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EDHEC-Risk Institute Research Insights

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Introduction
Noël Amenc

The latest issue of EDHEC-Risk Institute's Research Insights supplement in partnership with Investment & Pensions Europe (IPE) is being published concurrently with the EDHEC-Risk Days Europe conference in London, which is being held on 26–27 March, and some of the following pages address topics being presented at EDHEC-Risk's flagship European conference.

The first article deals with the question of non-financial risks within the European fund management industry, a subject on which we have recently made a series of proposals following the research conducted within the research chair supported by CACEIS. The first recommendation relates to the reinforcement of information on non-financial risks. The second recommendation aims to increase the responsibility of all actors within the fund management industry. Lastly, EDHEC-Risk Institute recommends that a new label of 'Restricted UCITS' be created. This would establish a UCITS category with a scope for investment that is limited to what the depositary can actually hold and thus return without difficulty. This 'Restricted UCITS' label would allow UCITS funds, which would rightly benefit from a secure image, to be marketed not only to European retail clients, but also on a global platform.

The second article, drawn from the BNP Paribas Investment Partners research chair on Asset-Liability Management and Institutional Investment Management, shows that relatively simple solutions exist that can be implemented as dynamic asset allocation strategies in order to control short-term risk levels while maintaining access to long-term sources of performance. These solutions are a substantial improvement over traditional strategies without dynamic risk-control.

In 'Implicit public pension liabilities and evaluating the solvency of European states', we determine that ignoring explicit and implicit pension liabilities when assessing the solvency of the EU-27 countries gives a distorted view of their relative situations. Investors must be more aware of the risks borne by pension schemes when evaluating the solvency of sovereign debtors and European institutions must keep working towards greater transparency and information regarding public finances.

In the following article, we affirm that institutional investors should express great interest in using index-based products to increase their exposure to infrastructure. Indices have the potential to meet the major expectations institutional investors have of infrastructure investment. Creating efficient benchmarks for infrastructure equity investing will also go a long way in allowing final investors like insurance companies and pension funds to assess the riskiness of such investments. This research is supported by Meridiam Infrastructure and Campbell Lutyens as part of the research chair on Infrastructure Equity Investment Management and Benchmarking at EDHEC-Risk Institute.

We then show how one can benchmark 'smart beta', or alternative equity index, strategies by flexibly combining the results of different choices for the key steps in portfolio construction – ie, stock selection and stock weighting. For a commercial index, it is possible to construct advanced beta benchmarks that pursue the same objectives and have similar exposures to risk factors but are built using diversified weighting schemes. We select two popular smart beta strategies for our analysis – defensive or low volatility and fundamental indexing – as examples to illustrate such benchmarking.

In a similar vein, we show in the following article that a distinction needs to be made between a stock selection decision and the choice of diversification scheme when constructing an advanced beta strategy. In particular, stock selection can be used as a tool to correct the risk factor exposures of the diversification-based weighting schemes while keeping most of the improvement in the respective risk/return objective. This result contradicts the claim that diversification-based schemes boil down to simple factor tilts.

Finally, we examine the 'low volatility puzzle' – ie, the discrepancy that exists in the academic literature between the theoretical predictions from standard asset pricing models regarding the risk-return relationship and the results obtained by researchers who have analysed this relationship in equity markets from a purely empirical perspective. We conclude that the fact that empirical results are not robust with respect to methodological choices should be taken as an indication that analysing the exact shape and nature of the risk-return relationship is a subtle question that requires extreme care and attention.

We wish you an enjoyable read of the supplement and look forward to the next instalment of this editorial partnership with our friends at IPE, whom we thank for their support. Our mutual aim with this supplement is to provide academic insights that will genuinely contribute to improving institutional investment practices.

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Proposals for better management of non-financial risks within the European fund management industry

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Within the framework of research on the topic of a better grasp of non-financial risks, which has been conducted over the last three years with the support of CACEIS, EDHEC-Risk Institute has summarised its findings and conclusions in a series of proposals targeting not only European regulators, but also fund management professionals and investors.

The proposals fall within the context of current significant European regulation, which came to fruition, in the wake of the 2007–08 crisis, due to heightened awareness of non-financial risks and of the need for increased protection of investors from such risks.

This strong commitment to investor protection with regard to non-financial risks derives from the notion that they are quite different from financial risks. In fact, within the framework of third-party asset management, these risks (assuming that they have been appropriately documented and well managed within the context of the mandate given to the fund manager) are ultimately borne by the investor who, logically, benefits from the premia linked to these risks. All the regulator's efforts should therefore be focused on the obligation of means that different investment management providers should respect, whether it involves informing the investor of the risks taken (specifically through adequate and comprehensible documentation, as planned for within the Key Investor Information Document [KIID]), ensuring that the investor understands the risks and has the capacity to bear them (duty to advise as prescribed within the Markets in Financial Instruments Directive [MiFID] framework and which shall be extended to some other packaged retail investment products [PRIPS] together with the updating of MiFID and the Insurance Mediation Directive [IMD]), and ensuring that the asset manager has the means to adequately manage these risks, which must be proportional to the fund's overall risk level, particularly with regard to eligible assets (in the post-Undertakings for Collective Investment in Transferable Securities [UCITS] III framework).

Regarding non-financial risks, the regulator (and often the investor) takes a different stance. On the one hand, these risks would not be rewarded by the markets and on the other hand they would stem from the very organisation and operation of the industry value chain and, as such, these risks should be borne by the value chain. In the same way that the risk of maturity and risk transformation assumed by banks requires the protection of depositors potentially up to a certain guarantee level, this thinking would require that the non-financial risks created by the industry be ultimately borne by the latter rather than by investors. In this context, the regulator has the temptation to go beyond requiring an obligation of means and impose an obligation of results on providers of fund management services. For instance, this is why the regulator, whether via the AIFM Directive or the draft UCITS V Directive, wished to stress that the ultimate responsibility rests with the depositary of funds with regard to the security and restitution of assets that have been put under its custody. More broadly, the regulator wants to convince itself and all stakeholders that an adequate level of regulation on the prevention of non-financial risks and the imposition on to the depositary of a strict liability to return lost assets would allow the two major non-financial risks to be addressed – namely (i) the consequences of counterparty default within the fund management value chain (for example, the default of the counterparty in a securities lending/borrowing operation or an OTC derivative); or (ii) the poor assessment/structuring of a fund's liquidity, thereby subjecting the investor to a loss due to the illiquidity of a fund that was initially branded liquid.

> *"We must, at all costs, avoid making investors believe that they can rely on the law or an external third party for protection against risks which could ultimately affect them seriously"*

EDHEC-Risk Institute considers that this dual approach – even if it has led the regulator to comprehensively investigate the sources of non-financial risks and allowed for them to be better managed – needs to be called into question.

It is contestable, firstly, as some forms of investment management are indissociable from certain forms of non-financial risk taking, with investors willingly accepting these risks rather than being merely subjected to them. As such, investing in hedge funds – which are often not subject to stringent regulation – carries the assumption that investors are well aware of and accept the non-financial risks of these funds; while they certainly wish to limit these risks as much as possible, they are recognised and factored into required returns. On this basis, we note that the required returns of hedge fund strategies offered through managed account platforms which reduce operational risk are lower than those of hedge funds which are managed and held in custody offshore. In the same vein, investing in certain emerging equity markets naturally exposes investors to infrastructure and market risks at large; compared to transactions carried out on more secure markets, these are supplementary risks which are duly factored into the price of assets. Exposure to non-financial risks can often result in direct remuneration as is the case with securities lending/borrowing activities for which the asking price does not solely depend on financial factors (interest rates, supply and demand for the security), but also on non-financial factors (the organisation, structure and level of collateral; the quality of the counterparty; the stature of the lending agent and the terms and conditions of the securities lending and borrowing agreement, etc).

Secondly, from a systemic point of view, it seems rather dangerous to put the 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. Concentration is derived from economies of scale and specialisation, and along with low capital intensity, allows post market operations to be optimised in terms of value for money.

Lastly, we certainly view it as risky to let investors and the industry at large believe that one law or a single stakeholder can solve everything. In the end, whether it be via UCITS V or the AIFMD, the depositary's responsibility for restitution will not cover all assets and, notably, not the operations and instruments which do not fall under the depositary's control.

So, any communication around a regulation that professes to be more secure, but which in reality turns out not to be so, will only serve to magnify the phenomena of adverse selection and moral hazard. We must thus, at all costs, avoid making investors believe that they can rely on the law or an external third party for protection against risks which could ultimately affect them seriously. In the same manner, the fund management industry as a whole must be encouraged to implement better modes of governance, monitoring and risk reduction rather than transferring the responsibility and costs of management or insurance of non-financial risks to a party that is not necessarily responsible for taking these risks in the first place.

A detailed survey conducted by EDHEC-Risk Institute in 2011, which targeted the spectrum of players within the fund management

industry, showed that these stakeholders were aware of the limitations of an approach based solely on the responsibility of the depositary. Some 61% of respondents ranked transparency, information and governance as their top priority with regard to regulation. However, regulation on restitution, which lies at the heart of the regulatory agenda, was only ranked fourth behind increasing the responsibility of the industry and regulation on distribution. On the issue of responsibility, the majority of respondents (67%) deemed it necessary for the fund manager to have increased responsibility when it came to the management of non-financial risks, given its central and decision-making role when selecting assets, counterparties, implementing risk management measures, respecting investment constraints and restrictions, asset valuation, investor information, etc. However, this certainly does not absolve the depositary of its share of responsibility (65%). Meanwhile, the study showed that a large majority of respondents (75%) felt that a clearer responsibility regime should be established for depositaries, particularly with a more robust obligation of means.

EDHEC-Risk Institute's proposals for a better grasp and management of non-financial risks as presented in this document take these findings and analyses into account. They fall into the twofold perspective of: (i) increased accountability of all parties (including investors) when it comes to non-financial risks; and (ii) preventing the creation of a false sense of security due to regulatory promises which will, in the end, magnify the very risks they aim to mitigate.

The EDHEC-Risk Institute proposals can be categorised into three themes.

The **first series of recommendations** addresses the issues of transparency, information and governance. Not only is this theme of major concern to all stakeholders, but it is also the necessary condition for non-financial risks to be taken into account in investment decisions and, more broadly, in the fund management value chain.

With regard to transparency, it is recommended that the information on non-financial risks required for the KIID be reinforced, thus rendering more effective the provision of information on the materiality of non-financial risks that is part of the CESR's statement of good practice for the presentation of the KIID (CESR, 2010). To achieve this, we recommend that it be obligatory for the KIID to contain a clear description of the non-financial risks to which the fund is exposed and of the management of these risks and lastly an assessment of the residual non-financial risk borne by the investor. This assessment would be translated into a synthetic indicator, the layout and calculation of which would be identified by ESMA.

Additionally, we suggest that an explicit rating be used to promote best practices with regard to transparency and risk management. This rating would benchmark the fund based on its level of non-financial risk and it would thus provide the investor with a synthetic indicator of the risk exposure it is assuming when investing in the fund. This information would effectively be a catalyst for improved practices and transparency within the fund management industry on this issue, and it would promote the adoption of standards going beyond regulatory requirements.

Of course no information is of any value unless it engages the liability of those who create or diffuse it. This is why we propose a clarification of the responsibility regime with regard to information on non-financial risks.

Within the value chain, the distributor is the actor who has to ensure that the information provided on all of the fund's risks is clear and comprehensible for the client. This information should allow the distributor to advise non-professional clientele on the nature and level of risks to which the fund is exposed and ensure that these fall in line with the client's profile and level of competence/knowledge. There is a priori no reason to limit such advice to financial risks and one would presume that the objectives underlying such advice should extend to non-financial risks.

However, this is rarely the case today. There is no choice but to accept that information on non-financial risks is often non-existent and that the due diligence questionnaires circulated during the know-your-customer process (as required by MiFID) do not allow the assessment of an investor's level of comprehension on these subjects. This lack of information should not absolve the distributors of their responsibility. They are certainly not in charge of producing the information or guaranteeing its accuracy, but their duty to advise should mean they refuse to sell a product which they feel has insufficient or incomprehensible information.

Furthermore, given the distributor's responsibility to verify the information's clarity and ease of comprehension, we feel it is all the more important for the regulator to further clarify the distinction between those who are professional investors and those who are not. If the former are not subject to the provisions on advice as laid out by MiFID and therefore exempt from all costs associated with fund distribution, it would seem logical that they automatically acknowledge the fact that they are in a position to assess the quality of information provided by funds. As such, the reduced fees demanded by professional investors should clearly prevent the latter from claiming, ex post, any damages linked to mis-selling on the part of fund sponsors or managers.

