

---

INVESTMENT & PENSIONS EUROPE

---

SPRING 2011

---

# EDHEC-Risk Institute Research Insights



**EDHEC-RISK**  
Institute

# EDHEC-Risk Indices & Benchmarks

London - New York - Nice - Singapore

Passive investment is becoming increasingly important in the asset management industry. In such a context, the selection of the right benchmarks will totally condition the risk-adjusted return of investors' core allocation.

For EDHEC-Risk Indices & Benchmarks, being an informed passive investor thus assumes being attentive to the choice of benchmark.

EDHEC-Risk Indices & Benchmarks will be an intellectual capital provider in the area of beta design for all passive investment players, whether index providers or asset managers.

For more information on  
EDHEC-Risk Indices & Benchmarks, please contact:

#### Europe

Eric Shirbini  
eric.shirbini@edhec-risk.com  
+44 207 871 6740

#### United States

Vijay Vaidyanathan  
vijay.vaidyanathan@edhec-risk.com  
+1 212 500 6476

#### Asia

Suresh Singh  
suresh.singh@edhec-risk.com  
+65 6438 0030



**EDHEC-RISK**  
Indices & Benchmarks

The Beta Company

# EDHEC-Risk Institute Research Insights

## Introduction **Noël Amenc**

It is my pleasure to introduce this special EDHEC-Risk Institute supplement to Investment & Pensions Europe. We are delighted to be teaming up with IPE to provide information on research-based solutions to some of the key challenges facing institutional investors today.

One of these challenges is the evolution in the asset management industry whereby passive investment is becoming increasingly important. In such a context, the selection of the right benchmarks will totally condition the risk-adjusted return of investors' core allocation. Being an informed passive investor thus assumes being attentive to the choice of benchmark. In the first article in the supplement, 'Alternative Weighting Schemes: Conditions for Optimality?' Felix Goltz and Lionel Martellini look at what alternative equity weighting schemes could be used by investors in the light of the shortcomings of cap-weighted indices. The aim of the article is to provide conceptual guidance to reposition the emerging alternative offerings within the context of portfolio theory so as to assess which new form of efficient index may make sense and add value in the long run.

In a separate article, Patrice Retkowsky and Felix Goltz examine a specific alternative to cap-weighted indices: the efficient indexation approach. This approach explicitly addresses the investor's objective of holding a portfolio that provides an optimal risk-return trade-off. Rather than representing broad market movements, the objective of efficient indices is to extract the equity risk premium in an efficient way.

In order to canvass European institutional investors for their views on the subject of indices, both equity and fixed-income, EDHEC-Risk Institute ran the EDHEC-Risk European Index Survey 2011. In an article reporting the results of this survey, we show that European institutional investors are well aware of a range of important problems with existing standard indices in the equity and fixed income arena. As a consequence, they have started to adopt alternative weighting schemes. As long as indices remain transparent and objective and focused on beta management rather than alpha

generation, investors are open to exploring new ways of designing indices that are suitable to their investment objectives, thus opening the room for further innovation and research in the field of index construction.

EDHEC-Risk Institute also conducted a survey on exchange-traded funds – the EDHEC-Risk European ETF Survey 2010 – as part of the 'Core-Satellite and ETF Investment' research chair in partnership with Amundi ETF. As Felix Goltz and Lin Tang report, the survey results reveal the increasing maturity of the ETF market, but respondents' views indicate that ETF products still have ample room for further development.

A further research chair, 'The Case for Inflation-Linked Corporate Bonds: Issuers' and Investors' Perspectives,' in partnership with Rothschild & Cie, is the subject of an article by Lionel Martellini and Vincent Milhau, with the paper focusing specifically on the optimal design of debt programmes. Overall, the authors find that optimising the structure of debt leads to lower default probability, and therefore to higher firm value. One key conclusion is that debt management decisions have a strong positive impact on firm value. Another key conclusion is that for reasonable parameter values, corporations should issue a non-zero share of inflation-linked bonds.

In our final article, Bernd Scherer reports results from the Deutsche Bank research chair on 'Asset-Liability Management Techniques for Sovereign Wealth Fund Management'. The article seeks to determine how to derive the optimal dynamic asset allocation for sovereign assets given different drivers of economic risks as well as varying levels of debt.

We wish you an enjoyable read of the supplement and look forward to continuing this editorial partnership with IPE in the months to come. Our mutual aim with this supplement is to provide academic insights that will genuinely contribute to improving institutional investment practices.

*Noël Amenc, Professor of Finance, EDHEC Business School, and Director, EDHEC-Risk Institute*

## Contents

Alternative weighting schemes: conditions for optimality	2
<i>Felix Goltz</i> <a href="#">EDHEC-Risk Institute</a> <i>Lionel Martellini</i> <a href="#">EDHEC Business School</a>	
Efficient indexation: an alternative to cap-weighted indices	3
<i>Felix Goltz</i> <a href="#">EDHEC-Risk Institute</a> <i>Patrice Retkowsky</i> <a href="#">EDHEC-Risk Institute</a>	
Indices in institutional investment management: results of a European survey	6
<i>Noël Amenc</i> <a href="#">EDHEC Business School</a> <i>Felix Goltz</i> <a href="#">EDHEC-Risk Institute</a> <i>Lin Tang</i> <a href="#">EDHEC-Risk Institute</a>	
Institutional investors' views on exchange-traded funds	7
<i>Felix Goltz</i> <a href="#">EDHEC-Risk Institute</a> <i>Lin Tang</i> <a href="#">EDHEC-Risk Institute</a>	
Inflation-linked corporate bonds and the optimal design of debt programmes	10
<i>Lionel Martellini</i> <a href="#">EDHEC Business School</a> <i>Vincent Milhau</i> <a href="#">EDHEC-Risk Institute</a>	
Integrated approach to sovereign wealth risk management	11
<i>Bernd Scherer</i> <a href="#">EDHEC Business School</a>	



EDHEC-Risk Institute Research Insights is published as a supplement to Investment & Pensions Europe  
IPE International Publishers Ltd, 320 Great Guildford House, 30 Great Guildford Street, London SE1 0HS  
Tel: +44(0)20 7261 0666, Fax: +44(0)20 7928 3332, Web site: [www.ipe.com](http://www.ipe.com), ISSN 1369-3727

Investment & Pensions Europe is published monthly by IPE International Publishers Ltd. No part of this publication may be reproduced in any form without the prior permission of the publishers. Printed by Hastings Printing Company, Drury Lane, St Leonards-on-Sea, East Sussex TN38 9BJ, UK.

# Alternative weighting schemes: conditions for optimality

**Felix Goltz**, Head of Applied Research, EDHEC-Risk Institute and Director of Research & Development, EDHEC-Risk Indices & Benchmarks

**Lionel Martellini**, Professor of Finance, EDHEC Business School, Scientific Director, EDHEC-Risk Institute, and Scientific Advisor, EDHEC-Risk Indices & Benchmarks

## Introduction: shortcomings of cap-weighted indices

Cap-weighted stock market indices are widely used by investors and asset managers as investment benchmarks. In the past few years, however, this well-established paradigm has been subject to increasing criticism. On the one hand, a number of papers have offered convincing empirical evidence that market cap-weighted indices exhibit a poor risk-adjusted performance because they are too concentrated in a limited number of stocks, while other studies have questioned the validity of utilising market cap as a proxy for a company size and economic influence.

The combination of these empirical and theoretical developments has significantly weakened the case for market cap-weighted indices, and a consensus is slowly but surely emerging regarding the inadequacy of market cap-weighted indices as investment vehicles. This attack on cap-weighted indices, which have been shown to be neither representative nor efficient, has however left investors with a void. As a result, a host of questions remain regarding what alternative weighting scheme should be used by investors, who certainly could use some conceptual guidance to reposition the new offerings within the context of portfolio theory so as to assess which new form of efficient index may make sense and add value in the long run.

## Building more representative benchmark portfolios

In a quest for a more representative weighting scheme, recently launched characteristic-based indices, also known as fundamental-weighted indices, have proposed to weight stocks by firm characteristics, such as earnings or book value (see for example Arnott, Hsu, and Moore (2005)). More specifically, these indices attempt to be more representative than cap-weighted indices by introducing a different measure of firm size. The idea behind such indices is not to optimise the risk/reward trade-off but to have measures of firm size that are more reliable than market capitalisation. As a result, conditions under which a fundamental weighting scheme would be optimal are not entirely clear. As an example, it would be optimal if risk parameters are identical and expected returns are proportional to the particular mix of fundamental variables used for the weighting.

