Managing risk in a financial crisis:

Risk management approaches to help Asian asset owners and asset managers

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Madhu Gayer
Head of investment reporting and performance Asia-Pacific
BNP Paribas Securities Services

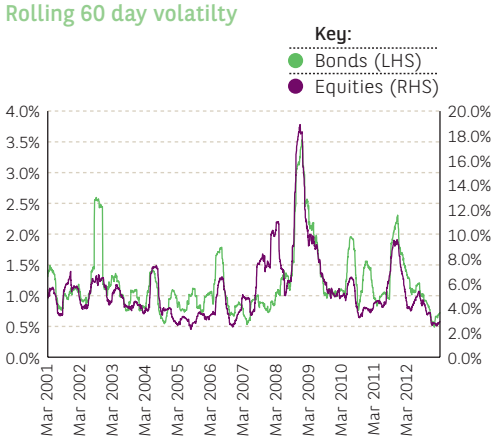
Risk management has come to the forefront of investors' minds in the past five years, spurred on by multiple market crises. Globalisation and increasingly interconnected financial markets mean that previously localised events reverberate around the globe with speed and far-reaching impact, to investors and managers in Asia. We take a practical look at how asset managers and asset owners in Asia can navigate through these crises, using various risk management approaches, and how this can help when allocating to or managing institutional portfolios.

Introduction

There has been a revival in the focus on risk-adjusted investment management over the past five years, as a direct result of the many market crises investors have navigated through, beginning with the US sub-prime market crash and through the Bear Stearns and Lehman collapses in 2008. Institutional investors fled to the safety of cash and liquid markets as the global financial crisis took hold. Just as investors were beginning to reallocate to risk assets in 2009 in the hopes of an equity market-led recovery, the Eurozone crisis deepened and spread to global markets, casting doubt on asset allocation choices and the rigorousness of legacy portfolio oversight frameworks.

In all, the changes in markets have been noted in sustained and increased correlation between asset classes, notably equities and fixed income and a rapid pace of change through heightened volatility. As the chart on the top right shows, on a rolling 60 day basis, the volatility of both bonds and equities spiked frequently in the past five years compared to the previous five, doubling or tripling from a benign level. As the chart on the bottom right shows, a high degree of correlation exists between equities and bonds since 2008, falling within a range of 0.5-0.8.

Rolling 60 day volatilty



Rolling 60 day correlation

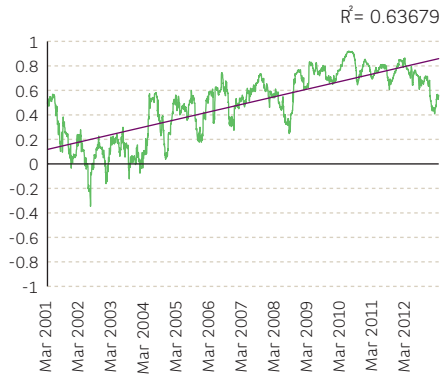


Figure 1: Volatility and correlation[1]

> It is increasingly common for investors and regulators alike to use a combination of the approaches to stress testing to provide a rigorous and transparent assessment of the sensitivity of the portfolio to market events and crises

Both changes have had a profound impact on institutional investors' approaches to asset allocation, given the implications for portfolio diversification. Critically, there have been two major dimensions to this impact:

1. More investment choices: investors have allocated to alternative asset classes, including illiquid long term assets, and increased the usage of derivatives in doing so
2. More scrutiny on asset allocation, the embedded risk in the portfolios and the investment objectives of institutional investors from regulators and from internal oversight boards and committees.

This has driven a need for **enhanced portfolio oversight**, focusing on the implications for asset allocation and risk management. Key attributes that are being debated in the investment community include different investment allocation approaches such as risk-weighted allocation, the use of alternative benchmarks, considering both liquidity and market risk, and attribution of risk. There are many other aspects up for debate of course, but our focus in this paper is to discuss one risk measurement approach to aid investors in managing their portfolios in a risk adjusted manner.

We use the case study of a theoretical crisis event and **focus on stress testing** as a means of increasing awareness, providing transparency and aiding with actionable outcomes when investors have to navigate through such an event.

