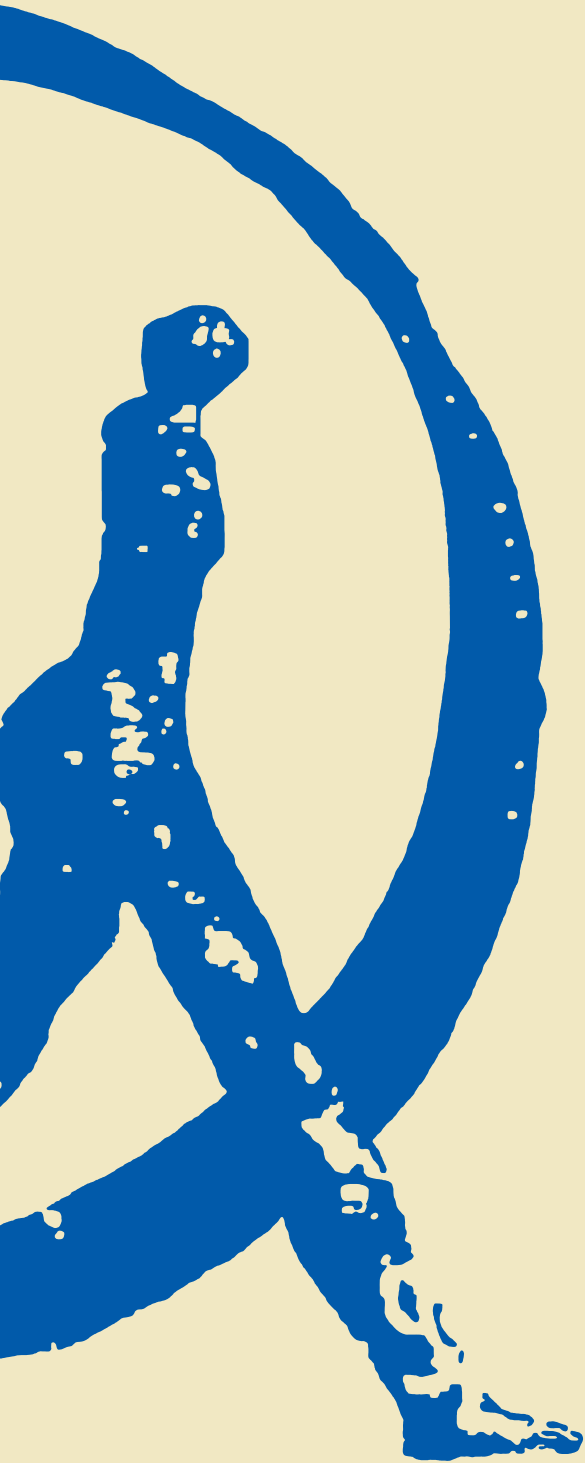


An Edhec Risk and Asset Management Research Centre Publication

The Benefits of Hedge Funds in Asset Liability Management



September 2005






Abstract: This paper examines the benefits of including hedge funds for investors facing liability constraints. We cast the problem in a stochastic surplus optimisation setup where hedge funds are treated as a complement, and not as an addition, to traditional asset classes, which alleviates the concern over *ex-ante* modelling of hedge fund returns, a notoriously difficult challenge given the short history and complexity of these alternative investment styles. Our conclusion is that, when added to bonds and stocks, suitably designed portfolios of hedge funds can allow for significant benefits in an ALM context, as can be measured in terms of reduction of the expected mismatch between assets and liabilities. This impact is more pronounced when the relevant objective turns to extreme risks. In fact, we show that the probability of extreme deficits (value of the assets falling below 75% of the value of liabilities) can be reduced by as much as 50% by allocating not more than 20% to hedge funds.

Edhec is one of the top five business schools in France and was ranked 12th in the *Financial Times* Masters in Management Rankings 2005 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 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.

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About the Authors



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Foreword

Since it was set up, in 2001, the Edhec Risk and Asset Management Research Centre has made a point of conducting research that is both independent and pragmatic.

The concern to render our research work relevant and operational led us, in 2003, to publish the first studies on the policies of the European asset management industry. The Edhec European Asset Management Practices survey allowed a comparison to be established between the academic state-of-the-art in the area of portfolio management and risks, and the practices of European managers.

This study was completed in the same year by a review of the state-of-the-art and the practices of European alternative multimangers, the Edhec European Alternative Multimangement Practices survey.

In drawing up the latter report, we were able to observe the gap that exists between the conclusions of academic research work and the practices of multimangers in measuring and reporting on the performance and risks of funds or portfolios of hedge funds. This observation led us to carry out research and a survey on this fundamental dimension of the relationship between investors and managers: the Edhec Funds of Hedge Funds Reporting Survey. This report was presented in February 2005 to pan-European institutional investors and professionals.

In 2005, on the occasion of the Edhec Asset Management Days, which brought together more than 600 professionals in Geneva, we had the honour of presenting our study on the place of structured products in asset management, entitled "Structured Forms of Investment Strategies in Institutional Investors' Portfolios". This question is a vital one in view of the importance of non-linear payoff products in the marketplace, notably following the difficult recent years on the stock markets.

Like structured products, hedge funds are non-linear payoff products and, probably for the same reasons, have been very much in the news in the asset management industry in the last five years. We feel that the present study is coming along at a very opportune time. After probably overestimating the long-term performance of hedge funds in the past, investors are beginning to doubt their usefulness as a result of the disappointing performance in recent years.

It seems to us that coming up with an answer of 100% or 0% for hedge funds emanates from an identical "in-sample" error. In the absence of modelling of hedge fund strategies' returns, and in view of the low level of historical track record, we feel that the use of the technical and conceptual framework of ALM for integrating hedge funds should at least be revisited, if not called into question.

That is the object of the study that has been carried out by Professor Lionel Martellini and Volker Ziemann. This research is part of a long line of research into hedge funds and asset allocation that has recently given rise to output that is not only academic, with the notable publication of "The Right Place for Alternative Betas in Hedge Fund Performance: an Answer to the Capacity Effect Fantasy" on the reality of the capacity effect for hedge funds, but also business-related, with the launch of the Edhec Hedge Fund Diversifier Benchmarks, which have been produced in co-operation with Lyxor.

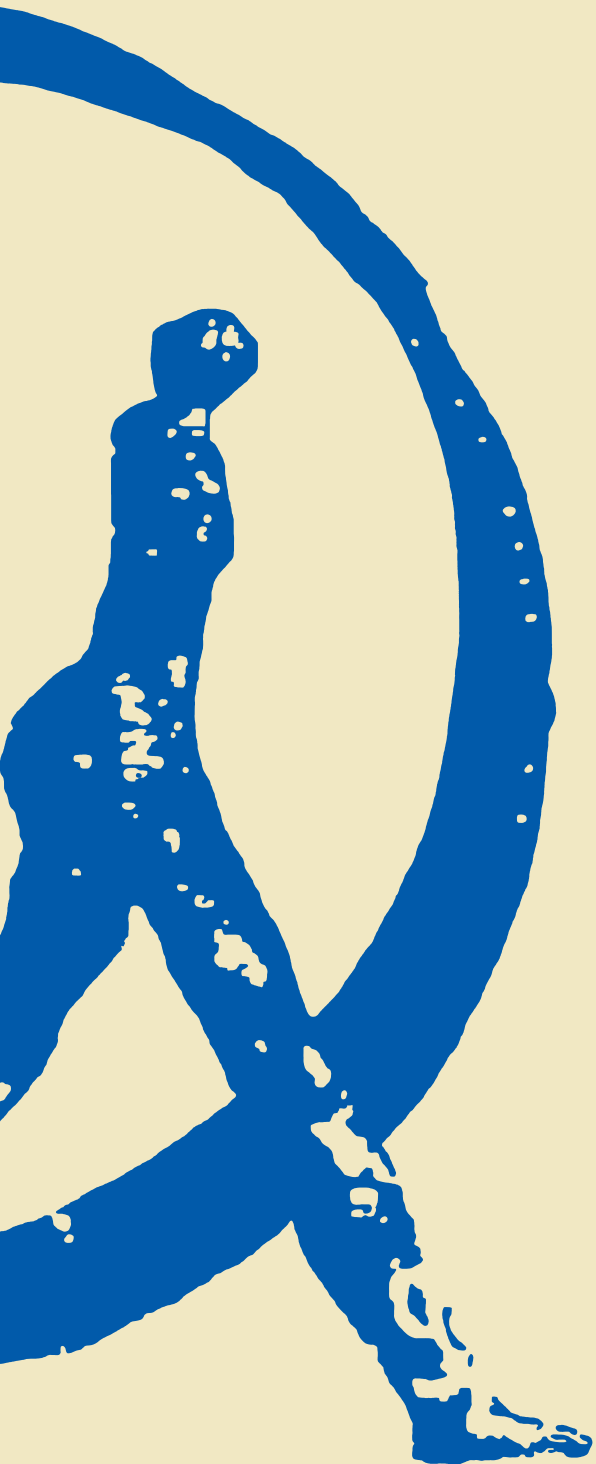
To conclude this foreword, I would like to thank SG CIB and Lyxor, who have supported our research work for many years and have enabled us to publish this research.



Noël Amenc,

Professor of Finance, Director of the Edhec Risk and Asset Management Research Centre

Executive Summary



Executive Summary



Institutional investors in general and pension funds in particular have been dramatically affected by negative stock market returns at the beginning of the millennium. In the context of a cumulative asset/liability deficit that was estimated at more than £55 billion in 2003 for the companies in the FTSE 100, institutional investors are seeking new asset classes or forms of investment management that would allow them to broaden their traditional choice of asset allocation.

Following considerable success in private wealth management, hedge funds are targeting institutional investment

An alternative investment offering has been introduced in the past several years, allowing investors to optimise the risk/return combination of their portfolio. While the original rise of hedge funds was explained by the success encountered with private clients, we now expect institutional investors to follow the lead of private banking with significant inflows of capital in the next few years. Moreover, these inflows have already begun, with the number of institutional investors using alternative investments in constant progression, particularly due to significant increases in Europe, Australia and Japan. In 2005, hedge fund use by European institutions has doubled to 48% from 24% in 2003. By 2007, European institutions are expected to dedicate 7.2% of portfolios to hedge funds, an increase from the 5.3% estimated for 2005.¹

However, the use of hedge funds in asset-liability management requires precautions

While it is certainly legitimate to seek to improve the asset/liability ratio with the help of hedge funds, a naïve approach to the question is likely to give extremely unstable results. For example, if we use the historical data on hedge fund returns without any precautions in a simple relative risk optimisation exercise (optimisation of the information ratio in relation to a stylised benchmark that is perfectly matched with the investor's liabilities), the optimal allocation to hedge funds obtained varies from 0% to 100% depending on the period used for calibrating the model! Such a lack of robustness in the analysis suggests that a naïve approach to the place of hedge funds in ALM is totally inappropriate.

