EDHEC-RISK Institute

Edhec-Risk Institute Research Insights

The most pressing issues facing investment professionals

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Introduction

It is my great pleasure to introduce this inaugural issue of the Edhec-Risk Institute supplement to *AsianInvestor*. The aim of the supplement is to provide research-based analysis of some of the most pressing issues facing investment professionals today.

Our first article looks at the shortcomings of Asian indices, specifically their risk/reward efficiency. By analysing the stock markets in Japan, China, Hong Kong, Korea, India, Taiwan, Singapore and the Asean region, we find that the level of inefficiency between Asian indices and European and US indices are quite comparable.

Drawn from research conducted with the support of Caceis, our second article looks at the protection of Asian investors against non-financial risks. After examining the rise of non-financial risks in Europe, and the evolution in the associated regulation, we analyse the relevance of these developments for Asian investors, regulators and asset managers.

We then look at equity volatility indexing products. Institutional and retail investors have been increasingly interested in gaining long exposure to equity market volatility in recent years. The recent crisis with the TVIX product shows, however, that investors need to be aware of the potential difficulties that may arise.

In the following article, we argue that investors in alternative equity index strategies should evaluate and control risk factor exposures by disentangling the effects of stock selection and stock weighting. Advanced beta weighting schemes can induce implicit factor tilts, but it is possible to correct them without completely sacrificing the benefits of such schemes. Investors can choose their desired type and level of risk factor exposure by separating stock selection from the weighting scheme.

Finally, we look at how to measure and manage the specific risks of smart-beta investing, using the framework of Modern Portfolio Theory to obtain an optimal answer to the question. We conclude that the benefits of diversifying away the specific risks of smart-beta benchmarks can be substantial.

We would like to extend our warmest thanks to our friends at *AsianInvestor*, in particular Rebekka Kristin and Jame DiBiasio, for their help in producing this supplement. We hope that it will prove to be a particularly useful source of research insights for Asian investors for many years to come.

Noël Amenc
Professor of finance, Edhec Business School, and director, Edhec-Risk Institute

Assessing the risk-reward efficiency of Asian stock indices

Interest in indexed management is rising, yet cap-weighted indices are being criticised. Analysis is needed from an Asian perspective.

By Véronique Le Sourd

Indexation continues to play an important role in global asset allocation. The market for exchange-traded funds (ETFs) – liquid, tracking vehicles for standard indices – has grown at an annual rate of 30% globally over the last three years.

In Asia, total ETF assets have increased 20-30% annually post-2008 and the number of products has gone up by more than 200%.

All of these factors point to increasing interest in indexed management and investing directly in tracking products for standard market indices, both globally and in Asia.

In the history of indices, which stretches more than 100 years, capitalisation-weighted indices have proven to be the most popular for equity markets.

Such indices are supposed to represent the market's average returns and – owing to their representative nature – often serve as sources of information and bellwethers for the economy.

Beyond this informational role, standard cap-weighted indices are tools that have become an integral part of the investment process, used by a variety of investors, including pension funds, endowments and insurance companies.

They are, however, used for many kinds of investment objectives, as well as different users and markets, without any question of suitability.

Even recently there has been criticism from both academics and practitioners regarding the efficiency, stability and representative nature of cap-weighted indices (Haugen and Baker 1991; Grinold 1992; Amenc et al. 2006; Arnott et al. 2005).

Such studies often show evidence based on US and European markets. Though indices are widely accepted in Asia, either when assessing performance of active managers or when implementing passive strategies, relatively little analysis is done from an Asian perspective.

Assessing Asian indices

Recent research* from Edhec-Risk Institute serves the purpose of assessing the properties of a range of popular Asian equity indices.

We focused on the indices that are most popular in terms of volume invested in related index products and analysed several indices for stock markets in Japan (Nikkei 225, Topix 100); China (FTSE China 25, CSI 300); Hong Kong (Hang Seng); Korea (Kospi 200); India (Nifty 50); Taiwan (FTSE TWSE 50); Singapore (FTSE Straits Times Index); and for the Asean region (FTSE Asean Index, which is built from stocks from Singapore, Malaysia, Thailand, Indonesia and the Philippines).

It should be noted that while most of these indices follow the standard cap-weighting scheme, the FTSE China 25 Index uses capping rules to limit the concentration in large-cap stocks, and the Nikkei index is price-weighted rather than cap-weighted.

In our study, we have examined whether the main issues with indices that have been outlined in the literature – often on the basis of analysing North American and European stock market indices – are also relevant for the major Asian market indices.

In this article, we focus on an analysis of efficiency. Whether indices are used as benchmarks in performance measurement or as underlyings for investment products, an efficient risk/reward profile of such indices is crucial to avoid using a poor starting point in the investment process (Amenc et al. 2006).

If an index is risk-return efficient, this means that – per unit of risk – investors are reaping optimal reward from their equity investments.

While Asian indices are not designed to offer any alpha opportunities related to Asian equity investments, indices should clearly provide investors with the normal return of Asian stock markets, and a relevant question is whether currently available indices are able to extract the

* Le Sourd, V., M. Mukai, N. Padmanaban and L. Tang. February 2013. *Assessing the Quality of Asian Stock Market Indices*, Edhec-Risk Institute Publication.

equity risk premium in an efficient way.

The risk-reward efficiency of standard stock market indices corresponds to a claim typically made by providers of such indices, often justified through the capital asset pricing model (CAPM).

Many index and passive investment product providers have emphasised that the CAPM provides a theoretical basis for standard market indices and for their market capitalisation scheme.

However, Haugen and Baker (1991) and Goltz and Le Sourd (2010) have both reviewed the theoretical literature on the efficiency of the cap-weighted market portfolio and point out that there are few theoretical reasons to believe in the efficiency of cap-weighted equity indices.

They present several arguments. Firstly, the CAPM, which makes a theoretical prediction of an efficient market portfolio, is based on a number of highly unrealistic assumptions, and even the academics whose work has led to the model recognise that under more realistic assumptions, cap-weighted market portfolios cannot be expected to be efficient (Markowitz 2005, Sharpe 1991).

In particular, if investors do not have identical beliefs on risk and return parameters or if the market has frictions such as short-sale constraints, the market portfolio in general is no longer risk/reward efficient.

Also, the market portfolio under CAPM refers to a portfolio that holds all assets in the economy. The market portfolio thus is a theoretical construct that includes not only publicly listed stocks, but also other assets that in practice are either very illiquid or cannot be traded at all, such as housing and human capital.

Clearly, the standard cap-weighted equity indices only include a fraction of assets available in an economy and therefore would be very poor proxies for the true market portfolio.

Empirically, Haugen and Baker (1991) and Grinold (1992) have shown that cap-weighted indices do not generate efficient risk/reward ratios.

Such empirical findings support the theoretical arguments suggesting that cap-weighted stock market indices cannot be expected to provide an efficient risk/reward ratio.

Asia vs the world

The present article conducts an analysis of the efficiency of popular Asian equity indices, to complement existing evidence for indices of other equity markets of the world.

In this efficiency analysis, we test the validity of the claim that standard cap-weighted equity indices are efficient investments by measuring the distance in terms of efficiency between a given Asian stock market index and its alternatives on a mean-variance plane.

The alternative portfolios we test are based on portfolios made up of the same set of stocks as the cap-weighted index but use a different weighting scheme, notably equal-weighting, global minimum variance (GMV) and maximum Sharpe ratio (MSR) weightings.

There are several reasons for choosing these three portfolios. Firstly, equal-weighting portfolios – which are even more simple than cap-weighting – have been proven to beat cap-weighted indices in terms of performance (Sharpe ratios or average returns) consistently because they are less concentrated than cap-weighted indices (DeMiguel et al. 2009).

