

INVESTMENT & PENSIONS EUROPE WINTER 2010/11

# EDHEC-Risk Institute Research Insights



## **EDHEC-Risk Institute Research Insights**

## **Introduction Noël Amenc**

I is a great pleasure to introduce this special supplement of *Investment & Pensions Europe* on the occasion of the EDHEC-Risk Institutional Days 2010, which are being held for the first time in Monaco. This year's event represents a milestone for EDHEC-Risk Institute because it is also the first time that our flagship institutional conference has been organised in conjunction with the IPE Pension Fund Awards, thus providing an exceptional opportunity for the awards ceremony attendees to take advantage of their visit to Monaco in order to bring themselves upto-date with the latest developments in institutional investment research.

This supplement complements the Global Institutional Investment Conference at the EDHEC-Risk Institutional Days 2010 and aims to provide researchbased solutions to some of the key challenges facing institutional investors today.

One of the most prominent of these challenges is to find an appropriate benchmark for institutional investments. As Lionel Martellini points out in his article on alternatives to cap-weighted indices, the latter have become an integral part of the investment process of long-term investors such as pension funds, endowments and insurance companies, even though convincing empirical evidence from academic research shows that cap-weighted indices provide an inefficient risk/return trade-off. Another key question is whether currently available bond indices are optimal for investors. In their article, Carlos Campani and Felix Goltz review some of the problems with existing corporate bond indices, outline some alternatives that have been proposed and conclude that for investors to embrace indexing of their corporate bond investments, improved index construction solutions need to become a priority for index providers.

In order to be able to bridge the gap between the results of academic research and the practices in the financial industry, it is of course essential to have a clear idea of what exactly the professional practices are. For many years EDHEC-Risk Institute has been conducting industry surveys that lead to publications which include both the results of the survey and the academic background to the survey topic. In his article on a recent survey of European pension funds, advisers, regulators and fund managers, taken as part of the AXA Investment Managers research chair on Regulation and Institutional Investment at EDHEC-Risk Institute, Samuel Sender explains that there are biases that prevent many pension funds from managing their assets optimally. In theory, rule-based risk-controlled investing and discretionary economic capital should lead to the same insurance of risks, but the reliance on discretionary investment policies involves the risk of delays and of behavioural biases that distort the theoretical strategy. We thus recommend more reliance on rule-based strategies

even for the management of economic capital and prudential risk-based regulations. Very simple and intuitive methods that require little or no mathematical background can prove to be efficient means of insuring risks.

In their article on integrated asset-liability management, which is based on research carried out as part of the Asset-Liability Management and Institutional Investment Management research chair at EDHEC Risk Institute, supported by BNP Paribas Investment Partners, Lionel Martellini and Vincent Milhau look at the impact of pension fund allocation decisions on the wealth of shareholders, bondholders and pensioners. Their model has important policy implications in that it provides a first step towards a much needed methodological framework for the design of firm-specific regulatory constraints and accounting valuation principles. It also has a number of implications in terms of investment decisions at the pension fund level, and funding decisions at the sponsor company level.

In a separate article, Bernd Scherer examines the optimal asset allocation for sovereign wealth funds. Our research in this area is drawn from the research chair on Asset-Liability Management Techniques for Sovereign Wealth Fund Management in partnership with Deutsche Bank, which is managed by EDHEC Risk Institute-Asia in Singapore. While outlining the benefits of the asset-liability management approach, Professor Scherer refers to themes that will be of crucial importance in years to come, such as the impact on sovereign funds of resource uncertainty, governance costs, and the macroeconomic leverage of an economy.

Our final contribution focuses on the question of whether private wealth managers will adopt institutional investors' risk management techniques. A survey conducted with the support of Ortec Finance as part of the Private ALM research chair at EDHEC-Risk Institute shows the relevance of customised risk management and asset-liability management techniques to professionals but reveals that while the concepts are useful, there is a lack of well-adapted practical tools available today that would allow the managers to move towards integrating such techniques in their investment process.

We wish you an enjoyable read of the supplement and extend our warmest thanks to IPE for this editorial partnership. As EDHEC-Risk Institute prepares to celebrate its tenth anniversary in 2011 we hope to continue 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

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# Alternatives to cap-weighted indices

Lionel Martellini, Professor of Finance, EDHEC Business School, Scientific Director, EDHEC-Risk Institute Felix Goltz, Head of Applied Research, EDHEC-Risk Institute

ap-weighted equity indices have come to dominate the market for equity index products. Standard & Poor's introduced its first cap-weighted stock index in 1923. Such indices were meant to provide information on the market's mood and direction and often serve as a bellwether for the economy. The leading economic indicator computed by the Conference Board, for example, has such a stock market index as one of its components. Stock market indices have also become a popular underlying for derivatives contracts. In 1982, the Chicago Mercantile Exchange introduced futures contracts on the S&P 500 index and, one year later, the Chicago Board Options Exchange listed options on the same index. The predominance of cap-weighting in equity index construction is closely linked to these uses. Arguably, reflecting the performance of stocks in proportion to their market capitalisation allows a good representation of market movements. And, for the kind of short-term trading needed to replicate derivatives contracts, the liquidity inherent to cap-weighting is an advantage.

However, investors do not use equity indices only to obtain information and for short-term trading. Today, cap-weighted indices have become an integral part of the investment process of long-term investors such as pension funds, endowments, and insurance companies. The choice of an index will have a critical impact on both asset allocation and performance measurement. In particular, by creating a set of rules for selection of the asset universe, the weighting scheme of the selected assets, and periodic rebalancing, a particular index construction method will direct the risk exposures and performance of related passive investment vehicles and of active mandates managed with reference to the index.

To be useful in the investment process, an index must be more than a reliable indicator of short-term market movements. Bailey, Richard, and Tierney (1990) and Bailey (1992) point out that a chosen benchmark needs to be unambiguous, investable, measurable, appropriate, reflective of the investor's current investment views, and specified in advance. These criteria may of course be fulfilled by construction methods other than cap-weighting, leaving room for different weighting schemes.

