Harry M. Markowitz on Modern Portfolio Theory, the Efficient Frontier, and His Life's Work

by Amy E. Buttell

Who: Harry M. Markowitz, Ph.D.
What: Winner of the Nobel Prize with Miller and Sharpe for their pioneering work in the theory of financial economics. Also adjunct professor of finance, UC San Diego and author of *Portfolio Selection: Efficient Diversification of Investments.*
What's on his mind: "My basic assumption is that the capitalist system will survive. And on the average, over the long run, equities will outperform fixed income. And you should put a reasonable combination of equities and fixed income, and a little cash, in your portfolio, and not be too greedy, and you'll be okay."

Ask Harry Markowitz what he considers his primary field and he replies, without hesitation, "Basically, I think I'm a philosopher. I'm certainly not a finance person." Quite a statement for a man who was commended by the Royal Swedish Academy of Sciences for his "pioneering work in the theory of financial economics." Examining his body of work, Markowitz says, "I've said that I'm an operational research person in finance and sparse matrices and simulation and applications."

As a high school student, he read science and delved into philosophy, eventually reading Descartes and Hume, whose books he still recommends to students and anyone searching for more information about knowledge and philosophy. The study of philosophy laid the groundwork for his studies in economics and finance that led him to develop modern portfolio theory. "This business of what we know and how do we know it really was good preparation for going into portfolio theory, which is sort of a practical application of the theory of rational decision making under uncertainty," he says.

Markowitz developed modern portfolio theory while a doctoral student at the University of Chicago, where he also received his undergraduate degree. While at Chicago, he studied under Milton Friedman, Tjalling Koopmans, Jacob Marschak, and Leonard Savage. He started working at the Rand Corporation in 1952, where he encountered George Dantzig, who helped him with his research into optimization techniques. In 1955, he finished his thesis and flew back to Chicago to defend it, which led to one of the most interesting moments of his life.

"I remember landing at Midway Airport thinking, 'Well, I know this field cold. Not even Milton Friedman will give me a hard time.' And, five minutes into the session, he says, 'Harry, I read your dissertation. I don't see any problems with the math, but this is not a dissertation in economics. We can't give you a Ph.D. in economics for a dissertation that isn't about economics.' And for most of the rest of the hour and a half, he was explaining why I wasn't going to get a Ph.D. At one point, he said, 'Harry, you have a problem. It's not economics. It's not mathematics. It's not business administration.' And the head of my committee, Jacob Marschak, shook his head, and said, 'It's not literature.'

"So we went on with that for a while and then they sent me out in the hall. About five minutes later Marschak came

out and said, 'Congratulations, Dr. Markowitz.' So, Friedman was pulling my leg. At the time, my palms were sweating, but as it turned out, he was pulling my leg," Markowitz continues.

Over the years, Markowitz's work has ranged widely. He was instrumental in developing SIMSCRIPT, a simulation programming language that is used for building simulation models. The current version is SIMSCRIPT 3. "You don't hear about it very often because the outfit that owns it, CACI, they have a very few large clients that they charge a lot to use it," he says. "It's not the sort of thing the average guy picks up for his PC. The Army, Navy, Raytheon, the Atomic Energy Commission, companies and agencies like that use it for big, war-game kind of simulation models. That's my intellectual product."

Markowitz's other pioneering work came in the field of sparse matrices, which shows "how to solve very large systems of equations where most of the co-efficients are zero, so that the non-zeros are sparse. The Markowitz Rule, as it's called, is used in big linear programming application now," he says. In 1989, the year before he earned the Nobel, Markowitz received the John von Neumann Theory Prize from the Operational Research Society of America—now the Institute for Operations Research and the Management Sciences or INFORMS—for his work in those three areas: modern portfolio theory, sparse matrix methods, and SIMSCRIPT.

At age 82, Markowitz has no intention of slowing down or retiring. He works three days a week—one day a week he teaches MBA students at the University of California at San Diego, the second day he gives video conference lectures, and the third day he works for consulting clients. "I love teaching," he says. "I have friends who keep telling me that I should retire, and I can't. I'm just having too much fun. And I want to have an income stream, because I've got four offices and three of them have bookcases in them. What would I do with all my books if I closed them down?"

Still an avid reader, Markowitz is currently reading *Quantum Physics of Atoms, Molecules, Solids Nuclei and Particles* (Second Edition) by Robert Eisberg and Robert Resnick. He's on page 645, and reads that tome for half an hour a day. Next on the list? *Principals of Neuroscience*. He and his wife also listen to audiobooks, and a recent favorite was a series of lectures on the human brain from The Teaching Company.

We talked with Markowitz about modern portfolio theory, the financial crisis, and the influence of his theories on investing.