Approaches to stress testing

Stress testing is a technique used to test the robustness or the sensitivity of a portfolio to market events, using various external shocks. There are multiple approaches to stress testing, including:

- **Piecewise approach**: evaluate the sensitivity to single factors in isolation, and the impact on portfolio values
- **Integrated approach**: combine multiple factors into a single estimate of the probability distribution of aggregate loss
- **Reverse approach**: use a predefined event to evaluate all possible factors that would lead to this event.

As can be seen in the table below each approach has its benefits and drawbacks, and thus it is increasingly common for investors and regulators alike to use a combination of the approaches to provide a rigorous and transparent assessment of the sensitivity of the portfolio to market events and crises.

Approach	Pros	Cons
Piecewise	Intuitive, easy to understand, provides board characterisation of a scenario.	No consideration of correlations between factors, low explanatory power over longer time horizons, linear relationships.
Integrated	Intuitive, can integrate multiple risk sources in the analysis, and more reflective of a real world scenario.	Specification of the factors critical, and time-dependent (from the scenario itself), cannot intuitively add up the impacts from the factors.
Reverse	Intuitive, allows the starting position to be defined as the event itself.	Multiple iterations and factors to model, difficult to implement due to the large range of possible factors to consider, highly dependent on subjective choice and selection.

Figure 2: Stress testing approaches: pros and cons

Case study

Let us now take an example of a stress test using one market event, the European Debt scenario. In designing the stress test, multiple issues have to be considered, including the choice of betas, and the choice of factors. Why are betas and factors important? We consider that the expected return of an asset or a portfolio in Arbitrage Pricing Theory (APT) is described thus:

$$r_{it} = \alpha_i + \beta_{i1} F_{1t} + \ldots + \beta_{ik} F_{kt} + \varepsilon_{it}$$

Figure 3: Arbitrage pricing theory

The theory states that the return of an asset is explained by a few common factors (represented by βF) and some idiosyncratic noise (ε). The common factors are ever-present and cannot be diversified away, whereas the noise element can be diversified as it is unique to the asset. In the above equation, **F** represents the common factor driving all asset returns, and β the sensitivity of the asset to the common factor. Thus it is highly important that the stress test specify the factors to stress, and also the betas given they will drive the impact of the factor to the portfolio.

Choice of factors

For example, in the below table a series of factors can be identified as typical variables used to shock the portfolio – however, would the stress test be performed solely on European equities as a broad based factor, or would there be need to drill down into the European financial sector to assess a more granular impact? In terms of a transmission to the Asian region, is it a regional mandate we are concerned with, or sub-regions (such as ASEAN or Asia ex Japan) or at the country level (Japan, China, Malaysia, etc). The choice depends on the preferences of the investor, the investment choices, the mandate of the portfolio, and the need for information at a granular level to help manage the portfolio in a risk-adjusted sense. The number of scenarios to model is also a critical factor, given there are numerous possible options to consider – ultimately in the investor must choose whether a single or multiple scenarios help provide a sound assessment of the likely impact of the event on the portfolio.

Factor	% or bps change		
	Scenario 1	Scenario 2	Scenario 3
USDEUR (%)	+	+	+
Eurozone Yield Curve (parallel shift bps)	–	–	–
Eurozone equities (%)	–	–	–
ITRAXX Europe bps	+	+	+
Asia Pacific Equities (%)	–	–	–
Oil (%)	–	–	–
EU Financials (%)	–	–	–

Figure 4: Potential stress test factors

Choice of betas

One of the key inputs for a stress test is the beta for each factor. In our study we used historical betas for equities, credit spreads, currencies and yields from the Lehman crisis over the period 19/09/2008-24/11/2008. A sample of the betas, along with the R^2 and t-tests are shown below.

