the tools for smoothing net profit (equalisation reserves, over-caution reserves, bond amortisation, etc.) and changes the perception of risks. Phase II of the IFRS should emphasise this trend in broadening the scope of the risks, notably with more specific integration of the liability risks and an overhaul of the calculation of technical reserves.

In the same way, we believe that Solvency II will add some requirements to the IFRS, notably in strengthening the requirements for the measurement, evaluation and management of risks. The scope of these will be extended to financial market, underwriting, credit and operating risks. Asset management and ALM will have to be rethought in order to integrate the forward-looking approach for future cash flows, the extension of the scope of the risks, the report on the correlation and the dispersion of risks, risk modelling (from the best estimate to the Value at Risk or Tail VaR probably), and the integration of hedges (structured products, reinsurance and securitisation).

In the first section, we analyse the impact of the introduction of “fair value” into the accounting report. Notably, we deal with the unnatural classification of bonds (which generate additional volatility on equity that is incommensurable with the reality), the complexity of the introduction of derivative instruments into the balance sheet and its consequences (from off-balance sheet before the implementation of the IFRS to change through profit or loss with the IFRS), the inefficient and cumbersome hedge accounting system, accounting mismatches and some specific cases with a strong impact on asset management and ALM (embedded derivatives, mutual funds, structured products, etc.). Moreover, we analyse the management in phase I of valuation at “fair value” for the assets and at cost for the liabilities, notably through “shadow accounting”.
The New IFRS and Solvency II Environment

We present the framework of Solvency II in the second section, because the first rules will probably not be completed before July 2007. However, through the analysis of the Solvency II objectives, notably the introduction of risks (financial market and ALM, underwriting, credit and operating risks), and the incitement to develop an internal economic model, we will evaluate how Solvency II could affect asset management and ALM processes and require considerable thought for the integration of this new approach to risk.

I.1. IFRS: the key concept of “Fair Value” and its consequences

In order to evaluate the impact of IFRS on asset management and ALM in insurance companies, we shall present and analyse the main IFRS standards that will affect asset management and ALM.

Since the techniques for measuring and managing exposure to the risks arising from financial instruments have evolved in recent years and continue to grow day by day, the International Accounting Standards Board (IASB) requires an overview of the entity’s use of financial instruments, the exposure to risks they create and how those risks are managed. This disclosure, which offers greater transparency regarding those risks, is based on qualitative (description of management’s objectives, policies and processes for managing those risks) and quantitative (description of how the entity is exposed to risk) information.

Before the IFRS, most national accounting rules defined a list of assets that were allowed to back insurance contracts, valued usually at the historical acquisition cost (except unit-linked contracts, which are valued at mark-to-market in the balance sheet), but including impairment rules when the financial markets collapse. Conversely, the IASB defines how each asset is measured (at fair value, amortised cost or cost) and how the change in fair value is dealt with through the income statement or the balance sheet.

In practice, most financial assets, including derivatives that are assets, are measured at their fair values. The IASB defines “fair value” as “the amount for which an asset could be exchanged or a liability settled, between knowledgeable, willing parties in an arm’s length transaction” (International Financial Reporting Standards, IASB, IAS 39, page 1,720).

Classification is based on the management’s intent at the date of purchase. After initial recognition, transfers between categories are very restricted.
I.1.1. How to evaluate and classify a financial asset

As we mentioned previously, the situation in most European countries has moved from an accounting system where a restricted list of assets was allowed to back insurance contracts, to a set of standards where all assets are now classified (including derivatives, which were off-balance sheet, and mutual funds, which were not consolidated). This classification is decisive because it defines accounting for unrealised capital gains and losses and impairment rules through the profit or loss or equity. Depending on the insurance company's different choices, the net profit or equity will be more or less volatile. Moreover, after initial recognition, transfers between categories are very restricted.

In practice, this classification is the fruit of different processes. The classification can be:

• obligatory (for example, derivatives which are not designated and effective hedging instruments — see section I.1.4.1. — have to be classified in financial assets "at fair value through profit or loss");

• based on the management's intent at the date of purchase (held for trading, held to maturity, etc.);

• according to the nature of the contract (unit-linked products are at fair value);

• to simplify the accounting process (convertible bonds "at fair value through profit or loss" to avoid separation between the embedded derivative and the host contract).

Our aim is to analyse how the IFRS generate new volatility in the profit or loss and in equity, and whether this volatility is commensurate with the real exposure of the company. In order to deal with this issue, we first have to analyse how to evaluate and classify a financial asset.

Under IFRS, financial assets usually have to be measured at fair value. However, some exceptions exist as we will see below.

The IASB provides some guidance in determining fair value. The best evidence of fair value is the quoted price in an active market. When the financial instrument is not quoted in an active market, the fair value is based on valuation techniques whose variables include only data from observable markets (observable market transactions, discounted cash flow analysis, option pricing models or a specific valuation technique commonly used by market participants to price a specific instrument). The aim of using a valuation technique is to establish what the transaction would have been on the measurement date in an arm's length exchange motivated by normal business considerations.
The New IFRS and Solvency II Environment

However, in phase I, IAS 39 (“Financial instruments: recognition and measurement”) lists some exceptions in measuring financial assets. More precisely, IAS 39 classifies all financial instruments into four categories, with for each one, its own measurement tools, gain and loss accounting, and impairment rules:

- financial assets at fair value through profit or loss;
- held-to-maturity investments;
- loans and receivables;
- available-for-sale financial assets.

I.1.1.1. Fair value through profit or loss

The standard requires financial instruments (assets or liabilities) to be measured "at fair value through profit or loss" in the following three cases only:

- when an instrument is held for trading (HFT);
- when it contains an embedded derivative that the company is unable to measure separately or;
- in order to provide more relevant information.

I.1.1.1. Classification as "held for trading"

A financial asset (or liability) is classified as held for trading, when it is:

- acquired or incurred principally for the purpose of selling or repurchasing it in the near term;
- part of a portfolio of identified financial instruments that are managed together and for which there is evidence of a recent actual pattern of short-term profit taking;
- or a derivative (except when it is a designated and effective hedging instrument or a financial guarantee contract). Note that IAS 39 defines a derivative as a financial instrument for which:
  1) its value changes in response to the change in a specified interest rate, financial instrument price, commodity price, foreign exchange rate, index of prices or rates, credit rating or credit index or other variable, provided, in the case of a non-financial variable, that the variable is not specific to a party to the underlying;
  2) it requires no initial investment (or a smaller one than would be required for other types of contract that would be expected to have a similar response to changes in market factors);
  3) it is settled at a future date.

1 - According to IAS 32 (“Financial instruments: presentation”), a financial instrument is any contract that gives rise to a financial asset of one entity and a financial liability or equity instrument of another entity. A financial asset is any asset that is i) cash, ii) an equity instrument of another entity, iii) a contractual right to receive cash or another financial asset from another entity or to exchange financial assets or liabilities with another entity under conditions that are potentially favourable to the entity or iv) a contract that will or may be settled in the entity’s own equity instruments. An equity instrument is any contract that evidences a residual interest in the assets of an entity after deducting all of its liabilities.
The New IFRS and Solvency II Environment

The consolidation of derivatives in the balance sheet, with change in value through the profit or loss statement, constitutes a major issue for asset management and ALM (notably regarding the fact that until now, derivatives were off-balance sheet).

In order to build their hedging strategy (notably when it is difficult to satisfy the effectiveness criteria), insurance companies also now have to take into account the impact of the volatility in the profit or loss (which sometimes does not reflect the economic reality), and it can constitute a major obstacle to using sophisticated hedging approaches drawn from the state-of-the-art in ALM or to managing extreme risks, a current issue for many insurers. We will see in section I.1.4. that the hedge accounting standard elaborated by the Board is insufficient or is too constraining to manage these problems.

I.1.1.1.2. “Fair value through profit or loss” when a financial instrument contains an embedded derivative that is not measurable separately

In order to deal with this standard, the IASB gives the following definitions:
- An "embedded derivative" is a component of a hybrid (combined) instrument that also includes a non-derivative host contract. Usually, the impact of this embedded derivative is that some of the cash flows of the combined instrument vary in a way that is similar to a stand-alone derivative.
- An embedded non-option derivative (embedded forward or swap) is separated from its host contract on the basis of its terms (it has a fair value of zero at initial recognition).
- An embedded option-based derivative (embedded put, call, cap, floor or swaption) is separated from its host contract on the basis of the stated terms of the option feature. The initial carrying amount of the host instrument is the residual amount after separating the embedded derivative.
- A derivative attached to a financial instrument but contractually transferable independently of this instrument (or different counterparty from this instrument), is a separate financial instrument and not an embedded derivative.

The Board roughly requires that all derivative financial instruments be measured at fair value. This requirement is extended (under certain conditions mentioned below) to derivatives that are embedded in an instrument which is a non-derivative host contract.

When the economic characteristics and risks of an embedded derivative are so closely related to the economic characteristics and risks of the host contract that the company is
unable to measure separately (strong interdependency), the entire hybrid (combined) contract may be designated upon initial recognition as “at fair value through profit or loss”.

More precisely, if a contract contains one or more embedded derivatives, unless the embedded derivative(s) does not significantly modify the cash flows that otherwise would be required by the contract or it is possible (with or without a little analysis) to demonstrate that when a similar hybrid instrument is first considered that separation of embedded derivative(s) is prohibited (e.g. prepayment option embedded in a loan that allows the holder to prepay the loan for approximately its amortised cost), then the entire hybrid contract may be designated “at fair value through profit or loss”.

For example, an embedded derivative in which the underlying is an interest rate index (which can change the amount of interest that would otherwise be paid or received on a host insurance contract), is closely related to the host contract, “unless the combined instrument can be settled in such a way that the holder would not recover substantially all of its recognised investment or the embedded derivative could at least double the holder’s initial rate of return on the host contract and could result in a rate of return that is at least twice what the market return would be for a contract with the same terms as the host contract.” Similarly, an embedded floor or cap on the interest rate on an insurance contract is closely related to the host contract (the cap or floor is not leveraged in relation to the host contract).

Conversely, an embedded derivative shall be separate from the host contract and accounted for as a derivative (held-for-trading, hence “fair value through profit or loss” category) if the economic characteristics and risks on the embedded derivative and on the host contract are not closely linked; and if a separate instrument with the same terms as the embedded derivative would meet the definition of a derivative.

For example, equity-indexed interest or principal payments embedded in a host insurance contract (through which the amount of interest or principal is indexed to the value of equity instruments) are not closely related to the host instrument because the risks inherent in the host and the embedded derivative are dissimilar. This is also the case for an equity conversion feature embedded in a convertible debt instrument or credit derivatives embedded in a host debt instrument.

I.1.1.1.3. “Fair value through profit or loss” in order to reduce accounting mismatch (more relevant information)

A financial asset (or liability) is designated
upon initial recognition as at fair value through profit or loss:

- When that eliminates or significantly reduces a measurement or recognition inconsistency (notably accounting mismatch) that would otherwise arise from measuring assets or liabilities or recognising the gains and losses on them on different bases (see also section I.1.4.2. in the specific case of hedges). It thereby eliminates a large part of the volatility in profit or loss and equity that results when matched positions of financial assets and financial liabilities are not measured consistently;

- Or when a group of financial assets and/or liabilities is managed and evaluated on a fair value basis (amendment to IAS 9 issued in June 2005), in accordance with a documented risk management or investment strategy and the information about this group is provided internally on that basis to the entity’s key management personnel. The Board requires documentation that is less demanding than that for hedge accounting, but that is able to demonstrate the consistency of the use of this option and the internal risk management.

The application of the fair value option to a component or a proportion rather than the whole financial asset or liability is not allowed by the Board. The latter decided not to offer detailed prescriptive guidance about when the fair value option could be applied, but IFRS 7 ("Financial Instruments: disclosures") requires provision of a narrative description of how designation as at fair value through profit or loss is consistent with the company’s documented risk management or investment strategy.

In conclusion to this section, it seems that in practice most insurers have designated the following assets as falling within the scope of the fair value option:

- Financial instruments containing embedded derivatives that are difficult to separate from the host contract (for example convertible bonds);

- Assets held by consolidated mutual funds (see box for more specific details) in which the insurer holds an interest of less than 100%, primarily to avoid a mismatch in accounting treatment between minority interests in changes in asset values on the one hand, and changes in the corresponding minority interests recorded as liabilities in a specific line on the other;

- Financial assets held in connection with unit-linked contracts, where the liabilities relating to the contract are measured on the basis of the fair value of the underlying units.
I.1.1.2. Held to maturity (HTM)

Held-to-maturity investments are non-derivative financial assets with fixed or determinable payments and fixed maturity that a company has the intention and ability to hold to maturity.

HTM investments are measured at amortised cost using the effective interest method. The amortised cost is the amount at which the financial asset is measured at initial recognition minus principal repayments, plus or minus the cumulative amortisation using the effective interest method of any difference between that initial amount and the maturity amount, and minus any reduction for impairment.

Note that this classification is very constraining, because an entity shall not classify any financial assets as held to maturity if the company has during the current year or during the two preceding financial years, sold or reclassified more than an insignificant amount of HTM investment before maturity (except if it is attributable to an isolated event that is beyond the entity’s control, non-recurring and could not have been reasonably anticipated by the company).

If it is no longer appropriate to classify an investment as HTM, it shall be reclassified as AFS and thus remeasured at fair value. The difference between its carrying amount and fair value shall be recognised in the profit or loss.

In practice, these requirements have a strong impact on asset management and ALM. Until now, bonds were valued at amortised cost and constituted a larger share of asset portfolios in order to insure stability of the assets held to back insurance contracts (natural ALM when the bonds' characteristics were adequate). Most bonds are bought with the aim of keeping them until maturity. In that case, the classification in "held-to-maturity" seems totally natural.

However, in practice, the holding constraints and the "tainting rules" do not offer enough flexibility:

• It is not possible to manage the interest rate risk of the bond portfolio dynamically, notably in a period of crisis (management of the policyholder yield);
• Nor is it possible to implement a policy of active credit risk management, particularly using permanent line-by-line arbitrage of corporate bonds in accordance with changes in the ratings;
• Finally, they generate significant operational risk, because a mistake by a subsidiary or a business unit generates the reclassification of the whole group’s HTM portfolio. As such, in large groups, non-core subsidiaries would generally never be allowed to classify bonds as HTM due to the risk that would weigh on the whole group.

2 - The effective interest rate is the rate that exactly discounts estimated future cash payments or receipts through the expected life of the financial instrument, or when appropriate, a shorter period to the net carrying amount of the financial asset.
In this last case, the company has to explain to the financial markets why such a reclassification is justified (reputation risks).

No practical classification for bonds backing insurance liabilities suits both IFRS phase I and II, and both HTM and Available for Sale (AFS) bring about "unnatural" volatility, notably in equity. In most cases, bonds backing contracts that are not fair valued are classified as AFS (see section I.1.1.4.). In Phase I, a progressive interest rate increase should impact shareholders' equity, and thus the solvency, in a measure that is incommensurable with the economic reality. On the other hand, in IFRS phase II when insurance contracts are valued on a discounted basis, any bond classified in HTM and matching a discounted liability would diminish shareholders' equity where interest rates decrease. Long-term bonds backing liabilities cannot therefore be classified in this category.

For all these reasons, a very low percentage of financial assets are classified as HTM (none for some companies).

However, the "shadow accounting option" offered by IFRS 4 on contracts with Discretionary Participation Features ("Insurance Contracts", see section I.1.5.) partly offsets this volatility and conduces all companies to avoid the classification in "held-to-maturity" in favour of the "available-for-sale" category, which generates strong volatility in equity and additional accounting mismatches as we will see below.

I.1.1.3. Loans and receivables

Loans and receivables are non-derivative financial assets with fixed or determinable payments that are not quoted in an active market, without the intention to sell in the near term (HFT) or designated as at fair value through profit or loss or available for sale.

Loans and receivables are measured at amortised cost using the effective interest method.

I.1.1.4. Available for sale (AFS)

Available-for-sale financial assets are those that are not classified in the other three categories (loans and receivables, HTM or at fair value through profit or loss) and are measured at their fair values with change through equity.

Regarding our previous criticism, we can understand why insurance companies choose to classify most of their assets in the "available-for-sale" category: the "held-to-maturity" category prevents dynamic and efficient bond portfolio management while the "fair value..."
through profit or loss” classification generates excessive volatility in the profit or loss.

I.1.2. How to account for capital gains and losses arising from financial assets

IAS 9 deals with the capital gains and losses arising from a change in the fair value of a financial asset (unrealised capital gains or losses), according to a classification into four categories:

- For financial assets classified as “at fair value through profit or loss”, an unrealised gain or loss is recognised in profit and loss.

- For financial assets classified as ‘available-for-sale”, an unrealised gain or loss is recognised directly in equity (through the statement of changes in equity – “IAS 1 Presentation of Financial Statements”). Note that dividends on an available-for-sale equity instrument are recognised in profit or loss.

- For financial assets carried at amortised cost (loans and receivables and held for maturity), an unrealised gain or loss is recognised in the profit or loss when the financial asset is derecognised or impaired, and through the amortisation process.

Note that this analysis considers that these financial assets are not hedged items. Accounting for the unrealised gain or loss from hedged items is dealt with later in section I.1.4.

Depending on the standards (obligatory rules) or the choice of classification (options) realised by the insurance company, the impact of the change in fair value will generate varying volatility in profit or loss or in equity.

I.1.3. How to account for financial asset impairment

At each balance sheet date, the company has to analyse whether one (or more) events (with any objective evidence) has impacted the estimated future cash flows of the financial asset and caused impairment. Objective evidence of impairment includes significant difficulty of an issuer or obligator, default risk, information about significant changes in an adverse effect that have taken place in the technological, market, economic or legal environment in which the issuer operates, and indicate that the cost of the investment in an equity instrument may not be recovered.

However, losses expected as a result of future events, no matter how likely, are not recognised, nor is a downgrade of an entity’s credit in itself, although it may be impaired when considered with other available information.

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4 - Naturally, there is an issue of volatility. The higher the frequency of release, the higher the impairments.
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Again, in order to determine the amount of any impairment loss and its accounting statement, the company has to consider the classification of the financial assets:

• For available-for-sale financial assets, when there is objective evidence that the asset is impaired, the cumulative loss (difference between the acquisition cost net of any principal repayment and amortisation, and current fair value, less any impairment loss on that financial asset previously recognised in profit or loss) that had been recognised directly in equity, moves from equity to the profit or loss, although the financial asset has not been derecognised. Impairment losses for AFS investment in equity instrument are not reversed. On the contrary, if in a subsequent period, the fair value of a debt instrument classified as AFS increases, the impairment loss recognised in profit or loss shall be reversed.

• For financial assets carried at amortised cost (loans and receivables or HTM investment), the impairment loss is measured as the difference between the asset’s carrying amount and the present value of estimated future cash flows discounted at the financial asset’s original effective interest rate. This difference is recognised in profit or loss and shall be reversed.

• For financial assets carried at cost (unlisted equity instrument with a fair value that is not reliably measured, or a derivative asset that is linked to and must be settled by delivery of such an unquoted equity instrument), the impairment loss is measured as the difference between the asset’s carrying amount and the present value of estimated future cash flows discounted at the current market rate of return for a similar financial asset. Impairment losses are recognised in profit and loss and shall not be reversed.

In comparison with most previous national GAAPs, IAS 9 is stricter, notably with equity instruments, as well as on the criteria of depreciation, on its amount (fair value versus recoverable amount in French GAAP for example) or its irreversibility.

<table>
<thead>
<tr>
<th>Category</th>
<th>Conditions</th>
<th>Measure of the value and change in the value</th>
<th>Impairment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair value through profit or loss</td>
<td>• held for trading (short-term profit taking and derivatives)</td>
<td>Measured at fair value with change through profit or loss</td>
<td>Recognised in profit or loss and reversed (if the investment is carried at cost it is not reversed)</td>
</tr>
<tr>
<td>Held to maturity</td>
<td>Intention and ability to hold to maturity</td>
<td>Measured at cost or amortisation cost using the effective interest method. Value change does not impact the profit or loss or equity but very constraining.</td>
<td>Recognised in profit or loss and reversed</td>
</tr>
<tr>
<td>Loans and receivables</td>
<td>Non-derivative with fixed or determinable payments that are not quoted in an active market</td>
<td>Measured at amortisation cost using the effective interest method. Value change does not impact the profit or loss or equity.</td>
<td>Recognised in profit or loss and reversed</td>
</tr>
<tr>
<td>Available-for-sale</td>
<td>Not classified in the other three categories</td>
<td>Measured at fair value with change through equity</td>
<td>Cumulative loss moves from equity to profit or loss. Unlike debt instruments, equity instruments are not reversed.</td>
</tr>
</tbody>
</table>
I.1.4. How to reduce the volatility generated by the classification of derivatives

While IAS 9 offers greater transparency in derivatives reporting, thanks to a move from off-balance sheet to on-balance sheet, it is often considered to be the most complex of all. Numerous additional disclosures require particular attention to the risk management strategies (internal and reporting process), to its impact on the income statement (volatility), and more generally to the financial markets (to decide how best to manage the message).

As seen in section I.1.1., all derivatives, including those designated as hedging instruments (albeit ineffectively), are classified as "held-for-trading" (fair value through profit or loss category).

The main problem with derivatives is that in most cases, changes in fair value of hedged assets and liabilities are reported in the balance sheet (AFS), or even in some cases, not recognised in the balance sheet (company commitments, forecasted transactions, etc.). Naturally, these different accounting treatments generate accounting mismatches in the timing of gain and loss recognition, and thus, provide more volatility in the income statement than the company really has to face.

To reduce the accounting mismatch and the volatility generated by this classification, IAS 9 allows a "hedge accounting" option, which attempts to match the offsetting effects of the fair value changes in hedged items and hedging instruments, and recognises them in the balance sheet or in net profit or loss (depending on the classification of the hedged item) at the same time. However, strict criteria are onerous and difficult to satisfy: an alternative and less demanding choice is the "fair value option."

I.1.4.1. Hedge accounting: a restrictive privilege in order to reduce the volatility in the profit or loss

The aim of this special accounting treatment in IFRS, called "hedge accounting", is to provide a better reflection of the reality of hedging activities and to reduce the volatility that might arise under usual accounting rules. More specifically, the changes in the derivative and the corresponding hedged item are recognised in the profit and loss statement or in the balance sheet (according to the classification of the hedged item and the type of hedge) in the same period, as offsetting the change in fair value or cash flows of a hedged item.

Three types of hedge accounting are recognised by the IFRS:

5 - We have seen that a trading asset is defined by IAS 9 as an asset that is acquired principally for the purpose of generating short-term gains (no restricted time period in which the instrument is held) or a dealer’s margin. Trading assets are carried at fair value and any changes in fair value are recognised in the profit or loss.
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- fair value hedge (interest rate swap, currency swap, equity forward or option), in relation to the exposure to changes in fair value of a recognised asset (or liability);

- cash flow hedge (interest rate swap converting a floating-rate loan to a fixed rate), in relation to the exposure to variability in cash flows that is attributable to a particular risk associated with a recognised asset (or liability) or a highly probable forecasted transaction;

- hedge of the net investment in a foreign operation (as defined in IAS 21).

For example, IAS 39 stipulates that if a company issues a fixed-rate debt instrument and enters into a receive-fixed, pay-variable interest swap to offset the exposure to interest rate risk associated with the debt instrument, because the issued debt instrument does not give rise to any exposure to variability in cash flows (since the interest payments are fixed), the company may designate the swap as a fair value hedge of the debt instrument but not as a cash flow hedge.

However, to override the normal accounting treatment of derivatives, companies have to meet numerous, onerous and complex requirements. Complete documentation is needed at the inception of the hedge explaining the risk management objective, the hedged item, the hedging instrument, the nature of the risk being hedged and how the effectiveness of the hedge will be assessed:

- The hedge must be expected to be highly effective (see the definition below). Gains and losses on the hedged item and the hedging instrument must be expected to be almost fully offset over the life of the hedge (backward-looking and forward-looking tests). More precisely, a hedge is regarded as highly effective if the fluctuation in the fair value of the hedging instrument is expected to almost fully offset the fluctuation in the fair value of the hedged item within 80%-125%. Hedge accounting would stop when the correlation falls outside these ranges.

- The hedged item has to be identified and designated at the inception of the hedge.

- The hedging instrument has to be identified and designated at the inception of the hedge.

- The derivative has to be designated as an offset to changes in fair value or cash flows of a hedge item.

I.1.4.1.1. Effectiveness

The hedge must be expected to be highly effective (amendment consistent with the wording in US GAAP) effective, in achieving offsetting changes in fair
value or cash flows attributable to the hedged risk:
• at the inception of the hedge;
• tested regularly throughout its life (at least on every reporting date);
• effective in a range of 80%–125% over the life of the hedge, both forward-looking (based on expectations of future effectiveness) and backward-looking (evaluation of actual effectiveness). For example, if actual results are such that the loss on the hedging instrument is 115 and the gain on the cash instrument is 100, the offset can be measured by 115/100, which is 115% or by 100/115, which is 87%.

To qualify for hedge accounting, the hedge must relate to an identified and designated risk. For example, if the hedged item and the hedging instrument are denominated in different currencies or if a hedge of interest rate risk uses a derivative for which a part of the change in the fair value of the derivative is attributable to the counterparty’s credit risk, these do not move in tandem and the hedge would not be fully effective.

If the hedge passes the effectiveness tests but is not perfectly effective, any ineffectiveness must be recognised in the income statement for the current period. Ineffectiveness could come from different maturities (although IAS 39 does not specify any requirement for the maturity), different underlying interest or equity indices, or different currencies between the hedged item and the hedging instrument.

Moreover, IAS 39 does not specify a single method for assessing hedge effectiveness in order to integrate the specific risk management strategy of a company. Consequently, if the strategy of a company is to adjust the amount of the hedging instrument periodically to reflect changes in the hedged position, the company needs to demonstrate that the hedge is expected to be highly effective only for the period until the amount of the hedging instrument is next adjusted.

IAS 39 thereby permits an insurance company to apply hedge accounting for a “delta-neutral” hedging strategy and other dynamic hedging strategies under which the quantity of the hedging instrument is constantly adjusted in order to maintain a desired hedge ratio.

The appropriateness of a given method of assessing hedge effectiveness will depend on the nature of the risk being hedged and the type of hedging instrument used: mathematical techniques including ratio analysis (i.e. a comparison of hedging gains and losses with the corresponding gains and losses on the hedged item at a point in time) or statistical measurement techniques (such as regression analysis).
I.1.4.1.2. Designation of the hedged item

For hedge accounting purposes, the hedged item (assets, liabilities, company commitments or highly probable forecast transactions) has to:

• involve a party that is external to the entity (which eliminates intragroup operations in consolidated financial statements, except in accordance with IAS 21 "The Effects of Changes in Foreign Exchange Rates);

• create an exposure to a risk that could affect the income statement, currently or in future periods. The exposure has to be to a particular risk that can affect the profit or loss. An exposure to general business risks, such as unseasonable weather, treasury shares, intra-group operations or a commitment to acquire a company, is not reliably measurable and cannot be a hedged item, except for foreign exchange risk;

• be identified and designated at the inception of the hedge.

To improve the effectiveness of the hedge, it is possible to designate as a hedged financial item, a simple portion of the risk or cash flows. For example, a company can designate the LIBOR portion of a debt instrument and not the credit spread. A portfolio of similar items can be designated as a hedged item and the hedge is tested for effectiveness on a group basis.

Moreover, financial institutions often manage their exposure to interest rate risk on a net basis for all or parts of their activities. They have enough internal information in order to estimate and aggregate cash flows and to schedule such estimated cash flows into the applicable future periods in which they are expected to be paid and received (including estimates of prepayments and defaults). For risk management purposes, companies often use derivative contracts to offset some or all exposure to interest rate risk on a net basis. Hedge accounting for hedges of net open positions is not allowed (e.g. the net of all fixed-rate assets and fixed-rate liabilities with similar maturities) because it is not possible to associate hedging gains and losses with a specific item being hedged. The "macro hedging" approach of banks (economic interest rate risk management is done on a net basis) has not been expanded to the asset and liability management of insurance companies.

However, it is possible to work around this by designating a share of the underlying items as the hedged item. For example, if a company has 100 assets and 80 liabilities with similar risks and terms, it is possible to designate the net 20 exposure (portion of the assets) as the hedged item. However, the designation is expressed as an amount of a currency (assets or liabilities but not as a net amount) rather than as individual assets. This amount also
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determines the percentage measure that is used for testing effectiveness. While the portfolio can contain only assets or liabilities or both assets and liabilities, and it is used to determine the amount of the assets or liabilities the company wishes to hedge, the portfolio cannot itself be designated as the hedged item. The company has to designate what interest rate risk is being hedged and a hedging instrument (for instance interest rate swaps). The change in the fair value of the hedged item that is attributable to the hedged risk (for example LIBOR), and of the hedging instrument are recognised in profit or loss.

In another way, if a company uses Eurostoxx 50 put options in order to hedge changes in the fair value of a portfolio of Eurostoxx 50 shares classified in AFS (in the same proportion as are used to calculate the index), the Eurostoxx 50 put options cannot qualify for hedge accounting. Changes in individual prices are not approximately proportional to the overall change in the fair value. Consequently, the company should:

• recognise the changes in the fair value through the balance sheet for the shares (except impairment) and through the profit or loss for the options;

• or in order to reduce the accounting mismatch, classify the shares on acquisition as “at fair value in profit or loss” (as we will discuss later).

Naturally, a held-to-maturity financial asset cannot be a hedged item with respect to interest-rate risk or prepayment risk because designation of an investment as held-to-maturity requires an intention to hold the investment until maturity without regard to changes in the fair value or cash flows of such an investment attributable to changes in interest rates. It shall be a hedged item with respect to risks from change in foreign currency exchange rate or credit risks.

Finally, according to IAS 39, a derivative cannot hedge another derivative. For example, if a company decides to “cap” the variable leg of a swap, this cap is considered a hedge of a swap and would need to be marked to market through the profit and loss account.

I.1.4.1.3. Designation of the hedging instrument

The hedging item has to be identified and designated at the inception of the hedge. Most derivative financial instruments may be considered as hedging instruments for hedge accounting when they affect the profit or loss and involve a party external to the group (condition required by IAS 39). Conversely, a non-derivative financial asset (or liability) may be designated as a hedging instrument only for a hedge of foreign currency risk, although the Board acknowledged that
some companies use non-derivatives to manage risk.

The following can be designated as a hedging instrument:
• a proportion of a derivative (in terms of amount, such as 50% of the notional amount, but not a portion of the remaining life of a derivative, or in terms of payoff, such as the intrinsic value of a put);

• a single derivative that hedges an asset and a liability (cross-currency interest rate swap);

• several derivatives that hedge one hedged item (an interest swap and a collar), a combination of offsetting derivatives;

• a purchased option or combination of options (only if the purchased and written options are combined in a single instrument and it is not a net written option) or derivatives with knock-in and knock-out features (except if the derivative is a net written option) although it will be difficult to demonstrate its effectiveness. An interest rate collar that combines a written option and a purchased option does not qualify as a hedging instrument if it is, in effect, a net written option (for which a net premium is received). The potential loss on an option that a company writes could be significantly greater than the potential gain in value of a related hedged item. Consequently, a written option is not effective in reducing the profit or loss exposure of a hedged item (including a written option used to hedge a callable liability). On the contrary, a purchased option has potential gains equal to or greater than losses and can therefore qualify as a hedging instrument.

Conversely, intra-group derivatives in consolidated financial statements (except often currency risk), written options (potential loss on an option that a company writes could be significantly greater than the potential gain in value of a related hedged item), and non-derivative instruments (except for foreign exchange risk) cannot be recognised as hedging instruments for hedge accounting.

If a derivative is classified as an equity instrument, it may not be designated as a hedging instrument. For example, for share-based compensation schemes for employees and share-based payment to pay consultants providing services to the entity, different cases appear when the company buys an option to purchase its own ordinary shares at a fixed price to hedge the risk. An option with no cash settlement alternative is an equity instrument and cannot therefore be designated as a hedging instrument. Conversely, a net cash settled option may be designated as a hedging instrument (the hedged item exposes the company to a risk that could affect the profit and loss statement).
1.1.4.1.4. Dealing with the gain or loss on the hedged item and the hedging instrument under the “hedge accounting” option

When a fair value hedge meets the conditions of the “hedge accounting” option, the gain or loss from re-measuring the hedging instrument at fair value and the gain or loss on the hedged item attributable to the hedged risk are both recognised in profit or loss, although the hedged item is AFS. This applies if the hedged item is otherwise measured at cost.

Example: Fair value hedge accounting and option to sell stocks

We consider a company that holds €100m in a listed entity A with a stock price of €100 per share. This stake is classified as AFS, hence, the change in fair value is recognised directly in equity. In order to hedge against a fall in the share price, the company decides to purchase an option to sell the share at any time in the next 18 months. The cost of the option is €10m. We assume that the management designates the option as a hedge against changes in the investment’s fair value and is able to demonstrate that all criteria for hedge accounting are met.

At the end of the year the stock price has fallen to €80 and the option’s fair value has increased to €20.

From the accounting view, the option is initially recognised in the balance sheet and classified as “fair value through profit or loss” at €10m.

At the end of the year, the change in the fair value of the derivative is recognised in the income statement (in the normal way, i.e. excluding the hedge accounting option), but the corresponding loss on the available-for-sale investment, which would otherwise be deferred in equity, is also recognised in the profit or loss.

### Scenario 1: without fair value hedge accounting

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFS</td>
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<td>10</td>
</tr>
<tr>
<td>Fair Value Through P&amp;L</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Year 1 + 1</th>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFS</td>
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</tr>
<tr>
<td>Equity -20</td>
<td></td>
<td></td>
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</tbody>
</table>

Impact on the P&L: +10

### Scenario 2: with fair value hedge accounting

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFS</td>
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<td>10</td>
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<tr>
<td>Fair Value Through P&amp;L</td>
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</table>

<table>
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<tr>
<th>Year 1 + 1</th>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFS</td>
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<td>20</td>
</tr>
<tr>
<td>Equity 0*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Impact on the P&L: -10

* before integration of the impact of the P&L

Source EDHEC
In the first scenario (without fair value hedge accounting), the unrealised losses on the AFS investment are directly recognised in equity, and the total impact on the profit or loss is €10m (equivalent to the unrealised gains on the put).

In scenario 2 (with the fair value hedge accounting option), the unrealised losses on the AFS investment are recognised through the profit or loss, and the total impact on the profit or loss is €-10m (equivalent to the €10m unrealised gains on the put and the €20m unrealised losses on the AFS investment).

When the fair values of the derivative and the AFS investment move in opposite directions, fair value hedge accounting allows the volatility in the profit or loss to be reduced.

We are able to increase the complexity of this example dealing with the question of whether an efficiency test would have succeeded. The delta of an option to its underlying stock is typically less than 0.5, as the time value of the option acts as a buffer. Moreover, delta changes with time, and it is often difficult to prove that the change in the value of a put would offset 80% to 125% of the change in the value of the underlying stock at all reporting dates. This is the case even if the expectation is conditional upon a fall in the stock price.

One possible solution consists of the two following stages:

a) definition of the hedged item as the fall of the stock price below a certain threshold;

b) definition of the hedging instrument as the intrinsic value of the put option.

When the threshold is equal to the strike of the option, there is no need to perform an efficiency test, because it is by definition 100% efficient.

In this case, the time value of the put is the inefficient part of the hedge and passes through profit and loss. As far as the efficient part is concerned, we observe the following:

- the change in intrinsic value of the put options is accounted for in profit and loss;
- only the change in fair value in our AFS equity stock that can be attributed to the hedged risk will be transferred from equity to profit or loss.

We will now suppose that the strike is the current stock price. The risk being hedged is a fall in the stock price. Therefore, when the stock price goes up, the change in fair value is recorded in equity. The intrinsic value of the put remains zero and the time value is equal to the value of the put. Its change (generally) diminishes profit or loss. If the stock price falls, the amount
of the fall is transferred into profit or loss, where it perfectly cancels out the change in the intrinsic value of the put. As before, the diminished time value of the put goes into profit or loss.

We consider the previous example with a time to maturity equal to one year and a strike to 90. The derivative is classified in fair value through profit or loss (FVTPL), and the stock in available for sale (AFS).

Example: Fair value hedge and available-for-sale stock in a foreign currency

We have seen that a fair value hedge could be defined as a hedge of the exposure to a change in the fair value of a recognised asset or liability but also of an identified portion of such an asset or liability, which is attributable to a particular risk and which will affect reported net income. We will illustrate this case, considering a European company that holds a stake in an entity B listed in the US in USD (this stake is classified as AFS) and that wishes to be hedged against foreign currency risk in respect of its AFS investment.

The company intends to hold the investment for 18 months and enters into a forward contract to sell USD and receive EUR in 18 months, at a notional amount equal to the USD investment in entity B. We assume that the management is able to demonstrate that all criteria for hedge accounting are met.

From an accounting viewpoint:
1) The change in the fair value of the forward contract is recognised directly in the profit or loss (like in the normal conditions for a derivative, i.e. when the fair value hedge option is not chosen);
2) The portion of the change in fair value of the AFS investment that relates...
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to the underlying change in value in USD terms is recognised in equity (like in the normal conditions for an AFS investment, i.e. when the fair value hedge option is not chosen);

3) The portion of the change in the fair value of the AFS investment that relates to changes in the spot USD/EUR exchange rate (i.e. the gains or losses from retranslating the investment into EUR) is recognised directly through the profit or loss.

Example: Cash flow hedges and interest-rate swap

When a cash flow hedge meets the conditions of the "hedge accounting" option, the portion of the gain or loss on the hedging instrument that is determined to be an effective hedge is recognised directly in equity through the statement of change in equity (IAS 1), and the ineffective portion in profit or loss.

For example, consider that on January 1st, a company issues a 5-year €100m variable-interest note at LIBOR, with semi-annual interest payments and semi-annual variable rate reset dates. In order to protect against an increase in interest rates, the company enters into an interest-rate swap to pay 6% fixed and receive LIBOR. The swap terms include a €100m notional principal, 5-year term, and semi-annual variable rate reset.

Six months later, the LIBOR rate decreases to 5%. As interest is paid semi-annually, the mark-to-market value of the swap does not include any accrued interest. The fair value of the hedge (before settlement) is -€2.5m.

The company designates the future cash flows under the swap as a hedge of the variable future cash interest payments on the note. We assume that the company expects the hedge to be fully effective because the principal and notional amounts, currencies, maturity, basis of the variable leg (LIBOR) and variable reset dates of the note and the swap are the same. The test of effectiveness states that a maturity schedule can be prepared in order to demonstrate effectiveness.

From an accounting viewpoint: Initially, the company should recognise the swap contract at fair value (zero) and the debt's carrying amount at €100m (accounted for at initial amortised cost).

Six months later, in the balance sheet, the fair value of the swap is -€2.5m and the debt's carrying amount is adjusted by the change in its fair value due to changes in interest rates (effectiveness assumption): €97.5m.

Since we are in the cash flow hedge environment, the change in the fair value of the swap is recognised in equity. The impact on the profit or loss is zero.
Naturally, on settlement of the interest liability and the swap every six months, the portion of the fair value of the swap deferred in equity that relates to the interest payment made is released to the profit or loss. The fair value is determined as the present value of the expected cash flows under the swap.

More precisely, the effective portion of the hedge is recorded in equity and the ineffective portion recorded in net income. Once the hedged item is recorded on the balance sheet, the effective portion of the hedge is removed from equity and taken to the profit or loss.

I.1.4.1.5. Presentation of gains and losses from derivatives in profit or loss statement

The IFRS are not prescriptive, but the presentation should be consistent with the company’s risk management strategy: gains and losses from designated and effective hedging instruments should be presented in the same line items as the gains and losses from hedged items. It should be a part of operating income. Ineffectiveness should be presented separately in other operating income and expense or after the underlying profit.

I.1.4.2. A less constraining alternative: the "Fair Value Option"

The “fair value option” allows financial instruments to be measured at fair value with changes in fair value recognised in profit or loss. The Board rejected the possibility of adding a fifth financial instrument category and considered that “fair value through profit or loss” should be used to describe a category that encompasses financial instruments classified as held for trading and those to which the fair value option is applied (see section I.1.1.).