1 *Modern portfolio theory has taken a lot of heat because of the way the market behaved in the financial crisis. But, surveys of Financial Planning Association members suggest that most devotees remain quite loyal. Would you say the reports of its demise were exaggerated?*

Oh, grossly. In fact, it proved itself in the crisis rather than disproved itself. Let me give you an example. There's a simplified model of covariance, a simplified model of portfolio theory that Bill Sharpe published in 1963 that said, "Things go up and down, you know, just assume that things go up and down together because they go up and down with the market. But, the amount that they go up varies from one asset class to another, depending on their beta."

So, the way they measure these things, the S&P 500 has a beta of one but the bonds have a much lower beta and emerging markets has a much higher beta. So, in 2008, the S&P 500 went down 38½ percent. Corporate bonds went down about 5 percent. Emerging markets went down about 60 percent. So, as things went up and down, roughly in proportion to their beta and people who had done a risk-return analysis and picked a portfolio high on the efficient frontier with a high beta, they got hammered a lot. But, on the average, over the long run, they should do better than the guys who are lower on the frontier, who got hammered less.

Talking Point

Speaking with Clients About Risk

Markowitz believes that financial planners need to make sure they fully disclose the risks involved to clients when constructing a portfolio. "At my firm, Guided Choice, we do a Monte Carlo simulation to show clients what the probability is of achieving retirement savings and spending goals, depending on the risk of a particular portfolio," he says. "Portfolios that are high on the efficient frontier will have higher return potential, but higher risk."

- Have you changed how you talk to your clients about risk following the financial crisis?
- What do you do to make sure clients fully grasp the potential for risk in their chosen investments?
- Is there more that financial planners can do to ensure their clients understand risk?

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So, there was a risk-return tradeoff and things worked out, in accord to the beta of your portfolio. Things worked out as one would have anticipated.

2 *So either people didn't understand the theory or were overly optimistic?*

Well, one of the things that an adviser should do, one of the things we do at the Guided Choice, is to help clients understand volatility. There is more volatility for portfolios high on the frontier and less volatility for portfolios low on the frontier. And that's the way it worked out.

> "… the lesson is sometimes you make more than average, and sometimes you make less than average. And when you make more than average, you should not spend it. You should accumulate it."

Now, the S&P 500, its move in 2008 was roughly a two and half standard deviation move. Moves to the bad side of two standard deviations or more should happen 2½ percent of the time. So exceeding two standard deviations on the downside, that's a once-in-40-years phenomenon. And when that happens, what's going to happen to you depends on whether you've got a high-risk portfolio or a low-risk portfolio.

3 *Given your theories on efficient portfolios, diversified holdings to lower overall risks, what would you say a successful portfolio looked like in 2008–2009?*

Let me take as an example one of the most successful portfolios around in the long run, which is the Yale Endowment portfolio—the David Swensen portfolio. He said, "Well, it got hammered because it's heavily in equities and things like that. We are in for the long run. We expect to get hammered for now."

When we talked on the phone, I reminded him that a year or two before, he had been in front of some congressional committee, which was telling Yale and Harvard that they should spend more. So the lesson is sometimes you make more than average, and sometimes you make less than average. And when you make more than average, you should not spend it. You should accumulate it.

On average, you should spend a little less than what you make. So, you know, just because a portfolio did poorly in 2008, as long as that was in line with its estimated volatility, then, that was perfectly acceptable performance for that portfolio.

4 *What advances do you think we might see in coming years in terms of portfolio modeling and theory? I'm wondering if there's any work in progress, including any that you might be involved in, that you're following, or you think might be interesting or promising.*

Well, there's plain vanilla portfolio theory, and then there is this fancy financial engineering kind of stuff. And, some of these … sophisticated, financially engineered things got hammered, really. I mean, it wasn't that they had a big loss, they just self-destructed.

And so, I would hope that the folks that do those kinds of things will rethink model risk, as well as parameter risk. But, for plain vanilla mean-variance, it worked just fine. It wasn't broken, so don't try to fix it.

5 *Is that why a lot of those things blew up?*

There were kinds of hedges, instruments or combinations of instruments where, if you did not have a two standard deviation or a two and a half standard deviation move, then you would make some money. But if you went beyond certain borders, then you lost a lot of money. Then there were these financially engineered products, which were highly leveraged.

You take a mortgage and if you put no money down on a mortgage, you're already instantly leveraged. You put that into a CMO (collateralized mortgage obligation) and you add leverage and then you slice it into tranches and you take some of these tranches and send it to CDOs (collateralized debt obligation), which involves even more leverage, then on top of that, companies get CDS (credit default swaps) to insure that. Well, those are built on calculations of what can happen. This is the difference between plain vanilla portfolio risk versus the fancy financial engineering type of risk.