Unlike traditional asset classes (stocks and bonds), for which we can find both reliable stochastic models and estimations of long-term parameters that are indispensable for carrying out a surplus optimisation study, major obstacles actually prevent institutional investors today from considering hedge funds to be an ALM class in the same way as traditional classes. Not only does the absence of a sufficiently long historical record, together with the opaqueness of the data and the biases that characterise the available databases, make any effort at projecting long-term risk and return parameters particularly illusory, but there is no satisfactory existing model for hedge fund returns, in spite of

1. Source: Russell Investment Group's seventh annual report on alternative investment, September 2005.

Executive Summary

recent progress in academic research on the subject. Hedge fund behaviour, which is typically characterised by dynamic management strategies that sometimes employ a multitude of complex products, is difficult to capture in the linear models that are classically used in finance.

A new approach to integrating hedge funds: as a complement, not a strategic allocation class

In order to cope with these difficulties in modelling hedge funds, and the risk relating to estimation of the parameters, in particular the expected return parameter, which is highly sensitive to the choice of sample, we propose in this study to adopt a more robust alternative approach to the place of hedge funds in the context of ALM. Rather than considering hedge funds to be an additional class to the traditional classes in an asset-liability exercise, we consider hedge funds to be complementary management styles for stocks and bonds.

This approach, in which hedge funds are not regarded as an asset-liability allocation class, is in fact consistent with the usual practices of institutional investors with respect to the traditional management styles. It is indeed common to model a very limited number of major asset classes in a stochastic asset-liability optimisation exercise, rather than seeking to model all the sub-components of the class. In the stock universe, for example,

we typically model the return of a global large-cap equity index, to which we might possibly add a small-cap stock index, without looking to independently model sector, geographical or style (value versus growth) indices. This approach to alternative investment as a complement to traditional investment management is also consistent with the idea that hedge funds are above all considered by institutional investors to be diversification tools that allow the risks of a stock or bond portfolio to be reduced, rather than a tool for improving long-term returns. This desire to see hedge funds as a diversification tool is reinforced by recent academic research results which have shown that the diversification properties (risk reduction benefits) of hedge funds were more robust from a statistical standpoint than their capacity to provide absolute performance (return enhancement benefits).

The study presented here shows that it is possible to construct diversification benchmarks that allow the risk related to holding stock or bond portfolios to be reduced in a very significant and robust way, by i) appropriately selecting the alternative strategies and ii) optimising these with proven techniques (minimising the extreme risks, as measured by the Value-at-Risk of the overall portfolio).

These diversification benchmarks thereby allow the long-term volatility parameters of the stock and bond classes to be reduced significantly.

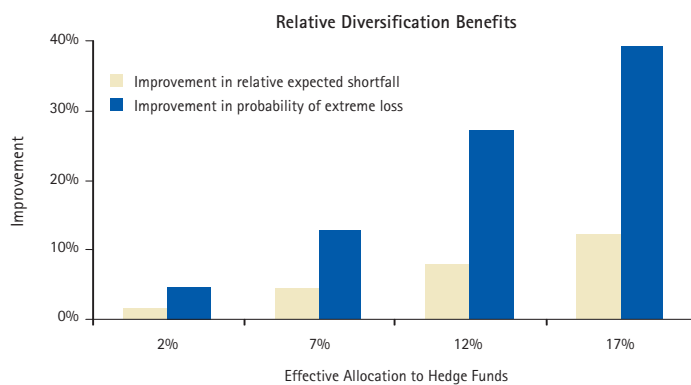
Table 1
Evolution of the long-term volatility parameters of stocks and bonds as a function of the proportions of hedge funds in each class.

	0% HF	5% HF	15% HF	25% HF	35% HF
Stocks	16.50%	15.62%	13.75%	11.99%	10.34%
Bonds	8.50%	7.98%	7.21%	6.70%	6.18%

Executive Summary

As a result, introducing these diversification benchmarks as complements to the traditional classes (stocks and bonds) enables ALM performance to be improved significantly, even for reasonable quantities of investment in hedge funds. In particular, we find that the introduction of only slightly more than 11% of hedge funds into the overall allocation can lead to a reduction of more than 27% in the probability of the value of the assets falling below 75% of that of the liabilities (asset-liability deficit greater than 25%). Moreover, it should be noted that an allocation to hedge funds of approximately 20% allows the probability of extreme risk to be reduced by more than 50%.

Figure 1
Improvement of expected relative shortfall and probability of a shortfall greater than 25% as a function of the effective proportion allocated to hedge funds.



Conclusion

While most institutional investors are looking into hedge funds as a possible solution to the challenges posed by asset-liability management in the presence of serious concerns over the size of the equity and bond premium and the associated risks, very little is known about how to include these alternative investment styles in an ALM context.

This study provides evidence of the contribution of hedge funds in a surplus optimisation context. To this end, we have proposed a pragmatic approach that does not treat hedge funds as an addition but rather as a complement to traditional asset classes (stocks and bonds), which alleviates the concern over the modelling of hedge fund return distributions and parameter estimation. Our conclusion is that suitably designed hedge fund portfolios can be particularly attractive when the objective of optimising expected returns is constrained to meeting liabilities. This is due to hedge funds' benefits in terms of diversification properties, which in turn is related to their appealing behaviours in terms of the impact on tail-distribution and extreme risks of stock and bond portfolios.

Résumé



Les investisseurs institutionnels en général et les fonds de pension en particulier ont été fortement affectés par les replis des marchés actions au début du millénaire. Dans un contexte de déficit cumulé actif/passif estimé en 2003 à plus de 55 milliards de livres pour les sociétés du FTSE 100 les investisseurs institutionnels sont à la recherche de nouvelles classes d'actifs ou formes de gestion qui leur permettraient d'élargir leur choix traditionnel d'allocation d'actifs.

Après un succès considérable dans la gestion privée les hedge funds ciblent la gestion institutionnelle

Une offre de gestion alternative se met en place depuis plusieurs années, permettant aux investisseurs d'optimiser le couple rendement/risque de leur portefeuille. Tandis que le succès originel des fonds alternatifs a longtemps été expliqué par le succès rencontré auprès de la clientèle privée, on s'attend désormais à ce que les investisseurs institutionnels imitent l'exemple des banques privées avec d'importants afflux de capitaux au cours des prochaines années. Le mouvement a d'ailleurs déjà commencé, avec une augmentation importante des investissements dans la gestion alternative par les investisseurs institutionnels, notamment en Europe, en Australie et au Japon. En 2005, l'utilisation des *hedge funds* par les institutions européennes a doublé, pour atteindre 48% par rapport à 24% en 2003. A l'horizon 2007, on s'attend à ce que les investisseurs institutionnels européens intègrent les *hedge funds* dans leurs portefeuilles à hauteur de 7,2%, comparé à un chiffre estimé à 5,3% pour 2005.¹

Cependant leur utilisation dans la gestion actif-passif suppose des précautions

S'il paraît a priori légitime de chercher à améliorer le ratio actif/passif à l'aide de fonds alternatifs, la recherche académique a cependant montré qu'une approche naïve de la question donnait des résultats extrêmement instables. Par exemple, si l'on utilise sans précaution les données historiques sur la rentabilité des *hedge funds* dans un simple exercice d'optimisation en risque relatif (optimisation du ratio d'information par rapport à un benchmark stylisé parfaitement adossé au passif de l'investisseur), l'allocation optimale en fonds alternatifs obtenue varie de 0% à 100% en fonction de la période utilisée pour la calibration du modèle ! Un tel manque de robustesse dans l'analyse suggère qu'une approche naïve de la place des *hedge funds* dans la gestion actif-passif est ainsi totalement inadaptée.

A la différence des classes d'actifs traditionnelles (actions et obligations), pour lesquels sont disponibles à la fois des modèles stochastiques fiables et des estimations de paramètres long terme indispensables à la conduite d'une étude d'optimisation de surplus, des obstacles majeurs empêchent en fait aujourd'hui les investisseurs institutionnels de considérer les fonds alternatifs comme une classe de gestion actif-passif au même titre que les classes traditionnelles. Non seulement l'absence de profondeur historique, ainsi que l'opacité des données et les biais qui caractérisent les bases disponibles, rendent tout effort de projection long terme des paramètres de risque, et surtout de rendement, particulièrement illusoire, mais il n'existe par ailleurs pas aujourd'hui, malgré de récents

1. Source : Russell Investment Group, septième rapport annuel sur la gestion alternative, Septembre 2005.

Résumé

progrès de la recherche académique sur le sujet, de modèles satisfaisants des rentabilités des fonds alternatifs, dont le comportement, typiquement caractérisé par des stratégies de gestion dynamique faisant parfois appel à une multitude de produits complexes, est difficile à capturer par les modèles linéaires classiquement utilisés en finance.

Une nouvelle approche de l'intégration des *hedge funds* : un complément et non une classe d'allocation stratégique

Pour faire face à ces difficultés de modélisation des fonds alternatifs, et au risque lié à l'estimation de paramètres, en particulier du paramètre de rentabilité, si fortement sensible au choix de l'échantillon, nous proposons dans cette étude une approche alternative, plus robuste, de la place des *hedge funds* dans le contexte de la gestion actif-passif. Plutôt que de considérer les *hedge funds* comme une classe *additionnelle* aux classes traditionnelles dans un exercice actif-passif, nous considérons les *hedge funds* comme *des styles de gestion complémentaires* aux actions et aux obligations.

Cette approche consistant à ne pas regarder la gestion alternative comme une classe d'allocation actif-passif est en fait cohérente avec la pratique courante des investisseurs institutionnels dans leur approche des styles de gestion traditionnels : il est en effet d'usage de modéliser dans un exercice d'optimisation stochastique actif-passif un nombre très limité de grandes classes d'actifs, plutôt que de chercher à modéliser l'ensemble des sous-

composantes de la classe. Dans l'univers des actions par exemple, on modélise typiquement la rentabilité d'un indice global de valeurs de large capitalisation, auquel on ajoute éventuellement un indice de valeurs de petite taille, sans chercher à modéliser de façon indépendante des indices sectoriels, géographiques, ou encore par styles de gestion (valeur contre croissance). Cette approche de la gestion alternative en tant que complément de la gestion traditionnelle est par ailleurs cohérente avec l'idée que les fonds alternatifs sont avant tout considérés par les investisseurs institutionnels comme des outils de diversification, permettant de réduire les risques d'un portefeuille action ou obligation, plutôt qu'un outil d'amélioration de la rentabilité à long terme. Cette volonté de voir en la gestion alternative un outil de diversification est confortée par des résultats récents de la recherche académique qui ont montré que les propriétés de diversification (*risk reduction benefits*) des fonds alternatifs étaient nettement plus robustes que leur faculté à offrir de la performance absolue (*return enhancement benefits*).

L'étude présentée ici montre qu'il est possible de construire des benchmarks de diversification permettant de réduire de façon très significative et robuste le risque lié à la détention de portefeuilles actions ou obligations, sur la base i) d'une sélection adaptée de stratégies alternatives et ii) d'une optimisation de celles-ci selon des techniques éprouvées (minimisation des risques extrêmes mesurés par la *Value-at-Risk* du portefeuille global).

Ces benchmarks de diversification permettent ainsi de réduire significativement les paramètres long terme de volatilité des classes actions et obligations.

