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Markowitz 2.0: Innovations for asset allocation

Singapore Management University

MARKOWITZ 2.0: INNOVATIONS FOR ASSET ALLOCATION

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The economic wreckage from the 2008 global financial crisis dealt a blow to the theoretical foundations of finance and economic. Many of these theories, such as Markowitz's *Modern Portfolio Theory* (MPT), were considered received wisdom and taught in practically all business schools. But now they appeared inadequate to the task of handling the "fat-tails" and "black swans" of extreme market events. These crashes were also occurring far more often than predicted by these theories.

Dr Paul Kaplan, quantitative research director for Morningstar Europe, a provider of independent investment research and management services, , presented several important innovations to address the limitations of Markowitz's MPT at SMU's Centre for Financial Econometrics seminar, which he termed "Markowitz 2.0".

The MPT or mean-variance optimisation (MVO) involves estimating expected returns and correlations between the various asset classes, with standard deviation of returns as the numeric representation of risk. Feeding these data into an optimiser, a mean-variance efficient frontier or curve is formed, with each point on the curve representing a combination of asset classes that maximises returns per unit of risk.

It generally led to a conclusion that a sound investment strategy requires diversification among asset classes, since there was an imperfect correlation between them. By diversifying between imperfectly correlated asset classes, risk can be reduced for a given level of returns, hence maximising or optimising the "mean-variance".

Rebalancing between the asset classes should also be done regularly to restore the designated weight for each of these classes as their values change with the market conditions.

While the historical record does indicate the soundness of this approach, there was widespread disappointment among investors in 2008, when the increased correlation of global equity markets during the downturn made even the most rabid of buy-and-hold investors question the wisdom of the diversification dogma.

At the tail end

Kaplan is of the view that the portfolio optimisation models used by the industry today has not kept pace with advancements in technology and market developments.

Many commentators would refer to the events of 2008 as a 'black swan' – a term made famous by Oxford University professor Nassim Nicholas Taleb to mean a highly improbable event that happens anyway. Kaplan suggested that 2008 was not so much a black swan but a “black turkey”, defined by Laurence B. Siegal, research director of the Research Foundation of CFA Institute, as “an event that is everywhere in the data – it happens all the time – but to which one is wilfully blind.”

For instance, in 1929, the Dow Jones industrial average fell 89 per cent from peak to trough. If that appeared to be too long ago, Kaplan reminded the audience that Japanese stocks’ long decline only ended recently, having lasted 19 years beginning in 1990. They fell 82 per cent. The technology bubble at the start of the new millennia was another recent case, with the Nasdaq composite crashing 78 per cent from 2000 to 2002.

“Markowitz’s model is limited as it cannot model fat tails,” said Kaplan. Such black turkeys are certainly not as rare as the lognormal bell curve distribution, typically used to model asset returns in MPT, would suggest. This lognormal bell curve distribution simply does not adequately describe the return distributions of the various asset classes, with some assets exhibiting skews while others exhibit kurtosis, or skinnier or fatter tails.

The lognormal distribution generally considers “tame randomness”, for example the average weight of a large random sample of people. Even if a sumo wrestler was introduced into the sample, the average weight does not increase significantly, since he is only several standard deviations higher than the average weight.

“Wild randomness” is more akin to average wealth, where the wealthiest person known is many standard deviations wealthier than the average. Financial markets exhibit wild randomness and hence a statistical distribution such as the log-TLF can be used as a more suitable statistical distribution since it has fat tails.

“Tail events have occurred often throughout the history of capital markets all over the world. Hence it is important for asset-allocation models to assign nontrivial probabilities to them,” explained Kaplan.

A scenario based approach where Monte Carlo simulation or historical data can also be used to construct a suitable distribution to capture the fat tails. Smoothing techniques can be used to retain the properties of the uneven distribution, while bringing all the power of continuous mathematics to its analysis.

Counting the returns

Another criticism of Markowitz’s original theory is that covariances between the returns of the asset classes are assumed to be linear. The result is a single number, the correlation coefficient which conveniently and sufficiently represents the covariation of the assets. It is however unable to accommodate the non-linearity of option returns. Besides, during extreme market upheavals, previously lowly correlated asset classes experience a significant increase in their correlation.

Clearly, correlation is not a static concept as envisioned by Markowitz. “For example, during normal times, non-US equities are considered to be good diversifiers for US equity investors. But during global crises, all major equity markets move down together,” Kaplan added. Scenario-based models can be used to handle these non-linear and non-static relationships, overcoming this deficiency in Markowitz 1.0.

The traditional Markowitz MVO is based on a single period investment horizon and it employs the arithmetic mean as the parameter for investment returns. Investors, however, would be more concerned with the accumulation of wealth over multiple time periods.

Geometric mean is hence more suited for the task of measuring reward. This performance metric can guide investors looking to repeatedly reinvest over a long period to seek the strategy that gives the highest rate of return as measured by the geometric mean.

Volatility, or the dispersion of returns as measured by standard deviation, is used as the measure of risk in Markowitz 1.0. However, since investors are more focused on wealth protection rather than dispersion, Kaplan advocated the use of 'Conditional Value at Risk' (CVaR) as a measure, in place of standard deviation.

While Value at Risk (VaR) describes the left tail in terms of a minimum amount of money that can be lost in a given period of time, CVaR is the expected or average loss of capital once VaR is exceeded, that is, the probability weighted return of the entire tail.

Such enhancements to Markowitz's theory might enhance asset allocation practices for the industry. However, scenario-based approaches require vast amounts of computational power, generate massive volumes of data, and are generally expensive and prohibitive to use.

Nevertheless, advancements in computer technology has made the manipulation of thousands of scenarios now possible. Data management techniques such as Distribution String (DIST) can also encapsulate thousands of trials as a single data element, lowering the computational demands.

With such techniques and technology at hand, users can "interactively explore different portfolios, distributional assumptions and potential black swans."

These enhancements, Kaplan suggest, build on the framework of Markowitz's mean-variance optimisation. Efficient frontiers in Markowitz 2.0 are formed using geometric means and Conditional Value at Risk, incorporating scenario-based approaches to covariance and applying new statistical technology.

Kaplan expects that this new type of efficient frontier can better demonstrate to investors the trade-off between risk and reward, and the long-term potential growth versus short-term potential loss.