More precisely, IAS 39 allows a company to designate a financial asset or liability as at fair value through profit or loss when it demonstrates that this choice provides reliable and more relevant information on the effects of transactions or other events and conditions on the company’s financial position. Notably, when designation eliminates or significantly reduces a measurement or recognition inconsistency that would otherwise arise.

However, the company has to demonstrate and document through a narrative description of how designation at fair value through profit or loss is consistent with the company’s documented risk management or investment strategy, how those particular assets and liabilities are managed.
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together, or how the management strategy is effective in reducing the risk.

This is a very important point as the Board agreed that these disclosures would assist both prudential supervisors in their evaluation of capital requirements and investors in making economic decisions.

The ability for companies to use “the fair value option” simplifies the application of IAS 9 by reducing some accounting mismatch impacts from the different measurement tools. In particular:

• When there are natural offsets in the hedges of fair value exposure, the “fair value option” eliminates the constraining needs with “hedge accounting” (related burden of designating, tracking and analysing hedge effectiveness);

• It also eliminates the burden of separating embedded derivatives.

As we have seen in section I.1., in order to determine the fair value, the best evidence is naturally the quoted price in an active market. If it is not active for a particular financial instrument, the company has to use a valuation technique to establish the fair value: a recent transaction price, a reference to the current fair value of another instrument that is substantially the same, discounted cash flow analysis, option pricing models, or a specific technique commonly used by market participants to price a specific instrument.

Example: Case of an EMTN indexed to an equity index

Let’s consider a structured product made up of a 10-year bond and a nominal of €5,000 and for which the repayment is defined as the sum of the nominal plus 60% of the rise in the Eurostoxx 50.

Under the IAS 39 standard, this structured product (see box) should be analysed as a combination of two instruments:

• a host contract represented by a zero-coupon bond with a nominal of €5,000, which will repay the €5,000 at maturity. Its value at the time of the acquisition is €4,000;

• an implicit derivative which corresponds to an option which offers 60% of the rise in the Eurostoxx 50. Its value when the structured product is acquired is €1,000.

Generally, as we saw previously, bonds are classified as AFS (scenario 1). Under IAS 39, the implicit derivative should be valued at fair value through profit or loss. Due to this difference in classification, the two instruments’ unrealised gains or losses will be handled differently: unlike the implicit derivative, the variation in the value of the zero-coupon bond will have no impact on the profit and loss account. This reveals a difference in accounting treatment which bears no relation to the economic reality. To remove this
discrepancy, IAS 39 implemented the fair value option.

More specifically, under the fair value option, it is possible to classify the zero-coupon bond in the 'fair value through profit or loss' category too. Under this option (scenario 2), the accounting treatment of the structured product is global (without distinguishing between the two instruments).

Let’s assume that one year on, the value of the structured product has fallen by 20% (with the derivative now worth €150 and the zero-coupon bond €3,850). The impacts on the profit and loss account and the balance sheet according to the scenario selected are as follows:

In scenario 1 (AFS), the unrealised loss on the implicit derivative of €850 moves through the profit and loss account, while the loss on the zero-coupon bond has a direct impact on equity. In scenario 2 (the fair value option), the whole loss from the structured product passes through the profit and loss account and the impact is therefore -€1000. Naturally, the effect is perfectly symmetrical in the case of unrealised gains.

<table>
<thead>
<tr>
<th>Scenario 1: AFS</th>
<th>Scenario 2: Fair Value Option</th>
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<tbody>
<tr>
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<tr>
<td>Fair Value Through P&amp;L</td>
<td>150</td>
</tr>
<tr>
<td><strong>Impact on Profit and Loss</strong></td>
<td><strong>Impact on Profit and Loss</strong></td>
</tr>
<tr>
<td>-850</td>
<td>-1000</td>
</tr>
</tbody>
</table>

* before integration of the impact of the P&L
Source EDHEC
The specific case of structured products

The IFRS require virtually all derivative financial instruments to be measured at fair value. This requirement extends to derivatives that are embedded in an instrument. More specifically, IAS 39 considers a structured product to be a hybrid instrument with two components:

- the host contract, which might be for example an equity or debt instrument, or an insurance contract;
- and one or more derivative instruments, called embedded derivatives (because they are embedded in the host contract).

The IFRS require that the embedded derivatives be separated from their host contract and classified separately as trading assets or liabilities and marked-to-market through the income statement (notably when the financial derivative is embedded in a non-financial host such as an insurance contract, a sale or purchase agreement or when the embedded derivative and host contract are not closely related).

However, IAS 39 stipulates that in three specific conditions, the embedded derivative does not have to be separated and measured:

- When the embedded derivative is included in a financial asset or liability that itself is marked to market through the income statement, i.e. when the host contract is measured at fair value through profit or loss. The change in value will be included in the changes of the combined instrument and reported in income.

- When the economic characteristics and risks of the embedded derivative are closely related to the host contract. The IFRS do not provide much further guidance on how to make the "closely related" judgement and simply provide some examples.

- When the company is unable to separate and measure the embedded derivative. In that rare case, IAS 39 mentions that the entire combined contract has to be classified as a trading instrument and is marked-to-market through the income statement (fair value through profit or loss).

Even though IAS 39 does not provide much guidance on how to make the "closely related" judgement, it is possible through the examples to establish a classification according to the performance, the maturity and the extension of the maturity:
• When the derivative is a debt instrument whose coupon is indexed on the variation in interest rates or inflation and if it is issued at the reference market rate, it can in principle be considered to be closely related to the host contract. It could involve caps, floors, collars, or fixed to floating interest rate swaps. The company must be sure of recovering almost all of its initial investment. The incorporated caps and floors must be at or out-of-the-money and must not be levered. It is then necessary for the coupon received to be less than twice the coupon paid by an equivalent bond (maturity, credit risk) without an incorporated derivative. On the contrary, the separation of the derivative from the host contract will be necessary from the moment that the amount of the coupons or the repayment of the nominal is indexed on variations in the prices of shares, commodity indices or credit spreads.

• For the derivative to be considered closely related to the host contract in the case of a prepayment option, the amount of the compensation must remain limited with respect to the capital that is still due. The strike price of the prepayment option must therefore be approximately equal to the amortised cost of the security on the balance sheet (for bullet issues, it involves redemption at par).

• In the case of the maturity being extended, for the derivative to be considered to be related, the options for extending a debt must be accompanied by a clause for adjusting the interest rate in accordance with the market conditions at the date of the extension.

All in all, the cost of complying with the IAS for complex instruments, including analysis of embedded derivatives (identifying whether the instrument contains one or more embedded derivatives, determining whether each embedded derivative must be separate or is prohibited) can be eliminated thanks to the “fair value option” applied to the combined contract. It is easier to measure and hence more reliable than the fair value of only those embedded derivatives that IAS 39 requires to be separated, but the level of volatility in the income statement will be higher.
I.1.4.3. Partial and inadequate treatment of hedges and derivatives

To conclude on accounting for hedges with derivatives, if a company applies the common IAS 9 standard, then this will generate some accounting mismatches since the hedged item (debt or equity instrument) is often classified at "available-for-sale", with the changes in the fair value recognised in equity, while the change in the fair value of the derivative is recognised in profit or loss. The risk is that higher volatility in the profit or loss which is incommensurate with the economic reality will be generated.

In this framework, IAS 9 dramatically penalises the use of derivatives, notably the modern hedging approaches originally drawn from the state-of-the-art in ALM (for example hedging liabilities through derivatives and managing the surplus with assets) or in order to manage extreme risks (a current issue for many insurers).

The two alternative solutions offered by IFRS are only partial because:

- hedge accounting reduces these mismatches but is too constraining (notably on effectiveness) to be generalised to all the hedge issues of an insurance company;
- the fair value option is less constraining than the hedge accounting option, but requires the hedged assets to be classified as trading assets, which generates more volatility in the profit or loss than those classified as "available-for-sale".

The most widely used in practice

Very constraining

Not very useful, too volatile

The New IFRS and Solvency II Environment
The New IFRS and Solvency II Environment

1.1.5. IFRS 4 defines new requirements for asset-liability management

The IASB has considered the specific characteristics of the management of insurance companies and has issued a standard (IFRS 4: “Insurance Contract”) to improve the accounting for insurance companies until the Board completes the second phase of its project on insurance contracts. In another words, IFRS 4 is a stepping stone to phase II. In phase I, it decided on some rules that have a strong impact on asset-liability management and thus on asset management:

1) An insurer has to disclose information that allows the amount, timing and uncertainty of future cash flows from insurance contracts to be understood and the nature and extent of risks arising from insurance contracts to be evaluated. That relates to the objectives, policies and processes for managing those risks (sensitivity, concentration, claims development, liquidity, credit, terms and conditions of insurance contracts that have a material effect on the amount, timing and uncertainty of the insurer's future cash flows). However, the probable maximum loss (PML) or similar measures are not required by the Board, given the lack of a widely agreed definition on PML.

2) Provisions for possible claims under contracts that are not in existence at the reporting date are now prohibited. Some insurance contracts expose the insurer to infrequent but severe catastrophic losses (earthquakes for example). Some jurisdictions permit, or sometimes require, catastrophe or equalisation provisions (which cover random fluctuations in claim expenses), built up gradually over the years out of the premium received, until a ceiling amount is reached. For many insurers these provisions were associated with unearned premiums, matching the insurer's costs and revenue over the long term and enhancing solvency protection. Thus, they were a natural security (of several billions of euros) to smooth the net profit and were a key component in ALM.

3) A test of the adequacy of recognised insurance liabilities (Liability Adequacy Test) and an impairment test for reinsurance assets are required (see section I.1.5.1.).

4) An insurer does not have to separate the embedded derivative from the host contract, when the embedded derivative meets the definition of an insurance contract.

5) To reduce the accounting mismatch in this phase (I) created by the valuation of assets at fair value and not insurance liabilities, IFRS 4 defines a mechanism called "shadow accounting" (see section I.1.6.).

Note that all references in IFRS 4 to insurance contracts also apply to reinsurance contracts.
I.1.5.1. The constraint of the Liability Adequacy Test: a new source of volatility

As we mentioned previously, the IASB did not have sufficient time to handle the specific characteristics of the liabilities of insurance companies (see main issues in section I.1.5.3.) and preferred to respect the constraint of the implementation deadline for the IFRS (2005) without settling the issue of valuing the liabilities.

Phase I of the IFRS for insurance companies is therefore characterised by assets that are mostly valued at fair value, while the insurance liabilities (the technical provisions) conserve the statutory approach that prevailed before the IFRS, i.e. historical cost (at cost).

However, in order to sensitise insurers as of now to what phase II of the IFRS will be (the concept of fair value accounting), the IASB specifically set up the Liability Adequacy Test (LAT) for phase I. This consists of analysing whether the insurance liabilities are adequate for the insurance company commitments vis-à-vis the policyholders, notably in including embedded options and guarantees.

The entire eventual deficiency is recognised in the profit or loss. In that sense, the LAT increases the volatility of the net profit.

More specifically, the company has to determine whether the carrying amount of its insurance liabilities (less related deferred acquisition costs and intangible assets such as VOBA - Value Of Business Acquired - or PVFP - Present Value of Future Profit) is adequate in the light of the estimated cash flows, including claim handling costs, embedded options and guarantees. Note that related reinsurance assets are not considered because they are accounted for separately.

Many existing internal accounting models have tests to confirm that insurance liabilities are not understated and that related amounts which are recognised as assets, such as deferred acquisition costs or intangible assets, are not overstated. The aim of the Board is not to create a new measurement model but to define minimum requirements that an insurer’s existing model must meet and which reduce the possibility that material losses remain unrecognised during phase I.

However, it is important to underline that the Board includes in these minimum requirements the consideration of cash flows from embedded options and guarantees (which are not often required by national practices and internal models). If an existing Liability Adequacy Test does not meet the minimum requirement, a comparison is made with the measurement that IAS 37 would require (IAS 37 refers to the
amount that an entity would rationally pay to settle the obligation or transfer it to a third party).

Again in relation to the LAT, the IASB has preferred to fix a target (adequacy of insurance liabilities) instead of defining strict rules (internal models can be used if they are adequate).

EDHEC believes that the complexity brought about by the IFRS' specific approach to insurance companies' liabilities is not only inefficient, but is actually at odds with the initial objectives of the IASB. In phase I, assets are mostly evaluated at fair value, while a large share of insurance companies' liabilities (technical provisions) continue to be recorded in accordance with existing national norms (generally at historical cost) before the beginning of phase II. Furthermore, it is nonetheless requested that as early as phase I the impact of valuing liabilities at market value be ‘roughly’ tested using the LAT, except where specific norms have been defined by the IASB. In particular, this is done by including the hidden options and guarantees, something that has rarely been done up to now in insurance companies' internal or national models. The use of the LAT, therefore, means that the IFRS 4 introduces a fair value approach to liabilities in relation to insurance contracts, which may appear to be inconsistent with the progressive nature of the decision to implement the IFRS in two phases. For if the evaluation of liabilities at market value results in underfunding, this must be directly accounted for in the income statement (increased earnings volatility), while national accounting standards (at historical cost) remain those that are to be applied to technical insurance provisions.

Ultimately, the LAT in particular — and the IFRS more generally — result in a short-term approach to managing insurance companies, whereby assets and liabilities would be liquidated annually. This is the polar opposite of the economic reality of managing insurance companies that hold long-term liabilities. Such use of the IFRS to alter the reality of the situation, under the guise of risk analysis, makes it difficult to justify the share allocated to risky assets in spite of their importance with regard to the duration of insurance companies’ liabilities. This same bias is to be found in the current debate over the standard Solvency II formula between the regulators, who propose prohibitory rules for stocks, and the insurers, who insist on the problem of long-term liability management.

I.1.5.2. An exception to IAS 39: when the embedded derivative is an insurance contract

We have seen previously that IAS 39 requires embedded derivatives to be
separated from their host contract, and
measured at fair value with changes
recognised in the profit or loss. IAS 39
applies also to derivatives embedded in
an insurance contract, but an insurance
company does not need to separate
an embedded derivative that itself
meets the definition of an insurance
contract.

It would indeed be contradictory
in phase I to require a fair value
measurement of an insurance contract
that is embedded in a larger contract,
when such measurement is not required
for a stand-alone insurance contract.
However, IFRS require specific disclosures
and the Liability Adequacy Test has to
integrate them.

When the embedded derivative is a
policyholder’s option to surrender an
insurance contract for a fixed amount
or for a fixed amount and an interest
rate, separation is not necessary.
However, when the surrender value
varies in response to a change in a
financial variable (equity, commodity
price or index, or if the put option can
be exercised if a stock market index
reaches a specific level) or a non-
financial variable that is not specific to
a party of the contract, IAS 39 applies
(separation).

I.1.5.3. Status quo for some
issues, until phase II

IFRS 4 does not deal with the following
topics in phase I, because the Board
needs a more fundamental review of
these issues and will solve them in
phase II:

• deferred acquisition costs (definition,
  period and amortisation method, and
  whether asset or reduction in insurance
  liabilities, have not been defined and
  could disappear in phase II);

• discounting (most general insurance
  claims liabilities are not discounted
  while the Board believes that this will
  be more relevant);

• investment management fees
  (embedded value discounts them in
  order to determine its fair value,
  while the Board believes that this
  is not consistent with a fair value
  measurement and will define revenue
  recognition);

• the use of non-uniform accounting
  policies in consolidation (according to
  local practices);

• excessive prudence (not adequate
  regarding the neutrality required by
  the IASB);

• future investment margin (many
  existing measurement practices for
  insurance liabilities use a discount
  rate, based on the estimated return
from the assets that back an insurance contract, but for the Board, the cash flows from an asset are irrelevant for the measurement of a liability, unless it recognises that those cash flows affect the cash flows arising from the liability or the credit characteristics of the liability, as product pricing, reinsurance and market transactions are based on this asset feature;

- fair value measurement for insurance liabilities assumed in a business combination (definition and practices regarding intangible assets such as VOBA and present value outside the scope of IAS 38 "Intangible Assets");

- discretionary participation features (the Board will explore in phase II whether the distributable surplus from an insurance contract or an investment contract is a liability or a component of equity, or part equity and part liability).

For most of these items, a particular accounting treatment in phase I would create the risk that the Board might decide on a very different treatment in phase II. For that reason, the status quo has been chosen in these cases.

I.1.6. How to manage the accounting mismatch for financial assets held to back insurance contracts through the shadow accounting option

In phase I, numerous accounting mismatches arise, because financial assets, and in particular interest-bearing investments held to back insurance contracts, are measured at fair value under IAS 9, whilst insurance liabilities are measured on a different basis (at cost) under IFRS 4. The volatility generated in equity or in profit or loss does not appear to be a faithful representation of changes in the company's financial position; it is only the consequence of deficiencies in the existing measurement of insurance liabilities.

The Board mentioned that introducing a current market-based discount rate for insurance liabilities (rather than the historical discount rate) would reduce mismatches but it would be difficult to adopt in phase I. The IASB discussed various suggestions (such as relaxing the criteria for "held-to-maturity" assets, or the creation, like in Japan, of an "assets held to back insurance liabilities" category carried at amortised cost, or the implementation of an "available-for-settlement" liabilities category analogous to available-for-sale assets). However, a new asset category would create complex new processes which would probably not survive in phase II.
Finally, in order to reduce these mismatches, the Board decided to offer a “shadow accounting” option. This allows a company to recognise unrealised gains or losses on an asset that affect the measurements of insurance liabilities in the same way that realised gains or losses do. In other words, the related adjustment to the insurance liability shall be recognised in equity if the unrealised gains or losses are recognised directly in equity.

Naturally, the main consequence of the shadow accounting option is to offset a large part of the “fair value” principle and, for a large share of the life insurance activities at least, to thereby provisionally avoid the IFRS constraints during this first phase. Indeed, this loophole probably explains why the insurance companies were less virulent than the banks with respect to significant evolution in the standards, notably concerning an easing in the application of hedge accounting or macro hedges.

In fact, it is important to underline that:

1) Shadow accounting is not applicable if the measurement of an insurance liability is not driven directly by realised gains and losses on assets held. In particular, it is not applicable for liabilities arising from investment contracts (in the scope of IAS 39) without a discretionary participation feature or for insurance liabilities measured based on a discount rate that reflects current market rates because it does not depend on asset values or asset returns. Consequently, the scope of shadow accounting and fair value hedge accounting is not the same (under IAS 39, a non-derivative financial asset or liability cannot be designated as a hedging instrument, unless it is a hedge of foreign currency risk).

2) IFRS 4 allows continued use of the national accounting approaches when realised gains or losses on assets have a direct impact on the measurement of insurance liabilities (related, for example, to deferred acquisition costs (DAC) or intangible assets).

3) Shadow accounting is an option (which is allowed) to reduce the accounting mismatches generated by the different approaches to evaluating the assets and liabilities of a company, but in phase II there may be no justification for this option surviving.

4) The main limitation of shadow accounting is that the mechanism is very artificial, and all the more so in that IFRS 4 does not offer any indication on the share of the discretionary participation between technical provisions and equity. Numerous insurance companies therefore fear that in the event of a crisis in the financial markets (a stock or bond market crash), the artificial reduction in the volatility in the profit and loss account or equity generated by the assets matched with
the amount of insurance contracts endowed with participations would no longer be recognised, either by the participants in the financial markets or by the regulatory authorities. The consequences for the solvency margin and the perception of the company would be very prejudicial.

### Example of shadow accounting in the case of unrealised capital gains and losses

Let’s consider an insurance company whose assets classified as available for sale are matched with equity (A assets for €30bn), with insurance contracts that do not contain a discretionary participation clause (B assets for €40bn) and, finally, with insurance contracts that do have a discretionary participation clause (C assets for €250bn). So as not to overcomplicate the example, we propose to reason in terms of IFRS before tax.

#### 1st case scenario: all 3 asset compartments increase in value by 20%.

- **The A assets increase from €30bn to €36bn (including €6bn in unrealised gains).** The equity increases in the same proportion.

- **The B assets rise from €40bn to €48bn (including €8bn in unrealised gains) while the technical reserves remain stable at €40bn.** Since the insurance contracts do not have a discretionary participation clause, they are not covered by IFRS 4 (insurance contracts) but by IAS 9 (investments). As such, the offsetting entry for the variation in the assets of €8bn is found in the equity, which rises by the due amount of €8bn. **Shadow accounting is only authorised in IFRS 4 and the whole change in the fair value of the assets therefore goes into equity.**

- **The C assets go from €250bn to €300bn.** According to IFRS 4, all unrealised gains impact the technical reserves and add €50bn to the ”deferred participation” item. Shadow accounting is authorised in IFRS 4 and the change in the fair value of the assets therefore goes into the technical reserves to the amount of the share that belongs to the policyholders (to simplify we will assume here that it is 100%), without as a result affecting the equity.

Naturally, in most national accounting systems which reason at cost, all of the unrealised gains are off-balance sheet and therefore have no impact on the balance sheet.

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<tr>
<th>Year n (in €1bn)</th>
<th>Assets</th>
<th>Equity</th>
<th>Total Liabilities</th>
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<td>Assets B</td>
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<th>Equity</th>
<th>Total Liabilities</th>
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<td>44</td>
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<tr>
<td>Assets B (including +8 from B assets)</td>
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<td>48</td>
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<tr>
<td>Assets C (including +50 in deferred participations from C assets)</td>
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<tr>
<td>Total Assets</td>
<td>384</td>
<td>384</td>
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### The New IFRS and Solvency II Environment

- The A assets increase from €30bn to €36bn (including €6bn in unrealised gains). The equity increases in the same proportion.
- The B assets rise from €40bn to €48bn (including €8bn in unrealised gains) while the technical reserves remain stable at €40bn. Since the insurance contracts do not have a discretionary participation clause, they are not covered by IFRS 4 (insurance contracts) but by IAS 39 (investments). As such, the offsetting entry for the variation in the assets of €8bn is found in the equity, which rises by the due amount of €8bn. **Shadow accounting is only authorised in IFRS 4 and the whole change in the fair value of the assets therefore goes into equity.**
- The C assets go from €250bn to €300bn. According to IFRS 4, all unrealised gains impact the technical reserves and add €50bn to the ”deferred participation” item. Shadow accounting is authorised in IFRS 4 and the change in the fair value of the assets therefore goes into the technical reserves to the amount of the share that belongs to the policyholders (to simplify we will assume here that it is 100%), without as a result affecting the equity.

Naturally, in most national accounting systems which reason at cost, all of the unrealised gains are off-balance sheet and therefore have no impact on the balance sheet.
The New IFRS and Solvency II Environment

2nd case scenario: all three asset compartments fall in value by 20% and the economic value of the assets remains above that of the liabilities.

- A assets go from €30bn to €24bn (including €6bn in unrealised losses). Equity is impacted in the same proportions.

- B assets go from €40bn to €32bn (including €8bn in unrealised losses) while the technical reserves remain stable at €40bn). Since the insurance contracts do not have a discretionary participation clause, they are not covered by IFRS 4 (insurance contracts) but by IAS 39 (investments). As such, the offsetting entry for the variation in the assets of €8bn is found in the equity, which decreases by the same proportion, i.e. €8bn. Shadow accounting is only authorised in IFRS 4 and the change in the fair value of the assets therefore goes into equity.

- The C assets go from €250bn to €200bn. A Liability Adequacy Test, which involves comparing the economic value of the liabilities with that of the assets, takes place each year. In case 2, we have assumed that the value of the liabilities remained below (for example, €80bn) that of the assets (which is now €200bn). According to IFRS 4, all unrealised losses impact the technical reserves and deduct €50bn from the "deferred participation" item. Shadow accounting is authorised in IFRS 4 and the change in the fair value of the assets therefore goes into the technical reserves to the amount of the share that belongs to the policyholders (to simplify we will assume here that it is 100%), without as a result affecting the equity.

Naturally, in most national accounting systems which reason at cost, all of the unrealised losses are off-balance sheet and therefore have no impact on the balance sheet.

We should note that at that level of equity in the IFRS standards, the insurance company remains very comfortable with respect to its regulatory solvency margin (4%*200 + 1%*40 = 8.4 versus €16bn in IFRS GAAP and €30bn in national GAAP).
3rd case scenario: all 3 asset compartments decrease in value by 20% and the economic value of the assets is lower than that of the liabilities.

- A assets go from €30bn to €24bn (including €6bn in unrealised losses). Equity is impacted in the same proportion.

- B assets go from €40bn to €32bn (including €8bn in unrealised losses) while the technical reserves remain stable at €40bn). Since the insurance contracts do not have a discretionary participation clause, they are not covered by IFRS 4 (insurance contracts) but by IAS 39 (investments). As such, the offsetting entry for the variation in the assets of €8bn is found in the equity, which decreases by the same proportion, i.e. €8bn. Shadow accounting is only authorised in IFRS 4 and the whole change in the fair value of the assets therefore goes into equity.

- The C assets go from €250bn to €200bn. A Liability Adequacy Test, which involves comparing the economic value of the liabilities with that of the assets, takes place each year. In case 3, we assume that the fair value of the assets (which is now €200bn) is for example 5% lower than that of the liabilities (€210bn). In view of this inadequacy, the fall in the assets from €250bn to €200bn results in a negative impact of €10bn on equity (drawn from the asset-liability shortfall) and the complementary amount of €40bn affects the "deferred participations" item in accordance with the shadow accounting principle.

Naturally, in most national accounting systems which reason at cost, all of the unrealised losses are off-balance sheet and therefore have no impact on the balance sheet.

We should note that at that level of equity in the IFRS standards, the insurance company is very uncomfortable with respect to its regulatory solvency margin (4%*210 + 1%*40 = 8.8 versus €6bn in IFRS GAAP or a shortfall of more than 30%).

To give a more sophisticated (and more useful) example of shadow accounting, as we have mentioned previously, under most national requirements for certain insurance contracts with discretionary participation (DP), deferred acquisition

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<tr>
<td>(including -6 from A assets)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(including -10 from C assets according to the Liability Adequacy Test)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets B</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Reserves without Discretionary Participation</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets C</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Reserves with Discretionary Participation</td>
<td>210</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(including -50 in deferred participations from C assets)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Assets</td>
<td>256</td>
<td>Total Liabilities</td>
<td>256</td>
<td></td>
</tr>
</tbody>
</table>
costs (DAC) are amortised over the life of the contract as a constant proportion of estimated gross profit (including investment returns and capital gains). We consider a contract with a policyholder participation rate of 95%. Assets backing the insurance contract are classified as AFS. The corporate tax rate is 35%. The DAC proportion is 20% of capital gains and losses.

One year later, we assume that unrealised capital gains on the assets are €1bn. Without the shadow accounting practice, €650m (€1bn * (1-0.65)) net of tax goes through equity.

With the shadow accounting practice, the impact of unrealised capital gains on equity is only €26m:

- Invested assets are valued at fair value and increase by €1,000m. The counterpart on the liability side is partly on the equity - the shareholders’ share is only 5%, based on (1 – policyholder participation rate) - and on the technical reserves (95%*1000);

- DAC are adjusted to reflect the impact of the unrealised capital gains, net of policyholder participation in future profits. The net impact for the shareholders is only 5%, hence the counterpart on the liability side is in the equity (5%*20%*1000 or 20%*(1000-950));

- The change in assets (€1bn), liabilities (€950m) and DAC (-€10m) has an impact of €14m on deferred taxes based on an assumed 35% tax rate.

- Consequently, equity is impacted by only €26m following a change in fair value of €1bn.

To conclude on the impact of IFRS 4 on ALM and asset management, we note the following:

- IFRS 4 defines what an insurance contract is, and constrains many insurance companies to add some significant insurance risks in policies that previously contained only financial risks (for example, unit-linked products without death benefits) in order to apply IFRS 4 instead of IAS 39, and consequently to adapt their ALM and asset management.

- In order to reduce the accounting mismatch generated by the fact that assets held to back insurance contracts are measured at fair value under IAS 39 whilst insurance liabilities are measured under IFRS 4 (national GAAP often at cost), most companies turn to the shadow accounting option, which allows unrealised gains or losses on an asset that affects the measurements of insurance liabilities to be recognised, in the same way as realised gains or losses are. The related adjustment to

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Assets</th>
<th>Liabilities</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invested Assets</td>
<td>+1000</td>
<td>Equity</td>
<td>+26</td>
</tr>
<tr>
<td>20%*(1000-950)</td>
<td>DAC -10</td>
<td>Technical reserves +950</td>
<td>95%*1000</td>
</tr>
<tr>
<td></td>
<td>Deferred tax liabilities +14</td>
<td>95%*(1000-950-10)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>+990</td>
<td>Total</td>
<td>+990</td>
</tr>
</tbody>
</table>
the insurance liability, DAC or intangible assets shall be recognised in equity if the unrealised gains or losses are recognised directly in equity. However, because IFRS 4 does not offer any indication on the share of the discretionary participation between technical provisions and equity, some insurers fear that in a financial crisis environment, this artificial mechanism would not be recognised, thus encouraging volatility in the profit or loss or in equity.

- The Liability Adequacy Test, which consists of analysing whether the insurance liabilities are adequate, and recognising the entire eventual deficiency in the profit or loss, has required some adjustments for certain insurance companies, notably to underline the embedded option and guarantee issues (which are not often required by national practices). In some cases, the ALM processes could be adapted to improve management of the embedded options and guarantees.

I.1.7. Conclusion: IFRS impact on ALM and asset management

Phase I is a transition phase, but until phase II comes into effect, it generates some accounting mismatches because assets that are held to back insurance contracts are measured at fair value under IAS 39, whilst insurance liabilities are measured under IFRS 4 (national GAAP often at cost). In certain cases, some options, like “shadow accounting”, “hedge accounting” and “fair value through profit or loss”, allow these mismatches to be reduced, but sometimes the option is too constraining and the insurance companies prefer not to use it or to use it parsimoniously.

More generally, with regard to the IFRS and their application to insurance companies, EDHEC believes that neither the method chosen nor the adaptational decisions made are satisfactory; above all, they are at odds with the intentions of the body for international accounting standards.

While the concept of fair value is at the heart of the IFRS structure, the implementation of a transitory phase leads to the exclusion from this approach of the main element of an insurer’s liabilities. The explanations put forward, we feel, are not sufficient in view of the importance of a straightforward and consistent representation of a company’s financial situation. The attempt to exclude insurance contracts from the fair value approach on the pretext that they would be too complex, would not be traded on the market and would therefore be difficult to value, does not appear to be consistent with the desire to treat derivatives or structured products at fair value on the asset side, even though they may be just as untradable and difficult to
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analyse and value. At a time when prudential regulators and the body for international accounting standards (via the IASB) are promoting internal models for use in ALM, the idea of excluding the majority of an insurer's liabilities from an actuarial analysis appears to be contradictory. When one considers, as in the case of life insurance, the importance of financial risks relative to other risks in the changing value of insurance liabilities, it is rather difficult to sustain a distinction between insurance contracts and financial liabilities on the pretext that the former present a non-financial insurance risk.

Ultimately in our opinion, the implementation of the IFRS undermines the very notion that financial accounts are a reflection of the value and risks of an insurance company. Considering that insurers carry long-term risk by virtue of the duration of their liabilities, it appears inconsistent to impose an evaluation of these liabilities based on market values (or their equivalent) which reflect short-term fluctuations in risk premiums. Such an approach actually leads to insurers being considered as liquidating their assets and liabilities on an ongoing basis, whereas, in fact, they employ management techniques based on an estimate of a liability's duration, an approach which justifies a policy of allocating to risky assets that are partly non-liquid. The IFRS do not allow the particular nature of insurers (long-term investors providing liquidity to the overall economy) to be taken into account.

Rather than undermine the very idea that financial statements provide the basis for a true picture of a company's value and its risks, the IASB, in an effort to 'save' the IFRS in the insurance sector, tried to offer measures that would reintroduce the notion of long-term holdings (HTM category) or mitigate the consequences of a fair value evaluation of financial assets (shadow accounting). Unfortunately, these minor accounting measures are inadequate in view of the specific characteristics of financial management in insurance companies. For example, while only a long-term liability can justify holding stocks, such holdings cannot be included in the HTM category and must therefore undergo a short-term valuation.

Instead of simply recording a company's operations and possibly providing a discounted value of its worth, the IFRS, by also claiming to provide a consistent and universal framework for the analysis of a company's value and its risks, reveal an ambition that is in our opinion disproportionate and dangerous: they do not favour good practice in long-term financial management (this will be further dealt with in a later section of this document).
I.2. Solvency II: a far-reaching evolution in the management of insurance companies

The European Union has undertaken an ambitious project in the decade 2000-2010 to completely overhaul prudential rules. This should constitute a genuine change in the management of insurance companies. With Solvency II, the EU wishes to "establish solvency requirements that are better adapted to the risks that are actually taken on by the insurance firms and encourage the latter to better evaluate and control their risks."

In the last few years, the evolution in the complexity of risks has led to a genuine desire to adapt the prudential and accounting rules in order to provide a better perception of all companies, notably with regard to the risks being run. Even though the ends are different, the means implemented by the IFRS, Solvency II, Basel II, the new rules for financial conglomerates and the EEV (European Embedded Value, developed by a group of financial directors (CFO) and risk management directors (CRO) from leading European insurance companies) all converge towards this goal.

The objective of Solvency II is to determine the level of prudential capital required for each insurance company, based on an economic evaluation of the risks and no longer on a fixed-rate approach, as is the case today with Solvency I. This development should therefore lead to the following:

- Regulatory prudential requirements that are more consistent with the economic objectives. This should simplify the management of insurance companies, which are also subject to accounting (IFRS) and rating targets, and simplify asset management and ALM, following the necessary adaptation of the internal models to integrate this new environment.

- A more systematic and proactive approach to risk management, notably through ALM and asset management. By developing a more subtle and more severe evaluation of the risks (distribution, correlation, diversification, consideration of extreme risks, etc.) and by broadening their field of application (market, ALM, credit, underwriting and operational risks) beyond that defined by Solvency I and the IFRS, insurance companies will have to better capture, quantify and manage their risks, which will henceforth be identified sooner. This should lead to better market discipline.

- More efficient management of economic capital. The objective of Solvency II is to compel insurance companies not only to measure their risks better, but also to incite them to manage and control them better. The amount of capital required will depend on the capacity to achieve
these objectives. The capital requirement exercises considerable pressure, because all mobilisation of capital has a cost, notably with regard to capital allocation optimisation by activity, which depends on the activity’s profitability and volatility.

More specifically, Solvency I is today based on backward-looking financial statements, which leads to a decorrelation between the solvency margin and the future cash flows. This causes numerous paradoxes: the lower a company’s reserves, the less capital it needs; the asymmetrical treatment of fixed-income gains or losses; integration of gains into assets without restating the liabilities (artificial wealth), etc.

Solvency II should adopt a more economic and forward-looking approach by establishing principles rather than directives, in order to incite each company to set up more sophisticated internal risk analysis, management and control models.

Depending on the means available (the leaders in the sector are several years ahead of the other actors), the work to adapt or indeed to overhaul the internal models (asset allocation, ALM, provisioning, embedded value, and economic capital) is ongoing. Beyond the requirements of Solvency II, these models are at the heart of the management of every company. They should improve the competitiveness of their owners in an environment in which Solvency II, like Basel II, could redefine the confines of the insurance market (profitability that will henceforth integrate the risks being run) and financial strategies (asset allocation, hedging, more sophisticated ALM techniques, etc.).

In this sense, the trend towards the increasing ‘financialisation’ of ALM observed over the last few years should continue to grow. Solvency II should integrate the issue of asset-liability adequacy in the level of capital required, which should lead to more dynamic management of the differentials in duration and convexity between assets and liabilities, notably by turning to more structured and sophisticated interest rate products, (caps, floors, swaptions, CDS, etc.), a transfer of some of the risks of mass insurance (securitisation of automobile and residential portfolios) and large insurance risks (natural catastrophe, mortality and life expectancy bonds) towards the financial markets.

Moreover, consideration of the diversification (even though it is still early to evaluate the proportion) could boost and broaden asset allocation towards alternative investments, private equity, structured credits, etc.

After showing that Solvency I has slowed down the modernisation of asset management and ALM, we will
analyse the extent to which Solvency II should constitute a deep change in the management of insurance companies.

I.2.1. Solvency I: a hindrance to dynamic asset management and ALM

European regulations require an insurance company to be solvent, i.e. sufficiently solid financially to respect its commitments to its policyholders and other creditors.

The foundations of the current solvency system date from the 1970s (notably directives 73/239 for general insurance and 79/267 for life insurance). Since then they have been updated during the work on Solvency I, which began in 1997 and led to publication in 2002. However, while they enabled the power of the insurance companies’ regulatory authorities to be extended, they barely modified the existing system.

We should stress that over the last few years, in spite of the increasing fragility of insurance companies’ balance sheets, due to the stagnation in the financial markets, to the significant slowdown in economic growth and to sometimes devastating loss experiences, the number of failures of insurance companies has remained very limited. In Europe, the frequency of failures is around 0.25%, significantly less than that observed for the rest of the economy, which is estimated at 2% (ACAM and Euler-Hermès estimates).

However, all the actors in the insurance industry (both the insurance companies themselves and the supervisors) recognise willingly that the simplicity of the rules of Solvency I no longer correspond to the evolutions in the sector and to the risks being run, hence the necessary reform of Solvency II.

Apart from this obsolescence, we feel that Solvency I hampers the development and adaptation of asset management and asset-liability management (ALM) techniques. By not recognising certain assets, quasi-equity, hedging techniques, numerous risks, risk distribution (extreme risks), correlation and diversification in the calculation of the solvency margin; and by only considering the present value of future profit and reinsurance partially, Solvency I does not encourage deployment of the entire range of asset management and ALM instruments, which would favour risk management and control and optimisation of capital allocation.

Moreover, it is interesting to observe the significant development of these techniques over the last two years in the leading insurance groups, who have started to set up internal models which are being shaped progressively in tandem with the construction of the major principles of Solvency II and, naturally, the IFRS.
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As such, while, as we have stressed previously, the IFRS have rendered a large number of profit smoothing tools outdated and, as a result, accelerated the ‘financialisation’ of ALM, Solvency II will amplify this trend by reinforcing and generalising the risk evaluation and management requirements. The integration of future cash flows (forward-looking approach to liabilities already integrated in the IFRS and the assets), the extension of the definition of risks, the study of the correlation and/or the dispersion of risks and their modelling (from best estimate to the VaR and the consideration of extreme risks), and the integration of risk hedging (structured products, reinsurance and securitisation) will naturally have major consequences on asset allocation and ALM.

I.2.1.1. The definition of the required minimum margin (RMM) according to Solvency I...

In order to guarantee policyholders a certain level of security, the prudential rules of Solvency I are based on requirements which all European insurance companies must respect:

- A sufficient level of reserves, determined prudently, i.e. offering a margin that is sufficient to integrate unfavourable variations in the different variables that make up the reserves. The interest rate, for its part, is set according to the rules of the competent authority in the country of origin.

- Assets that are safe, liquid\(^8\), diversified and profitable. Each member state has established a list of admissible asset categories.

- A minimum level of equity which exceeds the regulatory threshold of the required minimum margin (RMM).

In life insurance, the RMM is equal to the sum of the following elements:

- 4% of the mathematical reserves and the management reserves for the contracts whose investment risks are borne by the insurance companies (generally referred to in the Euro Zone countries as "contracts in euros");

- 1% of the mathematical reserves and the management reserves for unit-linked contracts (investment risk borne by the policyholder);

- a percentage of the capital under risk (0.30%, 0.15% or 0.10% depending on the duration of the commitments - respectively, less than 3 years, between 3 and 5 years and more than 5 years).

In general insurance, the calculation of the RMM is equal to the maximum of:

- 18% of the gross reinsurance premiums below €50m, and 16% if above;

- 26% of the average net recovered claims over the last three years below €50m.

\(^8\) - Although the liquidity is generally not an issue for the insurer’s balance sheet.
Reinsurance can be retained up to a limit of 15% for life insurance and 50% for general insurance.

It is certain that the strict respect of these extremely simple rules (with regard to their approach to insurance risks – the other risks are not explicitly integrated – and their arbitrary nature with regard to the fixed-rate calculation), is not a catalyst in the implementation of sophisticated internal asset management and ALM models that aim to measure and manage the risks that are inherent in the sector.