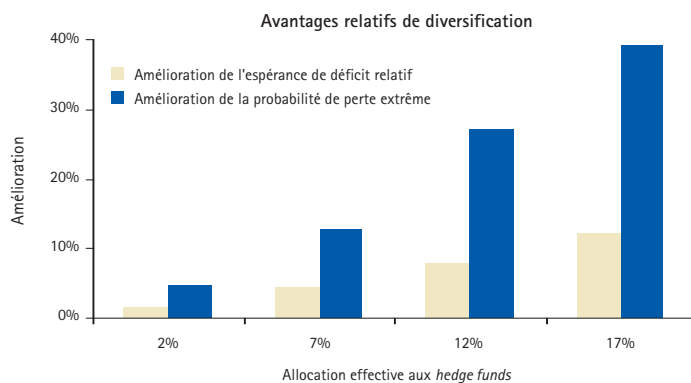
Tableau 1
Evolution des paramètres de long terme de volatilité des classes « obligations » et « actions » en fonction des proportions de *hedge funds* incorporées dans chaque classe.

	0% HF	5% HF	15% HF	25% HF	35% HF
Stocks	16.50%	15.62%	13.75%	11.99%	10.34%
Bonds	8.50%	7.98%	7.21%	6.70%	6.18%

Résumé

De ce fait, l'introduction de ces benchmarks de diversification en tant que compléments des classes traditionnelles (actions et obligations) permet d'améliorer significativement la performance d'une gestion actif-passif, et ce même pour des quantités raisonnables d'investissement en fonds alternatifs. Nous obtenons ainsi que l'introduction d'à peine un peu plus de 11% de fonds alternatifs dans l'allocation globale peut permettre une réduction de plus de 27% de la probabilité que la valeur de l'actif descende à moins de 75% de celle du passif (déficit actif-passif supérieur à 25%). Il est par ailleurs à noter qu'une allocation en *hedge funds* d'environ 20% permet de diminuer cette probabilité de risque extrême de plus de 50%.

Figure 1
Amélioration de l'espérance du déficit relatif et de la probabilité d'obtenir un déficit supérieur à 25% en fonction de la proportion effective allouée aux *hedge funds*.



Conclusion

Alors que la plupart des investisseurs institutionnels considèrent les *hedge funds* comme une solution possible aux défis posés par la gestion actif-passif, lorsqu'ils sont confrontés à de sérieuses préoccupations au sujet de la taille de la prime de risque des placements en actions et obligations et des risques qui leur sont associés, on en sait très peu sur la manière d'inclure ces styles d'investissements alternatifs dans un contexte de gestion actif-passif.

Cette étude fournit la preuve de l'intérêt des *hedge funds* dans un contexte d'optimisation de surplus. A cette fin, nous avons proposé une approche pragmatique qui ne traite pas les *hedge funds* comme un ajout mais plutôt comme un complément des classes d'actifs traditionnelles (actions et obligations). Ceci permet de réduire les difficultés de modélisation des distributions des rentabilités des *hedge funds* et d'estimation des paramètres. Notre conclusion est que des portefeuilles de *hedge funds* conçus de façon appropriée peuvent être particulièrement attrayants lorsqu'il existe une contrainte sur l'objectif d'optimisation des rentabilités espérées de façon à ce que cet objectif soit en adéquation avec le passif. Cet attrait est dû aux avantages procurés par les *hedge funds* en termes de propriétés de diversification. Ces propriétés sont liées aux comportements intéressants des *hedge funds* en termes d'impact sur la queue de distribution et sur les risques extrêmes des portefeuilles d'actions et d'obligations.

Zusammenfassung



Institutionelle Anleger im Allgemeinen und Pensionsfonds im Besonderen litten erheblich unter den negativen Aktienrenditen zu Beginn des Jahrtausends. Im Kontext von sich kumulierenden Aktiv-Passiv-Defiziten, welche für die am FTSE 100 gelisteten Unternehmen im Jahre 2003 auf etwa £55 Mio. geschätzt wurden, suchen institutionelle Anleger nun nach neuen Anlageformen, die ihnen ermöglichen, den Horizont in der Asset Allokation zu erweitern.

Nach ihrem bemerkenswerten Erfolg im Privatkundengeschäft, drängen Hedge Funds nun auch ins Blickfeld institutioneller Anleger

Im Laufe der vergangenen Jahre wurden alternative Investment-Angebote am Markt eingeführt, die es dem Investor ermöglichen die Risiko-Rendite-Struktur seines Portfolios zu optimieren. Während der Aufschwung der Hedge Funds vor allem durch den Erfolg im Privatkundengeschäft erklärt wurde, wird nun erwartet, dass institutionelle Investoren ihrem Beispiel folgen und in den nächsten Jahren nennenswerte Summen in den Markt fließen werden. Diese Kapitalzuflüsse haben im Übrigen schon begonnen und die Zahl der institutionellen Anleger, die alternative Investments benutzen, steigt, vor allem in Europa, Australien und Japan, stetig an. Im Jahre 2005 hat sich der Anteil der europäischen Institutionen, die in Hedge Funds investieren, auf 48% verdoppelt (2003: 24%). Für das Jahr 2007 wird angenommen, dass diese Institutionen 7,2% in Hedge Funds investieren, während sich diese Ziffer auf 5,3% für 2005 beläuft.¹

Dennoch, der Gebrauch von Hedge Funds im Rahmen des Aktiv-Passiv Managements (ALM) gebietet Vorsicht

Obwohl es legitim ist, eine Verbesserung der Aktiv-Passiv-Struktur mit Hilfe von Hedge Funds zu erzielen, sollte man Vorsicht walten lassen, da ein unüberlegter Einsatz zu extrem instabilen Ergebnissen führen kann. Wenn man beispielsweise historische Daten in einem Optimierungskontext verwendet (z.B. maximale Information Ratio (IR)), so variiert der optimal in Hedge Funds zu investierende Anteil zwischen 0% und 100%, je nachdem welchen Zeitraum man für die Analyse verwendet. Ein solcher Mangel an Robustheit zeigt, dass ein unüberlegtes Investment in Hedge Funds in einem ALM-Kontext nicht ratsam ist.

Im Gegensatz zu traditionellen Anlageklassen (Aktien und Obligationen), für die wir sowohl bewährte stochastische Modelle, als auch verlässliche langfristige Parameterschätzungen zur Verfügung haben (diese sind unerlässlich, um einen Mehrwert aus komplexen Modellen zu erhalten), verhindern zahlreiche Schwierigkeiten Hedge Funds in der selben Art und Weise wie traditionelle Anlageklassen als ALM-Anlageklasse zu verstehen. Nicht nur das Fehlen von ausreichend langen Datenreihen lässt eine Projektion von Risiko- und Rendite-Struktur illusorisch erscheinen, sondern auch die Abwesenheit zufrieden stellender Modelle für Hedge Fund Renditen (trotz gegenwärtiger Fortschritte in der akademischen Forschung).

1. Quelle: 7 Jahresbericht über alternative Investments der Russell Investment Group, September 2005.

Zusammenfassung

Das Verhalten von Hedge Funds, welches durch dynamisches Anlageverhalten und die Implementierung von teilweise komplexen Produkten gekennzeichnet ist, lässt sich nur sehr schwierig mit Hilfe der klassischerweise verwendeten, linearen Modellen beschreiben.

Ein neuer Ansatz Hedge Funds zu integrieren: Komplementäre statt strategische Anlageklasse

Um diese Schwierigkeiten zu bewältigen und das Risiko beim Schätzen der Parameter einzudämmen, welches vor allem durch die Wahl des Analysezeitraums erschwert wird, schlagen wir in unserer Studie einen robusteren Ansatz zum Einsatz von Hedge Funds in einem ALM-Kontext vor: anstatt Hedge Funds als eine eigenständige Anlageklasse zu verstehen, führen wir Hedge Funds als Komplement zu Aktien und Obligationen ein.

Dieser Ansatz ist konform mit der gängigen Praxis unter institutionellen Anlegern, Hedge Funds nicht als eine eigene Aktiv-Passiv-Klasse zu betrachten. In der Tat ist es eher gebräuchlich, nur die Hauptanlageklassen stochastisch zu modellieren, anstatt alle Unterkomponenten in den Modellierungsprozess einzubeziehen. Wenn man beispielsweise das Zusammenspiel von Large-Cap- und Small-Cap-Indizes untersucht, so modelliert man diese ohne dabei die geographischen, sektoriellen oder andere Gegebenheiten zu berücksichtigen. Der Ansatz, Hedge Funds als Komplement zu traditionellen

Anlageklassen zu betrachten, ist auch insofern nachzuvollziehen, als dass institutionelle Investoren Hedge Funds vor allem als Diversifizierungsvehikel benutzen und nicht als Instrument um hohe Renditen zu erzielen. Dies wird durch aktuelle akademische Forschung belegt, die zeigt, dass vom statistischen Standpunkt aus gesehen, die Diversifizierungseigenschaften von Hedge Funds robuster sind, als die Fähigkeit absolute Renditen zu generieren.

Die hier vorliegende Arbeit zeigt, dass es möglich ist, Diversifizierungs-Benchmarks zu konstruieren, die es erlauben, das mit den Aktien und Obligationen verbundene Risiko nennenswert und robust zu reduzieren. Dies wird erreicht, indem i) alternative Strategien sachgemäß ausgewählt werden und ii) ihre Gewichte gemäß bewährter Techniken optimiert werden (Minimierung extremer Risiken, gemessen mit Hilfe des Value-at-Risk des Gesamtportfolios).

Diese Diversifizierungs-Benchmarks erlauben es den langfristigen Volatilitätsparameter der Aktien- und Obligationenklassen nennenswert zu verringern.