So, let's take the typical application of modern portfolio theory. Let's suppose somebody ends up on the frontier, roughly, with a 60 percent stocks, 40 percent bond mix. They're a couple getting close to retirement. They have $600,000 of equities, and $400,000 of bonds between corporate and Treasuries.

Treasuries went up, corporate went down, so the bonds held roughly themselves, you know, their own. The equities went down, as I said, two and a half standard deviations. They went down 38½ percent. So, the $600,000 became roughly a little less than $400,000 and the $400,000 of fixed income remained $400,000.

So, this couple, instead of having a million dollars, they had $800,000, and, you know, that was too bad. So, maybe they won't be able to retire or buy the house in Florida or something like that. Compare that situation to a financial engineering situation where something completely self-destructed—a situation where people assumed that for an extra few basis points over the risk-free rate, they went into instruments that seemed to pay off, but then, they became very illiquid all of a sudden and they had big problems. Or, at

least with credit default swaps, all of them went bad because they're correlated risks and they didn't have enough backing behind [them].

So, as I said, just plain old-fashioned vanilla portfolio theory may have done a little worse than you would expect usually because it was a two and a half standard deviation move, not just a two standard deviation. So, that's where the extra little bit of the deviation [that] is a little bit bigger than you counted on made a little bit of a difference to you, as compared to people who did fine calculations, which, if they had worked out, would have made them some money. But, because they didn't work out, they just self-destructed.

6 *From where you stand, what were the causes of the financial crisis?*

There are two heavies in this story. One is Congress, pushing homeownership through Freddie Mac and Fannie Mae so that people who really shouldn't own homes were able to buy them. Two is the disconnect between who initiated, who wrote, and who sold the mortgages.

Then, the people who bought those mortgages and held them and there wasn't anybody retaining the risk, and of course, the people who bought these mortgages, these pools relied on the rating services.

The rating services did a lousy job. The rating services were good at valuing some securities, but they were lousy at valuing these new instruments, which were very complex. So, complexity is a danger.

7 *At what point do you decide that something's too complex, that it's too dangerous to invest in?*

If you do not understand it, don't touch it. So, anything where you don't understand, where you're getting a few extra basis points on the assumption that some market will remain liquid, or on the assumption that you'll stay between plus or minus two standard deviations or anything like that, or you don't know what the assumptions are, just avoid it.

8 *Do you think that anybody's ever going to be able to come up with models that are going to be more predictive of markets?*

No. The world is too uncertain. Somebody sent me a histogram of stock market returns from 1825 to the present. And it looked like a nice bell-shaped curve and 2008 fit in close to the bottom, but not at the bottom. It filled in a little dent that was down at the bottom. The distribution was just waiting for that year. Every 100 years, if two and half standard deviations is not a once-in-40-years occurrence, but a once-in-100-years, well, these things happen.

9 *When you came up with the ideas behind modern portfolio theory, did you have any idea of how they would ultimately affect the way institutions and individuals invest?*

No. I had no idea. My reaction was, when the insight happened, I said to myself, "This will get me a Ph.D. dissertation." And, I expected I would be able to persuade people to use it. But, the thought that there would be millions of dollars no—trillions of dollars, I understand—managed this way, never struck me.

When the three of us got the Nobel Prize, when Markowitz, Sharpe, and Miller got the prize, the American Finance Association was meeting in Washington, D.C., and they wanted all of us to come. I was in Japan. I flew to Washington, D.C., at their expense, my wife and I. There was a dinner and nice things were said, but then I left the room for a few minutes and a guy came up to me and he said, "Thank you, Dr. Markowitz, for inventing the field in which I make a living and many others make a living." And, that's very pleasing.

10 *Are there any ways that your understanding of the behavior of portfolios has grown and changed over time?*

There are a couple of things that are new since the theory came out. In the first place, the notion of doing a top-down analysis, first in terms of asset classes and parceling this out, that made portfolio theory, that enabled lots of financial analysts, financial advisers, able to do a good job for their clients. People who have no more ability to pick stocks than I have are now able to do a risk-return analysis at an asset class level, and they get you on the right part of the frontier. Then, they implement it in terms of mutual funds or ETFs. That was a stroke of genius.

And then, there's data like Ibbotson data. There are models of covariance like Barrows and so on. So, it isn't just me and the 1959 book—that was the mathematics of efficiency. But, the notion of asset allocation—I'll tell you what, I finally understood what I did at a conference that Peter Bernstein was attending. Peter said, "You folks don't know the haphazard way in which portfolios were constructed before portfolio theory really kicked in." And, he described this haphazard way and he said, "Now, you have a process."

I said to myself, "That's it. He's right. Now, I understand what I started." The process is not just Markowitz 1959, it's Gary Brinson and Ibbotson and so on.

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