Equities	Japan	China	Korea	Malaysia	Thailand
Beta	0.72	0.35	0.57	0.23	0.50
R^2	32%	18%	30%	34%	33%
t-test*	4.9	3.1	4.4	4.8	4.7

Figure 5: Equity market betas (to European equities)[2]

The table highlights the sensitivity of the individual country equity markets to European equities – both Japan and Korea are more sensitive to a move in European equities than for example China and Malaysia. But critically these betas are not constant and change over time, depending on the various market forces at work. The chart on the top right highlights the divergence in betas over the past 10 years for one of the markets – Japan versus Europe. As can be seen the betas are quite variable:

- Sometimes the beta is greater than 1, meaning that the Japanese equity market is more sensitive to European equity market movements
- At other times the beta is benign, suggesting that the Japanese equity market has low sensitivity to the European market
- And finally, the beta can also be negative, which would mean that the Japanese equity market would move in the opposite direction to the European equity market.

Source of volatility

In a factor-based approach to risk measurement, volatilities can be further attributed to the specific source – whether it is systematic or specific. Each asset will have some exposure to common factors and some unique diversifiable component as well. For example, in the theoretical portfolio on the bottom right side, there are 36 assets held in regional Asian equities. Each asset has a total volatility which is a combination of overall macro factors as well as its own unique business idiosyncrasies. The systematic volatility helps investors understand whether the risk in the asset is common to other assets and potentially adds to the portfolio risk. The specific volatility shows investors and asset managers the key risks driving the particular asset which are unique to that company or issuer. This latter risk can be diversified away at the portfolio level through the appropriate allocation to the asset, whereas the systematic volatility cannot be fully diversified. What is also highly pertinent to both investors and asset managers is that some assets have higher specific volatility compared to their systematic volatility – this is particularly important in the context of allocating to a stock selection based strategy, and the appropriate use of the risk budget.

Stress test output

As seen in the example on the next page, stress testing need not be esoteric, but practical and relevant to investment decisions.

Beta

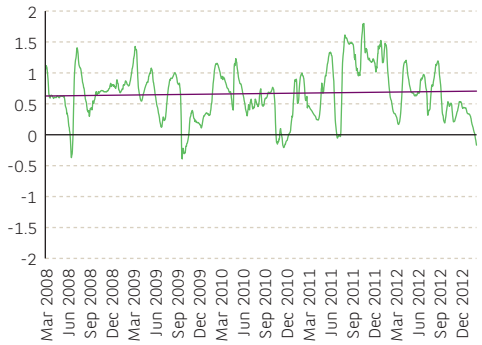


Figure 6: Beta of Japanese equities to European equities[3]

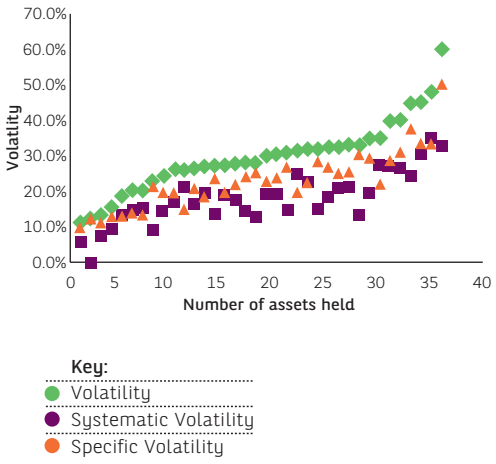


Figure 7: Total, systematic and specific volatility[4]