Secondly, the GMV and MSR portfolios lie on the efficient frontier and thus provide natural alternatives to a cap-weighted portfolio if one seeks risk/return efficiency as an objective.

The aim of the MSR approach is to be the most similar to a cap-weighted index in terms of constituents, but with a weighting scheme that allows risk/return efficiency to be improved.

Thus, MSR index weights are computed subject to several constraints, including no negative weights (no short sales are allowed) and upper and lower bounds constraints, depending on the number of index constituents.

These latter constraints ensure that the MSR index includes all cap-weighted index constituent stocks (cf. Amenc, Goltz, Martellini and Retkowsky, 2010).

The GMV index is also submitted to such constraints. In this study, we use in-sample construction of the efficient frontier portfolios to assess whether, in principle, moving away from the cap-weighted scheme of standard indices allows risk/reward properties to be improved and to what degree there may be room for improvement.

Our conclusion is that the existing Asian stock market indices are highly inefficient compared with either in-sample mean variance optimisation (the standard indices lie well inside the efficient frontier) or equal-weighting of the same stocks.

'Cap-weighted indices are used for many kinds of investment objectives without any question of suitability.'

We can summarise the results obtained from our analysis in the following table. The table shows the improvements in Sharpe ratio through an equal-weighted portfolio, which is rebalanced daily, as well as for mean-variance optimal portfolios (MSR and GMV), which are rebalanced annually.

The results suggest that considerable improvements in risk-reward efficiency (i.e. Sharpe ratio) are achieved by our stylised, alternatively weighted portfolios.

In fact, all alternative portfolios lead to a considerable increase in Sharpe ratio over the cap-weighted indices, except for the GMV-weighted portfolio of FTSE China 25 stocks, which ends up with a lower Sharpe ratio than the cap-weighted index.

Investor implications

These results suggest that standard stock market indices do not constitute an efficient portfolio in the sense of mean-variance efficiency. For an investor, this conclusion has strong implications when such stock market indices are used in the

Table 1: Improvements in Sharpe ratio through equal-weighted, maximum Sharpe ratio and minimum variance indices compared with standard index

Market index	Time period	Market index Sharpe ratio	Difference in Sharpe ratio of EW portfolio and market index	Difference in Sharpe ratio of max Sharpe portfolio and index market index	Difference in Sharpe ratio of Min VaR portfolio and market
Hang Seng	Jan 2002 - Dec 2010	0.53	0.11	1.38	0.47
NIKKEI 225	Jan 1996 - Dec 2010	N/A	N/A	N/A	N/A
TOPIX 100	Feb 1999 - Dec 2010	0.05	0.25	1.62	0.23
FTSE STI	Sep 2001 - Dec 2010	0.65	0.30	1.47	0.33
KOSPI 200	Jun 2001 - Dec 2010	0.48	0.23	2.21	0.27
TWSE 50	Jan 2003- Dec 2010	0.51	0.10	1.54	0.31
CSI 300	Jan 2006 - Dec 2010	0.83	0.51	1.79	0.64
FTSE China 25	Jan 2003 - Dec 2010	0.73	0.15	1.08	-0.19
NIFTY 50	Jan 2003 - Dec 2010	0.82	0.25	1.64	0.40
FTSE Asean	Jan 2001 - Dec 2010	0.79	0.16	2.25	0.19

[1] The Sharpe ratios for the Nikkei are invalid due to the negative aggregate return over the period. In fact, a negative Sharpe ratio is not meaningful as increases in volatility would increase the Sharpe ratio when excess returns are negative. Therefore we prefer not to report the results for indices where the Sharpe ratio is negative and hence indicate these cases as N/A.

investment process.

Prior to portfolio construction, investors conduct asset allocation studies to decide on the asset mix. Such studies are based on information on risk and returns for various asset classes or asset-class segments, which in general is obtained by looking at standard indices.

When using standard indices, it should be recognised that in the end asset allocation decisions will be based on an inefficient representation of investment opportunities in equity markets.

Likewise, monitoring of managers and performance analysis will depend on the selection of the index as it is commonly used as a reference.

Using indices that provide an inefficient risk-return profile obviously may not constitute a good starting point for such performance assessments.

The implication of the inefficiency of cap-weighted indices is, however, not necessarily that such indices should be discarded as useful references. Cap-weighted indices do reflect the average behaviour on the market, and thus constitute a natural choice of peer group for investors.

However, what such indices may not sufficiently achieve is attractive risk-adjusted performance. This implies that investors could be better off moving away from such peer group references.

Any alternative will, however, introduce a relative risk of deviating from the peer group. Therefore, other than analysing practical alternatives for improving efficiency, an interesting question for further research is to analyse how relative risk can be properly managed.

What the results mean

We would like to present some comments to provide context for further understanding of our results.

Firstly, it should be noted that due to differences in the historical data available for index constituents and constituent returns, the starting time of the analysis is different for each index, so that comparisons across indices are not possible.

Rather, the analysis provides a comparison of standard cap-weighted indexation against possible alternatives for a set of different data that spans different geographies and time periods.

Secondly, one should note that the analysis for GMV and MSR portfolios here has been conducted on an ex-post basis, meaning that we have computed optimal weightings for each year, based on perfect knowledge of optimisation inputs, namely the covariance matrix of stock returns and expected stock returns.

In practice, such information is not available and parameters have to be estimated using past data and such estimates will be subject to estimation error.

'Using indices that provide an inefficient risk-return profile may not constitite a good starting point for performance assessments.'

Although both optimised portfolios used in this study are not realistic in the sense that they require perfect knowledge of certain input parameters, the comparison with in-sample optimisation-based strategies provides some information about the magnitude of the inefficiency of cap-weighted indices.

Indeed, although the optimisation-based indices require perfect knowledge of risk/return parameters, they are based on the exact same universe of stocks as the standard indices and thus do not include the possibility to select stocks that lie outside the universe.

In addition, such in-sample optimisation strategies can provide information about how much more efficient a portfolio could be in the ideal case of perfect knowledge of input parameters.

To get an assessment of efficiency that does not rely on any input parameters, we also test an equal-weighted strategy in all of these universes. Even with such a naïve alternative, which weights all stocks equally, table 1 on the previous page shows clear outperformance of equal-weighted portfolios in terms of Sharpe ratio compared with the standard market indices.

Overall, our results are comparable with earlier studies on major indices in developed markets (Amenc et al. 2006), which were found to be highly risk-return inefficient compared with in-sample optimal portfolios and even equal-weighting portfolios.

The comparison of distances in terms of Sharpe ratio between market indices and test portfolios made up of the same components, but lying on the in-sample efficient frontier (max Sharpe portfolio, min var portfolio) has shown comparable magnitudes for Asian indices and European and US indices, showing that the level of inefficiency between Asian indices and European and US indices are quite comparable** .

'Although both optimised portfolios used in this study are not realistic in the comparison with in-sample optimisation-based strategies provides some information about the magnitude of the inefficiency of cap-weighted indices.'

However, such findings may not be surprising given that cap-weighting automatically gives very high weights to large companies and leads to highly concentrated portfolios, whereas equal-weighted portfolios provide some form of de-concentration, and the optimal portfolios by definition provide the best diversified portfolios that lead to efficient risk-reward. ■

By Véronique Le Sourd, senior research engineer, Edhec-Risk Institute

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** It should be noted that the time period of analysis is not the same across the various indices. This conclusion is thus very broad and differences in distance from optimality may occur when comparing indices over identical and shorter time periods.

Protecting investors against non-financial risks

Losses from the financial crisis exposed a lack of risk management. Even now Europe offers a lesson in regulatory inconsistencies and unequal compliance. But Edhec has made proposals to improve this.