Such alternatives have been developed in response to critiques of capitalisation weighting. About 20 years ago, many papers (such as Haugen and Baker (1991) among others) presented convincing empirical evidence that cap-weighted indices provide an inefficient risk/ return trade-off. In pursuit of a more representative weighting scheme, recently launched indices have proposed to weight stocks by firm characteristics such as earnings or book value (Arnott, Hsu, and Moore 2005). Other indices weight stocks to achieve the highest risk/reward efficiency (Amenc et al. 2010) or the lowest possible portfolio volatility (Nielsen and Aylursubramanian 2008). Other approaches have focused on constructing maximum diversification benchmarks (Choueifaty and Coignard 2008) or equal-risk contribution benchmarks (Maillard, Roncalli, and Teiletche 2008).

As a consequence of these developments, investors now have a wide range of weighting schemes at their disposal. A natural question is to ask how these schemes compare. In particular, these indices have very different objectives, ranging from minimising risk to improving the representation of the economy through a stock market index. They also use very different types of information to attribute weights. including risk/return data, accounting data, or even ignoring any information, as in the case of equal weighting. A detailed comparison will help investors decide which of these alternatives are most useful to them. Among the aforementioned approaches, our analysis focuses on those approaches that have given rise to indices published by major index providers. In particular, we focus on the four following weighting schemes that have been used by the main index providers to propose alternatives to marketcap-weighted indices: efficient indices (FTSE), fundamental indices (FTSE), minimum-volatility indices (MSCI), and equal-weighted indices (S&P). Our performance analysis roughly covers the past decade, for which data a variety of indices is available.

It should first be noticed that the various alternative indexation methods not only have very different objectives but also exploit very different sources of information to reach their objectives. Cap-weighted indices and fundamental indices are mainly concerned with representivity by weighting stocks by firm characteristics, either market capitalisation or accounting characteristics. Minimum volatility indices and efficient indices, on the other hand, exploit information in the returns data of constituent stocks, concerning either volatility and correlation (for minimum-volatility indices) or volatility, correlation, and expected returns (for efficient indexation). Equal weighted indices are the extreme in the sense that they do not exploit any stock-specific information. Their weights can be computed simply from the number of constituent stocks in the index without any further knowledge of any characteristics of these stocks.

R igure 1 shows performance statistics for different US equity indices, both non-capweighted equity indices and two of the most commonly used cap-weighted indices. The statistics are based on 11 years of weekly data from 8 January 1999 to 1 January 2010.

The analysis of their performance clearly shows that the non-cap-weighted indices beat the standard cap-weighted indices such as the S&P 500 and the Russell 1000 in terms of riskadjusted performance.

Moreover, the 'improved beta' strategies achieve the main objectives, which vary widely from one non-cap-weighted index to another, that they have set for themselves. The efficient index, whose aim is higher risk/reward efficiency, does indeed obtain the highest Sharpe ratio of all the indices. The minimumvolatility index obtains the lowest volatility. Equal-weighted indices and fundamental indices

## 1. Performance statistics

	Non-cap-weighted					Cap-weighted	
	Efficient	Minimum	Fundamental	S&P 500	S&P	Russell	
	index	volatility	index	equal-weighted	500	1000	
Average return (geometric)	6.4%	2.5%	5.3%	5.7%	0.9%	1.3%	
Standard deviation	19.4%	16.6%	20.5%	21.4%	19.8%	20.0%	
Semi-deviation (below zero)	13.9%	12.2%	14.5%	15.2%	14.3%	14.4%	
Tracking error (w.r.t. S&P 500)	5.8%	6.6%	6.5%	6.5%	0.0%	1.3%	
Beta (w.r.t. S&P 500)	0.94	0.80	0.99	1.03	1.00	1.01	
Sharpe ratio	0.18	-0.03	0.11	0.13	-0.10	-0.08	
Sortino ratio	0.46	0.20	0.36	0.38	0.06	0.09	
Information ratio	0.95	0.24	0.67	0.75	na	0.32	
Treynor ratio	0.04	-0.01	0.02	0.03	-0.02	-0.02	
95% value-at-risk	4.4%	3.9%	4.4%	4.8%	4.5%	4.6%	
99% value-at-risk	11.0%	10.3%	11.9%	11.3%	10.5%	10.6%	
Skewness	-0.62	-0.83	-0.39	-0.46	-0.50	-0.49	
Kurtosis	9.44	10.89	10.20	8.43	8.33	8.35	

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

	Non-cap-weighted					
	Efficient	Minimum	Fundamental	S&P 500		
	index	volatility	index	equal-weighted		
Difference in average return	5.5%	1.6%	4.4%	4.9%		
p-value	-0.4%	61.6%	2.5%	1.0%		
Difference in volatility	-0.4%	-3.2%	0.8%	1.6%		
p-value	64.3%	0.0%	36.1%	5.8%		
Difference in Sharpe ratio	0.28	0.08	0.22	0.23		
p-value	0.2%	53.6%	2.7%	1.0%		

obtain higher average returns as a result of their mechanical rebalancing feature.

Figure 2, based on the same 11 years of weekly data, shows differences in average returns, in volatility, and in Sharpe ratios between each index and the cap-weighted S&P 500 and the associated p-values computed from suitable tests of statistical significance. Differences that are significantly different from zero at the 5% level are indicated in bold.

It can be seen from Figure 2 that the noncap-weighted indices lead to significantly higher Sharpe ratios, while the minimum volatility approach lowers the volatility but does not increase the Sharpe ratio significantly. Efficient indices, which are the newest of the strategies analysed in this comparison, obtain the highest Sharpe ratios. Their volatility is lower than that of equal-weighted and fundamental-weighted indices, and since they are not subject to the same tilt towards low beta stocks their average returns are higher than those of minimumvolatility indices.

t should also be noted that on top of the performance numbers presented in Figure 2, 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 crucial. Minimum volatility indices for example do not explicitly aim at maximising the Sharpe ratio except if one introduces quite strong assumptions concerning stocks' expected returns. In particular, minimum variance portfolios only maximise the Sharpe ratio if all constituents have identical expected returns. Fundamentally weighted indices do not explicitly take into account any information on expected returns and covariance. Therefore, it is not clear why such indices would constitute well diversified portfolios, and even less clear why they would maximise the Sharpe ratio.