Each European member state added up its own prudential rules with its intrinsic requirements in a more or less marginal way. France implemented specific forward-looking reports on investments and reinsurance, quarterly T3 asset-liability reports (which introduce the notion of market value), C6 bis, C8 and C9 reports that respectively test the liquidity of assets in the face of a wave of redemptions and the quality of the reinsurance coverage in the face of a major risk (earthquake, epidemic, etc.). With the same objective, in the United Kingdom, the PSB (Prudential Sourcebook) system strengthens Solvency I by broadening the notion of risk to market, credit, insurance and liquidity risk. Operational risk and correlation between the classes are not yet truly integrated.

The system in the Netherlands is fairly sophisticated and an approach that is similar to Solvency II has already been adopted with:
• a standardised method based on a Risk Based Capital approach (see also section 1.2.3.3. ) integrating interest rate, stock market, real estate, credit and underwriting risks;
• an approach that accepts internal models as long as they model the distribution of the equity (satisfaction of the solvency requirements with a confidence interval of 97.5%).

Besides, it seems incongruous today that the solvency margin of a company in a country depends on the local statutory accounting standard and not on the economic reality that is common to the whole of Europe. Conscious that this lack of harmonisation between the solvency systems can sometimes curb free competition, Solvency II is seeking a maximal harmonisation solution, while at the same time having to handle the specific local characteristics (products, participation mechanisms, etc.).

I.2.1.2. ... and of the capital admitted in representation...

According to Solvency I, the following are generally admitted in representation of the available solvency margin:
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- the paid-up share capital or the effective initial fund, reduced by the amount of own shares;

- the capitalisation reserve or any reserves (statutory and free) not corresponding to underwriting liabilities;

- the profit or loss brought forward from the previous period after deduction of dividends to be paid;

- the subordinated securities or loans up to 25% of the amount of the RMM (or the solvency margin if it is less), or 50% if it involves loans that do not have a fixed maturity;

- the unrealised gains on assets when they are not of an exceptional nature;

- 50% of the company’s future profits (upon application with supporting evidence by the company and with the agreement of the competent local authority) obtained by multiplying the estimated annual profit by a factor which represents the average period left to run on policies;

- the guarantee fund reserve to the amount of the contribution paid in by the company and not used by the fund.

As in the previous section, the restricted nature of these relatively simple rules is not a catalyst in the implementation of sophisticated internal asset management and ALM models that aim to measure and manage the risks inherent in the sector.

I.2.1.3. ... hinders the dynamic management of asset management and ALM

We feel that Solvency I slows down the implementation of more elaborate internal models, in particular asset management and ALM, that would better reflect the real exposure of the risks being run, not only because of its arbitrary nature, but above all in the very minimalist view it gives insurance companies both in terms of the levels of the types of risks and in risk management and control.

The notion of risk is generally defined as any random event which reduces the insurance company’s capacity to cope with its commitments (policyholders, shareholders for a listed company, affiliate members for a pension fund, etc.). Insurance companies are exposed to the risks inherent in the assets that they hold, to their commitments in the liabilities with respect to the policyholders and to the correlations between the two.
I.2.1.3.1. Solvency I: a hindrance to managing the risks of assets

It is surprising after the stagnation in the credit and stock markets that the notion of asset risk is still so simplistic.

Within the framework of Solvency I, each country defined a list of admissible assets and the authorised proportions that satisfied the constraint on “safe, liquid, diversified and profitable assets”:

- In order to reduce the signature risk relating to the solvency of the issuer of financial securities, a minimum dispersion of the investments with regard to the issuers (maximum percentage for a single issuer), to their legal nature and to the type of market on which they are traded is required.

- Concerning exchange rate risk, which is relatively limited due to the principle of congruence, the insurance company can only hold assets that are in a different currency to that of the commitments taken with respect to the policyholders up to a certain limit of the value of the commitments.

The simplicity of these rules means that in practice, the Solvency I capital requirement is strictly identical to an asset portfolio 100% composed of AAA-rated government bonds, or unlisted Colombian debt instruments, or 100% of emerging market shares. The risks relating to the volatility of stock markets, of currencies, of interest rates, the use of derivative instruments, the liquidity, congruence or credit risks, are still not explicitly integrated in determining the solvency margin.

From this viewpoint, Solvency I does not encourage asset management to be optimised according to the risk/return combination. As we shall see in section I.2.3., Solvency II should remedy this weakness by implementing a risk weighting system for each asset. Therefore, the capital admitted in representation of the solvency margin will be accounted for in different amounts depending on whether it is invested in AAA bonds or in shares. The integration of hedging methods (which are not widely recognised by Solvency I, and are therefore at a fixed-rate) will also enable this approach to risk to be nuanced.

I.2.1.3.2. Solvency I: a hindrance to managing the risks of liabilities

On the liability side, Solvency I also contains simple and arbitrary rules that do not encourage insurance companies to manage their liability risks dynamically. In spite of the examples of Japanese and American bankruptcies that were very instructive on the sources of failure, Solvency I’s vision of the technical reserves still remains very administrative and accounting-oriented.
As we specified in section I.2.1.1., the capital requirement is fixed-rate (percentage of technical provisions, turnover or previous claims) in both life and non-life and does not explicitly integrate either the risks inherent in the insurance occupations, nor those qualified as “business related.”

The risks inherent in the occupation of insurer are characterised by:

- underwriting risks, i.e. those related to claims (catastrophes, epidemics, etc.). For example, in life insurance, the main risk is the life contingency, i.e. the risk relating to life expectancy. It exists from the moment that the insurer plans to pay out a benefit of a different amount or at a different date depending on whether the policyholder survives or dies. The risk for the insurer can be translated by a drift in mortality (the policyholders live longer than the mortality table selected for the contract) or an adverse selection phenomenon (the policyholders’ survival or death rates are different from those selected in the mortality or survival tables);

- the risks related to errors in evaluation, parameter setting, modelling and exposure;

- the risks related to the evaluation of the technical reserves;

- the risks related to the evolution of the competitive environment.

Alongside these risks that are inherent in the occupation of insurer, there are business-related risks which are identified and defined as:

- strategic risks, emanating notably from inadequate decisions in the area of markets, products, techniques, innovations, acquisitions or commitments;

- operational risks, such as ineffective fraud control, human errors, technical defects or malicious intent;

- legal risks relating to new regulations, laws, jurisprudence or taxation;

- reputation risks corresponding to the risk of a negative image in the eyes of the public, rating agencies or the more general financial community;

- internal risks related to infrastructure or information systems.

The integration of all of these risks by Solvency I only results in a global fixed-rate approach, according to a percentage of the technical reserves in life insurance or the turnover and past claims in general insurance. For example, the capital requirement is strictly identical between the different classes of general insurance. For an identical turnover, Solvency I requires exactly the same capital for insuring an automobile insurance portfolio, a civil medical responsibility portfolio or a natural catastrophe portfolio.
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From this perspective, Solvency I again does not invite optimised management of liabilities and their risks. As we shall see in section I.2.3., Solvency II should provide a solution by integrating all of the risks mentioned above.

It is interesting to stress that this mishap is probably related to the regulations' focus on equity and not on reserves. Equity is only the additional layer in the case of inadequacy of the technical reserves. In other words, a company with a satisfactory level of reserves, which already integrates the economic or financial uncertainties, should be able to survive by definition without equity, or at least the latter should only be set aside for very extreme risks.

The true issue therefore relates to the constitution of the reserves both for the IFRS (this is the challenge for phase II of the IFRS, since the IASB was not able to handle this question in time for phase I, which notably seeks to give a true and fair view of the company through the market value and the removal of so-called smoothing reserves covering non-identified future risks) and for Solvency II, which has to determine a formula that is relatively simple so as to be applied to all insurers (without being too costly) and sophisticated so as to integrate most of these risks as well as possible.

I.2.1.3.3. Solvency I: a hindrance to modern Asset-Liability Management

Asset-liability inadequacy is very often the source of failure of insurance companies. However, it is not considered by Solvency I, which again does not incite insurers to develop a sophisticated ALM model and consequently asset management that provides a better fit with the risks being run. For many insurance companies, the modelling of hidden options remains very elementary, even though they have become more numerous and complex in an insurance market that provides increasingly innovative offerings to its policyholders.

We recall that hidden options are guarantees or rights that are conferred upon policyholders by the regulations or contractual clauses and that are intended to make the insurance contracts more attractive. The term "hidden" illustrates the fact that these options are not subject to identified accounting reserves.

The main options in life insurance contracts are the following:
• renunciation (generally in the month that follows the subscription of the policy);
• buyback (all or part of the mathematical provision before the normal end date of the contract and often without any penalty);
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- transfer or arbitrage (modification of the composition of the assets that are used to index unit-linked contracts, sometimes limited by amount or duration, with or without fees);
- deferment (tacit or at the request of the client, for one year or for several years);
- reinvestment and/or payment at a rate guaranteed in advance (guarantee that was planned at the outset of the contract or prevailing at the time of the new payment);
- reduction (renouncing payment of periodical premiums);
- advance (loan on the savings amassed);
- transformation into an annuity (purchasing an annuity on the basis of all or some of the capital amassed, according to a mortality table and a technical rate predefined at the subscription stage or established upon conversion);
- guaranteed minimum rate (annual remuneration floor);
- ratchet effect (floor below which the value of the savings amassed cannot fall);
- floor value (buyback or redemption value defined in some unit-linked contracts).

The asset-liability adequacy requirements are numerous. As an illustration, let's take the framework of interest rate risk, one of the major threats to insurance companies.

In an environment of significantly falling interest rates, a decrease in the returns of fixed-income assets is all the more preoccupying in that the duration of the assets is lower than the duration of the liabilities, notably when the differential between the rate of return on the assets and the rate guaranteed to the policyholders is negative. This is the situation that was experienced in 2003, especially by Swiss insurers, who had pension funds with high guaranteed rates. Moreover, the reinvestment risk increased their difficulties.

To mitigate these problems partially, prudential reserves have been integrated into national European accounting systems (such as, for example, a portion of the financial products belonging to the policyholders conserved in a non-individual manner), which allow the remuneration of the contracts to be smoothed, up to a limit naturally of the amount constituted previously. Moreover, insurers have often implemented varyingly effective and sophisticated hedges against this interest rate risk, notably through derivative instruments (structured products, swaps, swaptions, caps) or reinsurance programmes.
Symmetrically, in the case of an increase in interest rates or a liquidity crisis, the risk is to have sold bonds before their maturity date while they are at a loss, either because the policyholder commitments arrive at maturity on average before redemption of the bonds held by the insurance company, or in the event of massive advance redemptions, themselves correlated with the increase in interest rates. Naturally this risk is all the more preoccupying in that the duration of the assets is longer than that of the liabilities.

The capital required by Solvency I will, all else being equal, be identical, whether the insurance company has several hundred million euros in prudential reserves or not, whether it has implemented hedging programmes (derivatives or reinsurance) or sophisticated ALM or not.

The calculation of the solvency margin does not today allow the specific characteristics of a reinsurance programme to be considered. The fixed rate reduction of 15% in life insurance and 50% in general insurance in the case of reinsurance seems to be without any economic basis.

Moreover, Solvency I does not integrate the advantages of the geographical or business diversification.

We therefore consider that here again the prudential rules do not incite insurers to develop more sophisticated asset management and ALM models with a view to better quantification and management of asset-liability adequacy risks.

Finally, we should underline that the minimum requirement rules for equity contain numerous paradoxes:

• Since the minimal equity levels are determined as a percentage of the technical reserves in life insurance, the more under-reserved a company is, the less it will need equity.

• The asymmetrical treatment of unrealised fixed-income gains and losses. The gains are added to the equity while the losses are not subtracted in the calculation of the solvency margin. Therefore, in a context of falling interest rates, the solvency margins are overestimated and integrate unrealised wealth that is very sensitive to an increase in interest rates.

• The asymmetrical treatment of unrealised fixed-income gains and the revaluation of the liabilities. The wealth from the unrealised fixed-income gains is artificial in two ways. Not only will a large share of the fixed-income portfolio be conserved until maturity and not therefore generate any gain, but in addition the liabilities are not revalued to integrate the fall in interest rates.
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I.2.2. What is the state of advancement of Solvency II?

To implement Solvency II, the European Commission decided to proceed in two stages:

- An initial phase focused on the general foundations of Solvency II. This phase ended on March 3rd 2003 following two years of work, with the implementation of a prudential control system architecture that was based on three pillars, similar to that adopted by Basel II.

- The second, more technical phase, involves defining detailed measures with respect to the integration of the different risks by the new solvency system. To do this, the CEIOPS (Committee of European Insurance and Occupational Pensions Supervisors) was set up in 2004. The first directive is planned for mid-2007, with an application towards 2010.

As with the IFRS, the philosophy of Solvency II is to establish principles rather than precise directives, so that each company can implement or adapt its own risk evaluation model, which will then naturally have to be validated externally.

For insurance, the choice of architecture and the risk measurement definition are mainly the fruit of:

• The goal of the solvency system is to detect any weakness or threat to an insurance company’s future capacity to satisfy its commitments with respect to the policyholders sufficiently early, notably following a deterioration in the total loss experience or the financial markets. It may seem paradoxical that the monitoring and calculation rules are produced after the event on past accounting statements (complete decorrelation between the solvency margin and the forward view). However, most European countries are progressively implementing complementary forward-looking prudential rules to mitigate this paradox (see section I.2.1.1.).

The net result is that Solvency I is a set of rigid rules, corresponding to an acceptable minimum, to the extent that in general, when a company is identified as having difficulties it is often too late for it to survive. The current system therefore corresponds to a “ready-to-wear” solution that suppresses any desire of a company to control its own risks.

On the basis of this section I.2.1. and of the few sophisticated internal models that exist within the leading insurance companies, we will show in the following sections the strong change that could be engendered by Solvency II in asset management and ALM.
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• A KPMG report, published on May 2nd 2002, ordered by the Internal Market Directorate on the issues of risk models, technical liabilities, asset valuation, alternative risk transfer and risk reduction techniques, the impact of the modifications of accounting rules, the role of ratings agencies and a comparative analysis of the solvency margin systems. The main conclusions are, on the one hand, that the three-pillar approach adopted by the Basel Committee would be compatible with the architecture of Solvency II and, on the other, that the solvency margin calculation formula should integrate technical, market and credit risks. However, KPMG still have reservations about the relevance of integrating operational risk and the asset-liability inadequacy in pillar I ("financial requirements", see section I.2.2.1.).

• The Sharma report, published in November 2002 and based on the pooling of knowledge about insurance companies’ problems. It recommends intervening in the prudential system through corrective, preventive or regulatory tools at all stages at which a problem manifests itself, from the earliest stage to the ultimate stage that is prejudicial to policyholders. The report also examined the definition of good risk management (company culture and strategy, decision-making process, information and risk monitoring system), the principle of prudent financial management and reinsurance programmes. The latter must not only be adapted to the insurer’s underwriting policy, but also be subjected to a detailed quality and liquidity study. At that stage, the amount of capital required could integrate reinsurance (no longer at a fixed rate) and more generally any risk transfer tool (securitisation for example). Reinsurance could thereby reduce the need for capital in the second pillar but not in the first pillar (see definitions below).

I.2.2.1. The three pillars of the architecture of Solvency II are similar to those implemented for Basel II

In 1998, the objective of the Basel Committee, which was made up of the representatives of central banks and regulatory authorities from twelve countries (since then the regulations have been adopted by more than one hundred countries), was to reinforce the strength and the stability of the international banking system and reduce the sources of competitive inequalities in the sector.

The contribution of Basel II was to adapt the prudential rules to fit the evolution of the risks in the banking sector. The work on Basel II began in 1998, the reform was published in 2004 and its application is expected in 2007.
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The first phase of Solvency II adopted the principle of rule architecture based on three pillars.

The first pillar corresponds to the quantitative requirements and should define the prudential rules with respect to reserves, assets and equity. As we saw previously for the IFRS, determining the technical life reserves will also be one of the major changes of Solvency II.

It should integrate a forward-looking approach, take into account an explicit margin for the risk of drift in the factors taken as calculation assumptions, be tied to a discount rate in accordance with the nature of the insurance contracts and the asset and liability evaluation method and determine provisions for additional guarantees (explicit valuation of options).

In general insurance, the equalisation provision is subject to debate with regard to the very heterogeneous treatments between countries, just like the desire to set a quantitative reference for the level of prudence in claims provisions. Concerning the assets, their risks could henceforth be taken into account quantitatively in the evaluation of the capital required (like in the United States).

The second pillar refers to qualitative requirements. It constitutes an extension to the statement of “good practice” in management in Solvency I that the regulatory authorities wish to see implemented in all companies at the level of their internal organisation. This pillar is based on the rules relating to internal control and risk management (assets and liabilities) through ALM tools and reinsurance programmes.

While the Commission accepts that ALM should be reinforced and integrated into the risk management process (especially in all internal models), there is no intention at the moment to explicitly modify the capital requirement according to the quality of the ALM and notably the handling of mismatches.

The third pillar relates to market discipline, for which the rules are intended to constrain companies to be more transparent with regard to their exposure and the management of their risks.
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I.2.2.2. The prudential objective of Solvency II is very different from that of Basel II

Solvency II does not focus on individual risks like Basel II, but on all the risks of each company. Besides, the main motivation behind the prudential solvency system is to protect policyholders against the risk of failure of an insurance company.

I.2.2.3. Solvency II has adopted the risk measurement hierarchy according to the three levels of Basel II

The banking sector defined:

• a standard method which classifies the risks on the basis of external ratings;

• a basic internal rating method which classifies the risks on the basis of the probabilities of default identified by the banks;

• an advanced internal rating method whose risks are classified according to the statistical series of the institution under consideration.

Therefore, from 2007 onwards, the calculation of bank credit risks will rely either on a standard method based on the ratings from ratings agencies, or on the use of internal models. The McDonough solvency ratio, which replaced the Cooke ratio, broadened the notion of credit risk to market and operational risks. It is defined as the ratio of the regulatory capital to the credit, market and operational risks and must be greater than 8%.

The consequence of Basel II is not an additional equity requirement, but its reallocation within each of the occupations, following the new risk weighting, which provides a better fit with the economic reality.

On the insurance side, the first phase of Solvency II concluded that the requirement of a regulatory solvency margin should be the basis for a prudential regime adapted to the risks, with the calculation method remaining to be defined in phase II.

However, a capital requirement can be established both to define the level of capital that leads to an acceptable probability of failure and a critical threshold under which the company is at a very high risk of failure. Like in the American and Canadian RBC systems (see below), a degree of intervention from the supervisors is envisaged, as a function of a multiple of the RMM.

Three possible types of capital requirement measure were unveiled in phase I:

• MCR (minimum capital requirement). When this level is not reached by a company, the supervisory authorities...
will have to be in a position to withdraw the company's regulatory insurance approval immediately. This threshold therefore has to be fairly low, has to be a safeguard and has to result from a relatively simple formula. The solvency margin defined by Solvency I could constitute the basis for this definition.

- The advanced alert threshold. At this level of threshold, a thorough control and a prescription of corrective measures phased out over time will have to be required. The calculation formula will therefore have to be more sophisticated than before in order to reflect the company's overall risk profile.

- SCR (Solvency Capital Requirement), or target capital, which will be the threshold above which the company's solvency margin will be deemed to be comfortable. Depending on the exogenous shocks (natural catastrophe, financial markets) or more marginally endogenous shocks, the company will be able to pass this threshold without calling its regulatory approval into question.

Like for Basel II, this SCR will be two-speed:
- A standard formula will be implemented. There is a vast debate taking place today on its degree of sophistication. It is necessary to find the right balance between a formula that is fairly simple and inexpensive for all insurance companies (including small ones), but also capable of integrating the asset, liability and ALM risks, and the notions of volatility and duration, etc. (see section I.2.5.).
- A second approach will allow the use of an internal economic capital model which will have to have been validated by the supervisors. The idea is to create an incentive for each company to measure its own risks, since the internal models seem to be the most appropriate for defining this target capital.

Today, all the proposals are being studied, including the search for a formula that is sophisticated enough to integrate the risk profile of any company so as to be used both to determine the absolute minimum margin and the desirable capital threshold.

I.2.3. The choice of model for Solvency II will be decisive for AM and ALM

The choice of calculation rules for the MCR and the SCR is the subject of lively debate between the various European countries, and the insurance companies have set up a veritable lobbying campaign. The debate notably opposes proponents of the RBC (Risk Based Capital), Fixed Ratio type models and those who recommend internal models tied to the Value at Risk.
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The stakes are decisive for the insurance companies because these models should have a significant influence on the asset management and ALM strategies. As an illustration, American life insurance companies have very few or no listed shares in their life insurance portfolios due to the overly dissuasive capital requirement (cost of capital too high). To make up for this, they have invested significantly in high yield bonds, which are not penalised by the American solvency model. Before entering into this debate, it is important to recall the targets that are imposed on the choices in Solvency II.

I.2.3.1. The targets for developing the Solvency II model

The choice of formula to define the solvency margin must take the constraints and objectives of Solvency II into account. These are characterised by the following elements:

- a desire to harmonise the different solvency systems in each country to as great a degree as possible; unlike in Basel II, the possibility that equity requirements will actually increase for most European insurance companies;
- a wish to be homogenous and more complete (broadening the field of risk, integration of the variance in the total loss experience, taking the impact of reinsurance into account);
- the applicability of the new calculation rules to all companies (broaden the constraint initially applied in the IFRS, which only concerns companies that invite investment from the general public), including the small-sized provident and mutual insurance institutions, which have very limited means for developing sophisticated internal models;
- the need for IFRS compatibility;
- the aim of avoiding market distortions or systemic risks by suddenly highlighting the difficulties of certain insurance companies, a crisis in confidence on the part of the policyholders could lead to widespread redemption of their contracts and accentuate the fragile situation of those companies to the benefit of companies that are correctly capitalised).

Therefore, while the solvency margin requirement is present in all the solvency systems (in Europe, the United States, Australia, Canada and Japan), the way in which it is determined is very different from one continent to another. The two major types of calculation are based on the concept of the “Fixed Ratio” and the “RBC”. The debate on determining the target capital according to Solvency II is based on the choice of one of these models, or a mix of the two, extended to the internal models.
I.2.3.2. The "Fixed Ratio" type model

The "Fixed Ratio" model is the most widely used model in Europe for determining the solvency margin requirement, which is based on the amount of technical reserves in life insurance and the amount of premiums income and claims in non-life insurance. Only the liability risk is therefore considered in this formula in Europe.

This model presents the advantage of being simple to implement and provides an instant value for the RMM. Indeed, it is for that reason that it has its proponents in the aim of determining the MCR, even though it seems to be quite rudimentary to be adopted as it stands with regard to the objectives of Solvency II.

Therefore, if this model were to be selected for the MCR in Solvency II, the formula could probably be given more substance, by choosing for example one or more fractions of different accounting elements in order to take a larger number of risks into account. However, the main weakness of this formula would be setting the value of the fractions.

I.2.3.3. The "Risk Based Capital" type model

Risk Based Capital (RBC) was first implemented in 1993 by the American regulatory authority NAIC (National Association of Insurance Commissioners). This model is inspired by the Cooke ratio adopted by credit institutions, according to which a coefficient that is proportional to the risk of the asset is assigned to each type of asset.

The RBC method therefore consists of associating a capital requirement with each of the main risks being run by the insurance companies. The ratio of available capital to required capital defines the possibility of action from the supervisory authorities.

In view of the widespread debate and the excessively important consequences on asset management and ALM, we propose to present the RBC models chosen in the United States, which constitutes the main reference in this area. According to QIS 2 (Quantitative Impact Studies 2, see section I.2.5.), they should form a basis for defining the standard SCR formula.

I.2.3.3.1. RBC in life insurance

In life insurance, the American RBC considers three types of risk:
- Investment risk, i.e. the risk of loss relating to asset value depreciation or issuer default (R₁) and the risks relating to interest rates (R₂). For R₁, the RBC coefficients applied to the value of the assets on the balance sheet vary between...
0% and 1% for government bonds and can reach up to 30% for very risky investments. For \( R_2 \), they are between 0.75% and 3% of the technical reserves depending on the nature of the product (duration, options, etc.).

• Technical risks, i.e. the risk of insufficient technical reserves or premium income (\( R_3 \)), such as under-pricing for example. The RBC coefficients applied to the risky capital (between 7% and 35% of premiums) vary between 0.06% and 0.15%.

• General business-related risk (\( R_4 \)), such as fraud, change in regulations, etc. The RBC coefficients applied to the premium income vary between 2% and 3%.

 Moreover, the RBC approach requires additional capital to provide for the risk of loss that can be engendered by the activity of insurance subsidiaries and off-balance sheet commitments (\( R_0 \)).

The American RBC formula which determines the minimum capital in life insurance is the following:

\[
RBC = R_0 + R_4 + \sqrt{(R_1 + R_2)^2 + R_3^2}.
\]

We recall that if two risks are considered to be perfectly correlated, the total capital is the sum of the two capitals relating to each of the two risks. However, if they are considered to be independent, the total capital required is the square root of the sum of each of the risks squared. The covariance adjustment thereby enables one to consider that the risks can mutually compensate each other.

This model is very flexible because in both life and non-life insurance, to determine each coefficient \( R_i \), it is possible to modulate the capital requirement with a view to reflecting a particular risk.

We can for example use an RBC coefficient of 0.3% for government bonds and 1% for other bonds, and then add on a supplementary requirement of 0.5% for example to reflect an excessively low number of issuers. Another example could involve doubling the RBC coefficient for the five main investment holdings (holdings in other companies) in the event of insufficient diversification. In comparison with the interest rate risk, it is possible to differentiate an RBC coefficient depending on whether the contract contains a buyback clause or not.

In order to appreciate the specific characteristics of the Fixed Ratio model presented in the previous section and those of the American RBC model, we propose to present an example that is simple but sufficiently demonstrative to appreciate the flexibility, the integration of the risks, and the arbitrary nature of the coefficients or formulas for both models.

Let’s consider a life insurance company whose asset portfolio is made up of:
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- €100bn in government bonds and €5bn in other bonds;
- €30bn in mortgage loans;
- €5bn in shares and €5bn in property.

This company has a turnover of €10bn. The technical reserves are €150bn, of which €2bn are contracts with buyback clauses. The capital under risk is €1,000bn.

On the basis of this data, we are in a position to determine the capital requirements associated with each of the risks and the available capital, in order to check that the company is solvent. The table below is a summary of the calculations and presents an RBC type approach and a Fixed Ratio type approach in accordance with Solvency I.

To illustrate the flexibility of RBC, we added a supplementary coefficient to the investment risk ($R_1$) to take into account the under-diversification of the fixed-income issuers. For the interest rate risk ($R_2$), we considered that the contracts with the buyback clause were riskier than those that did not have the clause (coefficient doubled). For the insurance risk ($R_3$) above a certain amount, the pooling of the risks enables the RBC coefficient to be reduced.

In this example, we observe that the company is solvent according to the RBC approach, but not according to Solvency I. In section I.2.3.3.3., we present a detailed summary of the pros and cons of the RBC approach.

### Table: RBC Calculations

<table>
<thead>
<tr>
<th>Risk Type</th>
<th>Amount (in €bn)</th>
<th>RBC Coefficient</th>
<th>RBC Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government bonds</td>
<td>100</td>
<td>0.3%</td>
<td>0.3</td>
</tr>
<tr>
<td>Other bonds</td>
<td>5</td>
<td>1.0%</td>
<td>0.05</td>
</tr>
<tr>
<td>Additional factor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortgage loans</td>
<td>30</td>
<td>3.0%</td>
<td>0.9</td>
</tr>
<tr>
<td>Shares</td>
<td>5</td>
<td>30.0%</td>
<td>1.5</td>
</tr>
<tr>
<td>Property</td>
<td>5</td>
<td>10.0%</td>
<td>0.5</td>
</tr>
<tr>
<td>Total investment risk $R_1$</td>
<td>145</td>
<td></td>
<td>3.565</td>
</tr>
<tr>
<td>Technical reserves [TR]</td>
<td>148</td>
<td>0.75%</td>
<td>1.11</td>
</tr>
<tr>
<td>TR with buyback clause</td>
<td>2</td>
<td>1.50%</td>
<td>0.03</td>
</tr>
<tr>
<td>Total interest rate risk $R_2$</td>
<td>150</td>
<td></td>
<td>1.14</td>
</tr>
<tr>
<td>Capital under risk</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical reserves</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net amount</td>
<td>850</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 500</td>
<td>500</td>
<td>0.15%</td>
<td>0.75</td>
</tr>
<tr>
<td>&gt; 500</td>
<td>350</td>
<td>0.10%</td>
<td>0.35</td>
</tr>
<tr>
<td>Total insurance risk $R_3$</td>
<td>850</td>
<td></td>
<td>1.1</td>
</tr>
<tr>
<td>Premium income</td>
<td>10</td>
<td>2%</td>
<td>0.2</td>
</tr>
<tr>
<td>Total business risk $R_4$</td>
<td>10</td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>Total risk $R = R_1 + R_2 + R_3$</td>
<td></td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>RBC = $R_4 + \sqrt{(R_1^2 + R_2^2 + R_3^2)}$</td>
<td>5.022</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Available capital</td>
<td>7,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RBC Ratio</td>
<td>139%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table: Solvency I Calculations

<table>
<thead>
<tr>
<th>Risk Type</th>
<th>Amount (in €bn)</th>
<th>Coefficient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical reserves</td>
<td>150</td>
<td>4%</td>
<td>6.00</td>
</tr>
<tr>
<td>Net capital under risk</td>
<td>850</td>
<td>0.30%</td>
<td>2.55</td>
</tr>
<tr>
<td>Required minimum capital</td>
<td></td>
<td></td>
<td>8.55</td>
</tr>
<tr>
<td>Available capital</td>
<td></td>
<td></td>
<td>7.00</td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td>82%</td>
</tr>
</tbody>
</table>

I.2.3.3.2. RBC in general insurance

In general insurance, the RBC approach retained in the United States considers two types of risks:
- Investment risks, i.e. risks of loss relating to asset value depreciation or issuer default. Three types of
investment are retained: fixed-income investments ($R_1$), other investments ($R_2$) and receivables ($R_3$).

- Technical risks, i.e. the risk of insufficient technical reserves ($R_4$) and the risk of insufficient premium income ($R_5$).

Moreover, the RBC approach requires additional capital to provide for the risk of loss that can be engendered by the activity of insurance subsidiaries and off-balance sheet commitments ($R_6$).

The American RBC formula which determines the minimum level of capital in general insurance is the following:

$$RBC = R_0 + \sqrt{R_1^2 + R_2^2 + R_3^2 + R_4^2 + R_5^2}$$

1.2.3.3.3. The pros and cons of the RBC approach

The main advantage of the RBC formula is the possibility of integrating all the sources of risk that one wishes and providing a high level of flexibility to adjust the RBC coefficients, as a function not only of each company but also of the market conditions at the time of the calculation. For example, as we have just seen, the American model integrates the provisioning risk, which is not the case of the Japanese, who preferred to integrate the management and natural catastrophe risks.

However, even though this type of model is particularly transparent, it is complex to implement in comparison with the Fixed Ratio and requires considerable means and time. Besides, and for us this is one of the major stumbling blocks, there is no theoretical justification that allows the formula to be justified (notably the covariance adjustment): in the event that the European Commission adopted this model, the choice of elements in the formula and the weighting keys would turn out to be a perilous and highly controversial exercise.

Finally, we should stress that it is a tool for orienting investment policy. In the countries that employ the RBC model, more than a quarter of the capital required relates to investment risk. As we have mentioned previously, the American life insurance companies have very few, or no listed shares, while the percentage share of high yield bonds can reach double figures. The increase in the number of failures of industrial corporations has been very costly for some American life insurance companies, as we observed in 2003. To satisfy the objectives of Solvency II, the RBC method would require a complete overhaul in order to integrate a larger share of risks (such as reinsurance, operational risks and ALM risks), a better integration of the correlations between the risks and a forward-looking approach that does not exist today in any of the countries that employ RBC.
In conclusion, the final criticism, which is a major argument for its main proponents, is that it was not able to prevent certain resounding failures in the United States.

In view of the weight of the standard SCR formula in orienting asset management and ALM strategies, it is easy to understand that even the very large insurance companies who will opt for the internal model approach are lobbying very strongly on the standard formula, because it will inevitably have repercussions on their management targets.

Reciprocally, a standard formula that was not sufficiently demanding in terms of capital compared to an internal model would lead the leading insurance companies to select the standard formula to determine their solvency margin, which would be a consequence that would be totally opposed to the objectives of Solvency II, which are to incite insurance companies to develop their own models, in order to better identify, measure and manage their risks.

To date, supervisory authorities, insurance federations and associations, and indeed individual insurance companies, from all corners of Europe have suggested standard formulas, but it is still too early to have an outline of these MCR and SCR formulas, which will be proposed at best in July 2007.

1.2.4. The acceptance of internal models to determine the Solvency Capital Requirement (SCR)

Solvency II, like Basel II, has adopted a two-speed approach to define the Solvency Capital Requirement (SCR):

- A standard formula will be set up for companies who do not have the means to implement an internal model that is sufficiently sophisticated to be used as a reference in calculating the SCR. We have just seen in section 1.2.3. that a vast debate is taking place today on how it is being developed with the constraint of being simple enough and inexpensive, but also capable of integrating the asset, liability and asset-liability risks, the notions of volatility and duration, etc.

- The second approach that should be authorised, or indeed favoured by Solvency II for determining the SCR is the deployment of an internal economic capital model, validated by the supervisory authorities. This is intended to incite each company to measure its own risks, since the internal models seem to be more appropriate because their customised nature enables the target capital of each to be defined.
I.2.4.1. Favouring internal models: a worldwide trend, but one that is still at an embryonic stage

Whether in Europe, the United States or Australia, recent research seems to confirm the relevance of implementing internal models. In Australia, the plan is for insurance companies to have the choice between three approaches for determining the RMM:

• A model prescribed by the legislator for companies that do not have the means or the desire to develop their own model. This prescribed method is based on the RBC model, which integrates the investment and technical risks like the American model described in the previous section, and also the concentration risk, which is intended to integrate catastrophic events.

• An internal model developed by each insurance company, reflecting most of the risks being run, especially those that are inherent in its activity profile. These models are naturally subject to the approval of the regulators.

• A combination of both methods is accepted, depending on the degree of sophistication of the internal models.

The other example of evolution towards internal models is the complementary regulation in phase II of the American C3 project. It integrates Cash Flow Testing for insurance companies so that they can directly test their own asset-liability management model, the impact of different interest rate scenarios (drawn up by the American Academy of Actuaries) on the amount of capital required and the asset-liability adequacy. The projection is carried out over thirty years and leads to an available surplus or deficit, which is integrated in determining the solvency margin. This approach is intended to encourage the insurance companies to build their own risk management models, an incentive that is strengthened by the fact that companies who do not have that type of tool are penalised by a 50% mark-up in the RBC coefficients.

Since the standard SCR formula is still the subject of lively debate as to its form, the definition of internal models to calculate it is not yet really on the agenda, on top of which it is giving rise to numerous questions with respect to the validity of the models (skills, resources, centralised at the European level or decentralised by country, handling the supervision of an international company, etc.).

According to the European Commission, the prudential rules could be tied to extensions to the internal models that already exist, such as asset allocation, ALM, embedded value, DFA (Dynamic Financial Analysis) or the global risk model.

These models could be deterministic (tests of different scenarios) or stochastic.
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(Monte Carlo simulation), based on a probability of ruin or default. On the basis of different scenarios, the probability of the worst scenarios occurring can be determined and lead to a measure of the equity needed for the probability of ruin or default to be below a certain threshold.

I.2.4.2. The global risk model according to the VaR or the Tail VaR

The global risk model has drawn particular attention from both the Solvency II working groups and the large insurance groups, and in a way would constitute, if not an ideal model, at least a reference model in determining the SCR in particular, and the management of insurance companies more generally.

Its goal, on the basis of modelling the probability distribution of real equity (or economic capital), is to determine the economic capital requirement as a function of the overall risk accepted by the firm and define the allocation of economic capital between the different activities. This economic capital requirement is generally defined either:

• according to a Value-at-Risk approach, where it corresponds to a quantile of the global risk distribution function (example of the Australian regulations);

• or according to a Tail VaR approach, which is also known as the Conditional Value at Risk, and which corresponds to the average loss beyond the VaR, i.e. occurring with a frequency that is lower than the threshold given by the VaR’s confidence threshold. This approach is favoured by some insurance companies, because it gives a better appreciation of the extreme risks beyond the VaR.

More specifically, the modelling of the liabilities consists of valuing the insurance company’s commitments and must integrate all the parameters that modify the commitments:

• a deterministic approach allows the average evolution of the company’s commitments to be analysed, but without taking the random nature of the different parameters into account;

• a stochastic approach, which associates a random component with all or some of the variables that make up the model, enables an occurrence probability law to be deduced, on the basis of a large number of scenarios.

To do this, the instrument for measuring the overall and probable risk is generally the Value at Risk (VaR). It is equal to the estimated loss for a specific time scale (for example, one year) with a given probability of occurrence (for example in 99.3% of the cases). In other words, it measures the incidence of the risk factors through the notion of potential risk of maximal loss.

11 - The notion of expected shortfall, which is generally interpreted as the average loss beyond zero, is also sometimes used.
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On the basis of the probability distribution of the equity and the level of VaR accepted or required, it is possible to determine the level of capital required.

The implementation of risk measurement tools, and more generally the implementation of these internal models, would also allow the companies’ strategies to be fine-tuned and the allocation of capital to be optimised, notably in terms of arbitrage between activities (on the basis of the Return on Risk-Adjusted Capital), of taking on or transferring risks, of reinsurance policy, of asset allocation (measurement of volatility and performance), and of liability management.

While the main advantage of these internal models is that the company’s profile and its risks are taken into account, their implementation nonetheless takes several years and is complex (information technology capacity, development and robustness of the assumptions, human means, etc.).

This type of internal global risk model exists today in fewer than twenty insurance companies in Europe (often in the final phase of completion, and therefore not yet totally operational), but we are already seeing the initial impact both in terms of asset management (desire to maintain a significant amount of listed shares – around 15% - in asset portfolios, to broaden the portfolios to alternative investments, private equity, CDS-type structured credits, etc.) and asset-liability management (use of more systematic derivative programmes such as swaps, caps, floors, swaptions, securitisation, super subordinated loans, reinsurance, etc.).

The goal of Solvency II is for insurance companies to manage and control their risks better. In order to achieve this, it favours the development of internal models, which should lead to capital requirements that are lower than those emanating from the standard Solvency formula implemented by Solvency II.

In an environment of that kind, asset management and ALM techniques should continue to become more sophisticated (we will present some solutions in part III of this report), especially in order to better manage extreme risks (the most costly risks in terms of capital requirements).
I.2.5. Intense debate caused by the ongoing development of the SCR standard via QIS 2

An important stage has been reached in the development of Solvency II with the publication by the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) of the second Quantitative Impact Study (QIS 2), which aims to use the responses given by insurance professionals to provide a quantitative estimate of the global impact of the new solvency system by the end of October 2006. The aim is to determine whether the initial proposals provide a sufficient balance between sensitivity to the primary risk factors faced by insurers and the complexity and soundness of the different approaches that were tested.

Unlike Solvency I, the QIS 2 of Solvency II is based on:
• the market consistent value of assets and liabilities;
• a wider balance sheet approach which notably includes the prudential nature of the cash flow policy;
• a broadening of the concept of risk (definition and scope);
• a recognition of the benefits offered by different forms of diversification.

This initial attempt to calibrate the MCR (Minimum Capital Requirement) and SCR (Solvency Capital Requirement) officially targets a level of prudence that corresponds to a VaR of 99.5%, this latter being used as a proxy for 99% Tail Var. However, the QIS 2 specifies not only that the factors and coefficients currently proposed must undergo tests by the CEIOPS, but also that the responses obtained by the QIS 2 will be invaluable in adapting these parameters. In other words, it would appear that according to a number of insurers, these parameters have not been fully set to match a VaR of 99.5%. They are therefore no more than proposals that can be fully negotiated and also fully modified by the CEIOPS.

In particular, the QIS 2 deals with:
• principles for evaluating assets and liabilities;
• the SCR using a standard formula;
• the SCR using the insurer’s internal model;
• the MCR.

I.2.5.1. Principles for evaluating assets and liabilities with a view to determining the standard MCR and SCR

Indications in relation to assets are relatively basic: they must be evaluated...
The reference valuation method for technical provisions, which must be presented as a gross and net figure after reinsurance, depends on the type of risk:

- for risks that can be easily hedged (such as financial risk), the valuation must correlate to the market value;
- for other risks, or if there is a doubt about the market value or the ‘hedgeable’ nature of the risk, a best estimate approach is used, together with a margin of error, making it possible to reach the 75\textsuperscript{th} quantile.

