



| NASDAQ ASSET OWNER SOLUTIONS

Risk Planning for the Next Market Crisis

Simulating the impact of a market shock
on a hypothetical public-plan portfolio

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Introduction

Between February 19, 2020 and March 23, 2020, the S&P 500 crashed almost 35%. The speed and ferocity of the selloff was shocking and caught many market participants unaware, as did the recovery when the S&P 500 surged more than 60% in just over five months.

In the economic aftermath, various corporate sectors are facing significant financial hardship and many markets globally are as volatile as they have been in generations, all of which leaves institutional investors across the world the responsibility of anticipating and planning for what may come next.

Market shocks can be fast, confusing and brutal. Attempting to react to them in real-time often results in suboptimal investment decisions. That's where risk scenario planning is essential.

The objective of scenario planning is twofold:

1. Quantitatively estimate the damage that various market shocks might inflict on the portfolio.
2. Develop a contingency plan to take advantage of the opportunities that may be created by the market dislocation.

About This Simulation

The Portfolio

In this analysis, we use the **Solovis Risk Analytics** application to simulate the impact of a market shock on a hypothetical public-plan portfolio.

This hypothetical portfolio was constructed from hundreds of actual public-plan allocation models, sourced from **eVestment Market Lens**. Market Lens tracks public plans in the U.S., U.K. and Australia and uses FOIA requests to obtain board documents from those plans, including allocation studies, consultant research and other documentation on each plan's portfolio.

Through a combination of document-reading technology and human analysis, Market Lens extracts intelligence on portfolios, fees, consultant ratings, manager rosters and other data points from the documents it obtains.

Our own analysis has aggregated this data to derive the hypothetical portfolio representative of a medium-size public pension used in this scenario.

Portfolio	Weight
All	100.0%
Cash	3.0%
Short-Term Investment Grade	19.0%
Long-Term Credit Focus	1.3%
Hedge Funds	8.8%
Public Equity	48.6%
Private Equity	5.5%
Venture Capital	6.5%
Real Assets	7.3%

The Risk Tool

Solovis Risk Analytics can generate two types of scenarios – historical and designed market stress. Historical scenarios are just as they sound: given a start and end date, the simulation engine projects what would happen to the current portfolio should the historical period happen again. Solovis also enables you to create a market stress scenario by specifying up to five simultaneous market shocks. By statistically analyzing the economic relationships, we calculate how an index shock (or shocks) reverberates to other economic variables and ultimately to portfolio returns.

In this analysis, we will model the impact that an uptick in corporate bankruptcies might have on our portfolio. We can model this by looking at what happens to our portfolio if Treasury bonds (with an average duration of seven years) were to go up by 5% and high yield corporate bonds were to decline by -10%; for reference, high yield bonds sold off by -21% during the March 2020 crash.

While in our example we are shocking ETFs for simplicity's sake, in practice the shocks can be anything from an interest rate such as 10-year Treasury yields to very investor-specific positions – an individual stock like Tesla for example. Solovis' simulation engine is flexible enough to accommodate any of these shocks or several of them simultaneously.

Viewing Scenarios Through Our Factor Lens

Solovis views every portfolio as a collection of factor exposures. The following table depicts the factor exposures of our hypothetical pension fund.

As you can see, the portfolio's dominant exposure is to the market, but it also holds small-cap exposure (Size) thanks to its private equity holdings as well as Rates and Credit Spread exposures from its fixed income allocation. Solovis Risk Analytics not only calculates the factor exposures of the entire portfolio, but it also calculates factor exposures for every sub-portfolio all the way down to the individual holdings.

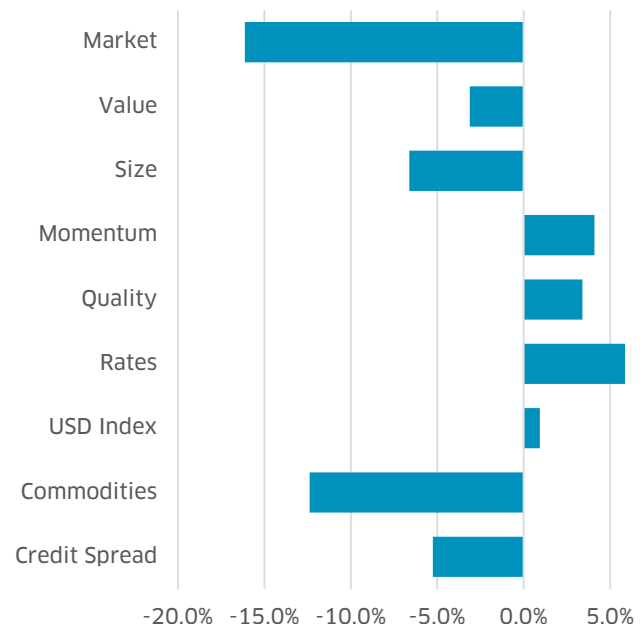
Also in the table are the factor exposures of our example pension fund's policy benchmark (a diversified portfolio that the pension fund's aggregate performance is measured against). As you can see, the factor exposures of our pension fund differ slightly from the benchmark's due to some active bets.