By Frederic Ducoulombier

Non-financial risks defined

The last decade has been marked by the materialisation of non-financial risks on an unprecedented scale. The heavy losses inflicted upon the fund industry exposed a lack of attention to the proper management of such risks.

Non-financial risks are risks in investment funds that arise out of failed processes and failed counterparties. In contrast to the negative materialisations of financial risks, which are associated with return shortfalls or negative returns on assets, the negative realisations of non-financial risks can include the outright loss of assets.

While retail investors knowingly take on financial risk with the objective of reaping risk premia, they are typically unaware of the non-financial risks that they bear and which, as they stem from the organisation and operation of the fund management value chain, need not be rewarded by the market.

Non-financial risks include non-financial counterparty and liquidity risks, internal or external fraud, mispricing/mis-evaluation or poor accounting, mis-selling, the breach of fund rules or regulation and legal risks.

Non-financial counterparty risk refers to the possibility of failure by a counterparty in the context of an operation where no credit risk exposure is sought as such, but where counterparty risk arises due to the structural features of the contracts or instruments used.

For example, when a fund purchases a certificate representing ownership of shares from a bank to gain indirect access to international markets, it is trying to capture the premium associated with the underlying equity rather than actively seeking the counterparty risk exposure of the issuing bank, which it nevertheless takes on as part of the transaction.

Non-financial liquidity risk refers to the failure of liquidity management processes at the vehicle level, which causes an open-ended fund to suspend redemptions (or subscriptions) or impose restrictions on redemption such as side pockets for illiquid assets or in-kind redemption of these assets.

'Non-financial risk in investment management has been discounted as an afterthought by too many fund managers.'

Non-financial risk in investment management has been discounted as an afterthought by too many fund managers on the assumption that it was marginal and to be managed by a third-party, the depositary.

Heretofore, end-investors, especially retail investors, have largely been kept in the dark about the non-financial risks of their investments.

Non-financial risks illustrated

The global financial crisis has served as a wake-up call on non-financial risks in the asset management industry. A series of high-profile incidents, blow-ups and scandals has underlined the materiality of non-financial risks and prompted regulators to review the adequacy of regulation in force with respect to the prevention and management of non-financial risks.

The freezing, closures or rescues of open-ended funds, which started with money-market funds – perceived to combine excellent liquidity, competitive returns and minimal downside risk – and subsequently spread across other segments of the fund management industry illustrated both the reality of non-financial liquidity risk and the failure of its management and the cost of reputational risks.

These disruptions underscored the

vagueness of the practical definition of liquidity requirements for funds and the limits of liquidity risk management.

While regulators promptly reaffirmed or made explicit the obligation for asset managers to employ adequate liquidity risk management processes to safeguard the liquidity of funds, practical rules are still in the making as of writing.

A milestone was reached in March 2013 with the release of Iosco guidelines on how to implement the liquidity risk management process in practice; while not directly applicable, these can be used as a blueprint by regulators.

With direct losses of $50 billion by the admission of its perpetrator, the Bernard Madoff fraud provided a vivid illustration of the relevance of non-financial counterparty risk.

While the case led to lawsuits against depositaries that had delegated custody to a Madoff entity, it also underlined significant legal uncertainties and stark cross-country differences with respect to the duties and liabilities of depositaries, along with important variations in the administrative sanctioning powers of supervisors around the world.

The demise of American International Group and Lehman Brothers highlighted the importance of counterparty and collateral risks in the context of over-the-counter (OTC) derivatives and securities-lending transactions as well as prime-brokerage activities.

The Lehman bankruptcy revealed not only disparities in the quality of non-financial risk management in the industry, but also confirmed the heterogeneity and uncertainties of legal approaches to collateral and protection of client money in cases of insolvency or bankruptcy.

The reaction of regulators worldwide has been to clarify and tighten collateral rules and, under the impetus of the Group of 20, to migrate as much of the OTC derivatives market as possible to central venues for trading and/or clearing through central counterparties.

European experience analysed

The 1985 Undertakings for Collective Investment in Transferable Securities (Ucits) directive established the regulatory framework for the growth of a pan-European market for retail investment funds.

'With losses of $50bn, the Madoff fraud provided a vivid illustration of the relevance of non-financial counterparty risk.'

Ucits regulation was modelled on country regulations at a time when funds invested mainly in domestic listed securities, which made it particularly easy for depositaries to hold the bulk of assets in custody.

The scope of eligible investments and authorised techniques was subsequently expanded (with the Ucits III Product Directive of 2001 and the Eligible Assets Directive of 2007) to keep up with financial innovation in competitive international markets.

Meanwhile, with the liberalisation of foreign indirect investment flows, investors gained access to new markets, and international portfolio investment accompanied economic globalisation.

In the process, the percentage of assets that could not be safe-kept increased, as did the reliance on sub-custodians and market infrastructures in multiple foreign jurisdictions; investors' exposure to non-financial risks rose.

In spite of these dramatic developments, provisions on Ucits depositaries essentially remained unchanged.

Such a lag has been observed under different skies. For example, before February this year the Hong Kong Trustee Ordinance had not been substantially reviewed since its 1934 enactment.

In the case of the European Union, not only has the regulation in place proven to be ill-suited to preventing or managing non-financial risks arising from changes in the investment funds industry, but it has also facilitated the growth of these risks by creating opportunities for jurisdictional arbitrage.

Regulatory and supervisory competition between countries in their implementation of the Ucits framework has been facilitated by gaps or the vagueness of some terms in European regulation and by the proportionality and subsidiarity principles at the heart of the European project.

Ambiguities in European fund management regulation indeed affect some of the core elements of the framework. For example, the Ucits definitions of eligible assets leave room for interpretation, which leads to asset menus varying with jurisdiction.

Likewise, the meaning of safe-keeping is not defined, there is no list of assets that are expected to be held in custody, the duties of a depositary with respect to the selection and oversight of sub-custodians are unclear, and liability in the case of loss of assets under custody is expressly left for each member state to define.

Accordingly, some European Union countries have imposed a strict liability of restitution on the depositary (obligation of results), while others have only required the depositary to exert due skill, care and diligence (obligation of means) to discharge its obligations.

This combines to create considerable legal uncertainties about the extent to which a depositary is liable for asset losses and allows for widely differing levels of investor protection.

Differences in efforts applied by supervisory authorities towards uncovering breaches of regulation and variations in sanctioning regimes are likely to lead to unequal levels of compliance, and therefore different levels of market integrity and investor protection. There is also much variety with respect to civil and criminal liabilities for wrongdoing.

Challenge to Ucits, and the response

The European Ucits framework has supported the growth of a pan-European fund market by facilitating cross-border distribution within Europe and earned strong brand recognition internationally – not least in Asia – for offering high levels of investor protection and prudential supervision.

As progress on the idea of a home-grown regional passport remains elusive, Ucits continue to be the dominant fund wrapper for domestic and international distribution in all three of Asia's key offshore markets: Hong Kong, Singapore and Taiwan.

The aforementioned materialisations of non-financial risks exposed the Ucits brand as a franchise with marked national identities. In particular they showed that the protection offered by Ucits depositaries was subject to legal interpretations and varied widely within Europe.

These traumatic events have allowed politicians to rally around an agenda focused on a better definition and a strengthening of depositaries' responsibilities. This became so urgent that these issues were dealt via the Alternative Investment Fund Managers Directive (AIFMD) and the draft Ucits V directive rather than a horizontal depositary directive.

The new environment creates a liability regime that is much more onerous than the one currently in force for Ucits as it makes the depositary liable for assets lost in custody except in narrowly-defined external events – essentially acts of nature and states – and provided the depositary has made all reasonable efforts to prevent or mitigate the loss that the materialisation of these events could cause.