## Building more efficient benchmark portfolios

As opposed to pursuing the goal of designing a representative portfolio, a number of index providers and asset managers have instead focused on efficiency – ie, achieving the highest risk/reward ratio – arguably a more relevant objective in the eye of the investor. We review below

five of the most popular methodologies that have been proposed to design better diversified portfolios than market cap-weighted indices.

### *Naïve approach to building better diversified portfolios: equal dollar contribution*

Equal-weighted indices simply attribute the same weight to each of their constituents. While such indices avoid the concentration and trend-following of cap-weighted indices and typically lead to higher Sharpe ratios, accepting equally-weighted indices as investment benchmarks really means that input parameter estimation is so hopeless that we agree to give up on any form of fundamental or statistical analysis. In fact, the equal-weighted portfolio would have the highest possible Sharpe ratio if and only if pairwise correlations, volatilities and expected returns were identical for all stocks.

### *Semi-naïve approach to building better diversified portfolios: equal risk contribution*

The starting point in this approach consists of recognising that contribution to risk is not proportional to dollar contribution. To correct for these imbalances, Qian (2005) and Maillard, Roncalli and Teiletche (2010) suggest forming so-called equal risk portfolios – ie, portfolios that are better diversified in the sense that the constituents of the portfolio exhibit a balanced contribution to risk. While attractive from an intuitive standpoint, this approach is purely ad-hoc and heuristic. In an attempt to analyse under which conditions ERC portfolios would be optimal Maximum Sharpe Ratio (MSR) portfolios, Maillard, Roncalli and Teiletche (2010) show that this would hold if and only if all Sharpe ratios are identical for all stocks, and if correlations are identical for all pairs of stocks, which is obviously a very restrictive assumption.

### *Statistical approach to building better diversified portfolios: maximum diversification ratio portfolios*

Diversification is not about generating a low volatility portfolio based on low volatility stocks, but instead about starting with high volatility constituents, and optimally mixing them so as to generate a low volatility portfolio by taking advantage of the structure of pairwise correlations. In fact, one may introduce a measure of portfolio diversification, known as the diversification ratio, and defined in terms of distance between portfolio volatility the volatility of individual components. This diversification index has been used by Choueifaty and Coignard (2008) in a portfolio optimisation context. While achieving an optimal risk-reward ratio is not the explicit focus in this approach, it is straightforward to see that maximum diversification portfolios would actually coincide with

maximum Sharpe ratio portfolios if all Sharpe ratios were identical for all stocks.

### *Scientific approach to building well-diversified low risk portfolios: global minimum variance portfolios*

One particular point on the efficient frontier is the Global Minimum Variance (GMV) portfolio, the only efficient portfolio for the estimation of which expected return estimates are not needed. More precisely, the GMV portfolio is the optimal risk/reward portfolio if one assumes that all stocks have the same expected returns, which is hardly a neutral or reasonable choice. Another outstanding problem with minimum variance benchmarks is their lack of performance. In a recent paper, DeMiguel, Garlappi and Uppal (2009) evaluate the out-of-sample performance of GMV portfolios and find that they do not perform consistently better than the equally-weighted counterparts rule in terms of Sharpe ratio. In other words, GMV portfolios appear to be low risk but also low return portfolios; they are typically highly concentrated in stocks with low volatility. Risk reduction is achieved not so much by diversification but rather by a bias towards stocks with low volatility.

### *Scientific approach to building well-diversified high risk-reward portfolios: maximum Sharpe ratio portfolios*

Recognising that the focus of investors is precisely on using investment benchmarks that achieve the highest risk-adjusted returns, Amenc *et al.* (2010) have proposed to focus on efficient-weighted indices, which are explicitly designed to improve the Sharpe ratio compared to cap-weighted indices by weighting stocks by their impact on portfolio risk and reward. Efficient indices focus directly on risk/reward properties. Their greater efficiency thus results from the construction method, as long as robust parameter estimates for expected returns, correlations, and volatilities are used. To obtain parameter estimates for the stocks' return comovements, an equity factor model is used to estimate common return drivers. Academic research also suggests that stocks that bear a high risk of losses for investors should also reward them with high expected returns. Using this robust relationship to find efficient portfolio weights leads to promising results, and equity indices constructed using this approach have substantially higher Sharpe ratios compared to their cap-weighting counterparts.

## Recent track records of alternative equity indices

It is useful to take a look at the recent performance generated by published indices that use the above mentioned weighting schemes. We conduct such an analysis for the four following

## 1. Risk/reward difference compared to S&P 500

	Non-cap-weighted			
	Efficient index	Minimum volatility	Fundamental index	S&P 500 equal-weighted
Difference in average	<b>5.5%</b>	1.6%	<b>4.4%</b>	<b>4.9%</b>
Difference in volatility	-0.4%	<b>-3.2%</b>	0.8%	1.6%
Difference in Sharpe ratio	<b>0.28</b>	0.08	<b>0.22</b>	<b>0.23</b>

weighting schemes that have been used by the main index providers to propose alternatives to market cap-weighted indices: efficient indices (FTSE), fundamental indices (FTSE), minimum-volatility indices (MSCI), and equal-weighted indices (S&P). These indices are fully transparent in that the respective index providers provide publicly available returns data and detailed index construction rules. Figure 1 shows differences in average returns, in volatility, and in Sharpe ratios between each US index and the cap-weighted S&P 500. The statistics are based on 11 years of weekly data from 8 January 1999 to 1 January 2010. Differences that are statistically significant at the 5% level are indicated in bold.

It can be seen from Figure 1 that the non-cap-weight indices lead to significantly higher Sharpe ratios, while the minimum volatility approach lowers the volatility but does not increase the Sharpe ratio significantly. However, it should also be noted that on top of the

performance numbers presented in the figure, it is important that investors judge the various alternative indexation forms by the implicit or explicit assumptions they make. As track records only provide a way of assessing the past, looking beyond track records and into the conceptual groundings of each indexation methodology is critical.

### Conclusion: concept selection versus concept diversification

The main objective of cap-weighted indices is to represent the stock market, thus neglecting the need for the most efficient risk-return trade-off. A number of alternatives exist that can allow investors to gain access to more representative and/or better diversified portfolios. Track records for all these non-cap-weighted indices look rather impressive, with strong outperformance compared to cap-weighted counterparts on a risk-adjusted basis.

As opposed to relying solely on track records, which by definition always look impressive, investors should perhaps focus on the conceptual assumptions underpinning these efforts. Some investors have decided to adopt one of these alternative non-cap-weighted indices as their investment benchmark, while others have instead decided to allocate to various non-cap-weighted benchmarks. Diversification may ultimately appear to be the best protection against concept uncertainty as much as it is a protection against return uncertainty!

Amenc, N., F. Goltz, P. Retkowsky, and L. Martellini, 2010. Efficient indexation: An alternative to cap-weighted indices, *Journal of Investment Management*, forthcoming.

Arnott, R., J. Hsu, and P. Moore, 2005. Fundamental indexation. *Financial Analysts Journal* 60 (2): 83–99.

Chouiefaty, Y. and Y. Coignard, 2008. Toward Maximum Diversification, *Journal of Portfolio Management*, 35, 1, 40–51.

DeMiguel, V., L. Garlappi, and R. Uppal, 2009. Optimal versus Naive Diversification: How Inefficient Is the 1/N Portfolio Strategy?, *Review of Financial Studies*, 22, 5, 1915–53.

Maillard S., T. Roncalli and J. Teiletche, 2010, On the Property of Equally-weighted Risk Contribution Portfolios, *Journal of Portfolio Management*, 36, 4, 60–70.

Qian E., 2005, Risk Parity Portfolios: Efficient Portfolios through True Diversification, Panagora Asset Management, September.

# Efficient indexation: an alternative to cap-weighted indices

**Felix Goltz**, Head of Applied Research, EDHEC-Risk Institute and Director of Research & Development, EDHEC-Risk Indices & Benchmarks

**Patrice Retkowsky**, Senior Research Engineer, EDHEC-Risk Institute and Deputy Head of Research & Development, EDHEC-Risk Indices & Benchmarks

Cap-weighted equity indices suffer from a variety of shortcomings that have been widely recognised. In particular, the high concentration of such indices in a small number of large cap stocks leads them to be under-diversified, thus providing investors with inefficient risk/reward properties. This inefficiency does not come as a surprise. In fact, financial theory shows that only under very unrealistic assumptions could cap-weighted indices be considered efficient investments. From a more practical perspective, cap-weighted indices have never been designed to be efficient investment supports but rather were meant to reflect broad market movements and trends. Efficient indexation provides a solution to the shortcomings of cap-weighted indices by explicitly addressing the investor's objective of holding a portfolio that provides an optimal risk-return trade-off. Rather than representing broad market movements, the objective of efficient indices is to extract the equity risk premium in an efficient way.