The best estimate must be shown independently of the 75\textsuperscript{th} quantile. The probable present value of future cash flows must be determined using the laws of probability for each risk factor based on the experience of the insurer or of the market (where data is insufficient or not credible), must make an allowance for the possibility of future inflation and management fees (not including economies of scale that are planned but not yet realised) and must reflect anticipated demographic, legal, medical, technological, social or economic developments. The discount rates are risk-neutral for the duration under consideration (the term structure of international rates is provided by the CEIOPS). A general insurance estimate must also be provided for technical provisions at a discount rate of 0%.

The margin added to the best estimate covers the risks linked to liabilities for the whole of their life cycle; it may be determined either by the difference between the best estimate and the 75\textsuperscript{th} quantile of the underlying distribution up to extended commitments, or on the basis of the cost of mobilising the SCR up to extended commitments. Additional studies must be carried out by the CEIOPS in order to determine the advantages and disadvantages of these two approaches.

It is worth noting, however, that these two approaches are the subject of intense debate between the proponents of what we might call the actuarial approach (quantile) and the more financial approach (cost of capital). The European Insurance Committee has been in clear opposition for several months to the quantile approach, highlighting that it depends on the very subjective risk distribution hypotheses held by each insurer and that the link between the 75\textsuperscript{th} quantile and the market consistent value of liabilities is not at all clear. However, the QIS 2 does offer the advantage of highlighting the risk concepts adopted and is sophisticated enough to handle the measurement and diversification of the risks. We mentioned earlier the failure of Solvency I to differentiate between insurance risks.
This is dealt with by Solvency II, mainly by the suggestion that the valuation of provisions depends on a breakdown based on activity and risk:

• 11 categories of activity in non-life insurance (accident and health, third party liability motor insurance, other classes of motor insurance, MAT, fire and other property damage, third party liability, credit and suretyship, legal expenses, assistance, miscellaneous non-life insurance and reinsurance);

• 4 categories in life assurance (contracts with profit participation clauses, unit-links, other contracts without profit participation clauses and reinsurance);

• 6 risk factors in life assurance (mortality, morbidity, longevity, lapse rate, option take-up rates and expenses assumption). Volatility and correlation hypotheses must be included particularly for the first three risks;

• 2 independent tests in non-life insurance. One relates to reserves for outstanding loss and the other to premium reserves (for premiums not yet received or for current risks). All factors that might have an impact on future payouts (recourse to run-off triangles) must be considered.

Furthermore, unlike Solvency I, it is explicitly stated that guarantees and financial options must be valued and included in the balance sheet at risk-neutral discount rates. As with European Embedded Value, the time value (value of the option – strike price of the option – the current underlying value) must also be taken into account.

I.2.5.2. Standard SCR Formula

As we mentioned earlier, the QIS 2 is no more than an initial test by the CEIOPS aimed at calibrating the parameters and assumptions and also at determining the methodological and conceptual problems involved in the development of the SCR. The factors and hypotheses concerning insurance shocks are theoretically based on an occurrence once every 200 years. However, many insurers believe that the values actually used do not correspond to this estimate and are in fact much more demanding in terms of capital needs.

The overall Solvency Capital Requirement is defined by the basic SCR (BSCR) adjusted to account for RPS, the capacity of future profit-sharing to absorb risks and for NL_PL, the anticipated profit or loss resulting from the following year’s activities.\(^1\)

\[
\text{SCR} = \text{BSCR} - \text{RPS} - \text{NL_PL}
\]

I.2.5.2.1. Determining the basic SCR (BSCR)

The BSCR is the basic SCR, that is, the SCR prior to adjustment for future dividends and anticipated earnings from non-life activities in the following year.

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\(^{12}\) Maritime, Aviation, Transport.

\(^{13}\) When the non-life activity is profitable, the theoretical pursuit of the activity can result in a reduction of the SCR, as explained in section I.2.5.2.3.
Unlike Solvency I, where capital needs were primarily necessary to face underwriting risks, Solvency II widens the scope of what constitutes risk. To achieve this, 6 primary categories of risk and associated capital needs are defined:

- **Capital needs for the market risk (SCRmkt).** The market risk is measured by the impact of shifts in financial variables such as share prices, interest rates, property prices and exchange rates, each of which is referenced with financial needs determined according to different stress scenarios (alteration of the interest rate curve according to specific values per duration provided by the CEIOPS, 40% fall in the stock market, 20% in property and 25% in currency exchange rates, where the investment policy such as hedging mechanisms is included). The coefficients for the correlation matrix of these four risks are defined by the CEIOPS and have provoked intense debate over their excessive value (0.75 between the interest rates and stocks, 1 between stocks and property). One of the primary sources of debate is the rate of 40% for a fall in shares for the year. Not only is it judged extremely high in relation to the actual market volatility (2 standard deviations), but above all it may prove to be totally confiscatory, as in the United States: American life assurance companies hold too few listed shares because of the demands on capital that result from the country's prudential solvency regulations.

- **Capital needs for the life assurance underwriting risk (SCRlife).** This risk is now broken down into biometric risks (mortality, longevity, morbidity and incapacity), lapse risk and expenses. Each of these risks is referenced with capital needs determined on the basis of volatility and particularly detailed stress tests, especially for the biometric risks. A correlation matrix defined by the CEIOPS makes it possible to determine total capital needs for the life assurance underwriting risk. Once again, the volatility suggested by the CEIOPS is considered to be excessive (particularly for the redemption rate).

- **Capital needs for the health underwriting risk (SCRhealth).** The health risk is broken down into three elements: 1) expenditure risk; 2) risk of excessive loss experience/mortality/cancellation; 3) risk of epidemic/accumulation.

- **Capital needs for the non-life underwriting risk (SCRnl).** This risk is broken down as follows: 1) cash flow-related risk; 2) risk associated with premiums (premiums lower than expenses and services provided); 3) catastrophe risk (extreme events). Premium risk and reserve risk of each line of business are aggregated by means of a correlation matrix. On the other hand, catastrophe risk is simply summed across the 11 non-life lines of business. The volatility factors make prohibitive demands on capital — two to four times as high as those used in Solvency I.
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- Capital needs for the credit risk (SCR\textsubscript{cred}). Controversy surrounds the factor values, which give rise to a completely disproportionate capital increase between the rating classes (for example, by a factor of 10 between AA and A which is not proportional to their relative probabilities of default over any given horizon).

- Capital needs for the operational risk (SCR\textsubscript{op}). This corresponds to the risk of losses due to poorly adapted or malfunctioning internal processes, either because of human resources, operating systems or external events.

The reference capital needs for the individual SCR risks, according to the rows and columns of the correlation matrix (\textit{Corr}SCR\textsubscript{rxc}), are written respectively as SCR\textsubscript{r} and SCR\textsubscript{c}.

Three levels of reference capital needs are defined for these six risk categories:

- correlation matrix provided by the QIS 2:

\[
\text{SCR}_1 = \sqrt{\sum \text{Corr}SCR^{rxc} \cdot \text{SCR}_r \cdot \text{SCR}_c} = B\text{SCR}.
\]

- total independence:

\[
\text{SCR}_2 = \sqrt{\text{SCR}_\text{Mkt}^2 + \text{SCR}_\text{cred}^2 + \text{SCR}_\text{Life}^2 + \text{SCR}_\text{Health}^2 + \text{SCR}_\text{nl}^2 + \text{SCR}_\text{op}^2}.
\]

- without regard for the diversification effects:

\[
\text{SCR}_3 = \text{SCR}_\text{Mkt} + \text{SCR}_\text{cred} + \text{SCR}_\text{Life} + \text{SCR}_\text{Health} + \text{SCR}_\text{nl} + \text{SCR}_\text{op}.
\]

The CEIOPS presents the standard formula for the different risk categories as follows:
I.2.5.2.2. Calculation of the Reduction for Profit Sharing (RPS)

In section I.2.5.1, which dealt with determining technical provisions, discretionary dividends were included. However, they can be used to tackle risks with often significant measures of success. The CEIOPS therefore suggests calculating capital needs in three stages:

- Initially, the capital needs for each individual risk are calculated prior to the adjustment for the capacity to absorb risks associated with future life insurance dividends. Only the guaranteed and statutory dividends are then included in the valuation of the technical provisions.

- The capital needs are then adjusted by finding the aggregate of needs for individual risks while accounting for a correlation matrix (diversification effects).

- Lastly, the final SCR is determined by integrating the fact that a proportion of the technical provisions associated with future discretionary dividends can be used to absorb some of the risks. This proportion, which is known as the $k$ factor and is between 0 and 1, is also the subject of intense debate among insurers, who argue as to the subjective nature of the figure.

I.2.5.2.3. Determining the anticipated profit or loss due to the following year’s activities (NL_PL)

The surplus or deficit expected in the following year (NL_PL) can be determined by adding together two elements:

- The expected surplus or deficit (NL_PL$^\text{premium}$) of the following year’s premiums, which is obtained from the combined estimated ratio between non-life activities (weighted average of the premiums from the various activities in the ratios of the last three to five years) and net earned premiums for each branch of activity for the following year;

- The expected surplus or deficit (NL_PL$^\text{release}$) from the liquidation of past periods during the following year. NL_PL$^\text{release}$ is the release of the market value margin defined as the difference between the 75th percentile and best estimate. It is assumed that cash flows are as expected (best estimate) during the following year, while they had been accounted for with a risk margin.

The overall SCR is thereby defined as follows:

$$\text{SCR} = \text{BSCR} - \text{RPS} - \text{NL_PL}$$
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I.2.5.3. SCR formula through the internal model approach

The approach adopted by the CEIOPS in the QIS 2 in relation to insurance companies’ internal models is highly pragmatic. In as much as is possible, estimates of required capital as produced by the internal models are requested for each of the risk models used by the CEIOPS (see presentation in previous section).

However, not only is it recognised that the level of granularity in the internal models may differ from that in the QIS 2, but above all, insurers are explicitly requested to comment on the differences encountered between the two approaches (QIS 2 and internal), particularly where the risk approach employed by the QIS 2 is deemed to be inappropriate.

I.2.5.4. Minimum Capital Requirement formula (MCR)

The QIS 2 provides two approaches to the MCR:

- One is a transition approach based on the requirement of Solvency I, but which reflects the methodology used in Solvency II for the valuation of technical provisions;

- The other is a post-transition approach based on the same calculation methods as used for the standard SCR formula (notably SCR$_1$, SCR$_2$ and SCR$_3$), whereby only the primary elements are accounted for and the factors are calibrated to set amounts with a lower degree of confidence. In the QIS 2, however, the operational risk is not used to determine the MCR, which reduces the number of risk categories to five: underwriting risk for life, non-life and health insurance, market risk and credit risk.

I.2.6. Conclusion: Solvency II reinforces the need for risk management

While the IFRS ultimately make insurers sensitive to volatility in the value of their assets and liabilities, Solvency II, which was designed not by an accounting standards authority that set out to reflect companies’ ‘true’ value, but rather by a European regulator concerned about ensuring their solvency, places the emphasis on the sustainability of companies’ management policies in light of extreme risks. From this point of view, Solvency II no longer holds a simple and static vision of how to account for risk, but rather uses internal models and the VaR to promote a true financial appreciation of capital needs.

This financial approach can and must find financial management solutions, provided that a more adequate risk
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calibration than that suggested by the QIS 2 can be developed. Although the model and the granularity of the standard formula proposed by the QIS 2 go some way towards meeting the objectives set by Solvency II (balance between sensitivity to primary risk factors and complexity), it would appear following tests carried out by insurance companies on the QIS 2 that its calibration leads to demands on capital well in excess of those made by Solvency I (between two and four times depending on risk and activity, in particular, with regard to companies that hold equities), while the regulatory authorities from each European country consider insurance companies to be well capitalised. This calibration, which the CEIOPS sees as a basis for negotiations, can therefore expect to see some important key modifications. More specifically, EDHEC believes that QIS 2 gives rise to several controversial points:

- The QIS 2 provides no indication as to the eligibility of certain instruments to be considered as available capital (hybrid capital, subordinated debt, securitisation, etc.).
- The CEIOPS suggests measuring risk using a VaR of 99.5%, but sets the calibration of risk model factors at a level such that demands on capital appear to have no bearing on this reference figure.

- Volatility factors that make it possible to determine capital needs per activity, particularly in non-life insurance, also lead to excessive demands on capital. The excessive so called market-wide standard deviation\textsuperscript{14} is a concern and EDHEC believes that the historical volatility of the net combined ratio is not a good measure of the risks. Indeed, because profitability is the result of two components (underwriting and financial profit), there is no objective reason why the net combined ratio should be stable over time in a well managed insurance company. It is possible to have stable good profitability with a high volatile net combined ratio which offset the opposite moves of financial profit\textsuperscript{15}. Fundamentally, computing the historical volatility of the net combined ratio over fifteen years brings little incentive to enhance risk management techniques.

- The factor volatility or stress scenarios are generally prohibitive. Probably the most irrelevant is volatility of 40% on the stock market over one year, which would create such demands on capital as to completely discourage insurance

\textsuperscript{14} The volatility currently used in the formula for reserve risk is the market wide estimate. For premium risk it is the market wide estimate if the number of available years is less than eleven and the historical volatility of the net combined ratio if there are 15 years available. In between, it is a geometric average of the two. From a quantitative point of view, the requirements from the standard formula have been judged too demanding by insurance companies.

\textsuperscript{15} Even without any risk in the balance sheet, the volatility of the net combined ratio would equal that of the price of a bond that has the same characteristics as the liabilities. More precisely, for any subscription year:

\begin{align*}
\text{Before Tax Profit} &= \text{Profitability}\times \text{Premium income} = \text{Premium income} - \text{Sum of discounted claims} = \text{Premium income} - \text{Price of Replicating Bond} \\
\text{Premium income} \times (1 - \text{Profitability}) &= \text{Price of Replicating Bond}
\end{align*}

As \text{Combined Ratio} = \text{Undiscounted Claims / Premium}, we obtain: \text{Combined Ratio} \times \text{Price of Replicating Bond} = \frac{1}{1 - \text{Profitability}} \times \text{Undiscounted Expected Claims}
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companies from holding stocks\(^{16}\). Moreover, the ratio of equity volatility relative to bond volatility is very high. While a 20\% volatility for the stock market and a probability of 40\% loss once in two hundred years seems in line with historical data, the shock applied to the yield curve is not\(^{17}\). In the light of historical Value at Risk, it seems that equity holdings are harshly penalised relative to bonds. The embedded stress correlation is also very high relative to the historical average. The reasoning is that correlation is higher in the tail than in the body of the distribution, making it somewhat illusory to rely on diversification\(^{18}\). This, together with the lack of recognition of alternative geographies and classes of assets, raises concerns about how much the benefits from diversification are accounted for in the calculation of SCR.

- In the standard formula, no benefits from geographical diversification or from beta management can be accounted for. This tends to penalise greatly low beta equity driven investment strategies, such as minimum variance portfolios - that is, unless the strategy has a long history. On the other hand, the current specification would considerably favour some long-short strategies, as "the immediate effect expected in the event of a 40\% fall in all individual equities, also considering the effect on derivatives and short positions" would be approximately zero.

- The lack of recognition of dynamic risk management strategies such as portfolio insurance is another source of concern at this stage. In QIS 2, only current holdings of options that expire in a year or more are considered, together with those that are rolled-over when explicitly stated in the investment policy. But "no consideration should be given to management actions or active trading strategies".

EDHEC underlines that the current simplistic assumption that the stock market falls by 40\% at the end of the reporting day would create strong incentives for mismanagement of risks. Indeed, the embedded simplistic scenario has a probability that is so low, and measures risks in a way that is so different from most up-to-date methodologies that the continuation of such techniques may lead to strong distortions in the form of regulatory capital arbitrage rather than good risk management.

The aim of Solvency II is to create incentives for insurance companies to measure and monitor their risks. EDHEC is thus confident that the significant

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\(^{16}\) As we have seen with the US life insurance company regarding the risk-based capital solvency approach.

\(^{17}\) The bond shock is 40 basis points only for a zero coupon interest rate with maturity of six to twelve years. According to Shiller’s data, the 10-year US bond yield rose by a maximum of 4\% since both 1980 and 1871, while the S&P fell by a maximum of 30\% (resp 65\%) since 1980 (resp 1871). We have chosen the US data as an example, because the stress tests currently do not depend upon the geography.

\(^{18}\) While this has a sound theoretical basis, historical data show that at a one year horizon, diversification between bonds and equities is a lot more efficient than embedded in the market risk module. Since 1871, any equity loss over 30\% has been accompanied by a rise in the ten year bond yield of less than 1.1\% or by a fall of less than 25 bp. Any rise in the ten year bond yield of more than 2\% has been accompanied by a loss in the S&P index of less than 12\%, and any fall of more than 2\% in the 10-year yield is accompanied by a rise in the stock market.
difference in the risk position between a company that has dynamic hedging schemes (be it a simple stop loss) and one that does not monitor its risk exposure will eventually be reflected in the calculation of required capital. This naturally implies a revision in the methodology and guidelines for the calculation of the SCR.

It may be said at this stage that because insurers are considered by the regulatory authorities of each European country to be well capitalised, it is likely that the QIS 2 will merely serve as a basis for negotiation, and its final calibration will probably be very different from that which has been put forward.

If this expectation is realised, EDHEC feels that Solvency II should strengthen insurance companies’ interest in portfolio insurance techniques and asset allocation techniques that aim to limit the extreme risks of the portfolio. We will see in the next section of this document that in terms of both portfolio insurance and asset allocation, insurance companies can benefit from state-of-the-art asset management techniques.
I.3. Conclusion

Through an analysis of the new prudential and accounting reference system formed by the IFRS and Solvency II, we have shown that insurance companies would be forced to upgrade their internal models (asset allocation, asset-liability management, provisioning, EEV, economic capital), which integrated accounting tools for smoothing results, towards more sophisticated ‘financialisation’, in order to take a broadening of the notion of risk into consideration (the field of risk, modelling, evaluation and management).

More specifically, the aim of the IFRS is to integrate the notion of risk better through the accounting system. To do this, the standards intend to value assets at their market value, and to assign their variation to the equity at each inventory, which has repercussions on the solvency margin. On the liability side, the deadline of 2005 did not leave enough time to develop fair value standards, but this trend is already present in phase I, notably through the adequacy test for the reserves and the fair value options. In phase II, the liabilities will have to be valued on the basis of a forward-looking approach, i.e. on the basis of the present value of future cash flows which will rely on a discount rate that is more representative of the reality and a better appreciation of the risks.19

The IFRS therefore require a rethinking of the systems of result guidance, classification of the assets and the definition of possible new allocation and/or revision of the hedging policy, an overhaul of the information systems, the setting up of a map of the contracts and an inventory of the risks and therefore more generally an adaptation or a rethinking of asset management and ALM techniques in order to integrate the volatility generated by this new referential accounting system.

When the initial annual results were published under the IFRS standards in the first quarter of 2006, the insurance companies were quick to modify their traditional presentations to the financial markets in order to highlight the volatility generated by the IFRS, notably on valuing securities at their fair value in the income statement. Their desire was to signal to the financial markets that the IFRS generated very favourable volatility on the growth of their net 2005 results (thanks to a fall in interest rates and a rise in the stock markets), but that it was not of a recurring nature. With these preliminaries on the IFRS out of the way, the companies preferred to communicate less flattering growth, restated for the IFRS re-evaluation impacts, in order to extract themselves from the accounting constraints.

Furthermore, to reassure the financial markets, some insurance companies explicitly mentioned that the management of that volatility was

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19 - It should be mentioned that phase I, in anticipation of phase II, proposed a ‘current market interest rate’ option which makes it possible to adjust the technical provisions in relation to a market interest rate. The variation of these provisions from one accounting period to another, as a result of the variation in the interest rate, is then accounted for in the earnings. However, this option has rarely been used, as insurers prefer to wait for the new definition of technical provisions in phase II.
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integrated into the core of their decision-making process in relation to asset management and ALM: volatility budgets by subsidiary or production unit could even be implemented progressively within each group.

By moving from reporting at historical cost, combined with numerous techniques for smoothing results that impinge very little on asset management and ALM, to much more transparent fair value (IFRS) accounting (the ALM and asset management choices are henceforth visible in the accounts), insurance companies are forced to adapt their financial engineering processes in order to control and contain this new volatility in the accounting statements. Asset management and ALM techniques will therefore inevitably become more and more ‘financial’ and sophisticated under the new requirements generated by the IFRS.

Naturally, EDHEC would see this eventual change as a positive development, because until now asset-liability management in several European countries has been structured by the national accounting standards, which meant that these standards favoured ‘cash flow matching’\(^{20}\) financial management and concealed market risks.

The idea to employ a ‘fair value’ for assets and liabilities by including all of their risk factors is naturally a significant step forward for financial managers.

However, this new ‘financial’ approach to accounting must not replace financial analysis, which in our opinion must remain independent from the chosen accounting approach. It is the capacity of financial analysts, investors and regulators to understand an insurance company’s asset allocation and risk management policy by examining its balance sheet that must play the central role in the evaluation of a company’s risks, and not the mathematical result that is reached by comparing and contrasting accounting figures, even if they are termed ‘fair value’! It is likely that the failure to sufficiently distinguish between the role of accounting and that of financial analysis, a phenomenon that has been heightened in recent years by the prominence in accounting of the true and fair view principle, has led to the inconsistencies highlighted in the first section of this document.

Moreover, Solvency II should engender a veritable evolution in asset management and asset-liability management. The prudential rules are going to evolve considerably by moving from an excessively simple Solvency I model, integrating only the underwriting risk with a strict fixed rate and bookkeeping approach, to a Solvency II model integrating most risks (market, underwriting, credit and operational) and also the effectiveness of asset-liability management, reinsurance and hedging (derivatives, securitisation, etc.).

\(^{20}\) This is a technique that essentially aims to match liability flows that are certain or almost certain with asset flows that are certain; it therefore relies on bonds. For further details, see section II.1.
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These developments are intended to incite insurance companies not only to measure their risks, but also to manage and control them (more complete risk analysis than that instituted by the IFRS and Solvency I by considering the types of risks, the distribution law, the correlation, the diversification, studying the extreme risks, etc.). The capacity to achieve these objectives will have a direct impact on the level of the capital requirement. The latter exerts a strong constraint, since any mobilisation of capital has a cost, notably with respect to optimising the allocation of capital by activity as a function of its profitability and volatility.

In view of the preponderance of the standard SCR formula in orienting insurance companies’ strategies (in the United States for example, Risk Based Capital calibration has led to a situation where very few insurers hold listed shares any longer, because of the prohibitive capital cost), it is easy to understand why supervisory authorities, insurance federations and associations and individual insurance companies from the four corners of Europe are lobbying to propose a standard formula that fits their asset management and ALM strategy.

The increasing ‘financialisation’ and sophistication of asset management and ALM techniques over the last few years should continue to grow. It should lead to an optimisation of the management of economic capital, through better asset-liability adequacy, more dynamic management of the differentials in duration and convexity between the assets and liabilities (more structured and sophisticated interest rate products, caps, floors, swaptions, CDS, etc.), a transfer of some of the risks of mass insurance (securitisation of automobile and residential portfolios) and large risks (natural catastrophe, mortality and life expectancy bonds) towards the financial markets, better management of the extreme risks of financial assets and optimisation of the diversification (even though it is still early for evaluating the degree to which it could boost and broaden asset allocation towards alternative investments, private equity, structured credits, etc.; this will depend on how those assets are treated in the standard formula).

Before providing sophisticated modern asset management solutions (part III) which will allow the management of insurance companies to be improved considerably in this new IFRS-Solvency II referential system, we propose in part II to define the framework in which the solutions are to be found and more specifically to examine the state-of-the-art of the risk management techniques in asset management and ALM.
II. Risk Management Techniques in Asset and Asset-Liability Management
As outlined in the previous section, the new regulatory environment provides strong incentives for the development and implementation of enhanced risk management techniques in the financial management of insurance companies.

IFRS accounting standards aim to emphasise the proper recognition of the impact of changes in various risk factors on the balance sheets of insurance companies. While it should be noted that this evolution is somewhat mitigated by 1) the fact that in phase I a key distinction is made between insurance liabilities and financial liabilities, and 2) the adoption of shadow accounting as a way to prevent too strong an impact of changes in asset values on equity value, it is nonetheless the case that such enhanced consideration of the impact of changes in risk factors necessarily induces an increased volatility in assets and liabilities, as well as a stronger recognition of changes in such values in income statements and balance sheets.

Of a limited scale in phase I, and fully developed in phase II, the increased volatility of the equity and income statements of insurance companies induced by the adoption of the “fair value” principle calls for the emergence of suitably designed financial management strategies. The goal is now for insurance companies to seek to control the volatility of assets and liabilities, and more specifically to try to control the volatility of the asset-liability surplus.

In other words, the focus of asset allocation strategies will turn towards minimising the volatility of assets as well as minimising the surplus volatility. This focus is known as a risk management focus that distinguishes itself from a focus on performance generation or alpha management.

In this context, we will present, in what follows, an overview of the state-of-the-art techniques developed over the last 30 years of academic and professional research in the field of asset management, with a particular focus on risk management. Before doing this, we first argue that asset management techniques in an insurance company should explicitly account for the presence of liability constraints, and re-position the asset management problem in the context of having to meet such liability constraints.

The adoption of a regulation on solvency requirements for insurance companies (Solvency II) involves a focus on the management of extreme risks in assets and asset/liability mismatches, measured by the potential for severe losses, as opposed to a pure focus on the management of average risk such as measured by volatility.

This second part of our study is cast in this dual context of enhanced focus on risk management and enhanced focus on extreme risks.
II.1. Risk management techniques in asset-liability management

Asset-Liability Management (ALM) denotes the adaptation of the portfolio management process in order to handle the presence of various constraints relating to the commitments that figure in the liabilities of an institutional investor's balance sheet (commitments to paying pensions, insurance premiums, etc.). In what follows, we first provide a brief review of standard techniques used in ALM, before presenting in a more detailed manner the modern approach based on a fund separation theorem. Finally, we present a numerical illustration that will showcase the benefits and limitations of the various approaches to ALM in the context of a realistic example.

II.1.1. A brief history of ALM

We present a (brief) history of ALM techniques both from a practitioner's perspective and from an academic perspective.

II.1.1.1. ALM from a practitioner's perspective

From a practical standpoint, ALM-type management techniques can be classified into several categories. A first approach called cash-flow matching involves ensuring a perfect static match between the cash flows from the portfolio of assets and the commitments in the liabilities. Let us assume for example that a pension fund has a commitment to pay out a monthly pension to a retired person. Leaving aside the complexity relating to the uncertain life expectancy of the retiree, the structure of the liabilities is defined simply as a series of cash outflows to be paid, the real value of which is known today, but for which the nominal value is typically matched with an inflation index. It is possible in theory to construct a portfolio of assets whose future cash flows will be identical to this structure of commitments. To do so, assuming that securities of that kind exist on the market, would involve purchasing inflation-linked zero-coupon bonds with a maturity corresponding to the dates on which the monthly pension instalments are paid out, with amounts that are proportional to the amount of real commitments.

This technique, which provides the advantage of simplicity and allows, in theory, for perfect risk management, nevertheless presents a number of limitations. First of all, it will generally be impossible to find inflation-linked securities whose maturity corresponds exactly to the liability commitments. Moreover, most of those securities pay out coupons, which leads to the problem of reinvesting the coupons. To the extent
that perfect matching is not possible, there is a technique called immunisation, which allows the residual interest rate risk created by the imperfect match between the assets and liabilities to be managed in a dynamic way. This interest rate risk management technique can be extended beyond a simple duration-based approach to fairly general contexts, including for example hedging larger changes in interest rates (through the introduction of a convexity adjustment), hedging non-parallel shifts in the yield curve (see for example Fabozzi, Martellini and Priaulet (2005)), or to simultaneous management of interest rate risk and inflation risk (Siegel and Waring (2004)). It should be noted, however, that this technique is difficult to adapt to hedging non-linear risks related to the presence of options hidden in the liability structures, and/or to hedging non-interest rate related risks in liability structures.

Another, probably more important, disadvantage of the cash-flow matching technique (or of the approximate matching version represented by the immunisation approach) is that it represents a positioning that is extreme and not necessarily optimal for the investor in the risk/return space. In fact we can say that the cash-flow matching approach in asset-liability management is the equivalent of investing in the risk-free asset in an asset management context. It allows for perfect management of the risks, namely a capital guarantee in the passive management framework, and a guarantee that the liability constraints are respected in the ALM framework. However, the lack of return, related to the absence of risk premia, makes this approach very costly, which leads to an unattractive level of contribution to the assets.

So as to improve the profitability of the assets, and therefore to reduce the level of contributions, it is necessary to introduce asset classes (stocks, government bonds and corporate bonds) which are not perfectly correlated with the liabilities into the strategic allocation. One then finds the best possible compromise between the risk (relative to the liability constraints) thereby taken on, and the excess return that the investor can hope to obtain through the exposure to rewarded risk factors. Different techniques are then used to optimise the surplus, i.e., the excess value of the assets compared to the liabilities, in a risk/return space. In particular, it is useful to turn to stochastic models that allow for a representation of the uncertainty relating to a set of risk factors that impact the liabilities. These can be financial risks (inflation, interest rate, stocks) or non-financial risks (demographic ones in particular). When necessary, agent behaviour models are then developed, which allow the impact of decisions linked to the exercising of certain implicit options to be represented. For example, a policyholder can (typically in exchange for penalties) cancel his/her life assurance contract if the guaranteed
contractual rate drops significantly below the interest rate level prevailing at a date following the signature of the contract, which makes the amount of liability cash flows — and not just their current value — dependent on interest rate risk.

It is also appropriate to mention non-linear risk-profiling management techniques, the goal of which is to provide a compromise between a risk-free and return-free approach on the one hand, and a risky approach, that does not allow the liability constraints to be guaranteed, on the other (see the table below for an overview of ALM techniques and the corresponding techniques in asset management). In particular, this involves introducing options which allow for (partial) access to the risk premia of stocks without all of the associated risks, or dynamic allocation methods, inspired by the portfolio insurance techniques transposed into an ALM framework (see in particular Leibowitz and Weinberger (1982ab) for the contingent optimisation technique, or Amenc, Malaise and Martellini (2004) for a generalisation in terms of a dynamic core-satellite approach).

Finally, it is appropriate to mention a new approach that is referred to as liability driven investment ("LDI"). This is an approach that has rapidly gained interest from pension funds, insurance companies, and investment consultants alike, following recent changes in accounting standards and regulations that have led to an increased focus on liability risk management. Essentially, these changes force institutional investors to value their liabilities at market rates (mark-to-market), instead of fixed discount rates, which results in an increase in the volatility of the liability portfolio. As a result, institutional investors have to increase their focus on risk management to reduce the volatility of their funding ratio, a new constraint reinforced by stricter solvency requirements. While they can vary significantly across providers, LDI solutions typically involve a hedge of the duration and convexity risks via seven standard building blocks, while keeping some assets free for investing in higher yielding asset classes.

These solutions may or may not involve leverage, depending on the institutional investor's risk aversion. When no leverage is used, a fraction of the assets (known as the liability-matching portfolio) is allocated to risk management, while another fraction of the asset is allocated to performance generation. One may actually view this approach as a combination of two strategies, involving investing in immunisation strategies (for risk management) as well as investing in standard asset management solutions.
Risk Management Techniques in Asset and Asset-Liability Management

(for performance generation). This approach stands in sharp contrast to more traditional surplus optimisation methods, where both objectives (liability risk management and performance generation) are pursued simultaneously in an attempt to achieve the portfolio with the highest possible relative risk/relative return ratio. When leverage is used, it can be explicit, in the form of a short position in the risk-free asset, or implicit, in the form of leverage induced by the use of derivatives (typically interest rates and/or inflation swaps) in the liability-matching portfolio. This allows for more potential for performance generation. For example, one may consider a stylised example where derivatives are used to match the liability portfolio so that virtually 100% of the assets are still available for investment in the performance generation portfolio. It should be noted that the performance target for this "risky" portfolio then becomes the risk-free rate, which legitimates the use of absolute return portfolios (hedge funds, capital guaranteed products, etc.).

We actually argue below that this allocation approach, expressed in terms of allocation to three building blocks (cash, liability-matching portfolio and performance portfolio), as opposed to allocation to standard asset classes, is consistent with a three-fund separation theorem that extends standard results from modern portfolio theory to situations involving the presence of liability constraints, and constitutes a first step toward a better asset-liability management process.

II.1.1.2. ALM from an academic perspective

While it seems that a priori a variety of techniques are available to institutions who seek to manage their asset portfolio in the face of their liability constraints, it remains to be seen what results, if any, are available from an academic perspective about the optimality, or lack thereof, of these various approaches to ALM. The existing contributions in the academic literature fall within two different, and somewhat competing, approaches to ALM.

On the one hand, several authors have attempted to cast the ALM problem in a continuous-time framework, and extend Merton’s intertemporal selection analysis (see Merton (1969, 1971)) to account for the presence of liability constraints in the asset allocation policy. A first step in the application of optimal portfolio selection theory to the problem of pension funds was taken by Merton (1990) himself, who studied the allocation decision of a university that manages an endowment fund. In a similar spirit, Boulier et al (1995) have formulated a continuous-time dynamic programming model of pension fund management. It contains all of the basic elements for modelling dynamic pension fund behaviour, and can
be solved by means of analytical methods. Rudolf and Ziemba (1994) extend these results to the case of a time-varying opportunity set, where state variables are interpreted as currency rates that affect the value of the pension’s asset portfolio. Also related is a paper by Sundaresan and Zapatero (1997), which is specifically aimed at asset allocation and retirement decisions in the case of a pension fund. This continuous-time stochastic control approach to ALM is appealing because it enjoys the desirable property of tractability and simplicity, allowing one to fully and explicitly understand the various mechanisms affecting the optimal allocation strategy.

On the other hand, because of the simplicity of the modelling approach, such continuous-time models do not allow for a full and realistic account of uncertainty facing institutions in the context of asset-liability management. A second strand of the literature has therefore focused on developing more comprehensive models of uncertainty in an ALM context. This has led to the development of a stochastic programming approach to ALM, including Kallberg et al (1982), Kusy and Ziemba (1986), or Mulvey and Vladimirou (1992). This strand of the literature is relatively close to industry practice, with one of the first successful commercial multistage stochastic programming applications appearing in the Russell-Yasuda Kasai Model (Cariño et al (1994), 1998), Cariño and Ziemba (1998)). Other successful commercial applications include the Towers Perrin-Tillinghast ALM system of Mulvey et al (2000), the fixed-income portfolio management models of Zenios (1995) and Beltratti et al (1999), and the InnoALM system of Geyer et al (2001). A good number of applications in asset-liability management are provided in Ziemba and Mulvey (1998) and Ziemba (2003). In most cases, stochastic programming models require the uncertainties to be approximated by a scenario tree with a finite number of states of the world at each time. Important practical issues such as transaction costs, multiple state variables, market incompleteness due to uncertainty in liability streams that is not spanned by existing securities, taxes and trading limits, regulatory restrictions and corporate policy requirements can be handled within the stochastic programming framework. On the other hand, this comes at the cost of tractability. Analytical solutions are not possible, and stochastic programming models need to be solved via numerical optimisation. In an attempt to circumvent the concern of the black-box flavour of stochastic programming models, some interesting attempts have been made to test for the optimality of various rule-based strategies (see Mulvey et al (2005)).
II.1.2. A formal model of asset-liability management and the LDI approach

In this section, we introduce a stylised continuous model for intertemporal allocation decisions in the presence of liability constraints, which falls within the first strand of the literature (optimal allocation decisions in a continuous-time model). Under specific assumptions, we will be able to provide explicit solutions, and show that a three fund separation theorem holds and can be related to the recent LDI approach to ALM.

In this section, we introduce a general model for the economy in the presence of liability constraints. Let \([0, T]\) denote the (finite) time span of the economy, where uncertainty is described through a standard probability space \((\Omega, \mathcal{A}, P)\) and endowed with a filtration \(\{\mathcal{F}_t; t \geq 0\}\), where \(\mathcal{F}_\infty \subset \mathcal{A}\) and \(\mathcal{F}_0\) is trivial, representing the \(P\)-augmentation of the filtration generated by the \(n\)-dimensional Brownian motion \((W^1, \ldots, W^n)\).

II.1.2.1. Stochastic model for the value of assets and liabilities

We consider \(n\) risky assets (or asset classes), the prices of which are given by:

\[
\begin{align*}
\text{d}P^i_t &= P^i_t(\mu_t \text{d}t + \sum_{j=1}^{n} \sigma_{ij} \text{d}W^j_t), \quad i = 1, \ldots, n
\end{align*}
\]

We shall sometimes use the shorthand vector notation for the expected return (column) vector \(\bar{\mu} = (\mu^i_{t-})\) and matrix notation \(\bar{\sigma} = (\sigma_{ij}_{t-})_{i,j=1,\ldots,n}\) for the asset return variance-covariance matrix. We also denote \(\mathbb{1} = (1, \ldots, 1)'\) an \(n\)-dimensional vector of ones and by \(\bar{W} = (W^j)'\) the vector of Brownian motions. A risk-free asset, the 0th asset, is also traded in the economy. The return on that asset, typically a default free bond, is given by \(\text{d}P^0_t = P^0_t \text{r} \text{d}t\), where \(\text{r}\) is the risk-free rate in the economy.

We assume that \(\text{r}, \mu\) and \(\sigma\) are progressively measurable and uniformly bounded processes, and that \(\sigma\) is a non-singular matrix that is also progressively measurable and bounded uniformly\(^{21}\). For some numerical applications below, we sometimes treat these parameter values as constant.

We also introduce a separate process that represents in a reduced-form manner the dynamics of the present value of the liabilities:

\[
\begin{align*}
\text{d}L_t &= L_t(\mu_L \text{d}t + \sum_{j=1}^{n} \sigma_{Lj} \text{d}W^j_t),
\end{align*}
\]

where \((W^e_t)\) is a standard Brownian motion, uncorrelated with \(W\), which can be regarded as the projection residual of liability risk onto asset price risk and represent the source of uncertainty that is specific to liability risk, emanating from various factors such as uncertainty in the growth of work force, uncertainty

\(^{21}\) More generally, one can make expected return and volatilities of the risky assets, as well as the risk-free rate, depend upon a multi-dimensional state variable \(X\). These state variables can be thought of as various sources of uncertainty impacting the value of assets and liabilities. In particular, one may consider the impact of a stochastic interest rate on the optimal policy.
in mortality and retirement rates, etc. The integration of the above stochastic differential equation gives:

\[
\dot{L}_t = L_t \eta(t, T) \eta_t(t, T), \quad \text{with:}
\]

\[
\eta(t, T) = \exp \left\{ \int_t^T \left( \mu_t(s) - \frac{1}{2} \sigma_{t,t}(s) \right) ds + \int_t^T \sigma_{t,t}(s) dW_t \right\}
\]

\[
\eta_t(t, T) = \exp \left\{ -\int_t^T \frac{1}{2} \sigma_{t,t}(s) ds + \int_t^T \sigma_{t,t}(s) dW_t \right\}
\]

When \( \sigma_{t,t} = 0 \), then we are in a complete market situation where all liability uncertainty is spanned by existing securities. Because of the presence of non-financial risks (e.g., actuarial risks), such a situation never occurs in practice, and the correlation between the liability and the liability-hedging portfolio (i.e., the portfolio with the highest correlation with liability values) is always strictly lower than one. In general, therefore, \( \sigma_{t,t} = 0 \) and the presence of liability risk that is not spanned by asset prices induces a specific form of market incompleteness.

II.1.2.2. Objective and investment policy

We now introduce a couple of variables of interest, which will be used as state variables in this model. The first one is the surplus, defined as the difference in value between assets and liabilities: \( S_t = A_t - L_t \); the second one is the funding ratio, defined as the ratio of assets to liabilities: \( F_t = A_t / L_t \).

A pension trust has a surplus when the surplus is greater than zero (funding ratio > 100%), is fully funded when it is zero (funding ratio = 100%), and under funded when it is less than zero (funding ratio < 100%). In an asset-liability management context, what matters is not the value of the assets per se, but how the asset value compares to the value of liabilities. This is also the reason why it is natural to assume that the (institutional) investor’s objective is written in terms of relative wealth (relative to liabilities), as opposed to absolute wealth: \( \max_w E_0 [U(F_t)] \).