While the AIFMD allows contractual discharge of liability when objective reasons to do so exist, this is not possible under the draft Ucits V directive.

These new responsibilities of depositaries translate into enhanced protections for investors in funds registered in European Union jurisdictions that previously only imposed a duty of care upon depositaries.

From an investor protection standpoint, they also make Ucits more attractive than funds registered in jurisdictions where the duty of trustees and/or custodians is one of care, as is the norm in common law countries, such as Hong Kong and Singapore.

We consider, however, that the new regime is not without its risks and suggest a different approach to regulation.

Unintended consequences of new European depositary regime

From a systemic point of view, Edhec-Risk Institute considers that it is dangerous to put the responsibility for non-financial risks – through liability for asset restitution – solely on the depositary, particularly within an industry characterised by a high concentration of players and low levels of shareholder equity.

The new liability regime may trigger further concentration in the securities services industry as new economies of scale and specialisation are required to compensate the costs added by regulation.

Such adverse systemic risk consequences would be magnified if depositaries started competing on the restitution obligation and the level of non-financial risks they were willing to take on, as this could result in concentration of non-financial risks in the hands of overly aggressive or less-than-honest providers and increase the risk of default by a depositary; stringent prudential requirements and enforcement are needed to mitigate such risks.

Due to moral hazard, the focus on depositaries may lead to an overall increase of non-financial risks across the industry as other links in the fund management value chain may choose to increase risk-taking with the knowledge that financial risks will eventually be borne by depositaries.

At the very least, the proposed approach does not directly encourage these stakeholders to contribute to the improvement of information on, and the management of, non-financial risks.

Edhec-Risk Institute has also warned that trumpeting the guarantees of the new depositary regime could give investors, in particular retail investors, a false sense of security about non-financial risks, which would then lead them to let their guard down against these risks and reduce efforts to conduct the essential analysis and due diligence that is their responsibility.

In this context, adverse selection of the riskiest funds would be likely, which would contribute to a rise in non-financial risks across the industry.

An unintended consequence of establishing a strict liability regime for the restitution of assets under custody could be to create expectations of guaranteed restitution of all assets when it is not possible, short of transforming the depositary into an insurer – although it does not have the required regulatory status, earnings or capital to play this role.

Ultimately, the protection that can be provided by a depositary is limited and does not cover all non-financial risks, and the obligation of restitution put into law or put forward by the legislator only relates to the portion of a fund's assets that are safe-kept by the depository, a ratio that need not be disclosed.

'Edhec Risk Institute considers that it is dangerous to put the responsibility for non-financial risks solely on the depositary.'

Proposals for better regulation of non-financial risks

Against this backdrop, Edhec-Risk Institute has put forward proposals for better management of non-financial risks within the European fund management industry in the context of a research chair supported by Caceis.

These proposals are based on the promotion of transparency on, and accountability for, non-financial risks across the industry and on the avoidance of regulatory promises that magnify the very risks they aim to mitigate. These proposals can be categorised into three themes.

The first series of recommendations relates to the reinforcement of information on non-financial risks in the fund's Key Investor Information Document (which would include a description of the gross risk exposure and risk management techniques employed and a synthetic indicator of the fund's net risks) and of the distributor's duty to advise with respect to non-financial risks.

The second series of recommendations aims to create economic incentives to manage non-financial risks better for the key actors in the fund management value chain, namely the asset manager and the depositary.

The idea is first to impose capital requirements proportional to the level of non-financial risk assumed by depositaries and fund management companies and then to allow these entities to reduce this capital requirement by establishing a residual risk assessment in the form of an internal model rewarding the application of best practices for managing non-financial risks such as centralised clearing of OTC trades, tripartite agreements for the securing of collateral, or adequate segregation of a client's assets.

The third and final series of recommendations centres on the creation of a subset of Ucits for which depositaries would guarantee the full restitution of all assets. This would allow such funds to be marketed without any duty to advise or any restriction specific to non-financial risks.

To avoid increasing systemic risk, the range of assets and operations eligible under this new form of fund would be restricted to assets that can be held in custody by the depositary and operations that do not involve counterparty risk (aside from regulated central counterparties).

Additionally, the only transactions that would be authorised would be those conducted in jurisdictions that sufficiently guarantee ownership rights and have market infrastructures that conform to the Bank for International Settlements' CPSS-Iosco standards.

While restrictions on the scope of investments would certainly lead to a fall in the profits generated from the markets and financial innovations such as security lending/borrowing or the use of OTC derivatives, full protection against non-financial risks would be ensured, and at a very low cost for investors.

Relevance for Asian investors, regulators and asset managers

Ucits not only dominate the offshore fund market in Asia, but they are also the preferred type of vehicle for distribution in Hong Kong, Singapore and Taiwan. In the absence of a regional funds passport, even Asian asset managers wrap their funds in the Ucits cloak to distribute their products in the region.

While Ucits have been accepted as the international gold standard of regulation and investor protection, the new investment freedoms that the Ucits III Product Directive and the Eligible Assets Directive introduced created concerns about the complexity and opacity of Ucits in some realms, especially in Asia.

The alternative investment industry's taste for embracing the Ucits wrapper to offer funds, the so-called "newcits", that exploit the new investment freedoms to the limit further fuelled fears that retail investors could gain access to complex products via Ucits.

'The idea of restricted Ucits could be particularly attractive for Asian investors, regulators and asset managers.'

These concerns and fears affected the image of the Ucits label even before the global financial crisis underlined the importance of non-financial risks and exposed weaknesses and inconsistencies in the Ucits framework.

As a result, while Ucits have remained the vehicle of choice for distribution in Asia, regulators have subjected funds to higher levels of scrutiny. For example, while Hong Kong had initiated a fast-tracking procedure at the time of Ucits III, fund approval has become a slow and sometimes intractable process for many funds. Specific areas of attention include use of derivatives, leverage and, of late, securities lending.

In this context, the idea of restricted Ucits could be particularly attractive for Asian investors, regulators and asset managers. Retail investors could invest with the knowledge that their assets are safe from non-financial risks which they may have difficulty understanding; regulators would continue to work with a familiar structure but see many of their concerns addressed or alleviated; and asset managers would see the approval processes streamlined and would continue to benefit from a trusted platform for the distribution of their funds, in the region and in other parts of the world.

These restricted collective investment schemes, which would rightly benefit from a secure image, could also be given privileged access to some market segments for which security should be paramount, such as the retirement and provident fund sector.

While they were developed in the context of the update of the Ucits framework, the Edhec-Risk Institute proposals are general. Irrespective of the choices made in Europe, regulators in Asia can develop domestic or multilateral regulatory overlays on the Ucits foundation to improve the management of non-financial risks, or draw on these ideas to update domestic fund regulation or define the contours of a regional fund passport.

A detailed presentation of the ideas herein can be found in: *Proposals for Better Management of Non-Financial Risks within the European Fund Management Industry*, Edhec-Risk Institute, December 2012. This document concludes three years of research on better management of non-financial risks within the European fund management industry that were made possible by the generous support of Caceis. ■

By Frederic Ducoulombier, director, Edhec Risk Institute for Asia

Equity volatility indexing products

Volatility ETNs provide easy access to gain long exposure to equity market volatility. But investors need to be aware of the risks, while product providers should ensure sufficient education.

By Felix Goltzand and Stoyan Stoyanov

Investors are willing to gain exposure to market volatility for a variety of reasons, such as diversifying equity risk, hedging an existing short volatility exposure or simply taking directional bets.

Over-the-counter (OTC) or exchange-traded volatility derivatives using volatility indices as underlyings to alleviate losses during market downturns are increasingly being relied on, based on the negative correlation between equity returns and volatility which has been well-documented in the academic literature.

