

## Creating a Custom Risk-Neutral Asset

by Dan Finn, Managing Director

Most of Conning’s clients are used to creating custom asset classes in a real-world model. With the flexibility built into the GEMS® Economic Scenario Generator, users can bring in a nearly unlimited set of explanatory variables to create the desired relationships between this new asset class and other variables within their simulation. However, when we move over to a risk neutral simulation, we have to be much more diligent to ensure that the new asset classes will be appropriate for that type of simulation. In particular, the user needs to follow some specific rules to ensure that the new asset class will pass the Martingale test.

So, what are the key considerations for this conversion? To answer this question, it is useful to go back to what the Martingale test is actually doing. Specifically, this test is an extension of the fundamental idea behind risk neutral scenarios: for a set of cash flows, Initial Price =  $E[\sum \text{Cash Flow}_t * \text{Discount}_t]$ . If we consider a strategy that buys and holds \$1 of a specific investment for  $N$  years, then our  $\text{Cash Flow}_N = 1 +$

Cumulative Return $_N$  for that investment, which leads to  $1 = E[(1 + \text{Cumulative Return}_N) * \text{Discount}_N]$ . This is the middle line in the Martingale test. With this understanding, it is possible to derive some key characteristics that any custom risk-neutral asset class will need to pass this test:

- The model can only use returns, not economic variables (e.g. yields, GDP)
- The weights across asset classes must sum to 1
- The weights must be the same for Price and Income for every asset class
- Any residual must be independent and cannot adjust the mean return

To see these considerations in action, let’s start with a fairly straightforward custom asset class: the International Diversified Equity Asset Class that Conning developed for the NAIC’s scenarios. This asset class is driven by the S&P 500. Since the yields on the target MSCI EAFE index have been histori-

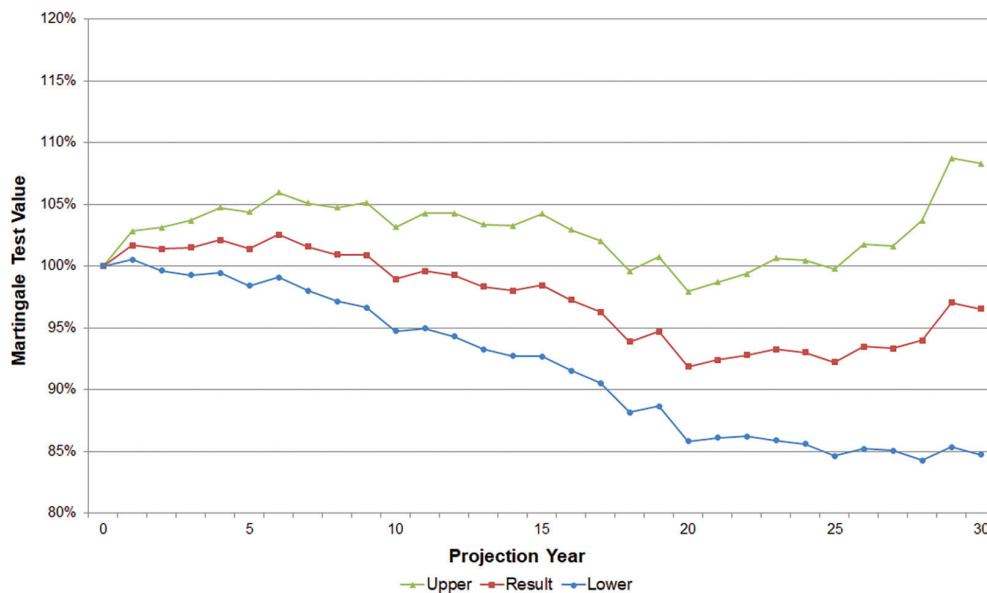


Figure 1: Martingale results for the NAIC’s Real-World International Diversified Equity Asset Class. ©2024 Conning, Inc.

cally higher than the US market, we have a large Income beta of 1.652. However, the price movements have been less correlated with the US movements, so Price only has a 0.864 beta. The model also has a residual for both Income and Price changes. If we simply run this setup in a risk neutral model, the resulting values do not pass the Martingale test, as seen in **Figure 1** (previous page).

So, what adjustments do we need to make to this asset class? First, we need to harmonize the weights for Price and Income. Since most of the variability comes from the Price side, we simply use the Price Weights for both. Second, we need to make the weights sum to 1. Since there is no way to force this in regressions, we typically do this by adding in a low-

risk investment, usually 1-month Treasuries, with the remaining weight. Finally, we need to make sure that the error term doesn't change the mean returns. In this model this is easy: we just set the Income and Price Mean adjustments to 0, since the error terms are additive. When we make these changes, the resulting asset class produces acceptable Martingale results, as seen in **Figure 2** (below).

In the end, by following a few simple rules, Conning can easily convert a company's existing real-world models into appropriate risk-neutral versions. This process can even be extended to your company's most complex investments (e.g. volatility-controlled funds).

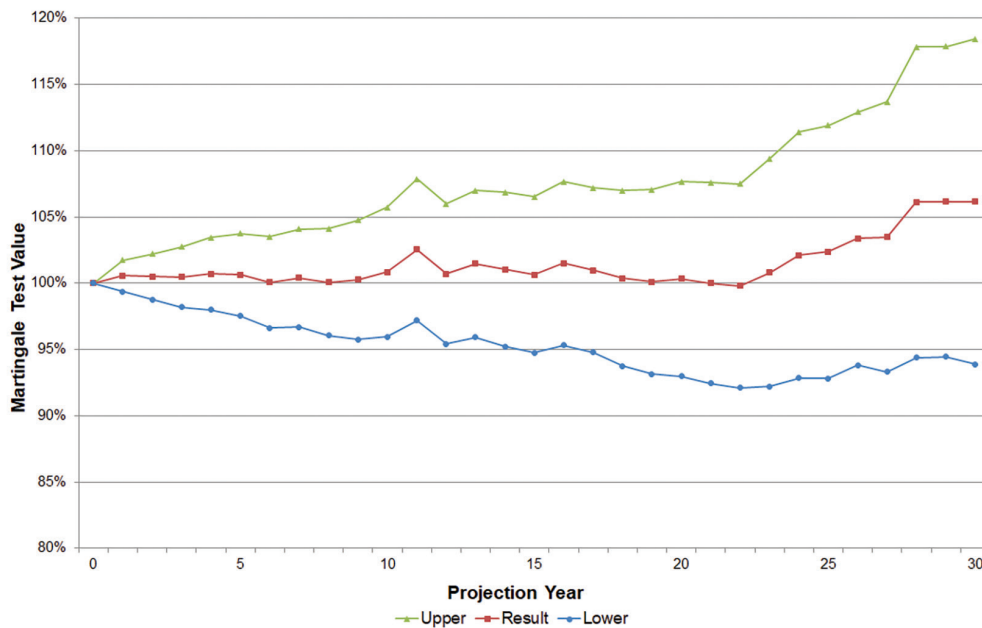


Figure 2: Martingale results for the Risk-Neutral International Diversified Equity Asset Class. ©2024 Conning, Inc.

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