"Given the distributor's responsibility to verify the information's clarity and ease of comprehension, we feel it is all the more important for the regulator to further clarify the distinction between those who are professional investors and those who are not"

Bearing in mind the alignment of restitution obligations with the depositary's liability regime for assets under its custody within the UCITS V framework, we consider it important for the depositary of each fund to clearly establish the percentage of assets covered by the obligation of restitution. This information would allow for risks posed by moral hazard, as previously highlighted, to be limited.

Lastly, we should remember that fund managers have a key role when it comes to providing information on non-financial risks. They must explain the source of these risks and, in conjunction with the depositary, they must assess not only these risks, but also the effectiveness of their management and mitigation. As a result, to achieve perfect investor information, EDHEC-Risk Institute believes that it is the fund manager's responsibility to inform investors of the responsibilities, regarding non-financial risks, of active parties with which the fund manager has established contracts in the fund's name. We therefore recommend that the KIID mentions all contractual agreements that detail the responsibilities of stakeholders as regards the restitution of assets or guarantees.

As for the governance of non-financial risks, EDHEC-Risk Institute calls for clarification and a reinforcement of the fiduciary responsibilities of fund administrators or fund management companies. Such a clarification is all the more important at this time because the UCITS framework is not explicit on this point and does not allow for upward harmonisation of different systems of responsibility and modes of risk governance in Europe.

In the same vein, EDHEC-Risk Institute recommends that depositaries be given the responsibility to directly inform distributors of anomalies or non-compliance with legal and contractual rules which they become aware of as part of their operation.

Finally, as EDHEC-Risk Institute's philosophy is that the actions of investors themselves lead down the best possible path for limiting both financial and non-financial risks, we recommend giving investors the means to defend themselves and take legal action to protect their rights by introducing European class actions that will allow investors to seek redress and obtain fair compensation for the prejudice suffered.

The **second series of recommendations** is linked to the establishment of economic incentives to encourage better management of non-financial risks. Within this context, EDHEC-Risk Institute has two principal proposals. On the one hand, we call for the adoption of capital requirements proportional to the level of non-financial risk assumed by the major players in the fund management industry value chain – namely depositaries and fund management companies. The calculation of the regulatory capital requirement would be addressed in an initial analysis within the framework of a standard model, for which the methods of calculation and parameters would be defined by ESMA.

At the same time, we propose reducing this capital requirement by establishing a residual risk assessment in the form of an internal model whose calculation principles would also be harmonised at the European level. This internal model would allow for the reduction of regulatory capital requirements depending on 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. This new approach for prudential capital and its assessment should not be seen as a safety net for non-financial risks, but rather an encouragement which ultimately aims to ensure that the reduction of capital linked to improved risk management is greater than the increased cost of implementing additional requirements relative to the standard formula.

EDHEC-Risk Institute considers this so-called 'risk-based capital' approach, which using the internal model should not lead to a strong increase in the economic capital of depositaries and asset managers, to be more virtuous than the costly contribution to an investors' guarantee fund, which the Commission is proposing to extend to UCITS. The approach being proposed by the Commission would effectively create a pooling and transfer of risk which would not ►

reduce it in the slightest, but on the contrary encourage the phenomena of adverse selection and moral hazard. Indeed, fund managers and investors would have no interest to reduce non-financial risks, but instead would have incentives to minimise their management costs or to maximise the profits they can generate from financial risk taking.

The **third and final series of recommendations** is probably the most important because we feel that not only does it address the challenge of marketing UCITS funds to inexperienced individual clientele, but it also helps clarify and strengthen the global image of the UCITS label, which was affected following the emergence of NewCITS and also altered due to a number of issues and scandals that have come to light since 2007. In fact, the recent financial crisis shed light on a number of new sources of financial risk – on one hand we have the extreme correlation between the real estate mortgage and equity markets and, more broadly, on the other hand the extreme price sensitivity of all assets to counterparty and liquidity risks of the financial system with respect to off-balance-sheet operations such as securitisation.

Despite being quite pronounced in 2007–08, the first type of risk was regarded, after the fact, as a logical consequence of increasingly globalised markets and probably of the theoretical character, from the perspectives of both investors and the regulator, of the very idea of distinct asset classes or categories and the reduction of this risk through its dissemination.

The second type of risks led regulators to absolutely want to reduce counterparty and liquidity risks by strongly stressing the need to increase regulatory pressure with regard to proper management of these risks by actors in the financial world.

Within the fund management industry, this focus paradoxically led the regulator not to question the extent of operations and assets eligible for regulated funds (and on a European level particularly the flagship investment vehicles that are UCITS), but rather focus on non-financial risks within funds and call for a trusted third party – the depositary – to act as a guarantor for the risks taken by all parties.

We believe this approach is wholly ineffective and dangerous, to say the least.

Ineffective because, in the end, the goal of fully protecting an investor's assets against non-financial risks by subjecting the depositary to restrictive regulation does not stand up to a careful analysis of how these risks materialise and how they can be controlled. Short of transforming the depositary into an insurer – although it does not have the required regulatory status, earnings or capital to play this role – it would be impossible to demand the restitution of assets which do not fall under its control. 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 a portion of the assets.

This approach is dangerous because, as previously pointed out, in terms of protecting investor interests, we believe it is highly counter-productive to 'over-sell' the objective of security when neither regulation nor its current state of implementation can uphold such a promise and security-related rhetoric.

Regardless of the architecture of the laws on the management of non-financial risks within the UCITS framework, these risks will continue to exist and thus potentially materialise. Hence, encouraging investors to believe that regulation can solve everything leads them to let their guard down against these risks and does not motivate them to conduct the essential analysis and due diligence that is their responsibility.

This is why we have drawn up these proposals; in order for investors to better protect themselves against non-financial risks, they first of all need to be as well informed as possible. Nevertheless, we are aware that it would be rather naïve of us to think individual investors would be capable of carrying out such analysis and due diligence on their own. This is why we previously suggested strengthening the responsibility of the distributor in terms of advice on non-financial risks. In this same spirit, and also because the distribution of funds can occur without advice being given, including for individual investors, EDHEC Risk Institute proposes a new label of 'Restricted UCITS'.

In some ways, the concept of Restricted UCITS is a mirror image of NewCITS, which left investors exposed to greater non-financial risks given the nature of operations and assets eligible within the post UCITS III framework. It is a reasonable response to a call for more security for the operations of actors within the fund management industry value chain. Its prescriptive nature also prevents the potential scenario of escalation in which depositaries would attempt to satisfy their clients by offering guarantees for risks they cannot really control.

"The goal of fully protecting an investor's assets against non-financial risks by subjecting the depositary to restrictive regulation does not stand up to a careful analysis of how these risks materialise and how they can be controlled"

Additionally, we believe that this Restricted UCITS proposal is a better response to the issue of non-financial risk control than the attempt to distinguish between complex and non-complex products, which leads more towards questions about an average investor's ability to understand financial risks and fund pay-offs rather than to a relevant approach to deal with the presence or absence of non-financial risks – EDHEC-Risk Institute had touched upon the issue of how to approach complexity during the debate on the risks of exchange-traded funds that took place in the first half of 2012.

EDHEC-Risk Institute recommends that the depositary guarantees the full restitution of all assets for this new UCITS category.

Such a guarantee would allow the 'Restricted UCITS' to be marketed without any duty to advise or any restriction when dealing with retail clients.

Furthermore, so that the depositary is not put at risk and obliged to make restitution commitments that it would not be able to fulfil, we recommend that the range of assets and operations eligible under this new form of UCITS 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 as per the European definition). Additionally, the only transactions that will be authorised will 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.

This restriction of 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; however, in exchange for this reduction, full protection against non-financial risks would be ensured, and at a very low cost for investors.

In this sense, the performance of Restricted UCITS would also serve as a benchmark for non-restricted UCITS, which would have to justify increased risks and management fees via a significant increase in performance. To conclude this summary, we would like to emphasise the positive contribution of our proposals to the development of the European fund management industry. By introducing more stringent requirements in terms of information and proper management of non-financial risks for all UCITS at a reasonable cost, the proposals put forward by EDHEC-Risk Institute are responding to the demands of the investor community and, on a broader scale, to the demands of professionals within the European fund management industry.

Moreover, the creation of a new UCITS category that carries virtually no non-financial risk would allow the UCITS label to benefit from a renewed international image in the post-crisis world, thus offering retail clients across the globe an easy-to-understand product, whose guarantee of restitution would enable it to be marketed across all distribution platforms with no specific restriction.

The research from which this article was drawn was supported by CACEIS as part of the research chair on Risk and Regulation in the European Fund Management Industry at EDHEC-Risk Institute.

The chair deals with the issue of operational risk and performance in a changing regulatory framework for the European fund management industry. It analyses the major risks those in the industry face as a result of regulation and of their practices, assesses their importance and impact in terms of solvency and business models, and proposes methods to mitigate them.

The full version of the research is available on the EDHEC-Risk Institute website at the following address: http://www.edhec-risk.com/best_execution/CACEIS_Research_Chair

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Long-horizon investing with short-term constraints

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Designing investment solutions that meet investors' needs requires the conflict inherent in the coexistence of long-term objectives and short-term constraints to be addressed.

Meeting the challenges of modern investment practice involves the design of novel forms of investment solutions, as opposed to investment products, customised to meet investors' long-term objectives, while respecting a number of constraints expressed in terms of dollar budgets, but also risk budgets which are often set over short horizons.

The conflict between the presence of long-term objectives and short-term constraints is in fact one of the most critical challenges faced by long-term investors. Focusing on equity investments, the dilemma can be summarised as follows. On the one hand, investing substantial fractions of their wealth in equity markets makes it difficult for investors to ensure that short-term risk budgets are respected, and leads to a dominant allocation to safe assets that show better correlation with the investors' liabilities. On the other hand, shying away from investing in equity involves a substantial opportunity cost, especially for long-term investors, because the equity risk premium is positive, hence attractive for all investors, but also mean-reverting, hence even more attractive for long-term investors.

One of the main findings in the academic literature on long-term allocation decisions with mean-reverting equity returns is the fact that equities serve as a hedge against unfavourable equity returns in the presence of mean-reverting equity returns. As a result, the optimal allocation to stocks is higher compared to the myopic case, and investors with longer time-horizons hold more stocks compared to investors with shorter horizons. This prescription has very often been taken at face value by target-date funds or life-cycle funds, an investment solution advocating a deterministic decrease of equity allocations (also known as glidepath) when approaching retirement date.

One key problem, however, is that this prescription can lead to extremely difficult situations when risk is assessed from a shorter-term perspective, in particular in the context of a severe bear equity market such as the one experienced in 2008. In fact, it appears that most, if not all, investors, even those (such as pension funds or sovereign wealth funds) with the longest possible horizons, inevitably face a number of short-term performance constraints, imposed by accounting and/or regulatory pressure, political pressure, peer pressure, etc. In a private wealth management context, there is also strong evidence that investors typically face (mostly self-imposed) short-term constraints, eg, maximum drawdown constraints.

While it is widely perceived that tension exists between a focus on hedging long-term risk and a focus on insurance with respect to short-term constraints, we cast new light on this debate by arguing that long-term objectives and short-term constraints need not be mutually exclusive.[1] In fact, our analysis shows that both motives may naturally coexist within the context of a long-term investing strategy consistent with short-term performance constraints.

In the absence of short-term risk constraints, the presence of a mean-reverting equity risk premium justifies that the allocation to equities should be anti-cyclical and increasing with time-horizon.

Investors endowed with consumption/liability objectives need to invest in two distinct portfolios, in addition to cash: one performance-seeking portfolio (PSP) and one liability-hedging portfolio (LHP); this is the liability-driven investing (LDI) paradigm. The allocation to the 'risky' PSP versus the 'safe' LHP is found to be increasing in the PSP Sharpe ratio.

> *"Long-term objectives and short-term constraints need not be mutually exclusive. Our analysis shows that both motives may naturally coexist within the context of a long-term investing strategy consistent with short-term performance constraints"*

As such, the optimal strategy displays a state-dependent component, suggesting that the allocation to equity should be increased (respectively, decreased) when equity has become cheap (respectively, expensive), as measured through a proxy for the equity risk premium. In the context of a model with a stochastic mean-reverting equity risk premium, one can also show that the optimal allocation involves hedging demand against unexpected changes in the PSP Sharpe ratio, known as the risk premium hedging portfolio (RPHP), which indeed implies a deterministic decrease of the allocation to equity as the investor gets closer to the time-horizon.

One key element that is missing in the analysis presented so far is the integration of short-term constraints into the design of the optimal allocation strategy.

The presence of short-term constraints justifies that the allocation to equities should also be an increasing function of the current value of the risk budget, in addition to being an increasing function of time-horizon and the current value of the equity risk premium.