That the four weighting schemes have different risk and return properties and that they incorporate very different types of information also suggests that different investors may choose different alternatives, depending on which characteristic they value most. Likewise, investors should consider which explicit or implicit assumptions they deem to be reasonable. Moreover, combining these alternatives may be an option for investors without a view on these issues, to allow them to move away from the inefficiencies of capitalisation weighting.

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# Are currently available corporate bond indices optimal for investors?

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hen choosing a benchmark for corporate bond portfolios, investors should carefully consider which type of bond index they choose. From an investor's perspective, appropriate selection and adequate use of corporate bond indices is not a simple task. In fact, there are various shortcomings of bond indices and with the way their constituents are weighted. This article reviews some of the problems with existing corporate bond indices and outlines some alternatives that have been proposed.

## Shortcomings of corporate bond indices

The two main problems, the reliability problem, and the concentration problem, or so-called 'bums problem', are explained below.

Index investors typically see indices as a somewhat 'neutral' investment. In other words, they expect risk factor exposures to be relatively stable over time so that decisions that have been made on risk exposures at the asset allocation level are not compromised by fluctuations of risk exposures within the building blocks that have been chosen to implement these decisions. The two relevant risk exposures when considering corporate bonds are of course interest rate risk and credit risk.

It has been argued that the existing corporate bond indices do not provide reliable interest rate risk exposures as their duration is more a result of issuers' preferences than of investors needs. The conflict of interests between issuers and investors about the duration of corporate bonds has been described in detail by Siegel (2003). Each bond investor has a specific time horizon of his investment in mind, and there is no reason to expect that these needs correspond to the optimal financing plan of the issuers. In fact, the duration structure of outstanding bonds reflect the preferences of the issuers in their aim to minimise the cost of capital. This minimisation is fundamentally opposed to the interest of the investors, who usually try to maximise their returns.

The duration mismatch in the corporate bond market is of primordial importance to investors. Pension funds for example have some fixed nominal liabilities originating from their defined benefit plans. Given this long-term perspective, long-term bonds are a much better hedge than short-term debt. Issuers of such bonds have to pay therefore only a small yield premium – even though they are more volatile. In contrast, for short-term investors with no fixed time horizon in mind such investments are far less attractive. As a result, there is no general bond investment strategy in terms of duration. Rather each investor has different needs.

The duration of the indices is however a result of the sell-side of corporate bonds – so that no investor should hold just this benchmark duration.<sup>1</sup> Hence, many corporate bond indices are not adequate for serving as benchmark for corporate bond investors.<sup>2</sup> Siegel (2003) concludes that the choice of duration is an active asset allocation decision which should not be left to the index.

Other than not necessarily matching investors' needs in terms of the level of duration, it is clear that corporate bond indices, which simply reflect the value-weighted duration available on

"It has been argued that the existing coporate bond indices do not provide reliable interest rate risk exposures as their duration is more a result of issuers' preferences than of investors' needs"

the market, will also suffer from pronounced changes in duration. Investors typically have a desire to control their exposure to interest rate risk rather than simply submit their portfolio risk exposures to the changing structure of bonds available in the market. The following graphs (Figures 1 and 2 on page 4) show that differences in risk exposure can be quite dramatic both across indices and across time.

Similar arguments can of course be made with respect to the credit riskiness. When using a debt-weighted index for the investment grade corporate bond universe, for example, depending on the issuance of corporate bonds ►

<sup>1</sup> Siegel (2003) calls the duration of an index an "historical accident".
2 Duration is a measure for bonds' risk exposure to interest rate changes, as beta is a stock's risk exposure to market movements. However, although the beta of the market is always 1, there is no 'neutral' duration of the corporate bond market.

## 1. Comparative duration time series



The graph is based on index duration as provided by Datastream for the time period from 1 January 1997 until 31 December 2009 (3.392 daily datapoints). The indices used are the Dow Jones US Corporate Bond Index (equal-weighted) and the Barclays US Corporate & Investment Grade Index (cap-weighted)

## 2. Average credit risk



We plot the average credit risk exposure time evolution for Barclays and BofA Merrill Lynch US broad corporate bond indices. The risk is the expected percentage of defaulted bonds (in terms of market value) within 10 years.

▲ on the market, the index will give a more or less pronounced allocation to various rating segments. Figure 2 below shows fluctuations in the average credit riskiness of two widely used corporate bond indices. Just like in the case of variations in durations, such variations in credit riskiness may not be desirable to investors, who wish to keep a constant credit risk exposure rather than following arbitrary fluctuations in an index.

Another severe problem of corporate bond indices is the so-called 'bums-problem' (Siegel, 2003). The bums problem denotes the fact that issuers with a large amount of debt outstanding account for a relatively large fraction of the total debt market – although the creditworthiness of the issuer is likely to be adversely affected by large outstanding debt issues. Thus, corporate bond indices that are capitalisation weighted have a tendency to be overinvested in rather risky assets, which are more likely to be downgraded or even default. Increased exposure to such assets might lead to a lower total performance of the overall portfolio. Alternative weighting schemes, as discussed in the next section, attempt to offer a solution to the problem.<sup>3</sup>

### Alternative weighting schemes

Mainly because of the above-mentioned shortcomings of market capitalisation-weighted indices, alternative weighted schemes have been proposed.

An alternative to cap-weighted indices is equally weighted indices. These indices attribute the same weight to all issues that are eligible to take part in the index composition. Equally weighted indices are much easier to calculate since there is no need to keep track of the outstanding amount of debt (unless, however, the bond falls below some minimum requirements). Another advantage of equally weighted indices is that they reduce the bums problem capitalisation-weighted indices are exposed to, since equal weighting automatically limits the exposure to large debtors with creditworthiness. However, if important debtors not only have larger issues compared to other borrowers, but also issue more (different) tranches of debt, the bums problem is still relevant.

There is a significant negative dimension to equally weighted indices: since relative prices change constantly, the portfolio has to be rebalanced at regular intervals even though the index universe does not change. From a pure index calculation perspective, this is of course not an issue. However, in the case that the index is used as basis for bond portfolio investments, ongoing reshuffling can provoke significant transaction costs, thereby reducing overall performance.