### Rehabilitating the tangency portfolio

A potential answer to investors concern to hold well-diversified equity portfolios comes from modern portfolio theory, which precisely focuses on taking into account the stocks' risk and return characteristics in order to provide

investors with optimal diversification within a given universe of constituent stocks.

Modern portfolio theory unambiguously prescribes holding the portfolio with the highest reward-to-risk ratio, also known as the tangency portfolio, or the maximum Sharpe ratio (MSR) portfolio. In an effort to improve on cap-weighted indices, we focus on designing indices with an improved Sharpe ratio. The aim of this efficient indexation approach is to provide investors with benchmarks that reflect the possible risk/reward ratio from a broadly diversified stock market portfolio, and that are thus a proxy for the normal returns of an exposure to equity risk.

To generate an investable proxy for the maximum Sharpe ratio tangency portfolio, we resort to standard mean-variance optimisation. Although our aim to maximise risk/return efficiency is fully consistent with financial theory, successful implementation of the theory depends not only on its conceptual grounds but also on the reliability of the input to the model. In the end, the results depend greatly on the quality of the parameter estimate, the covariance matrix and the expected returns of all stocks in the index.

### Estimating risk parameters

The key problem in covariance matrix estimation is the curse of dimensionality, with

a number of risk parameters growing more than linearly with the number of stocks under consideration. Therefore at the estimation stage, the challenge is to reduce the number of factors that come into play. Several improved estimates for the covariance matrix have

*"In an effort to improve on cap-weighted indices, we focus on designing indices with an improved Sharpe ratio. The aim is to provide investors with benchmarks that reflect the possible risk/reward ratio from a broadly diversified stock market portfolio"*

been proposed, including most notably the factor-based approach. While the factor-based estimator is expected to allow for a reasonable trade-off between sample risk and model risk, the problem of choosing the "right" factor model remains. We take a somewhat agnostic approach to this question, and aim to rely ▶

as little as possible on strong theoretical assumptions by using Principal Component Analysis (PCA) to determine the underlying risk factors from the data. The PCA method is based on a spectral decomposition of the sample covariance matrix and its goal is to explain covariance structures using only a few linear combinations of the original stochastic variables which will constitute the set of (unobservable) factors. Overall, the main strength of the PCA approach at this stage is that it leads to “letting the data talk” in order to tell us the underlying risk factors that govern most of the variability of the assets at each point in time. This strongly contrasts with having to rely on the assumption that a particular factor model is the true pricing model and reduces the specification risk embedded in the factor-based approach while keeping the sample risk reduction.

### Estimating expected return parameters

One outstanding challenge that remains at this stage is the estimation of expected return parameters. Instead of relying purely on statistics, which is known to generate poor expected return estimates (Merton (1980)), we use a robust estimate of expected returns that relies on the risk/reward trade-off.

More specifically, both common sense and asset pricing theory suggest that expected return parameters should be positively related to risk parameters. The academic literature has generated a wealth of insights on the risk-return relationship, starting with the classic view that there should be a linear positive relationship between the excess expected return on a stock and the stock’s beta with a variety of systematic risk factors. Such multi-factor explanations of differences in expected returns are supported by the Arbitrage Pricing Theory (Ross (1976)). More recently it has been recognised that specific risk may also be rewarded in equilibrium (Merton (1987)) in the event that investors are unwilling or unable to fully diversify their portfolios. In fact, a number of papers have found that aggregating both systematic and specific risk in simple measures of downside risk allows the cross-section of expected returns to be explained (see Amenc, Goltz, Martellini and Retkowsky (2010) for more details and references to this literature).

Building on this rich literature, we suggest using a downside risk measure as a proxy for excess expected returns. We further introduce minimum and maximum weight constraints in the design of the maximum Sharpe ratio portfolio to help further increase the robustness of the methodology (see Jagannathan and Ma (2003) for a formal analysis of portfolio constraints).

### Performance of efficient indices

We use constituent data for the S&P 500 index to construct tangency portfolio proxies based on the same set of stocks as these cap-weighted indices. Overall, our efficient indices obtain both higher average returns and lower volatility than do cap-weighted indices (figure 1). However, portfolios rebalanced every quarter are subject to high turnover. We reduce turnover by

## 1. Long-term risk and return in the US

Index	Annual average return (compounded)	Annual standard deviation	Sharpe ratio (compounded)	Information ratio	Tracking error
Efficient index	11.63%	14.65%	0.41	0.52	4.65%
Cap-weighted	9.23%	15.20%	0.24	0.00	0.00%
Difference (Efficient – cap-weighted)	2.40%	-0.55%	17.31%	-	-
p-value for difference	0.14%	6.04%	0.04%	-	-

Figure 1 shows risk and return statistics for portfolios constructed with the same set of constituents as the cap-weighted index. Rebalancing is quarterly subject to an optimal control of portfolio turnover (by setting the reoptimisation threshold to 50%). Portfolios are constructed by maximising the Sharpe ratio given an expected return estimate and a covariance estimate. The expected return estimate is set to the median total risk of stocks in the same decile when sorting by total risk. The covariance matrix is estimated using an implicit factor model for stock returns. Weight constraints are set so that each stock’s weight is between  $1/2N$  and  $2/N$ , where  $N$  is the number of index constituents. P-values for differences are computed using the paired t-test for the average, the F-test for volatility, and a Jobson-Korkie test for the Sharpe ratio. The results are based on weekly return data from January 1959 to December 2008.

## 2. Recent risk and return profile in various markets

	Annual average return			Annual standard deviation			Sharpe ratio		
	Efficient index	Cap-weighted	Difference	Efficient index	Cap-weighted	Difference	Efficient index	Cap-weighted	Difference
US	9.05%	5.59%	3.46%	20.47%	18.96%	1.51%	0.33	0.17	0.16
Euro-zone	10.55%	7.22%	3.33%	18.84%	21.37%	-2.53%	0.41	0.20	0.20
UK	13.37%	8.99%	4.38%	19.57%	19.33%	0.24%	0.54	0.32	0.22
Dev Asia ex Japan	20.12%	18.96%	1.16%	21.37%	23.80%	-2.44%	0.83	0.70	0.13
Japan	5.17%	2.70%	2.46%	19.09%	21.42%	-2.34%	0.26	0.12	0.14

The statistics are based on weekly returns data from 23 December 2002 to 31 December 2009

limiting rebalancing; only when significant new information arrives do we rebalance our optimal weights.

This approach leads to significantly less turnover yet maintains high Sharpe ratios. Annual turnover in excess of the cap-weighted index is less than 20%. Over the long term, our efficient index increases the Sharpe ratio of the S&P 500 cap-weighted index by more than 70%. Interestingly, this improved risk/reward trade-off does not come at the cost of an increase in extreme risk, and it holds when conditioning on business cycles or implied volatility. When performance over several 10-year periods is analysed, the efficient indexation strategy had lower Sharpe ratios only during the bull markets of the 1990s, although volatility was still lower than that of the cap-weighted indices.

In addition to the long-term US analysis reported above, it is interesting to test the approach in other markets around the world. Figure 2 shows results based on five regional markets where we use the corresponding FTSE indices for large- and mid-cap stocks to constitute the universe. The figure shows risk and return statistics computed for efficient indexation and cap-weighting applied to these stock market index constituents.

The results show that risk/return efficiency in terms of the Sharpe ratio is improved considerably for all five indices. In addition, the improvement is actually quite similar across the five indices, with Sharpe ratios approximately 0.15 higher than those of the cap-weighted index. In general, analysis of international data suggests that our results are not specific to US data, as the method yields similar results in stock markets around the world.

### Designing better equity benchmarks

Cap-weighted indices weight stocks by the footprint they leave on the stock market. Recently introduced characteristics-based indices weight stocks by their footprint in the economy (Arnott, Hsu and Moore (2005)). Our approach weights instead stocks by the “risk/return footprint” they have on the investor’s portfolio. Obviously, investors want to have a high weight in stocks that contribute positively to the portfolio’s Sharpe ratio and a low weight in stocks that contribute less to increasing the Sharpe ratio. Our research shows that it is possible to design an index construction methodology that explicitly takes this investor objective into account.

For more information on the efficient indices, please visit [www.efficient-index.com](http://www.efficient-index.com).