These short-term constraints are not managed through hedging strategies, which focus on immunising the portfolio value with respect to changes in risk factors impacting asset and liability values, but instead through dedicated insurance strategies. The practical implication of the introduction of short-term constraints is that optimal investment in a performance-seeking satellite portfolio is not only a function of risk aversion, but also becomes a function of risk budgets (margin for error measured in terms of distance with respect to minimum acceptable wealth levels), as well as probability of the risk budget to be spent before horizon. In a nutshell, a pre-commitment to risk management allows one to adjust risk exposure in an optimal state-dependent manner, and therefore to generate the highest exposure to the upside potential of the PSP while respecting risk constraints.

It is widely perceived that tension exists between a focus on hedging long-term risk and a focus on insurance with respect to short-term constraints: dynamic risk-controlled strategies, which imply a reduction to equity allocation when a drop of equity prices has led to a substantial diminution of the risk budget, have often been blamed for their pro-cyclical nature, and long-term investors are often reluctant to sell equity holdings in those states of the world where equity markets have become particularly attractive in the presence of mean-reversion in the equity risk premium.

Our research actually suggests that long-term objectives and short-term constraints need to be mutually exclusive, and can be integrated into a comprehensive asset allocation framework. Depending on market conditions and parameter values the pro-cyclical risk-controlled motivation may outweigh the revision of strategic asset allocation motivation, or vice-versa, with risk management always prevailing ultimately. In other words, the risk-control methodology can be made entirely consistent with internal or external processes aiming at generating active asset allocation views. In fact, casting the active view generation process within the formal framework of a dynamic risk-control strategy appears to be the only way to successfully implement active asset allocation decisions while ensuring the respect of risk limits.

In practice, a number of key improvements can be used in implementation. While the original approach was developed in a simple framework, it can be extended in a number of important directions, allowing for the introduction of more complex floors. A large variety of ►

1 For more details, see Deguest, R., L. Martellini and V. Milhau (2013). *Hedging versus Insurance: Long-Horizon Investing with Short-Term Constraints*, EDHEC-Risk Publication.

◄ floors can in fact be introduced (simultaneously if necessary) so as to accommodate the needs of different kinds of investors. Among the possible floors, the following possibly stand out in terms of their relevance for various kinds of investors: capital guarantee floors allowing for the protection of a fraction of the initial capital; benchmark protection floors allowing for the protection of a fraction of the value of any given stochastic benchmark (with the liability portfolio being the most natural benchmark for investors facing liabilities); max drawdown floors allowing for the respect of limits on maximum consecutive losses; trailing performance floors allowing for the protection of a fraction of the prior value of the portfolio on a rolling basis, etc.

In addition to accounting for the presence of floors, the dynamic risk-controlled strategies can also accommodate the presence of various forms of caps or ceilings. These strategies recognise that the investor has no utility over a cap target level of wealth, which represents the investor's goal (actually a cap), which can be a constant, deterministic or a stochastic function of time. From a conceptual standpoint, it is not clear a priori why any investor should want to impose a strict limit on upside potential. The intuition is that by forgiving performance beyond a certain threshold, where they have relatively lower utility from higher wealth, investors benefit from a decrease in the cost of the downside protection (short position in a convex payoff in addition to the long position–collar flavour).

Putting it differently, without the performance cap, investors have a greater chance of failing to achieve an almost-reached goal when their wealth level is very high, and we show that the presence of upper (in addition to lower) bounds on performance, consistent with the kind of utility satiation often exhibited by long-term investors, is another, independent, reason why a fall in equity prices should not always lead to a decrease in equity allocation, even without the mean-reverting equity risk premium.

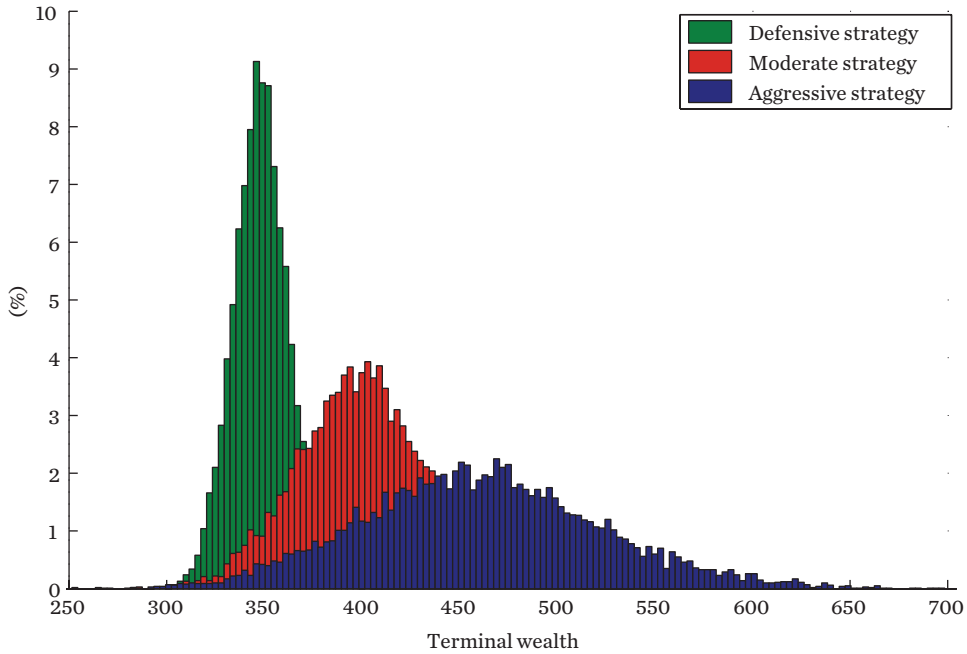
The opportunity costs implied by the short-term constraints are significantly lower when these constraints are optimally addressed through insurance strategies, as opposed to being inefficiently addressed through an unconditional decrease in the equity allocation.

Our analysis suggests that asset allocation and portfolio construction decisions are intimately related to risk management.

The quintessence of investment management is essentially about finding optimal ways to spend risk budgets that investors are reluctantly willing to set, with a focus on allowing for the highest possible access to performance potential while respecting such risk budgets. Risk diversification, risk hedging and risk insurance are three useful approaches to optimal spending of investors' risk budgets. In this context, improved forms of investment solutions rely on a sophisticated exploitation of the benefits of the three competing approaches to risk management, namely risk diversification (key ingredient in the design of better benchmarks for performance-seeking portfolios), risk hedging (key ingredient in the design of better benchmarks for hedging portfolios) and risk insurance (key ingredient in the design of better dynamic asset allocation benchmarks for long-term investors facing short-term constraints).

In the end, risk management, which focuses on maximising the probability of achieving investors' long-term objectives while respecting the short-term constraints they face, appears to be the key source of added value in investment management.

1. Distributions of terminal wealth generated by long-term investment strategies



The results we obtain confirm that dynamic asset allocation benchmarks can be designed so as to allow for a more efficient spending of investors' risk budgets. Intuitively, this is because the pre-commitment to reduce the allocation to equity in times and market conditions that require such a reduction, so as to avoid over-spending risk budgets, allows investors to invest on average more in equities compared to a simple static strategy that is calibrated so as to respect the same risk budget constraints. The welfare gains involved in this higher allocation to equities are found to be substantial for reasonable parameter values, especially for long-term horizons and in the presence of a mean-reverting equity risk premium.

As a numerical illustration of the benefits of risk-controlled strategies, we first simulate the performance of unconstrained strategies, taking the time-horizon to be equal to 20 years, while the risk aversion parameter, which is not observable, is calibrated in such a way that the average allocation to equity over the 20-year life of the strategy is equal to a target of 10%, 20% or 30%. The three corresponding long-term unconstrained strategies will be referred to as defensive (leading to an average stock weight of 10%), moderate (leading to an average stock weight of 20%) and aggressive (leading to an average stock weight of 30%) respectively.

Figure 1 shows the resulting distribution of unconstrained terminal wealth for various risk aversion levels. We find the usual risk-return trade-off: strategies implemented by less risk-averse investors will contain a higher allocation to equities, which will result in a higher average wealth level as well as higher uncertainty around the terminal wealth level.

While long-term strategies are engineered to achieve optimal risk/return trade-offs over the long term, short-term losses and drawdown levels can remain extremely large, especially for the aggressive investor, with a maximum drawdown at 24.4%, as can be seen from figure 2.

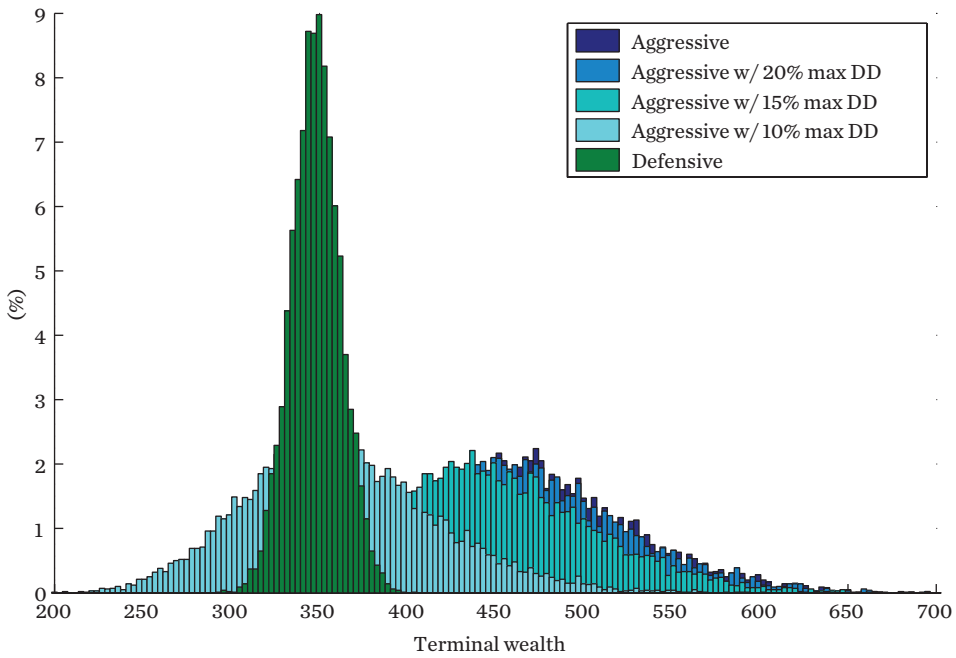
In this context, an investor wishing to (or obliged to) maintain the maximum drawdown around say 15% would have to opt for the defensive strategy, even if the level of wealth achieved with this strategy is much less attractive than what is allowed by the aggressive strategy. In this context, the objective measure of the opportunity cost associated with a 15% max drawdown can be formally defined as the additional initial contribution needed to reach with the defensive strategy the same average wealth level as with the aggressive strategy, a cost which turns out to be a prohibitive 32.51% in this particular example.

A less costly solution is to use insurance, as opposed to hedging, to manage downside risk. Hence, as an alternative to opting for the defensive strategy, the investor can choose the aggressive strategy, which allows for much higher access to the equity risk premium, and implement a dynamic risk-controlled investing

2. Risk and performance indicators for long-term investment strategies

	Aggressive	Moderate	Defensive
Min wealth	251.71	280.10	293.75
Q_5	362.39	345.16	324.78
Low target wealth (Q_{25})	419.64	378.00	338.89
Medium target wealth (Q_{50})	459.49	399.71	348.11
High target wealth (Q_{75})	500.33	421.75	357.40
Q_{95}	567.38	456.22	371.75
Max wealth	739.16	540.35	403.29
Average wealth	461.37	400.15	348.18
High minus low	80.69	43.75	18.51
(High minus low)/(2 × medium)	8.78%	5.47%	2.66%
Max 3-year loss	15.89%	9.26%	7.75%
Max drawdown	24.40%	17.78%	15.16%

2. Distributions of terminal wealth generated by long-term investment strategies in the presence of max drawdown constraints



overlay designed to ensure that the maximum drawdown will be kept below 15% (see figure 3 for the resulting distribution of terminal wealth, where we have also tested maximum drawdown levels at 10% and 20%).

We now observe from figure 3 that the average wealth of the aggressive strategy with a 15% maximum drawdown constraint is substantially higher than the unconstrained defensive one, for essentially the same level of extreme losses. This result makes a strong case for the management of short-term constraints through dynamic risk budgeting rather than through the choice of unnecessarily conservative investment policies. So as to provide an objective assessment of the opportunity cost of imposing stricter drawdown constraints, when these constraints are optimally managed through insurance techniques, we find that a mere 5.38% additional investment is needed to reach with the aggressive benchmark with a maximum drawdown constraint of 15% the same average wealth level as with the aggressive strategy without maximum drawdown constraints. This value very favourably compares to the aforementioned 32.51% opportunity cost involved in managing maximum drawdown constraints inefficiently through an excessive level of hedging.