Recent literature by Arnott *et al.* (2010) transfers the idea of fundamental indexation

## "Overall, there are few

alternatives available to investors today who wish to avoid the problems inherent with standard corporate bond indices. This fact probably explains why passive investing in this asset class clearly lags behind compared to its success in equity investing

from equities to the fixed income universe. They analyse whether weighting schemes that are based on fundamental company characteristics, such as the firm's total cash flows, dividend payments, book value of assets, sales, would have performed better than the standard market capitalisation form of weighting. In fact, the authors find that bond indices that are based on such fundamental company characteristics perform better than the corresponding market capitalisation-based benchmarks. However, the difference is not large and in many cases statistically not significant.

Overall, there are few alternatives available to investors today who wish to avoid the problems inherent with standard corporate bond indices. This fact probably explains why passive investing in this asset class clearly lags behind compared to its success in equity investing. This may be disappointing as indexing comes with many advantages that are well recognised, such as transparency and low cost. For investors to embrace indexing for their corporate bond investments, developing improved index construction solutions needs to become a priority for index providers.

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<sup>3</sup> Default risk is usually compensated for by higher returns. Thus, *a priori*, higher risk exposure is not bad in itself.

# Rule-based strategies for pension funds

## Samuel Sender, Applied Research Manager, EDHEC-Risk Institute

DHEC-Risk Institute undertook a recent survey of pension funds, their advisers, regulators, and fund managers. A total of 129 of these asset and liability management (ALM) professionals, representing assets under management (AUM) of around €3trn, responded to the survey, taken as part of the AXA Investment Managers research chair in regulation and institutional investment at EDHEC-Risk Institute. Respondents in continental Europe generally have hybrid liabilities (23% in central and southern Europe and 71% in northern Europe), a reflection of the shift from traditional defined benefits to hybrid pension plans. Hybrid schemes do not exist in the UK.

### Hedging risk away and the liabilityhedging portfolio

The first challenge for a pension fund involves meeting its liabilities by hedging this risk away, usually with a liability-hedging portfolio (LHP), the portfolio that best replicates liabilities. Pension funds generally hedge their interest rate and inflation risks. The survey, however, suggests that the LHP is not fully modelled at 45% of pension funds. After all, 46% of respondents use optimisation tools such as surplus optimisation or economic capital that do not require an LHP.

When pension funds do define an LHP, the instruments it contains vary across geographies. In the UK, formal indexation to inflation is the standard, and inflation-linked assets account for more than 20% of the portfolios of 64% of UK respondents; there, caps and floors in the indexation formula explain the reliance on inflation derivatives, which represent more than 20% of the LHP of 40% of respondents from the UK compared to 12% in continental Europe.

### Asset-management and riskdiversification practices

The second challenge for pension funds is to gain access to performance. Their exposure to the markets can be set in a performance-seeking portfolio (PSP), in which market risk should be optimally diversified. The PSP has a mix of asset classes and an appropriate benchmark for each asset class. We find that 81% of pension stakeholders use highly sub-optimal market indices as benchmarks for their investment funds. They should rather resort to simple heuristics such as the equally weighted portfolio, to fundamental indices (Arnott, Hsu, and Moore 2005), to optimisation methods to try to build efficient portfolios (Amenc et al. 2010) or by default minimum-variance portfolios (DeMiguel, Garlappi, and Uppal 2007).

Equities often account for a large share of the PSP (on average, 32%), much larger than that of potentially illiquid assets (hedge funds, private equity, and infrastructure), even though pension funds, as long-term investors unburdened by liquidity concerns, are in a good position to take on liquidity risk.

Dynamic risk-budget management and the

management of minimum funding ratios

After hedging and diversification, the third challenge for pension funds is to ensure that minimum funding ratios are not breached by insuring risk away. Prudential regulations generally require recovery plans involving additional contributions from the sponsors when funding requirements are not met. IAS19 also penalises sponsors whose pension funds have funding ratios that lie outside the 90–110% range. Defined benefit pension funds usually look to ward off deficits which the sponsor may not fully compensate.

Stricter regulations have led to the development of risk-controlled insurance (RCI) techniques that focus on risk control through state-dependent asset allocation to ensure that minimum funding constraints are respected. When incorporating terminal funding constraints in the utility function, pension funds can rely on the martingale or convex duality approach to dynamic asset allocation problems (Karatzas, Lehozcky, and Shreve 1987; Cox and Huang 1989), first to find the optimal terminal payoff - an option - then to replicate this terminal payoff. This replication requires a form of dynamic asset allocation that may be called dynamic risk-budget management or risk-controlled investing (RCI). RCI strategies can be illustrated with the following weight function:

 $\omega = f_1(A_s, RB_s) \cdot \omega_L + f_p(RB_s) \cdot \omega_{PSP}$ 

where  $\omega_L$  represents the LHP and  $\omega_{PSP}$  the PSP, *A* the asset value, and *f* designates the allocation to the building blocks based on *RB*, the risk budget:

$$RB_s = \left(1 - \frac{k}{F_s}\right)$$

with F the funding ratio at time s. The allocation to the LHP reflects the hedging of liability risk. (The amount of hedging depends on the utility function of the pension fund and on its risk budget. Regulatory constraints usually involve hedging so that the surplus is not sensitive to interest rate risk.) The allocation to the PSP depends on the risk budget, and may be simply a multiplier of the risk budget (when the pension fund has CRRA utility over the excess of the terminal funding ratio over k). And simple heuristics based on these insights ensure that risks are covered.

Some 50% of pension funds are fully versed in these strategies, but only 30% use them. 28% of respondents, for instance, use these strategies to manage prudential constraints, whereas 56% use economic/regulatory capital, a static risk budgeting method that requires that the value at risk be less than the surplus.

Economic capital, like risk-controlled strategies, relies on a risk budget and a surplus; Binsbergen and Brandt (2007) implicitly suggest that economic/regulatory capital management plus maximum weight constraints result in a strategy similar to the optimal portfolio insurance programme. Economic capital, however, involves a discretionary investment strategy and possible delays. Applying riskcontrolled strategies to economic capital creates what might be called rule-based economic capital, a strategy that would compel pension funds to manage economic capital with less discretion and greater adherence to predefined rules.