Initial value vs Stressed value

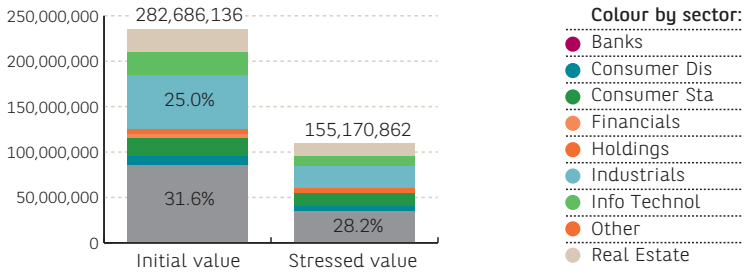


Figure 8: Stress test decomposition by sector

P&L contributions

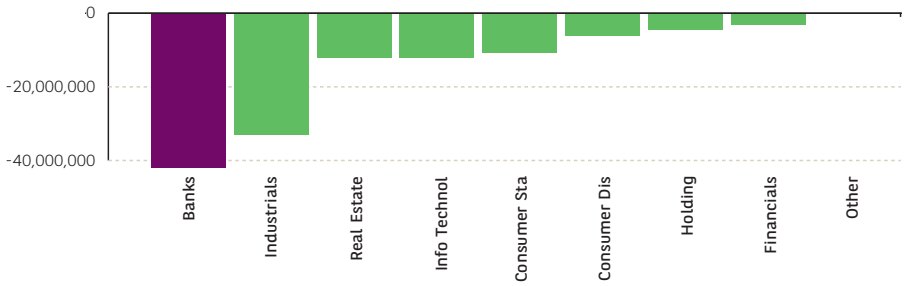


Figure 9: Contribution to profit/loss by sector from the stress test

In the above example, the analysis compares the initial portfolio value, and compares it to the stressed portfolio value. These values are decomposed into various categories, such as sectors or countries or regions and further, into the actual positions that impact the net change from initial to stressed value. We can then further drill down from the sector into the specific asset that is the top contributor to the change in value for the portfolio, and assess the impact from systematic and specific volatility. The benefit of this approach is that there is immense granularity on the impact of the scenario, and this is real information that the investor and the asset manager can act upon. In making the stress test more practical and more accessible, the investment management process is continuously enhanced, with active benefits to portfolio construction.

Implications for investors and managers to consider

The key implications to consider on the back of the results above are categorised into two broad areas: the first one area concerns implications for asset allocation in a risk-adjusted sense, and closely related, the second area concerns the implications for portfolio oversight in terms of risk management.

Asset allocation

Predominantly asset allocation for institutional investors has favoured a top down approach based on the Modern Portfolio Theory (MPT). The fundamental tenet being the building of a diversified portfolio, based on an optimal combination of different imperfectly correlated assets to produce the maximum expected return for a given level of risk[5]. A growing shift towards emphasising risk as a driver for asset allocation choices has been reinforced by the various crises of the past five years, as investors have seen dramatic shifts in volatility in the short-term, as well as correlations amongst seemingly diverse assets go to 1 and critically, persist. Both factors have caused seemingly well-diversified portfolios to lose value, and this has been exacerbated due to a lack of insight into the true underlying risks in the portfolios.

Typically asset allocation has been an exercise in allocating across equities, bonds or other asset classes, with the benefits of diversification at the asset class level. Sometimes there is a further drill down seen within asset classes such as sectoral/global splits. Increasingly however, investors are fine-tuning the allocations in a risk-adjusted sense, with choices across themes, styles, objectives, and factors. Some examples include beta and factor driven strategic

allocation, asset-liability portfolios, or treating currency, volatility and even investment horizons as distinct asset classes. Thus, rather than simply allocating to regional mandates[6], investors can target more precise examples built up from the factors, to more optimally allocate the risk budget, control risk and measure the success/lack thereof of the implemented investment strategy.