Amenc, N., F. Goltz, L. Martellini, and P. Retkowsky, 2010. *Efficient Indexation: An Alternative to Cap-Weighted Indices*, EDHEC Risk Institute Publication.  
 Arnott, R., J. Hsu, and P. Moore, 2005. Fundamental Indexation, *Financial Analysts Journal*, 61, 2.  
 Jagannathan and Ma, 2003. Risk Reduction in Large Portfolios: Why Imposing the Wrong Constraints Helps, *Journal of Finance*, 58, 4, 1651-1684.  
 Merton, R., 1980. On Estimating the Expected Return on the Market: An Exploratory Investigation, *Journal of Financial Economics*, 8, 1-39.  
 Merton, R., 1987. A Simple Model of Capital Market Equilibrium with Incomplete Information, *Journal of Finance*, 42, 483-509.  
 Ross, S., 1976. The Arbitrage Theory of Capital Asset Pricing, *Journal of Economic Theory*, 13, 3, 341-360.

# EDHEC-Risk Alternative Investment Days 2011

Bringing Academic Insights to Alternative Investment

5-6 April 2011, The Tower (Tower Hill) - London

*The EDHEC-Risk International Herald Tribune CNBC Hedge  
Fund Roundtable of Global Thought Leaders*

Why Institutional Investors Are Returning to Alternative Investments  
and Hedge Funds

## **EDHEC-Risk Conference**

Dealing with Non-Normality in Portfolios that Include Alternatives  
New Forms of Volatility Indices

Extreme Hedge Fund Risk Diversification with Volatility  
Diversification at Reasonable Cost: Mitigating Downside Risk without Compromising  
Long-Term Growth Prospects

Factor Models for Hedge Funds: from Macro to Micro  
Capturing the Risk Premium of Commodity Futures: The Role of Hedging Pressure

Private Equity and Investment Returns over the Last Thirty Years

Trade-Offs between Commodity Futures and Other Proxies  
for Commodity Investment

Optimal Portfolio Allocation with Hedge Funds

Commodities and Inflation Hedging

conference



**EDHEC-RISK**  
Institute

# Indices in institutional investment management: results of a European survey

Noël Amenc, Professor of Finance, EDHEC Business School, Director, EDHEC-Risk Institute  
 Felix Goltz, Head of Applied Research, EDHEC-Risk Institute  
 Lin Tang, Research Assistant, EDHEC-Risk Institute

As the choice of an index is a crucial step in both asset allocation and performance measurements, it is useful to investigate index use and perceptions about indices. The recent EDHEC-Risk European Index Survey 2011, which elicited responses from 104 European institutional investment professionals, aims to contribute to this awareness by analysing the current uses of and opinions on equity indices and fixed income indices. It is our hope that this survey will provide unique insight into the users' perspective in the index industry.

## What makes a good-quality index? Investors' evaluation criteria

We began the questionnaire by asking our respondents about how to evaluate the quality of an index. We find that liquidity, objectivity and transparency are the most important criteria investors have for indices. The importance of these criteria is quite intuitive. Liquidity of an index means that it can be used by many investors at the same time – trading large positions in vehicles tracking the index does not have an impact on the market prices of securities in the index. The importance of objectivity and transparency suggests that investors want to be able to understand and follow what exactly drives the index risk and return. On the other hand, respondents to our survey suggest that a buy-and-hold character is not a requirement for an index. This finding is interesting as their buy-and-hold nature is often cited as one of the key reasons for the dominance of cap-weighted indices in various asset classes. If objectivity, transparency and liquidity are key, this opens many possibilities to construct indices as in fact any set of transparent and liquid portfolio construction rules could be used as an index by investors.

Furthermore, the results also reveal that there is an obvious confusion linked to equating indexing with “passive investing”. The majority of respondents actually does not think that indices should only reflect passive strategies (58%). Together with the low importance of the buy-and-hold property of an index, this suggests that respondents widely accept the notion that their indices can move away from traditional cap-weighted approaches. Respondents do however indicate that indices should not be based on alpha (75.2%). Overall, the responses thus suggest that investors indeed

ask for “normal returns” from “systematic” portfolios when investing in an index. Of course, finance theory and concepts leave a wide range of choice for what these systematic portfolios could look like.

## Slicing and dicing the market: broad indices versus sub-segment indices

Within equity indices or bond indices, investors have a wide set of categorisations to choose from. In equity investing, some investors use broad worldwide or regional indices, while others prefer to separate indices by country, sector or style. When comparing the results for the importance of sub-segment indices across different asset classes, we find that sub-segment indices are of relatively little importance to equity investors – where broad market indices

*“If objectivity, transparency and liquidity are key, this opens many possibilities to construct indices as in fact any set of transparent and liquid portfolio construction rules could be used as an index by investors”*

dominate – but are of prime importance to bond index users (figure 1). This finding may be explained by the fact that equity investors mainly seek exposure to the overall equity risk premium without necessarily having a clear view on drivers of differences of expected returns within equity markets. Of course, the main motivation behind equity investing is often to seek performance in return for taking on equity risk, rather than hedging of clearly specified risk factors.

On the contrary, hedging of clearly defined risk factors is a much more important issue for bond investors. As investors are concerned with their exposure to bond market risk factors, such as interest rate risk, inflation risk, and credit risk, they need fixed-income instruments with specific characteristics to match their desired risk exposures. Hence, sub-segment indices could offer more flexible solutions for different needs of fixed-income investors.

Another important background to the

different findings for the use of equity sub-segment indices versus fixed income sub-segment indices is that the relevant underlying risk factors are quite consensual in the fixed income arena but much more debatable for equity investments. While, at least since Ross's work in the 1970s on Arbitrage Pricing Theory and its subsequent application in investment practice, there is a consensus that equity returns are driven by multiple risk factors, there is no such consensus when it comes to specifying the risk factors or the portfolios that should represent them. In fact, researchers often prefer to use implicit factors to let the data decide which factors matter most, while index providers have largely concentrated on explicit factors due to the more straightforward use of explicit stock characteristics in index construction.

While index providers have recently made forays into equity indices that replicate explicit financial factors, such indices are not widely used. Likewise, sector and style indices are relatively little used despite the evidence that sectors and styles are important drivers of equity correlations, thus justifying the use of such indices as building blocks in portfolio construction.

In the end, due perhaps to the lack of consensus on relevant explicit equity risk factors, and due to the lack of precise hedging demands of investors for categories like styles and sectors, sub-segment indices play a rather minor role in equity indexation. Whether or not categories could be defined that are more relevant for investors and would lead to more widespread usage is a question beyond the scope of what we can answer from the survey results.

## Generic indices versus investors' objectives

The take-up rate of sub-segment indices is not the only marked difference between equity and bond index use. When comparing the problems investors see with the existing indices across different asset classes, we find that there are pronounced differences. For example, equity investors are mainly concerned that standard cap-weighted indices overinvest in overpriced stocks and provide poor diversification within the constituent universe. In contrast, fixed-income index users pay more attention to reliable duration exposure and are concerned with liquidity issues.

This difference in perceived problems with indices in different asset classes is also consistent with the results above on the importance of broad and sub-segment indices: equity indices are used for seeking performance while bond indices are used to hedge risk exposures.

## 1. Comparison of importance of sub-segment indices across different asset classes

	Equity indices	Government bond indices	Corporate bond indices
Importance of sub-segment indices as opposed to broad indices	Dominance of broad indices	Importance of maturity and credit rating segment indices	Importance of credit rating and maturity segment indices

## 2. Comparison of important issues associated with indices across different asset classes

	Equity indices	Government bond indices	Corporate bond indices
Important issues associated with indices	<ul style="list-style-type: none"> <li>● Overinvestment in overpriced stocks</li> <li>● Poor diversification</li> <li>● Sector and size biases</li> </ul>	<ul style="list-style-type: none"> <li>● Difficult to invest/replicate</li> <li>● Instability of duration</li> <li>● Inconsistent security selection rules and non-systematic pricing</li> </ul>	<ul style="list-style-type: none"> <li>● Lack of liquidity</li> <li>● Overinvestment in more risky companies</li> <li>● Unreliable credit and duration exposure</li> </ul>

## 3. Comparison of adoption of alternative weighting schemes

	Equity indices	Government bond indices	Corporate bond indices
Adoption of alternative weighting schemes	45.2%	17.6%	12.5%
% of respondents who see current indices as not problematic	24.7%	35.1%	23.6%
% of respondents who are not familiar with alternative weighting schemes	7.8%	20.3%	18.1%

Despite these significant differences on objectives and in perceived issues, index providers typically apply the standard cap-weighting approach indifferently to both equity and fixed income indices. It seems surprising that a weighting methodology is applied uniformly to different asset classes, which investors use to pursue different objectives and for which they see different sets of issues. Investors' answers across the survey suggest that, even if the cap-weighting approach were the best approach in one asset class, it is unlikely that it is also necessarily the best answer to different issues in another asset class.