## An insufficiently comprehensive view of risks

For RCI or economic capital to effectively insure pensioners against the risk of losses, pension funds must have a comprehensive view of risks. Sponsors offer defined-benefit funds a guarantee that disappears if it goes bankrupt. Pension trustees must act in the interest of participants and should thus manage sponsor risk. Managing sponsor risk may also require dynamic allocation to the sponsor company stock or, when they are available, to credit default swaps or hybrid options. If a major risk such as sponsor risk is not adequately taken into account, then, for all its sophistication, the pension fund may be poorly managed.

Most survey respondents have a blinkered vision of the risks they face: prudential risk (the risk of underfunding) is managed by only 40% of respondents, accounting risk (the volatility from the pension fund in the accounts of the sponsor) by 31%, and sponsor risk (the risk of a bankrupt sponsor's leaving a pension fund with deficits) by less than 50%.

## A lack of performance measurement

In the wake of Brinson, Hood, and Beebower (1986, 1995), numerous academic methods have analysed the drivers of performance in asset management, but they do not yet evaluate portfolio performance in the presence of risk insurance. The lack of recognised academic methods to attribute performance for convex strategies should lead pension funds to benchmark the design of the strategy against its stated goals, but also to assess the quality of the LHP and the risk-adjusted performance of the PSP independently. After all, classic attribution methods usually suffice for these building blocks.

But pension funds generally do not assess the adequacy of their ALM strategies or fail to do so with appropriate metrics: 30% of respondents do not assess the design of the PSP, and more than 50% use crude outperformance measures. Likewise, 27% of respondents do not assess the adequacy of the design of the PSP and the preferred performance measure is the outperformance of a market index, without any reference to risk. These shortcomings may mean that less than optimal decisions are made again and again.

#### Conclusion

The underfunding of sophisticated pension funds in late 2008 suggests that there are biases that prevent many pension funds from managing their assets optimally. In theory, ✓ rule-based risk-controlled investing and discretionary economic capital should lead to the same insurance of risks, but the reliance on discretionary investment policies involves the risk of delays and of behavioural biases that distort the theoretical strategy. As it happens, many Dutch pension funds failed to reduce risk as significantly as the FTK regulation theoretically commands. We thus recommend more reliance on rule-based strategies even for the management of economic capital and prudential risk-based regulations. Very simple and intuitive methods that require little or no mathematical background can prove to be efficient means of insuring risks. For all their sophistication, pension funds seem to make insufficient use of these basic but robust methods.

Amenc, N., Goltz, F., Martellini, L. and P. Retkowsky. 2010. Efficient indexation: an alternative to cap-weighted Indices. EDHEC-Risk Institute Publication (January). Arnott, R., J. Hsu, and P. Moore. 2005. Fundamental indexation. *Financial Analysts Journal.* 61 (2): 83–99 Binsbergen, van J., and M. Brandt. 2007. Optimal asset allocation in asset and liability management. Working paper.

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# Integrated ALM

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One of the main risks for plan participants, actually the only source of uncertainty for a defined-benefit plan with unconditional liability payments, is that of sponsor bankruptcy when the pension plan is underfunded. In an attempt to address this concern, a number of dramatic changes have occurred over the past few decades in the legal, regulatory, accounting and fiscal environments of corporate pension funds, which have collectively led to significantly heightened scrutiny over pension liabilities valuation, with a focus on greater transparency with respect to the impact of both the market and credit risk components on pension obligation values.

Correctly assessing the value of a pension plan in deficit with a weak sponsor company remains, however, a real challenge given that no comprehensive model is currently available for the joint quantitative analysis of capital structure choices, pension fund allocation decisions and their impact on rational pricing of liability streams. In fact, international accounting standards SFAS 87.44 and IAS19.78 recommend that pension obligations be valued on the basis of a discount rate equal to the market yield on AA corporate bonds, the same rate for all firms. While the use of a market rate is arguably a progress with respect to using a constant rate (including a credit spread component or not) independently of market conditions, the use of the same market rate to discount all pension liabilities regardless of the sponsor credit rating, pension funding situations and asset allocation policy is not likely to lead to a correct assessment by the various stakeholders of the impact of specific default risk on the value of pension obligations.

In recent research supported by BNP Paribas Investment Partners in the context of the asset-liability management and institutional investment management research chair at EDHEC-Risk Institute, we have attempted to fill this gap by analysing the valuation of pension liabilities regarded as defaultable claims issued by the sponsor company to workers and pensioners in the context of an integrated model of capital structure.<sup>1</sup> The analysis focuses on the interaction between the allocation decisions of the pension plan and the valuation of these liabilities, thereby extending the capital structure literature and the defaultable bond pricing literature to account for the presence of a pension plan. Our

 I Martellini, L., and V. Milhau. 2010. Capital Structure Choices, Pension Fund Allocation Decisions and the Rational Pricing of Liability Streams, EDHEC-Risk Institute publication. model is a stylised representation of the relationships between various stakeholders of a company with a pension plan, including notably shareholders of the sponsor company, bondholders and beneficiaries of the pension fund (workers and pensioners).

The model can be summarised as follows: the sponsor company issues a debt with face value D, and also issues pension claims, perceived as a collateralised form of debt held by workers and pensioners with face value L. The initial capital of the firm is allocated to funding investment projects (company asset value denoted by V) and to funding the pension plan (pension asset value denoted by A). The pension fund allocates a fraction  $\omega$  of the initial endowment to some performance-seeking portfolio (PSP) and a fraction  $1-\omega$  to some liability-hedging portfolio (LHP). In case the assets of the pension fund A are insufficient to deliver the promised pension payment L, the sponsor makes a contribution equal to the deficit L-A. If the sponsor is unable to make this contribution, default is triggered. If the pension fund enjoys a surplus, equity holders receive a fraction  $\gamma$  of this surplus, which can be used to pay back bondholders. If debt cannot be fully repaid, bankruptcy is also triggered. When default has not been triggered, equity holders are left with the remaining assets of the pension fund and the sponsor, plus their access to surpluses. Otherwise, they receive nothing. We also incorporate tax effects, bankruptcy costs, as well as contributions triggered by the presence of regulatory funding ratio constraints.