The investment policy is a (column) predictable process vector \( \left( w_t = \left( w_{1t}, \ldots, w_{nt} \right) \right)_{t \geq 0} \) that represents allocations to risky assets, with the remainder invested in the risk-free asset. We define by \( A_t^w \) the asset process, i.e., the wealth at time \( t \) of an investor following the strategy \( w \) starting with an initial wealth \( A_0^w \).

We obtain:

\[
dA_t^w = A_t^w \left[ (1 - w_t) \frac{dB_t}{B_t} + w_t \frac{dP_t}{P_t} \right]
\]

or:

\[
dA_t^w = A_t^w \left[ (r + w_t(\mu - r)) dt + w_t \sigma dW_t \right]
\]
Using Itô's lemma, we can also derive the stochastic process followed by the funding ratio under the assumption of a strategy w:

\[
\frac{dF_t^w}{F_t^w} = \left( r + \omega (\mu - r) \right) dt + \omega \sigma_1 \sigma_t dt + \omega \sigma_2 \sigma_t dW_t - \omega \sigma_1 \sigma_t dW_t
\]

or:

\[
\frac{dF_t^w}{F_t^w} = \left( r - \mu_1 + \sigma_1 \sigma_t \right) dt + \omega \sigma_1 \sigma_t dt + \omega \sigma_2 \sigma_t dW_t - \omega \sigma_1 \sigma_t dW_t
\]

For later use, let us define the following quantities as the mean return and volatility of the funding ratio portfolio, subject to a portfolio strategy w:

\[
\mu_t^w = \left( r - \mu_1 + \sigma_1 \sigma_t + \sigma_2 \sigma_t \right) + \omega \left( \mu - r \right) - \omega \sigma_1 \sigma_t
\]

\[
\sigma_t^w = \left( \sigma_1 \sigma_t + \omega \sigma_2 \sigma_t \right)^{1/2}
\]

II.1.2.3. Solution using the dynamic programming approach

Define the indirect or derived utility process at time t:

\[
J_t = \max_w E_t \left[ U(F_t) \right]
\]

where \( E_t[\cdot] \) denotes the expectation conditional about information available at time t, such as described by the filtration generated by the n Brownian motion driven asset prices and the (n+1)th Brownian motion driving pure liability uncertainty.

II.1.2.3.1. General solution

For a Markovian control process \( \{w_t\}_{t \geq 0} \) and a function \( \phi(t,F_t) \in C^{12} \) the infinitesimal generator of the funding ratio process is:

\[
A^w \phi(t,F_t) = \phi_t + F_t \phi_{\mu}^w + \frac{1}{2} F_t^2 \phi_{\sigma}^w \sigma_t^w
\]

where the derivative of a function f with respect to variable x is denoted as \( f_x \).

Given the objective function, the appropriate Hamilton-Jacobi-Bellman equation associated with this problem is:

\[
\sup_w \left\{ A^w J(t,F_t) \right\} = 0
\]

subject to \( J(T,F_t) = U(F_t) \)

Optimising with respect to w yields:

\[
F_t \frac{\partial \mu_t^w}{\partial w} w^* + \frac{1}{2} F_t^2 \frac{\partial \sigma_t^w}{\partial w} w^* = 0
\]

or:

\[
\frac{dF_t^w}{F_t^w} = \frac{1}{2} \frac{\partial \sigma_t^w}{\partial w} w^* dW_t + \frac{1}{2} \frac{\partial \sigma_t^w}{\partial w} w^* dW_t + \frac{1}{2} \frac{\partial \sigma_t^w}{\partial w} w^* dW_t
\]
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In order to better understand the nature of the second portfolio, it is useful to remark that it is a portfolio that is minimising the local volatility $\sigma^w_\ell$ of the funding ratio. To see this, recall that the expression for the local variance is given by

$$\sigma^w_\ell = \left[ (w^* - \lambda^w_\ell) - (w^* - \lambda^w_\ell) + \sigma^2_s \right]^{\frac{1}{2}},$$

which reaches a minimum for $w^* = (\lambda^w_\ell)^{-1}\lambda^w_\ell$, with the minimum being $\sigma^2_s$. As such, it appears as the equivalent of the minimum variance portfolio in a relative return-relative risk space, and also the equivalent of the risk-free asset in a complete market situation where liability risk is entirely spanned by existing securities ($\sigma^2_s = 0$).

Alternatively, this portfolio can be shown to have the highest correlation with the liabilities. As such, it can be called a liability-hedging portfolio, in the spirit of Merton (1971) intertemporal hedging demands. Indeed, if we want to maximise the covariance $w^* \sigma_{\ell} w$ between the asset portfolio and the liability portfolio $\ell$, under the constraint that $\sigma^2_s = w^* \sigma_s w$, we obtain the following Lagrangian:

$$L = w^* \sigma_{\ell} w - \lambda \left( w^* \sigma_s w - \sigma^2_s \right).$$

Differentiating with respect to $w$ yields:

$$\frac{\partial L}{\partial w} = \sigma_{\ell} w - 2\lambda \sigma_s w$$

with a strictly negative second derivative function. Setting the first derivative equal to zero for the highest covariance
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portfolio leads to the following portfolio, which is indeed proportional to the liability-hedging portfolio

\[ w = \frac{1}{2\lambda} (\sigma \sigma')^{-1} \sigma L = \frac{1}{2\lambda} (\sigma')^{-1} \sigma L \]

II.1.2.3.2. Specific solution in the case of CRRA utility

Let us now consider a specific utility function of the CRRA type:

\[ U(F_t) = \frac{(F_t)^{1-\gamma}}{1-\gamma} \]

We try a solution to the non-linear Cauchy problem

\[ q_t + F q_t u_F^w + \frac{1}{2} F^2 q_{FF} \left( \sigma_F^w \right)^2 = 0 \]

which is separable in \( F \) and can be written as:

\[ q_t(t,F_t) = \frac{g(t,T)(F_t)^{1-\gamma}}{1-\gamma} \]

with

\[ g(t,T) = \exp \left[ (T-t) \left( \frac{1}{2} (1-\gamma)(\theta - \sigma_L) - \gamma (\sigma_L^2 - \sigma_L\theta) + \frac{(1-\gamma)(2-\gamma)}{2} \right) \right] \]

where \( \sigma - \sigma_L \) is defined as the matrix whose general term is equal to that of \( \sigma_L \) outside the diagonal and is equal to \( \sigma^2 - \sigma_L \), also written as \( \sigma^2 - \sigma_L \) on the diagonal.

Given that \( \frac{F_{t+1}}{F_{t+1}^L} = \frac{1}{\gamma} \), we finally obtain:

\[ w^* = w^*(t,F_t) = \frac{1}{\gamma} (\sigma \sigma')^{-1} (\mu - r I) + \left( 1 - \frac{1}{\gamma} \right) (\sigma')^{-1} \sigma_L \]

As is well-known, it should be noted that when \( \gamma = 1 \), i.e., in the case of the log investor, the intertemporal hedging demand is zero (myopic investor).

In general, again, the optimal strategy consists of holding two funds, in addition to the risk-free asset — the standard mean-variance portfolio and the liability-hedging portfolio — and the proportions invested in these two funds are constant in time.

It is remarkable that the optimal solutions to a formal ALM problem such as the one presented above are strongly reminiscent of the so-called LDI solutions, which advocate an approach to ALM that is expressed in terms of allocation to three building blocks (cash, liability-matching portfolio, and performance portfolio), as opposed to allocation to standard asset classes, as previously done in the context of surplus optimisation techniques.

This is an approach that has rapidly gained interest from pension funds, insurance companies, and investment consultants alike. While they can vary significantly across providers, LDI solutions typically involve a hedge of the duration and convexity risks via several standard building blocks, while keeping some assets free for investing in higher yielding asset classes. These solutions may or may not involve leverage, depending on the institutional investor’s risk aversion. When no leverage is used, a fraction of the assets (known as the liability-matching portfolio) is allocated to risk management, while another fraction of...
the assets is allocated to performance generation. One may actually view this approach as a combination of two strategies, involving investment in immunisation strategies (for risk management) as well as investment in standard asset management solutions (for performance generation). This approach stands in sharp contrast to more traditional surplus optimisation methods, where both objectives (liability risk management and performance generation) are pursued simultaneously in an attempt to achieve the portfolio with the highest possible relative risk/relative return ratio.

Note also that, as outlined in the previous sections, several investment banks have suggested using customised derivatives to perform liability-matching, and use leverage so that the full amount of the asset portfolio is still invested in a risky asset. This strategy corresponds to -100% in cash, 100% in liability-hedging portfolio and 100% in market portfolio, which can be rationalised under a specific choice of the risk aversion coefficient. More risk-averse investors, on the other hand, will prefer solutions involving less or no leverage.

In closing, it should be noted that ALM models such as the one introduced above focus on long-horizon asset allocation problems. On the one hand, one can certainly make the case that the focus on long-horizon, as opposed to short-horizon, is precisely what is specific to institutional asset allocation decisions, so that it should be regarded as a desirable feature of the problem. On the other hand, it has to be recognised that the presence of regulatory constraints induces a dramatic shortening of the horizon. In other words, it can well be the case that the solution that is optimal from a long-horizon standpoint violates some short-term restrictions. This situation might lead to the adoption of sub-optimal policies from a long-term ALM perspective, because of the need to comply with short-term funding requirements. Possible solutions to the critical question of how to reconcile long-term objectives with short-term regulatory constraints are discussed in the next section, which specifically focuses on the challenges of implementation of risk management techniques in the face of the new regulatory environment.

II.1.3. Implementing liability-hedging portfolios

The usefulness and limitations of these ALM techniques, and the question of how to best design the liability-hedging or liability-matching portfolio, can perhaps be best understood though numerical examples. While cash instruments such as bonds can be used in the design of liability-matching portfolios, derivatives instruments such as futures and swaps typically allow for a more efficient implementation of the strategy.

Broadly speaking, there are two main risk factors that can exist in real-world liability portfolios of insurance
companies: interest rate risk and inflation risk (see below for more details on the relative importance of these two risk factors). In what follows, we will review different types of financial instruments (cash and derivatives instruments) that can be involved in the design of liability-matching portfolios. The illustrations that follow will alternatively bring a focus either on protection with respect to inflation risk or protection with respect to interest rate risk, depending on the example at hand.

Overall, we will argue that, while cash instruments such as bonds can be used in the design of liability-matching portfolios, derivatives instruments such as futures and swaps typically allow for a more efficient replication of interest rate, as well as — when needed — inflation risk, present in liability structures.

II.1.3.1. Use of cash contracts in the design of liability-hedging portfolios

Life insurance remains the preferred vehicle to save for retirement in many continental countries. In most “Bismarck” countries, retirement schemes are primarily organised on a national basis and pension funds have historically been less developed. With this in mind, let us consider the example of an insurance company that builds products specific to this class of investors, and as such proposes inflation protected capital. In order to keep the example as simple as possible, the product will be single premium and fixed term with no lapse.

The size of the premium is €45.7m net of all fees. The term date is 2026. There is a guaranteed yield of 1% per annum, and mathematical reserves are always inflation protected. Here, the reserves increase according to the following formula: Mathematical Reserves (t) = Mathematical Reserves (t-1) * 1.01 * (1 + inflation(t)). This means that the €45.7m premium, with a 1%, real yield and inflation protected is equivalent to €45.7 * (1+1%)^{20} = €55.76m in real terms.

This is a simple example where all payments are real payments and thus can be replicated by real instruments, such as inflation linked [real] bonds. An inflation linked bond that has approximately the same maturity as the liability can help in reducing inflation risk. However it would not perfectly replicate the liability. To be precise, coupons paid on these bonds do not match any liability payment, and have to be reinvested. Perfect replication with inflation linked bonds would imply being short real bonds with lower maturities.

We are considering a zero-coupon inflation yield curve that rises linearly between 2% and 2.9% between year 1 and 20, and a zero-coupon yield curve that rises linearly between 4% and 5%.
The replicating portfolio of real bonds is as follows:

In this case, the value of the portfolio is €7m and €54m needs to be invested in a 20-year real bond. Perfect replication of the liability is never possible because of the lack of available maturities in the inflation-linked market. In addition, any portfolio that cannot be short bonds would be significantly different from the replicating portfolio, and thus have greater risk.

This argument favours the use of derivatives, as will be shown in sub-section II.1.3.4. In this case, zero coupon inflation swaps would be the unit bricks to build the replication portfolio.

In practice, the bulk of the portfolio could be made up of real bonds, as derivatives are used mainly as an adjustment.

In our example, the present value of the liability, €37.23m can be invested in the designated real bond, with zero-coupon inflation swaps being used to adjust the portfolio. It is worth mentioning here that depending on the structure of the portfolio, inflation swaps may be needed in larger amounts than inflation bonds where static replication is desired. The reader will refer to section II.1.3.4 of this document for a description of the use of swaps in the design of replicating portfolios.

II.1.3.2. Use of futures contracts in the design of liability-hedging portfolios

In the next section, we will argue that swaps contracts are convenient tools for
proper management of the assets and liabilities mismatch. On the other hand, insurance companies wishing to focus on the use of exchange-traded derivatives, as opposed to OTC derivatives, may prefer using futures contracts in the context of a simple duration matching strategy. In what follows, we describe a simple exercise illustrating the use of futures contracts in the context of interest rate management in an ALM perspective. This illustration is borrowed from Goltz, Martellini and Ziemann (2006), to which we refer for more details.

An insurance company is exposed to significant interest rate risk in the case of a duration mismatch between assets and liabilities. This exposure may represent a large, unacknowledged, strategic bet on interest rates and the mismatch in duration exposes the company to uncompensated risk. Assuming for example a liability structure that leads to an average duration between 10 and 15 years, it is obvious that there is an opportunity cost and dramatic risk/reward difference of using government bonds with a duration that will be significantly lower than that of the liabilities.

It should be noted at this stage that it is not unusual for insurance companies to have liability streams with long duration. In Belgium for instance, there are single and regular premium products with a fixed term that is the retirement age. Where policyholders are under 40, the duration of the contracts is greater than twenty years, and overall these contracts may have a substantial duration. As the market for very long-term bonds is underdeveloped, some companies build a risk position that consists in funding a long-term equity book with very long liabilities. These companies have a negative duration gap, in other words, they have a net short position in very long-term fixed cash flows.

A given decrease in the level of interest rates will have a more dramatic impact on the value of the liabilities than on the value of the assets, with a dramatic decrease of surplus size as a consequence. A positive duration gap indicates that assets are more interest rate sensitive than liabilities, on average. Thus, when interest rates rise (fall), assets will fall proportionately more (less) in value than liabilities and the market value of equity will fall (rise) accordingly. On the other hand, a negative duration gap indicates that weighted liabilities are more interest rate sensitive than assets. Thus, when interest rates rise (fall), assets will fall proportionately less (more) in value than liabilities and the market value of equity will rise (fall).

On the liability side, in an attempt to focus on a stylised liability structure, we model the liabilities as a short position in a global bond index, which can be represented by a zero-coupon bond with constant time-to-maturity. Using a standard interest rate model, it has to be underlined that duration is only a first-order approximation to the measure of exposure with respect to small and parallel changes in the yield curve. When large changes in the level and/or changes in the shape of the yield curve are to be expected, other risk indicators can be used such as convexity or factor-duration (slope-duration, and curvature-duration). See Martellini, Priaulet and Priaulet (2003) for more details.
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Longstaff – Schwartz (1992) model) allows us to easily price liabilities modelled in this manner. Our chosen method of representing liabilities reflects that an insurance company’s liabilities are first and foremost affected by changes in interest rates and changes in interest rate volatility. As a result, liabilities would be perfectly correlated with the return on a bond index. In practice, there are certainly other factors, such as actuarial uncertainty, that determine the returns on liabilities. This is the reason why we introduce a disturbance term in our liability process as a convenient reduced-form way to achieve a target correlation between liabilities and the discount bond (see Goltz, Martellini and Ziemann (2006) for more details).

We assume that the liability duration is equal to 10 years, and consider the effect of investing into different derivatives strategies on the performance relative to liabilities. In order to isolate the effects of short-term changes in the interest rate and interest rate volatility, we assess the gap between assets and liabilities after a three-month horizon.

We will first look at our base case, where the investor just holds a position in a standard average maturity contract, i.e., the Bund future contract. Assuming an initially fully funded situation, we assess the outcome of investing 100% of the assets into this strategy in terms of shortfall measures. Since the duration of the Bund future is lower than that of the liabilities we model, it can be expected that the shortfall risk will be significant. As highlighted above, having long-term maturity instruments for hedging purposes at their disposal is a critical need for institutional investors since the convexity of the price-yield relation for a bond increases with longer maturities. The significant shortfall risk for the two strategies based on the Bund futures actually stems from the lower duration compared to the liabilities. This problem is all the more significant in times of low interest rate coupons which also have a positive impact on convexity. Given these problems, we propose to assess the usefulness of a 0-year bond future for hedging purposes. This contract corresponds to a duration of roughly 18 years which is actually higher than the duration for the liabilities in our model (10 years), while the duration of the Bund contract is lower in both cases. To ensure proper risk management, we obtain the weights of the Bund and Buxl strategy by minimising the shortfall variance.

The figure below shows the distribution of the difference between assets and liabilities at the three-month horizon. Again, this allows us to assess the impact of interest rate shocks on the investor’s situation, given that he/she faces liability constraints. The left-hand histograms show the surplus/deficit distribution in the case where the liabilities correspond exactly to a short position in a bond index. The histograms on the right hand side show the surplus/deficit distribution.

---

25 - We favour this approach to simple duration calculations, which rely on certain assumptions, notably that the yield curve is only affected by small parallel shifts, which may not hold in a general setup.
The table below shows the weights that we obtain for the different cases. The positive contribution of the Buxl future is obvious. The longer duration of this futures contract leads to significant reduction of the surplus/deficit variance, allowing investors with liability constraints to achieve enhanced matching compared to the case where the Buxl future is not available. This is reflected in the significant allocations the Buxl futures strategy obtains in the duration matching portfolios, which is higher than 60%.

<table>
<thead>
<tr>
<th>Composition of duration matching portfolios</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration of Liabilities</strong></td>
</tr>
<tr>
<td>Without white noise</td>
</tr>
<tr>
<td>With white noise</td>
</tr>
</tbody>
</table>

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II.1.3.3. Use of repo transaction contracts in the design of liability-hedging portfolios

It should be noted that repo transactions, as an alternative to futures transactions, can also be used to adjust the duration of a bond portfolio. The added advantage is that they allow for an enhancement in the return on the T-Bond portfolio. One problem there is that the implied leverage may be inconsistent with existing domestic regulations. One should further note that repo transactions can only be used to increase, rather than decrease, the duration of a bond portfolio. This section provides a presentation of repo transactions, as well as an example of application in the context of interest rate risk management.

Repurchase (repo) and reverse repurchase (reverse repo) agreement transactions are commonly used by traders and portfolio managers to finance either long or short positions (usually in government securities). A repo is a means for an investor to lend bonds in exchange for a loan of money, while a reverse repo is a means for an investor to lend money in exchange for a loan of securities. More precisely, a repo agreement is a commitment by the seller of a security to buy it back from the buyer at a specified price and at a given future date. It can be viewed as a collateralised loan, the collateral here being the security. A reverse repo agreement is the same transaction viewed from the buyer’s perspective. The repo desk acts as the intermediary between the investors who want to borrow cash and lend securities and the investors who want to lend cash and borrow securities. The borrower of cash will pay the bid repo rate times the amount of cash borrowed while the lender of cash will get the ask repo rate times the amount of cash lent. The repo desk gains the bid-ask spread on all the transactions that it makes.

As an example, let us consider an investor who lends EUR1m of the 10-year Bund benchmark bond (i.e. the Bund 5% 07/04/2011 with a quoted price of 104.11, on 10/29/2001) over 1 month at a repo rate of 4%. There is 160 days’ accrued interest as of the starting date of the transaction. At the beginning of the transaction, the investor will receive an amount of cash equal to the gross price of the bond times the nominal of the loan, i.e.

\[(104.11 + 5 \times \frac{117}{360}) \times 1,000,000 = €1,057,350\]

At the end of the transaction, in order to repurchase the securities he will pay the amount of cash borrowed plus the repo interest due over the period, i.e.

\[1,057,350 \times (1 + 4\% \times \frac{30}{360}) = €1,060,875\]
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What follows are examples of the application of repo transactions for the adjustment of the duration of a bond portfolio. Repo operations are a way of raising additional cash in a portfolio, allowing the completion of the existing asset profile with new investments that will help reach a targeted structure. This solution is efficient in particular when the government bonds put in repos cannot be sold because of an undesired accounting impact or because they themselves contribute to the targeted structure in term of duration, cash flow scheme or earnings.

Some concrete examples using repos follow:

- **Objective:** to lengthen the duration when no cash is available. If the bonds available in the market are not long enough to reach the duration target, a second layer can be built with the help of repos. Using swaps to lengthen duration may be one solution. Using repos is an alternative, with the advantage of being simple and adding the repo spread to the revenues, with no need to provide efficiency tests. The cons include less flexibility on maturities selection.

- **Objective:** decreasing convexity while keeping duration unchanged. This may be achieved by a combination of 1) the sale of a long-dated swap (i.e. fixed payer) and 2) repos as part of the bond portfolio with reinvestment of cash in intermediate maturities. Again, this is an alternative to a full swaps solution.

- **Objective:** being long both duration and credit (extension of the first example). The targeted structure may necessitate a volume of assets bigger than the balance sheet size, i.e. there may not be enough room for both government bonds (duration target) and corporate bonds (revenue target and/or liquidity target). Repos may once again be an alternative to swaps. Some documentation may be required to prove that the balance sheet is not at risk with leveraging. It makes sense to argue the following:
  1. Government bonds present (almost) no credit risk but duration (AAA rating is better for that purpose).
  2. A credit exposure is achievable without duration (short-term instruments + CDS or duration-hedged corporate bonds portfolio).

These two assets are orthogonal regarding duration and credit: there is no leverage here but as a result a synthetic credit bond with duration. Another way to put it is to say that repos’ short-term debt plus reinvestment in credit with hedged duration are forming a credit excess return that comes on top of government bonds.

One should of course also mention the typical use of repo transactions as a way to enhance the performance of a bond portfolio with limited additional risks by earning the repo spread when liquidity is not required from the bonds. In the case of repo bonds that benefit from a high demand and that show wide spreads below short term rates,
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one can reinvest the cash in short term instruments that may be backed to repo redemption dates. In case of a certain volume of rolled repos, with a minimum amount stable through time, the cash may be pooled and invested on longer horizons than the repo horizons, within a dedicated mutual fund accounted for in AFS with change in fair value in P&L (no look through). This will allow, with more diversification, to add some basis points above the repo spread.

II.1.3.4. Use of swap transactions in the design of liability-hedging portfolios

In what follows, we turn to an illustration of the use of swap, as opposed to futures, contracts, in the design of liability risk management strategies. In a nutshell, interest rate swaps are naturally fitted for implementing cash-flow matching strategies, which involves ensuring a perfect static match between the cash flows from the portfolio of assets and the commitments in the liabilities, while exchange-traded futures should be the instruments of choice in the implementation of immunisation strategies, which allows the residual interest rate risk created by the imperfect match between the assets and liabilities to be managed in a dynamic way. Moreover, inflation swaps allow for the management of inflation risk in addition to the management of interest rate risk.

We now specifically consider a stylised liability structure for an insurance company that is affected by interest rate risk and inflation risk.

It should be noted that inflation risk is particularly important for the contracts that relate to non-life insurance. Non-life insurance companies provide protection against damage to goods and people. Underwriting risk, only hedgeable through reinsurance (and as such considered non-hedgeable), is the largest risk exposure. However, the present value of the outstanding claims is subject to hedgeable risk factors as follows:

• Expected fixed cash flows need to be discounted, which makes for an exposure to interest rates.

• Claims that are settled through judicial schemes and paid late relative to their date of report are usually inflated with legally accrued interest rates. These legal rates are generally revised periodically, which makes for another form of exposure to interest rates.

• Damaged goods must be replaced or repaired for an amount which is subject to the price of goods; care and treatment has to be provided in the case of bodily injury for an amount subject to the price of health and services. The sum of exposures to individual components of the consumer price index can be treated statistically as an overall exposure to the consumer price index, which is hedgeable (in
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This approach to liability management based on cash instruments, however, is not the only (nor the most optimal) approach. An alternative asset and liability match would be to buy a risky portfolio of straight bonds or invest in absolute return strategies (so-called performance-seeking portfolio) and use the swaps market to convert the bond cash flows to the precise inflation-linked cash flows required to pay the projected liability payments. Insurance companies will pay fixed flows (extracted from the portfolio), while it receives inflation-linked cash flows tailored to meet the projected liabilities. Relative to index-linked gilts, this solution would provide more precise management of inflation risk. It would also introduce leverage, and hence generate a higher expected return, due to additional performance from the risky portfolio – but additional risk (in case the portfolio underperforms the fixed swap rate).

Use of inflation and interest swaps for the implementation of liability-matching portfolios (case of inflation-linked liability streams). Note that payments are netted so that only the net amount is exchanged between parties.

Investment Bank → Insurance Company → Client

RPI-linked cashflows to match liability payments
Notional x ((CPI_T/CPPI_0)-1)

RPI-linked liability payments

Fixed cash-flows extracted from return on bond portfolio or performance portfolio.
Notional x ((1+fixed rate/1)}
In an attempt to better illustrate the mechanics of cash-flow matching with derivatives instruments, we will reconsider the stylised example where we were using real bonds. A single liability cash-flow equal to €55.76m in real terms is to be paid in 2026. Assuming a 2.5% inflation rate, the expected nominal liability payment amounts to 

$55.76 \times (1+2.5\%)^{20} = €91.7m$,

i.e., an additional €5.61m. The present value of such a cash-flow payment in 2006 is equal to $34.44 = (55.76 + 35.61) / (1 + 5\%)^{20}$, assuming a 5% discount rate.

The core question in the design of a liability-matching portfolio is how to immunise the present value to changes in inflation and interest rates (see figure below).

In case liability streams are not inflation-indexed, the hedging strategy only involves interest rate swaps, as illustrated in the figure below.
To achieve perfect inflation and interest rate risk management, the insurance company enters a swap with a nominal of €55.76m, per which it will make a single zero-coupon payment based on a breakeven rate assumed to be at 2.9% and will receive €55.76m \times \text{Inflation\_Index(2026)/Inflation\_Index(2006)}. This assumption means that the nominal yield on a 20-year bond is 290 bps higher (4.51%) than the real yield on a 20-year inflation protected bond (1.61%). This also means that inflation would have to average more than 2.9% per year until the maturity of the bond for the inflation-linked bond to do as well as the nominal bond of similar term. Note that investors do not necessarily expect inflation to be as high as 2.9%. Since they do not know what the future will bring, they are willing to sacrifice some current yield for inflation protection on the principal. In other words there is an inflation risk premium embedded within this 2.9% rate. In 2026, the insurance company must pay $98.77=55.76\times\text{1.029}^{20}$ million euros. To face this payment, assuming say a 4.51% current zero-coupon yield on the 20-year horizon, the insurance company buys for $40.88=\frac{98.77}{(1+0.0451)^{20}}$ worth of a 20-year zero-coupon bond (see figure below).
The cash-flow matching strategy for the insurance company therefore consists of holding a zero-coupon plus an inflation swap. It allows for an immunisation against changes in interest rates and inflation rates; the present value of future obligations is locked.

To see this, let us assume for example that an unfavourable outcome occurs leading to a severe increase in liability value triggered by a higher inflation rate (e.g., 3.5%) combined with a decrease in interest rate (e.g., going down from 4.51% to 4%), where both of these changes concur to an increase in the present value of liabilities. The insurance company had bought a zero-coupon bond in 2006, the new price of which is $45.08 - 98.77 / (1 + 4\%)^{20}$ under the assumption of a 4% discount rate. The mark-to-market value of the swap is then $5.56 = \frac{55.76(1 + 3.5\%)^{20} - 55.76(1 + 2.9\%)^{20}}{(1 + 4\%)^{20}}$, based on the 3.5% inflation assumption. Total asset value therefore reaches $45.08 + 5.56 = €50.64m$. On the other hand, liability value is given by $50.64 - 55.76(1 + 0.5\%)^{20} / (1 + 4\%)^{20}$. Hence, as can be seen from the figure below, the strategy leads to a perfect asset-liability match.

Conversely, let us now assume a favourable outcome leading to a significant decrease in liability value triggered by a lower inflation rate (e.g., 2%) combined with an increase in interest rate (e.g., up from 4.51% to 5%). The insurance company had bought a zero-coupon bond in 2006, the new price of which is $37.23 - 98.77 / (1 + 5\%)^{20}$ under the assumption of a 5% discount rate. The mark-to-market value of the swap is then $-6 = \frac{55.76(1 + 2\%)^{20} - 55.76(1 + 2.9\%)^{20}}{(1 + 5\%)^{20}}$, based on the 2% inflation assumption. The total asset value therefore reaches $37.23 - 6 = €31.23m$. On the other hand, liability value is now also given by $31.23 - 55.76(1 + 0.5\%)^{20} / (1 + 5\%)^{20}$. Hence, as can been from the figure below, the strategy again leads to a perfect asset-liability match.
While inflation swaps appear to be well-suited instruments for the management of inflation risk, it should be underlined that there exist situations when the effectiveness of the hedging transactions is less obvious because of some uncertainty about the very size of the cash-flows that need to be protected. One solution then consists in implementing an overhedging strategy, as is the case in the following example.

Overhedging strategy for inflation exposure in a Non-Life book.

One interesting feature of Non-Life insurance is indeed the randomness of the exposure to risk factors. One can easily see that when claims are severe, inflation exposure is naturally higher and vice-versa. To illustrate this, we will consider a very simplified model. We assume that claims are reported and paid at the same time, in one year. The uninflated sum of claims to be paid is assumed to follow a lognormal process, with mean equal to 4.6% and volatility equal to 20%.

We also assume that the price index follows a lognormal process with mean equal to 2% and volatility equal to 20%. The price index is released with no delay. Inflation and claims are assumed to be independent processes. The above drifts and volatilities are such that price index is 1 and uninflated claims are 100, on average. There is no interest rate, so both the discounted and undiscounted reserves are 100. We then calculate the 99th percentile or Value at Risk and the 99% Tail VaR (also known as Conditional VaR), given by the expected value above the 99th percentile.
percentile. We obtain in particular that the Tail Value at Risk at the 99% probability for inflated claims is 209 without any hedging strategy. This is to be compared with a Tail Value at Risk for uninflated claims of 171\(^{26}\).

Since the best estimate of uninflated claims is 100, a "natural" hedge would consist in buying zero-coupon inflation swaps for a nominal amount (k) of 100. These will pay consumer price index minus one in a year. With this swap transaction, the 99% Tail VaR is 176, which is 15% below the Tail VaR without hedging inflation exposure. This is still far above the Tail Var for uninflated claims, because when claims are high, inflation exposure increases. In the Tail of the distribution, inflation exposure is higher because claims are higher. An exposure greater than that of the best estimate can thus help diminish economic capital. This can be done by an increased exposure to inflation.

As stated in section II.2.2.1 of this document, minimising Conditional VaR leads to more stable results than the same with Value at Risk. We have chosen to minimise the risk on the claims by finding the appropriate nominal of inflation swaps, where the risk is measured by the TVaR99% of the Portfolio. Minimising TVar99% (C * inflation – k * (inflation -1)) gives a value of k=171, and the solution is very close to TVar(C). This is because TVar(C) is the average exposure to inflation where C>Var(C) because the two factors are independent. In our example there would be an analytical solution because the lognormal is tractable. However, numerical procedures generally need to be employed because TVar(C) is not exactly the inflation exposure in the TVar(C-TVar(C))* infl + Tvar(C)) zone. C>Var99%(C) generally approximates but does not match exactly (IC-kopt)* infl + kopt > Var99%(IC-kopt)* infl + kopt).

The optimum is fairly stable because the exposure to inflation is extremely low in the TVaR of the portfolio. In addition it remains fairly low even in the case of a moderate error of estimate. In our case, the Conditional VaR of our portfolio varies between 171 and 172 for a hedge ratio between 140 and 180, when factors are independent.

While bonds, futures and swaps transactions are key ingredients for the design of liability-matching portfolios, other kinds of interest rate derivatives are also very useful in the management of liability risk when the presence of embedded options has to be accounted for.

\(^{26}\) - The results come from 250,000 draws on each variable using the Mersene-Twister generator.
II.1.3.5. Use of option contracts in the design of liability-hedging portfolios

The examples we have considered so far only involve a linear exposure to inflation and interest rate risks. An additional complexity in ALM for insurance companies is the presence of non-linear risk exposures, as in insurance policies with Guaranteed Annuity Options (GAO). GAOs are minimum return guarantees where the guarantee takes the form of the right to convert an assured sum into a life annuity at the better of the market rate prevailing at the time of conversion and a guaranteed rate. Many life insurance companies in the UK issued pension type policies with GAO in the 1970s and 1980s. During this time UK interest rates were very high, above 10% between 1975 and 1985. Hence, adding GAOs with implicit guaranteed rates around 8% was considered harmless at that time due to the fact that these options were so far “out-of-the-money”. Due to the fall of UK interest rates far below 8% (currently UK interest rates are at a level of 5%), the GAOs have become a significant risk factor in liability streams. A common way to hedge for minimum interest rate guarantees in Europe involves the use of either receiver swaptions or CMS floors. As with the standard interest rate floor contract a CMS floor consists of a strip of options known as floorlets. The CMS floor contract will specify: nominal amount, strike, maturity of floor, frequency of floorlets (i.e., annual, semi-annual or quarterly) and the reference swap rate to use (e.g., the 10-year Euribor swap rate). For example, for a floor with a nominal of €150m, strike of 4.75%, 10-year maturity, annual floorlets, based on the 10-year swap rate, there will be 10 floorlets with payments made annually. The payoff for each floorlet will be €150m x max(0, 4.75% - 10-year CMS rate), where the 10-year CMS rate is the 10-year EUR interest rate swap rate two days before payment. For example, if the observed rate is 3.5%, the payoff will be €150m x (4.75% - 3.5%) = €1.875m (see Martellini, Priaulet and Priaulet (2003) for more details on swaptions and CMS).
II.2. Risk management techniques in asset management

In the previous section, we presented different techniques used in asset-liability management, and we considered a general intertemporal portfolio problem in the presence of liability constraints. In particular, we presented a three-fund separation theorem that provides formal justification of some recent so-called liability-driven investment solutions offered by several investment banks and asset management firms. In a nutshell, these solutions advocate allocation strategies based on investment in two underlying building blocks (in addition to the risk-free asset), the standard optimal growth portfolio and a liability-hedging portfolio.

In other words, these solutions involve a separation between the management of risk (through the liability-hedging portfolio) on the one hand, and the management of performance on the other hand. In this context, it should be noted that the use of risk management techniques, as opposed to simple asset management techniques, is critical in the design of the performance-seeking portfolio. In what follows, we also argue that the design of this portfolio should be cast in the context of the core-satellite approach to portfolio construction, which has proven to be an efficient way to disentangle the search for alpha (abnormal return emanating from active portfolio management) and the search for beta (normal return emanating from a diversified exposure with respect to rewarded sources of risk).

We then argue that risk management can be achieved in two possible ways, one being the reduction of risk through proper asset allocation decisions (diversification benefits), the other being the elimination of risk through the use of suitably designed solutions based either on derivative instruments or dynamic asset allocation strategies (hedging benefits). Before presenting an overview of how to implement asset management with a focus on risk control, we first introduce the modern framework for institutional money management known as the core-satellite approach, which advocated a separation of beta and alpha benefits in the portfolio performance.

II.2.1. The core-satellite approach

Most active managers still have dominant passive exposure to their benchmark. Instead of paying high fees on the passively managed part of their portfolio, the core-satellite approach suggests passively investing in a low-fee index fund (or an enhanced index product) as a core portfolio and in a variety of satellite active managers with
higher tracking error. In its purest form, this approach leads to an investment in market-neutral managers who provide only portable alpha benefits without passive exposure to the index, so that they only compensate active managers for their abnormal returns, not for their passive exposure to rewarded sources of risk.

Driven by the desire to improve investment efficiency, a growing number of institutional investors have moved to this core-satellite approach to portfolio management over the past several years. The move towards core-satellite management has brought with it some key changes in the asset management industry, such as the increased demand for high alpha products such as hedge funds, pursuing absolute performance strategies in the absence of tight tracking error constraints.

In what follows, we present in more detail the core-satellite portfolio construction methodology, which has become the reference technique for the design of the performance-seeking portfolio.

The Arithmetics of Core-Satellite Portfolio Management

We first consider a core-satellite approach with a single satellite portfolio. We show how to derive the optimal proportion to invest in satellite versus core portfolio by setting the problem in a simple mean-variance analysis. We also demonstrate that, if the core portfolio perfectly replicates the benchmark, then the information ratio of the overall portfolio is independent from the proportion in core versus satellite and equal to the information ratio of the satellite portfolio.

We first consider a core-satellite approach with a single satellite portfolio. The mathematics of a core-satellite approach is then straightforward. The overall portfolio corresponds to: \( P = wS + (1-w)C \), where \( w \) is the fraction invested in the satellite \( S \), and \( 1-w \) is the fraction invested in the core \( C \). We now calculate the tracking error with respect to a benchmark \( B \). We obtain:

\[ P - B = wS + (1-w)C - B = w(S-B) + (1-w)(C-B) \]

If we now assume for simplicity that the core portfolio is perfectly replicating the benchmark, we get \( C=B \), then we have: \( P - B = w(S-B) \).

As a result, we obtain that

\[ \text{TE}(P) = \sqrt{\text{var}(P-B)} = w \sqrt{\text{var}(S-B)} = w \text{TE}(S) \]

Let us consider the following example. We assume an investor has a target level of risk relative to a given benchmark, such as a 2.5% tracking error budget.
Two options are possible. Either the investor hires one manager with a tracking error equal to 2.5% for the entire portfolio, or the investor forms a passive core portfolio and leaves 20% in an aggressively managed satellite with a 12.5% tracking error.

The next step consists in deriving the optimal proportion \( w^{*} \) to invest in satellite versus core portfolio. We solve the problem in the context of a simple mean-variance analysis.

The optimisation program reads:

\[
U = \mathrm{E}(P - B) - \lambda \sigma^2(P - B) = \mathrm{E}(P) - \lambda \mathrm{TE}(P)
\]

where \( \mathrm{IR}(P) \) is the information ratio of the portfolio \( P \) with respect to the benchmark, i.e.,

\[
\mathrm{IR}(P) = \frac{\mathrm{E}(P - B)}{\sigma(P - B)} = \frac{\mathrm{TE}(P)}{\sigma(P - B)}
\]

(see for example Grinold and Kahn (2000)).

It should be noted that when the core portfolio perfectly replicates the benchmark, the information ratio of the overall portfolio \( \mathrm{IR}(P) \) is actually independent of the proportion in core versus satellite and equal to the information ratio of the satellite portfolio \( \mathrm{IR}(S) \) (as long as the proportion \( w \) is strictly positive). This can easily be seen from the following:

\[
\mathrm{IR}(P) = \frac{\mathrm{E}(wS + (1 - w)C - B)}{\sigma(wS + (1 - w)C - B)} = \frac{w\mathrm{E}(S - B)}{\sigma(wS + (1 - w)C - B)} = w\mathrm{IR}(S)
\]

We may rewrite the optimisation program as:

\[
U(w) = \mathrm{IR} \times w \times \mathrm{TE}(S) - \lambda w^2 \mathrm{TE}^2(S),
\]

and the first-order condition reads:

\[
\frac{\partial U}{\partial w}(w^{*}) = 0 \Rightarrow w^{*} = \frac{\mathrm{IR}}{2\lambda \mathrm{TE}(S)}
\]

For example, let us assume that the tracking error of the active fund is 5%, that the Information Ratio (IR) is 0.5, and that the coefficient of risk-aversion with respect to relative risk is \( \lambda = 0.2 \). Then, the optimal proportion invested in the active portfolio is:

\[
w^{*} = \frac{\mathrm{IR}}{2\lambda \mathrm{TE}(S)} = \frac{0.5}{2 \times 0.2 \times 5\%} = 25\%.
\]

The resulting tracking error is

\[
\mathrm{TE}(P) = 25\% \times 5\% = 1.25\%.
\]

Extending the analysis to the case of a satellite invested in a number \( n \) of active portfolio managers \( S \) according to the proportions \( w_{i} \), the excess return on the satellite portfolio is then

\[
S = \sum_{i=1}^{n} w_{i} S_{i}
\]

and the tracking error of the satellite portfolio reads

\[
\mathrm{TE}(S) = \left( \sum_{i=1}^{n} w_{i} \sigma_{i} - 2 \sum_{i=1}^{n} w_{i} \sigma_{i} + \sigma_{S} \right)^{1/2}
\]

where \( \sigma_{i} \) is the covariance between portfolio managers \( S_{i} \) and \( S \) and \( \sigma_{S} \) is the volatility of the benchmark.
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One can then find the optimal fraction invested in each active manager within the satellite portfolio so as to achieve the highest possible Information Ratio.

\[ \frac{w_k \alpha_k}{w_k \sigma_k^2 + \sum_i w_i \alpha_i} = \frac{w_l \alpha_l}{w_l \sigma_l^2 + \sum_i w_i \sigma_i} \]

We emphasise that a core-satellite portfolio approach can be used as an effective strategy for institutions that want to diversify their portfolios without giving up the potential for higher returns generated by selected active management strategies.