Overall, these results illustrate that not disentangling long-term risk-aversion and short-term loss-aversion may lead to poor investment decisions. Relatively simple solutions exist that can be implemented as dynamic asset allocation strategies in order to control short-term risk levels while maintaining access to long-term sources of performance. These solutions are a substantial improvement over traditional strategies without dynamic risk-control, which inevitably lead to under-spending of investors' risk budgets in normal market conditions, with a strong associated opportunity cost, and over-spending of investors' risk budget in extreme market conditions.

The research from which this article was drawn was supported by BNP Paribas Investment Partners as part of the research chair on Asset-Liability Management and Institutional Investment Management at EDHEC-Risk Institute.

The chair examines advanced ALM topics such as dynamic allocation strategies, rational pricing of liability schemes, and formulation of an ALM model integrating the financial circumstances of pension plan sponsors.

The full version of the research is available on the EDHEC-Risk Institute website at the following address: http://www.edhec-risk.com/ALM/BNPPAM_Research_Chair

Reference

Deguest, R., L. Martellini and V. Milhau (2013). *Hedging versus Insurance: Long-Horizon Investing with Short-Term Constraints*, EDHEC-Risk Publication produced as part of the BNP Paribas Investment Partners research chair on Asset-Liability Management and Institutional Investment Management.

Implicit public pensions liabilities and evaluating the solvency of European states

Francois Cocquemas, PhD Candidate, Research Assistant, EDHEC-Risk Institute

Much of the discussion surrounding the solvency of the EU-27 countries has focused on the Stability and Growth Pact criteria (maximum of 3% deficit-to-GDP and 60% debt-to-GDP), and more recently on the concept of 'structural deficit', corresponding to the budget deficit net of cyclical effects and one-off and temporary measures. This structural deficit should not exceed 0.5% of GDP (1% for countries with debt-to-GDP ratios significantly below 60%) and should be monitored by independent institutions.

These measures are commonly used as a touchstone of virtuous and less virtuous countries. However, they leave out the explicit and implicit pension liabilities that are weighing on public finances, which are likely to be very significant. With the crisis they could soon add to public deficits under the double pressure of an increasing funding need, and a decreasing funding basis of public pensions.

Due to the variety of national systems, gaining a clear view of pension liabilities is not straightforward. The recent 2012 Ageing Report (European Commission, 2012) goes a long way in providing comparable figures and projections of public pension expenditures, as well as non-public occupational, private mandatory and private voluntary pensions for the countries that provide them. Considering the complexity in designing a one-size-fits-all European model, the European Commission has chosen to rely on national models, with some subsequent harmonisation.

In research that we have conducted recently[1] we analysed the main demographic, economic, and political determinants that could influence these projections, and we performed an estimation exercise analogous to that of Mink (2008). Using several fixed discount rate hypotheses, we compute the net present value of public pension liabilities for the 27 countries, and compare their relative situation. We then propose a heuristic categorisation of the main risks borne by each country's pensions from their underlying projections. ►

1 Cocquemas, F. *Towards Better Consideration of Pension Liabilities in European Union Countries*. EDHEC-Risk Institute Publication.

Evaluating the weight of public pension commitments

From this analysis of the factors underlying public pension risks, we can now proceed to an evaluation of the weight of pension commitments and how they change the relative position of the EU-27 countries.

Clustering of countries based on fundamentals

To add to the two standard criteria of the Stability and Growth Pact, we perform a simple cluster analysis on the following 2010 fundamentals: GDP per capita, unemployment rate, old-age dependency ratio, and fertility. We use the k-means algorithm which partitions the observations into k clusters, where k is determined using the 'elbow criterion' to be 4 for our set of data.

A first cluster is made up of Belgium, Denmark, Germany, Ireland, France, Italy, the Netherlands, Austria, Finland, Sweden and the United Kingdom. A second cluster is composed of Bulgaria, Estonia, Latvia, Lithuania, Hungary, Poland, Romania and the Slovak Republic. The Czech Republic, Greece, Spain, Cyprus, Malta, Portugal and Slovenia are in a third cluster, while Luxembourg is assigned a cluster of its own.

If the implicit public pension liabilities that we compute in the next subsection did match the clusters, then factoring in the fundamentals would possibly be sufficient and it would not be indispensable to assess the weight of pensions themselves. This does not however seem to be the case.

Computing accrued-to-date pension liabilities

To give an idea of the size of implicit public pension liabilities, we perform an exercise similar to Mink (2008), using the latest forecast from the European Commission. We compute the 2011 value of the perpetuity using the forecasted expenditures to 2060 and extending the forecasted growth rate from 2060 to infinity. We subtract a similarly obtained perpetuity for pension contributions. Finally, we subtract the value of current public pension assets. We are implicitly assuming that these can grow on average at the discount rate. For the discount rate, we use a rate fixed at 3%, 4% and 5% so as to assess the sensitivity (Mink, 2008, uses 3% and 5%).

The results are shown in figure 1. For the highest discount rate of 5%, we obtain accrued-to-date liabilities of around or above 100% of 2011 GDP in 18 out of 27 countries, of above 200% in eight countries and up to 484% for Belgium. The results are even more dramatic for lower discount rates, with 12 countries above 200% and seven countries above 400% for a rate of 4%, and with 11 countries above 400% and six countries above 800% for a 3% rate, and it is impossible to calculate a discount rate for three countries with pension expenditure growth rates above 3%.

"Current pensions arrangements are likely to become unsustainable in many countries. Sources of financing will have to be found, retirement ages will have to be pushed up, and/or current entitlements will have to be slashed"

These figures are based on projections under the current respective public pension systems, based on economic hypotheses, notably of convergence within the EU-27. This shows the extent to which current pensions arrangements are likely to become unsustainable in many countries. Sources of financing will have to be found, retirement ages will have to be pushed up, and/or current entitlements will have to be slashed. In pay-as-you-go, mainly DB systems, it seems impossible to ask a diminishing workforce share of the population to finance an ever-growing retired population.

The question of the appropriate discount rate is not innocuous. "The real discount rate applied has a relatively large impact on the overall amount estimated. Sensitivity analyses using several different discount rates (or discount rate differentials) are strongly recommended" (Mink, 2010). This is quite surely an understatement. For public pensions, three countries' liabilities grow faster than 3% and the perpetuity cannot be computed with a 3% discount rate. Going from a 5% to a 3% discount rate often as much as triples the accrued size of the liabilities, and sometimes more. This extreme sensitivity makes the exercise more of a warning than a precise forecast.

Furthermore, should the discount rate be the same for all countries? Sovereign debt emissions happen at the national level, at very different risk premiums, while other financial markets are not fully integrated, at least in practice. It is very likely that the discount rate should be in fact endogenous and depend on the underlying economic hypotheses.

Undoubtedly, the sensitivity analysis to other hypotheses, notably on growth, unemployment and productivity, would also reveal large shifts in the size of the accrued liabilities. Modifications to the scheme of contributions could balance the increase in spending and would likely lower the most extreme figures (eg, Luxembourg), but would also impact

1. Maastricht criteria and accrued-to-date pension liabilities under several discount rate hypotheses (2011)

	Main pension scheme	Maastricht-sense GDP (2011, €bn)	Maastricht-sense government surplus (2011, % GDP)	Total Maastricht debt (2011, % GDP)	Public pension deficit (2011, % GDP)			Main risks for pension liabilities
					3%	4%	5%	
Austria	DB	300.7	–2.5	72.4	568.5	311.2	214.6	Employment, hours worked, potential GDP
Belgium	DB	369.8	–3.7	97.8	2,294.6	792.3	484.3	
Bulgaria	DB	38.5	–2.0	16.3	196.7	95.4	60.0	Demography, employment+, hours worked+
Cyprus	DB	18.0	–6.3	71.1	–	760.4	142.1	Potential GDP
Czech Republic	DB	156.2	–3.3	40.8	411.8	112.4	50.0	Demography, employment, hours worked, potential GDP
Denmark	DB	240.5	–1.8	46.6	635.2	394.6	286.9	Financial markets
Estonia	DB	16.0	1.1	6.1	64.6	51.0	40.7	Demography, employment+, hours worked+, potential GDP+
Finland	DB	189.4	–0.6	49.0	150.1	46.6	8.3	Financial markets, employment, hours worked
France	DB + PS	1,996.6	–5.2	86.0	339.0	177.6	119.7	
Germany	PS	2,592.6	–0.8	80.5	228.0	140.3	101.3	Financial markets, demography, employment+, hours worked+, potential GDP
Greece	Flat rate + DB	208.5	–9.4	170.6	386.6	253.7	188.0	Demography, employment, hours worked
Hungary	DB	99.8	4.3	81.4	286.8	126.5	75.6	Demography, employment+, hours worked+
Ireland	Flat rate + DB	159.0	–13.4	106.4	–	677.4	264.3	Financial markets, potential GDP
Italy	NDC	1,579.7	–3.9	120.7	204.2	139.7	104.7	Demography
Latvia	NDC	20.2	–3.4	42.2	–131.5	–44.8	–19.7	Demography+, employment+, hours worked+
Lithuania	DB	30.8	–5.5	38.5	570.7	169.8	83.9	Demography, employment+, hours worked+, potential GDP
Luxembourg	DB	42.6	–0.3	18.3	–	1,187.6	319.7	Potential GDP
Malta	Flat rate + DB	6.5	–2.7	70.9	993.5	267.9	128.8	Demography, employment, hours worked, potential GDP
Netherlands	DB	602.0	–4.5	65.5	560.3	198.3	113.3	Financial markets, employment, hours worked, potential GDP
Poland	NDC	369.7	–5.0	56.4	139.4	135.4	113.3	Demography+, employment+, hours worked+, potential GDP
Portugal	DB	171.0	–4.4	108.1	273.9	148.5	99.0	Demography, employment, hours worked
Romania	PS	131.3	–5.5	33.4	–557.0	–45.1	3.9	Demography+, employment+, hours worked+, potential GDP
Slovak Republic	PS	69.1	–4.9	43.3	1,920.9	424.3	223.0	Demography, employment+, hours worked+, potential GDP
Slovenia	DB	36.2	–6.4	46.9	1,215.4	333.2	167.6	Demography, employment, hours worked, potential GDP
Spain	DB	1,063.4	–9.4	69.3	661.2	129.0	44.5	Demography, potential GDP+
Sweden	NDC	387.6	0.4	38.4	874.4	446.6	294.7	Financial markets
UK	DB	1750.4	–7.8	85.0	1,174.8	459.7	285.3	Financial markets

Source: Eurostat, European Commission (2012), own calculations.
Implicit pension liabilities are accrued to date using a constant discount rate hypothesis of 3%, 4% and 5%. The present value cannot be computed in three cases for the lower discount rate, since liabilities are predicted to grow faster than 3%.
Countries are coloured based on a k-means clustering of the following 2010 fundamentals: GDP per capita, unemployment rate, old-age dependency ratio, and fertility

employment and growth. A more detailed analysis of these issues would therefore require running simulations on national-level models, which is beyond the scope of this article.

In figure 2 we compare the relative situation of countries in the traditional budget surplus-to-GDP and debt-to-GDP ratios space, to that when implicit pension liabilities are added to debt. All in all, the values for public pension liabilities that we calculated can lead to solvency analyses that are substantially different from those habitually taken into account by ratings agencies or investors. As such, countries with virtuous public finances in the Maastricht sense, such as Sweden, Luxembourg or Denmark for example, are much less virtuous if their public pension commitments are included, while the situation of countries such as Spain, Italy, or even Portugal, is relatively better. It is hard to see a common pattern for each cluster, which means that simply using the standard fundamentals to compare countries is not enough to account for the considerable variations in terms of public pension liabilities.

Main risks identified for each country

An in-depth country risk analysis, which would require taking a close look at historical, geographical, institutional and political factors, is beyond the scope of this paper. The main risks we identify for each country in figure 1 are the most concerning forecast trends for the pension liabilities' driving hypotheses. If we are to believe in the convergence hypothesis at the 2060 horizon, then many of the most dramatic changes stem from the progressive loss of each country's past comparative strengths.

For demography, our criterion corresponds to countries with an old-age dependency ratio forecasted above 60% in 2060. This is the case of Central and Eastern European and Baltic countries, Southern Europe except Cyprus, and Germany. A '+' mark indicates a larger demographic concern, corresponding to a forecast ratio above 70%.