Under standard assumptions regarding the dynamics followed by all variables of interest, including the return on the performance-seeking portfolio and the return on the real assets held by the firm, one can use option pricing theory to find the rational value of the claims held by all stakeholders, and also analyse the impact on the value of these claims of funding and leverage decisions at the sponsor company level, as well as asset allocation decisions at the pension fund level. The main ingredients of the model are the size of the pension fund relative to the assets of the sponsor company (L/V), the relative size of the pension assets with respect to the pension liabilities (aka the A/L ratio), and the relative size of the outstanding debt of the sponsor company relative to the assets of the sponsor company (also known as the D/V ratio). Other important parameters are those defining the allocation strategy of the pension fund, as well as the correlation between the return on pension assets and the return on the sponsor company assets<sup>2</sup>.

Our findings have two main kinds of implications, macro implications on the one hand with a number of possible policy recommendations for pension fund regulators, and micro implications on the other hand, with a number of strategy recommendations for pension fund managers. We focus on the latter dimension in this article, and analyse in what follows how investment decisions at the pension level impact stakeholders' wealth.

hen the correlation between the value of the firm process and the stock index return process is positive, we find that the fair value of promised payments to bondholders and pensioners is a decreasing function of the allocation to risky assets by the pension fund. This is a clear case of asset substitution, since a higher allocation to risky assets leads to an increase in the total riskiness of the total assets held by the firm (financial assets held off the balance sheet through the pension funds and real assets directly held on the balance sheet), which is the underlying state variable on which the value of such claims is based. When the correlation is negative, however, a higher allocation to risky assets may induce diversification benefits. This competition between the asset substitution effect and the diversification effect, which has never been analysed in the related literature. leads to an interior optimal solution with respect to maximising total firm value (and also with respect to maximising pensioners' value), at least for reasonably low funding ratios. Overall, there is in general clear evidence of conflicts of interests between the various stakeholders, and in particular between shareholders and pensioners. Assuming they do not have access to any surplus of the pension fund, risk-taking is detrimental from the pensioners' perspective, because it involves increasing the likelihood of partial recovery of pension claims, while risktaking allows shareholders to reduce the burden on contributions needed to meet expected pension payments due to exposure to the upside potential of the performance-seeking assets (see Figure 1).

These conflicts of interests could be mitigated

<sup>2</sup> Institutional elements such as those governing the surplus sharing rule, the tax rate and the bankruptcy costs will also have an impact on the numerical results.

by granting pensioners some partial access to the surplus (cf. conditional indexation rules in the Netherlands), thereby allowing plan beneficiaries to benefit from the increases in expected performance related to more aggressive investment strategies. More generally, our results have implications in terms of the optimal design of pension plans, since they advocate the emergence of more subtle surplus sharing rules, which could include for example the use of hybrid retirement plans, and/or the use of contribution holidays for defined benefit plans, that would allow equity holders to reduce the burden of contributions while protecting the interests of pensioners. We also find that an effective way to align the incentives of shareholders and pensioners without any complex adjustment to the pension plan structure consists of enlarging the set of admissible investment strategies so as to include dynamic risk-controlled strategies such as constant-proportion portfolio insurance (CPPI) strategies, or their extension in a pension management context sometimes referred to as contingent immunisation strategies or dynamic liability-driven investment (LDI) strategies. In fact, implementing risk-controlled strategies aiming at insuring a minimum funding ratio level above 100% allows shareholders to get some (limited) access to the upside performance of risky assets, while ensuring that pensioners will not be hurt by the induced increase in risk (see Figure 2).

While we have found that the benefits of moving away from static allocation strategies to consider even the simplest form of dynamic risk-controlled strategies were substantial for both shareholders and pensioners, it would be useful to try and test more sophisticated forms of welfare improving strategies in a more general dynamic context, including strategies with a floor given as a function of the (regulatory and/or fair) value of the liability portfolio, strategies with a performance cap in addition to floors, which can allow for a decrease in the cost of downside risk protection, as well as strategies involving corporate bonds in the liability-hedging portfolio. This is left for further research.



These figures perform comparative static analysis with respect to the risky asset, when the firm is positively correlated with the market. The pension fund is fully funded in the regulatory sense at the initial date





2. Impact of allocation decisions with risk-controlled strategies

These figures perform comparative static analysis with respect to the multiplier of the constant-proportion portfolio insurance (CPPI) strategy when the firm is positively correlated with the market. The initial funding ratio is 130%, so as to create a positive risk budget. The vertical line identifies the base case, where the initial weight allocated to the stock is 50%

## Will wealth managers adopt institutional risk management?

Felix Goltz, Head of Applied Research, EDHEC-Risk Institute

rivate wealth managers frequently recognise that every client has unique needs and tailoring portfolio advice to their personal investment context is precisely the privilege that these managers offer to the wealthy individual they serve. Academic research findings as well as institutional investment management processes fortunately provide a lot of techniques that allow specific investment-related objectives and constraints to be taken into account. In particular, asset-liability management (ALM) techniques and liability-driven investing (LDI) approaches shift the focus of investments to the capacity to reach certain spending objectives (or 'liabilities') rather than focusing on performance relative to commonly used indices for example. For example, while the riskless asset from a pure asset management perspective is always cash, the riskless asset from an asset-liability management perspective is different across investors. For a

given investor, the riskless asset will be the asset that best hedges the spending objectives of that investor.

#### Investigating current practice in private wealth management

While ALM techniques are widely used in institutional investment management, their adoption would also be natural in private wealth management, where clients are typically concerned more with their relevant purchasing power than with wealth per se. For example, a wealthy individual who wants to spend savings on building up a collection of Japanese art is exposed to risk factors that are different from another individual who plans to use wealth to purchase a penthouse in Manhattan. More generally, the risk faced by the client will depend on the type of assets, the currency and the region of his future expenditures. Taking into account such expenditure objectives

is formally similar to taking into account liabilities of a pension fund for example<sup>1</sup>.