The exhibit below illustrates how the core-satellite approach provides the framework for targeting and controlling those areas.

<table>
<thead>
<tr>
<th></th>
<th>&quot;Core&quot;</th>
<th>&quot;Satellite&quot;</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>75%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>Tracking Error</td>
<td>0%</td>
<td>20%</td>
<td>5% (0.75 x 0.75 + 0.25 x 0.25)</td>
</tr>
</tbody>
</table>

One can show (see for example Scherer (2002)) that the optimal condition is that the ratio of return to risk contribution is the same for all managers, which reads:

Let us assume that an investor has a relative risk tracking error budget equal to 5%. The first solution is to allocate 100% of the portfolio to an active manager who will commit to respecting the 5% tracking error constraint. The second solution consists of allocating 75% of the portfolio to a purely passive product, e.g., an Exchange Traded Fund (ETF) or preferably to a strategy that is based on an efficient benchmark (see part II.2.2), and 25% of the portfolio to a 20% tracking error manager. This solution, which is consistent with a core-satellite approach to active asset management, offers two benefits.

First, allowing the active manager to deviate significantly from the benchmark leads to a better use of the manager’s skills. If the manager has reliable views on market trends and directions, a 5% tracking error constraint leaves him with too little room for implementing active decisions consistent with these views. Beating the market is a notoriously tough game to play. Playing it with one hand tied behind one’s back does not seem to be a good starting point!

The second benefit is to allow for a clear distinction between the value added by the design of the strategic asset allocation represented by the benchmark (core portfolio) and the outperformance generated by active portfolio management.
Indeed, the first, and arguably more important, source of added-value emanates from optimal allocation decisions that lead to the design of an efficient core portfolio (see below for state-of-the-art techniques involved in the design of core portfolios). This source of added-value should be rewarded, given that the design of the core portfolio can be a decision from the investor’s part (with the possible help of consultants) or a task delegated to the asset manager. The second source of added-value emanates from the abnormal performance that is generated by active managers, which also deserves a separate reward. Similarly, the manager selection decision can be made by the investor (again with the possible help of consultants) or delegated to a multi-manager.

### II.2.2. Optimal beta management in the core portfolio: diversification benefits

Strategic allocation is the first step in the investment management process. This allocation involves choosing the portfolio’s composition over a long period between the different asset classes, in accordance with the investor’s objectives. Today, asset allocation is tending to play a greater role in the investment management process. This interest in asset allocation can be explained by the results established by various empirical studies which suggest that this step can contribute significantly to the result of the portfolio. Brinson, Hood and Beebower (1986) and Brinson, Singer and Beebower (1991) have for example shown that a considerable share (90%) of a portfolio’s performance can be attributed to the initial allocation decision.

Contrary to a common misperception, managing the core portfolio does not necessarily imply passive investment in a commercial index. It instead consists of using state-of-the-art asset allocation techniques so as to design an optimal benchmark based on investor’s preferences, as well as constraints, including notably liability constraints.

Strategic allocation was formalised by the seminal work of Markowitz (1952), who was the first to quantify the link that exists between the risk and return of a portfolio, and thereby introduced modern portfolio theory. Markowitz developed a theory of portfolio choice in an uncertain future based on a quantification of the difference between the risk of a portfolio’s assets taken individually and the global portfolio risk. The theory developed by Markowitz is based on maximising the utility of final wealth for a risk-averse investor, who measures risk through the variability of asset returns (volatility). Optimal portfolios, from a rational investor’s point of view, are defined as...
the portfolios with the lowest level of risk for a given return, or dually, the portfolios with the highest return for a given level of risk. These portfolios are said to be efficient in the mean-variance sense.

The portfolio selection method developed by Markowitz therefore involves obtaining an optimal portfolio as a function of first order (expected return) and second order (variance and covariance) moment estimations of the returns of the asset classes being considered. The quality of the estimation of these parameters is all the more decisive in that it has been shown that the portfolio optimisation programme is characterised by very significant dependence on the initial conditions: minor discrepancies in the estimation of the parameters lead to very significant changes in the optimal allocation. This problem has been shown to be particularly acute in the case of errors in expected return estimation (see Chopra and Ziemba (1993)). As a result of the lack of robustness in Markowitz efficient frontier analysis, it has been suggested to focus on the only portfolio for which expected return estimates are not needed, i.e., the minimum variance portfolio. The key challenge then is to use a robust method for an enhanced estimation of the asset returns variance-covariance matrix, a problem that has been extensively studied in the literature. We provide in what follows an overview of the main findings on how to mitigate the sample risk problem in the estimation of the second-order moments and co-moments of asset return distribution.

II.2.2.1. Enhanced estimates of variance-covariance matrices

Several solutions to the problem of asset return covariance matrix estimation have been suggested in the traditional investment literature. The most common estimator of return covariance matrix is the sample covariance matrix of historical returns.

\[
S = \frac{1}{T-1} \sum_{t=1}^{T} (H_t - \bar{H})(H_t - \bar{H})',
\]

where \(T\) is the sample size, \(H_t\) is a \(Nx1\) vector of hedge fund returns in period \(t\), \(N\) is the number of assets in the portfolio, and \(\bar{H} = \frac{1}{T} \sum_{t=1}^{T} H_t\) is the average of these return vectors. We denote by \(S_{ij}\) the \((i,j)\) entry of \(S\).

A problem with this estimator is typically that a covariance matrix may have too many parameters compared to the available data. If the number of assets in the portfolio is \(N\), there are indeed \(N(N-1)/2\) different covariance terms to be estimated. The problem is particularly acute in the context of alternative investment strategies, even
when a limited set of funds or indices is considered, because data is scarce given that hedge fund returns are only available on a monthly basis.

One possible cure for the curse of dimensionality in covariance matrix estimation is to impose some structure on the covariance matrix to reduce the number of parameters to be estimated. In the case of asset returns, a low-dimensional linear factor structure seems natural and consistent with standard asset pricing theory, as linear multi-factor models can be economically justified through equilibrium arguments (see Merton’s Intertemporal Capital Asset Pricing Model (1973)) or arbitrage arguments (see Ross’s Arbitrage Pricing Theory (1976)). Therefore, in what follows, we shall focus on K-factor models with uncorrelated residuals\(^{27}\). Of course, this leaves two very important questions: how much structure should we impose? (the fewer the factors, the stronger the structure) and what factors should we use? A standard trade-off exists between model risk and estimation risk. The following options are available:

- **Impose no structure.** This choice involves low specification error and high sampling error, and led to the use of the sample covariance matrix\(^ {28}\).

- **Impose some structure.** This choice involves high specification error and low sampling error. Several models fall within that category, including the constant correlation approach (Elton and Gruber (1973)), the single factor forecast (Sharpe (1963)) and the multi-factor forecast (e.g., Chan, Karceski and Lakonishok (1999)).

- **Impose optimal structure.** This choice involves medium specification error and medium sampling error. The optimal trade-off between specification error and sampling error has led either to an optimal shrinkage towards the grand mean (Jorion (1985, 1986)) or an optimal shrinkage towards the single-factor model (Ledoit (1999)), or to the introduction of portfolio constraints (Jagannathan and Ma (2003)).

One other alternative is to consider an implicit factor model in an attempt to mitigate model risk and impose endogenous structure. The advantage of that option is that it involves low specification error (because of the “let the data talk” type of approach) and low sampling error (because some structure is imposed). Implicit multi-factor forecasts of asset return covariance matrix can be further improved by noise dressing techniques and optimal selection of the relevant number of factors (see below).

More specifically, we use Principle Component Analysis (PCA) to extract a set of implicit factors. The PCA of a time-series involves studying the correlation matrix of successive shocks. Its purpose is to explain the behaviour

\(^{27}\) - Another way to impose structure on the covariance matrix is the constant correlation model (Elton and Gruber (1973)). This model can actually be alternatively thought of as a James-Stein estimator that shrinks each pairwise correlation to the global mean correlation.

\(^{28}\) - One possible generalisation/improvement to this sample covariance matrix estimation is to allow for declining weights assigned to observations as they go further back in time (Litterman and Winkelméann (1998)).
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of observed variables using a smaller set of unobserved implied variables. Since principal components are chosen solely for their ability to explain risk, a given number of implicit factors always capture a larger part of asset return variance-covariance than the same number of explicit factors. One drawback is that implicit factors do not have a direct economic interpretation (except for the first factor, which is typically highly correlated with the market index). Principal component analysis has been used in the empirical asset pricing literature (see for example Litterman and Scheinkman (1991), Connor and Korajczyk (1993) or Fedrigo, Marsh and Pfleiderer (1996), among many others).

From a mathematical standpoint, it involves transforming a set of $N$ correlated variables into a set of orthogonal variables, or implicit factors, which reproduces the original information present in the correlation structure. Each implicit factor is defined as a linear combination of original variables. Define $H$ as the following matrix:

$$H = (h_{it})_{i=1}^{N}$$

We have $N$ variables $h_i$, $i=1,...,N$, i.e., monthly returns for $N$ different hedge fund indices, and $T$ observations of these variables. PCA enables us to decompose $h_{it}$ as follows:

$$h_{it} = \sum_{i=1}^{N} \sqrt{\lambda_i} u_{it} v_{i} := \sum_{i=1}^{N} s_{it} v_{i}$$

where

$U$ is the matrix of the $N$ eigenvectors of $H'H$
$V$ is the matrix of the $N$ eigenvectors of $HH'$. Note that these $N$ eigenvectors are orthonormal. $\lambda_i$ is the eigenvalue (ordered by degree of magnitude) corresponding to the eigenvector $U_i$. Note that the $N$ factors $V_i$ are a set of orthogonal variables. The main challenge is to describe each variable as a linear function of a reduced number of factors. To that end, one needs to select a number of factors $K$ such that the first $K$ factors capture a large fraction of asset return variance, while the remaining part can be regarded as statistical noise:

$$h_{it} = \sum_{i=1}^{K} \sqrt{\lambda_i} u_{it} v_{i} + \varepsilon_{it} := \sum_{i=1}^{K} s_{it} v_{i} + \varepsilon_{it}$$

where some structure is imposed by assuming that the residuals $\varepsilon_{it}$ are uncorrelated to one another. The percentage of variance explained by the first $K$ factors is given by:

$$\frac{\sum_{i=1}^{K} \lambda_i}{\sum_{i=1}^{N} \lambda_i}$$

29 - The asset returns have been normalised to have zero mean and unit variance.
30 - For an explanation of this decomposition in a financial context, see for example Barber and Copper (1996).
A sophisticated test by Connor and Korajczyk (1993) finds between 4 and 7 factors for the NYSE and AMEX over 1967-1991, which is roughly consistent with Roll and Ross (1980). Ledoit (1999) uses a 5-factor model. In this paper, we select the relevant number of factors by applying some explicit results from the theory of random matrices (see Marchenko and Pastur (1967))\(^\text{31}\). The idea is to compare the properties of an empirical covariance matrix (or equivalently correlation matrix since asset returns have been normalised to have zero mean and unit variance) to a null hypothesis purely random matrix such as one could obtain from a finite time-series of strictly independent assets. It has been shown (see Johnstone (2001) for a recent reference and Laloux et al (1999) for an application to finance) that the asymptotic density of eigenvalues \(\lambda\) of the correlation matrix of strictly independent asset reads:

\[
f(\lambda) = \frac{T}{2\pi N} \sqrt{\frac{1}{\lambda - \lambda_{\text{max}}}(\lambda - \lambda_{\text{min}})}
\]

\[
\lambda_{\text{max}} = 1 + \frac{N}{T} + 2\frac{N}{\sqrt{T}}
\]

\[
\lambda_{\text{min}} = 1 + \frac{N}{T} - 2\frac{N}{\sqrt{T}}
\]

Theoretically speaking, this result can be exploited to provide formal testing of the assumption that a given factor represents information and not noise. However, the result is an asymptotic result that cannot be taken at face value for a finite sample size. One of the most important features here is the fact that the lower bound of the spectrum \(\lambda_{\text{min}}\) is strictly positive (except for \(T=N\)), and therefore, there are no eigenvalues between 0 and \(\lambda_{\text{min}}\). We use a conservative interpretation of this result to design a systematic decision rule and decide to regard as statistical noise all factors associated with an eigenvalue lower than \(\lambda_{\text{max}}\). In other words, we take \(K\) such that \(\lambda_{K} > \lambda_{\text{max}}\) and \(\lambda_{K+1} < \lambda_{\text{max}}\), where \(\lambda_{1}\) is the greatest eigenvalue\(^\text{32}\).

A problem of a different nature comes from the non-stationarity of the data. Numerous empirical studies have for example highlighted the fact that the volatilities of asset classes are not constant over time and that an optimisation where the risk parameters are set equal to their past values would not be very robust, due to their non-stability. The dynamic character of the parameters renders the task of estimation more arduous, a challenge that can be addressed by the use of suitably designed statistical models such as Garch models. Good modelling brings robustness back to portfolio optimisation over a long period by relying on the stability of the models that define the variation in the risk parameters (variance-covariance) and no longer on the stability of the risk parameters themselves.

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\(\text{31}\) - Another decision rule would be: keep sufficient factors to explain \(x\%\) of the covariation in the portfolio.

\(\text{32}\) - In case no factor is such that the associated eigenvalue is greater than lambda max, we take \(K=1\), i.e., we retain the first component as the only factor.
While it appears that there are a large number of techniques that can be implemented to allow for a better estimation of the variance-covariance matrix of asset returns, a major challenge remains: that of estimating the mean returns. This is the reason why, as recalled in the introduction, it has been suggested to focus on minimum risk portfolios whose derivation does not depend on any estimate of expected returns.

II.2.2.2. Accounting for extreme risk measures

One important limitation in Markowitz analysis is that volatility is used as the definition of risk. Going back to the basics of utility-maximisation, we note that the mean-variance approach, provided asset returns are non-normal, is in fact only a second order approximation of a general utility function.

In order to take higher moments into account, we consider any arbitrary utility function. The investor is assumed to be maximising the utility emanating from wealth invested in a portfolio with return denoted by \( R \). The fourth-order Taylor expansion gives us:

\[
U(R) = \sum_{k=0}^{4} \frac{U^{(k)}(E(R))}{k!} (R - E(R))^k + \alpha (R - E(R))^4
\]

where \( U(k) \) denotes the \( k \)th derivative of the function \( U \). Taking the expectation on both sides yields:

\[
E[U(R)] = U(E(R)) + \frac{U^{(2)}(E(R))}{2} \mu^{(2)}(R) + \frac{U^{(3)}(E(R))}{6} \mu^{(3)}(R) + \frac{U^{(4)}(E(R))}{24} \mu^{(4)}(R)
\]

with the centralised moments:

\[
\mu^{(2)}(R) = E[(R - E(R))^2]
\]

\[
\mu^{(3)}(R) = E[(R - E(R))^3]
\]

\[
\mu^{(4)}(R) = E[(R - E(R))^4]
\]

Thus, we can approximate any utility function of a portfolio return as a function of expected portfolio return and standard deviation, but also as a function of third and fourth moments of the portfolio return distribution. The mean-variance corresponds to a second order approximation that is, of course, less exact. The new maximisation problem yields:

\[
\max_{\omega} \Phi(\mu(R), \mu^{(2)}(R), \mu^{(3)}(R), \mu^{(4)}(R))
\]

Such that

\[
\sum_{i=1}^{n} \omega_i = 1 - \omega_0
\]

---

33 – An interesting attempt at improving portfolio allocation techniques in the presence of uncertain expected return parameter estimates can be found in Black and Litterman (1992).
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with;
\[
\begin{align*}
\mu(R_t) &= E(\omega R) + \omega_0 R_t = \omega^\prime E(R) + \omega_0 R_t \\
\mu^{(\alpha)}(R_t) &= \omega^\prime E \left[ (R - E(R))(R - E(R)) \right] = \omega^\prime \Sigma = \omega^\prime \Sigma_{\omega} \\
\mu^{(\omega)}(R_t) &= \omega^\prime E \left[ (R - E(R))(R - E(R)) \right] \otimes (R - E(R)) = \omega^\prime \Omega_{\omega}
\end{align*}
\]

where \( \otimes \) denotes the Kronecker-product, \( R=(R_1,...,R_n)' \) the vector of asset returns, \( \omega=(\omega_1,...,\omega_n)' \) the vector of portfolio proportions invested in these assets, \( \omega_0 \) the position held in the risk-free asset (return \( R_0 \)) and \( \mu=(\mu_1,...,\mu_n)' \) the mean return vector. \( \Omega_{\omega} \) is the vector of co-skewnesses for the weighting vector \( \omega \) and \( \Psi_{\omega} \) the vector of co-kurtoses respectively (see Section 3 for more details). We take this matrix representation from Jondeau and Rockinger (2004) who used it in a different approach.

Alternatively, one could argue that in the real world, investors are not only interested in maximising expected return and minimising volatility, but also in limiting the loss with a given probability (1\(-\alpha\)). This is the reason why our objective shall focus on a measure like Value-at-Risk at (1\(-\alpha\))% which is defined as the negative value of the \( \alpha \)-quantile of the underlying return distribution. Assuming a normal distribution this measure is simply given by:

\[ \text{VaR}(1-\alpha) = - (\mu + z_{\alpha} \sigma) \]

with \( z_{\alpha} \) the \( \alpha \)-quantile of the standard normal distribution.

Because asset returns are generally not normally distributed, we should incorporate higher moments in the Value-at-Risk measure. This can be done through a method called a Cornish-Fisher expansion (see Jaschke (2002) for a detailed description) which approximates distribution percentiles in the presence of non-Gaussian higher moments. The Cornish-Fisher expansion is derived from the general Gram-Charlier expansion, using the standard normal distribution as the reference function. For a four-moment approximation of \( \alpha \)-percentiles the following formula is given:

\[ z_{\alpha} = z_\alpha + \frac{1}{6}(z_\alpha^2 - 1)S + \frac{1}{24}(z_\alpha^3 - 3z_\alpha)K - \frac{1}{36}(2z_\alpha^3 - 5z_\alpha)S^2 \]

where \( S \) denotes the sample skewness, \( K \) the sample’s excess-kurtosis and \( Z_{\alpha} \) the \( \alpha \)-percentile of the standard normal distribution. \( Z_{\alpha} \) denotes the modified \( \alpha \)-percentile. This approximation is built on the hypothesis that the underlying distribution is close to a normal distribution. We obtain the modified Value-at-Risk measure with confidence (1\(-\alpha\)):

\[ \text{VaR}_{\text{mod}}(1-\alpha) = - (\mu + Z_{\alpha} \sigma) \]

where \( \sigma \) denotes estimated values for the standard deviation and \( \mu \) the mean.

Another relevant measure of extreme risk is the Conditional Value-at-Risk (CVaR), defined as the expected loss beyond the
VaR, which focuses on the left tail of the returns distribution beyond a threshold, as opposed to a mere certain quantile like VaR does. Interestingly, CVaR would also be a preferred risk objective from an optimisation perspective. VaR is difficult to optimise when it is calculated over scenarios because it leads to non-convex optimisation problems; there are multiple extrema and the local optimisation algorithms are unsuccessful whereas the global algorithms are inefficient. On the other hand, CVaR can be optimised through stochastic linear programs (see Rockafellar and Uryasev (2000))4.

In addition, it should also be recalled that VaR can in fact be used as a portfolio risk management tool. To achieve this objective, one must be able to define the composition of a portfolio’s VaR and analyze the impact of a new transaction on the total VaR of the portfolio. This is the objective of incremental VaR calculations. The goal of the incremental VaR is precisely to define the contribution of each asset to the total VaR of the portfolio. The total VaR of the portfolio is not equal to the sum of the VaRs of the assets that make up the portfolio, because there are correlations between the assets. The incremental VaR, for its part, is defined in such a way that the sum of the incremental VaRs is equal to the total VaR of the portfolio. It is obtained from the delta VaR, which is the vector of the VaR’s sensitivity to each asset. It is made up of partial derivatives of the portfolio’s VaR with respect to each asset. The incremental VaR of asset i is then calculated by multiplying the ith component of the portfolio’s VaR delta by the quantity of asset i held. If we denote the proportion of asset i held in the portfolio as $x_i$, the incremental VaR for asset i in portfolio P, denoted by $\text{IVaR}_i(P)$, is given by:

$$\text{IVaR}_i(P) = x_i \frac{\partial \text{VaR}(P)}{\partial x_i}.$$ 

If the incremental VaR of an asset is positive, it contributes to an increase in the total VaR of the portfolio. On the other hand, if the incremental VaR of the asset is negative, introducing it into the portfolio will decrease the total VaR.

II.2.2.3. Numerical illustrations

We will now provide simple examples of the usefulness of optimisation methods. We first present an exercise with a focus on minimising the portfolio variance, and then turn to a focus on extreme risk management. Our goal here is not to introduce a fully-fledged state-of-the-art optimisation model, but instead to present evidence that even a basic and simple procedure can lead to substantial efficiency gains.

As recalled above, the most widely quoted quantitative model in the

---

4 - At first, CVaR calculation seems to be complex, since it depends on the VaR itself, but through little optimisation tricks one can formulate CVaR in an optimisation problem without having to know the VaR value. And interestingly, optimisation of CVaR will help one calculate VaR for that same level, as further explained in Rockafellar and Uryasev (2000).
The strategic allocation literature is of course Markowitz's (1952) optimisation model. The input data are the means and the variances, estimated for each asset class, and the covariances between the asset classes. The model then provides the optimal percentage to assign to each asset class to obtain the highest return for a given level of risk, measured by portfolio volatility.

We have argued that the main drawback of the Markowitz model stems from the fact that the optimal proportions are very sensitive to the estimates of expected return values. What is more, the statistical estimates of expected returns are very noisy (see Merton (1980)). As a result, the model often allocates the most significant proportion to the asset class with the largest estimation error. Therefore, the efficient frontiers are extremely difficult to obtain in practice and sophisticated methods such as the one advocated by Black and Litterman (1992) are needed to generate meaningful portfolio decisions.

Even in situations where one is not in a position to rely on active views for the return on various asset classes, there is a pragmatic approach that avoids the problems without abandoning the model. This approach consists in focusing on the only portfolio on the efficient frontier for which the estimation of mean returns is not necessary, namely the minimum variance portfolio. Since the future returns of assets are always difficult to estimate precisely, it is preferable to obtain an efficient portfolio by minimising the risk rather than by optimising the risk/return combination. (For more details on the minimum variance approach, see for example Chan, Karceski and Lakonishok (1999) or Amenc and Martellini (2002).) Though this approach avoids the problem of estimation risk for the expected returns, it is still faced with the estimation risk for the covariance matrix, a problem that can be addressed by using some of the techniques described above. In the illustration we provide below, for simplicity, our forecasts of the covariance matrix are simply derived from the sample estimates. In practice, an investor may choose to implement the noise dressing techniques referred to above. On the other hand, we choose to deal with the problem of estimation risk, not by imposing a model, but by imposing a maximum constraint of 20% for the weight of a given sector. Imposing constraints has been shown as a useful option as this increases the performance of asset allocation that uses the sample covariances compared to more sophisticated approaches of modelling the covariance matrix (see Jagannathan and Ma (2003)). This means that our conclusions apply more generally rather than being limited to a certain type of model used for covariance forecasts.

In order to assess the performance of minimum variance portfolios, we run the following tests:
It can be seen that the volatility of the minimum variance portfolio is always significantly lower than that of the corresponding market index. As opposed to the in-sample results reported in section 3, this dominance is not achieved by construction and the portfolios can actually be obtained ex ante by an investor. What may perhaps be more surprising is that the lower risk of the minimum variance portfolio does not lead to a lower expected return for five out of six indices. This is only the case for the minimum variance portfolio of sectors composing the S&P 500 index. All other minimum variance portfolios also have higher expected returns than the corresponding index. Consequently, the Sharpe ratios show strong improvements compared to the market index, except for the S&P 500. The table below summarises the results.

<table>
<thead>
<tr>
<th>Country</th>
<th>Min Var</th>
<th>Cap Weighted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>7.15%</td>
<td>4.07%</td>
</tr>
<tr>
<td>UK</td>
<td>8.76%</td>
<td>4.03%</td>
</tr>
<tr>
<td>Eurozone</td>
<td>6.56%</td>
<td>4.07%</td>
</tr>
<tr>
<td>Japan</td>
<td>1.69%</td>
<td>-2.11%</td>
</tr>
<tr>
<td>USA</td>
<td>5.50%</td>
<td>8.11%</td>
</tr>
</tbody>
</table>
While the minimum variance approach leads to a reduction of average risk, a focus on the reduction of extreme risks is more suited to the focus on avoidance of extreme losses that is present in Solvency II. For this reason, we now present an attempt to minimise portfolio risk, where we choose Value-at-Risk (VaR) or Conditional Value-at-Risk (CVaR) as opposed to portfolio return variance, as the risk measure.

We use weekly data on DJ Stoxx Euro sector indices (Bank, Construction, Energy, Health, Insurance, Media, Telecom, Technology, Utility) as well as DJ Stoxx Euro global index for the period extending from January 1992 to December 2005. Using a one-year rolling window sample analysis, we estimate second moments and co-moments (volatilities and correlations), as well as third-order moments and co-moments (co-skewness and co-kurtosis). Every six months, we optimise the portfolio allocation by minimising the portfolio CVaR, without any constraint on expected returns. We record the out-of-sample performance of these portfolios and compare it to the performance of the DJ Stoxx Euro global index. In the figure and table below, we show the out-of-sample performance of the optimised portfolio and compare it to the performance of the benchmark.

Comparison of minimum variance portfolios with capitalisation weighted portfolios.

This illustration summarises information from the table with the performance statistics. The right hand column indicates the difference in Sharpe Ratio between the capitalisation-weighted index and the sector allocation strategy in the minimum variance portfolio. It can be seen that in all cases, except for the case of the S&P 500, the minimum variance portfolio obtains a higher Sharpe Ratio than the capitalisation weighted index. It should be noted that for the S&P 500, the average return of the capitalisation weighted index is higher but the volatility is also higher than that of the minimum variance portfolio.

<table>
<thead>
<tr>
<th></th>
<th>Sharpe Ratio of Minimum Variance Index</th>
<th>Sharpe Ratio of Cap Weighted Index</th>
<th>Efficiency Loss (-)/ Gain (+) of cap weighted index</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&amp;P 500 (USA)</td>
<td>0.12</td>
<td>0.24</td>
<td>0.12</td>
</tr>
<tr>
<td>Topix 1666 (Japan)</td>
<td>-0.15</td>
<td>-0.30</td>
<td>-0.15</td>
</tr>
<tr>
<td>DJ Stoxx 600 (Europe)</td>
<td>0.32</td>
<td>0.17</td>
<td>-0.15</td>
</tr>
<tr>
<td>FTSE All Share 700 (UK)</td>
<td>0.39</td>
<td>0.17</td>
<td>-0.22</td>
</tr>
<tr>
<td>DJ Euro Stoxx 300 (Eurozone)</td>
<td>0.42</td>
<td>0.19</td>
<td>-0.23</td>
</tr>
<tr>
<td>Prime All Share 380 (Germany)</td>
<td>0.30</td>
<td>0.02</td>
<td>-0.28</td>
</tr>
</tbody>
</table>

While the minimum variance approach leads to a reduction of average risk, a focus on the reduction of extreme risks is more suited to the focus on avoidance of extreme losses that is present in Solvency II. For this reason, we now present an attempt to minimise portfolio risk, where we choose Value-at-Risk (VaR) or Conditional Value-at-Risk (CVaR) as opposed to portfolio return variance, as the risk measure.
As can be seen from this illustration, the out-of-sample measures of extreme risks (VaR and CVaR) appear to have been significantly reduced in the case of the optimally designed portfolios when compared to the benchmark, which suggests that a sound ex-ante focus on risk management at the portfolio construction level is likely to have an ex-post impact at the performance level.

We have also performed a similar experiment in the context of a bond portfolio. The opportunity set is made up of the MSCI ECI Government 3-5 year index, the MSCI ECI Government 7-10 year index, the MSCI ECI Corp. AAA index, as well as the MSCI ECI Corp. BBB index. We design the minimum CVaR portfolio based on a 6-month rolling window analysis using 3 years’ worth of weekly data in the calibration phase, with data ranging from July 1997 through June 2006. We impose a minimum 50% investment in Treasury bonds (and a minimum of 10% in each of its maturity sub-indices) with a maximum 20% investment in high yield bonds (BBB bond index), and compare the out-of-sample performance of the optimised portfolio to that of the MSCI ECI Overall index used as a benchmark.

Again, these results show the out-of-sample benefits of asset allocation techniques implemented with a focus on risk management.
II.2.3. Non-linear beta management of the core portfolio: hedging benefits

As recalled earlier, two different approaches to risk management can be followed. The first approach, described in the previous section, consists of risk diversification, i.e., reducing risk by optimal asset allocation techniques on the basis of imperfectly correlated assets. The second approach, which we will now describe, consists of risk hedging, i.e., reducing risk by using some form of insurance contract or derivative instrument on a given underlying asset.

Diversification and hedging are two different, and perhaps competing, forms of risk management. Asset pricing theory actually allows us to better understand the nature of the relationship between allocation and structuring from a conceptual standpoint. It can be argued that a structured product approach to risk management, based on hedging, can be regarded as the most general, dynamic, as opposed to static, form of asset allocation. It is indeed well known, since Merton’s (1973) replicating argument interpretation of the Black and Scholes (1973) formula, that non-linear payoff based on an underlying asset can be replicated by dynamic trading in the underlying asset and the risk-free asset. As a result, it appears that an investor willing and able to engage in dynamic asset allocation strategies will be in a position to generate the most general form of risk management possible, and this encompasses both static diversification and dynamic hedging. While the benefits of dynamic asset allocation strategies in a stochastically time-varying environment have been recognised since the late 1970s (see Hakanson (1969, 1971) and Samuelson (1969), in a discrete-time setting, as well as Merton (1971), in a continuous-time setting, for the development of a multi-period approach to optimal asset allocation decisions), it is only recently that specific optimal asset allocation models that exhibit explicit time-dependency in the presence of stochastic opportunity sets have been introduced. With dynamic asset allocation, portfolio weights change through time, either as a response to changes in the investment opportunity set or in an attempt to generate non-linear payoff structures. This is opposed to a buy-and-hold strategy where weights evolve according to changes in prices, but also to a fixed weight strategy, where rebalancing is allowed to revert to the initial weights, hence severely restricting the kind of payoffs generated to simple linear functions of underlying asset classes.

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35 - An earlier mentioned example of use of dynamic asset allocation techniques to generate a structured product type of payoff is the CPPI technique, where dynamic rebalancing between the risky and risk-free asset is performed so as to guarantee a minimum capital at maturity.

36 - See for example Lynch (2000), Lioui and Poncet (2001), and Liu (2002), among others.

37 - A dynamic investor can also respond to conditioning information in order to exploit predictability of return dynamics or to hedge changes in the investment opportunity set (see recent papers by Brandt and Santa-Clara (2004) and Bansal, Dahlquist, and Harvey (2004) for interesting attempts at considering strategies aiming at exploiting returns predictability in the asset menu of a static investor).
When it comes to implementation, a hedging strategy can be implemented either through direct trading in derivatives (e.g., OTC options), a case we discuss first, or via the investment in structured products which result from the packaging of both the underlying asset and the insurance contract (or the suitably designed equivalent dynamic portfolio strategy), a situation we subsequently consider.

II.2.3.1. Risk hedging with derivatives

The investment management process comprises a variety of tasks and involves both passive (indexing) and active (timing and picking) strategies. All these tasks may effectively be facilitated by using derivatives. In particular, futures instruments help investors or managers to neutralise biases in terms of factor exposure that may result from bond picking bets. Conversely, an investor may decide to protect himself from market risk in order to conserve only the return linked to the active bets taken by a manager. Another natural use of futures is for timing strategies between different styles within the equity universe or the bond universe.

In what follows, we focus on how the use of options can further improve risk management thanks to their ability to generate non-linear, convex payoffs that offer downside risk protection. A favourite strategy with investors and asset managers alike is a protective put buying (PPB) strategy. This strategy consists of a long position in the underlying asset and a long position in a put option, which is rolled over as the option expires. It should be underlined that PPB is different from portfolio insurance, since the put is rolled over in each sub-period. Therefore, the payoff at the end of a total period with multiple sub-periods does not simply correspond to a guaranteed minimum payoff, as in the case of portfolio insurance. At the end of every sub-period, however, the long position in the put option offers a protection against downside risk, which leads to avoiding the left tail of the returns distribution.

The PPB strategy has been widely studied in the context of equity portfolio management (see Merton et al (1982), Figlewski et al (199)), as well as in the context of fixed-income portfolio management (Goltz, Martellini and Ziemann (2006)), from which we borrow the forthcoming illustration.

We construct the PPB strategy similarly to Merton et al (1982, p.35) as follows. The portfolio held is made up of a number $N$ of the underlying bond plus the same number of put options. We then scale the initial investment to be equal to an amount $I$, say €100. Put options with time to expiration equal to $\tau$ are bought at $t_0$ so that they expire at $t_0 + \tau$. Hence, an option pricing formula is only needed to establish the premium...
Risk Management Techniques in Asset and Asset-Liability Management

at the initial investment and when the strategy is rolled over.

One outstanding question is the choice of the strike price of these options. Given the fact that exchange traded options are issued with strike prices rather close to the current price of the underlying asset, an investor will choose from this proposed range of strike prices and end up with options that are not too far in or out of the money. The typical range of moneyness considered in the literature on options strategies is from 10% out of the money to 10% in the money. Hence, Merton, Scholes and Gladstein (1982) consider moneyness of -10%, 0% and 10%. Likewise, Figlewski, Chidambaram and Kaplan (1993) consider moneyness of -10%, -5%, 0%, 5% and 10%.

As outlined in Merton, Scholes and Gladstein (1982), there is no single best alternative for the strike price. Instead, the choice depends on the preferences of the investor, such as his risk tolerance with a trade-off versus the cost of the hedging strategy. In what follows, we decide to set the strike price to 10% out of the money. This corresponds to an investor who is willing to take on some downside risk in any sub-period and is concerned over decreasing profitability of the strategy when the strike price is increased (see e.g. Macmillan (2000, Chapter 17)). Fabozzi (1996, Chapter 16) highlights that in the context of bond portfolio management, protective puts are usually implemented with out-of-the-money puts on bonds or futures. In the context of Solvency II requirements, with a focus on the management of severe downside risk, it should be noted that further out-of-the-money options can appear as an appealing choice. On the other hand, using a far out-of-the-money option may induce additional complexity in terms of the accounting treatment of the solution, a question which we return to in section III.

The table below, extracted from Goltz, Martellini and Ziemann (2006) shows the results obtained in the context of a base case experiment with parameter values estimated stemming from a historical calibration of a two-factor interest rate model.

<table>
<thead>
<tr>
<th>Performance statistics</th>
<th>Bond</th>
<th>PPB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.96%</td>
<td>5.98%</td>
</tr>
<tr>
<td>Sharpe-Ratio (2%)</td>
<td>0.52%</td>
<td>0.70%</td>
</tr>
<tr>
<td>VaR (95%)</td>
<td>4.59%</td>
<td>3.20%</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.28</td>
<td>0.14</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>0.00</td>
<td>0.41</td>
</tr>
</tbody>
</table>

38 - Several solutions are available for investors and managers seeking to reduce the cost of protection. One such solution consists in adding (typically further out-of-the-money) short option positions to the original option protections so as to decrease the overall cost while taking some additional marginal risks. Various exotic options can also be used as cheaper alternatives to standard plain vanilla options, such as barrier options that get activated or de-activated depending on the behavior of the underlying.
In order to assess the results for the PPB strategy with Bund futures and options on Bund futures compared to the position in the Bund futures only, we look at the portfolio returns after one year. The table shows both the percentiles of the returns distribution and typical performance statistics. It should be underlined that all these statistics are based on the distribution of the final portfolio value across the 1,000 scenarios that we generate. This is different from calculating such statistics from a time-series of asset returns, as is done in empirical studies.

Examining the performance statistics leads to the conclusion that the PPB strategy is largely favourable. In particular, the mean return also increases. This stems from the fact that the put option is exercised in scenarios with strongly negative returns. Consequently, the left tail of the returns distribution is cut off, which increases the mean return. This effect is equally apparent from the higher skewness of the PPB strategy. The figure above shows the return distributions for both the futures strategy ("Bond") and the PPB strategy.

Inspection of the probability distribution functions of annual returns confirms the aforementioned results. Focusing on negative returns below 7%, it can be seen that the PPB strategy has less frequent losses of this magnitude.

II.2.3.2. Risk hedging with structured products

The use of a structured form of asset management by institutional investors has found its roots in constant proportion portfolio insurance (CPPI) and other forms of portfolio insurance strategies. Since then, a wide range of structured products have been developed, allowing institutional investors to customise their exposure to equity markets so as to make it consistent with their preferences and liability-driven constraints. Generally speaking, structured products, which allow their user to achieve a non-linear option-like exposure with respect to the return on traditional asset classes, are natural investment vehicles for

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39 - It is not true of course that "PPB" dominates "Bond Only" for each single scenario. Intuitively speaking, one may actually expect that the cost of purchasing the downside protection will have an impact on the performance. However, the negative effect of paying the option price does not outweigh the benefits of avoiding the most negative drawdowns, as can be seen from the complete returns distribution. In other words, the PPB does underperform slightly when bond markets are doing well, and outperforms significantly when bond markets are doing poorly.
institutional investors, who have a particularly strong preference for non-linear payoffs because of the non-linear nature of the liability constraints they face (see for example Draper and Shimko (1993)). From an academic standpoint, Leland (1980) has shown in a fairly general context that investors whose risk tolerance increases with wealth more rapidly than the average will rationally wish to obtain portfolio insurance. This is the case in particular for institutional investors whose portfolio value must at all cost exceed a given value, but who thereafter can accept reasonable risks.

In an attempt to clarify the terminology used throughout the paper it should be stated from the outset that we interchangeably use the labels "structured products" or "structured investment strategies" to refer to any contractual non-linear payoff resulting from a large variety of quantitative asset management techniques. The definition of "structured asset management", as a family of investment strategies, is actually quite large as it encompasses static asset allocation strategies as a trivial specific case, dynamic allocation strategies such as CPPI and OBPI, as well as payoffs resulting from the inclusion of exotic derivatives.

In what follows, we first present an overview of structured products, and also present the risk management benefits derived from including such assets.

II.2.3.2.1. An overview of structured products used in institutional money management

The salient characteristic of structured products is the repackaging of strategies that involve long and short positions in derivatives, or alternatively in dynamic trading strategies that replicate derivatives-type payoffs, and the underlying asset in an investment vehicle that is easily accessible by investors. In particular, since the investor does not have to access derivatives markets himself, he is not constrained to respect margin requirements. Historically, the first occurrence of a structured form of asset management was the introduction of portfolio insurance such as the simple option based portfolio insurance (OBPI) strategy. While any asset may be used in a structured product, we focus on the case of a stock index as an underlying. In this first section, we provide an overview of the institutional aspects of structured products. We also review a range of structured products that are available to institutional investors.