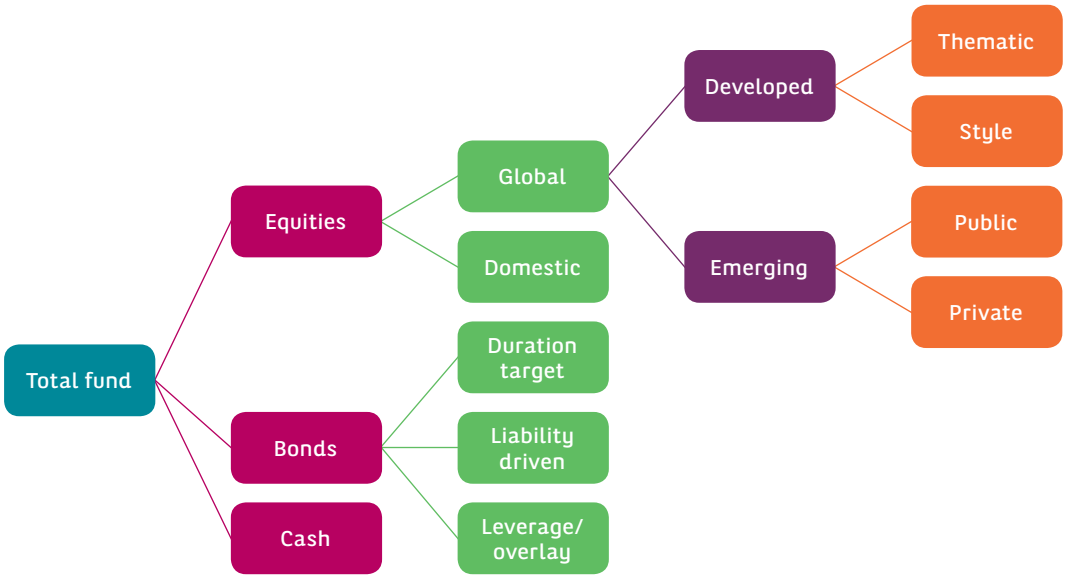


Figure 10: More focused mandates

As such, a key repercussion is for investors to re-categorise their asset class choices in terms of the underlying risk factors rather than broad asset class definitions. This 'risk-allocation' approach can be thought of as an optimised asset allocation approach, whereby the assets are modelled for their underlying sensitivity to various risk factors (equity/currency/commodity/interest rates) and regrouped for strategic risk allocation, as per the example below. The advantage of this approach is that the factors can be isolated and combined for more efficient portfolios, with the added advantage of being better aligned with protecting against potential market stresses.

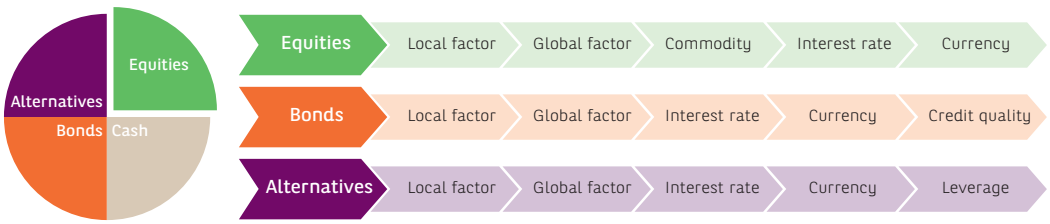


Figure 11: Risk vs. asset allocation

Investors need to consider that these choices are made in relation to their risk appetite and importantly how these allocations help them meet their investment objectives:

- Using a risk factor based approach can help investors drill down to the proportionate drivers from both systematic and specific risk. This is highly important in being able to control and diversify risk sources, in building a balanced portfolio that best meets the investor's objectives. For example, the choice of an allocation to a bank or the financial sector can be more quantitatively controlled through the drivers of return from a sectoral or a country or a company specific perspective
- Critically this shift in approach will need to be done in a consultative manner, with both the asset managers employed by the investors to implement the strategies and with the asset servicers chosen to provide risk and analytical support services. The 'contract' between the three parties is important in the sound functioning of the risk based allocation approach – the investor, the asset manager and

the asset servicer each can then 'play to their strengths' in delivering the requisite services and meeting their objectives

- A common mechanism underlying this discussion will be the crafting of a suitable Investment Manager Agreement (IMA) that details the explicit or implicit ranges and limits governed by the allocation choices. For example, investors wanting to minimise exposure to the Eurozone may specifically exclude the countries in scenarios 1 and 2. However this may curtail the investment opportunities for the asset manager in terms of executing their strategy in an otherwise optimal manner.

Asian asset managers need to consider building new or modifying existing products to be more risk-aware, to meet the challenges posed by investors' preferences. Key considerations for an Asian asset manager include:

- The appropriate choice of benchmark; if the allocation is to very specific risk buckets, a traditional market capitalisation approach in a benchmark may not be suitable, and could introduce spurious tracking error and downside risk to the mandate
- Size and liquidity constraints; an allocation made by the investor needs to be considered in terms of the size of the intended market/asset class as well as the allocation commitment itself. How quickly can the position be implemented, and with minimal market impact (explicit and implicit)? For example the allocation to frontier market equities may be theoretically sound but may need to be refined for actual execution costs, especially in the context of relative value
- The choice of investment vehicle through which the allocation can be executed successfully; related to the considerations above, the asset manager may implement the allocation through synthetic exposures, rather than physical stocks/bonds. A key question to address is what the relative value is in each of the investment vehicles. Protection against the blowout in credit spreads may need careful implementation through a bespoke, over the counter (OTC) instrument in the case of shallower credit markets such as China.