In order to get an understanding of how and to what degree such techniques and concepts are actually used by private wealth managers, EDHEC-Risk Institute, with the support of Ortec Finance, conducted a survey<sup>2</sup> earlier this year of 159 private wealth managers focusing on the mass affluent (financial assets of less than \$1m) to the ultra high net worth individual (financial assets of more than \$30m) segment of private investors. The survey was targeted at a European population of private wealth managers, though Switzerland accounts for almost half the respondents, reflecting its importance in

<sup>1</sup> See Amenc, N. L. Martellini, V. Milhau, and V. Ziemann. 2009. Asset liability management in private wealth management, Journal of Portfolio Mana

<sup>2</sup> See EDHEC-Risk Institute (2010), European Private Wealth Manage ment Practices Survey

◄ private wealth management. The 159 survey participants are mainly made up of very senior investment professionals working within private banks, asset management companies and family offices, with more than half of the respondents representing organisations managing more than €1bn in private clients' money.

The survey reveals that private wealth managers see the close relationship with their clients as a main source of their value added. They do not however exploit this closeness by truly customising solutions to their clients' needs, as evidenced by the fact that market factors are more frequently taken into account than individual characteristics in designing portfolios for clients. Taking into account client-specific spending objectives is seen by private wealth managers as having the potential of adding great value but the approach is currently being implemented by only a small minority of private wealth managers.

Overall, the survey results show the relevance of customised risk management and asset-liability management techniques to professionals but reveal that while the concepts are useful, there is a lack of well-adapted practical tools available to them today that would allow them to move towards integrating such techniques in their investment process.

#### Private ALM is still rarely used

Wealth managers are dissatisfied with standard investment management methods and concepts, in particular when it comes to incorporating the client's spending objectives. The most widely known methods for investment analysis are judged best in terms of their usefulness in communicating with clients and their capacity to capture clients' preferences in terms of investment risk and time horizon. Wealth managers are most critical about the current methods' ability to incorporate the client's spending objectives. These results clearly highlight possible space for improvements in this area.

Likewise, when assessing in more detail which concepts private wealth managers are most familiar with, it becomes clear that such methods (such as mean variance analysis, fundamental and macroeconomic analysis, performance analysis and due diligence) are quite unrelated to specific spending objectives of clients, and private wealth managers recognise themselves that these methods are of little value in addressing such client-specific spending objectives.

A look at some detailed results of the survey makes this clear: on average 77% of respondents are familiar with methods such as fundamental analysis, macroeconomic analysis, due diligence, performance evaluation and mean-variance portfolio construction, which respondents judge to not be very useful in addressing client-specific spending objectives (average rating of 0.95 out of 2). On the other hand, only 59% of respondents on average are familiar with techniques such as asset-liability management and life-cycle portfolio choice (which receive an average score of 1.31 out of 2 in terms of usefulness for addressing client-specific spending objectives).

A majority of private wealth managers are not familiar with asset-liability management techniques and among those who are familiar with the concept, a majority do not apply it. A large majority of those who have knowledge about asset-liability management techniques but do not currently use them nevertheless judge them to be useful, showing that the low adoption of asset-liability management techniques in PWM compared to institutional investment management is not due to a poor evaluation of these techniques but rather due to a lack of managers who are actually putting such concepts into practice. A main factor hindering wider adoption is the perceived difficulty of implementation.

To cite precise numbers on key results on asset-liability management adoption, half the respondents (48%) are not familiar at all with asset-liability management. Only 29% of respondents actually use asset-liability management concepts in their asset allocation.

When considering liability-hedging properties of various asset classes, PWMs mainly focus on general inflation, as opposed to client-specific inflation. Thus asset-liability management seems to be mainly seen as a tool for hedging against approximated or "typical" liabilities whereas optimal solutions should in principle put emphasis on investor-specific liabilities.

In particular, inflation-linked bonds, real estate and commodities receive ratings of 3.2 to 3.7 out of six in terms of their usefulness in hedging inflation for private clients, but respondents attribute less usefulness (with scores in the range of 2.25 to 2.6 out of six) when it comes to more specific liability-hedging solutions like customised equity portfolios fulfilling specific hedging demands or specific derivatives contracts. Likewise, only a minority of those respondents who actually employ an asset-liability management approach focus on integrating client-specific spending objectives as opposed to general inflation-oriented objectives.

Private wealth managers are keen to adopt an asset-liability management approach but implementation remains a challenge

Results from a quantitative survey provide a comprehensive picture of current practices but it is more difficult to assess the respondents' future plans and intentions. A series of face-to-face meetings with private wealth managers across Europe has allowed us to reflect on the findings of the quantitative survey and to discuss with private wealth managers where they see the areas of progress and the key issues for the future of private wealth management.

The interviews show that private wealth managers clearly see value in integrating client-specific spending objectives through an asset-liability management framework. In fact, it becomes clear from the interviews that thinking of the client's investment problem in terms of managing assets relative to spending objectives is natural to private wealth managers. They recognise that client wealth in the end only has the function of allowing them to fulfil consumption objectives. They are aware that often clients have specific targets such as retirement and often also have specific ideas about the type of spending or consumption that is important to them. Interviewees also agree that risk is perceived by clients as the inability to reach objectives, rather than the risk of not preserving capital in nominal terms.

Consequently, private wealth managers have a keen interest in advanced asset-liability management techniques that would allow them to take into account client objectives and corresponding hedging demands. While the concept is clearly judged to be relevant and advanced asset-liability management techniques are available from research, the private wealth management industry as a whole faces hurdles with implementation. Thus, while asset-liability management is perceived as an avenue of progress for the future, the private wealth management industry requires better tools for advanced customised risk management so as to be able to better serve their clients.

# Optimal asset allocation for sovereign wealth funds

## Bernd Scherer, Professor of Finance, EDHEC Business School

**F** or the purpose of this contribution I define sovereign wealth funds (SWFs) as sovereign investment vehicles (returns enter the government's fiscal budget) with high foreign asset exposure, non-standard liabilities and a long (intergenerational) time horizon.<sup>1</sup> Among the 10 biggest SWFs we find eight funds that are sourced from oil revenues. Given an estimated market size of about \$3trn at the beginning of 2008 the three biggest oil revenue funds account for 52% of total SWF assets.

Given the mediocre long-term performance

of spot oil (underground wealth) SWFs have been created to perform an oil-to-equity transformation to participate in global growth. The speed of this transformation will depend on the optimal path of extraction, which depends in turn on the impact of increased supply on oil prices, extraction costs (technology) and oil price expectations.