There are two theoretical explanations – the leverage effect and volatility feedback effect. The leverage effect hypothesises that the market downturn increases the leverage of the firm and thus the risk of the stock.

The volatility feedback effect assumes that the volatility is incorporated in the stock prices; a positive volatility shock would increase the future required return on stock, and stock prices are expected to fall simultaneously.

From an investor perspective, the negative correlation presents hedging and diversification opportunities. In addition, negative correlation and high volatility are particularly pronounced in stock market downturns, offering protection against stock market losses when it is most needed and when other forms of diversification do not provide very effective exposure.

Traditional approaches to gaining exposure to volatility

There are several traditional ways of gaining exposure to the volatility of an asset through derivative products written on it. The simplest approach is through straddles or strangles which represent option strategies composed of a long put and a call option allowing investors to express a bet on the price distribution at maturity.

A disadvantage is that they do not take into account the daily changes in volatility and, although delta-neutral at construction, they gain a directional exposure to the price of the underlying.

A traditional approach resolving two of the above deficiencies is to delta-hedge a put or call option. In contrast to straddles and strangles, constant rebalancing is needed to maintain delta-neutrality and, thus, the daily changes in volatility are taken into account.

However, Mougeot (2005) shows that apart from the exposure to variance, the profit-and-loss has exposures other than the exposure to variance – there is a vega exposure, because the delta hedge is implemented at the option-implied rather than at the unknown realised volatility, and there is also a volatility path dependency risk because volatility can change with time.

Pure exposure to variance can be obtained through variance swaps. Introduced in the 1990s, these are OTC products that have become quite popular.

Variance swaps are forward contracts paying at maturity the difference between the realised variance of an underlying and a predefined strike price. Since the seller of the swap has an unlimited potential loss, variance swaps are often capped.

They can be replicated through a portfolio of a continuum of put and call options written on the underlying. In fact, the pay-off from a variance swap is the difference between the realised and option-implied variance of the

> *'There are several traditional ways of gaining exposure to the volatility of an asset through derivatives. The simplest is via straddles.'*

underlying, which is often negative, reflecting the presence of a variance premium (see Mougeot (2005)).

Implied volatility related products

For the US market, and also globally, the most popular volatility index is VIX, which represents a forward-looking market view of the 30-day volatility of the S&P 500 index derived from prices of options on this index.

Methodologies similar to CBOE's model-free implementation of VIX have been used to calculate the option-implied volatilities of other major equity indices.

Although not investable themselves, futures on VIX have been available since 2004 for maturities ranging from one to nine months. The key difference between VIX futures and VIX is that at any current point in time the futures price represents the risk-neutral expectation of VIX at the contract's maturity and is, therefore, different from the value of VIX observed at the current point in time (Lin (2007)).

Thus, the VIX futures prices observed on a given day define a term structure that reflects investors' expectations about future volatilities.

A common approach to investing in volatility futures is to build a roll-over portfolio with a constant maturity. Index providers have started publishing constant-maturity volatility futures indices such as the S&P 500 VIX Futures Index series.

From an investor standpoint, however, the roll-over is costly because of the presence of the volatility risk premium, which is negative (Bakshi and Kpadia (2003)).

A possible economic explanation of this phenomenon is that a long exposure to market volatility provides downside protection in times of market declines and risk-averse investors are willing to pay a premium.

Exchange-traded notes (ETNs) are exchange-traded products that represent debt obligations of the issuer not guaranteed by any collateral. They are regarded as easily accessible investment vehicles designed to track the performance of other index products.

A wide variety of ETNs exists on the market-tracking equity indices, commodities, currencies and volatility. Introduced in 2009, volatility ETNs normally track constant maturity volatility futures indices and are broadly categorised as short-term and mid-term volatility ETNs. Since 2009, they have increased in number to about 30 and have become more diverse, including inverse and leveraged products.

An incident: the crisis with TVIX in 2012

A surge in the demand of volatility ETNs created a market distortion in 2012 that illustrates potential problems with such products.

At the beginning of 2012, TVIX was the second biggest volatility ETN and the biggest leveraged volatility ETN in terms of volume. The product was created by VelocityShares and backed by Credit Suisse.

According to the prospectus, it tracks 2x the returns of the S&P 500 VIX Short-Term Futures Index (SPVXSP). As reported by Bloomberg, by February 21 last year the market value of TVIX had more than quadrupled since December 30, 2011, and the shares outstanding had increased seven times.

The surge in demand was concurrent with a bullish stock market in which the S&P 500 gained 8.3% and is consistent with the hypothesis that many investors were expecting that volatility would increase.

On February 21, Credit Suisse discontinued issuing new TVIX ETNs, stating that "internal limits on the size of the ETNs" had been reached. Because of the high demand of TVIX in the wake of these events, the price of the ETNs on the secondary market deviated above the indicative value. In the period from February 22 to March 23, the premium of TVIX over its indicative value increased steadily and peaked on March 21 at almost 89%. Over the following two days, it rapidly decreased to 6.5%.

'The roll-over is costly because of the presence of the volatility risk premium, which is negative.'

The price plunge was concurrent with a statement by Credit Suisse on March 22 that, starting from March 28, they may resume issuing these ETNs conditional on the availability of hedging instruments.

Regarding the possible reasons for the crisis, Goltz and Stoyanov (2012) indicate that there is another leveraged product (UVXY) tracking the same index, but in contrast to TVIX, it is an ETF.

UVXY did not accumulate a premium, which shows that the causes of the crisis were related to the type of product (ETN versus ETF) and the specific market state.

In contrast to ETNs, ETFs are open-ended passive investment funds that are traded on a stock exchange designed to track an index. ETFs are generally characterised by a transparent and fluid share creation process that ensures that the price of the ETF remains close to the indicative value.

Like any other exchange-traded

product, the prices of ETFs are determined by the corresponding supply and demand and may deviate from the indicative value that is published intra-day and can be compared with the price of the ETF almost in real time. Thus, if an ETF appears to be undervalued, then an arbitrageur can buy ETF units, redeem them at the custodian bank for the underlying securities and sell them on the market, realising a profit.

Alternatively, if an ETF is overvalued, an arbitrageur can buy the underlying securities, redeem them for ETF units, and sell the ETF units on the market, realising a profit.

As long as this mechanism is not limited by any regulatory or liquidity constraints, the price of an ETF remains close to the indicative value. These two simple strategies are, however, not applicable for ETNs (Wright et al. 2010).

In contrast to ETFs, the creation process is controlled solely by the issuer, and although the intention is to maintain liquidity and to ensure correspondence with the indicative value, the issuer is under no obligation to do so.

Thus, in the absence of a mechanism for investors to create shares, a positive premium may build up if the issuer is unable to provide liquidity.

In line with the arguments above, it has been reported in the literature that prices of ETNs can deviate significantly from the indicative values, creating a positive premium (Wright et al. (2010)).

Using a sample of 93 ETNs, Diavatopoulos et al. (2011) find that positive premium is usually preceded by abnormally high returns of the underlying, which is consistent with the hypothesis that the mispricing is caused by a combination of return-chasing investors and issues with the share creation process rather than by informed investors anticipating future price movements or any liquidity constraints. This observation is especially relevant for the case of TVIX.

In the presence of a positive premium, a natural strategy would be to short-sell TVIX and data indicates that short-selling intensified at the end of February and throughout March 2012.

A reason why TVIX could have been impossible to short-sell even more intensively is the inability of investors to borrow the security in a rising market – an intuition confirmed with practitioners from the industry. For additional details, see Goltz and Stoyanov (2012).