Even within each asset class, it should be noted that investors see a variety of issues with index investments and the most appropriate weighting scheme for a given investor may depend on which problem is the most relevant for him. It seems unreasonable to assume that

a single weighting scheme could be applied uniformly to all investors, given the differences in their objectives.

Rather, there may be a case for the design of more "objective oriented" as opposed to generic indices. Designing indices that explicitly relate to objectives may be more challenging than designing somewhat ad-hoc indices, but would potentially provide more useful tools for performance measurement and asset allocation of investors.

Of course, standard cap-weighted indices do not take into account such investor-specific objectives, as they are constructed on the notion of providing an aggregate snapshot of the market average. But even many of the more recently introduced alternative weighting schemes show little difference with cap-weighting when it comes to taking into account differences between investors or different requirements for different

asset classes. We now turn to a discussion of the use of various non-cap-weighted indices.

### Adoption of alternative weighting schemes

Figure 3 shows that the adoption of alternative weighting schemes is reasonably high among respondents concerning equity indices, but in the bond index area, adoption of non-standard indices remains much lower.

Interestingly though, for both stock and bond indices only a minority of respondents does not see the existing standard indices as problematic. For bond indices, this implies that although investors are not satisfied with the current weighting schemes, they have not made a move to alternatives.

The last row of figure 3 offers a reasonable explanation for this observation – about one-fifth of respondents are not familiar with alternative approaches in bond indices, while only about 10% of equity investors are unfamiliar with alternative indices in this area. Hence, unfamiliarity with alternative approaches for bond indices is one of the most plausible barriers to the adoption of alternative weighting schemes at the current stage.

Overall, our survey results have shown that European institutional investors are well aware of a range of important problems with existing standard indices in the equity and fixed income arena. As a consequence, they have started to adopt alternative weighting schemes. As long as indices remain transparent and objective and focused on beta management rather than alpha generation, respondents to our survey are open to exploring new ways of designing indices that are suitable to their investment objectives, thus opening the room for further innovation and research in the field of index construction.

# Institutional investors' views on exchange-traded funds

**Felix Goltz**, Head of Applied Research, EDHEC-Risk Institute and Director of Research & Development, EDHEC-Risk Indices & Benchmarks

**Lin Tang**, Research Assistant, EDHEC-Risk Institute

In the recent EDHEC-Risk European ETF Survey 2010, EDHEC-Risk Institute – with the support of Amundi ETF – collected and analysed 192 responses from European investment professionals on their use and perceptions on ETFs and competing indexing instruments. The survey results reveal an increasing maturity of the ETF market. Despite this increasing maturity, the respondents' views indicate that ETF products still have ample room for further development.

### Use of and satisfaction with ETFs

Figure 1 summarises the use of ETFs and the satisfaction rates with ETFs among our respondents for various asset classes. In addition to the current survey's results for 2010, we show the results of our earlier surveys for comparison.

The number of ETF users refers to the percentage of respondents who use ETFs in a given asset class in which they invest. Our results show that this percentage is starting to level off.

### 1. ETFs: summary of usage and satisfaction rate

	Equities	Government bonds	Corporate bonds	Commodities	Real estate	Hedge funds
<b>Number of users</b>						
2006	45%	13%	6%	15%	6%	7%
2008	78%	42%	40%	48%	35%	30%
2009	95%	61%	55%	62%	40%	34%
2010	95%	68%	60%	64%	39%	38%
<b>Percentage of assets within asset class</b>						
2008	22%	10%	7%	16%	7%	7%
2009	36%	17%	12%	22%	12%	5%
2010	25%	35%	29%	38%	34%	21%
<b>Satisfaction</b>						
2006	92%	80%	75%	65%	50%	27%
2008	92%	85%	66%	87%	77%	58%
2009	94%	78%	61%	79%	355%	28%
2010	92%	90%	72%	77%	83%	65%

There are some notable increases in usage, such as ETFs for fixed-income products (from 61% to 68% for government bond ETFs and from 55% to 60% for corporate bond ETFs over the last year)

and hedge fund ETFs (which increase from 34% to 38%). However, on the whole, increases in the number of users are much less pronounced than in past years. Another aspect of use is the ▶

intensity of use in terms of assets invested in ETFs as a percentage of overall assets invested in a given asset class. The intensity of usage has grown significantly over the past year. For the respondents who do invest in the particular asset class, figure 1 shows the share of their portfolios accounted for by ETFs. Other than equity ETFs, whose share has fallen, ETFs have gained a significant share of assets over the past 12 months. Hedge fund ETFs now account for one-fifth of the hedge fund investments of the respondents who use ETFs for this particular asset class.

It is interesting to note that the high and increasing usage of ETFs comes against a backdrop of equally high satisfaction levels. Even for asset classes where ETF satisfaction had dropped during the 2008 liquidity crisis – such as corporate bond and hedge fund ETFs – the satisfaction levels have reverted to the pre-crisis level or even higher levels.

These high degrees of satisfaction are consistent with survey respondents' views of ETFs, views often more favourable than those for competing indexing vehicles. In fact, when it comes to comparing ETFs, futures, total return swaps, and traditional index funds, our survey confirms that ETFs, along with futures, are the preferred indexing vehicles.

We compare the respondents' views on different indexing instruments for 10 different quality criteria in figure 2 to see the advantages and disadvantages of each instrument. The numbers in the exhibit indicate the average ratings received by each instrument on a scale of one (poor) to three (very good). Overall, ETFs and futures receive the highest scores, while total return swaps receive the lowest. ETFs are rated outstanding for ease of use (minimum subscription and operational constraints) and range of products. ETFs also outscore traditional index funds on all 10 criteria; overall, index funds have a score of 2.15, as compared to 2.37 for ETFs. These ratings suggest that total return swaps (TRSs) are particularly poor in the sense that they are less liquid, costlier, and harder to use than the three other products.

### ETFs in the investment process

Given the perceived benefits in terms of liquidity, cost efficiency, and product variety, ETFs have become important to asset allocation strategies. In our survey, we are able to recover information not only on satisfaction and usage, but also on the ways in which ETFs are used and how they fit into the overall asset allocation of respondents.

ETFs stand out for a number of more advanced features, such as securities lending, trading options on ETFs, short selling ETFs and inverse/leveraged ETFs. In our survey, we find that the use of inverse and leveraged ETFs is now relatively common and these product innovations are now firmly established. The greater popularity of inverse and leveraged ETFs may be the result of their operational simplicity. Inverse and leveraged ETFs are pre-packaged margin products. It is not necessary for investors to manage the margin account on their own as they must when they short ETFs by themselves. Though they are still far from mainstream instruments, options on ETFs have progressed somewhat over the years, as they are now used by 8% of investors, up from 6% in 2009. In contrast, securities lending, trading options on ETFs, and short selling ETFs, are used by only a small fraction of respondents (less than 15%). This may be due to the obstacles raised by the recent criticism of short selling in general.

When asking investors how they use ETFs in their overall investment process, the results

## 2. Summary of ratings for ETFs, futures, total return swaps and index funds

Quality	ETFs	Futures	Total return swaps	Index funds
Liquidity	2.42	2.82	1.73	2.15
Cost of liquidity	2.16	2.70	1.78	2.08
Other costs	2.25	2.70	1.83	1.89
Tracking error	2.28	2.51	2.47	2.19
Product range	2.52	2.07	2.10	1.99
Transparency	2.27	2.75	1.93	2.20
Minimum subscription	2.76	2.13	1.55	2.28
Operational constraints	2.53	2.15	1.60	2.24
Regulatory regime	2.39	2.42	1.80	2.36
Tax regime	2.12	2.19	2.02	2.09
<b>Average score</b>	<b>2.37</b>	<b>2.44</b>	<b>1.88</b>	<b>2.15</b>

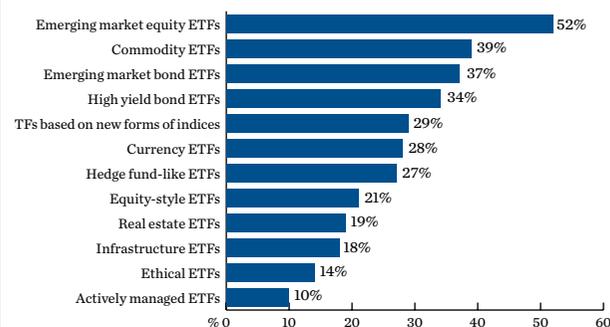
## 3. Summary of use of different instruments in core-satellite allocation

	In the core	In the satellite	In both
<b>Equity ETFs</b>			
Broad market ETFs	73%	12%	8%
Style ETFs	18%	47%	3%
Sector ETFs	10%	52%	5%
<b>Government bond ETFs</b>			
Broad market ETFs	84%	4%	0%
Maturity-segment ETFs	32%	32%	0%
Inflation-protected bond ETFs	48%	16%	4%
<b>Corporate bond ETFs</b>			
Broad market ETFs	70%	26%	4%
Maturity-segment ETFs	26%	30%	0%
ETFs by credit-rating segment	7%	37%	4%
Sector ETFs	11%	37%	0%
<b>Alternative asset ETFs</b>			
Real estate	16%	32%	0%
Commodities	18%	55%	7%
Hedge funds	14%	27%	4%
Infrastructure	4%	36%	0%

show that investment in ETFs is associated mainly with long-term exposure to broad market indices. All the same, that up to 50% of respondents frequently use ETFs for short-term exposure to specific market sub-segments and for tactical bets indicates that other investment purposes are increasingly important as well.