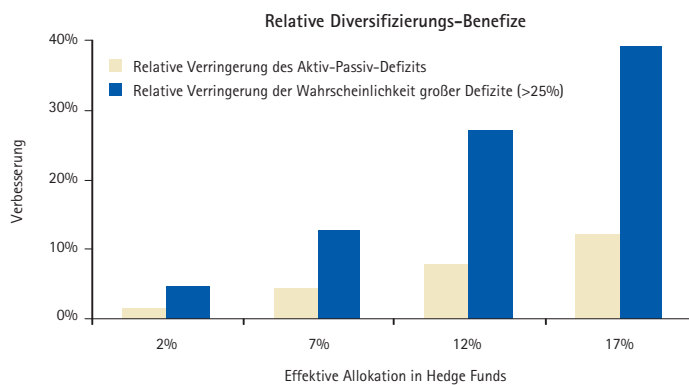
Als Ergebnis stellen wir fest, dass die Zugabe der Diversifizierungs-Benchmarks zu den traditionellen Klassen (Aktien und Obligationen) es ermöglicht, die ALM-Performance signifikant zu erhöhen, selbst wenn nur geringe Hedge-Fund-Anteile zugelassen werden. Als ein nennenswertes Resultat finden wir zum

Tabelle 1
Entwicklung der langfristigen Volatilitätsparameter von Aktien und Obligationen in Abhängigkeit des Hedge-Fund-Zusatzes zu der jeweiligen Klasse

	0% HF	5% HF	15% HF	25% HF	35% HF
Aktien	16.50%	15.62%	13.75%	11.99%	10.34%
Obligationen	8.50%	7.98%	7.21%	6.70%	6.18%

Zusammenfassung

Grafik 1
Verringerung des Aktiv-Passiv-Defizits und der Wahrscheinlichkeit, dass dieses größer als 25% ist (in Abhängigkeit des Hedge-Fund-Anteils im Gesamtportfolio)



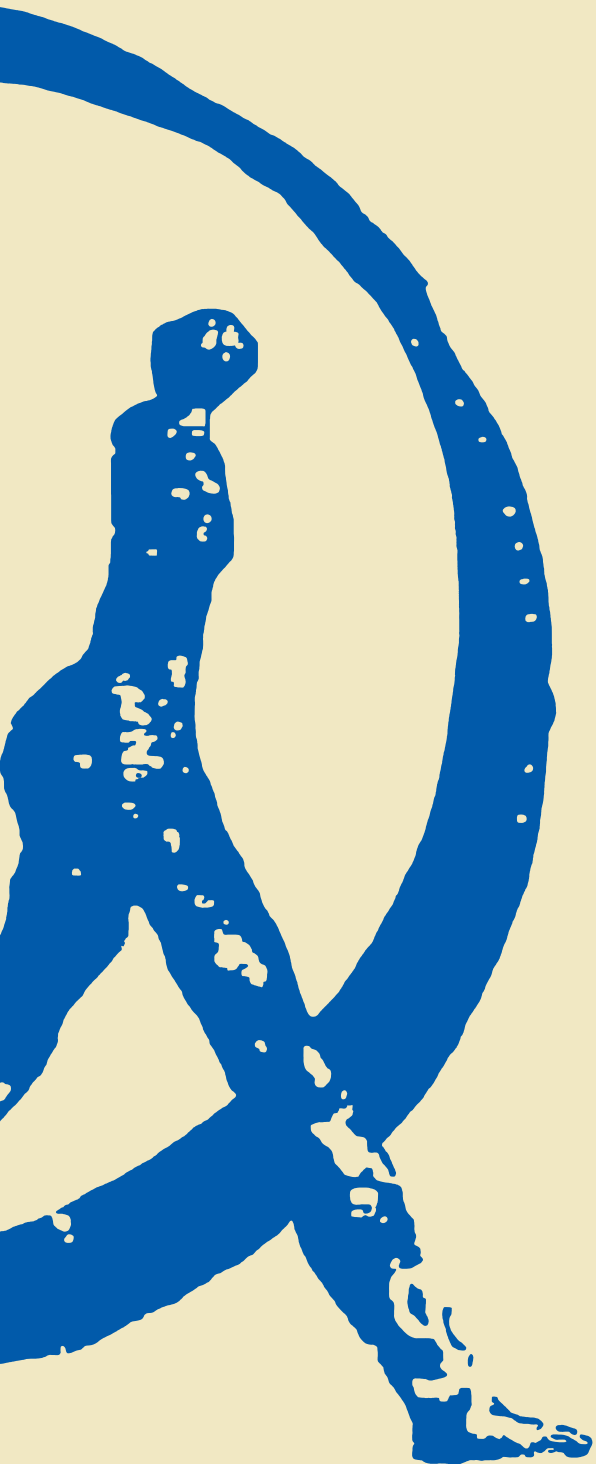
Beispiel, dass mit der Zugabe von etwa 11% Hedge Funds zum Gesamtportfolio die Wahrscheinlichkeit, dass der Wert der Aktiva unter 75% des Wertes der Passiva fällt (Aktiv-Passiv-Defizit größer als 25%), um 27% gesenkt werden kann. Diese Wahrscheinlichkeit sinkt gar um mehr als 50% wenn man etwa 20% der Aktiva in Hedge Funds investiert.

Schlussfolgerung

Während die meisten institutionellen Anleger Hedge Funds als eine mögliche Lösung für die Herausforderungen im Aktiv-Passiv-Management (Unsicherheit über Höhe der Risikoprämien und der damit verbundenen Risiken im traditionellen Sektor) ins Auge fassen, ist sehr wenig über Methoden bekannt, wie alternative Investment-Vehikel im ALM-Kontext einzusetzen sind.

Diese Studie liefert den Beweis, dass Hedge Funds einen positiven Beitrag in der Überschuss-Optimierung leisten. Zu diesem Zweck haben wir einen pragmatischen Ansatz vorgeschlagen, der Hedge Funds nicht als eigenständige Anlageklasse versteht, sondern eher als komplementär zu traditionellen Klassen (Aktien und Obligationen). Damit umgehen wir die Schwierigkeit, Hedge-Fund-Renditen und ihre Verteilung zu modellieren. Wir schlussfolgern, dass geeignete Hedge Fund Portfolios besonders attraktiv sind, wenn es darum geht, optimale Lösungen für die Asset-Allokationen unter Berücksichtigung der Verbindlichkeiten (Passiva) zu finden. Dies ist mit den besonderen Diversifizierungseigenschaften der Hedge Funds zu erklären, die sich vor allem aus ihrem positiven Einfluss auf die Extremrisiken und deren Verteilung der Aktien- und Obligations-Portfolios ableiten lassen.

The Benefits of Hedge Funds in Asset Liability Management



Introduction

Recent difficulties have drawn attention to the risk management practices of institutional investors in general and defined benefit pension plans in particular. A perfect storm of adverse market conditions over the past three years has devastated many corporate defined benefit pension plans. Negative equity market returns have eroded plan assets at the same time as declining interest rates have increased market-to-market value of benefit obligations and contributions. In extreme cases, this has left corporate pension plans with funding gaps as large as or larger than the market capitalisation of the plan sponsor. For example, in 2003, the companies included in the S&P 500 and FTSE 100 indices faced a cumulative deficit of \$225 billion and £55 billion respectively (Credit Suisse First Boston (2003) and Standard Life Investments (2003)), while the worldwide deficit reached an estimated 1,500 to 2,000 billion USD (Watson Wyatt (2003)).

The fact that institutional investors have been so dramatically affected by market downturns had led to major changes in institutional money management, including notably the need for an increased focus on asset-liability management (ALM). In this context, institutional investors in general, and under-funded pension funds in particular, are desperately seeking new asset classes or investment styles that could be cast in a surplus optimisation context and that would offer access to equity-like premium without all the associated downside risks.

Because of their focus on absolute performance and risk control, hedge funds are typically suggested as a natural alternative to stocks and bonds. While long-only investment

strategies can only generate a simple linear exposure to the return on underlying asset classes (go up and down with the indices), the main benefit of hedge fund strategies is actually that they allow for a non-linear exposure with respect to stock and bond returns in such a way that the downside risk is typically limited.² This is because hedge fund managers, who operate in the absence of regulatory constraints, can incorporate a variety of dynamic investment strategies and/or investments in derivatives likely to generate non-linear payoffs (Fung and Hsieh (1997)). While the assessment of the benefits hedge funds offer when included in an investor's portfolio has given rise to a burgeoning literature (e.g., Agarwal and Naik (2004)), this question has not been examined in an ALM framework. This paper can be seen as an attempt to fill this void.

From a conceptual standpoint, there are two possible approaches that lead to the inclusion of hedge funds in an ALM context. A first approach to a formal model of introduction of hedge funds in an ALM context consists of treating hedge funds as a *supplement* to traditional asset classes, i.e., considering hedge funds as an additional asset class that can be added to stocks and bonds in a traditional ALM surplus optimisation exercise. In what follows, we will argue that this approach, while seemingly straightforward, is too simplistic and involves a level of sample-dependence that is too high to be of any practical relevance, as is perhaps best evidenced by the fact that it often leads to very unreasonably high (close to 100%) levels of optimal allocation to hedge funds.

2. It has recently been shown that financial products which offer non-linear return profiles are particularly useful in an ALM context (see for example Draper and Shimko (1993)).

Introduction

In this paper, we introduce a competing, more cautious, approach, which consists of treating hedge funds as a *complement*, as opposed to an *addition*, to traditional asset classes. Overall, the results obtained with this more robust approach strongly suggest that, when added to bonds and stocks, suitably designed portfolios of hedge funds can allow for significant, yet reasonable, benefits in an ALM context, as can be measured in terms of reduction of the expected mismatch between assets and liabilities. This impact is more pronounced when the relevant optimisation objective includes a focus on extreme risks. In fact, we show that the probability of extreme deficits (value of the assets falling below 75% of the value of liabilities) can be reduced by 50% by allocating 20% to hedge funds. These results should be taken into account by investors who are constrained to meeting liabilities.

The rest of this paper is organised as follows. The next section presents an overview of asset-liability management techniques. We then present a formal surplus optimisation model and discuss some conceptual and technical challenges related to the introduction of hedge funds in the context of surplus optimisation. In the following section, we propose a novel approach that treats alternative investment strategies as a complement, as opposed to an addition, to traditional asset classes. After that, we present a formal numerical experiment and test for the impact of introducing hedge funds in terms of surplus optimisation benefits based on reasonable parameter values. A conclusion and list of references follow, while some information on hedge fund indices is relegated to a dedicated appendix.

An Overview

of Asset-Liability Management Techniques

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.). There are therefore as many types of liability constraints as there are types of institutional investors, and thus as many types of approaches to asset-liability management.

ALM-type management techniques can be classified into several categories. A first approach called *cash-flow matching* involves ensuring a perfect match between the cash flows from the portfolio of assets and the commitments in the liabilities. Let's 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 an optimal way. This interest rate risk management technique can be extended beyond a simple duration-based approach to fairly general contexts, including for example hedging non-parallel shifts in the yield curve (see for example Priaulet, Martellini and Martellini (2003)), 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 (see Le Vallois et al. (2003)), 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

An Overview of Asset-Liability Management Techniques

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.

In a concern 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. It will then involve finding 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 allows the impact of decisions linked to the exercising of certain implicit options to be represented. For example, an insured person 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.

Different optimisation models are used by institutional investors within the framework of ALM (see for example Mulvey et al. (2005) for an example), and it is impossible to provide an exhaustive list here.³ We now describe the specific model we use in this study.

3. Finally, and for the sake of completeness, it is 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 in particular Leibowitz and Weinberger (1982) for the *contingent optimisation* technique or Amenc, Malaise and Martellini (2004) for a generalisation in terms of a *dynamic core-satellite* approach).

A Formal Surplus Optimisation Model

A surplus optimisation model is basically founded on optimising the match between the asset and liability sides of financial structures in companies.

Instead of making assumptions on the detailed allocation to single assets or funds in investors' portfolios, one uses proxies for the different asset classes. In the context of this exercise, we consider three basic underlying asset classes (in addition to hedge funds, which will be introduced later): stocks, nominal bonds and inflation-indexed bonds (TIPS). The portfolio return R_{PF} is then given as:

$$R_{PF,t} = \sum_{i=1}^n \omega_i R_{i,t} \quad t = 1 \dots T$$

where i represents the proxy for the asset class i and ω_i its weight in the portfolio.