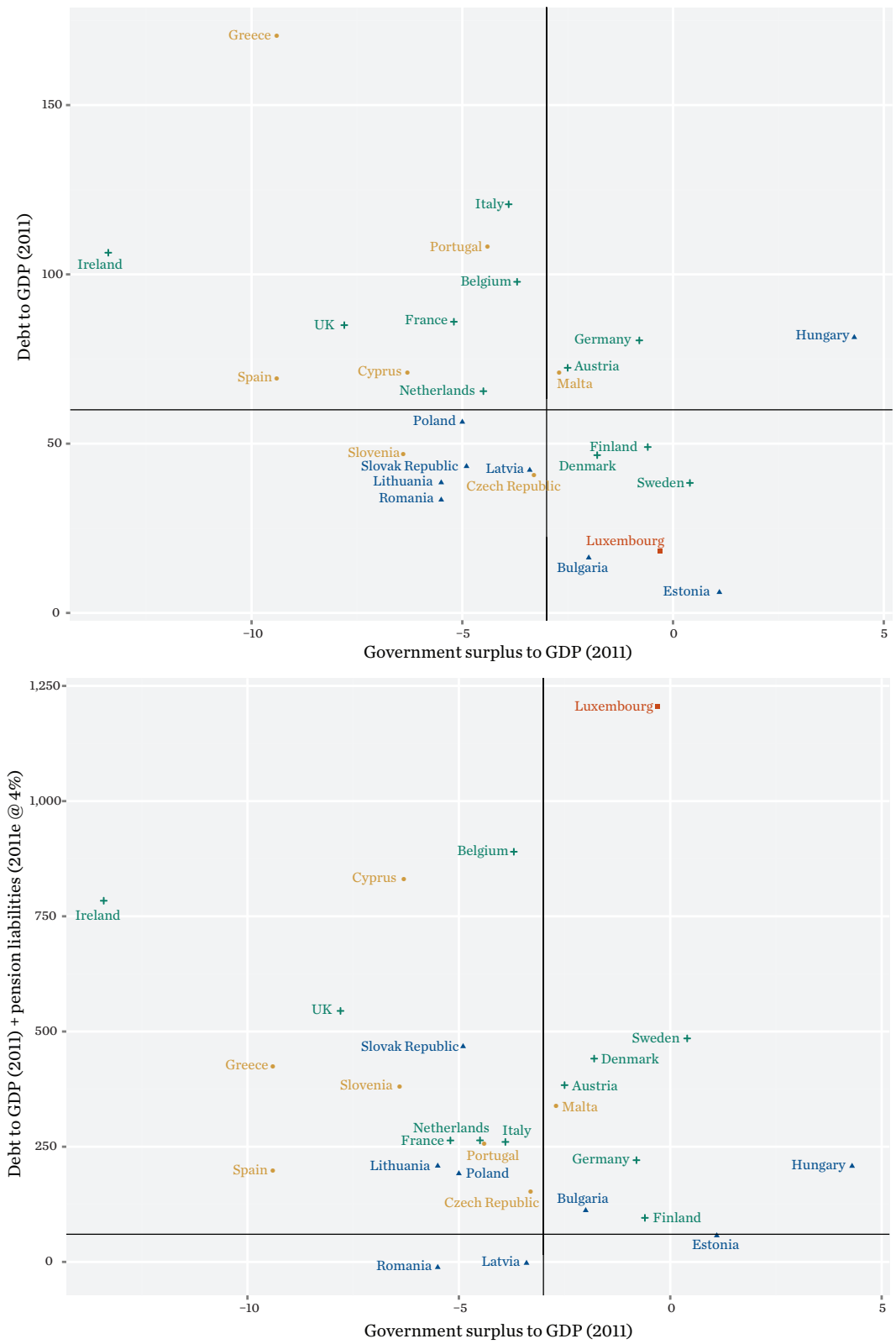
Unemployment remaining high is a major risk factor for most countries, especially when they rely on pay-as-you-go systems. The criterion we pick for employment risk is whether unemployment is forecasted to increase from its 2010 level. The trend is especially worrying for Central and Eastern European and Baltic countries, as well as Germany, Austria, the Netherlands, Finland, Greece, Malta and Portugal. A '+' mark indicates a forecasted decrease in employment larger than 0.5%.

The number of hours worked by the people actually in employment is also a factor that heavily impacts pension liabilities. In the forecasts, countries with a reduction of hours worked at the 2060 horizon coincide with those with employment risk. A '+' mark indicates a forecast decrease in hours worked larger than 0.5%.

There is a more general risk of GDP stagnation, beyond employment and hours worked which are major parts of its determinants. Our criterion is whether the average growth rate of potential GDP is expected to be lower than 1.5% per annum until 2060. A sluggish potential GDP growth reveals bad fundamentals, such as underlying institutional and/or social issues that go beyond business cycle fluctuations. This is the case for many EU-27 countries, including most Central and Eastern European and Baltic countries (except Bulgaria, Hungary and Latvia), Germany, Austria, the Netherlands, Luxembourg, Spain, Malta and Cyprus. A '+' mark indicates a forecasted average growth lower than 1% (Germany and Spain).

We do not include political risks, which are harder to quantify and altogether too complex to analyse in such a paper, but they are undoubtedly some of the most significant uncertainties weighing on pensions. All countries in Europe have not, in the past, shown the same relation to the question of the permeability of public accounts and more generally policy enforcement.

2. EU-27 budget surplus and debit without and with implicit pension liabilities



Source: European commission (2012), Eurostat, own calculations.
Implicit pension liabilities are accrued to date using a central 4% discount rate hypothesis. Countries are coloured based on a k-means clustering of the following 2010 fundamentals: GDP per capita, unemployment rate, old-age dependency ratio, and fertility. The black lines represent the Stability and Growth Pact targets for deficit and debt-to-GDP ratio.

Conclusion

Ignoring the explicit and implicit pension liabilities when assessing the solvency of the EU-27 countries gives a distorted view of their relative situations. After a short analysis of the main demographic, economic, and political determinants that could influence these projections, we computed the net present value of pension liabilities for the 27 countries under several discount rate hypotheses, and compare the relative situation of countries. We then proposed a heuristic categorisation of the main risks borne by each country's pensions from their underlying projections.

Based on this analysis, the Commission should in our view take advantage of the ►

◄ current debate on pensions to facilitate the move towards greater coordination of pension provision systems in Europe. From this perspective, firstly, investors must be more aware of the risks borne by pension schemes, when evaluating the solvency of sovereign debtors. Secondly, European institutions must keep working towards greater transparency and information regarding public finances, notably with respect to the available data and the modelling of public and private pension liabilities. Ultimately, taking into account explicit and implicit pension commitments in the stability targets should be envisaged. This would allow stakeholders to better apprehend pension risk and to foster coordinated long-run reforms across countries.

This article is a short version of the EDHEC-Risk document Towards Better Consideration of Pension Liabilities in European Union Countries *(Cocquemas, 2013, available on the edhec-risk.com website), focused only on public pensions. Figures for the liabilities are slightly different as they are accrued in this paper to 2011 rather than 2010.*

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Effective benchmarks for infrastructure equity investment

Frédéric Blanc-Brude, Research Director, EDHEC-Risk Institute–Asia

A recent research quandary with respect to infrastructure equity investment has also been a source of interrogation for final investors: while the economics of underlying infrastructure investment suggests a low and potentially attractive risk profile, the experience of investors and available research evidence have been different and rather mixed. This article, based on recent research we have conducted[1], attempts to explain why this has been the case and what new research and benchmarking efforts are necessary to create investment solutions that realign expectation and observed investment performance as well as to inform the regulatory debate in relation to institutional investing in long-term assets like infrastructure equity.

Our contribution is threefold: in a first part, we discuss the nature of underlying infrastructure equity and what mechanisms explain its investment characteristics. Next, we review the rationale for infrastructure investing by insurance companies and pension funds and existing empirical research on the performance of existing investment routes and vehicles. Finally, we discuss what approaches to benchmarking and portfolio construction might best capture the characteristics of underlying infrastructure and highlight the need for new data collection and appropriate benchmarking methodologies.

The nature of underlying infrastructure investments

Infrastructure equity investments derive their characteristics from the contractual relationship that creates the opportunity to delegate investment in stand-alone infrastructure facilities. These investments are relationship-specific – they have little or no value outside of the contractual relationship in question, in particular, they have no value if they are not used. In this respect they are the opposite of real assets since they have no intrinsic value. From the relationship specificity of infrastructure investments also springs their tenor, since they can only be recouped over a period of effective use. This tenor is typically long enough (beyond 10 years) to qualify as long term.

Furthermore, a significant proportion of any country's infrastructure is public infrastructure insofar as a public entity guarantees the continuity of service. Thus, despite investment delegation, the ownership of most tangible infrastructure remains explicitly in the public domain, and always implicitly under the eminent domain of the state. Hence, when contracts have a well-defined tenor (eg, project finance), the terminal value of such investments can be considered to be zero.

"Infrastructure equity investments derive their characteristics from the contractual relationship that creates the opportunity to delegate investment in stand-alone infrastructure facilities. These investments are relationship-specific – they have little or no value outside of the contractual relationship in question, in particular, they have no value if they are not used"

Likewise, when assets are held in perpetuity (eg, utilities) the exit value of the firm's equity should solely be a function of risk-adjusted expected cash flows to equity. In the absence of valuable tangible assets, it follows that firms existing solely to enter into long-term contracts delegating investment in standalone infrastructure projects – usually known as project companies or special purpose vehicles, but also utilities – derive their value solely from the characteristics of those contracts and the cash flows to which they give rights. These contracts delegating infrastructure investment are characterised by a risk-sharing mechanism embodied by the revenue model agreed between the delegating party and the party carrying out the investment. While numerous risk-sharing agreements can be envisaged, in principle, few are used in practice (Blanc-Brude 2012).

Thus, three types of contracts are used to delegate investment in 'public' infrastructure, ie, when the party delegating investment in an infrastructure project is the public sector:

- Availability payment schemes, by which the public sector promises to pay a fixed income over a pre-agreed period, typically in excess of two decades, in exchange of what the investor accepts responsibility for the investment, operating, debt service and residual equity cash flows related to delivery of an infrastructure project, according to an agreed output specification. Terminal value is set to zero and control of the physical assets is returned to the public sector at the end of the contract. This model is typically used to deliver social infrastructure projects like schools, hospitals or government building.
- Commercial schemes, by which the public sector enters into the same contract with an investor but in exchange for a variable income ►

1 Blanc-Brude, F. (2013). *Towards Efficient Benchmarks for Infrastructure Equity Investments*. EDHEC-Risk Publication produced as part of the Meridiam/Campbell Lutyens research chair on Infrastructure Equity Investment Management and Benchmarking.

◄ cash flow. This is typically the case with tolled transportation projects, for which the investor is granted the right to collect tolls/tariffs from users. Terminal value is set to zero in most jurisdictions. This model is typically used for transport projects with real tolls.

➲ Capped commercial schemes consist of the same investment proposition as commercial schemes but with a larger degree of revenue sharing with the public sector on the upside (eg, capped/floored equity returns in utilities, shadow tolls in transport projects, etc). Terminal value may not always be set to zero – eg, privatised utilities own tangible assets outright and in perpetuity – but, as discussed earlier, an implicit contractual relationship with the public sector (eminent domain), to which an explicit regulatory framework may be added, conditions the value of the investment.

The first proposition can be considered as the reference contract while the second and third propositions are variants including a risk premium for commercial risk and varying degrees of risk sharing between the public and private sector. Downside protection for example may take the form of implicit (eg, continuity of public service for utilities) or explicit government guarantees (eg, minimum revenue guarantees in some toll road concession contracts).

In the case of private infrastructure, that is when both parties are private firms, contractual arrangements tend to combine the availability payment model using a so-called 'take-or-pay' purchasing agreement, by which the party delegating investment also commits to paying for up to a certain level of output defined as a proportion of capacity, and commercial risk for the remaining capacity (eg, coal processing terminal).

Having acknowledged the contractual nature of infrastructure equity investments, we review how they are created empirically. The immense majority of them correspond to either privatised utilities or project financing. Together, these two forms account for most privately invested infrastructure in Europe and the world since the 1980s.

Hence the contractual and regulatory arrangements found in project financing and utility regulation can explain cash flows to equity and what risks should be taken into account when valuing individual projects. The literature argues that project-specific risks like construction and operations are well managed through networks of contracts. The role of the financial structure is also of interest given the high leverage observed in project financing and the increasing leverage of regulated utilities' balance sheets in recent years. Here, the academic literature on corporate finance argues, perhaps counter-intuitively, that high leverage is a sign of low asset risk.

As is well documented in the economic literature, private investment creates incentives for cost control and operational efficiency. Hence, construction or credit risk in a project finance setting can be considered endogenous or managed risks. Exogenous sources of risk affecting cash flows to equity in infrastructure projects and utilities include demand risk, contract renegotiation and political risk. Empirical studies show that the presence of demand risk in the revenue model of an infrastructure investment vehicle creates significantly riskier equity. To the extent that the equity returns of different infrastructure assets are influenced by different demand risks or influenced differently by the same demand risk, there is diversification potential in a portfolio context.