Given the large variety of indices tracked by ETFs, an interesting point is to see which types of ETFs are used in different areas of portfolio management. Figure 3 summarises the use of different ETFs in the core-satellite allocation. The results show that there is a dominance of broad market ETFs which is particularly pronounced in core portfolios. Although ETFs on narrower segments of the respective markets are used relatively often as satellite vehicles, the dominance of broad market ETFs in the

## 4. What type of ETF product would you like to see developed further in the future?



core is clear. This dominance is not limited to equities, as these ETFs also account for the bulk of the demand for government bond ETFs and corporate bond ETFs, though to a somewhat lesser degree. On the whole, perhaps the most telling information from Figure 3 is that, instead of actively managing their long-term beta exposure to obtain the most efficient risk/return trade-off in their core portfolios, European investment managers focus on using broad market indices.

### An increasingly mature market with room for improvement

As the ETF market is maturing and as these instruments are ever-more widely used, one naturally wonders what impact ETFs make on the broader markets. The survey finds that many respondents have themselves observed that ETFs have improved the price efficiency of the spot and future markets. Moreover, many respondents have observed increased liquidity in the underlying market after the introduction of an ETF. Many practitioners, then, seem to

*“Our survey results suggest that, despite the hundreds of ETFs already made available to investors in Europe, there is considerable room for new product development”*

share the views of academic studies – that is, that the liquidity of underlying markets and the price efficiency of the futures market improve significantly after the introduction of ETFs. In addition, we find that about half of respondents frequently monitor information on ETFs rather than on the underlying markets. This finding suggests that practitioners exploit relationships between ETFs and underlying markets. Thus, in accordance with their increased use, it seems that ETFs have entered a phase in which they actually have an impact on their underlying baskets of securities and on related futures markets. About half of respondents frequently monitor information on ETFs rather than on the underlying market. In other words, practitioners rely heavily on the price leadership of ETFs and thus exploit ETFs not just as investment vehicles but also as sources of information.

Our survey results suggest that, despite the hundreds of ETFs already made available to investors in Europe, there is considerable room for new product development. Figure 4 shows that, on the whole, investment management professionals are requesting access to non-standard beta (emerging markets and alternative asset classes) or to traditional equity beta through new weighting schemes. On the other hand, investment managers are far less interested in ETFs that select securities either through ethical screening or through active stock-picking by a manager.

Overall, the significant impact that ETFs now have even on related and underlying markets, as well as the high rates at which they are used, shows that the ETF market has attained a considerable degree of maturity. At the same time, patterns of use and survey responses suggest that there is considerable room for further development of ETF products and for new ways of using them. In future surveys, we intend to keep monitoring how products and usage of ETFs in Europe will evolve.

# Proudly in London

Following the grand opening of its Singapore campus on January 21, 2011, EDHEC Business School will be organising the official opening of its new premises in London at 10 Fleet Place in April 2011.

Since 2003, EDHEC has hosted more than 5,000 professionals from the City at its research seminars and conferences. Today, EDHEC is proud to be the business school that, from Tokyo to New York, through Singapore, London, Paris, Zurich, Frankfurt, Milan, and twenty other international capitals, trains the financial and economic elite.



For more information on EDHEC's international activities, please contact Carolyn Essid: [carolyn.essid@edhec-risk.com](mailto:carolyn.essid@edhec-risk.com) or +33 493 187 824.

[www.edhec-risk.com](http://www.edhec-risk.com)

# Inflation-linked corporate bonds and the optimal design of debt programmes

**Lionel Martellini**, Professor of Finance, EDHEC Business School and Scientific Director, EDHEC-Risk Institute

**Vincent Milhau**, Senior Research Engineer, EDHEC-Risk Institute

A recent surge in inflation uncertainty has further increased the need for investors to hedge against unexpected changes in price levels. Inflation hedging has in fact become a concern of critical importance for pension funds, given that pension payments are typically indexed with respect to consumer price or wage level indexes, but also for private investors, who consider inflation as a direct threat with respect to the protection of their purchasing power. In the face of an increasing need for inflation hedging, inflation-linked securities have been introduced, first by sovereign states. While a dominant fraction of inflation-linked debt is still issued by sovereign states, there has been recent interest amongst various state-owned agencies, municipalities but also corporations, in particular utility or financial-services companies, to issue inflation-linked bonds. In fact, the intuition suggests that if a firm's revenues tend to grow with inflation, then having some inflation-linked issuance can be a natural hedge.

In this context, it is perhaps surprising that some large corporations are still sitting on the sidelines, as they implement debt structure decisions involving no inflation-linked bonds. This situation may in part be explained by a common belief that debt management decisions should be governed by the desire to reduce the cost of debt financing. In particular, the standard argument suggests a corporation should seek to issue fixed (floating) debt if it anticipates an increase (a decrease) in interest rates and issue nominal (inflation-linked) bonds if it anticipates an increase (a decrease) in inflation. In this context, inflation-linked bonds would not seem attractive from the issuer's perspective since the cost of debt servicing would be expected to increase with inflation. This seemingly straightforward line of reasoning suffers, however, from one fatal flaw: the difference in fixed versus floating (versus real) rates merely reflects market expectations and a risk premium. In the end, the only non-trivial impact may come from the chief financial officer's active views if they deviate from the market views and the "raison d'être" of a corporation is hardly to make profits from trading in financial markets.

In a recent paper supported by Rothschild & Cie, we introduce a general framework for analysing debt management decisions by a corporation subject to default risk.<sup>1</sup> We argue that the main motive behind debt management is not reducing the cost of debt financing, but instead hedging interest rate and inflation risk exposures. In fact, by matching the interest rate

and inflation exposure of the liabilities to that of the assets, the managers of a firm can contribute to reducing the variability of the cash flows. This has a direct positive consequence in terms of decreasing the probability of default, and consequently decreasing the cost of equity and increasing equity value.

More specifically, we attempt to answer the following question: given an exogenous revenues process for a corporation, what is the optimal liability structure when the issuer faces various forms of debt instruments, including in particular, fixed-rate debt, floating-rate debt, and inflation-linked debt? In fact, this problem is the exact counterpart of the standard asset-liability management problem for a pension fund, where the liabilities are exogenously given while the allocation decision is to be optimised over.

To gain an intuitive understanding of why the presence of specific risk factors in asset returns matters, let us consider the problem of optimal issuance of inflation-indexed bonds by sovereign

dominate nominal debt both in terms of risk and return, and the optimal composition of a debt portfolio will be affected accordingly. In other words, the intuition suggests that the optimal debt structure should not so much emanate from a concern over minimising the cost of debt, but also involve hedging motives with respect to risk factors impacting the revenues of the firm.

Beyond these basic intuitions, it is fair to say that our formal understanding of liability allocation decisions by corporations (capital structure decisions and debt structure decisions) is relatively limited. In particular, relatively few quantitative insights are available about the optimal allocation to various classes of debt (fixed, floating, inflation-linked) by a corporation, and the cost associated with suboptimal debt management strategies. To formalise these intuitions, we consider a stylised debt management problem whereby three classes of debt can be issued by a firm: fixed-rate bonds, floating-rate bonds and inflation-linked (IL) bonds. In an attempt to increase shareholder wealth, the managers of the firm seek to immunise debt servicing with respect to the exposure to interest rate and inflation risk factors. In fact, what matters is not so much the variability of debt servicing as the volatility of the firm cash flows net of debt payments. Hence, decreasing the share of fixed-rate bonds increases uncertainty about debt servicing since interest payments on floating-rate and inflation-linked bonds are uncertain. On the other hand, this may lead to increases in the correlation between changes in liability and asset values provided that the correlation between asset value and interest rate or inflation is positive. In other words, issuing floating-rate bonds or inflation-linked bonds may increase risk from a pure debt management perspective, but decrease risk from an integrated asset-liability management perspective. From this trade-off emerges an optimal debt structure, and one can show that under (mild) simplifying assumptions, minimising the volatility of assets versus liabilities is equivalent to minimising the (risk-adjusted) default probability, which in turn is equivalent to maximising firm value.