Conclusions

In contrast to the traditional approaches, pure exposure to volatility can be achieved through equity volatility indexing products.

Volatility ETNs, in particular, provide easy access for institutional and retail investors to gain long exposure to equity market volatility.

The recent crisis with the TVIX product shows that investors in volatility ETNs need to be aware that (i) the underlying that the product is tracking does not correspond to the actual volatility index but rather to a systematic strategy of investing into volatility index futures; and (ii) an ETN runs the risk of a decoupling of its returns from the underlying.

Product providers, on the other hand, need to ensure that sufficient education is provided to investors on the limits of such products in order for the significant growth in these products to be sustainable. ■

> *‘Volatility ETNs provide easy access for institutional and retail investors to gain long exposure to equity market volatility.’*

By Felix Goltz, head of applied research, Edhec-Risk Institute, and Stoyan Stoyanov, head of research for Edhec-Risk Institute, Asia

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Smart-beta indices: selecting risk exposures

Most alternative indices are based on ad hoc choices by an index provider. But investors need to learn how to evaluate risk factors and disentangle the effects of stock selection and stock weighting.

By Amitabh Dugar

Interest in alternative equity index strategies, often referred to as "advanced" or "smart" beta strategies, has increased in recent years.

In response, several index providers including Russell, FTSE, Standard & Poor's, Stoxx and MSCI have launched families of alternative indices, some of which have attracted significant investment from pension funds.[1]

Nevertheless such alternative indices are not yet well understood because most are based on a set of methodological choices made by an index provider that are often ad hoc in nature and poorly documented.

Therefore investors lack a clear understanding of how the different steps of each methodology contribute to portfolio risk and return. The examples in table 1 highlight that fact that the methodological choices inherent in advanced beta indices fall into two categories: stock selection and stock weighting, both of which can be based on information other than the stocks' market capitalisation.

Table 1: An overview of stock selection and weighting decisions of some alternative equity indices

Index name	Stock selection	Stock weighting
FTSE GWA index series	As in the corresponding market index	• Net income • Cash flow • Book value
FTSE RAFI index series	• High sales • High cash flow • High book value • High dividend	• Sales • Cash flow • Book value • Dividend

Table 1 indicates that the FTSE GWA index series selects stocks by their market capitalisation but weights them by their fundamental characteristics, whereas the FTSE RAFI index series uses this metric at both the first (stock selection) stage and the second (weighting) stage.

Thus, the pre-packaged nature of first-generation smart-beta indices forces investors to accept the implicit style biases inherent in the weighting scheme chosen by the providers of these indices, instead of allowing them to choose the risk-reward properties of their benchmark based on their individual risk preferences.

Unsurprisingly this has led to the perception that smart-beta investing amounts to generating outperformance through factor tilts (Arnott 2011).

We argue that investors should evaluate and control risk factor exposures by disentangling the effects of stock selection and stock weighting.

Explicit distinction between stock selection and diversification-based weighting schemes and an intelligent combination of the two to control risk

[1] http://www.professionalpensions.com/global-pensions/feature/2106785/alternative-indices-continue-rise

'Alternative indices are not well understood because most are based on methodological choices by an index provider that are ad hoc.'

'Stock selection and weighting schemes can be viewed as complimentary tools for accomplishing investment goals.'

factor exposures can yield investment solutions that provide both risk transparency and control.

This approach allows assessment of the value added by alternative indexing after correcting for factor tilts and thus represents a significant improvement over first-generation smart-beta indexing strategies that simply seek outperformance without regard to accompanying risks.

Stock selection and weighting schemes can be viewed as complementary tools for accomplishing investment goals. We classify weighting schemes into two categories: characteristics-based and diversification-based.

Characteristics-based weighting schemes assign weights to stocks in proportion to one or more stock-level characteristics of interest; in principle they provide exposures that are similar to stock selection because they ignore interaction effects among stocks.

Stock selection and characteristics-based weighting have limited ability to influence the overall risk and return properties of the portfolio as they focus solely on the standalone properties of stocks, but they do provide an explicit and transparent way of attaining desired risk-factor exposures.

On the other hand, diversification-based weighting schemes such as maximum Sharpe ratio (MSR) optimisation and global minimum volatility (GMV) optimisation exploit both individual characteristics of stocks and their correlation properties to accomplish explicit risk/return objectives.

However, such weighting schemes can result in implicit factor tilts that investors may deem undesirable. For example, several research studies conclude that minimum-volatility optimisation leads to a concentration in low-volatility stocks (Andersen, Malavergne and Simonetti 2000).

Stock selection as a tool to control factor tilts

We illustrate the benefits of combining stock selection and weighting to maximise the advantages offered by both of these index construction steps.

There are two ways to correct unwanted risk factor exposures resulting from diversification-based weighting schemes: stock selection aimed at excluding stocks with undesired properties (prior to applying the diversification scheme) and application of constraints on factor exposures during optimisation.

To demonstrate how size-based stock selection can be used to control small-cap exposure in optimised portfolios, we study three different weighting schemes – maximum Sharpe ratio, global minimum volatility, and maximum decorrelation.

Our discussion draws upon the results described in Amenc, Goltz and Lodh (2012), who report qualitatively similar results across a variety of risk-factor exposures of concern to investors, such as value and volatility.

We limit our analysis to the mitigation of small-cap exposure for sake of brevity. In this context we also consider the opportunity cost of correcting factor tilts via stock selection versus the attainment of a diversification objective.

Intuition suggests that the diversification benefits of the portfolio should be compromised when diversifying across fewer stocks, so we also analyse the extent to which the diversification goal is affected by stock selection.

The three diversification-based weighting schemes that we consider, namely global minimum variance (GMV), efficient maximum Sharpe ratio (MSR) and maximum decorrelation (MDC), differ.

The objective of GMV portfolios is to minimise portfolio volatility. The goal of MSR optimisation is to maximise the Sharpe ratio of the portfolio.

Since Sharpe ratio calculations require estimates of expected returns of stocks, we estimate them indirectly based on the downside risk of stocks.

MDC optimisation aims to use the correlation structure among stocks to reduce overall portfolio risk rather than overweighting low-volatility stocks; as noted previously, the latter is a limitation of traditional GMV approaches.

The MDC approach attempts to minimise portfolio volatility under the assumption that all stocks in the universe have the same volatility (Christoffersen et al. 2010).

This forces the optimiser to exploit differences in correlations rather than differences in volatility across stocks.[2]

To examine how stock selection techniques can be used in conjunction with the three diversification-based schemes under consideration, we sort all stocks in the S&P 500 universe into three groups according to their market capitalisation.

After constructing optimal portfolios within the broad S&P500 universe and within each of the three sub-universes, we analyse the ex-post factor exposures of each portfolio. Our results are reported in table 2.

[2] We use weekly total return data from January 2, 1959 to December 31, 2010, from the S&P 500 universe of stocks for the empirical analysis. Quarterly rebalancing is used and long-only weight constraints are imposed for all optimised portfolios. At each rebalancing date, the S&P 500 constituent is considered as the broad universe and weekly stock return data over the past two years is used for optimisation purposes. GMV optimisation is performed in the presence of norm constraints (DeMiguel et al. 2009) with a lower bound of N/3 on the effective number where N is the total number of stocks in the relevant universe. The downside risks of stocks are used as a proxy for their expected returns (Amenc et al. 2011) and the covariance matrix is obtained using principal component analysis.