In order to go from scenario shocks to investment returns, our designed market shocks are statistically translated into a set of factor changes. The Solovis Risk model forecasts that the following factor changes (in the chart below) would be produced by Treasury bonds going up 5% and high yield corporate bonds declining -10%.

As expected, the Rates factor, which measures Treasury bond exposure, goes up while the Credit Spread factor declines. But these returns don't occur in a vacuum – Solovis' simulation engine calculates that equities (Market) and Commodities will also be negatively impacted and that the Quality and Momentum style factors will outperform the Value and Size style factors.

Factor	Fund Exposure	Benchmark Exposure
Market	0.53	0.55
Value	0.05	0.06
Size	0.25	0.18
Momentum	-0.01	0.00
Quality	0.00	0.07
Rates	0.17	0.25
USD Index	-0.11	-0.06
Commodities	0.03	0.01
Credit Spread	0.21	0.08

Factor Returns

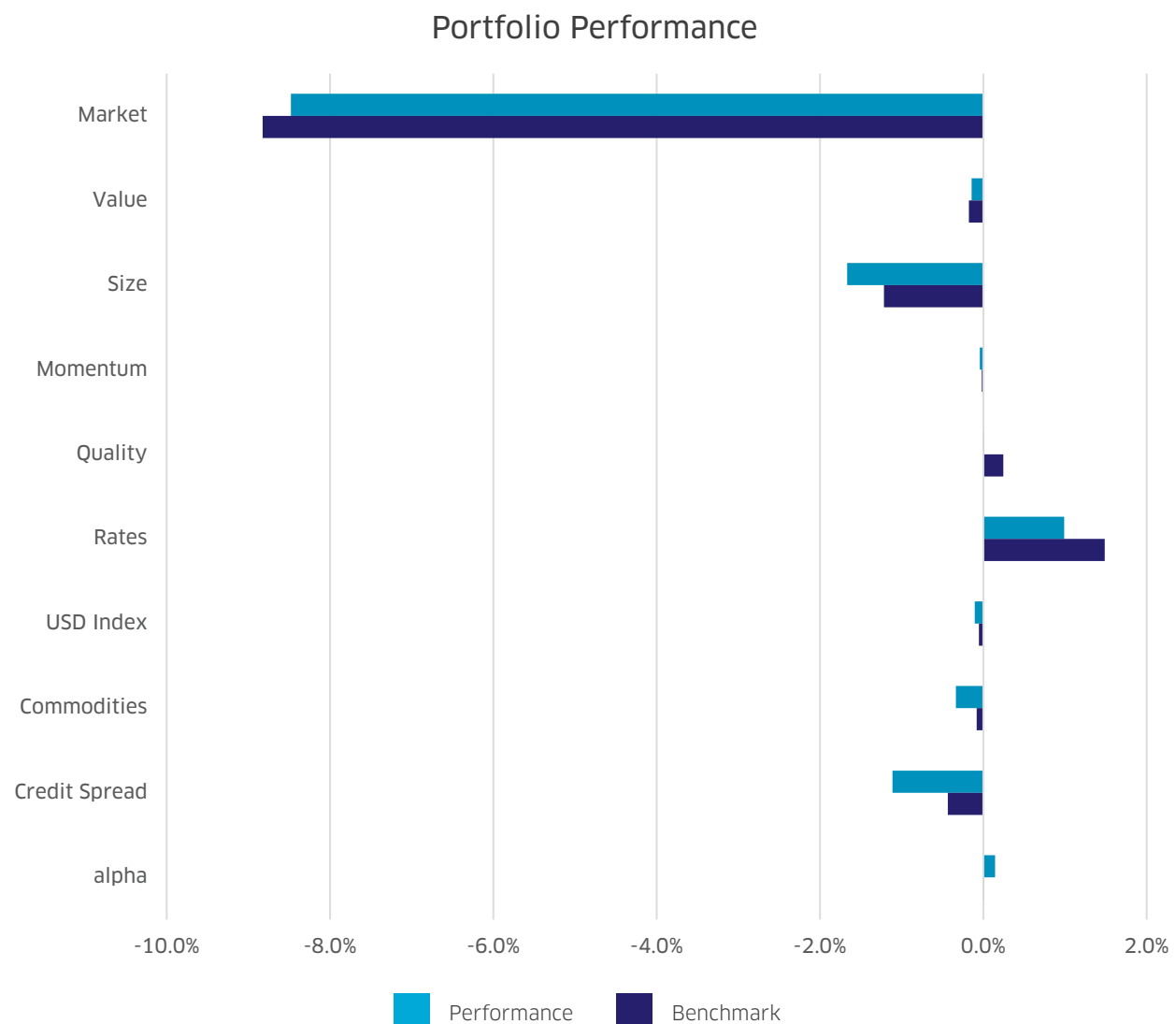


Shock Scenario Results

Once we know the factor exposures of our portfolio and the way each factor changed during the scenario, it's straightforward to calculate our portfolio's return. We forecast that the pension portfolio will decline -10.75% in this scenario, underperforming its benchmark, which is projected to only decline by -9.07%.

The following chart breaks down the total return of our pension portfolio by factor. The dominant negative drivers of the scenario return are the long Market, long Size (small-cap), and long Credit Spread exposures of the portfolio. On the other hand, the positive Rates exposure provides a small, but welcome hedge. In the chart, alpha does not mean alpha relative to the policy benchmark; rather it is a statistical estimate of the excess return of an asset relative to its factor exposures. It mainly derives from the coupon portion of fixed income returns.

It's interesting that despite our pension portfolio having a lower Market beta than its benchmark, it underperforms because of its relative over-weights to Size and Credit Spreads and its underweight to Rates (Treasury bonds).



From the asset class returns in the scenario, we can see that illiquid and economically sensitive asset classes like private equity, venture capital, and real assets are projected to perform the worst. To be clear, these simulated returns are crisis returns that happen over the duration of the economic shock. They are not the returns an investor should expect from these assets over an entire business cycle.

It's important to note that this analysis assumes a high correlation between private equity and public equities. While private equity returns can exhibit less variance and low correlations to public markets due to the method and timing of PE valuations, we believe that the intrinsic risk of private equity investments is not significantly different than that of public equities. Thus, we've modeled it according to these beliefs using U.S. small-cap equities as our proxy.