Risk management

Implications for risk management arise from the motivation of supporting the investment decision making process in enhancing portfolio oversight. The changing of investors' allocation preferences poses challenges for risk management in terms of providing granular insights while balancing data and system capabilities. These challenges are echoed by asset managers' motivation to construct more efficient portfolios, monitor their investment strategies and explain their performance successfully to investors. The modern risk manager has to be able to provide timely, effective and efficient risk **measurement** to ensure holistic risk **management** whether for an investor or the asset manager.

A critical aspect to note is that risk emanates from multiple sources, such as both market risk and liquidity risk. In a stressed market environment, liquidity risk is often the 'unexpected risk' that overrides all other risks in terms of severity and impact. It underlies many of the other risks that typically investors are cognisant of, and can add complexity and cost to the portfolio. Notably liquidity risk means different things to different investors – let us take for example a sovereign wealth fund operating on a multi-decade investment horizon and an endowment fund operating for a university. Both potentially have large allocations to illiquid asset classes such as private equity, real estate and infrastructure. While the sovereign wealth fund has little liquidity risk given its positive cashflow and lengthy investment horizon, it still faces the issue of modelling the risks in these assets to provide a consolidated view of total fund risk. The endowment fund on the other hand has higher liquidity risk given its need to fund liabilities and manage constant cash inflows and outflows, and also has the same struggle with asset modelling.

A key implication from these scenarios is the explicit input of risk **measurement** into the portfolio construction process. Rather than use risk measurement as an after-the-fact control measure, a holistic risk management framework includes various risk measurement approaches such as allocating to risk factors, measuring and monitoring drivers of risk including systematic and specific risk, liquidity and tail risk, into the portfolio construction process. The means that both investors and asset managers need to incorporate risk management techniques and frameworks as a foundational part of the portfolio construction process. Indeed, the construction of the modern diversified portfolio depends very much on modelling the behaviours of the assets in response to the different risk drivers. In the example on the next page, a typical investment process whether within an investor's office or in an asset manager has four primary steps, and risk measurement can be seen to be a major contributor in three of these steps.