Moreover, the life-cycle of infrastructure projects – from construction to operations to decommissioning – can be expected to impact equity valuations, risk and profitability and be a source of portfolio diversification as well.

Finally, the economic literature argues theoretically and empirically that long-term contracts will almost necessarily lead to renegotiations either because the contract is silent about a particular state of the world, or because the opportunity to continue the delegation process under the conditions initially agreed is questioned by one party. In this context, the economic regulation of utilities is a case of planned renegotiation. However, the outcome of renegotiation is not necessarily to increase equity risk in so far as it allows for the continuous adaptation of the contractual commitment of the parties. It can however be a source of opportunism and redistribute the contract surplus ex post.

Thus, economics and financial economics provide a rich framework to understand the nature of underlying infrastructure equity investment. Theoretical and empirical work on contracts and economic regulation in particular highlight the mechanisms that drive the risk and returns of infrastructure equity.

Investing in underlying infrastructure

The decision to invest equity in firms that solely enter into long-term contracts delegating investment in infrastructure projects must rest on an explicit or implicit model. In line with our review of the nature of underlying infrastructure, we call this model the infrastructure investment narrative after Daniel Kahneman's definition of a narrative as "the passive acceptance of the formulation given" (Kahneman, 2002). According to this often implicit model, tangible infrastructure assets, immobile and demanding high sunk capital costs and long repayment periods are expected to create monopolies thanks to barriers to entry and increasing returns to scale. Thus, asset owners are expected to benefit from the low elasticity of demand creating pricing power and an inflation hedge, as well as low return covariance with other investments, allowing attractive risk-adjusted returns.

> *"Existing academic research finds that listed infrastructure indices and unlisted infrastructure PE do not deliver the infrastructure investment narrative consistently, while direct investment can be expected to suffer from important portfolio construction issues leading to over-concentration"*

Investors may decide to invest in infrastructure equity for reasons other than the investment narrative defined above, with different time horizons and different return expectations. Still, we expect the majority of investors to be considering infrastructure equity investment in order to replicate this investment narrative, either to contribute to objectives of performance seeking (higher Sharpe ratio) or liability hedging (duration, inflation link, etc).

The empirical question is how this investment narrative may be captured. We review existing research on several vehicles: listed infrastructure indices, listed infrastructure funds, unlisted close-ended seven- to 10-year private equity style funds (PE) and direct investment (without intermediation or external managers) in project company equity and privatised utilities by final investors. Existing academic research finds that listed infrastructure indices and unlisted infrastructure PE do not deliver the infrastructure investment narrative consistently, while direct investment can be expected to suffer from important portfolio construction issues leading to over-concentration. The research results that we review may help explain the evolution of the perception of infrastructure equity investment amongst final investors over the past decade, and their reported frustration regarding the delivery of the infrastructure investment narrative.

However, we argue that none of these strategies is designed to access the characteristics of underlying infrastructure effectively and efficiently. Indeed, they are driven by a focus on the physical characteristics of underlying infrastructure assets and, in the case of unlisted PE funds, they are speculative strategies with a focus on exit value as opposed to capturing the full tenor of infrastructure contracts. Direct investments by final investors should be more suitable in principle but lot sizes create significant diversification challenges without intermediation – ie, access to granularity.

In order to capture the investment narrative suggested by the economics of infrastructure investment, better benchmarks and more appropriate strategies are needed.

Benchmarking infrastructure equity investments

Institutional investors should express great interest in using index-based products to increase their exposure to infrastructure. Indices have the potential to meet the major expectations institutional investors have of infrastructure investment.

In a multi-asset class context, indices can provide infrastructure market beta and therefore a means of diversification. Also supporting the fact that index instruments make infrastructure diversification possible, infrastructure index portfolios by themselves are likely to provide attractive risk-adjusted returns, a suitably designed index portfolio will optimise the risk-reward ratio at the portfolio level by combining constituents on the basis of scientific diversification. The production of an infrastructure beta requires that the portfolio be made free of specific risk. If specific risk cannot be easily diversified, then betas will not be available and there will be the basis for compensation of total risk rather than market risk only.

Although the potential benefits of index-based infrastructure products seem very attractive, our current knowledge based on past experience of PE funds or listed infrastructure companies is inappropriate to develop such products.

Building infrastructure betas will require concerted efforts between final investors, investment managers and academics.

We argue that infrastructure equity investment should rely on two principles: building blocks that are representative of the contractual nature of the underlying and portfolio/benchmark construction that optimises the risk/return trade-off of these building blocks.

Efficient portfolio construction and benchmarking using infrastructure equity should aim to optimise diversification benefits by exploiting the different phases of the asset lifecycle and the different level of systematic and remunerated risk found between different types of contractual and regulatory frameworks. Creating efficient benchmarks for infrastructure equity investing

will go a long way in allowing final investors like insurance companies and pension funds to assess the riskiness of such investments.

It is apparent from our review and discussion that substantial data reclassification as well as new data collection is needed, and a significant amount of theoretical and empirical work remains to be done to arrive at appropriate benchmarks and to test the sensitivity of equity investment to different categories of risk found in project finance, regulated utilities and other legitimate infrastructure investments areas, including the role and diversification potential of the different periods in the life-cycle of infrastructure investments.

We also aim to inform the regulatory debate in relation to institutional investing in long-term assets like infrastructure equity under, for example, the Solvency II regime. Data collection, reporting standards and the development of infrastructure equity benchmarking research will be some of the major undertakings of the EDHEC-Risk Institute Research Chair supported by Meridiam & Campbell Lutyens in 2013 and 2014.

The research from which this article was drawn was supported by Meridiam Infrastructure and Campbell Lutyens as part of the research chair on "Infrastructure Equity Investment Management and Benchmarking" at EDHEC-Risk Institute.

The purpose of the chair is to provide a better understanding of the nature and investment profile of equity investment in infrastructure assets. It focuses on fostering data collection and aggregation from investors and on improving the benchmarking of return distributions for direct and indirect investment in infrastructure equity by developing an academically-validated and industry-recognised index.

The full version of the research is available on the EDHEC-Risk Institute website at the following address: http://www.edhec-risk.com/multistyle_multiclass/Meridiam_Infrastructure_and_Campbell_Lutyens_Research_Chair

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Benchmarking of popular smart beta strategies

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In recent times, alternative equity index strategies or 'smart beta' strategies have gained in popularity. According to a recent Financial Times article, State Street witnessed a 53% rise in assets under management in smart beta strategies over a one-year period and puts the total amount invested in such strategies at $5trn[1]. Despite the increasing interest of investors in such strategies, one must note that commercial strategies have not been the subject of much risk assessment. This article highlights a framework that allows for a detailed analysis of commercial strategies.

Commercially-available smart beta strategies are pre-packaged choices of stock selection and weighting. A simple performance and risk analysis is not sufficient in explaining how different parts of the methodology affect overall portfolio performance. In order to beat the cap-weighted index, smart beta indices deviate from them in terms of stock selection, stock weighting, or sometimes both. However it remains unclear which selection and which weighting method is most appropriate to reach a given objective. Often one compares apples and oranges – for example, one weighting scheme which changes the stock selection versus another strategy that changes both stock selection and weighting. It is not then clear to an investor what drives the differences in performance.

It appears that the ad-hoc index construction approaches are driven more by marketing innovations than by a justified decision framework. This article draws on research published in the Journal of Portfolio Management (see Amenc, Goltz and Lodh, 2012) and shows how one can benchmark smart beta strategies by flexibly combining the results of different choices for the key steps in portfolio construction, ie, stock selection and stock weighting. For a commercial index, it is possible to construct advanced beta benchmarks that pursue the same objectives, have similar exposures to risk factors but are built using diversified weighting schemes. It also allows possible methodologies beyond existing offers to be tested. We select two popular smart beta strategies – defensive or low volatility and fundamental indexing – as examples to illustrate such benchmarking.

Benchmarking defensive strategies – the Low Volatility index case

In this section, we construct an advanced beta benchmark that has a similar low-risk investment objective and similar constraints to the S&P 500 Low Volatility index. The S&P 500 Low Volatility index is made up of the 100 least volatile stocks from the S&P 500 universe. These stocks are then weighted by the inverse of their volatility to bring down portfolio volatility further. In other words, the strategy uses a combination of low-volatility stock selection and an inverse-volatility weighting scheme.

In the benchmarking exercise below, we accept the objective to make a rather aggressive choice in terms of stock selection by selecting only 20% of stocks in the universe, the 100 stocks with the lowest volatility. However, we assess how the next step – weighting scheme selection – can be done in other ways and analyse the results of such alternatives. In particular, an alternative would be to use a diversification-based weighting scheme on a low-volatility stock selection. The advantage of using it is that it has the potential to further minimise the overall risk by exploiting the covariance structure of stocks whereas inverse-volatility weighting only looks at standalone properties.

The global minimum volatility (GMV) weighting scheme is the appropriate weighting scheme to construct low-volatility portfolios if one wants to take into account not just standalone properties of stocks but also how risk can be reduced through smart combinations of stocks that exploit their correlation properties. Hence our primary focus is to compare these two portfolios: S&P 500 Low Volatility index and a smart beta benchmark that selects the 100 least volatile stocks and uses minimum volatility optimisation for weighting. However, it would be interesting to see within the same stock selection to what extent other weighting schemes maintain the low-volatility objective. We include two more diversification-based weighting schemes – maximum Sharpe ratio (MSR) and maximum decorrelation (MDC). MSR optimisation aims to maximise the Sharpe Ratio of the portfolio. MDC optimisation aims to minimise portfolio volatility with the assumption that volatilities across all stocks are identical (Christoffersen et al [2010]).[2] Two more ad-hoc weighting schemes – cap-weighting and equal-weighting are added for comparison.[3] Table 1 summarises the performance statistics of all competing strategies.

Table 1 shows that the volatility reduction achieved by the S&P Low Volatility index is similar to that achieved by the benchmark that equal-weights the 100 least volatile stocks. It suggests that the volatility reduction in the low-volatility index stems from the selection ►

1 See http://www.ft.com/intl/cms/s/0/db361f1e-2912-11e2-9591-00144feabdc0.html#axzz2Lvr3V67r

2 The objective of maximum decorrelation can be measured by the GLR measure. This is the ratio of the portfolio variance to the weighted variance of its constituents (Goetzmann et al [2005]).

3 At each rebalancing date, the S&P 500 constituent is considered to be the broad universe. The 100 least volatile stocks are selected from the broad universe at each rebalancing date based on the stocks' volatilities over the period of the past two years. Weekly stock return data over the past two years is used as optimisation inputs. All optimised portfolios used in the analysis are long only. 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. A robust covariance matrix is estimated using a statistical factor model following the approach in Amenc et al (2011). The downside risk of stocks is used as a proxy for their expected returns (Amenc et al [2011]).

1. Performance statistics of portfolios using low-volatility stock selection

	All S&P 500 stocks	100 least volatile stocks in S&P 500 universe					
	Cap weighted (S&P 500)	S&P 500 Low Volatility index (LVI)	Ad hoc weighting: Cap weighting	Ad hoc weighting: Equal weighting	Diversified weighting: GMV	Diversified weighting: MSR	Diversified weighting: MDC
Annual return	9.46%	10.31%	9.15%	11.18%	10.42%	10.49%	10.81%
Tracking error with S&P 500	0.00%	9.53%	9.07%	9.23%	10.73%	10.34%	9.86%
Effective number	125.02	na	28.82	100.00	33.33	33.42	43.33
Annual volatility	16.92%	12.95%	13.58%	13.15%	11.94%	12.18%	12.49%
Reduction in volatility compared to S&P 500 LVI		–	–4.9%	–1.6%	7.7%	5.9%	3.5%
Improvement in diversification objective over S&P 500 LVI		–	–	–	7.7%	9.1%	na

The table presents the performance statistics and deconcentration measures of the portfolios based on low-volatility selection (bottom 100 volatile stocks in the S&P 500 universe like the S&P 500 Low Volatility index methodology). All statistics are annualised and the period of analysis is from 16 November 1990 to 31 December 2010.

2. Performance statistics of portfolios using fundamentals-based stock selection

	Selection by market cap	Selection by fundamental size (book value + cash flow + revenues) – Top 500 stocks					
	Cap weighted (S&P 500)	Heuristic weighting strategies: CW	Heuristic weighting strategies: FUND	Heuristic weighting strategies: EW	Diversified weighting strategies: GMV	Diversified weighting strategies: MSR	Diversified weighting strategies: MDC
Annual return	10.56%	10.89%	12.05%	13.36%	12.22%	12.86%	13.99%
Effective number	126.1	113.7	153.0	500	166.7	120.3	167.0
Annual volatility	16.69%	16.31%	16.57%	17.83%	13.20%	13.59%	17.67%
Sharpe ratio	0.36	0.39	0.45	0.49	0.58	0.61	0.53
GLR measure	0.239	0.223	0.194	0.184	0.159	0.162	0.125
Improvement of objective over fundamental weighting	–	–	–	–	21%	36%	36%

The table presents the performance statistics and deconcentration measures of the portfolios based on fundamental size selection combined with ad-hoc and diversified weighting. Due to the limited availability of fundamentals data from Worldscope the period of analysis is from 5 January 1984 to 31 December 2010.

