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Replicating Portfolio Implementation

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INSURANCE COMPANIES use a variety of risk management and performance measurement techniques that involve the valuation of liabilities under a wide range of scenarios that reflect different market risk factors. Some examples include: economic capital calculations, asset-liability management, hedging and attribution analysis (e.g., hedgeable vs. non-hedgeable investment returns, investment vs. non-investment operating income). However, a major challenge of embedding such techniques into management's decision-making is the massive simulations required, which result in unwieldy complexity and long run times.

In direct response to this challenge, some companies are adopting replicating portfolios. A replicating portfolio is a basket of financial instruments designed to replicate, as closely as possible, the value and market sensitivity of a target portfolio of liabilities in different economic scenarios. Using replicating portfolios allows the market-risk section of risk dashboards to be monitored in real time, as instruments in a replicating portfolio can often be quickly re-valued under different economic scenarios using closed form formulae. As a result, the use of replicating portfolios can drastically reduce the time and resources that would otherwise be required.

To take full advantage of replicating portfolios, companies would benefit from carefully addressing considerations in two areas:

- Selection of the replicating portfolio tool
- Enterprise-wide implementation

SELECTION OF THE REPLICATING PORTFOLIO TOOL

There are currently a number of replicating portfolio tools in the market. To select the most appropriate one, companies should consider issues that significantly affect the tool's ability to generate the optimal portfolio, with sufficient power to replicate market sensitivities of target portfolio of liabilities in a wide range of market scenarios, and do so in a relatively short period of time.

Replicating Power Issues

- *What market risk factors are supported?*

The ideal tool will allow a user to identify the optimal replicating portfolios, which can be re-valued under economic scenarios comprising all key market risk factors that affect the company's major businesses.

- *What economic scenarios are used in the fitting process to identify the optimal replicating portfolio?* Generally, cash flows of the target portfolio of liabilities under the set of market-consistent scenarios at the valuation date are used for fitting. The ability to incorporate additional extreme investment scenarios can improve the fitting of the optimal replicating portfolio to some of the more severe market shocks. This can be very valuable for exercises with a focus on tail risks.

- *What existing candidate financial instruments are supported?* The richness of the candidate financial instruments available for fitting is one of the most important success factors in a tool's ability to find the optimal portfolio with strong replicating power. The universe of candidate financial instruments should include not only the tradable assets available in financial markets, but also a wide range of synthetic ones.

- *How easy is it to incorporate new financial instruments?* The ability for a user to create and include additional financial instruments for fitting can be a huge plus, particularly when working with a target portfolio of complex liabilities with unique investment philosophies, crediting strategies, and embedded options and guarantees.

Run-Time Issues

- *How easy is it to restrict the candidate financial instruments for fitting to identify the optimal replicating portfolio?* The ability of a user to quickly narrow the universe of candidate financial instruments to



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CONTINUED ON PAGE 20

Replicating Portfolio Implementation | from Page 19

allow only relevant ones to be considered can substantially shorten the time required to identify the optimal portfolio. For example, allowing only certain tradable assets to be part of the optimal portfolio might be necessary when dealing with performance attribution related to hedging activities.

- *What optimization algorithm does the tool use?* The speed with which the tool can effectively search the universe of all possible portfolios, with different asset combinations from all candidate financial instruments, and locate the optimal replicating portfolio, is a critical factor in its success. Understanding the underlying algorithm methodology, how it is implemented and its performance are therefore important. One can expect a good tool to provide performance measures of its optimizer and offer meaningful descriptions of its optimizer in the tool's user manual.
- *How fast can the tool re-value (i.e., re-price) the optimal replicating portfolio under new economic scenarios?* A tool that is slow to re-price the optimal replicating portfolio under new scenarios destroys the very benefits and causes for its use. As a potential benchmark, a good tool can typically re-price an optimal portfolio, consisting of only financial instruments that can be valued through closed form formulae, under tens of thousands of economic scenarios in a matter of minutes.

Some additional issues surrounding tool selection are listed below:

- *Is scenario bucketing supported?* Typically, if a set of market-consistent, or risk-neutral, scenarios is used for fitting, the majority of the scenarios would concentrate somewhere near the average of all scenarios. Scenario bucketing, also called clustering as it relates to statistics and data mining, allows a user to put more emphasis on the more extreme scenarios of interests.
- *Is term bucketing of cash flows supported?* A good fit to instantaneous market sensitivities of the liabilities does not guarantee a good fit to the liabilities over time, and the ability to fit over time is largely

dependent on the ability to fit the profile of liability cash flows.

- *Is the replicating portfolio suitable for the company's planned usage?* A robust tool that addresses the above issues should have a very good chance of identifying the right optimal portfolios with excellent replicating power for many types of liabilities. However, there is no guarantee that an optimal portfolio that meets the company's fitting error tolerance will exist. It is important to conduct a pilot study by applying the tool to blocks of the company's main business lines to gauge the effectiveness of the technique before making a commitment.

ENTERPRISE-WIDE IMPLEMENTATION

Once the tool and technology provider have been identified, companies will need a detailed implementation plan to roll out the tool to all users in the enterprise. In addition to the usual considerations in implementing any business application, companies might also want to consider the issues below, which are unique to replicating portfolio implementations:

- *Governance:* To achieve better consistency, efficiency and accuracy across the organization, companies should make choices about who has decision-making power regarding the issues that will affect the quality of the replicating portfolios. Companies should give guidance on the following areas: the universe of candidate financial instruments, the economic scenarios to use for fitting, the fitting measures and fitting error tolerance levels. Standards and controls might be established for different levels of users, based on their level of sophistication and experience in using the tool.

A related but more general issue is the choice in the type of control. A centralized approach might simplify the overall process, provide better controls, and reduce the time and cost associated with training and communication. On the other hand, a decentralized approach might allow local users to better use their unique insight and knowledge of the risk characteristics of the target liabilities to improve the quality of the optimal replicating portfolio and shorten the time it takes to get it finished.

“There are many challenges to effective implementation ... with the proper planning and guidance, companies can be more confident of reaping the rewards of replicating portfolios ...”

- *Level of Granularity:* A decision will need to be made regarding the optimal level for the creation of replicating portfolios (e.g., by product or by line of business). The decision involves balancing tradeoffs between a variety of factors, including timing, accuracy, complexity in process management and ability to interpret the resulting replicating portfolio.
- *Frequency of Recalibration:* Optimal replicating portfolios should be periodically recalibrated to reflect non-economic changes in target portfolio liabilities and enable it to stay meaningful and relevant. The frequency of recalibrations should be defined and guidelines should be given to allow for interim updates with unusual market movements.
- *Data Integrity:* Large amount of information and data might be produced and exchanged between corporate and local users. For most companies,

establishing the proper controls to maintain data integrity will not be a small challenge.

- *Independent Validation:* Depending on the nature of the particular application, a third-party review of the whole process and methodology might be warranted.

The promise offered by replicating portfolios to significantly reduce model run time for the valuation of liabilities with complex options and guarantees under a variety of market scenarios is attractive. However, there are many challenges to effective implementation. Armed with the above list of issues, and with the proper planning and guidance, companies can be more confident of reaping the rewards of replicating portfolios – faster run times without sacrificing quality. As a result, it is possible to incorporate better risk and performance analysis into management information and better support decision-making. ♦

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