Table 2

Universe	Global Minimum Volatility (GMV)				Maximum Sharpe Ratio (MSR)				Maximum Decorrelation (MDC)			
Market Size	All	Small	Medium	Large	All	Small	Medium	Large	All	Small	Medium	Large
(Big - Small)	-26.20%	-25.41%	-28.03%	-23.92%	-21.92%	-23.69%	-23.94%	-20.09%	-8.60%	-7.93%	-10.57%	-6.59%
	-19.00%	-43.75%	-19.32%	1.83%	-21.13%	-46.28%	-21.40%	0.29%	-37.07%	-65.59%	-27.26%	-3.15%

Table 2: This shows the excess (over S&P 500) risk-factor exposures of the global minimum volatility, maximum Sharpe ratio, and maximum decorrelation portfolios based on the broad S&P 500 stock universe and three size-based stock selections. The stock selection is done at each rebalancing date. Weekly return data from July 5, 1963, to December 31, 2010, is used for the analysis and values significant at the 1% level are highlighted in bold. We run the following regressions to identify factor exposures

$$R_P - R_{CW} = \alpha + \beta_M . R_{CW}$$

$$Res = \beta_S . R_S$$

R_P is the time series of test portfolio returns, R_{CW} is the S&P 500 time series returns, β_M is the market beta, β_S is the size (big-small) beta, and Res is the residual time series from equation 2 regression. This two-step process is used for each risk factor and for each test portfolio. The bold values indicate that the beta for the size factor tilt is significant at the 1% confidence level.

The results in table 2 indicate that without explicit specification of the stock universe all three optimised strategies have significant implicit small-cap exposure relative to the S&P 500 index.

However, the GMV and MSR portfolios do not exhibit meaningful small-cap exposure if they are built using stocks from the large-cap universe alone.

Similarly, the small-cap exposure of the MDC strategy declines to an insignificant level (from -37.07% to -3.15%) if only large-cap stocks are used to construct the optimised portfolio.

The results in table 2 suggest that constructing portfolios on a specific size-based sub-universe may be an effective way to achieve desired risk exposures.

Next, we assess if the diversification objectives of each strategy: GMV (low volatility objective), MSR (high Sharpe ratio objective) and MDC (low concentration objective) are sacrificed by doing so.

For this purpose we use the GLR concentration measure (Goetzmann et al. 2005), which is the ratio of the portfolio variance to the weighted variance of its constituents.

A low GLR measure indicates that correlations have been well exploited and the resulting portfolio is well diversified. Table 3 on the next page provides an answer to this important question.

Table 3

Panel 1	**Global Minimum Volatility (GMV)**			
Universe	**All**	**Small**	**Medium**	**Large**
Annual Volatility	12.40%	13.67%	12.67%	12.59%
% Reduction relative to broad CW	19.8%	11.6%	18.0%	18.6%
Panel 2	**Maximum Sharpe Ratio (MSR)**			
Universe	**All**	**Small**	**Medium**	**Large**
Sharpe ratio	0.51	0.65	0.51	0.35
% Increase relative to broad CW	85.6%	139.9%	85.9%	30.2%
Panel 3	**Maximum Decorrelation (MDC)**			
Universe	**All**	**Small**	**Medium**	**Large**
GLR Measure	0.139	0.134	0.167	0.208
% Reduction relative to broad CW	43.1%	45.3%	31.9%	15.0%

Table 3: this compares the attainment of the optimisation objective for the three optimised portfolios: global minimum volatility, maximum Sharpe ratio, and maximum decorrelation portfolios, each based on the broad S&P500 stock universe and three size-based stock selections.

Weekly return data from January 2, 1959, to December 31, 2010, is used for the analysis.

The results reported in panel 1 of table 3 indicate that for all stock sub-universes GMV portfolios achieve a reduction in volatility of 11% or more compared with the broad cap-weighted index.

Results for the MSR portfolio in panel 2 show that the effects of stock selection are qualitatively similar with significant enhancement in the Sharpe ratio over the S&P500 index in all size-selected portfolios.

For the MDC portfolios, results for mid- and large-cap stock sub-universes show higher GLR measures than the broad MDC portfolio but they are still substantially lower compared with the GLR ratio of the broad cap-weighted index.

Overall, the results in table 3 imply it is possible to attain the risk/return objectives of a diversification scheme even after controlling for a specific risk factor through stock selection, and big improvements over the cap-weighted reference index can indeed be achieved.

Conclusion

This article shows that providers and users of any advanced-beta strategy should distinguish between their stock selection decision and their choice of weighting scheme.

It provides evidence that stock selection can be used as a way to correct the risk-factor exposures of any chosen diversification-based weighting scheme while retaining most of the improvement offered by its risk/return objective.

This finding is contrary to the popular belief that the benefits of alternative diversification-based schemes are due to their simple factor tilts.

Our results imply that advanced-beta weighting schemes can induce implicit factor tilts, but it is possible to correct them without completely sacrificing the benefits of such schemes.

Current alternative equity index offerings do not allow risk control since they are pre-packaged solutions and hence investors in those products are forced to accept the implicit risk choices of the index provider.

Separating stock selection from the weighting scheme is an elegant way to control risk as it allows investors to choose their desired type and level of risk factor exposure. ■

'Advanced-beta users and providers should distinguish between their stock selection decision and choice of weighting scheme.'

By Amitabh Dugar, business development director for North America, ERI Scientific Beta

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Measuring and managing the risks of smart-beta investing

Clear-sighted investors will need to carry out due diligence to evaluate specific risks rather than rely on assessment of past performance of the index.

By Noël Amenc and Lionel Martellini

In smart-beta investing, every solution contains risks, which can be filed into two categories: systematic and specific.

Systematic risks come from the fact that new indices or benchmarks can be more or less exposed to particular risk factors depending on the methodological choices guiding their construction.

This exposure can be expressed either in absolute terms or, more often, in relative terms with respect to the cap-weighted index which is representative of the same universe of securities.

The second type of risk to which investors are exposed when they use a benchmark is the risk that is specific to the construction of that benchmark.

Whatever the weighting scheme envisaged, it relies on modelling assumption and on parameter estimation, which obviously always leads to a risk of a lack of out-of-sample robustness.

Any investor who strays from a weighting scheme such as capitalisation weighting, for which the assumptions that determine the construction are largely open to criticism and not proven, and whose outputs are hardly compatible with the definition of a well-diversified portfolio, will probably take a well-rewarded risk, in the sense that there is a strong probability of doing better in the long term.

However, by moving away from consensus, from the default option constituted by the cap-weighted indices, this investor will be questioned on the relevance of the new model chosen and on the robustness of the past performance that will probably underpin their choice to a large degree.

In this sense, like in the area of systematic risk, every informed smart-beta investor will have to be clear-sighted and carry out sound due diligence to evaluate the specific risks rather than rely only on an assessment of the past performance of the index.

There has been extensive documentation on the question of systematic risks (cf. the article in this supplement entitled *Smart-beta indices – selecting risk exposures*), but less attention has been paid to specific risks. In this article we will, therefore, focus on measurement and management of the specific risks of smart beta investing.

Modern portfolio theory

The evaluation and especially the management of specific risks have not given rise to any real application that is appropriate for "smart-beta" (alternative equity) indices. However, turning to the analysis framework of modern portfolio theory provides a relevant conceptual structure for replying to this question.

Modern portfolio theory has a very straightforward prescription, namely that every investor should optimally seek to allocate to risky assets so as to achieve the highest possible Sharpe ratio.

Implementing this objective, however, is a complex task because of the presence of estimation risk for the required expected returns and covariance parameters.

As recalled above, the costs of estimation error may entirely offset the benefits of optimal portfolio diversification (see DeMiguel, Garlappi and Uppal, 2009, for evidence of the domination of naively-diversified portfolios over scientifically-diversified portfolios from an out-of-sample Sharpe ratio perspective).