◄ and not from the weighting. A potential explanation for this is that within the universe of the 100 least volatile stocks, the differences in volatilities across stocks are relatively small. This means that equal weighting and inverse-volatility weighting are not much different from each other within this universe.

However, all three diversification-based weighting schemes result in better volatility reduction than the S&P Low Volatility index. In particular, the GMV optimisation attains 7.7% lower volatility than the Low Volaility index, suggesting that exploiting correlation properties across stocks in a GMV optimisation adds value over considering only the standalone properties of stocks.

One must note that when selecting only 100 stocks by low volatility the investor is highly concentrated in a few stocks. Low-volatility selection also results in sector biases, as it is well known that these stocks typically belong to certain defensive sectors such as utilities and consumer staples (Chan, Karceski and Lakonishok [1999]). Hence when being highly concentrated in a few stocks with many of them coming from the same sectors, perhaps it is time to look at exploiting the differences in correlations that may exist for some of the selected stocks. Therefore using diversification-based weighting schemes may make a lot of sense in a concentrated stock selection. It should also be noted that the MDC weighting scheme is based on the assumption of equal volatilities, which turns out to be quite reasonable in this case as the 100 least volatile stocks in the universe are likely to have relatively similar volatilities. An MDC weighting scheme allows the benefits of imperfectly correlated stocks to be exploited given that the stock selection has already done the job of creating a defensive portfolio. Indeed, when assessing the results obtained by maximum decorrelation weighting of the 100 least volatile stocks, one ascertains that the reduction in volatility is comparable to what the low-volatility index achieves, while by construction the MDC scheme also ensures reasonable levels of diversification across stocks with different behaviour.

It is also interesting to note that other diversification objectives (like Sharpe ratio maximisation using the MSR scheme) can also be successfully met in tandem with the objective of holding the least volatile stocks.

Overall, the results show that once the stock selection decision has been made, the investor has choices for weighting scheme that can successfully address a range of diversification objectives.

Benchmarking fundamental strategies

In this section, we benchmark fundamental equity indexing strategies. We analyse the portfolios that select stocks by their composite fundamental size – where we use a composite size measure based on revenues, book value and cash flows. We select the top 500 highest fundamental size stocks from the broad US equity universe. Proponents of fundamental indexation not only cite the objective of better representativeness as its primary function but also believe that fundamental weighting delivers superior performance by avoiding the most overpriced stocks in the stock selection (Hsu [2006], Arnott and Kuo [2011]). In this regard, we compare the risk and return characteristics of a fundamentally-weighted strategy with diversification-based strategies applied to the same fundamental stock selection.[4] It allows us to break down the out-performance of fundamental equity indexing (over cap-weighting) into selection and weighting components, and allows alternatives to fundamental weighting to be explored while maintaining the fundamental selection of stocks. Table 2 presents the performance statistics of portfolios based on fundamentals-based stock selection.

"Fundamental weighting ignores stock correlations, focusing solely on stock-specific characteristics. Diversification-based schemes on the other hand have a clear and measurable objective, which they strive to achieve using correlation effects between the stocks"

The table shows that fundamentals-based selection adds about 33 basis points to annual performance over the cap-weight selection when cap-weighting is used. By using fundamental weighting along with fundamental selection, the performance increases by a further 115bps. However, when applied to stocks selected by fundamentals rather than by market cap, all diversification-based weighting schemes achieve higher Sharpe ratios than fundamental weighting applied to the same stock selection. The results show that fundamental weighting is indeed effective in reducing portfolio concentration (ie, increasing the effective number of stocks) when compared to cap-weighting. The lower concentration is due to the use of a composite of multiple characteristics like book value, cash flow and revenues as opposed to the use of a single parameter in the cap-weighting scheme. However, fundamental weighting ignores stock correlations focusing solely on stock-specific characteristics. Diversification-based schemes on the other hand have a clear and measurable objective, which they strive to achieve using correlation effects between the stocks.

It is interesting to see whether an investor who aims at a specific objective within the fundamentally-selected universe can benefit from a diversification-based weighting. Within the fundamental selection, each diversified weighting scheme proves to be better in attaining its objective than the fundamental weighting. Looking at volatility minimisation, the GMV weighting of fundamentally-selected stocks attains 13.20% volatility as opposed to 16.57% volatility for the fundamental-weighting strategy. This reduction is indeed sizeable and it does not come at the cost of lower returns. Therefore if one wants to avoid overpriced stocks, one can do so

4 For fundamental weighting, the last available fundamental is used to weight the stocks. Only year-end fundamental values are available so the latest annual value for each stock is used.

through stock selection. But if one additionally wants to lower volatility, one can use GMV on a fundamental stock selection of that kind. Our results suggests that such a strategy was more attractive over the time period we studied in terms of risk-adjusted performance than a basic fundamental equity indexation strategy which combined fundamental selection and fundamental weighting.

Both Sharpe ratio and GLR measure are improved by 36% by the respective dedicated diversified weighting schemes as compared to fundamental weighting. It is clear that the embedded fundamental equity index strategy – by not making a clear distinction between the two index construction steps of selection and weighting – misses out on considering the potential added value of exploiting correlation properties of stocks through diversification-based approaches. Our results show that – once the investor has addressed the problem of inclusion of too many overpriced stocks through the fundamental-based stock selection – it may be useful to exploit correlation properties of stocks by using a diversification-based weighting scheme instead of simply weighting stocks by the fundamentals that have already been used in the stock selection.

Conclusion

Creating an advanced beta benchmark that differentiates between stock selection and weighting scheme allows the investor to identify the source of performance of a given smart beta strategy. It also allows alternative methodologies to be assessed for a given investment objective. The results show that even with a desired stock selection, it may be useful to employ a diversified weighting scheme to reduce risk and to reach a portfolio level objective. Selection and weighting decisions can be made independently keeping in mind the risk factors one wants to be exposed to and the objective one needs to attain. Analysing the historical performance of pre-packaged strategies that do not follow a coherent construction framework leads to unclear conclusions. The benchmarking conducted in this article aims at providing a coherent framework to assess strategies with similar objectives but different methodologies, and is thus a first step towards greater transparency of smart beta offerings.

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Choosing risk exposures of alternative equity indices

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In the past few years there has been a rapid increase in the number of alternative equity index strategies or advanced beta strategies. Leading index providers such as FTSE, Stoxx, S&P and MSCI have launched a large number of alternative indices and a large number of pension funds have made sizeable investments in these indices.[1] According to a recent bfinance Pension Fund Asset Allocation Survey,[2] more investors are considering investment in smart beta strategies, citing risk reduction as the prime motivation. However, despite their increasing popularity, such indices come with an important limitation. Most indices are a pre-packaged set of methodological choices and do not provide a clear understanding of how the different steps of the methodology contribute to portfolio risk and reward, nor do such embedded solutions allow for any risk control. Table 1 shows that advanced beta indices are based on combining a stock selection and weighting scheme, where either the stock selection and/or the weighting scheme are based on information other than the stocks' market capitalisation. The table provides an overview of some selected commercial indices as an illustration.

"More investors are considering investment in smart beta strategies, citing risk reduction as the prime motivation. However, despite their increasing popularity, such indices come with an important limitation"

All providers use first a stock selection that is different from cap-weighted (CW) indices and/or a weighting scheme that is different from CW for creating their smart beta indices. For example, FTSE RAFI and FTSE GWA use fundamental weighting but FTSE RAFI selects stocks by fundamentals while FTSE GWA selects them by market cap. Furthermore the S&P GIVI index makes low risk selection and intrinsic value weighting without providing any justification for the methodology.

The pre-packaged nature of such strategies means that investors are faced with accepting implicit choices rather than truly choosing the precise properties of their benchmark. Indeed, with such first-generation products providing embedded solutions, investors will simply follow whatever implicit style tilts a weighting scheme comes up with. Thus they do not have any potential to conduct an explicit choice of risk exposures that they desire.

Moreover, it is often argued that smart beta is only about generating outperformance through factor tilts (Arnott [2011]). However, this completely ignores that one can possibly control such risk factor exposures. We propose to combine stock selection and diversification-based weighting to control risk factor exposures while aiming for an investment objective. Such an approach helps in assessing the value added after having corrected for factor tilts. Such a distinction between weighting scheme and stock selection is one of several useful ingredients that allow the risks of smart beta strategies to be controlled and move from solutions that simply seek outperformance without any view on risks to solutions which not only provide risk transparency but also allow investors to control those risks if needed. ►

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
MSCI Minimum Volatility Index Series	As in the corresponding market index	Volatility minimisation
S&P GIVI	Low market beta	Intrinsic value

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

2 http://www.bfinance.ca/en/investment-advisory/investment-intelligence/409-pension-fund-asset-allocation-survey-smart-beta-thematic-index-solutions-identified-to-reduce-risk&Itemid=303

An investment objective can be attained by using either stock selection or weighting scheme. Conceptually, weighting schemes can further be divided into two categories – diversification-based and characteristics-based. Diversification-based weighting schemes consider both standalone characteristics of stocks and the correlation among them. Maximum Sharpe ratio (MSR) optimisation and global minimum volatility (GMV) optimisation are two prime examples of this. On the other hand, characteristics-based weighting schemes assign weights to stocks that are proportional to a stock-level characteristic (such as market beta or dividend). By ignoring the interaction effects across stocks, characteristics-based weighting schemes end up being quite similar to stock selection. The only difference from pure stock selection is that characteristics-based weighting assigns positive weights to all stocks in the universe. In this article, we focus on the distinction between pure stock selection and diversification-based weighting schemes.

The stock selection step is a way to define the sub-universe where the strategy needs to be invested in terms of stock-level characteristics. For example, an investor who wishes to invest only in high-market-cap stocks to remain highly liquid can make a size-based selection at the stock level. Since the stock selection step takes into account only the standalone properties of stocks, it has limited ability to influence the risk and return properties of the portfolio. However, it is an explicit and transparent way of seeking desired risk factor exposures. It must be noted that the overall factor tilt of a portfolio is simple a weighted average of individual stock characteristics. Stock selection, although it does not take into account the dependence structure across stocks, can still be used as a lever to fine-tune the factor exposures of the portfolio.

A diversification scheme has an explicit risk/reward objective which is achieved by exploiting the covariance structure of stocks. However these weighting schemes often come with implicit factor tilts which may be undesirable to investors. For example, it is a well-documented fact that minimum-volatility optimisation leads to concentration in low-volatility stocks (Chan, Karceski, and Lakonishok [1999] and Andersen, Malavergne, and Simonnetti [2000]). All results appearing in the forthcoming sections are extracted from the Journal of Portfolio Management article by Amenc et al (2012).

Stock selection as a tool to control factor tilts

We can combine stock selection and weighting to benefit from the advantages that both index construction steps offer. Stock selection can be used as a tool to correct the risk factor exposures resulting from diversification-based weighting schemes by excluding stocks with the undesired properties prior to applying the diversification scheme. An alternative is to use constraints on factor tilts in the optimisation. However the advantage of correcting tilts through stock selection is that it is simple and intuitive and remains within the standard framework of smart beta index providers of using selection and weighting. However, using stock selection is only one way of ensuring that factor tilts of smart beta strategies are controlled and our analysis can be furthered by considering explicit constraints of factor exposures within diversification-based weighting schemes.

In this section, we present an example to show how size-based stock selection can be effective in controlling small size tilts in the following optimised portfolios – MSR, GMV and maximum decorrelation (MDC) portfolios. Amenc, Goltz and Lodh (2012) have checked for this and other exposures and found qualitatively similar results across a range of risk factor exposures; for brevity here we focus on small-cap exposure as an illustration. An interesting question that arises at this point is – what is the opportunity cost of factor tilt correction in terms of the attainment of a diversification objective? It is intuitive to assume that the performance of the diversified portfolio should be compromised when there are fewer stocks to diversify across. To address this question we also analyse how much the diversification objective is affected by stock selection.