The purpose of surplus optimisation is to find the allocation that minimises at horizon T (here taken to be equal to 10 years) the relative expected shortfall SF beyond a certain target α , which is defined as follows:

$$SF(\alpha) = -E \left(\frac{R_{PF,T} - L_T}{L_T} \middle| \frac{R_{PF,T} - L_T}{L_T} < \alpha \right)$$

where L denotes the company's liabilities.

In the remaining sections, the optimal allocation will be obtained as a solution to the following optimisation:

$$\omega^* = \arg \min_{\omega} SF(0)$$

In order to optimise expected values of the portfolio distribution, we need to generate stochastic scenarios for both the asset and

liability sides from an *ex-ante* basis. On the asset side, Monte-Carlo analysis is used to generate 10,000 random paths for each asset class using geometric Brownian motions and we generate scenarios.

$$S(t) = S(0) \exp \left(\left(\mu - \frac{1}{2} \sigma \right) t + \sigma B(t) \right)$$

where $B(t)$ is a Brownian motion with $\Delta B(t) \sim \Delta(0, \Delta t)$ so that:

$$S(t+s) = S(t) \exp \left(\left(\mu - \frac{1}{2} \sigma \right) t + \sqrt{s} N \right)$$

with $N \sim N(0, \sigma)$.

In order to take the correlation of the underlying asset classes into account we will introduce the 3-dimensional geometric Brownian motion:

$$S_a(t+s) = S_a(t) \exp \left(\left(\mu_a - \frac{1}{2} \sigma_a \right) t + \sqrt{s} N_a \right)$$

$$S_b(t+s) = S_b(t) \exp \left(\left(\mu_b - \frac{1}{2} \sigma_b \right) t + \sqrt{s} N_b \right)$$

$$S_c(t+s) = S_c(t) \exp \left(\left(\mu_c - \frac{1}{2} \sigma_c \right) t + \sqrt{s} N_c \right)$$

with the 3-dimensional Gaussian:

$$\begin{pmatrix} N_a \\ N_b \\ N_c \end{pmatrix} \sim \mathcal{N} \left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_a^2 & \sigma_a \sigma_b \rho_{ab} & \sigma_a \sigma_c \rho_{ac} \\ \sigma_a \sigma_b \rho_{ab} & \sigma_b^2 & \sigma_b \sigma_c \rho_{bc} \\ \sigma_a \sigma_c \rho_{ac} & \sigma_b \sigma_c \rho_{bc} & \sigma_c^2 \end{pmatrix} \right)$$

The calibration of the model is performed using long-term estimates (see exhibit 1). For mean return and volatility on stocks, bonds and TIPS, we have used Dimson, Marsh and Staunton's (2002) 1900-2000 estimates; for volatility on TIPS, and for the correlation matrix, we have used Kothari and Shanken's (2004) 1953-2000 estimates.⁴

4. For stocks we have used data on world markets (see table 34-1 page 311). For bonds, because of the impact of a high inflation period in some European countries in the vicinity of World War II, we have focused on the US estimate (see table 6-1 page 79), and we have added a 0.4% credit spread to the 2.1% real rate plus a 3.3% inflation estimate. For the return on TIPS, we have used the US inflation rate (3.3%) plus the real short-term rate (1%), in the absence of a reliable estimate of the long-term risk premium for that asset class.

A Formal Surplus Optimisation Model

Exhibit 1
Long-term parameter estimates.

Correlation	Stocks	Bonds	TIPS
Stocks	1		
Bonds	0.24	1	
TIPS	-0.05	0.52	1
Mean	10.4%	5.8%	4.3%
Volatility	16.5%	8.5%	6.58%

As explained below, we do not attempt to estimate long-term parameter values for hedge funds, as we believe that doing so would be of little relevance, nor do we attempt to model hedge funds returns, a notoriously challenging task. We will instead model the introduction of hedge funds through their impact on these long-term parameter values for stocks and bonds; in particular we will estimate the decrease in stock and bond volatility that can be achieved by the introduction of suitably selected hedge fund strategies to be included in the stock, or bond, allocation of an institutional investor.

On the liability side, in an attempt to focus on a stylised institutional investor, we take the return on liabilities to be equal to the return on inflation-indexed bonds to which we add 300 basis points. This is because most institutional investors' liabilities are impacted by two main risk factors, inflation and interest rates. As a result liabilities are perfectly correlated with the return on TIPS in our model. In practice, TIPS is certainly the asset class that exhibits the highest correlation with liabilities, even though the correlation is not perfect due to the presence of a number of extraneous sources of risk beyond inflation and interest rates.

The relative expected shortfall is then given as:

$$SF(0) = -\frac{1}{n} \sum_{s=1}^{10000} \left(\frac{R_{PFT}^s - L_T^s}{L_T^s} \cdot \mathbf{1}_{\{R_{PFT}^s - L_T^s < 0\}} \right)$$

where the exponent s denotes the scenario and n is the number of scenarios yielding deficits after 10 years:

$$n = \sum_{s=1}^{10000} \left(\mathbf{1}_{\{R_{PFT}^s - L_T^s < 0\}} \right)$$

Allocation to Hedge Funds

in the Context of Surplus Optimisation: the Naïve Approach

There are two possible approaches that lead to the inclusion of hedge funds in an ALM context, one that consists of treating hedge funds as a *supplement* to traditional asset classes, and one that consists of treating hedge funds as a *complement* to traditional asset classes.

In this section, we will argue that while the first approach, which consists of considering hedge funds as an additional asset class that can be added to stocks and bonds in an ALM surplus optimisation exercise, is a straightforward attempt at formalising the benefits of hedge funds in an ALM context, it nonetheless faces a number of conceptual and technical difficulties.

First, and most importantly perhaps, this approach to hedge fund investing in an ALM context is implicitly based upon the assumption that hedge funds can be treated as a coherent asset class in an ALM stochastic simulation exercise. This is certainly not satisfying from a conceptual standpoint, and a strong case can be made that hedge funds do not constitute a homogenous new asset class, but rather a set of very diverse investment strategies.

Secondly, from a technical standpoint, it must be recognised that i) there are not yet any truly satisfying models for representing the dynamics of hedge fund returns that can be used in an *ex-ante* Monte Carlo simulation approach, and ii) even if such models existed the lack of a long history of hedge fund returns and various concerns over the quality of hedge fund return data would make the estimation of reliable parameter values a very challenging task.

Challenges in Modelling Hedge Fund Returns

The fact that hedge funds have started to gain widespread acceptance while remaining somewhat mysterious investment vehicles has enhanced the need for better measurement and benchmarking of their performance. While understanding the risk exposures of hedge funds has actually become a rather important and fertile area of academic research, and even though it has long been recognised that a better understanding of hedge fund risks is needed for individuals and institutions who wish to make investment decisions involving hedge funds, a satisfactory description of the dynamics of hedge fund returns has yet to be developed.

The issues regarding the nature of risks associated with different hedge fund strategies are actually challenging because of the complex nature of the strategies and limited disclosure requirements faced by hedge funds. In particular, since hedge fund returns exhibit non-linear option-like exposures to traditional asset classes (Fung and Hsieh (1997, 2000)), standard asset pricing models offer limited help in evaluating the performance of hedge funds. The importance of taking into account such option-like features has been underlined by recent research. In particular, Fung and Hsieh (2002) and Mitchell and Pulvino (2001) stress the importance of taking into account option-like features while analysing the performance of "trend-following" and "risk-arbitrage" strategies, respectively. More recently, Agarwal and Naik (2003) build on these insights and extend our understanding of hedge fund risks to a wide range of equity-

Allocation to Hedge Funds in the Context of Surplus Optimisation: the Naïve Approach

oriented hedge fund strategies. They characterise the risk exposures of hedge funds using buy-and-hold and option-based strategies, and show that a large number of equity-oriented hedge fund strategies exhibit payoffs resembling a short position in a put option on the market index (see also Schneeweis and Spurgin (2000) and Fung and Hsieh (2001) for related papers).

There are actually two possible ways to try and adapt standard asset pricing models to analyse returns on portfolios that exhibit a non-linear dependency with respect to standard asset classes. The first approach consists of using a non-linear APT model (see in particular Bansal and Viswanathan (1993) or Bansal, Hsieh and Viswanathan (1993)). The other method, which has been used by Glosten and Jagannathan (1994), as well as in the papers on hedge fund benchmarking referenced in the previous paragraph, is to include new regressors with non-linear exposure to standard asset classes, e.g., returns on option positions, to proxy for dynamic trading strategies in a linear regression.

The goal of the modelling is to find one or more factors that offer the best explanatory power for a given variable. Applied to hedge fund returns, it allows for a better understanding of their sources. In the search for significant factors, two means can be employed, namely return-based style factors (henceforth RBS factors) and asset-based-style factors (henceforth ABS factors). RBS factors refer to the notion of an implicit factor model. They are obtained through Principal Component Analysis. The aim is to explain the return series of observed variables through a smaller group of non-observed implicit

variables. Each implicit factor is defined as a linear combination of the primary variables. The implicit factors are extracted from the time-series of returns. The advantage is that it avoids the risk of underspecifying the model (omitting true factors) or overspecifying the model (including spurious factors). The drawback relates to the economic significance of the implicit variables obtained. ABS factors refer to the notion of an explicit factor model. In this approach the specification of the model plays an important role. Observable market risk factors are included through a discretionary choice, and the risks of misspecification are non negligible. On the other hand, it is easier to interpret the different factors in the model.⁵

There are a number of papers that fall within this strand of the literature, including notably Mitchell and Pulvino (2001) for the replication of risk arbitrage returns, Fung and Hsieh (2001) for the trend following strategy, Fung and Hsieh (2002) for the fixed-income arbitrage strategy, Fung and Hsieh (2003) for the modelling of Long/Short Equity, Fung and Hsieh (2004) for a diversified hedge fund portfolio, Agarwal, Fung, Loon, and Naik (2004) for the modelling of convertible arbitrage returns, and Karavas, Kazemi, and Schneeweis (2004) for the modelling of European-based hedge fund managers.

While the aforementioned papers offer interesting progress in the direction of modelling hedge fund returns, investors are not yet in a situation where they can easily rely on a set of models that can be used to generate stochastic scenarios for various hedge fund strategies. By reviewing studies on hedge fund performance modelling, it

5. It should be noted that the two approaches are not completely opposed. A combination of both approaches can be achieved, by initially carrying out the RBS factor approach and by deducting ABS factors from RBS factors (see for example Fung and Hsieh (2002)).

Allocation to Hedge Funds in the Context of Surplus Optimisation: the Naïve Approach

appears that the performance and quality of replication tends to be relatively low, especially from an out-of-sample perspective (see for example Karavas, Kazemi, and Schneeweis (2004)).

This stands in sharp contrast with traditional asset classes, where satisfactory, albeit imperfect, models are available (in particular stochastic volatility models for stock prices and multi-factor models of the term structure of interest rates for bond prices). This technical difficulty in modelling hedge fund returns can be somewhat mitigated by the introduction of non-parametric bootstrapping techniques that allow one to generate a multitude of scenarios based on random sampling of some history of hedge fund returns. The latter solution is not fully satisfactory, however, as it remains strongly sample-dependent. The problem of sample dependency of parameter estimates is what we turn to next.