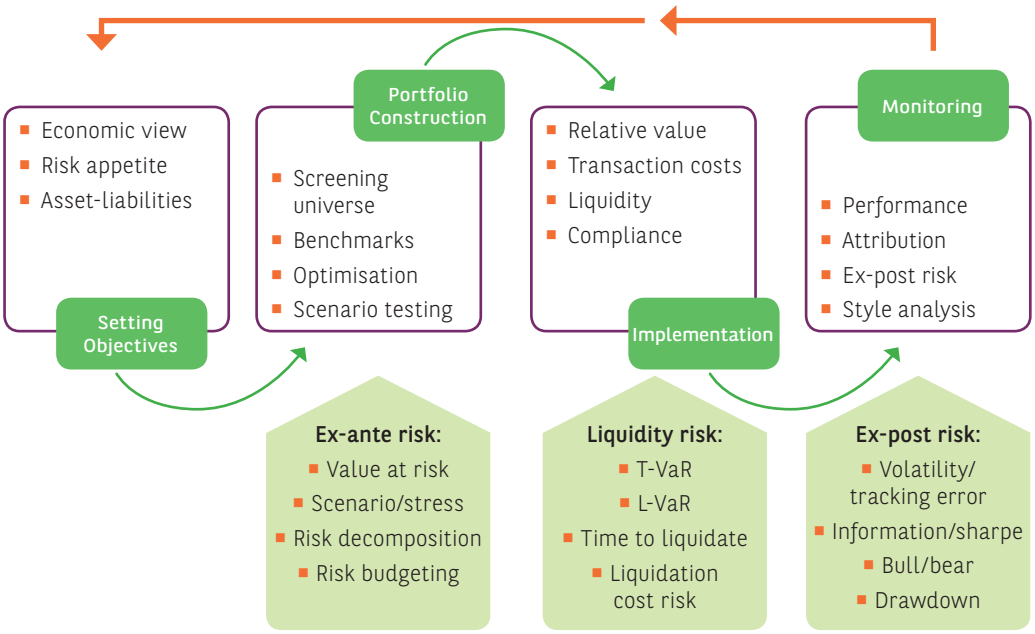


Figure 12: Investment process and risk measurement

Ex-ante risk can help at the construction stage, with a range of techniques to optimise portfolio allocations. Liquidity risk can assist at the implementation stage when assessing the sensitivity of the portfolio to market depth, market efficiency and capital funding sources. And finally ex-post risk can help validate the investment process of the portfolio through a quantitative assessment of the realised track record.

Risk management becomes an integral part of the tri-party discussions between investor, asset manager and service provider, whether in terms of the appropriate risk measures and tools used to model risk, or even in the efficient construction of the IMA. After all – any investment objective must be able to be quantified, to be monitored and refined. Investors can thus adopt more explicit risk controls into the IMAs, whether through limits on Tracking Error or Volatility, and Marginal Contributions to both, or even to the extent of monitoring Value at Risk and Conditional Value at Risk at portfolio or strategy level.

Finally, the closeness of the asset allocation decision to the risk management process means that the flow of information within an investor's organisation and within the asset manager's front office is strengthened. Having access to readily available, granular and detailed risk analytics through online and tablet delivery media enhances the operational efficiency of the risk management process as communication on complex issues can be immediate. This supports the ultimate aim of enhancing portfolio oversight through smarter delivery of richer information.

Summary

As investors and asset managers continue to navigate through multiple financial and global crises the need for optimal asset allocation in a risk-adjusted manner has become more critical than ever. Risk measurement approaches such as stress testing play an important role in increasing the information flow to the investor, and promoting a risk-aware construction of portfolios to better navigate these crises. Importantly stress testing is not the only technique available in the risk measurement toolset – the investor and asset manager can leverage a range of approaches, including Value at Risk analysis, risk decomposition, risk budgeting and liquidity risk analysis, to better allocate assets in a risk-adjusted manner.

The increased complexity of regulation, market volatility and investment choice means that investors and asset managers now more than ever need to rely upon a strong platform, consultative service and global expertise. As guardians of client portfolios and market data, asset servicers play an important role in this paradigm shift and with integrated global analytical capabilities, are optimally placed to assist investors and asset managers with risk adjusted asset allocation and holistic risk management.

Contacts

BNP Paribas Securities Services

Madhu Gayer, Head of investment reporting and performance Asia-Pacific

madhu.gayer@asia.bnpparibas.com

+ 65 6210 4964

Mostapha Tahiri, Head of asset and fund services Asia

mostapha.tahiri@asia.bnpparibas.com

+ 65 6210 1676

Elizabeth Chia, Head of client development, Asia
Asset Owners, Asset Managers, Alternative Investments

elizabeth.chia@asia.bnpparibas.com

+ 65 6210 1736

1. Indices: HSBC Asian Local Bond Index, MSCI Asia Price Index, Daily, March 2001 to March 2013, Source: Investment Reporting and Performance, BNP Paribas Securities Services
2. Indices: MSCI Europe, Nikkei, SET, Shanghai Composite, KOSPI, KLSI Composite. Source: Investment Reporting and Performance, BNP Paribas Securities Services. T-test with 95% level of confidence and 41 degrees of freedom. The beta is significantly different from zero if the t-statistic is higher than 2.1
3. Rolling 60 day betas, indices: Nikkei, MSCI Europe, Daily, March 2008 to February 2013. Source: Investment Reporting and Performance, BNP Paribas Securities Services
4. Implied volatility for equity assets. Source: Investment Reporting and Performance, BNP Paribas Securities Services
5. Or minimise risk for the given level of expected return
6. Such as Asia ex Japan or EAFE

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