In particular, we consider three diversification-based weighting schemes. GMV portfolios aim to minimise portfolio volatility. The efficient MSR optimisation aims to maximise the Sharpe ratio of the portfolio. An assumption behind this approach is that a positive relationship exists between risk and return in the cross-section of stocks, as expected returns are estimated indirectly through the downside risk of stocks. MDC optimisation is an approach which exploits low correlations across stocks to reduce portfolio risk rather than concentrating in low-volatility stocks, which is a limitation often underlined with GMV approaches. The MDC approach aims to minimise portfolio volatility under the assumption that volatility across all stocks is identical (Christoffersen et al [2010]), hence focusing on exploiting differences in correlations rather than on exploiting differences in volatility across stocks.[3]

To test how stock selection can be used in conjunction with these diversification-based weighting schemes, we divide the S&P 500 universe into three sub-universes by sorting the stocks by their market capitalisation. The portfolios are optimised for the broad S&P 500 universe and for each of the sub-universes and their factor exposures are observed ex-post. The results are summarised in table 2.

Table 2 shows that all three optimised strategies have significant implicit small-cap exposure relative to the S&P 500 index when no stock selection is made. GMV and MSR portfolios on the large-cap stock universe do not show any significant small-cap exposure. The small-cap exposure of the MDC strategy is also reduced from –37.07% to –3.15% when using only the largest market cap stocks in the optimised portfolio.

Furthermore, the respective objectives of the portfolios formed on the size-based sub-universes are achieved. The diversification objective of the GMV, MSR and MDC strategies are low volatility, high Sharpe Ratio and low GLR concentration measure (Goetzmann et al [2005]) respectively. The GLR measure is the ratio of the portfolio variance to the weighted variance of its constituents and a low GLR measure thus indicates that correlations have been well exploited and in this sense the portfolio is well diversified. These results are reported in table 3.

Table 3 shows that GMV portfolios created ►

2.

	Global minimum volatility (GMV)				Maximum Sharpe ratio (MSR)				Maximum decorrelation (MDC)			
Universe	**All**	**Small**	**Medium**	**Large**	**All**	**Small**	**Medium**	**Large**	**All**	**Small**	**Medium**	**Large**
Market	–26.20%	–25.41%	–28.03%	–23.92%	–21.92%	–23.69%	–23.94%	–20.09%	–8.60%	–7.93%	–10.57%	–6.59%
Size (big–small)	–19.00%	–43.75%	–19.32%	1.83%	–21.13%	–46.28%	–21.40%	0.29%	–37.07%	–65.59%	–27.26%	–3.15%

The table shows the excess (over S&P 500) risk factor exposures of the GMV, MSR and MDC 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 5 July 1963 to 31 December 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 :

$$R_P - R_{CW} = \alpha + \beta_M . R_{CW} \quad (1)$$

$$Res = \beta_S . R_S \quad (2)$$

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.

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%

The table compares the attainment of the optimisation objective for the three optimised portfolios: GMV, MSR and MDC portfolios, each based on the broad S&P 500 stock universe and three size-based stock selections. Weekly return data from 2 January 1959 to 31 December 2010 is used for the analysis.

3 We use weekly total return data from 2 January 1959 to 31 December 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.

◄ for all stock selections achieve at least 10% reduction in volatility compared to the broad cap-weighted portfolio. Stock selection on the MSR portfolio shows qualitatively similar results, meaning that the increase in Sharpe ratio S&P 500 index is observed in all size-selected portfolios. The MDC portfolios on mid and large-cap stock selection show higher GLR measures than broad MDC portfolio but they are still considerably lower than that of the broad cap-weighted index. Overall, the results show that – even after controlling for a specific risk factor through stock selection – the risk/return objectives of a diversification scheme can still be met and significant improvements over the cap-weighted reference index are possible.

Conclusion

Our research shows that a distinction needs to be made between a stock selection decision and the choice of diversification scheme while constructing an advanced beta strategy. In particular, stock selection can be used as a tool to correct the risk factor exposures of the diversification-based weighting schemes while keeping most of the improvement in the respective risk/return objective. This result contradicts the claim that diversification-based schemes boil down to simple factor tilts. While it is important to recognise that – in the absence of risk control – advanced beta weighting schemes may lead to implicit factor tilts, one also needs to recognise the possibility to control for such tilts. Indeed, in the presence of a possibility for investors to adjust factor tilts through simple stock selection decisions, claiming that weighting schemes are nothing but tilts towards factors is meaningless. Current offerings do not integrate any risk control since they are embedded solutions; thus the investor simply follows the implicit risk choices of the index. Separating stock selection from the weighting scheme is a simple way to obtain risk control and let investors choose where they want to be exposed in terms of risk factors.

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Understanding the low volatility anomaly

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An interesting discrepancy exists in the academic literature between the theoretical predictions from standard asset pricing models regarding the risk-return relationship and the results obtained by researchers who have analysed this relationship in equity markets from a purely empirical perspective.

Asset pricing theory, as well as common sense, suggest the existence of a strictly positive relationship between systematic risk and expected return, and a positive or zero relationship between specific risk and expected return.

On the one hand, theory suggests a positive relationship between risk and return. This relationship should be strictly positive for systematic risk measures, and positive or zero for specific risk measures.

Standard asset pricing models first suggest that systematic risk should be (positively) rewarded – that is, stocks with higher betas should earn a higher expected return. This prediction applies in both the Capital Asset Pricing Model (CAPM) single-factor equilibrium model (Sharpe [1964]) and multi-factor models supported by equilibrium arguments (Intertemporal Capital Asset Pricing Model, Merton [1973]) or arbitrage arguments (Arbitrage Pricing Theory, Ross [1976]).

While such models predict that investors should not expect to receive compensation (earn a risk premium) for specific risk, because specific risk can be diversified away, a number of subsequent papers have underlined the explanatory power of idiosyncratic, as opposed to systematic, risk for the cross-section of expected returns. In particular, Merton (1987) shows that an inability to hold the market portfolio, whatever the cause, will force rational investors to care about total risk to some degree in addition to market risk so that firms with larger firm-specific risk require higher average returns to compensate investors for holding imperfectly diversified portfolios (see also Malkiel and Xu [2006] or Barberis and Huang [2001]).

> *"Models predict that investors should not expect to receive compensation (earn a risk premium) for specific risk, because specific risk can be diversified away, a number of papers have underlined the explanatory power of idiosyncratic, as opposed to systematic, risk for the cross-section of expected returns"*

In closing, academic theory suggests that systematic volatility should be positively rewarded, and that specific volatility may be positively rewarded, or earn no reward (which is obviously different from saying it should earn a negative reward), depending on underlying assumptions.

Empirical analysis, however, has unveiled evidence of a negative risk-return relationship in equity markets

On the other hand, a number of older as well as more recent papers have reported a series of puzzling, or at least, contrasted findings from an empirical perspective. First, the 'low beta anomaly' stipulates that the relationship between systematic risk as measured by a stock beta and return is much flatter than predicted by the CAPM (see early papers by Black [1972], Black, Jensen, and Scholes [1972], as well as Haugen and Heins [1975], who claim that the relationship was not merely flat in their sample period, but actually inverted).

More recently, Ang, Hodrick, Xing and Zhang (2006, 2009) have drawn new attention to these results with a focus on the specific risk component, finding that high idiosyncratic volatility stocks have had "abysmally low returns" in longer US samples and in international markets. This result is now widely known as the 'idiosyncratic puzzle' or 'iv puzzle' in short. Yet other papers have documented a rather flat or even negative relationship between total (as opposed to specific) volatility and expected return, an anomaly that some call the 'total volatility puzzle', or 'tv puzzle' in short.

In early work, Haugen and Heins (1972, 1975) analyse pitfalls in commonly-used cross-sectional tests of the risk-return relationship, and express doubts regarding the existence and significance of the risk premia implied by standard asset pricing models. In a more recent study, Haugen and Baker (1996) find a positive or negative average payoff to total volatility in the cross-section of stock returns, depending on the dataset under consideration (see also Haugen and Baker [1991, 2010] for related results). Blitz and van Vliet (2007) analyse a 20-year period and show results in which portfolios of low-volatility stocks have higher returns than portfolios of high-volatility stocks, albeit without reporting significance levels. Similarly, Baker, Bradley and Wurgler (2011) find that portfolios formed by sorting stocks by past volatility display higher returns for the low-volatility quintile over the subsequent month than for the high-volatility quintile. Finally, Bali, Cakici and Whitelaw (2011) investigate a measure of lottery-like return distributions, which is highly correlated with other risk measures, and find that it is also associated with poor performance.

Recent research has proposed a number of attempts to explain, or explain away, the volatility puzzle

That we are left with such a puzzling picture regarding the exact nature of the risk-return

relationship, and that we do not have a clear idea regarding whether it is positive, flat or even negative, is rather surprising, and somewhat embarrassing, given that a fair understanding of this question is of central importance in both asset pricing theory and investment practice. Fortunately, a number of recent papers have tried to provide various insights into these puzzling empirical findings. Broadly speaking, there are two types of 'explanations' of the volatility anomaly in the literature, which can be classified, respectively, as (i) attempts to explain the puzzle – ie, attempts to find economic reasons that explain why a negative relationship might exist between some risk measure and expected returns – versus (ii) attempts to explain it away, – ie, attempts to argue that these empirical findings are not robust in the first place, and may simply disappear when slightly different methodological choices are made when conducting the empirical investigations.

Regarding economic explanations behind some of the empirical puzzles, it is for example now well understood that the 'low beta anomaly' is not an anomaly, but instead a mere indication that the cross-section of stock returns is poorly explained by a single-factor model such as the standard CAPM. For example, while Fama and French (1992) find that, while the relationship between a stock beta with respect to the market portfolio and the stock average return was not significant, stocks with high exposure to the size and/or B/M factor do earn a higher expected return, in accordance with the predictions of standard asset pricing models. Turning to the volatility puzzle, one possible explanation relates to investors' preference for lottery-like payoffs obtained with high-volatility stocks and limits to leverage (see in particular Baker, Bradley and Wurgler [2011]). According to this explanation, the high demand for low-volatility stocks by investors deviating from the mean-variance paradigm implies that the prices of such stocks are driven up, hence generating lower expected return. A related explanation relates to the existence of institutional limitation on using leverage (Baker, Bradley and Wurgler [2011]). Hence, risk-tolerant investors who seek to implement highly aggressive strategies would optimally opt for a leveraged investment in the maximum Sharpe ratio portfolio. Because of the presence of leverage constraints, such investors would instead overweight high-volatility bonds in an attempt to spend their risk budget. This increased demand for high-volatility stocks leads to increases in prices for these stocks, and explains again their low level of performance.

Alternatively, another set of papers has provided evidence that these empirical findings are not robust in the first place, and may simply disappear when slightly different methodological choices are made when conducting the empirical investigations. Hence, a number of recent papers have questioned the robustness of the results in Ang et al (2006, 2009) and have therefore questioned the very existence of the volatility puzzle. Among other concerns, the findings are not robust to changes in data frequency, portfolio formation, portfolio weighting scheme (cap-weighted versus equally-weighted) to the screening out of illiquid stocks (Bali and Cakici [2008]) or to past maximum returns (Bali, Cakici and Whitelaw [2011]). The use of geometric versus arithmetic averaging for portfolio returns has also been found to have a strong impact on the result.

Other authors change the short-term measure of volatility in Ang et al (2006) with measures obtained over longer horizons and then find a positive relationship (Fu [2009], Spiegel and Wang [2005], Brockmann and Schutte [2007], Eiling [2006]). In a related effort, Cao and Xu (2010) decompose idiosyncratic volatility into its short- and long-term components and find a positive relationship between the long-term component and expected stock returns. The most popular explanation might be the one related to the existence of short-term reversals. Indeed, the empirical underperformance of high-volatility stocks tends to be concentrated in the highest decile, and a careful analysis unveils that most of the stocks in that decile for one particular sample period have enjoyed a strong rally in the calibration period. A short-term correction usually occurs after the rally has taken place, hence explaining why the one-month horizon performance of the highest volatility stocks tend to be poor subsequent to the identification of these stocks having enjoyed a substantial increase in prices. Huang et al (2010) find that the low volatility anomaly disappears after adjusting for such short-term return reversals. More generally, it appears that the risk-return relationship seems to become more and more positive as intuition suggests as the holding horizon increases (see Huang et al [2011] for holding periods of 12 months, or Goltz and Martellini [2013] for holding periods of up to 60 months).

"Regarding economic explanations behind some of the empirical puzzles, it is for example now well understood that the 'low beta anomaly' is not an anomaly, but instead a mere indication that the cross-section of stock returns is poorly explained by a single-factor model such as the standard CAPM"

Low volatility strategies can be useful, regardless of whether or not one believes in a positive, or negative, risk-return relationship. The debate about the low volatility puzzle has important practical implications. Different priors, such as "all stocks have the same expected returns", or "more risky stocks have lower expected returns" or "more risky stocks have higher expected returns", will indeed lead to different proxies for the optimal tangency portfolio every rational risk-averse investor will want to hold according to modern portfolio theory. Overall, the fact that empirical results are not robust with respect to methodological choices should be taken as an indication that analysing the exact shape and nature of the risk-return relationship is a subtle question that requires extreme care and attention.

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