How Vulnerable is Your Retirement "Monte Carlo" to a Black Swan?

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In early November 2007, Robert (age 62) and Sandra (age 78) happened to meet in the waiting room of their financial advisor. By chance, both were there to discuss a financial plan for their retirement. As part of the process they were shown a Monte Carlo Simulation (MCS) "number", which has now become ubiquitous in financial planning circles. Robert and Sandra were told, independently, that given their current investment asset allocation, desired spending rate, age and health, their retirement sustainability (a.k.a. success rate) was approximately 80%. In other words, their plan was in good, albeit not great, shape. Stated differently, their retirement ruin probability was 20%. Thus, according to the MCS analysis, although Robert and Sandra differed from each other in many ways, both were in the same "retirement risk" category.

And yet now, a year or so later, Robert and Sandra are in a very different financial situation. Robert has seen his nest egg decline by almost half and has very little hope of sustaining his original retirement plans. In contrast, Sandra – who, recall, had the same 80% diagnostic as Robert a mere 18 months ago – has also lost money, but she is in a much better situation compared to Robert. Yes, she might have to tighten her spending belt, but nothing as drastic as Robert.

Alas, as you might have suspected by now, Robert had most of his nest egg allocated to the stock market while Sandra was invested primarily in U.S. government bonds.

WHERE DID MONTE CARLO GO WRONG?

Monte Carlo Simulation (MCS) algorithms generate many different financial scenarios for the future, but the reported output often only mentions the percent of cases in which a certain income/spending target was met. This is the success rate. Rarely, however, do MCS software packages provide any sort of sensitivity analysis. And, when this feature is available it is rarely used. Indeed, both Robert and Sandra can have a relatively similar sustainability forecast for their retirement income, but a high exposure to the stock market means that these numbers can change very quickly. *How do we measure, report and make sure this is clear to individual clients?*

DEFINING SEQUENCE OF RETURNS DOWNSIDE EXPOSURE

So, the essence of my idea is as follows: I propose that whenever a Monte Carlo Simulation is conducted -- or similar analytic techniques are implemented -- the user should compute the sustainability number assuming two different sets of assumptions. The first baseline set of assumptions represents the client's current situation. The second hypothetical set assumes that THREE years have gone by and the underlying investment portfolio has experience a 1-in-100 event. I label this a sustainability analysis

under Nassim Taleb's Black Swan scenario. What will the success ratio be *in 36 months* from now if the portfolio declines to a level which is forecast to have a 1% of occurring within the same Monte Carlo Simulation? The ratio of the current baseline sustainability number to the Black Swan sustainability number, minus one, is defined as the Sequence of Returns Downside Exposure (SORDEX) Ratio. The greater this ratio, the more vulnerable the plan is to abnormal market conditions.

NUMERICAL EXAMPLE

Let's go back to Robert and Sandra to complete some of the missing background details. Robert was 62 (in November 2007) with a $950,000 investible portfolio. He wanted to consume $37,110 per year in inflation-adjusted terms, which is equivalent to a spending rate of 3.91%. At 62 he was relatively young, considered himself to be risk tolerant and therefore allocated only 10% of his portfolio to safe bonds, which earned a meager inflation-adjusted real return of 2%. The remaining 90% of his portfolio was allocated to equities, which according to the embedded economic assumptions were expected to earn 7% real rate with a standard deviation (a.k.a. investment volatility) of 25%. Thus, using a basic Monte Carlo Simulation (or analytic) calculation, Robert's plan had a 20% ruin probability, which is equivalent to an 80% sustainability. In the common parlance, his MCS "number" was 80%.

Sandra, on the other hand, was 16 years older than Robert. She only had $330,000 of investment assets (back in November 2007) from which she wanted to consume $25,780 per year, also in real terms. This was a spending rate of 7.81% which was much higher than Robert's, but she was obviously older. More importantly, Sandra was very conservative and risk averse. Her asset allocation consisted of 75% in safe bonds and only 25% in diversified equities. The economic return and volatility assumptions for Sandra's MCS analysis were exactly the same as Robert's. Remember, Sandra also had a sustainability value of 80%. Under the baseline analysis they were both in the same risk category. Yet, we all intuitively sense that Robert was taking on more risk.

Thus, my recommendation is as follows. On the day of the baseline analysis an advisor should hypothetically estimate Robert and Sandra's sustainability ratio, assuming that three years have gone by and hence Robert is 65 and Sandra is 81. Second, assume that markets have produced Black Swan returns -- an event that has a 1% chance of occurring according to the same Monte Carlo simulation -- and hence Robert's wealth has declined to $342,400 while Sandra's wealth has declined to $197,700. Under Black Swan assumptions, the Monte Carlo Simulation produces a hypothetical 29.6% sustainability for a 65-year-old Robert and 53.7% for an 81-year-old Sandra. Note that Black Swan numbers will always be much lower than baseline numbers. The important question is: by how much?

In our case the ratio of the baseline sustainability value (80%) to the Black Swan sustainability value -- 29.6% for Robert and 53.7% for Sandra -- is 2.7 and 1.49 respectively. Finally, subtract one from both numbers to convert them into a marginal percentages and we see that Robert's SORDEX Ratio is **1.7 units**, while Sandra's SORDEX Ratio is a much lower **0.49**. Ergo, Robert's sustainability is about 3.5 times more vulnerable to Black Swans compared to Sandra's, even though her spending rate is double his.

Whose Retirement "Monte Carlo Number" is Safer?

	Robert Younger	Sandra Older
Current Age:	62	78
Initial / Current Wealth:	$ 950,000	$ 330,000
Desired Spending Amount:	$ 37,116	$ 25,777
---> Rate:	3.91%	7.81%
Current Bond Allocation:	10%	75%
Current Equity Allocation:	90%	25%
Today's Sustainability:	80.00%	80.00%
Black Swan Probability:	1.0%	1.0%
Black Swan Wealth: (Year 3):	$ 342,398	$ 197,681
Black Swan Sustainability:	29.64%	53.68%
SORDEX Ratio:	1.70	0.49

IN SUM:

The Sequence-of-Return Downside Exposure (SORDEX) Ratio can be easily computed in any pre-existing Monte Carlo Simulation or analytic software tool and thus requires no new mathematical tools or skills. Some MCS packages allow for such scenario analysis and should thus be easy to implement. The SORDEX Ratio is a value between zero (very good) and infinity (very bad) that summarizes the vulnerability of a number to statistical outliers, defined within the same simulation. A SORDEX Ratio greater than 1 should raise alarm bells, while anything above 2 should set-off ear piercing sirens. Moreover, this technique can be extended to inflation and longevity Black Swans as well. Here is the bottom line. Instead of condemning the entire Monte Carlo Simulation industry for missing the meltdown, let's take this unique opportunity to properly harness the full power of stochastic methods.

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