Challenges in Estimating Parameters for Hedge Fund Return Distributions

The hedge fund industry is a relatively young industry, with really reliable data on hedge fund index returns, which can be used as a proxy for the return on various hedge fund strategies, available since the early 1990s. Moreover, because of the absence of mandatory reporting requirements, data on hedge fund returns is actually scarce and incomplete. Hedge fund indexes are built from databases of individual fund returns, and therefore inherit their shortcomings in terms of scope and quality of data, which vary a lot among various data vendors. In what follows, we briefly review the biases hedge fund indexes are known to suffer from.

A fund's participation in a database is voluntary, which poses a real problem in terms of the reliability of the data published ("self reporting bias"). A fund can in fact decide, for one reason or another, to register in one or more databases. Since the funds that have refused to report to one or other of the databases are, by definition, unobservable, it is not possible to evaluate the impact of this bias. In addition, since some refuse to display their performance because of poor results and others because they have already reached their critical size, it is even difficult to know whether this bias has a positive or negative impact on the performances announced. The lack of transparency also poses a problem in terms of the reliability of data and exposes investors, in particular, to a risk of a change in the manager's management style (this is known as "style drift", cf. Lhabitant (2001)). Hedge fund managers are under no obligation to publish the details of their positions, so it is very unlikely that they will hesitate to seize an investment opportunity, even if this means modifying their management style temporarily (without going as far as declaring it). It is once again difficult, or indeed impossible, to put a figure on the impact of this bias, due to the prevailing lack of transparency.

The voluntary nature of the act presupposes that only some of the funds will decide to register. Since hedge funds do not have the right to advertise, the fact that they are recorded in a database is important in terms of communication, which is why they may decide to register even if they do not intend to give out information on a regular basis. This makes it possible to smooth the results, a practice that is largely facilitated by the complexity and low level of liquidity of the products handled by the hedge funds (i.e. a "stale prices" or "managed prices" problem).

Allocation to Hedge Funds in the Context of Surplus Optimisation: the Naïve Approach

Asness, Krail and Liew (2000), for instance, revealed an increase in the volatility of convertible arbitrage returns of 41.5% when one switches from monthly data to quarterly data. In the same vein, Okunev and White (2002) showed that the volatility of fixed income strategies could be undervalued by up to 100%.

Depending on the date at which the database began, the quality of past information will vary (notably for funds that ceased their activity before the database began). This affects the performance of the index to a greater or lesser degree, depending on the number of funds that stop communicating their results each year (referred to as the attrition rate) and the average performance differential observed between those funds and the remaining funds. This is known as a "survivorship bias". Since the HFR and MAR databases began in 1994, it is likely that they will dispose of more accurate information than the CSFB database (which only begins in 2000) over the period 1994/2000, and that they will not be affected in the same way by survivorship bias. Fung and Hsieh (2000) valued the average impact of this bias at 3.0%, compared to 2.6% for Park, Brown and Goetzmann (1999). As a comparison, it should be noted that Malkiel (1995) estimated this bias to be 0.5% for mutual funds. The various databases are again affected in different ways by this bias. For example, the TASS database has a higher survivorship bias than the HFR database because it has a higher attrition rate, which in turn is due to different selection criteria for adding and removing funds.

The funds have selection criteria that can be very diverse, and the data provided will not be representative of the same management universe. This is referred to as "selection bias". For instance, HFR excludes managed futures from its databases while TASS and MAR take them into account. Most funds are present in one but not the other: of the 1,162 HFR funds and the 1,627 TASS funds, only 465 are common to both databases. 59% of the funds that are still in activity and 68% of the funds that no longer report to HFR are not part of the TASS database (cf. Liang (2001)).

A Simple Illustration

The following simple *ex-post* experiment illustrates the dramatic lack of robustness induced by a naïve use of hedge fund returns in the context of relative risk optimisation.

Assuming for simplicity, as explained above, that the return on liabilities is equal to the return on inflation-indexed bonds to which we add 300 basis points, we perform an optimisation of the information ratio of the asset portfolio, composed of stocks, bonds and hedge funds, with respect to the liabilities, defined as the ratio of excess return divided by tracking error. Arguably, this simple experiment does not entirely describe the flavour of a fully-fledged asset-liability model. However, it suffices to serve the purpose of illustrating the lack of robustness implied by a straightforward use of hedge fund return data in portfolio optimisation.

Allocation to Hedge Funds in the Context of Surplus Optimisation: the Naïve Approach

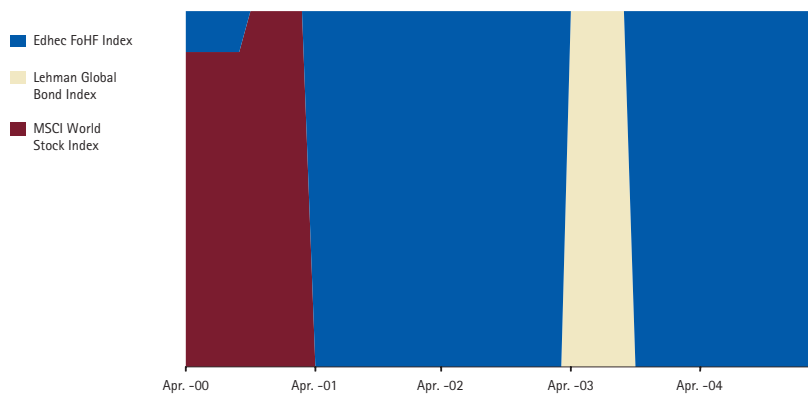
Exhibit 2

A simple experiment. The Edhec Fund of Hedge Funds Index is used as a proxy for hedge fund returns. The Lehman Brothers Bond Index is used as a proxy for bond returns. The MSCI World Index is used as a proxy for stock returns.

Exhibit 2 shows the result of the maximisation of the information ratio based on a rolling-window on the out-of-sample period ranging from 04/2000 to 03/2005.

The results, which suggest that the different asset classes (stocks, bonds and hedge funds) should represent either 0% or 100% of an optimal allocation, are typical of the problem of unintuitive, highly-concentrated, input-sensitive portfolios that are obtained from naïve optimisation procedures.

They suggest that a straightforward use of hedge fund returns in an optimisation procedure cannot be a satisfactory answer to the questions relating to the place of hedge funds in an ALM context. We now turn to a pragmatic alternative approach to the question.



Allocation to Hedge Funds in the Context of Surplus Optimisation: a More Robust Approach

For all the conceptual and technical reasons outlined in the previous section, we advocate in this paper a competing approach that does not treat hedge funds as an *addition* but rather as a *complement* to traditional asset classes (stocks and bonds). This alleviates the concern over *ex-ante* modelling of hedge fund returns: hedge funds only enter the surplus optimisation exercise through the impact they have on risk parameter estimates for stocks and bonds. In a nutshell, we model the introduction of hedge funds through a reduction in the risk measures for stocks and (nominal) bonds. On the other hand, we choose not to add hedge funds to the real bonds (TIPS) component of the investor's portfolio. This is because introducing hedge funds would have a negative impact on the correlation between the TIPS portfolio and the liability returns, while the *raison d'être* of the TIPS portfolio is precisely to show very high correlation with the investor's liabilities (perfect correlation in our simplified model of liabilities) for which it serves as a natural hedge.

Previous research has actually shown that some (but not all) hedge fund strategies mix well with either stocks or bonds in terms of risk reduction benefits, where risk is measured not only in terms of portfolio volatility but also in terms of impact on higher moments of portfolio distribution.

In what follows, we reproduce results obtained in Amenc et al. (2005), who propose to construct multi-strategy hedge fund benchmarks that would exhibit a persistent and robust factor exposure and meet the needs of different classes of investors. In particular, we aim to design two separate hedge fund portfolios: i) an Equity Diversifier Hedge Fund Benchmark, which is meant to

diversify an equity portfolio, and ii) a Bond Diversifier Hedge Fund Benchmark, which is meant to diversify a bond portfolio. The design of these benchmarks again involves two separate steps, a selection stage and an allocation stage.

Selection Stage

In the selection stage, we look at the diversification properties of different hedge fund strategies with respect to portfolios of stocks or bonds. Because of evidence that hedge fund returns are not normally distributed, they look beyond the first and second order moments of hedge fund return distributions when searching for strategies allowing good diversification properties.

Since it is widely accepted that investors have a non-trivial preference for higher moments of the return distribution, it is indeed crucial to assess how an asset contributes to the different moments of the portfolio's return distribution. The betas for all four moments can be calculated. The second moment beta is the contribution of an asset to the second moment (volatility) of the portfolio when a small fraction of this asset is added. This corresponds to the standard CAPM beta commonly used in investment analysis. The third moment beta and fourth moment beta give the contribution to the portfolio's third and fourth moments. The table below shows values for the different betas for the most important hedge fund strategies, when adding these to a portfolio of equities or bonds. In general, the lower the beta for a given strategy, the higher the diversification benefits when adding this strategy to a portfolio of traditional assets. In particular, it can be shown that the addition of a small fraction of a new

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asset (e.g., a hedge fund) to a portfolio leads to a decrease in the portfolio's second moment (respectively, increase in the portfolio's third moment and decrease in the portfolio's fourth moment) if and only if the second moment (respectively, third moment and fourth moment) beta is less than 1 (see Martellini and Ziemann (2004) for more details).⁶

For these results, we have used Edhec Alternative Indexes as proxies for the return on hedge fund strategies. The appendix is devoted to a brief presentation of these indices.

Exhibit 3

Higher Moment Betas of returns of several hedge fund strategies (as represented by EDHEC Alternative Indexes) with stock and bond returns (as represented by the MSCI World indexes for sovereign bonds and equity). Based on monthly returns for the period 01/1997 to 08/2004.

	Convertible Arbitrage	CTA Global	Event Driven	Long/Short Equity	Equity Market Neutral	MSCI World Bonds	MSCI World Equity
2nd Moment Beta with Equity	0.05	0.06	0.26	0.37	0.03	-0.08	1.00
2nd Moment Beta with Bonds	-0.07	0.00	-0.11	-0.05	0.23	1.00	-0.41
3rd Moment Beta with Equity	0.10	0.07	0.46	0.37	-0.09	-0.19	1.00
3rd Moment Beta with Bonds	-0.26	-0.07	-0.47	-0.68	0.42	1.00	-1.68
4th Moment Beta with Equity	0.11	0.07	0.36	0.38	-0.04	-0.11	1.00
4th Moment Beta with Bonds	-0.04	0.03	-0.05	0.06	0.33	1.00	-0.30

Considering these results, as in Amenc et al. (2005), we select a sub-set of three strategies to construct the diversification benchmark aimed at diversifying equity-oriented portfolios and a sub-set of four strategies to construct the diversification benchmark aimed at diversifying bond-oriented portfolios. The table below shows the result of the selection process. The strategies that are selected are marked "Yes" in the column corresponding to the respective diversifier benchmark.