A few caveats about this proxy approach:

- One advantageous characteristic of private equity returns is that they often lag and are smoother than public market valuations as their valuations are not subject to the daily ebbs and flows of financial markets. Because we opted for using a public proxy, our analysis will not include these beneficial aspects of private equity returns.
- Also, the simulation we ran assumes that the pension plan's private market investments are fully allocated and invested. In cases where they are not and there is cash waiting to be committed and invested, the simulated returns would overstate the magnitude of the decline.
- Solovis Risk Analytics provides ample ability to customize how each investment is modeled – users of our software can easily change the proxy used or enter custom factor exposures that they believe properly captures the economic exposures and risk of each investment. If a time series of historical returns is available, factor exposures can be statistically estimated as well.

One silver lining is that post crisis, the portfolio is over-allocated to diversifying assets like cash, fixed income, and hedge funds. Assuming no immediate liquidity needs, this presents an attractive opportunity to rebalance into the hardest hit assets.

Portfolio	Scenario Return
All	-10.7%
Cash	0.0%
Short-Term Investment Grade	-0.6%
Long-Term Credit Focus	-0.1%
Hedge Funds	-2.3%
Public Equity	-14.2%
Private Equity	-18.3%
Venture Capital	-19.3%
Real Assets	-17.3%

To get a sense of the magnitude of the rebalance, we can compare the allocations of the pension fund portfolio prior to and post the shock.

Portfolio	Weight	Scenario Return	Scenario Weight	Change in Weight
All	100.0%	-10.7%	100.0%	--
Cash	3.0%	0.0%	3.4%	0.4%
Short-Term Investment Grade	19.0%	-0.6%	21.1%	2.2%
Long-Term Credit Focus	1.3%	-0.1%	1.4%	0.2%
Hedge Funds	8.8%	-2.3%	9.6%	0.8%
Public Equity	48.6%	-14.2%	46.7%	-1.9%
Private Equity	5.5%	-18.3%	5.1%	-0.5%
Venture Capital	6.5%	-19.3%	5.9%	-0.6%
Real Assets	7.3%	-17.3%	6.7%	-0.5%

Finally, as mentioned previously, Solovis Risk Analytics allows us to drill down and see the scenario returns and post-shock weights at multiple levels. In this paper, we presented it at the asset class level, but within the solution an investor can easily go deeper and see it at the sub-asset class or even the holdings level.

Conclusion

Market shocks can't be predicted, but they can be planned for. The scenario analysis capabilities in Solovis Risk Analytics can help institutional investors estimate the impact of market shocks, highlight key areas of vulnerability in their portfolios and create action plans for moving forward.

To learn more about eVestment Market Lens
or Solovis Risk Analytics, please contact:

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