In this context, the choice in risk and return parameter estimation for efficient diversification is between "trying", which has a cost related to parameter estimation risk, i.e., the risk of a substantial difference between the estimated parameter value and the true parameter value, or "giving up", which also has an optimality risk, related to the risk that the heuristic benchmark – such as global minimum variance (GMV) or equal-weighted (EW) – can be very far from the optimal MSR benchmark.

The trade-off occurs because using objectives that involve fewer parameters leads to a smaller amount of parameter risk, but a higher amount of optimality risk, since one is using fewer dimensions for optimisation.

In this sense, it can perfectly happen that a "good" proxy (i.e., a proxy based on parameters with little estimation risk) for a "bad" target (i.e., a target *a priori* far from the true MSR based on true population values) eventually dominates a "bad" proxy (i.e., a proxy based on parameters plagued with substantial estimation risk) for a "good" target (i.e., a target *a priori* close to the true MSR based on true population values).

Hence, different portfolios are intuitively expected to incur more estimation risk or more optimality risk. For example, investing in equal-weighted (EW) benchmarks involves no estimation risk, since no parameter estimates are required, but arguably a large amount of optimality risk, since these benchmarks are not expected to be good proxies for the corresponding true MSR portfolios, unless all constituents have the same expected return, the same volatility and the same correlations.

In other words, holding EW portfolios, which are not subject to estimation risk, involves an opportunity cost related to the fact that their Sharpe ratio may be dramatically inferior to the Sharpe ratio of the true MSR.

On the other hand, investing in GMV or equal risk contribution (ERC) benchmarks involves more estimation risk compared with EW benchmarks, because covariance parameter estimates are needed, and possibly less optimality risk if it turns out that these heuristic benchmarks are closer to the optimal MSR benchmarks than the EW benchmark is.

Estimation risk

Finally, investing in MSR benchmarks involves even more estimation risk, since (possibly very noisy) expected return parameters are used in addition to covariance parameters; on the other hand, it does not involve any optimality risk since the target portfolio would coincide with the true optimal portfolio in the absence of estimation risk.

In this context, it is useful first to propose an empirical analysis of optimality risk taken in isolation, i.e., in the absence of any estimation risk.

To conduct this analysis, we consider a large number of possible equity universes, defined in terms of many different possible reasonable true population values for risk and return parameters, and measure the difference for these parameter values (in terms of ex-ante Sharpe ratios, i.e., based on true parameter values) between the true MSR portfolios and various heuristic portfolios, as well as various combinations of these portfolios (see Martellini, Milhau and Tarelli, 2013, for more details).

We then analyse the distribution of this distance across all possible sets of parameter values so as to generate an absolute assessment of optimality risk for various heuristic portfolios, as well as a relative assessment of optimality risk amongst competing heuristic portfolios.

For example, this analysis allows us to answer questions such as what is the probability (across all tested parameter values) that the GMV portfolio is closer than the EW portfolio to the (true) MSR portfolio, hence allowing us to provide a quantitative comparison of the optimality risk involved in EW versus GMV (or any other heuristic) benchmark.

In a second step, estimation risk is introduced so as to help measure the distance of various heuristic benchmarks using imperfect estimates with respect to the true MSR portfolio.

This analysis allows us to analyse the interaction between estimation risk and optimality risk, and allows us to answer questions such as: given realistic estimation errors in the covariance matrix and expected returns, what are the chances that an imperfectly estimated MSR, which suffers only from estimation risk (estimated MSR different from true MSR) will be closer to the true MSR portfolio in terms of ex-ante Sharpe ratios compared with a GMV portfolio (for example), which is subject to optimality risk (because the true GMV portfolio is different from the true MSR portfolio) but to a lower amount of estimation risk (there is less difference between the estimated GMV and the true GMV than between the estimated MSR and the true MSR, since the GMV does not require any expected return parameters)?

Overall, our analysis allows us to provide a detailed empirical assessment of total specific risk of smart beta benchmarks (in terms of differences in *ex-ante* Sharpe ratios) between a given benchmark and the true MSR portfolio, by decomposing this specific risk as indicated in equation (1), which we rewrite as follows:

Total distance (in terms of ex-ante Sharpe ratio based on true parameter values) of a given benchmark with respect to the true MSR portfolio = distance of the given target benchmark with respect to the true MSR portfolio assuming away estimation risk (optimality risk in the absence of estimation risk) + distance between the imperfectly estimated target and the true target (estimation risk).

'Our analysis allows us to provide a detailed empirical assessment of total specific risk of smart-beta benchmarks.'

'These results suggest that the benefits of diversifying away the specific risks of smart-beta benchmarks can be substantial.'

This analysis can also be used to manage specific risks of smart-beta benchmarks. In particular, one may seek to have a strategic exposure to various smart-beta benchmarks so as to diversify away these risks.

For example, table 1 below shows the average Sharpe ratio across 2,226 different sets of reasonable parameter values for the S&P 500 universe.

This table shows that, assuming true covariance and expected returns parameters are known, an exceedingly large value of 13.34 is generated for the average Sharpe ratio of the maximum Sharpe ratio portfolio.

This value by far exceeds the value obtained for GMV, EW and cap-weighted (CW) portfolios, thus underlining the opportunity costs involved in optimality risk for such portfolios.

On the other hand, when a realistic estimate of estimation error is introduced for covariance and expected return parameters (assuming that such estimates are generated by the use of a parsimonious factor model), the average Sharpe ratio of the scientifically diversified portfolios is substantially reduced, much more substantially so for the MSR portfolio which suffers from the presence of estimation errors in both covariance and expected return parameters, compared with the MSR portfolio, which only suffers from estimation errors in covariance parameters.

Interestingly, we see that the GMV dominates the MSR portfolio after estimation risk is taken into account, as also does the EW portfolio, albeit by a lower margin.

Moreover, a mixture of GMV and EW portfolios generates the highest average Sharpe ratio. These results, which can be extended to other possible combinations of smart-beta indices, are consistent with theoretical results by Kan and Zhou (2007), who show that a portfolio that combines the sample-based MSR and GMV portfolios dominates the sample-based MSR alone in the presence of parameter uncertainty.

These results suggest that the presence of estimation risk completely alters the standard prescriptions of the fund separation theorem, and also suggest that the benefits of diversifying away the specific risks of smart-beta benchmarks can be substantial.

More generally, beyond a static diversification approach, one may also implement an improved dynamic diversification approach based on making the allocation to various smart-beta benchmarks conditional upon market conditions such as average correlation levels, volatility levels, etc. ■

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Table 1

Portfolio strategy	Average Sharpe ratio with no estimation risk	Average Sharpe ratio with estimation risk	St. dev. of Sharpe ratio with estimation risk
MSR (maximum Sharpe ratio)	13.3377	0.5587	0.6114
GMV (global minimum variance)	2.4904	0.8859	0.5743
EW (equal-weighted)	0.6048	0.6048	0.0000
CW (cap-weighted)	0.4972	0.4972	0.0000
50% GMV + 50% EW	1.0773	0.9443	0.3003

Sharpe ratios for selected weighting schemes in the presence of estimation errors in expected excess returns and covariances - Results taken from Martellini, Milhau and Tarelli (2013). The table shows statistics on the ex-ante Sharpe ratio of different portfolios. These results have been obtained by simulating ("true") population parameters and estimation errors. The first column contains results when expected excess returns and the covariance matrix are perfectly estimated (no estimation risk), in particular the average annualised Sharpe ratio. The average is taken across different sets of "true" parameters. The 2nd and 3rd columns contain results when we simulate estimation errors for risk and return parameters. We calculate the mean and standard deviation of the distribution of Sharpe ratios that we obtain across our simulations for each set of "true" parameters, the 2nd and 3rd columns show the average of these statistics across all sets of "true" parameters.