Exhibit 4

Strategies Entering the Equity and Bond Diversifiers

Investable Index	Equity Diversifier	Bond Diversifier
Convertible Arbitrage	Yes	Yes
CTA Global	Yes	No
Equity Market Neutral	Yes	Yes
Event Driven	No	Yes
Long/Short Equity	No	Yes

Optimisation Stage

The next step is to find the optimal allocation of the selected strategy indices. As in Amenc et al. (2005), our methodology is based on the following two key principles:

- Principle 1: Because expected returns are notoriously hard to estimate with any degree of accuracy, they focus on minimising the risk of an investor's overall portfolio (stock or bond).
- Principle 2: Because hedge funds are not normally distributed, the measure of risk used should be more general than volatility.

In what follows, we carry out a risk minimisation calculation, where we use the VaR at a threshold of 95%, integrating the Cornish-Fisher correction that allows them to take investors' aversion to extreme risks into account. Furthermore, we constrain the weight of the hedge fund portfolio to take on different values (5%, 15%, 25%, 35%) of the investor's global allocation, given that the remaining wealth is fully invested in either bonds or stocks.

The tables below (exhibits 5 and 6) show the diversification benefits obtained from adding the diversification benchmarks to a stock or bond portfolio. The first column reports the performance statistics for the stock and bond indices respectively. The columns to the right report the same statistics when adding the diversifier with different weights.

6. The condition that an increase in portfolio skewness follows from a third moment beta lower than 1 is only valid in the case that the skewness of the portfolio is negative. When the skewness of the portfolio is positive, then the condition is that the third moment beta is greater than, as opposed to less than, one.

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Exhibit 5

Portfolio performance when adding an equity diversifier to the MSCI World Equity Index. Summary statistics for a portfolio composed of the MSCI World Equity Index and an optimal diversifier. Allocation to hedge funds (= optimal diversifier) ranges from 5 to 35%. The 0% case is reported for comparison purposes. The diversifier is constructed by minimising the 95% Cornish Fisher VaR of the overall portfolio. It is composed of Edhec indexes for Convertible Arbitrage, CTA Global and Equity Market Neutral. Weights of a single index are constrained to a maximum of 40% in the optimal diversifier. Based on monthly return data from 10/2001 to 09/2004.

Allocation to Hedge Funds	0%	5%	15%	25%	35%
Annualised Mean Return	2.0%	2.2%	2.7%	3.2%	3.7%
Annualised Std Deviation	15.0%	14.2%	12.5%	10.9%	9.4%
VaR (95%)	7.6%	7.1%	6.2%	5.3%	4.4%
Sharpe Ratio (risk-free rate = 2%)	-0.03	0.015	0.057	0.111	0.184
Skewness	-0.56	-0.54	-0.49	-0.41	-0.30
Kurtosis	3.27	3.24	3.17	3.08	2.95

Exhibit 6

Portfolio performance when adding a bond diversifier to the Lehman Composite Global Treasury Index. Allocation to hedge funds (= optimal diversifier) ranges from 5 to 35%. The 0% case is reported for comparison purposes. The diversifier is constructed by minimising the 95% Cornish Fisher VaR of the overall portfolio. It is composed of Edhec indexes for Convertible Arbitrage, Event Driven, Long/Short Equity and Equity Market Neutral. Weights of a single index are constrained to a maximum of 30% in the optimal diversifier. Based on monthly return data from 10/2001 to 09/2004.

Allocation to Hedge Funds	0%	5%	15%	25%	35%
Annualised Mean Return	-0.3%	0.1%	0.9%	1.8%	2.6%
Annualised Std Deviation	3.3%	3.1%	2.8%	2.6%	2.4%
VaR (95%)	1.7%	1.5%	1.3%	1.1%	0.9%
Sharpe Ratio (risk-free rate = 2%)	-0.71	-0.61	-0.38	-0.09	0.25
Skewness	-0.26	-0.23	-0.13	0.05	0.25
Kurtosis	2.40	2.51	2.82	3.24	3.65

From the numbers in these tables, it becomes clear that even with a small percentage allocated to hedge funds, an investor achieves diversification benefits that are economically important. For the case of an equity investor, including hedge funds with a weight of 15% in the suggested way considerably reduces monthly Value-at-Risk and volatility, and increases the mean return of the portfolio. For an equity investor who constrains hedge fund exposure to 15%, mean return increases by more than 30% (from 2% to 2.7%), while the risk is reduced by more than 15%, regardless of the definition of risk as either volatility (reduction from 15% to 12.5%) or Cornish Fisher VaR (reduction from 7.6% to 6.2%). For

a bond investor, the mean return improves slightly, while the risk declines by more than 12% in terms of VaR and by more than 15% in terms of volatility.

In the long-term ALM allocation exercise that follows in the next section, we model the introduction of hedge funds in a surplus optimisation context through the impact in terms of reduction of the long-term volatility parameter for stocks and bonds. We make the implicit assumption that the reduction in volatility obtained on the sample 10/2001 to 09/2004 is a robust indication of what can be obtained on a longer-term basis. Based on estimates from exhibits 5 and 6 for estimates of the decrease in volatility due to the introduction of hedge funds, and on long-term estimates of stock and bond volatility in the absence of hedge funds borrowed from exhibit 1, we obtain in exhibit 7 the corresponding parameter (σ) estimates as a function of the portion of hedge funds added to the traditional asset classes.

Numbers in exhibits 5 and 6 show that in the sample from 10/2001 to 09/2004, adding 5% to 35% of a suitably designed portfolio of hedge funds (labelled equity diversifier) to stocks reduces the volatility of that asset class by 5.33% to 37.33%. We apply these reduction coefficients to the long-term estimate (16.50% volatility estimate for stocks, see exhibit 1) to obtain that the introduction of 5% to 35% of hedge funds can bring these values down to 15.62% (case of 5% addition of hedge funds) to 10.34% (case of 35% addition of hedge funds). The respective risk reduction for bonds yielded 6.06% to 27.27% when a suitably designed

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Exhibit 7

Evolution of volatility of stocks and bonds as a function of the proportion allocated to hedge funds in the stock and bond portfolios. The volatility estimates for stocks and bonds in the base case without hedge funds (0% HF) are taken from exhibit 1.

	0% HF	5% HF	15% HF	25% HF	35% HF
Stocks	16.50%	15.62%	13.75%	11.99%	10.34%
Bonds	8.50%	7.98%	7.21%	6.70%	6.18%

portfolio (labelled bond diversifier) is used. We again apply these reduction coefficients to the long-term estimate (8.50% volatility estimate for bonds, see exhibit 1) to obtain that the introduction of 5% to 35% of hedge funds can bring these values down to 7.98% (case of 5% addition of hedge funds) to 6.18% (case of 35% addition of hedge funds). The numbers that appear in exhibit 7 will be used in the surplus optimisation exercise below.

It should be emphasised that we have chosen *not* to consider the impact in terms of expected returns in the context of this surplus optimisation exercise. While the addition of hedge funds to a stock or bond portfolio is likely to have a non-trivial impact on performance (a positive impact in this sample), the intuition suggests that such return enhancement benefits may not necessarily be very robust, and should not be incorporated in a long-term allocation exercise. That intuition has been formalised in Martellini, Vaissié and Ziemann (2005) who have shown that hedge funds' ability to diversify traditional asset portfolios both in terms of reduction in variance and kurtosis is rather robust through time, while benefits in terms of increase in expected returns and decrease and skewness are less stable.⁷ This legitimates the focus on the impact of hedge funds in terms of risk reduction, as opposed to return enhancement.⁸

7. This is consistent with the fact that even moments (variance and kurtosis) are natural measures of dispersion (i.e., risk), while odd moments (expected return, skewness) are measures of location, which are notoriously less stable.

8. Martellini, Vaissié and Ziemann (2005) analyse the robustness through time of co-moment estimates on the basis of an analysis of time-conditional properties of the higher moment betas, where these coefficients are modelled by a Kalman Smoother technique. The Kalman Smoother is a technique that is often used in the framework of *ex-post* modelling of regression coefficients. It compares favourably to GARCH approaches, which focus on smoothing the regression errors, in that it is known to be much more reactive since it responds directly to shocks.

Numerical Results

For each of these parameter values, we create 10,000 scenarios and run the optimisation problem described above, where mean and correlation parameter values for stocks, bonds and TIPS, as well as the volatility estimate for TIPS, are borrowed from exhibit 1, and volatility estimates for stocks and bonds vary as a function of the percentage allocated to hedge funds, as expressed in exhibit 7. For the optimal portfolio allocation as well as the benefits in terms of relative expected shortfall and probability of extreme losses we obtain the results in exhibit 8.

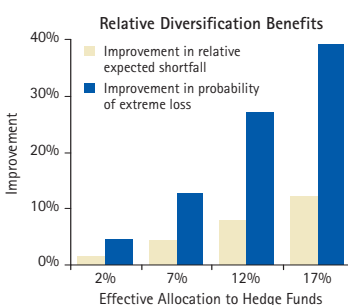
Exhibit 8
Evolution of optimal asset allocation, expected relative shortfall and probability of a shortfall greater than 25% as a function of the proportion allocated to hedge funds in the stock and bond portfolios.

	Stocks	Bonds	TIPS	Exp. Relat. Shortfall	Benefit of HFs	Prob(SF>25%)	Benefit of HFs
0% HF	15.71%	29.11%	55.19%	17.81%	0%	19.58%	0%
5% HF	16.93%	24.90%	58.17%	17.57%	1.36%	18.66%	4.70%
15% HF	18.24%	29.20%	52.55%	17.04%	4.36%	17.09%	12.72%
25% HF	27.83%	18.39%	53.78%	16.42%	7.82%	14.29%	27.02%
35% HF	32.89%	14.49%	52.62%	15.66%	12.09%	11.89%	39.27%

Exhibit 9
Evolution of effective allocation to hedge funds in the global portfolio as a function of the proportion allocated to hedge funds in the stock and bond segments.

	Stocks	Bonds	TIPS	Hedge Funds
0% HF	15.71%	29.11%	55.19%	0.00%
5% HF	16.09%	23.66%	58.17%	2.09%
15% HF	15.51%	24.82%	52.55%	7.12%
25% HF	20.88%	13.79%	53.78%	11.56%
35% HF	21.38%	9.42%	52.62%	16.58%

Exhibit 10
Improvement of expected relative shortfall and probability of a shortfall greater than 25% as a function of the effective proportion allocated to hedge funds.



From these numbers, we obtain that the introduction of hedge funds allows for a significant improvement in the risk management process in an ALM context. For example, introducing 25% of hedge funds into the stock and bond allocation portions of the investor's portfolio allows for a decrease of 7.82% in the expected shortfall. The impact is even more spectacular when focusing on extreme risks, as the introduction of 25% of

hedge funds in the stock/bond allocation allows for a 27.02% decrease in the probability of a shortfall greater than 25% (i.e., deficit worse than 75%).