40 - Leland (1980) also shows that investors whose return expectations are more optimistic than average will also rationally wish to obtain portfolio insurance.
41 - "Structured products" are typically perceived as standalone investments. That is the reason why it is perhaps preferable to refer to "structured asset management" as a family of quantitative asset management techniques.
42 - It should be noted that the use of "structured products" in this context could be confusing, given that it is more commonly used in the United States to refer to mortgage-backed securities and other forms of asset-backed securities.
II.2.3.2.1.1. Institutional aspects of the market for products with non-linear payoffs

The concrete investment vehicle that is used to provide a structured product to an investor may take on various legal or organisational forms. These obviously depend on the legal framework in the given legislation. However, in principle, structured products may be organised as bonds or as investment funds. Bonds allow a straightforward implementation of structured products that involve a capital guarantee. The guarantee is achieved because the holder of the bond is entitled to the payment of the face value at maturity. The coupon payment may then be linked to the price of an underlying asset. In this way, the bondholder effectively holds a portfolio of a zero-coupon bond and a derivative asset. In other words, one component of the payoff at maturity is certain while the other part depends on the price of the underlying asset. While bonds that have a limited lifetime may seem to be a more natural vehicle, investment funds also allow structured products to be implemented. Investment funds pool investors’ wealth into a portfolio whose management is delegated to a professional manager. The investment policy of the fund may then be defined as a strategy that achieves the desired payoff at maturity. In particular, the fund manager may make use of government bonds, an underlying asset and derivatives on the latter in order to achieve the desired payoff.

Since secondary markets exist for both bonds and investment fund shares, structured products may be exchanged between investors outside the subscription at the initial date and redemption at maturity. In fact, the issuer of the structured product often acts as a market maker for his product. It is typically argued that providers of structured products are more efficient than end-users in managing products involving non-linear payoffs for a variety of reasons including, among others, economies of scale, privileged market access (to the underlyings and to the derivatives), mutualisation effect (managing a portfolio of options is cheaper than managing each option individually) and efficient financing (better access to money markets compared to conditions that would be faced by end-users if they had to borrow to implement the corresponding dynamic replication strategy).

II.2.3.2.1.2. Typology of structured products

While the immense variety of structured products makes it difficult to provide a clear classification, existing products may be distinguished among several areas. From an investor’s perspective, what matters is the type of payoff he obtains with the structured products. Therefore, the classification below builds on the payoffs and is partly based on a common way of classifying options.
Risk Management Techniques in Asset and Asset-Liability Management

• Curvature
Structured products offer payoffs that are non-linear functions of the price of an underlying. According to the type of non-linearity, one can divide these products into those with concave and those with convex payoffs. Convex payoffs are typical for products that include a capital guarantee, typically offered by an investment bank. This may be the most obvious form of non-linearity investors are looking for. Concave payoffs occur with discount certificates and other covered call writing strategies. These products allow investors to access limited upside potential of a given asset at a lower price than full upside potential. More complex structured products may mix both types of non-linearity.

• Vega
One of the reasons for investing in structured products is their exposure to changes in volatility of the underlying asset. Sensitivity (Vega) of the structured product may be positive or negative. Depending on their views on the evolution of volatility, investors may optimally select different types of exposure.

• Path dependency
Rather than depending on the observed price of the underlying asset at maturity, the payoff may be a function of the extreme (lookback or hindsight option) or average (Asian option) price observed during the lifetime of the structured product. For example, path-dependent products are used by investors who want to lock in the performance of a perfect timing strategy on a single asset (which corresponds to a lookback straddle strategy).

• Type of underlying asset
The underlying assets involved in a structured product may be an index or a basket of stocks. A number of structured products involve payoffs that depend on a large number of assets. Structures may include options to exchange one asset for another, or structures that pay the maximum return among a number of assets. Such products are used by investors who want to lock in the performance of a strategy that times perfectly among a number of assets.

II.2.3.2.2. Diversification effects of non-linear payoffs in institutional asset allocation

It can be argued that typical institutional investors, with a strict focus on risk management driven by the presence of liability constraints, should optimally allocate a significant fraction of their portfolio to structured investment strategies, since such products allow investors to profit from the equity risk premium without being fully exposed to the downside risk associated with investing in stocks.
In order to show how this structured product can be used by an institutional investor, Goltz, Martellini and Simsek (2005) considered the following framework. Our investor maximises his holding period returns, subject to a level of Conditional Value-at-Risk (CVaR). As opposed to Value-at-Risk (VaR) which describes a given quantile, i.e., a maximum loss that will not be exceeded with a given confidence level, the CVaR measure summarises the distribution of returns that are below this threshold. This allows us to take into account both the existence of fat tails in the return distributions and institutional investors’ aversion towards taking on extreme risk.

In order to assess the inclusion of the structured product, they consider that the investor has access to a stock portfolio (such as a stock market index) and to a bond portfolio (such as a global bond index, which we model as a zero-coupon bond with constant time-to-maturity). We model an economy with stochastic interest rates and mean reversion in the excess returns on the stock index. We choose to introduce these two features, stochastic interest rates and mean reversion, because both effects are well-documented stylised features of financial markets. More importantly, both of these features matter to institutional investors when it comes to their asset allocation decision. Time variation in interest rate affects both the price of the bond holdings of an investor and the level of his liabilities. Mean reversion in long horizon returns, i.e., the fact that periods with high returns are prone to be followed by periods of low returns and vice versa, obviously also has important implications for the asset allocation decision.

On each path, they calculate the returns for stocks, bonds and for the guaranteed structured product. The scenarios for the total returns on each asset class are then fed to the optimisation program, which allows us to draw efficient frontiers. They minimise a convex combination of the portfolio CVaR and the negative of the expected portfolio return for different levels of risk aversion. Their results show that considerable improvement in the efficient frontiers depicting the risk return trade-off of the investor is achieved when the latter is allowed to invest in the structured product.

In the following figure, extracted from Goltz, Martellini and Simsek (2005), one may observe the change in asset allocation with respect to the change in risk aversion. The GSP (Guaranteed Structured Product) helps the risk-averse investors increase their returns by replacing the stock allocation in their portfolio and the risk-seeking investors to decrease the shortfall risk they are exposed to by replacing the bonds in their portfolio.
For investors with a strong aversion to risk (points 1-3) the weight of the structured product takes on values between 70 and 90 percent. On the other hand, risk-seeking investors (points 5-9) can actually decrease shortfall risk exposure by replacing the bonds in their portfolio with a structured product. For this group of investors, optimal allocation to the structured product ranges from 10 to 70 percent. In fact, only the most risk-seeking investors (point 10) would have a zero allocation for a structured product and invest 100 percent of their wealth in stocks.

Likewise, most portfolios, especially those corresponding to a high risk aversion parameter, contain a significant allocation to the structured product. On the one hand, this product helps the risk-averse investors to increase their returns by replacing the stock allocation in their portfolio. The weight of the structured product for this type of investors takes on values of between 70 and 90 percent. On the other hand, the risk-seeking investors can actually decrease the shortfall risk they are exposed to by replacing the bonds in their portfolio with the structured product. Optimal allocation to the structured product for this group of investors ranges from 10 to 70 percent. In fact, only the most risk-seeking investors have a zero allocation to the structured product and invest 100 percent of their wealth in stocks.

One may also study the impact of the presence of realistic levels of market frictions and heterogeneous expectations on volatility estimates. The inclusion of fees for the structured product is modelled by overpricing the option component relative to its theoretical value, which reduces the upside participation the structured product allows for. As a consequence of the fees, the stock and bond indices become more attractive and replace part of the allocation to the structured product. The decrease in allocation to the structured product, however, has been found to be relatively small, even for high levels of fees.
The previous analysis has justified a demand from institutional investors for the structured product for the sole purpose of gaining access to non-linear return profiles. Another motivation for investors to buy a structured product may lie in expectations of volatility that diverge from those of the structurer. In fact, an underpricing of the structured product by the structurer according to the investor’s expectations of future volatility gives an additional motivation for investing. On the other hand, if the product is overpriced according to the expectations of the investor, this would reduce the allocation he chooses.

Since it is not reasonable to expect institutional investors to allocate a dominant fraction of their portfolio to structured products, one may also test the impact of imposing an upper bound on the allocation to the product. Obviously, the weight constraint is binding because the optimal allocation in the base case was very high. Overall, these results strongly suggest that adding even a limited fraction of the overall allocation to structured products allows for significant benefits.

It is important, however, to recognise that an insurance company should always weigh the cost associated with the convexity (downside protection) involved in these standard types of structured products versus the expected benefits. In particular, one can argue that when the company has accumulated a sufficient amount of realised gains in the management of the portfolio performance, it can be in a position to take on naked, as opposed to covered, positions. In other words, the insurance company can always decide to self-insure against adverse market movements. The cost of the protection in this case is simply the cost of equity for the company, which should be compared to the cost of an outside protection provided for by the market place, which may or may not be higher.
II.3. Conclusion on risk management techniques

Given the fair value principle that leads to a marked-to-market evaluation of assets in phase I, and assets and liabilities in phase II, the new accounting standards provide strong incentive for the use of advanced risk management techniques, based on risk diversification or risk hedging, that lie at the core of some of the recent most spectacular advances in portfolio theory.

In this section, we have argued that the LDI approach to asset-liability management is consistent with a "separation theorem" that advocates that the objectives of risk management and performance generation are best dealt with when handled separately. On the one hand, the insurance company is to design a liability-matching or liability-hedging portfolio based in cash instruments, or derivatives for a better customisation of the strategy. On the other hand, performance generation can be dealt with in the traditional context of asset management, with an enhanced focus on risk management justifying the use of such sophisticated techniques for risk diversification of risk hedging (with or without derivatives). Besides, the possible focus on the control of extreme risks makes such strategies also well-suited in the context of Solvency II regulation.

Unfortunately, however, we will see in the next section that implementing these risk management strategies requires a fair level of flexibility in the use of dynamic portfolio strategies and/or derivatives instruments. The problem is that neither the implementation of dynamic strategies nor the use of derivatives is facilitated by IFRS accounting standards. Hence, it seems that these new accounting standards lead the insurance company to a rather "schizophrenic situation", where on the one hand the risks are more emphasised but on the other hand their management is made more difficult.
III. Challenges in Implementation
The objective of the profound transformation currently being experienced by insurance companies is to better integrate all of the risks (financial market, ALM, credit, underwriting and operational) being run by the sector. The regulatory authorities' requirement for a better measure of risk exposure (volatility for the IFRS and VaR for Solvency II) should lead to companies being empowered with respect to their risks, and hence incite them to manage risks better.

For this purpose, we presented the modern approaches to ALM in the previous section, notably by focusing on two separate building blocks, one being the liability-matching portfolio and the other being the performance-seeking portfolio. In this part of the document, we will show that the IFRS can work against the goal of better risk management.

We shall see that dynamic asset management in the presence of insurance liabilities, which aims to reduce the risk exposure while managing allocation performance, can rely, depending on the strategies chosen, on long-term bonds, derivative instruments, mutual funds, structured bonds, or on a combination of some of these, but the treatment of the variation in the fair value under IAS 39 of each of these assets leads to a very high level of volatility in the income statement and/or the equity which is incommensurate with the real exposure to the risks of the different strategies:

- Bonds acquired with the intention of being held to maturity have in the end not been classified in HTM by insurers, in view of the constraints inherent in this category, and the classification in AFS generates considerable volatility in equity during phase I of IFRS.

- Derivatives and structured products are henceforth not only consolidated but the different accounting treatment of the underlyings can lead to accounting mismatches that result in a rise in the volatility of the income statement that is opposed to the real overall situation (underlying + derivatives).

- Mutual funds are also consolidated now and no longer provide the same leeway for carrying out the necessary adjustments. Within the framework of dynamic asset management, following a variation in the financial markets, regular arbitrages must be carried out so as to converge permanently towards the asset allocation that was defined as optimal. Moreover, particular treatment of minority interests leads to increased volatility in the income statement.

Therefore, the rules that govern the IFRS, in particular IAS 39, often work against their goal of dynamic risk management. They often lead to high levels of volatility in the income statement and/or equity, which bear no relation to the real exposure to the risks of the management and protection strategies implemented.
III.1. Management of liability risk

The aim of the techniques used in the design of a liability-matching portfolio is to generate a portfolio whose value will be as closely related as possible to the value of the liability portfolio, and hence to provide a hedge against the risk factors that can affect the value of the liabilities.

The main risk factors are of two kinds:

- Financial risks: interest rate risk(s) (not only standard exposure to changes in level of the yield curve, but also exposure to changes in shape, as well as non-linear exposure with respect to changes in level because of the presence of embedded options in insurance companies liability streams) and inflation risk in particular;

- Non-financial risks: actuarial risk in particular for mixed savings products (mortality and morbidity risks, risk of anticipated departure to retirement for pension funds, etc.), as well as pure insurance risk for general insurance.

It should be noted at this point that the emergence of new offerings of products such as longevity bonds provides an increasingly thorough set of instruments that allow insurance companies to hedge away some of the risk associated with deviations between actual aggregate payoffs and expected payoffs estimated from mortality tables.

Three possible solutions can be followed in the design and practical implementation of the liability-matching portfolio.

III.1.1. Liability-matching portfolio with cash instruments

From a financial management standpoint, this solution is acceptable provided that the investor can rely on a sufficiently liquid market for bonds with sufficiently long maturities.

Designing a liability-matching portfolio on the basis of cash instruments involves a number of challenges from a financial standpoint.

An initial technical challenge related to the sole use of bonds in the liability-matching portfolio is the inability to allow for management of embedded options in liability portfolios. A second, and arguably more important challenge, is a lack of performance. There is evidence that the increasing demand from institutional investors for long-term nominal and real Treasury bonds has already led to a high increase in the value of these instruments, and a resulting decrease in their yields. The excess return expected from investing in long-term TIPS for example is reaching historical lows in the UK for example. In this context, the temptation is present...
Challenges in Implementation

for institutional investors to invest in corporate bonds instead, in an attempt to earn an extra credit premium that will boost the performance of their fixed-income portfolio somewhat. The problem there is that investment in long-term bonds is problematic for a number of reasons. First, the low number of issuances of long-term corporate bonds implies that the resulting portfolio will suffer from a lack of diversification (strong bias towards the financial sector for example, so that credit events in that sector would have a dramatic effect on the value of such portfolios). Furthermore, the market for such long-term corporate bonds is rather illiquid, which is a serious concern in case of a need for rapid liquidation of significant positions in such bonds. Finally, even if institutional investors wish to buy these securities and hold them until maturity, leaving them non-sensitive to short-term fluctuations in credit spreads, the impact of such fluctuations will be felt unless those bonds are held as HTM (an option which is not favoured by most insurance companies, as we have seen in part I). The long-term visibility over default risk is rather low over long time-horizons. As a result, the tendency so far for those wishing to earn an extra premium is to favour government bonds issued by such countries as Greece or Italy, for which the extra credit risk involved earns a credit premium without leading to a significant exposure to default risk, as opposed to investing in corporate bonds.

In addition to the difficulties from a risk and asset management standpoint related to the use of bonds in the liability-matching portfolio, it has to be recognised that this approach is not favoured either by the new IFRS regulation. This is true for a number of reasons.

First, the fact that in phase I of the IFRS, only assets are valued on a mark-to-market basis (IFRS 7, IAS 32, IAS 39) while fair valuation is not used for insurance liabilities (IFRS 4), induces a mismatch from an accounting standpoint, if not from a financial standpoint, that will result in a significant impact of fluctuations of bond prices on financial statements.

Secondly, the IFRS lead to a fall in the use of historical value rules, which have a dampening effect in terms of impact of bond price fluctuations. Bonds constitute the larger part of the assets held to back insurance contracts in order to secure the commitments vis-à-vis the policyholders, and are bought with the aim of matching liabilities, generally through keeping those bonds until maturity. In that case, it seems natural to account for them in a symmetrical way with regard to the liabilities, i.e. generally at amortised cost during phase I and at fair value through equity in phase II. The classification in "held-to-maturity" seems totally natural for phase I. However, as we have seen in section I.1.1., the classification of
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assets as “HTM investments”, measured at amortised cost using the effective interest method, is very constraining and in practice insurers rarely use it.

To be eligible, a held-to-maturity investment has to be a non-derivative financial asset, with fixed or determinable payment and fixed maturity and the insurer has to have the intention and ability to hold to maturity. But, if it is no longer appropriate to classify this investment as HTM then a “tainting” rule shall apply as follows:

• all the HTM investments have to be reclassified as AFS and remeasured at fair value;

• the difference between the carrying amount and fair value has to be recognised in the profit or loss (very bad signal for the policyholders and financial markets);

• the entity shall not classify any financial assets as held-to-maturity for the following two years (except if the reclassification or the sale is attributable to an isolated event that is beyond the entity’s control, non-recurring and could not have been reasonably anticipated by the company).

Thus, we can underline that these constraints do not offer enough flexibility to manage the bond portfolio, and thus the financial margin, dynamically, notably in a period of pressure (arbitrage on corporate bonds or credit risk management).

Moreover the “HTM” classification generates significant operational risk: a mistake by a subsidiary or in one portfolio generates the reclassification of the whole group’s HTM portfolio.

Finally, as we saw in part I, the shadow accounting option (IFRS 4) offers the opportunity to partly offset the volatility generated in profit or loss (classification in fair value through profit or loss) or mostly in equity (AFS classification instead of HTM), which reinforces the eviction from the HTM category. However, many insurance companies are afraid that in a period of crisis, because shadow accounting is totally artificial and created specifically for phase I, that the financial markets and the insurance supervisory authorities would be unable to continue considering this mechanism, notably in terms of the solvency margin.

As a result, the AFS classification is the most widely used by insurance companies when dealing with their bond portfolios. We recall that the assets classified in the AFS category are valued at fair value with the change in value recognised in equity. We think that this is unnatural, since insurance companies choose bonds in order to have a regular yield and to keep most of the bond portfolio until maturity. The volatility, and to a lesser extent, the impact on the regulatory solvency, generated by this classification in AFS is incommensurable with the reality and the strategy of the company.
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More precisely, even if profit or loss is not affected, EDHEC believes that IFRS do not assist in exposing insurance companies to state-of-the-art management techniques. Traditionally insurance companies were insensitive to imperfect matching of the liabilities when they remained in a buy-and-hold scheme. With IFRS, imperfect static matching leads to some volatility in the balance sheet.

Moreover, companies that engage in dynamically correcting their exposure will greatly increase the volatility of their P&L because most realised gains will be passed through income. This is even in the case of a “dynamic hedging scheme” that focuses on matching liabilities.

It should also be noted that immunisation techniques, which lead to dynamic hedging of the interest rate risk present in liability streams, because they involve active trading with direct impact in terms of profit-and-loss, and justify the use of the trading category, opposed to the AFS category, will be even less favoured by IFRS than cash-flow matching, which is based on the implementation of a static replicating portfolio for liabilities. We have seen in the first part of this document that IAS 39 requires that a financial instrument be measured at “fair value through profit or loss” when it is held for trading (HFT is one of the three cases of the “fair value through profit or loss” category).

Again, we think that the IFRS generate artificial volatility in the profit or loss in that case. It is surprising that a company which implements a dynamic hedging programme for the long term in order to protect against interest rate risk sees its profit or loss account strongly affected by this hedging strategy.

As a conclusion, it can be argued that implementing a liability-matching portfolio with cash instruments is becoming more difficult in the IFRS environment, due to the new volatility on equity (AFS category). The choice of insurance companies to invest in bonds satisfies prudent management, notably in order to protect the capital and part of the policyholders’ returns. Before the IFRS, the variations in unrealised gains or losses did not affect either the income statement or the balance sheet (since they were off-balance sheet), which could have appeared to have been relatively consistent with the desire to hold on to the bonds until maturity.

Moreover, since the information on the amount of unrealised losses was available, the financial markets and supervisors could restate the figures for their reports as required, notably in the case of a bond crash. Henceforth, with the IFRS, since the natural class for a large share of the bonds (HTM) is too restrictive (reclassification as AFS, with an initial revaluation through the income statement), the insurance companies have classified nearly all of their bonds in AFS with all the
III.1.2. Liability-matching portfolio with derivatives

From a financial management standpoint, it is clear that derivatives, in particular interest rate and inflation swaps, are well suited for the design of the liability-matching portfolio because they allow for perfect customised hedging of financial risks in liability streams. In particular, perfect cash-flow matching can be implemented, with the use also of interest rate derivatives such as swaptions so as to allow for management of non-linear risks related to the presence of embedded derivatives in liability structures. Finally, the use of derivatives allows for the presence of leverage that can prove useful in the implementation of LDI solutions; in particular the full value of the liability portfolio can be matched with derivative instruments, while leverage is used to add an exposure with respect to a performance-seeking portfolio.

The problem here from an accounting impact perspective is that the IFRS do not recognise the macro hedge and in particular the effectiveness of hedging transactions from an ALM perspective. It is therefore impossible to avoid having the value of these swap instruments being marked-to-market, with dramatic consequences in terms of accounting impact.

III.1.3. Liability-matching portfolio with bonds and derivatives

In this solution, derivatives such as interest rates and inflation swaps are used, not as a pure substitute to bonds, but as a complement to bonds. In particular, starting from an initial investment in bonds, these derivatives can be used to shorten or increase the duration of the bond portfolio, and make it consistent with the investor’s target.

Fixed-to-floating swaps are used to (dramatically) shorten the duration of bonds, and therefore lower their exposure with respect to interest rates movements. Conversely, forward-start swaps are used to increase the duration of a bond instrument beyond the maturity date.

In both cases, it is possible to use “hedge accounting” so as to avoid having to resort to fair valuation of these instruments.

One of the most important changes in the IFRS is the treatment of the derivatives. Thanks to a move from off-balance sheet to on balance sheet, IAS
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39 offers greater transparency. However, depending on the accounting standard, derivatives are carried at fair value with change in the fair value recognised in the profit or loss and in most cases, changes in the fair value of the hedged assets and liabilities are recognised in the balance sheet.

These different accounting treatments generate accounting mismatches in the timing of gain and loss recognition, and provide more volatility in the income statement than the company really has to face. In order to reduce this volatility, IAS 39 permits a "hedge accounting" option, which recognises, as we have seen in part I, the change in the derivative and the hedged item in profit or loss statement (fair value hedge) or in the balance sheet, according to the classification of the hedged item (cash flow hedge) in the same period. In practice, to override the normal accounting rules, companies have to meet numerous, onerous and complex requirements: this is so constraining that it is not often used.

As we have seen in part I, one of the most constraining requirements is the effectiveness. The hedge must be expected to be highly effective in achieving offsetting changes in fair value or cash flows attributable to the hedged risk, 1) at inception of the hedge, 2) tested regularly throughout its life (minimum at every reporting date) and 3) effective in a range of 80%-125% over the life of the hedge (for more details, we invite the reader to refer back to section I.1.4.).

Moreover, one outstanding problem is that this solution is only usable in the context of micro-hedge trades, as opposed to macro-hedge trades aimed at hedging the net exposure of a portfolio (as opposed to hedging each exposure separately), which are more efficient from a risk management perspective. Since 2002, there has been widespread debate on "macro hedging" for interest rate risk, and the Board has explored whether and how IAS 39 might be amended to deal with it.

For the moment, as we have seen in part I, it is possible to work around this by designating part of the underlying items as a hedged item. For example, it is permitted to designate the net exposure as a portion of the assets or the liabilities as the hedged item. However, the designation is expressed as an amount of a currency (assets or liabilities but not as a net amount) rather than as an individual asset. This amount also determines the percentage measure that is used for testing effectiveness. If the portfolio can contain only assets or liabilities or both assets and liabilities, and it is used to determine the amount of the assets or liabilities the company wishes to hedge, the portfolio cannot itself be designated as the hedged item (see section I.1.4.1.2. for an example based on an interest rate swap).

Finally, the Board decided not to
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reconsider the fundamental approach to accounting for financial instruments from IAS 39 and issued an amendment to IAS 39 in June 2005 relating to the "fair value option".

This fair value option permits financial instruments to be measured at fair value with changes in value recognised in profit or loss. More generally, IAS 39 allows a company to designate a financial asset or liability as at fair value through profit or loss, when that eliminates or significantly reduces a measurement or recognition inconsistency that would otherwise arise. A narrative description has to be provided on how designation at fair value through profit or loss is consistent with the company’s documented risk management or investment strategy. This approach reduces the volatility because changes in fair value of hedged and hedging instruments are recognised in the profit or loss, but it is quite constraining in terms of volatility of the hedged instruments (from AFS to "fair value through profit or loss").

In conclusion, it seems that the new IFRS standards, at least in their first phase, favour mixed solutions, involving both cash instruments and derivatives, as opposed to bond-only or swap-only solutions. This is because the hedging effectiveness is only recognised from an asset management standpoint, so that it can be used to avoid marking-to-market of unrealised profits and losses only when derivatives are used in association with a specific underlying bond portfolio.
Strategies to be considered when hedge accounting is not recognised

Example: The importance of the hedge’s formulation

Consider that a policy of contracts has a fixed thirty-year term and the current assets backing these liabilities have a five-year term. Management decides to lengthen the duration of the assets so as to perfectly match that of the liabilities.

This is done by means of a forward swap that starts in five years and ends in thirty years. The economic reasoning is fairly simple — assets must hedge liabilities. However, the IFRS hold an obligation to evaluate how best to define and account for this hedging relationship.

IAS39 does not enable a net position to be defined as a hedged item. Therefore, swaps defined as cash flows of assets minus those of liabilities cannot be defined as a hedge.

Nevertheless, these swaps can be seen as preventing the fair value of assets from dropping below those of liabilities, and their effectiveness may be tested for a fair value hedge. However, there are potentially problems with this definition:

• In a fair value hedge of the liabilities, the change in fair value of the defined liabilities is recorded in profit or loss. Thus unexpected patterns in liabilities due to experience changes will increase profit or loss volatility.

• When there is only one group of assets that backs all liabilities, as opposed to assets defined at the model-point level, it is arguable that no assets can be defined as backing a given liability.

• A hedge strategy over thirty years can hardly be proved effective at all reporting dates.

• A hedge strategy over thirty years imposes large holding constraints: the composition of current assets cannot be changed from their current definition in the hedge strategy over too long a period of time.

For these reasons, it appears more practical to modify the very definition of the hedge strategy. Instead of defining the swaps as part of a very long fair value hedge, an alternative is to commit to buying a 25 year bond with a given yield in 5 years, and to use the forward swap as a protection against the change in fair value of this intended purchase. This is a

43 – “Comparing a hedging instrument with an overall net position (e.g. the net of all fixed rate assets and fixed rate liabilities with similar maturities), rather than with a specific hedged item, does not qualify for hedge accounting”
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cash flow hedge strategy and the change in fair value of this swap is recorded in equity.

The advantages are as follows:
• The hedge is obviously efficient provided that the bond to buy has roughly the same characteristics as the swap.
• The transaction is easily proved highly probable either by documenting its benefits or by simply committing to buying the designated assets in the future.
• Holdings virtually disappear, as the hedged item is not in the balance sheet.
• No additional profit or loss volatility is recorded at any point in time.

However, swaps must be sold in five years when they stop being forward, and a bond must be bought. This is both a cost and a risk, as selling one instrument to buy its equivalent does not make any sense from an economic standpoint; if the desired bond is not liquid in 5 years, this may be a risk or an additional cost.

Example: Protection against the risk of massive surrenders

When interest rates rise steeply, insurance companies face the risk of massive surrenders. In most non-linked savings contracts in continental Europe, the policyholder can surrender his contract at book value. As such, he owns an "embedded" put option on the value of the assets of the fund.

We should assume that the more the surrender option is in the money, the higher the number of policyholders who will exercise. Good risk management should cover this risk. Nevertheless, it is generally impossible to prove the accuracy of the estimate of contingent surrender outflows because of the lack of data for calibration purposes, and as a consequence no hedge scheme would pass the efficiency test required.

Unfortunately, the lack of recognition of a hedge strategy would lead to fair value through profit or loss (FVTPL) classification of the hedging instruments. It may be possible to reformulate the strategy as a fair value hedge on the bond portfolio. Nevertheless, it has the following drawbacks: it may be difficult to specify the assets being hedged; it may impose...
strong holding constraints on these assets and additional profit or loss volatility because of possible inefficiency.

In that case, hedging instruments are classified in FVTPL and there are the following two cases:

a) When this hedge is performed on a with-profit fund, at least during phase I, the most practical would be not to recognise the hedge and to classify the options bought in FVTPL. Most of the volatility of the options will indeed be passed through policyholder deferred participation in phase I.

b) For non-DPF contracts in phase I (and probably for all contracts in phase II), no shadow accounting is allowed. There is a natural mismatch between the asset option classified as FVTPL and the liability surrender option which is not generally isolated from the host contract.45 Even though IAS 39 and IFRS4 do not make the split mandatory, it is interesting in this case to envisage isolating the surrender option and classifying it as an FVTPL liability. The change in the value of the option on the asset would approximately match the change in value in the embedded surrender option on the liability side, and would cancel out in the profit or loss. The change in the value of the bonds would match that of the liabilities they are backing, and would approximately cancel out in Other Comprehensive Income also referred to as equity.

With these two examples, we have shown that the strict criteria to be met in order to recognise a hedge under IFRS oblige management to optimise not only the economics of the transactions, but also the very definition of the hedge. We have seen that IFRS accounting imposes transactions that are otherwise not needed to manage the balance sheet. This may arise because of the artificial segmentation between cash and derivatives instruments as in the example of an interest rate swap, or because of an overly rigid set of rules for the classification of the assets as in the Fair Value Option example. This is an extra burden for the company.

EDHEC believes that over and beyond the previous points, there is a considerable lack of recognition of the economics of hedging. It seems obvious that good risk management first consists in protecting a company against the risk of failure from improbable events, but this is typically not recognised in IFRS.

45 - “An insurer need not separate, and measure at fair value, a policyholder’s option to surrender an insurance contract for a fixed amount (or for an amount based on a fixed amount and an interest rate), even if the exercise price differs from the carrying amount of the host insurance liability.”
III.2. Management of performance

As recalled above, the next ingredient in sound asset-liability management is the performance-seeking portfolio, which should have an absolute return focus because liability risk is managed separately. In that respect, the use of risk management techniques, as opposed to simple asset management techniques, is critical.

We have argued in favour of the core-satellite approach methodology in the construction of the performance-seeking portfolio. In the context of the core portfolio, risk management can be achieved in two possible ways, one being the reduction of risk through proper asset allocation decisions (diversification benefits), the other being the elimination of risk through the use of suitably designed solutions based either on derivative instruments or dynamic asset allocation strategies (hedging benefits). On the other hand, it should be recognised that the presence of constraints in terms of accounting impact can be integrated in an active portfolio management process and therefore be a part of the design of the satellite portfolio.

III.2.1. Active satellite management under the constraint of accounting impact

The implementation of active portfolio strategies should explicitly recognise the presence of accounting impact constraints. This can be done in an equity universe as well as in the fixed-income universe. In what follows, we present explicit illustrations based on sophisticated portfolio construction processes developed by AXA that show how regulatory constraints can be embedded within the portfolio construction process.

III.2.1.1. Alpha equity portfolio management in compliance with IFRS

In the context of equity management, significant value can be added in terms of risk management if the concern over risk management is introduced at the security selection level.

In what follows, we present as an example a two-step process implemented by AXA Rosenberg for quantitative equity management in an effort to ease costs in terms of economic capital and impact/variability on the balance sheet and income statements of an insurance company. This process, which is consistent with the core-satellite approach that was introduced in

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section II.2.2., focuses on the design of active satellites that would better fit the regulatory constraints in terms of volatility impact.

III.2.1.1. Implementing sound management of the market risk budget

The aim is to try to ensure that the actively managed equity portfolio will have good properties in terms of risk exposure, and in particular in terms of downside risk. The (loosely defined) objective is to design a portfolio that will have relatively low volatility, and in particular, relatively low downside risk with solid performance whatever the stage of the business cycle, without giving up too much of the exposure to the equity premium.

Based on their long-lasting expertise in quantitative equity management, AXA Rosenberg has developed the following methodology for a customised portfolio management process adapted to the constraints of insurance companies within the context of the new regulations.

Selecting a universe of stocks

This is done by starting with a universe of 17,000 stocks and excluding the 5% of them that lie at the extreme of the growth spectrum (very high growth stocks), which tend to be the most volatile. The design of such a value-oriented universe is not very selective, since 95% of all stocks are potential candidates for inclusion in a portfolio, as opposed to 50% of all stocks if the reference universe is given by a typical value-oriented index.

Designing a reference, or normal, portfolio

The price of each of the 95% of remaining stocks in the universe is decomposed into the sum of two components, one related to the book value of the company, and the remaining one, which is regarded as the implied growth potential that is valued by the market for the company. The next step consists of trying to explain that implied growth potential in terms of a series of attributes, including return attributes (current dividend yield, stability in dividend yield, price-earning ratio, earning forecast, etc.) as well as risk attributes (beta, volatility, etc.). If the implicit growth potential cannot be explained by objective attributes of the stock, then the stock is regarded as expensive.

A reference portfolio is designed based on the whole universe of stocks (after exclusion of the 5%), with a weighting scheme that is proportional to the unexplained fraction of the implicit growth potential, as opposed to the market cap of each stock. Hence, stocks with implied growth potential that is parsimoniously explained by objective attributes will be severely underweighted in the reference portfolio. This portfolio...
has a value bias that matches the focus on risk management because stocks with a price-to-book ratio that cannot be explained by attributes tend to underperform (unless in the very short-term in the context of a high growth bull market) and to be more volatile. As a result, this reference portfolio is expected to dominate a broad-based index on a risk-adjusted basis.

This reference, or normal, portfolio is rebalanced monthly.

Managing and optimising an active portfolio

The next step involves selecting a limited number of stocks for inclusion in the active portfolio that will be used in implementing the reference portfolio. This is done by maximising the excess return of the portfolio with respect to the reference portfolio, under the constraint that the distance between the actual and reference portfolios (measured in terms of attributes as opposed to a simple measure in terms of tracking error) be kept at a target level. An additional constraint in terms of accounting impact is also added (see next section).

It should be noted that most portfolios managed by AXA have now adopted a similar focus. Even for the portfolios managed on a more qualitative basis, the aforementioned normal portfolio and the corresponding universe of stocks are used as a reference for risk purposes.

III.2.1.2. Implementing sound management of the accounting risk budget

In addition to designing an equity portfolio with a reasonable risk profile, with a focus on market risk management, the new regulation provides strong incentive for an added focus on accounting risk management. A typical portfolio process implemented by AXA Rosenberg implies a 100% turnover, which means that 100% of the profits and losses incurred on a portfolio will impact the financial statements of the investor within a given year. Obviously, this will lead to levels of accounting impacts that will be too high in the context of the new regulations.

In an attempt to take accounting impact constraints into account, an additional constraint is imposed, which is expressed in terms of a profit or loss budget. Hence, the difference between the actual price of each stock, and a fair price estimated after adjusting the implied growth rate to reflect the value of objective attributes, is perceived as an “alpha” that should lead to a corresponding profit, and an annual budget is set in terms of realisation of these potential mispricings. The addition of such accounting impact constraints leads to levels of turnover of around 50%, and in some cases as low as 20%, which tend to be more consistent with the new regulatory environment.
III.2.1.2. Alpha fixed-income portfolio management in compliance with IFRS

In the context of fixed-income portfolios, significant value can also be added in terms of risk management if the concern over risk management is introduced at the security selection level.

It should also be emphasised that the portfolio construction process can be optimised so as to ease the cost in terms of economic capital and impact/variability on the balance sheet and income statements of an insurance company. Here again, the focus is on the design of active satellites that not only meet the standard requirements of potential for alpha generation, but also compliance with respect to accounting impact constraints.

As an illustration, we describe in what follows the fixed-income portfolio construction process that is used by AXA in particular in the context of the design of the optimal allocation to credit-risky bonds.

III.2.1.2.1. Modelling fixed-income markets

The first step involves state-of-the-art modelling of the main risk factors relevant for fixed-income portfolio management, which notably include interest rate risk(s), credit risk and currency risks.

III.2.1.2.2. Modelling fixed-income strategies

The second step involves modelling various strategies that can be followed in fixed-income markets, as well as various kinds of portfolio implementations of such strategies.

These strategies can be of two kinds: active strategies and passive strategies. The modelling of passive strategies boils down to modelling the performance of a portfolio intended to track a given fixed-income benchmark, and is based on a simple buy-and-hold investment in all the bonds in the benchmark.

The modelling of active strategies, on the other hand, boils down to modelling the performance of a portfolio intended to outperform a given fixed-income benchmark. The latter exercise involves modelling security selection bets that are active views expressed by fixed-income portfolio managers. This is achieved by two means, one being based on a perfect observation of future realisations, with a filter imposed to introduce noise in this perfect foresight process (string structure for uncertainty), the other being based on a probabilistic view of future outcomes and generation of views based on this integration of future uncertainty (tree structure for uncertainty).

Finally, two types of active portfolio are considered. The first kind of portfolio is meant to be short-term oriented (typically under a mutual fund format), with an objective to outperform a pre-
specifying benchmark. As we shall show later, IFRS treatment of such portfolios will generate impacts on both the balance sheet and income statement. The focus there is not so much on accounting risk management, but rather on (relative) performance generation, in such a way that no specific accounting risk budget will be set. So as to avoid a dramatic impact from such portfolios in terms of accounting risk management, these strategies are designed so as to be duration-neutral strategies, which allows for a reduction in the volatility due to (small) interest rate changes\(^{46}\).

The second kind of portfolio is meant to be long-term oriented (typically under a managed account format), with an objective not only related to pure performance generation but also to accounting risk management. IFRS treatment of such portfolios will generate an impact on the balance sheet only. Such a process seeks to identify bonds with stable credit ratings, and avoid major credit events by anticipating rating migrations and future spread stability, on the basis of a fundamental credit research. As it implies a low turnover, this process is properly designed to be accounted for in AFS, with the benefit of not generating volatility in the P&L account. Active short term and buy-and-hold approaches offer higher instantaneous yields as they consider the whole credit universe, including the riskier issuers. The implied cost of the long term strategy, compared to buy-and-hold, can be offset on the long run thanks to the quality of the issuer peaking.

III.2.1.2.3. Modelling the accounting impact

Overall, the objective of the third and last phase is to generate optimal allocation to various strategies. In particular, for the corporate bond asset class, a breakdown is performed in terms of short-term versus long-term and passive versus active, with also a simple buy-and-hold strategy used as a possible alternative. Each such portfolio of strategies is known as a strategy allocation. A large number of stochastic scenarios are generated for all market factors over a 10-year horizon (see step 1), and risk/return measures are recorded for each possible strategy allocation. Roughly speaking, the idea is to find the optimal trade-off between economic return (terminal portfolio value) and accounting risk (volatility of accounting impact). An example of a qualitative conclusion obtained from such an analysis is that active credit risk management is likely to outperform a simple buy-and-hold passive strategy over the long-term because the benefits in terms of avoiding some of the default risk (even when a very low level of credit risk selection skill is allowed for) outweighs the costs related to selecting a less diversified portfolio of corporate bonds through active selection decisions.

Overall, the analysis allows for good risk management of the accounting impact based on realistic modelling of the fixed-income portfolio management process. In particular, as a medium

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46 - Perfect neutral duration is actually not targeted at the portfolio level; instead some exposure to interest rate risk is kept so as to add diversification benefits due to imperfect correlation between credit and interest rate risks.
III.2.2. Dynamic core portfolio management under the constraint of the accounting impact

While the presence of regulatory constraints can be accounted for in the process of implementing active portfolio strategies that will be used in the satellite fractions of the performance-seeking portfolio, the main issue is how to implement a sound allocation process in the design of the core component of that performance portfolio in the new regulatory environment.

As mentioned above, there are two approaches to risk management, one based on risk diversification via the asset allocation decision, the other based on risk hedging based on the use of derivative instruments, or equivalently on dynamic asset allocation strategies with a focus on generating convex payoffs that allow for strict management of downside risk.

III.2.2.1. Managing risk through optimal allocation decisions

As explained in the previous section, the goal here is to design optimal allocation benchmarks in an attempt to reduce the volatility and/or (C)VaR of the performance portfolio.