Consistent with the hedging motive, we find that the optimal share of floating rate bonds increases with the correlation between changes in interest rates and changes in the revenues of the firm. Hence, a firm with positive (negative) correlation between its operating cash-flows (before interest expenses) and interest rates should maintain higher (lower) floating-rate debt to avoid the (bankruptcy) costs associated with situations with low cash-flows and high debt servicing. Similarly, the optimal share of inflation-linked bonds

*"Issuing floating-rate bonds or inflation-linked bonds may increase risk from a pure debt management perspective, but decrease risk from an integrated asset-liability perspective. From this trade-off emerges an optimal debt structure"*

states, municipalities or corporations. Issuing inflation-indexed bonds leads to a reduction in the cost of debt since the issuing party is selling insurance against inflation and receives the associated premium. On the other hand, issuing inflation-linked bonds, as opposed to nominal bonds, increases the uncertainty in the financing costs because of heightened uncertainty in coupon payments. This is a cost-risk trade-off which is the counterpart from a pure liability management perspective of the return-risk trade-off in asset allocation decisions. Recognising the presence of the assets in place leads, however, to a somewhat more contrasted picture. Indeed, because revenues (tax revenues for states and municipalities, or operating cash-flows for corporations) are often positively related to changes in inflation, it is not necessarily the case that increases in inflation always lead to a decrease in net revenues for the issuer. In other words, while issuing inflation-indexed bonds leads to an increase in risk from a pure liability perspective, it is not necessarily more risky from a combined liability-asset management perspective. In this context, inflation-indexed debt would appear to

<sup>1</sup> Martellini, L., and V. Milhau, 2011, *Inflation-Linked Corporate Bonds and the Optimal Design of Debt Programs*, EDHEC-Risk Institute publication produced with the support of Rothschild & Cie.

increases with the correlation between changes in inflation rates and changes in the revenues of the firm. Overall, we find that optimising the structure of debt leads to lower default probability, and therefore to higher firm value. One key conclusion that we obtain is that debt management decisions have a strong positive impact on firm value. Another key conclusion is that for reasonable parameter values, corporations should issue a non-zero share of inflation-linked bonds. We also find the opportunity costs associated with not issuing IL bonds to be substantial. From an implementation perspective, one

could also use derivatives to adjust interest rate and inflation risk exposures, but derivatives would not be the natural approach for long horizons in the presence of counterparty risk.

Our analysis could be further extended in a number of useful directions. In particular, it would be useful to include other types of instruments, such as convertible bonds, preferred shares and other equity-linked structures in the liability mix, in addition to fixed-rate and floating-rate bonds. On a different note, it should be emphasised that our model, following previous literature, considers the liability allocation

problem from the standpoint of the original owners of the firm, assumed to be risk-neutral with respect to the (diversifiable) source of uncertainty impacting the firm value. In practice, however, the managers of the firm, as opposed to the owners of the firm, are in charge of making corporate risk-management and liability allocation decisions. Academic research has documented the role of conflicts of interests and managerial incentives in the design of corporate debt structure programmes and incorporating the impact of these conflicts of interest would be of relevance.

# Integrated approach to sovereign wealth risk management

Bernd Scherer, Professor of Finance, EDHEC Business School, Member, EDHEC-Risk Institute

## Introduction

Asset allocation for sovereign wealth funds (SWFs) predominantly focuses on optimal portfolio choice with non-tradable wealth (usually resource-based wealth like underground oil). In this framework SWFs will – depending on their preferences – allocate their resources towards a combination of minimum-variance portfolio, speculative demand and hedging demand (against oil price shocks). The generic advice from these models is to invest less in assets with strong positive oil price correlation and instead increase the exposure to recession-hedging assets like government bonds that pay off well if oil prices are down. SWFs following this advice would have avoided in 2008 the large losses incurred with more traditional asset allocation advice. This is essentially a risk management argument with strong support in economic theory. Oil price movements are unpredictable and volatile with extremely wide confidence intervals.

Little research so far has been undertaken in the area of FX reserve-related SWF investments. Resource-based SWF assets are financed through (owned/taxed) foreign currency earnings on commodity exports. These assets provide a very good representation of sovereign wealth that can be used to manage macroeconomic risks or intergenerational distribution. However, many Asian SWFs are instead financed from FX reserves after periods of significant reserve accumulation. Reserve accumulation in managed exchange rate regimes is usually accompanied by sterilisation (ie, the domestic currency created to purchase foreign assets is sterilised through local currency debt issuance). Given that we can think of these funds as being financed through borrowed funds (local currency debt) it is not always clear that they represent net sovereign wealth. In fact, not only do assets grow but so do liabilities (issued bonds for sterilisation purposes). As a consequence, increased economic leverage should induce more conservative asset allocation policies. This illustrates the need to move from an SWF-centric framework to an asset/liability approach integrating sovereign liabilities (monetary base, local and foreign debt). Instead of focusing on SWF assets and liabilities in isolation, the SWF is now integrated into total sovereign assets and

liabilities. This is analogous to modern pension fund investing where a pension fund is being integrated into the corporate balance sheet and capital structure (enterprise-wide risk management) rather than managed in isolation. The size of local- and foreign-currency-denominated debt (or contingent liabilities towards pension systems or industries) relative to foreign reserves and sovereign assets will, for example, determine sovereign leverage and is expected to have a material impact on optimal sovereign asset management. Our research asks how to derive the optimal dynamic asset allocation (DAA) for sovereign assets given different drivers of economic risks as well as varying levels of debt.

## Integrating economic leverage into the one-period model

So far SWF asset allocation has not taken liabilities into account. In fact, there is a widespread belief in the SWF literature that SWFs lack dedicated liabilities. While this is true from the bottom-up view of an SWF portfolio manager it is not true from the top-down view of a sovereign risk manager (sponsoring country). The approach taken in this section is to look at sovereign assets and liabilities in the same way as we would look at corporate assets and liabilities. We present a simplified version of a sovereign balance sheet that can be found in figure 1. All values are in foreign currency. The left side of the sovereign balance sheet contains sovereign assets. These contain FX reserves, the SWF and the present value of the primary budget. The latter can be thought of as the present value of future taxes minus future expenditures. It reflects the present value of economic surpluses from running a country. The right-hand side of the sovereign balance sheet describes how the economy is financed. We view the monetary base and local debt as equivalent to shares such that its local currency value multiplied by the current exchange rate resembles the

sovereign market capitalisation. Foreign currency debt is treated as a senior claim. Sovereign default occurs if sovereign assets fall below foreign debt (in foreign currency). Given that default is costly (ie, it comes with frictional bankruptcy costs in the form of social unrest, capital flight, and so on) we treat the level of foreign currency debt as a hard threshold. If the Modigliani/Miller proposition applied on the sovereign level the asset allocation decision would be irrelevant. Moreover, the above approach offers only an approximate summary of the economic position of a sovereign sponsor. For example, we left out the sovereign sponsor's contingent liabilities against key industries (banks, for example).

An economy with zero foreign debt exhibits a leverage of 0%. Suppose our sovereign desires to maximise the long-term growth of net sovereign wealth (sovereign assets minus

*“There is a widespread belief in the literature that SWFs lack dedicated liabilities. While this is true from the bottom-up view of an SWF portfolio manager it is not true from the top-down view of a sovereign risk manager”*

senior sovereign liabilities). Our model shows that economic leverage leaves hedging demand unchanged but has a material effect on speculative demand. High economic leverage leads to strongly reduced speculative demand. A SWF is not a standalone investment vehicle. Second, an SWF should find it desirable to invest in assets that have low correlation with changes in their primary budget. Assets that offer insurance in bad states for the particular sovereign sponsor (tail hedge) are even more desirable. Economies differ, and so should SWF asset allocation.

As examples we look at China, Russia and the Gulf Cooperation Council (GCC) coun-

## I. Sovereign balance sheet

Assets	Liabilities
Foreign exchange reserves ( $\hat{x}$ )	Monetary base ( $h$ )
Sovereign wealth fund ( $swf$ )	Local currency debt ( $d$ )
Present value of primary budget ( $b$ )	Foreign currency debt ( $f$ )

tries. The main risk factor for the primary budget in China is a slowdown in US consumer demand. Hence a Chinese SWF should not hold US retail stocks (unless return expectations are high enough to generate enough speculative demand to offset negative hedging demand). In fact a Chinese SWF might want to sell short Wal-Mart stocks (the biggest US retail stock highly dependent on Chinese exports and the main distribution channel for cheap Chinese goods to Americans). On top of hedging a fall in US consumer demand it will also prove to hedge a renminbi appreciation. The situation in Russia is different. Here the Russian budget is strongly dependent on oil price growth combined with economic balance sheet leverage. Finally, the GCC countries share the dependence of Russia on oil revenues, but with much less economic balance sheet leverage (GCC countries have little outstanding foreign debt).

