Future Projections of Modern Portfolio Theory

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Good evening everyone. It's a pleasure to be here.

Harry, Bill Sharpe once said about you: "Ordinary people think about problems; extraordinary people think about how to think about problems." That aspect of your intellect is what makes my task tonight—to discuss the future of Modern Portfolio Theory—so pleasurable and, frankly, so easy. Because Modern Portfolio Theory is not simply a solution to a problem. It is a revolutionary way of thinking about the problem of investment uncertainty. From it evolved the vast field of quantitative finance that has produced extraordinary innovations for more than fifty years. And it will continue to do so for generations. The pace of innovations based on MPT has not slowed. I'll give you an example I'm partial to.

In the past few years, my partner Ken Levy and I turned to MPT to tackle a problem that has long concerned us--the impact of financial leverage, not only at the macro level, where it was a major contributor to the recent global financial crisis and other crises before it, but also at the portfolio level. Leverage, whether stemming from outright borrowing, from the use of derivatives, or from shorting, can magnify a portfolio's volatility. Harry's mean-variance optimization model takes into account portfolio volatility.

However, Ken and I started thinking about other risks of leverage that are not captured by MPT. Most significantly, there is the risk of margin calls, which requires the sale of portfolio holdings, if additional capital is not provided. These forced liquidations are often at "fire sale" prices. We refer to these risks as the "unique risks of leverage." Not only are these risks for leveraged investors, but also for the market overall as the forced selling can have contagious effects.

In order to limit portfolio leverage, investors often adopt the classic solution of incorporating a leverage constraint in portfolio optimization. Harry himself outlined methods for doing so in 1959. But constraints cannot solve the whole problem. An investor can determine the portfolio that is optimal for a given level of constraint, but which level of constraint is optimal? Mean-variance optimization takes into account the tradeoff between expected return and volatility risk, but investors need a method to take into account the tradeoffs between expected return, volatility risk, and leverage risk.

In a series of articles starting in 2013, we proposed adding to the MPT utility function a term that captures aversion to the unique risks of leverage. Just as an investor averse to volatility risk will give up some expected return in exchange for a lower volatility, an investor averse to leverage risk will give up some expected return in exchange for less exposure to the unique risks of leverage.

The resulting mean-variance-leverage optimization model allows the investor to consider the effects of volatility risk *and* leverage risk and provides a straightforward approach to selecting optimal portfolios. In general, use of a mean-variance-leverage model will provide optimal portfolios with more modest leverage levels than those based on the mean-variance model.

In response, Harry suggested an alternative solution--the development of a stochastic margin call model. I needn't delve into the details of the comparison of these two models, because they are discussed elsewhere, but the important point is that increased awareness and consideration of leverage risks in portfolio formation can only have salutary effects for the market and economy.

And so MPT continues to evolve; and so does another approach that Harry pioneered: simulation models. His contributions here again demonstrate how he is a master at "thinking about how to think about problems."

Back in the 1950s, Harry was working at the RAND Corporation building models to analyze industrial activity. He soon realized that analytical solutions and linear programming were just not capable of dealing with the complexities of real-world manufacturing processes. Simulation techniques, he thought, might provide a better approach. One problem, however, was that a language for programming complex simulation models didn't exist.

People who know Harry well, know that he likes nothing better than to find a challenging technical problem to solve—the more difficult, the better. While he is a Nobel Laureate in economics, he once said that he sees himself as “more of an operations research kind of guy.” So Harry went on to create a simulation programming language—SIMSCRIPT.

In the early 2000s, Harry, Ken, and I discussed the idea of collaborating on the design of a financial market simulator. At the time, most financial market models were continuous-time models that allowed for analytical solutions. What these models can’t do is model markets in which changes in regulations or in the composition of market participants change the price process. Nor can continuous-time models tell us whether the behavior of individual financial agents and market mechanisms aggregates to the observed market behavior.

The Jacobs Levy Markowitz market simulator, JLMSim, by contrast, is an asynchronous-time simulator, which allows changes to unfold in an irregular fashion as the result of the actions and characteristics of participants and of the system itself. Market prices result from market participants trading in order to maximize their own individual utility. Price changes may be discontinuous, gapping up or down in reaction to events.

We found that with the right mix of value and momentum investors, the market would be stable, but if there were too many momentum investors, prices could increase explosively.

We also found that flash crashes, similar to those we’ve seen lately, can occur when traders are not “anchored” to recent price levels.

Like Harry, Ken and I believe that an asynchronous-time model like JLMSim is better able than continuous-time models to capture the reality of financial markets. Since we made JLMSim available on our website, it has been used by researchers in more than 70 countries.

Before our collaboration with Harry on JLMSim in the 1990s, he developed a financial decision-making simulator for individuals. Harry’s “Game of Life” model would, ideally, allow users to lay out their own savings, investment, and consumption goals, based on their own incomes, savings, education and skill sets, health, et cetera. A streamlined version of this “game” is incorporated in several products now available to help individuals plan their retirement finances.

I am especially pleased that Harry’s groundbreaking efforts in the field of retirement planning earned him the inaugural Wharton-Jacobs Levy Prize for Quantitative Financial

Innovation in 2013. The prize, which is awarded by the Jacobs Levy Equity Management Center for Quantitative Financial Research at the Wharton School, recognizes individuals who have undertaken outstanding quantitative research that has contributed to an important innovation in the practice of finance.

Harry has always believed strongly that theories, including his own, are improved by incorporating the innovations of others. That is why I feel confident in predicting that many future generations of researchers will benefit from his insights. A wise man once wrote, and I quote: “One measure of one’s success in achieving a useful understanding and techniques for rational action is to have theory and techniques tried, accepted and endure.” The wise man who wrote those words was you, Harry, and although you are too modest to apply those words to yourself, the rest of us are bound by no such constraint. We salute you for your many contributions, past, present, and, yes, future, because your contributions continue and your monumental body of work will endure.

Harry, it’s been our pleasure to collaborate with you for many years and we look forward to many more.