A 25% allocation to hedge funds might be perceived as unusually high. It should be noted, however, that the implicit introduction of hedge funds has been carried out only for bonds and stocks, and not for TIPS. Consequently, the effective amount invested in hedge funds is lower than mentioned in the tables above (5%-35%). The effective allocation to hedge funds as a function of the portfolios obtained is given in exhibit 9. For example, introducing 25% of hedge funds into the stock and bond portions of the portfolios only leads to a very reasonable 11.56% of the total portfolio being allocated to hedge funds.

Exhibit 10 summarises the relative benefits in terms of expected relative shortfall and probability of extreme losses.

Overall these results strongly suggest that, when added to bonds and stocks, suitably designed portfolios of hedge funds can allow for significant benefits in an ALM context, as can be measured in terms of reduction of the expected mismatch between assets and liabilities. This impact is more spectacular when the relevant objective turns to extreme risks. Our most important finding is perhaps that even limited levels of investment in hedge funds allow for a significant decrease in extreme risks. In fact, we show that the probability of extreme deficits (value of the assets falling below 75% of the value of liabilities) can be reduced by as much as 50% by allocating not more than 20% to hedge funds.

Conclusion

While most institutional investors are looking into hedge funds as a possible solution to the challenges posed by asset-liability management in the presence of serious concerns over the size of the equity and bond premium and the associated risks, very little is known about how to include these alternative investment styles in an ALM context.

This study provides evidence of the contribution of hedge funds in a surplus optimisation context. To this end, we have proposed a pragmatic approach that does not treat hedge funds as an addition but rather as

a complement to traditional asset classes (stocks and bonds), which alleviates the concern over the modelling of hedge fund return distributions and parameter estimation. Our conclusion is that suitably designed hedge fund portfolios can be particularly attractive when the objective of optimising expected returns is constrained to meeting liabilities. This is due to hedge funds' benefits in terms of diversification properties, which in turn is related to their appealing behaviours in terms of the impact on tail-distribution and extreme risks of stock and bond portfolios.

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Appendix:

Construction Methodology for the Edhec Alternative Indexes

The difficulties related to the development of indices, which are already evident in the traditional universe, are exacerbated in the alternative investment world. Due to the scarcity of information, the logic of representativeness through market capitalisation is difficult to apply to the alternative universe. Finding a benchmark that is representative of a particular management universe is therefore not a trivial problem. Given that it is impossible to come up with an objective judgment on what the best existing index is, a natural idea consists of using some combination of competing indices (i.e. the different indices representative of a given investment style available on the market) to reach a better understanding of what the common information about a specific investment style would be.

One straightforward method would involve computing an equally-weighted portfolio of all competing indices. Since competing hedge fund indices are based on different sets of hedge funds, the resulting portfolio of indices would be more exhaustive than any of the competing indices it is extracted from. One might however want to push the logic one step further.

An optimal solution involves using factor analysis techniques to generate a set of alternative indices that can be thought of as the best possible one-dimensional summaries of information conveyed by competing indices for a given style, in the sense of the largest fraction of the variance explained. Technically speaking, this amounts to using the first component of a Principal Component Analysis of competing indices (5 to 9 depending on the strategy). The composition of the series of Edhec indices of indices is obtained through a simple normalisation of the weights of the first component (see Amenc et al. (2004) for further details). The composition of the Edhec indices is rebalanced every 3 months using a 36-month rolling window calibration period. For more information, please visit the Edhec-Risk website at http://www.edhec-risk.com/indexes/pure_style/about

About the Edhec Risk and Asset Management Research Centre

Edhec is one of the top five business schools in France and was ranked 12th in the *Financial Times* Masters in Management Rankings 2005 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 (US-Global), 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 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. This board is made up of both internationally recognised researchers and the centre's business partners. The management

of the research programmes respects a rigorous validation process, which guarantees both the scientific quality and the operational usefulness of the programmes.

To date, the centre has implemented six research programmes:

Multi-style/multi-class allocation

This research programme has received the support of Misys Asset Management Systems, SG Asset Management and FIMAT. The research carried out focuses on the benefits, risks and integration methods of the alternative class in asset allocation. From that perspective, Edhec is making a significant contribution to the research conducted in the area of multi-style/multi-class portfolio construction.

Performance and style analysis

The scientific goal of the research is to adapt the portfolio performance and style analysis models and methods to tactical allocation. The results of the research carried out by Edhec thereby allow portfolio alphas to be measured not only for stock picking but also for style timing. This programme is part of a business partnership with the firm EuroPerformance (part of the Fininfo group).

Indices and benchmarking

Edhec carries out analyses of the quality of indices and the criteria for choosing indices for institutional investors. Edhec also proposes an original proprietary style index construction methodology for both the traditional and alternative universes. These indices are intended to be a response to the critiques relating to the lack of representativity of the style indices that are available on the market. Edhec was the first to launch composite hedge

About the Edhec Risk and Asset Management Research Centre

fund strategy indices as early as 2003. The indices and benchmarking research programme is supported by AF2I, Euronext, BGI, BNP Paribas Asset Management and UBS Global Asset Management.

Asset allocation and extreme risks

This research programme relates to a significant concern for institutional investors and their managers – that of minimising extreme risks. It notably involves adapting the current tools for measuring extreme risks (VaR) and constructing portfolios (stochastic check) to the issue of the long-term allocation of pension funds. This programme has been designed in co-operation with Inria's Omega laboratory. This research programme also intends to cover other potential sources of extreme risks such as liquidity and operations. The objective is to allow for better measurement and modelling of such risks in order to take them into consideration as part of the portfolio allocation process.

Asset allocation and derivative instruments

This research programme focuses on the usefulness of employing derivative instruments in the area of portfolio construction, whether it involves implementing active portfolio allocation or replicating indices. "Passive" replication of "active" hedge fund indices through portfolios of derivative instruments is a key area in the research carried out by Edhec. This programme is supported by Eurex and Lyxor.

ALM and asset management

This programme concentrates on the application of recent research in the area of asset-liability management for pension plans and insurance companies. The research centre

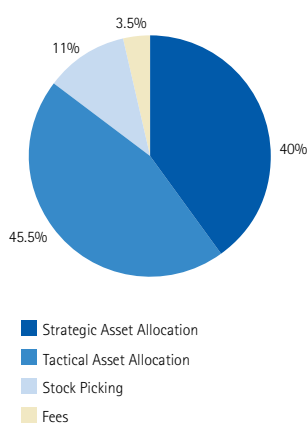
is working on the idea that improving asset management techniques and particularly strategic allocation techniques has a positive impact on the performance of Asset-Liability Management programmes. The programme includes research on the benefits of alternative investments, such as hedge funds, in long-term portfolio management. Particular attention is given to the institutional context of ALM and notably the integration of the impact of the IFRS standards and the Solvency II directive project. This programme is sponsored by AXA IM.

Edhec Risk and Asset Management Research Centre Advisory Board

In a desire to guarantee that its research work is both relevant and operational, the **Edhec Risk and Asset Management Research Centre** has set up an advisory board chaired by Mr. Jean-François Lepetit, associate professor with Edhec and former president of the French regulatory authority, the COB (Commission des Opérations de Bourse). The board is made up of around twenty members, chosen for their experience and their expertise in the financial domain and, more specifically, in asset management. The functions of the board are, on the one hand, to validate the objectives of the research programmes proposed by the management of the centre and, on the other, to evaluate the results of the research with a view to the impact that they could have on the practices of the asset management industry.

The board will also be called on to give its opinion on the content of the projects that Edhec develops from the research of its asset

Percentage of variation between funds



Source: Edhec (2002) and Ibbotson, Kaplan (2000).

About the Edhec Risk and Asset Management Research Centre

management research centre (initial training, executive training, etc.). The board meets on a yearly basis in plenary sessions that allow current and future research centre developments to be reviewed. The board chairman may also, on certain subjects, form ad-hoc working groups that would be in charge of preparing or studying in greater detail themes that have been or will be brought up in the plenary session.

Research for business

In order to facilitate the dialogue between the academic and business worlds, the centre has recently undertaken four major initiatives:

- Opening of a web site that is entirely devoted to the activity of international research into asset management. www.edhec-risk.com is aimed at a public of professionals who wish to benefit from Edhec's expertise and analyses in the field of applied portfolio management research, such as detailed summaries, from a business perspective, of the latest academic research on risk and asset allocation as well as the latest industry news assessed in the light of the results of the Edhec research programme. www.edhec-risk.com is also the official site for the Edhec Indices.
- Launch of **Edhec-Risk Advisory**, the consulting arm of the research centre focusing on risk management issues within the buy-side industry, and offering a wide range of services aimed at supporting fund managers and their service providers in the

fields of operational risk, best execution, structured products, alternative investment due diligence and risk management system implementation.

- Launch of **Edhec Investment Research**, in order to support institutional investors and asset managers in implementing the results of the **Edhec Risk and Asset Management Research Centre's** research. **Edhec Investment Research** proposes asset allocation services in the context of a "core-satellite" approach encompassing alternative investments.
- Launch of **Edhec Alternative Investment Education**, which is the exclusive official CAIA association course provider for Europe.

The Team

The aim of the **Edhec Risk and Asset Management Research Centre** is to become the leading European centre of research into asset management in the coming years. To that end, Edhec has invested significantly to give the centre an international research team made up of both professors and permanent researchers, with whom professionals are affiliated in the capacity of research associates. To date, the **Edhec Risk and Asset Management Research Centre** has 31 members: 15 permanent members and 16 associates who are operating in firms that are reputed for their proficiency in asset management. This team is managed by Professor Noel Amenc, who has considerable experience in asset management as both an academic and a professional.

About Lyxor AM

A wholly-owned subsidiary of Société Générale, belonging to SG Corporate and Investment Banking, Lyxor AM specialises in three businesses:

- **Structured Alternative Investments:** at the end of December 2004, Lyxor AM managed almost 19.5 billion euros worth of assets. The asset management firm has innovated by creating a platform that allows one to invest in a wide variety of alternative funds, while benefiting from independent risk control and weekly liquidity. In 2004, Lyxor AM received the "Best Managed Accounts Platform" prize from Albourne, an alternative fund consultancy firm, as part of a survey of 19,000 investors in the alternative investment industry.

- **Structured Funds:** at the end of December 2004, Lyxor AM managed almost 17.2 billion euros worth of assets. It benefits from the expertise and capacity for innovation of SG CIB's Index & Equity Derivatives department, which was recently elected "Best Equity Derivatives House of the Year" by The Banker (Financial Times), IFR and Risk magazine.

- **Index Tracking:** at the end of December 2004, Lyxor AM managed almost 6.6 billion euros worth of assets. Its range of trackers (ETFs) ranks number one in Europe with almost 6.2 billion euros under management. www.lyxoretf.fr

Set up in 1998, Lyxor AM managed nearly 43.3 billion euros in assets at the end of December 2004. Its clients, distribution networks and institutional and private investors, are located in Europe, the United States and Asia. In 2004, Lyxor AM was named Asset Manager of the Year in Asia by AsiaRisk (the prizes awarded by the professional magazine AsiaRisk reward companies for their professional skill and capacity for innovation). www.lyxor.com

Notes



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