**The multi-period model of SWF portfolio choice**

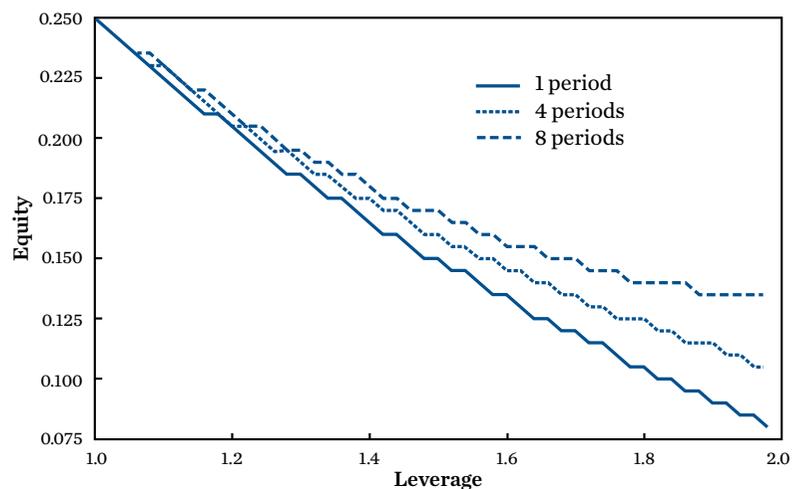
Suppose the objective of the SWF is to maximise long-term portfolio growth of net sovereign wealth. Net wealth decreases as economic leverage increases. The sterilisation of accumulated FX reserves arising from undervalued exchange rates results in increased sovereign leverage and should hence lead to less aggressive investment policies. To model sovereign assets we use equity (MSCI US), bonds (Barclays Long Treasury Index) and cash (rolling one-month US T-bills). We assume the primary budget is driven by commodity prices (GSCI). All data are quarterly and run from Q1 1970 to Q4 2009. We assume  $n = 12$  (three-year time horizon with quarterly rebalancing). Figure 2 shows the optimal equity allocation for a sovereign sponsor with 50% of sovereign wealth being tied up in sovereign financial assets for a one-period, four-period and eight-period investor.

Given the high volatility of the primary budget (approximated by GSCI commodities) even the most aggressive sovereign sponsor will invest only 25% in US equities. This amount falls as economic leverage increases. The remainder of the portfolio will be invested in bonds. For an investor with four periods to go the optimal asset allocation in the first period is higher than for a one-period myopic investor. This reflects the advantage of our dynamic stochastic programme. We can afford to invest a higher portion of current wealth in equities because we are aware that the optimal asset allocation can be reduced if period-one returns disappoint. This logic carries over to the eight-period investor. For low leverage there is virtually no difference between the optimal dynamic and the rollover myopic investor.

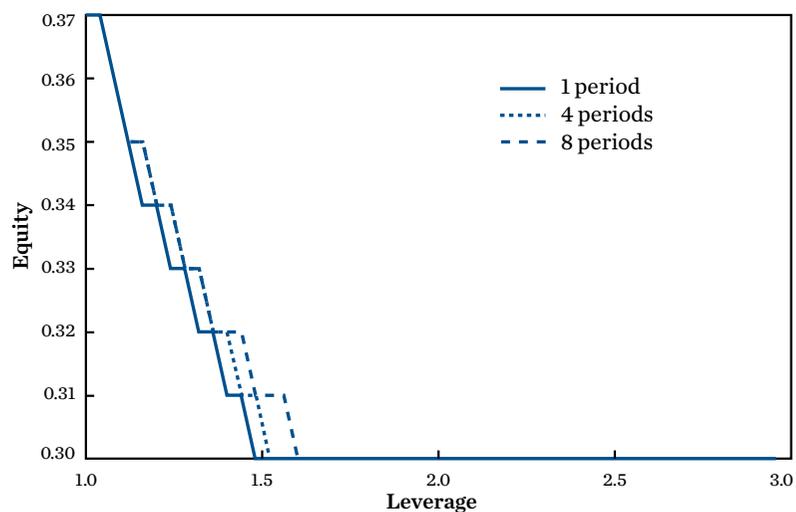
**The impact of constraints**

Investment guidelines designed by SWF risk management committees often impose target ranges for SWF asset allocation purposes. For example, if the target allocation to equities is set to 50%, tactical boundaries of 40% and 60% are set. While initially thought to be conservative this will reduce the benefit of purely risk-based dynamic decision making. Figure 3 shows the impact of a [70%/30%] range on the optimal equity allocation over time. The equity allocation is smaller over all time horizons when compared to the unconstrained case as risk management effectiveness is largely reduced. Our dynamic stochastic programme is not allowed to invest 100% in cash if leverage becomes very high.

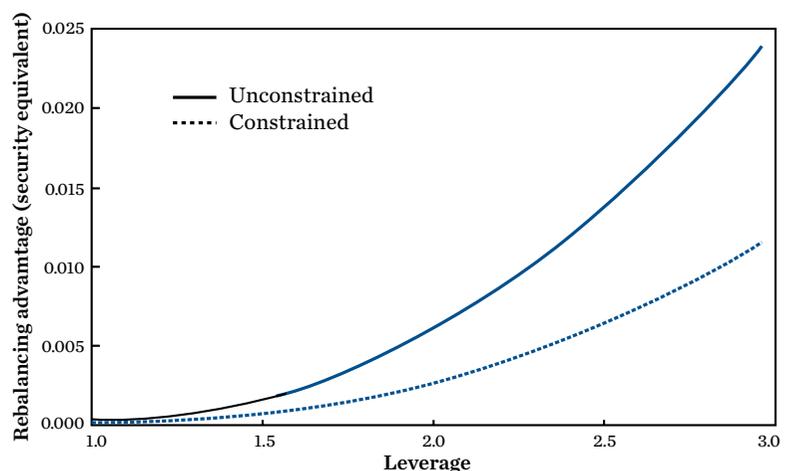
**2. Optimal asset allocation for a one-, four- and eight-period unconstrained investor ( $q = 0.5$ )**



**3. Optimal asset allocation for a one-, four- and eight-period constrained investor (70%/30% range for equities and bonds)**



**4. Impact of constraints**



This has consequences for the extent of the rebalancing advantage (advantage of dynamic decision-making versus a buy-and-hold investor) summarised in figure 4. We see that the rebalancing advantage is small for investors with little leverage. In this case the difference from a constrained solution is also small as the constraints do not bind. However, as we are increasing leverage the difference between optimal and myopic solutions grows and so

does the advantage of having few constraints. Dynamic investment policies are even more desirable for highly leveraged sovereigns.

The author thanks Steffen Kern for his valuable comments and Deutsche Bank for its research support. This research is drawn from the Deutsche Bank research chair at EDHEC-Risk Institute on 'Asset-Liability Management Techniques for Sovereign Wealth Fund Management'.

# The Ultimate Degree for Finance Executives

**EDHEC-Risk Institute PhD in Finance**

London • Nice • Singapore

Since 2008, EDHEC-Risk Institute has been offering a unique PhD in Finance programme to elite practitioners who aspire to higher intellectual levels and aim to redefine the investment banking and asset management industries.

Drawing its faculty from the world's best universities and enjoying the support of a leader in industry-relevant academic research, the EDHEC-Risk Institute PhD in Finance creates an extraordinary platform for professional development and industry innovation.

Following a stimulating scientific curriculum and working individually with leading specialists on research issues of particular relevance to their organisations, practitioners on the programme's executive track learn to leverage their expertise and insights to make original contributions at the frontiers of financial knowledge and practices.

Challenging professionals to step back, reflect, and generate radical innovations, the EDHEC-Risk Institute PhD in Finance is the ultimate degree for finance executives.

**Next information sessions:**

March 15 (Singapore), March 17 (Kuala Lumpur), March 24 (Jakarta),  
April 4 (Dubai), April 6 (London).

To reserve your place, email [maud.gauchon@edhec-risk.com](mailto:maud.gauchon@edhec-risk.com),  
or call us now on +33 493 183 267 or on +65 64 389 896.

**Next application deadlines:**

Executive Track: May 13      Residential Track: March 31

<http://phd.edhec.edu>

EDHEC Business School is accredited by:



**EDHEC-RISK**  
Institute