Given an estimated \$40trn value of underground oil compared to \$50trn in global equities, SWFs will have a major impact on global equity markets. This will also lead to a shift from traditional reserve currencies (dollar, yen) to currencies from emerging markets, where much of the global growth is to be expected. For many oil-exporting countries, crude oil or gas reserves are the single most important national asset. Any change in the value of reserves directly and materially affects these countries' wealth, and thus the wellbeing of their citizens.

Sovereign wealth funds have been created to manage macroeconomic risks and to increase economic diversification. We have evidence that managing macroeconomic risks increases growth. Oil price movements are unpredictable and volatile with extremely wide confidence intervals. This provides a powerful argument to reduce the volatility of oil-related revenues with a positive impact of consumption smoothing on total welfare. The usual routes to consumption smoothing, ie, borrowing funds or hedging revenue risk, are not available due to limited

<sup>1</sup> This research is supported by Deutsche Bank as part of the "Asset-Liability Management Techniques for Sovereign Wealth Fund Management" research chair at EDHEC Risk Institute.

access to international debt markets (precautionary savings motive) or incomplete markets for oil price hedging instruments (size, liquidity, contract choice).

Related to this is the idea of economic diversification. Diversify an economy away from its vulnerability to oil price shocks: macroeconomic diversification (developing a competitive non-oil sector) and investment diversification (setting up an international SWF). To an economist, macroeconomic diversification runs counter to specialisation advantages and takes a long time to implement. Investment diversification (SWF) is faster and easier to implement as the preferred route of self insurance.

## Incorporating the SWF into government budgets

I view the optimal asset allocation problem of a SWF as the decision-making problem of an investor with non-tradable endowed wealth (oil reserves). Resource rich countries are much richer than their financial wealth implies. As such they can and should invest more aggressively to create diversification on the macroeconomic level. Most importantly, these funds should not duplicate the risk the underlying economy is already running. GCC countries for example are exposed to oil price movements. They need investments into assets that pay off if the economy is doing badly, ie, recession-hedging assets like government bonds. The credit crisis is a perfect case study here. Investments should be made into assets with negative correlations to the country's economic drivers. These principles are equally applicable to excess reserve funds. The economic drivers for China are US consumer demand, the US dollar and commodities China's sovereign financial wealth should target different exposures.

## The impact of resource uncertainty

Much of the sovereign wealth is tied up in non-tradable oil reserves. Yet the true value of these reserves is unknown, as claims among neighbours might be disputed, there is uncertainty around the size of an oil field or the development of extraction costs. The interaction of unknown non-tradable wealth and asset price volatility makes sovereign returns more volatile as well as fat-tailed. The optimal response to this is taking less risk. An increase in background risk will lead to a decrease in risk-taking for the SWF. Empirically we should observe that SWFs with larger resource uncertainty should invest less aggressively and vice versa. Also we would expect that economies with low reserves relative to financial wealth are less affected by resource uncertainty.

## Asset allocation and oil reserves over time

What will drive the optimal asset allocation for a SWF over time? How is the SWF expected to shift its assets over time? How fast will financial wealth of oil rich countries accumulate? This question can be answered by solving the dynamic portfolio choice problem for an SWF. For a 'young' SWF where financial wealth is low relative to resource wealth a more risky asset allocation is optimal, while mature SWFs with large assets relative to natural resources should dial back their risks. To decide on the optimal asset allocation over time we therefore need to calculate the optimal extraction policy, ie, how fast is oil wealth transformed into financial wealth. If expected oil price changes are high relative to asset returns (opportunity costs of keeping resources under ground) we would expect slower oil extraction and therefore

## 1. Optimal SWF allocation in risky asset over time











a lower ratio of financial wealth to resource wealth. Also if extraction technology improves (lower extraction costs) we expect a faster 'oil to equity transformation'. The result of this dynamic portfolio optimisation can be found in Figure 1.

Aggregate demand for the risky asset arises from speculative and hedging demand. Over time, hedging demand reaches zero as resources become depleted.

My hypothetical SWF starts out as an aggressive investment vehicle with a leveraged position (150% exposure) in the risky asset. As time goes by hedging demand is reduced but so is speculative demand. Hedging demand is negative for positively correlated assets, ie, the SWF fund scales back risks it would otherwise take on a standalone basis. With no resources left the SWF would invest about 50% in the risky asset with the remaining allocation in cash.

#### **Governance costs**

As many have observed, the biggest peril for a government-run investor is political meddling. Few SWFs are specifically set up to get rid of political influence, such as Norway's Government Pension Fund and New Zealand's Superannuation Fund, and many of the oilrevenue-funded SWFs operate under complete opacity. All this might somewhat limit the use of a normative model like the one presented in this article. However we can use the model to put a price on ignoring the impact of underground wealth on the optimal asset allocation. We pursue this exercise by calculating the direct loss in utility from ignoring underground wealth for different assumptions on the fraction of financial wealth to total wealth. The optimal solutions are then plugged into the correct decision-making problem with the difference in utility being interpreted as the security equivalent (the risk-free return that would equate both utilities). Results can be seen in Figure 2.

Ignoring the relation between financial assets in SWFs and total sovereign wealth leads to strong utility losses of around 600bps per annum for small funds and still around 400% where sovereign wealth funds represent 20% of total wealth. If all sovereign wealth is stored in financial assets the costs of portfolio inefficiency become zero. These inefficiency costs could be reduced by running an overlay strategy on top of financial and resource wealth. A risk-based overlay - whilst leaving the governance of the sovereign wealth fund and the management of oil resource revenues separate - could take the correlations between resource wealth and financial wealth into account and correct deviations from optimal asset allocation using traded derivatives.

Leverage: including sovereign debt

Finally, any realistic analysis of SWF's needs to address the macroeconomic leverage of an economy. Many Asian SWFs are financed from foreign exchange reserves after periods of significant reserve accumulation. Reserve accumulation in managed exchange rate regimes are usually accompanied by sterilisation (ie, the domestic currency created to purchase foreign assets is sterilised through local currency debt issuance as in the case of China). 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 sovereign wealth. This illustrates the need to move from a 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.

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