One problem here is that implementing optimal allocation decisions requires dynamic trading so as to maintain the actual allocation in line with the target optimal allocation as prices move. In particular, it has been argued that the emergence of new accounting standards (IFRS) provides investors with an incentive not to rebalance their portfolios so as to avoid an overly significant impact on their balance sheets and income statements from the realised profits and losses thereby incurred. This is a possible source of concern since rebalancing is often needed in a portfolio management context, especially for maintaining a desired asset allocation. For example, if an investor starts off say with 70%/30% bonds/stocks as an initial and supposedly optimal asset allocation decision, he will gradually suffer a deviation from his target allocation as asset prices move over time. Maintaining the initial and target allocation can only be achieved by continuous trading, with a strong accounting impact.

In an attempt to help quantify the magnitude of the problem, we have performed a simple experiment aimed
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at outlining the loss of efficiency induced in a portfolio management context by the presence of constraints that prevent investors from rebalancing their portfolios. We have collected daily returns on all components of the CAC 40 stock index on the period ranging from January 1997 to December 2005. Next, we perform an in-sample optimisation of the portfolio’s Sharpe ratio, i.e. we find the allocation that allows an investor to achieve the highest possible (excess) return/volatility ratio over the sample. This can be considered as the optimal target allocation for a mean-variance investor with perfect market information on expected return and variance-covariance parameter values, who can trade continuously so as to maintain the target allocation.

Next, we consider the case of an investor who is prevented from trading and therefore gradually drifts away from this theoretically designed optimal allocation as stock prices move. The table below shows that this buy-and-hold strategy leads to a significant decrease in the portfolio’s Sharpe ratio, decreasing from the optimal value of 1.45 down to 1.17, or an almost 20% deterioration in the objective.

It should of course be noted that the presence of transaction costs will obviously prevent an investor from trading continuously. So as to better understand what kind of results would be obtained with a more realistic trading frequency, we also consider the performance of an investor who implements a monthly rebalancing strategy, first in the absence of transaction costs (2nd line in the table), and then with an assumption of 10 basis points proportional transaction costs (rd line in the table), which we take as a reasonable estimate of the total cost that would be faced by a large institutional investor. We obtain a result in terms of the Sharpe ratio (1.7 with no transaction costs and 1.29 in the presence of frictions) that falls, as expected, between the fixed-mix case and the buy-and-hold case, while still being notably higher than the latter case. This suggests that dynamic trading may allow investors to remain relatively close to a target optimal allocation, even with a reasonable trading frequency and realistic levels of transaction costs.

48 - It should also be noted that this experiment is somewhat related to the literature on the relative benefits of buy-and-hold versus fixed-mix strategy, a brief and very incomplete review of which is provided below. It has actually often been argued that the efficient frontier for the rebalanced portfolio outperforms the buy-and-hold strategy (see Fernholz and Shay (1998) for theoretical results, as well as Mulvey et al (2000) and Swensen (2005) for a more practical approach to the question). In a related effort, Perold and Sharpe (1988) also examined and compared four dynamic strategies with stocks and bills: 1) buy-and-hold (they recognised this static strategy as a dynamic “do nothing” strategy); 2) constant mix (i.e., fixed mix); 3) constant-proportion portfolio insurance (CPP); and 4) option-based portfolio insurance (OBPI). They suggested that a fixed-mix strategy will outperform a comparable buy-and-hold or CPP strategy in a flat (but oscillating) market because it exploits reversals. On the other hand, in strong bull or bear markets, when reversals are small and relatively infrequent, fixed-mix clearly underperforms.
Before the IFRS, mutual funds were very useful key tools for implementing optimal allocation decisions to reduce the volatility and/or VaR of the performance portfolio, without impact on the profit or loss statements (linked to the realised capital gains or losses as this strategy requires dynamic trading to maintain the actual allocation in line with the target optimal allocation as prices move). They were not consolidated and hence the dynamic trading did not have any impact on the financial reporting statements.

However now, with the IFRS, IAS 27 "Consolidated and Separate Financial Statements" requires consolidation of mutual funds in the consolidated financial statements (except when there is evidence that control is intended to be temporary - with the intention of keeping them for more than 12 months - for more details, see box below). Hence, the scope of consolidation is widened in comparison with most previous national GAAPs. From a practical viewpoint, it is very complex to track the control percentage and to recover the valuation of the assets and liabilities line by line, including possible embedded derivatives, accrued coupons, etc.

Hence, dynamic trading to maintain actual allocation in line with the target optimal allocation generates considerable volatility in the profit or loss (when mutual funds are classified as “held for trading”) or in equity only (when mutual funds are classified as AFS).

Moreover, beyond the first problem with the consolidation of mutual funds, a second issue emerges when dealing with minority interests. According to IAS 32, the minority interests’ share of a mutual fund has to be classified as a liability with the change in fair value recognised in the profit or loss.

That means that when a company does not hold 100% of a mutual fund classified as AFS, the change in fair value is recognised in the equity but the change associated with the share of the minority interests (liability) is recognised in the profit or loss.

The solution is to:

• live with this accounting mismatch;
• choose the fair value through the profit or loss option or;
• hold 100% of the mutual funds.

To conclude on this approach, the consolidation of mutual funds and the handling of minority interests under IFRS could significantly curb optimisation of the return-volatility combination through dynamic asset management.
The specific case of mutual funds

IAS 27 ("Consolidated and Separate Financial Statements") stipulates that in preparing consolidated financial statements, a company has to combine the financial statements of the parent and its subsidiaries, line by line, by adding together assets, liabilities, equity, income and expenses.

Moreover, IAS 27 adds that a subsidiary cannot be excluded from consolidation, simply because the entity is a venture capital organisation, mutual fund, unit trust or similar entity. Thus, the scope of consolidation for the insurance group is widened in comparison with most previous national GAAPs. Instead of putting mutual funds in the assets on the balance sheet (domestic GAAP), under IFRS, the company has to integrate the assets and the liabilities of the mutual funds into its consolidated financial accounts line by line. From a practical viewpoint, it is very complex to track the control percentage and to recover the valuation of the assets and liabilities line by line, including possible embedded derivatives, accrued coupons, etc.

The IASB defines control as the power to govern the financial and operating policies of an entity, so as to obtain benefits from its activities. The control is presumed to exist (IAS 27, IAS 28, IAS 31):

• when the parent owns more than half of the voting power of an entity directly or indirectly;

• when the parent owns less than half of the voting power of an entity, but there is:
  1) power over more than half of the voting rights by virtue of an agreement with other investors;
  2) power to govern financial and operating policies of the entity under a statute or an agreement;
  3) power to cast the majority of votes at meetings of the board or appoint or remove a majority of the members of the board of the governing body.

IAS 27 does not require consolidation of a subsidiary (or a mutual fund) acquired when there is evidence that control is intended to be temporary (intention to dispose of it within twelve months following the last amendment at the end of 2005). Under IAS 28, which defines the conditions for significant influence, mutual funds that are more than 20% owned are accounted for as associates.
Challenges in Implementation

Beyond the first problem of the consolidation of the mutual funds, a second issue emerges because the consolidated financial statements naturally have to present financial information about the group as that of a single economic entity and have to identify minority interests in the profit or loss and in the balance sheet.

According to IAS 32, a financial instrument that gives the holder the right to sell it back to the issuer for cash or another financial asset (a "puttable instrument") is a financial liability (unless the amount of cash or other financial assets is determined on the basis of an index or other item that has the potential to increase or decrease, or when the legal form of the puttable instrument gives the holder a right to a residual interest in the assets of an issuer).

In consequence, the minority interest share in a mutual fund has to be classified as a liability, with the change in fair value recognised in the profit or loss.

When an insurer consolidates a mutual fund, of which it does not hold 100%, if the assets of the mutual funds are classified as "available-for-sale", unrealised gains and losses are recognised in equity but the change associated with the share of the minority interests (liability) is recognised in the profit or loss.

In practice, in order to reduce the impact on the accounting mismatch generated by the consolidation of the mutual funds and the treatment of the minority interest, most insurers decide to adopt the fair value through profit or loss option, when they do not hold 100% of a mutual fund and they have to consolidate it. Conversely, a mutual fund that is 100% held by an insurer is generally classified as "available for sale".

Example: Adaptation of the mutual fund management policy

Since the IFRS require the consolidation of mutual funds, AXA decided to define a clear management decision in order to reduce the volatility.

When AXA holds less than 20% of a mutual fund, the latter is not consolidated and is accounted for like a direct invested asset under AFS (unless it is an asset held to back unit-linked or with-profit insurance contracts, that is automatically classified in fair value through profit or loss according to IAS 39).
Challenges in Implementation

When AXA holds more than 20% but less than 50% of a mutual fund, the latter is consolidated according to equity method consolidation.

When AXA holds more than 50% of a mutual fund, AXA follows this decision tree:

- If it is defined as a core block (in practice in that case, it is usually held at 100%, hence the minority interest issue disappears) it is classified in AFS (no volatility in the profit or loss but only on the equity).
- If it is defined as a satellite block (usually when minority interests exist), it is classified at fair value through profit or loss and the change in fair value increases the volatility of the net profit.
- If it is held to back unit-linked or with-profit insurance contracts, it is naturally classified at fair value through profit or loss but the change in the fair value matches the unit-linked or with-profit liabilities and does not generate any volatility on the net profit.

III.2.2.2. Managing risk through optimal hedging decisions

The goal here is to generate non-linear (convex) payoffs so as to provide an explicit focus on downside risk protection. As explained in section II, three different approaches can be used.

III.2.2.2.1. Use of Derivatives

One legitimate solution for investors who wish to profit from the risk premium associated with investing in risky assets (e.g., stocks) without having to be exposed to all of the associated downside risk is to hold a position in derivatives (e.g., 25% out-of-the-money put option).

The problem here is that even though those products make perfect sense from a risk management standpoint, they will be marked-to-market and the accounting impact can be significant. One solution consists of documenting the effectiveness of the hedge so as to allow for hedge accounting, but we have seen previously in part I that hedge accounting is very demanding in terms of requirements and only used marginally.

Moreover, in order to reduce this accounting mismatch, it would be worthwhile to use the fair value option, but in practice, insurers prefer to keep a large part of bonds and equity in AFS instead of "fair value through profit or loss" to manage their volatility.
Thus, in most cases, for the moment, insurers have decided to live with the accounting mismatch (change in value of the derivatives recognised in profit or loss and change in value of the corresponding hedged items in equity), which increases the volatility of the profit or loss and is incommensurable with the real exposure. This impact is however limited by shadow accounting when it is allowed (in order to hedge financial assets held to back insurance contracts).

Under these conditions, the leeway to use derivatives for hedging and optimal asset management purposes should inevitably be reduced.

On the other hand, in the event that the conditions for applying the hedge accounting option are not met, it should be noted that because these products are meant to allow for the control of extreme risks, the derivative products are usually far out-of-the-money initially so that they tend not to be too volatile. Obviously, concern over the accounting impact will arise as these options’ become nearer to the money.

As we have mentioned, the IFRS require that the derivative instruments be carried at fair value with the change in value recognised in profit or loss. This requirement of IAS 9 is extended to derivatives that are embedded in an instrument. Embedded derivatives must be separated from the host contract, classified separately as trading assets or liabilities and marked-to-market through the income statement. However, IAS 39 stipulates that under the following three specific conditions, the embedded derivative does not have to be separated:

- when the embedded derivative is included in a financial asset or liability

III.2.2.2. Use of structured products

As pointed out earlier, a structured product is a package resulting from the combination of the underlying asset and a derivative instrument aimed at offering either downside risk protection and/or access to performance potential.

The question naturally arises as to whether the use of structured products is favoured by the new regulation in comparison with the use of derivative positions.

In terms of accounting impact, the presence of the option component in structured products will have a significant effect. When the option is sufficiently out-of-the-money and its value is so small that it is barely sensitive to fluctuations in the value of the underlying asset, the accounting impact is limited. On the other hand, when the option value shows a significant amount of variability, investors have a strong incentive to avoid having to mark these positions to market.
that itself is marked to market through the income statement;

• when the economic characteristics and risk of the embedded derivative are closely related to the host contract;

• when the company is unable to separate and measure the embedded derivative.

Even though IAS 9 does not provide much guidance on how to make the “closely related” judgement, through the examples that it gave, we have seen in part I that it is possible to establish a classification according to performance, maturity and extension of the maturity:

• When the derivative is a debt instrument whose coupon is indexed on the variation in interest rates or inflation, and if it is issued at the reference market rate, it can in principle be considered to be closely related to the host contract. It could involve caps, floors, collars, or fixed to floating interest rate swaps. The company must be sure of recovering almost all of its initial investment. The incorporated caps and floors must be at- or out-of-the-money and must not be levered. It is then necessary for the coupon received to be less than twice the coupon paid by an equivalent bond (maturity, credit risk) without an incorporated derivative. Conversely, separation of the derivative from the host contract will be necessary from the moment that the amount of the coupons or the repayment of the nominal is indexed on variations in the prices of shares, commodity indices or credit spreads.

• For the derivative to be considered closely related to the host contract in the case of a prepayment option, the amount of the compensation must remain limited with respect to the capital that is still due. The strike price of the prepayment option must therefore be approximately equal to the amortised cost of the security on the balance sheet (for bullet issues, it involves redemption at par).

• In the case of the maturity being extended, for the derivative to be considered to be related, the options for extending a debt must be accompanied by a clause for adjusting the interest rate in accordance with the market conditions at the date of the extension.

Moreover, according to IFRS 4, an insurer does not have to separate the embedded derivative from the host contract when the embedded derivative meets the definition of an insurance contract (for example, for a policyholder’s option to surrender an insurance contract for a fixed amount or for a fixed amount and an interest rate; conversely, when the surrender value varies in response to a change in a financial variable, e.g. equity, IAS 39 applies).

Again, “the fair value option” is the simplest to use but generates additional volatility in the profit or loss.
III.2.2.3. Use of dynamic asset allocation strategies

As recalled above, it is well-known since the Merton (1973) replicating portfolio interpretation of the Black-Scholes (1973) formula that payoffs that are non-linear functions of some underlying asset value can be replicated by dynamic trading in the underlying and in the risk-free asset. This justifies the use of dynamic trading strategies for the design of non-linear payoffs in asset management.

From a historical standpoint, the first example of such dynamic trading strategies aiming at offering downside protection is the CPPI strategy. Introduced by Black and Jones (1987) and Black and Perold (1992), the CPPI procedure allows option-like positions to be produced through systematic trading rules. This procedure dynamically allocates total assets to a risky asset in proportion to a multiple of the cushion, i.e., the difference between current wealth and a desired protective floor. This produces an effect similar to owning a put option. Under such a strategy, the portfolio’s exposure tends to zero as the cushion approaches zero; when the cushion is zero, the portfolio is completely invested in cash. Thus, in theory, the guarantee is perfect: the exposure strategy ensures that the portfolio never descends below the floor; in the event that it touches the floor, the fund is “dead” — it can deliver no performance beyond the guarantee. These strategies are very much in fashion and are used with different kinds of underlying risky assets (e.g., CPPI on funds of hedge funds) because they conveniently allow investors to gain a non-linear convex exposure with respect to the underlying asset.

One problem here is that by definition such strategies involve dynamic trading in the underlying assets, with a possible dramatic impact in terms of impact on the profit or loss. In particular, CPPI types of strategies have a momentum component that leads investors to sell in bear markets and buy in bull markets, hence realising profits and losses.

One possible solution again would consist in structuring the payoff of such strategies under the form of an indexed note, with an attempt to claim for no impact on the income statement provided that capital guarantee is offered, with a cap on the maximum level of coupon that can be offered (see previous section on structured products based on derivatives).

III.2.2.3. Managing regulatory capital through an optimal choice of assets

Ideally, a regulatory framework gives only good incentives. Solvency II represents a large step forward in risk...
Challenges in Implementation

management for insurance companies. Indeed, managing a company in a risk-based framework eliminates many of the market distortions that arose from the arbitrary Solvency I framework.

For instance, a Bermudan reinsurance company is subject to minimal local regulation, and holds either economic capital or rating agency capital. On the other hand, under Solvency I, a European insurance company is subject to arbitrary capital. This naturally creates price distortions, and a strong incentive to use reinsurance towards the Bermudas not primarily to mitigate risk, but to externalise capital where it is cheaper because of inadequate local regulation. Within Solvency II, where internal models are agreed by the supervisors, it allows decisions to be taken to mitigate risk according to economic needs, i.e. to optimise the diversification of risk holdings.

What the requirements are to have an internal model approved is an open question – including for calibration. We can anticipate that internal models will need to be calibrated on the assumptions embedded in the standard formula for regulatory capital. Where the embedded assumptions are unrealistic, especially where hedgeable risk factors are concerned, this creates distortions in the form of theoretical incentives to manage regulatory capital as opposed to economic capital.

To illustrate this idea, we propose the following simplistic example. We suppose that the cost of capital is 3% above the risk free rate, i.e. that the return from core business is 6%, and that risk capital defined as a buffer earns the risk-free rate. IFRS reporting is done on an annual basis.

The company finds that its optimal equity holdings are €100m, with partial portfolio insurance. With the current guidelines, investing €100m of shareholder capital in equities increases risk capital by 40% of that amount, i.e. by €40m. This investment is only worthwhile if the expected return on this asset is 3% above the risk-free rate, i.e. 6% or €2.4m. As portfolio insurance is implemented but not recognised as a protection by Solvency II, the company will seek to reduce its capital requirements by buying an option.

The cost of a one-year European put option of nominal amount €100m, with a strike of 90% of current spot price is worth €2.8m. A similar option of the Asian type (where the asset price is the average spot price over one year) is worth €0.7m. If the stock market falls by 40% at the end of the day, both options will be worth approximately €27m.

With current guidelines, buying an Asian option diminishes capital requirements by €26m, which is equivalent to a

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49 - This is overstated because the diversification benefits in the standard formula of the different risk capital amounts are aggregated thanks to a correlation matrix.

50 - The Hull pricer is used with interest rate at 3%, volatility at 20%, and dividend yield at 0.
Challenges in Implementation

return of €1.5m, and it appears to be a good management decision to buy this option, which will provide very poor protection for the portfolio. Also, given that the portfolio is already protected by a dynamic strategy, buying a European option saves only €24.5m of capital, and has a higher cost. As such, it may be disregarded by management.

To give proper incentives to the development of internal models and high performance risk-management schemes, the standard approach must remain reasonably accurate in the description of the risk factors. However it is necessarily simpler and less precise than what could be expected from internal models.

The standard approach gives poor recognition of the fact that diversification and alternative investing can diminish volatility. The approach embedded in QIS 2 is that reduction of equity risk can only be achieved by means of derivatives. If this is not changed in revisions of the Solvency II formula, the face-value of risk-reduction achieved by diversification, hedging strategies and state-of-the-art optimisation methods such as the one described above proposed by AXA Rosenberg, would be diminished. Companies would have significant incentives to generate considerable exposure to long-short strategies and not to build an internal model for market risk. This is because if all equities were to fall by 40% today as is assumed in the standard approach, the market value of a long-short fund would be unchanged. This means that holding such a fund does not require any capital.

This would create conflicts with the statement made by the CEIOPS that "partial internal model estimates would also be welcome — particularly in areas such as interest rate risk and equity risk where VaR approaches may be more familiar."

51 - “The 40% decline in equities is based on the average market decline for a 1-year horizon and 99.5% confidence level. Individual shares may be less or more volatile than the average, but on average they behave according to the market. It is essential that a factor other than -40% can be supported with data over an acceptable time horizon. The investment background is of no relevance to the factor, since valuation is based on the market”, QIS 2 Q&A.
III.3. Conclusion: the IFRS do not favour the implementation of good risk management for ALM and AM

 Regarding certain standards, some insurance companies have adapted ALM and asset management and created mechanisms to reduce pure accounting volatility in the profit and loss that is linked to new approaches or definitions. In that case, the IFRS do not always seem efficient:

- We believe that it is inefficient to create a "held-to-maturity" category in order to integrate the specific characteristics of insurance companies' bond portfolios (the major share of their assets) and their management objectives. It is so constraining that in practice it is unusable. Most assets of life insurance companies (whose contract risks are supported by the policyholder) are generally bonds, in order to be able to provide policyholders with competitive annual returns (an important argument in the quest for new sales). So as to manage some of the interest rate risk, these bonds are generally held to maturity. The sell-offs, which are few and far between, are generally intended to correct the ALM risks (notably with respect to the duration of the assets compared to the duration of the liabilities). The excessive constraint of reclassifying all bond portfolios as soon as one bond is sold under IAS 39 and its consequences have forced insurance companies to avoid this asset class (or use it very parsimoniously), even though it was specifically created for these bond portfolios. The latter have therefore been classified as "available for sale" in spite of their nature (held to maturity). This unnatural classification generates excessive volatility in insurance companies' equity and, to a lesser extent, profit and loss account (impairment, derivatives, etc.) which is incommensurate with the reality of management. The consequences are important, because now, when the insurance company defines its asset management and asset-liability management policy, it adapts its choice according to the impact on the volatility in profit or loss or in equity. This new constraint is a purely accounting consideration, without any link to the economic reality.

- The new requirement to consolidate mutual funds (not consolidated previously in some national GAAP) constrains insurers to build new mechanisms (sometimes extremely cumbersome ones!) or to change their management (holding percentage) in order to avoid the volatility generated in the profit or loss. Indeed, the treatment of minority interests reduces, or even prevents, classification of mutual funds as "available-for-sale", because it generates an accounting mismatch. Last but not least, dynamic management of mutual funds is considerably penalised
Challenges in Implementation

by this new standard. This consequently affects the ALM and asset management policy, as seen in part III.

• Due to its new principles, the IFRS strongly reduce the use of derivatives, notably the modern hedging approaches (for example hedging liabilities through derivatives and managing the surplus with assets) or managing extreme risks (a current issue for many insurers). The IASB is aware of that and has developed the “hedge accounting” option, but in practice it is often too constraining, and the insurance companies decide to use it parsimoniously. The classification of derivatives (previously off-balance sheet in most national GAAPs), and embedded derivatives (separable or not from the host contract) generates accounting mismatches and thus a high level of volatility in the profit or loss which is disconnected from the economic reality.

• IFRS 4 (“Insurance Contracts”) defines new constraints for asset-liability management and asset management, notably, without details, on the scope of the Liability Adequacy Test and without solving the key questions on the calculation of liabilities: discount rate, discretionary participation, future investment margin, provisioning and caution, deferred acquisition costs, etc. This will be done in phase II (in 2008?), but consequently, phase I generates numerous accounting mismatches that do not reflect the reality of the ALM and asset management policy, and thus the real exposure of a company to its risks, although the shadow accounting option allows these effects to be reduced.

Let us come back to the example of the use of swap transactions in the design of liability-hedging portfolios (section II.1.3.3.), where we considered that an insurance company entered a swap for which it will pay a single zero-coupon payment based on a breakeven rate assumed to be at 2.9% in an attempt to protect future liability cash flow (€55.76 million euros in real terms to be paid in 20 years) against interest and inflation risks.

Assuming for example (as in section II.1.3.3) that changes in economic conditions lead to a decrease in inflation rate (e.g., down from 2.9% to 2%) combined with an increase in interest rate (e.g., up from 4.51% to 5%), we find that the change in asset value of the combined position (zero-coupon bond + swap transaction) is exactly equal to the change in liability value, hence allowing for a perfect asset-liability match. If, on the other hand, the insurance company had not entered this suitably designed swap transaction, the change in value on the asset side would not have been perfectly compensated by a change in value on the liability side, hence generating a significant risk exposure from an asset-liability management standpoint.

52 - The company assumes a 2.9% inflation rate, the expected nominal liability payment amounts to 55.76*(1+2.9%)20 = €98.77 million in 2026. The present value of such a cash-flow payment in 2006 is equal to €40.88 million (98.77/(1+4.51%)20), assuming that to achieve perfect inflation and interest rate risk management, the insurance company enters a swap for which it will pay a single zero-coupon payment based on a breakeven rate assumed to be 2.9%.
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While the benefits of including such swap transactions is therefore obvious from a risk management perspective, it should be noted that in terms of accounting impact the situation is reverse, as the solution with the swap transaction appears as less favourable than a non-hedged solution without the swap transaction. If we assume that the company expects the hedge to be fully effective because the principal and notional amounts, currencies, maturity and variable reset dates of the liability and the swap are the same, the change in the fair value of the swap is recognised in equity. In these circumstances, it can actually be shown that the aforementioned changes in interest rate and inflation will generate a drop of 23.7% in value of the balance sheet in the solution involving the swap transaction (mostly due to the unrealised losses on the swap), while it will lead to a mere 9% drop in the solution without the swap transaction.

Naturally, if it is too difficult to demonstrate the effectiveness of the hedge transaction and document it (as is often the case), the unrealised losses on the swap will be recognised in the profit or loss while the new interest rate and inflation rate environments are actually better than they were before (lower present value of liabilities)!

In a nutshell, it appears that the additional volatility generated by the hedging instrument in the short term in order to manage a long-term liability is incommensurable with the economic reality and adds some confusion because the profit or loss is affected by losses (volatility increases) in a more favourable rate environment. The arbitrage between an efficient long-term hedging and the volatility of the profit or loss on a quarterly basis therefore appears to be a tricky challenge.

The problem obviously becomes more acute when the derivatives used cannot be recognised as part of an IFRS hedge. We have recalled in section I that all hedged items are required to have approximately the same risk exposure, which unfortunately is not generally the case, in particular for non-life claims:

- Their individual exposure to the consumer price index is fairly low, as each type of claim has an exposure to a specific price index. For instance, when a car needs to be replaced, the exposure would be to car prices, where correlation to consumer prices would be pretty low.

- The amount of the exposure of each claim is random, because it depends on the random uninflated value of the claim (which is zero with a high probability).

- And finally, inflation cannot be defined as an embedded option of an insurance contract.

53 - The detailed calculation is as follows: the change in the swap value due to changes in interest rates and inflation rates is given by \(-6 = (55.76(1+2\%20) - 55.76(1+2.9\%20))/(1+5\%20)\). On the other hand, the new value of the zero-coupon bond position is given by \(7.2 = 98.77/(1+5\%20)\). Overall the new position amounts to \(1.2 = 7.2 - 6\), which leads to a percentage drop in equity value equal to \((40.88-1.2)/40.88 = 2.7\%\). If the swap transaction is not entered, the impact is only related to the change in the zero-coupon value, which is \((40.88 - 37.2)/40.88 = 9\%\). 

An EDHEC Risk and Asset Management Research Centre and Financial Analysis and Accounting Research Centre Publication
Traditionally, inflation exposure was not managed in a very sophisticated manner in Non-Life insurance. This was in part because of the lack of incentives in the (Solvency I) statutory accounting frameworks. Unfortunately, it seems that the recent developments lack effectiveness in bringing Non-Life companies to allocate more resources to the management of inflation risk. The strategies evoked in this example bring more volatility in the IFRS income statement: they do not reduce capital requirements in the QIS 2 version of the standard formula, as inflation is not considered a hedgeable risk-factor, and as inflation exposure is not netted between assets and liabilities.

We have also presented different examples in section II.2.2.3. related to risk management through optimal allocation decisions in asset management. In particular, we have compared the (out-of-sample) performance of a simple buy-and-hold strategy consisting of a passive investment in the DJ Stoxx Euro global index to the performance of a portfolio based on an optimisation of the allocation to different DJ Stoxx Euro sector indices54, with a focus on minimising the portfolio CVaR, without any constraint on expected returns (see section II.2.2.3 for details on the process).

In the table below, we recall the out-of-sample performance of the optimised portfolio and the performance of the benchmark. We can see that the out-of-sample measures of extreme risks (Var and CVaR) from January 1993 through December 2005 appear to have been significantly reduced in the case of the optimally designed portfolios (optimal dynamic allocation strategy) when compared to the benchmark (buy-and-hold strategy in the DJ EuroStoxx index).

<table>
<thead>
<tr>
<th></th>
<th>Average Return</th>
<th>Maximum Drawdown</th>
<th>Volatility</th>
<th>Weekly 5% VaR</th>
<th>Weekly 5% CVaR</th>
</tr>
</thead>
<tbody>
<tr>
<td>DJ EURO STOXX</td>
<td>11.62%</td>
<td>62.99%</td>
<td>19.13%</td>
<td>4.36%</td>
<td>7.10%</td>
</tr>
<tr>
<td>PF MinCVaR</td>
<td>13.82%</td>
<td>48.33%</td>
<td>16.76%</td>
<td>3.81%</td>
<td>6.39%</td>
</tr>
</tbody>
</table>

While the dynamic management through optimal allocation decisions reduces the financial volatility and extreme risks in comparison with a buy-and-hold strategy, it is interesting to analyse what will be the impact on the profit or loss and on the balance sheet (in equity) under IFRS.

54 - We use weekly data on DJ Stoxx Euro sector indices (Bank, Construction, Energy, Health, Insurance, Media, Telecom, Technology, Utility) as well as DJ Stoxx Euro global index for the period extending from January 1993 to December 2005. Using a one-year rolling window sample analysis, we estimate second moments and co-moments (volatilities and correlations), as well as third-order moments and co-moments (co-skewness and co-kurtosis). Every six months, we optimise the portfolio allocation by minimising the portfolio CVaR, without any constraint on expected returns.
While the Optimal Allocation Strategy allows one to reduce the volatility and the extreme risks in terms of financial performance, the impact of IFRS should be discouraging in terms of profit or loss statement volatility (with a maximum drawdown at 48.33% and a volatility of 16.76%).

In the table below, we compare the impact on the profit or loss statement regarding the IFRS according to the two strategies.

### Comparison of the impact on the profit or loss statement according to the two strategies

(*) if we assume that at the end of the period, the equity portfolio is sold.

<table>
<thead>
<tr>
<th></th>
<th>Average Return</th>
<th>Maximum Drawdown</th>
<th>Volatility</th>
<th>Weekly 5% VaR</th>
<th>Weekly 5% CVaR</th>
</tr>
</thead>
</table>
| **DJ EURO STOXX**  
(Buy and Hold Strategy)  
AFS category   | 11.62% (*)     | 0%               | 0%         | 0%            | 0%            |
| **PF MinCVaR**  
(Optimal Allocation Strategy)  
Fair Value Through Profit or Loss category | 13.82% | 48.33% | 16.76% | 3.81% | 6.39% |

### Comparison of the impact on shareholders’ equity according to the two strategies

(*) if we assume that at the end of the period, the equity portfolio is sold.

<table>
<thead>
<tr>
<th></th>
<th>Average Return</th>
<th>Maximum Drawdown</th>
<th>Volatility</th>
<th>Weekly 5% VaR</th>
<th>Weekly 5% CVaR</th>
</tr>
</thead>
</table>
| **DJ EURO STOXX**  
(Buy and Hold Strategy)  
AFS category   | 11.62% (*)     | 62.99%           | 19.13%     | 4.86%         | 7.10%         |
| **PF MinCVaR**  
(Optimal Allocation Strategy)  
Fair Value Through Profit or Loss category | 13.82% | 48.33% | 16.76% | 3.81% | 6.39% |

Hence, with the buy-and-hold strategy, the volatility and maximum drawdown of shareholders’ equity are obviously higher than those of the optimal allocation strategy. When we calculate for each quarter, the impact on the profit or loss and on the equity for the two strategies, the optimal allocation strategy, which is more relevant in terms of financial risk management, does not perform well in terms of volatility on the P&L.
Here again, IFRS generate a tricky arbitrage between a sound management of risks from a financial standpoint (here through an efficient dynamic optimal allocation process leading to a minimisation of the long-term portfolio volatility and extreme risks) and the accounting impact that shows a strong volatility in the short term (at each accounting reporting) in the profit or loss for the optimal strategy.
Conclusion
Conclusion

From a Fair Value-based to an ALM-based approach to the evaluation of risks and solvency of insurance companies

While nobody would dispute the value of having a real view of the impact of the primary financial and actuarial risk factors on an insurance company’s accounts, we feel it is regrettable not only for the insurance sector but for the economy as a whole that the fair value of assets and liabilities be a basis for analysing the financial soundness and solvency of insurance companies. For most of their activities, insurance companies have long-term or even very long-term liabilities that in turn justify long-term allocation. Measuring their solvency on the basis of short-term values is not only incompatible with the need for investment in assets that, while risky, yield very positive average long-term returns, but also means that any genuine asset-liability management is an illusion, even though the regulators actually hope to promote ALM.

Similarly, EDHEC feels it is contradictory to favour the implementation of internal risk analysis models within the scope of the new prudential provisions (Solvency II), while at the same time basing the ultimate assessment of a company’s solvency on ratios taken from accounting values.

We believe that the only basis for analysts and regulatory authorities to assess the financial soundness and durability of an insurance company should be an analysis of the consistency between the liability risks and asset risks and an evaluation of the consistency and robustness of the asset-liability management models used.

This ALM-based approach to financial analysis presupposes that there is precise documentation of the company’s ALM allocation policy and the robustness tests that have been performed. This information should serve to support the LAT tests, which are planned for the transitory phase of the application of the IFRS to the insurance sector.

EDHEC believes that neither the solutions put forward by the IASB to circumvent or diminish the short-term nature of the IFRS nor the transitory provisions are satisfactory. They ultimately render accounts more complex, arbitrary and unclear, and they increase accounting risk without offering any real solutions to facilitate good financial ALM management practices in insurance companies. On the contrary, we have shown in this study that good ALM, risk and asset management practices remain heavily penalised by the accounting provisions.

EDHEC hopes that European regulators and financial analysts will take full
Conclusion

stock of the consequences of the new ‘financial’ approach to prudential regulation, Solvency II. This means abandoning all references to external and accounting approaches to solvency evaluation in favour of an evaluation of risk measurement and risk management procedures, internal models and the choice of risk parameters that underpin asset allocation and liability management decisions. In light of this, EDHEC regrets the approach chosen by the CEIOPS, as put forward in the QIS 2. Not only does it not correspond to the state of the art in global and optimal management of risk and insurance capital, but furthermore, and more importantly, in cases such as the treatment of options or the explicit absence of consideration for dynamic allocation strategies, it is at odds with the objective set out by Solvency II to control financial risks.

In conclusion, EDHEC feels that the particular nature of long-term investors’ liabilities, be they insurance companies or pension funds, is such that both regulators and financial analysts need to attach greater importance to the ongoing concern principle (which is an accounting principle), rather than suppose that the notion of fair value will transcend the whole of the accounting doctrine. It is only by finding this necessary balance that the invaluable contribution of the IFRS to the transparency of risk, particularly market risk, will not be undermined by the legitimate aim of allowing institutional investors, and insurance companies in particular, to continue to operate as long-term investors and perform their invaluable role of constant liquidity providers for the market and the economy at large.
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References

About the EDHEC Risk and Asset Management Research Centre

EDHEC is one of the top five business schools in France and was ranked 7th in the Financial Times Masters in Management Rankings 2006 owing to the high quality of its academic staff (over 100 permanent lecturers from France and abroad) and its privileged relationship with professionals that the school has been developing since it was established in 1906.

EDHEC Business School has decided to draw on its extensive knowledge of the professional environment and has therefore concentrated its research on themes that satisfy the needs of professionals. EDHEC is one of the few business schools in Europe to have received the triple international accreditation: AACSB (USGlobal), Equis (Europe-Global) and AMBA (UK-Global). EDHEC pursues an active research policy in the field of finance. Its "Risk and Asset Management Research Centre" carries out numerous research programmes in the areas of asset allocation and risk management in both the traditional and alternative investment universes.

The choice of asset allocation
The EDHEC Risk and Asset Management Research Centre structures all of its research work around asset allocation. This issue corresponds to a genuine expectation from the market. On the one hand, the prevailing stock market situation in recent years has shown the limitations of active management based solely on stock picking as a source of performance. On the other, the appearance of new asset classes (hedge funds, private equity), with risk profiles that are very different from those of the traditional investment universe, constitutes a new opportunity in both conceptual and operational terms. This strategic choice is applied to all of the centre’s research programmes, whether they involve proposing new methods of strategic allocation, which integrate the alternative class; measuring the performance of funds while taking the tactical allocation dimension of the alphas into account; taking extreme risks into account in the allocation; or studying the usefulness of derivatives in constructing the portfolio.

An applied research approach
In a desire to ensure that the research it carries out is truly applicable in practice, EDHEC has implemented a dual validation system for the work of the EDHEC Risk and Asset Management Research Centre. All research work must be part of a research programme, the relevance and goals of which have been validated from both an academic and a business viewpoint by the centre’s advisory board, which is made up of both internationally recognised researchers and the centre’s business partners.

To date, the centre has implemented six research programmes:
- Multi-style/multi-class allocation
- Performance and style analysis
- Indices and benchmarking
- Asset allocation and extreme risks
- Asset allocation and derivative instruments
- ALM and asset management

Research for business
To optimise exchanges between the academic and business worlds, the research centre maintains a website devoted to asset management research for the industry: www.edhec-risk.com, circulates a monthly newsletter to over 75,000 practitioners, conducts regular industry surveys and consultations, and organise annual conferences for the benefit of institutional investors and asset managers. The centre’s activities have also given rise to the business offshoots EDHEC Investment Research, which supports institutional investors and asset managers in the implementation of the centre’s research results and proposes asset allocation services in the context of a ‘core-satellite’ approach encompassing alternative investments and EDHEC Asset Management Education, which helps investment professionals to upgrade their skills with advanced risk and asset management training across traditional and alternative classes.
About the EDHEC Financial Analysis and Accounting Research Centre

The EDHEC Financial Analysis and Accounting Research Centre was created in 2006 as part of the EDHEC Research Department’s goal to develop exceptional academic research capabilities and publish articles in the major academic journals in this area. Businesses remain central to this process: dynamic industry-centred communication enables companies to apply the EDHEC research findings to their business practices.

The diversity in the expertise and backgrounds of the centre’s staff is a considerable asset. The EDHEC Financial Analysis and Accounting Research Centre includes academic and industry specialists in financial analysis, accounting and law, which allows it to tackle interdisciplinary issues related to financial analysis: company valuation, the impact of the IFRS and Solvency II on the financial management of insurance companies, the impact of the IFRS on valuing and pricing risks, developments in the use of fairness opinions and the status of independent financial experts.

Today, most valuations carried out by professionals rely on the discounted cash flow method using a discount rate that is based on a risk premium or beta. The difficulties brought about by the statistical irrelevance of these two variables often lead practitioners to excessive simplifications, which means that their reasoning and appraisal may no longer be valid. Our objective therefore is to use state-of-the-art academic expertise to question certain financial paradigms, particularly that which ignores idiosyncratic risks in the calculation of the risk premium on the basis that such risks are diversifiable. We can thereby reject the notion that changes in the accounting framework are neutral with regard to how risks are perceived by showing that they have an impact either on the financial aggregates used by analysts or on the strategy used by companies to neutralise the accounting impact.

Through partnerships with major financial institutions and European industry representatives, the centre wishes to carry out extensive research on the issues central to its development and validate this work through publications in respected academic journals. At the same time, the research centre’s constant aim to focus on the preoccupations of the industry means that it will foster permanent dialogue between professionals via regular conferences, as well as via the EDHEC ‘Position Papers’, which respond to current developments of public interest in the centre’s research areas.

The EDHEC Financial Analysis and Accounting Research Centre also aims to accompany professionals with a customised application of the centre’s research findings, thereby offering consultancy and technical expertise.
AXA Investment Managers

AXA Investment Managers is a multi-expert investment management company and part of the AXA Group, a world leader in financial protection.

AXA IM has enjoyed strong and sustainable growth over the last 12 years and today has more than 2,600 employees operating in 18 different countries, with 472 billion euros under management as at 30th September 2006.

With more than 800 funds and 500 fund managers and analysts, AXA IM offers expertise across all major asset classes and alpha strategies.

As a multi-expert company, it believes that specialisation is the key to sustainable performance and therefore focuses its resources on the investment capabilities where it can add real and sustained value:

• Fixed Income

• Equity (AXA Rosenberg, AXA Framlington, Equity Conviction, Talents)

• Alternatives (Structured Finance, AXA REIM, AXA Private Equity, Hedge Funds)

• Investment Solutions (Structured Products, ALM Solutions, Tactical Asset Allocation, Insurance Investment)

Its ambition is to offer high-performance financial products and investment solutions that meet the specific needs of its clients — institutional investors, distributors or the AXA Group — and provide them with quality information and support throughout the investment process.

Thanks to the commitment and professionalism of its staff, AXA IM is always able to understand and respond to clients’ requirements and investment needs.

AXA IM is an expert, trendsetting and leading company that is acknowledged as a key player in the asset management industry owing to its steady investment performance and the quality of its solutions and services.