

Building the Perfect Stock Portfolio

What Happens Next - 10.21.2022

Larry Bernstein:

Welcome to What Happens Next. My name is Larry Bernstein.

What Happens Next is a podcast which covers economics, finance, history, science and politics. Today's session will be Designing the Perfect Portfolio.

Today's podcast was recorded previously at Stanford at an event to honor my old boss and close friend Myron Scholes who won the Nobel Prize in Economics.

Our first speaker will be Andy Lo who is a Finance Professor at MIT, and he will discuss his book *In Pursuit of the Perfect Portfolio*. Andy interviewed a dozen leaders in academic finance and top practitioners about how to design a portfolio balancing risk and reward by maximizing diversification.

Our second speaker will be Jonathan Levin who is the Dean of Stanford's Graduate Business School. Jon will explain how Myron Scholes' ideas have shaped academic research in finance and how his models have been applied by investment professionals.

Our third speaker is Victor Haghani. Vic and I worked together at Salomon Brothers before he left to be one of the founding partners at Long-Term Capital Management. Vic will answer the question, how much should you gamble when you have an excellent investment. Vic's ideas are very important, because most of us focus on what to invest in and spend little time wondering how big to bet? And whether to increase or decrease the wager when uncertainty and volatility increases or decreases over time.

Our fourth speaker is my good friend Bruce Tuckman who teaches at NYU's Stern Business School and is the former Chief Economist of the CFTC. Bruce will discuss the benefits that derivatives like interest rate swaps and commodity futures provide hedgers and investors.

Our final speaker today will be Myron Scholes who will discuss the best ways to adjust your portfolio if you are concerned about ESG. Some market participants who are concerned about carbon emissions are selling shares in their polluters, but Myron thinks that investment managers should first optimize the portfolio and then buy carbon credits to maximize returns while minimizing carbon in the environment.

Buckle up.

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Ok, let's start today's session with Andy Lo.

Andy Lo:

It's an incredible honor for me to be part of Myron's 80th birthday celebration.

The topic that I'm going to focus on is this book in Pursuit of the Perfect Portfolio. Larry, thank you for assigning so many chapters. I felt quite bad because you guys had a lot of homework, but I'm going to treat you like I treat my MBA students and I'm going to assume that only 10% of you have done the readings for the class.

The book began as a very thinly veiled hero worship. My co-author, Steve Forster and I, both taught investments over the years. Luminaries that have inspired us in our research, and so we decided, why not ask them, what a perfect portfolio is.

We ended up collecting these wonderful interviews. Everybody that's featuring in the book, we've interviewed on video. There are YouTube videos that you can see. And we were thrilled that we got such diversity of opinions about what the perfect portfolio is.

There isn't a single perfect portfolio. This is meant to capture a summary of the different perspectives and bring it down to the level of a non-MBA, non-finance, individual to be able to make use of these ideas.

Larry Bernstein:

Today's discussion is part of the Myron Scholes' Celebration Day. What do you think were Myron's major contributions to the field of finance?

Andy Lo:

Myron's impact, it's been extraordinary. Everybody understands the impact of Black-Scholes, but my first exposure to his work had nothing to do with options. It was the CAPM, the Black, Jensen and Scholes. Through that paper I realized that taking a serious statistical and economic approach to financial data could tell you about how asset prices are related. It had some deep ideas about the underlying statistics that were not couched in mathematics. They were couched in economics.

The second paper that I read of Myron's was by Scholes and Williams about how you can get predictability in asset returns that aren't there. It's a figment of the way that prices are recorded, the fact that certain prices close at 3:00 pm and other prices close at 4:00 pm. Now, it may seem strange that Myron would think about these kinds of esoteric issues. It turns out they're not so esoteric when you look at the implications from a trading or an investment point of view. I discovered later that Myron was the head of CRSP for seven or eight years.

Larry Bernstein:

CRSP is the Center for Research in Security Prices.

Andy Lo:

I would argue that CRSP is really the beginning of big data in finance that ability to put together all the data sets to allow us to do research. It changed the way I thought about finance, and it

convinced me that combining econometrics and finance was a reasonable career pursuit. I have Myron to thank for that.

Myron's background is firmly rooted in passive investing and efficient markets. Myron worked for John McQuown, often credited with the very first index fund. It was a \$5 million account for Samsonite's pension fund.

And that is really what got McQuown to start thinking about the index approach. And McQuown gives credit to Myron for that. At the very birthplace of passive index investing, Jack Bogle tells you to invest in cheap indexes and keep costs low. But that's not what Myron said. His focus was on risk. And his advice is that if you can manage risk carefully, you can add value. And the idea that risk is something which he calls volatility drag.

Compound returns are on average less than arithmetic returns. The more volatile an investment is, the bigger the gap between the arithmetic return and the compound return. Now why do you care about that? Well, because the amount of beer you get to buy is your compound return. And we care about compound return and volatility affects it.

I was at Queens College in New York, and there was an economics class that I decided to sit in on. And the instructor who was a graduate student gave an example of GDP, it's a hundred, and imagine that GDP goes down by 20%, so it goes down to 80. And then later, GDP goes up 20% from 80 and it goes up to 96. And a puzzled student in the class raised his hand and said, "Excuse me, professor, but why is it the case when you go down by 20% and then you go up by 20%, you don't get back to a hundred. And the TA scratched her head for a while, she did a few calculations on the board, and she said, "Well, economics is an inexact science, so don't worry about it <laugh>.

Larry Bernstein:

Just to make sure that everyone at home understands the point. The compounded return is multiplying $(1+r)*(1+r)$. In this case $(1.2)*.8$ which is .96 for a two period return of negative 4 percent. The average return for this example of +20% and -20% is zero. But the reality is that you lost money.

Andy Lo:

That example, which Myron used about the asymmetry between ups and downs is an instructive one because it says that when you have high volatility, you're not going to get back to a hundred. And you must be cognizant of that risk. That is very relevant for biotech stocks are among the most volatile out there. They have extraordinary binary risk. Either a clinical trial succeeds, or it fails. And I can promise you that nobody in the biotech world is thinking about volatility drag.

Larry Bernstein:

Here is a question from John Cochrane at Stanford's Hoover Institution:

John Cochrane:

Hedging individual risk. Investor owns a small business. The number one rule of investing is do not invest in your own company, beyond what you must own. Short it, if you can.

Don't invest in your own industry. Don't get a situation where you lose your job, and your portfolio goes down at the same time. That seems obvious but bringing that to practice has been very difficult.

Andy Lo:

Let's suppose we're talking about startups in the life sciences. They may have huge exposure to that sector, so they should take their assets and invest it in something else. Part of the reason that I think they don't is that they simply don't have time to focus on anything else.

For the entrepreneurs that I've talked to in the life sciences, when you're doing a startup, someone once said that it's like chaining yourself to a tiger. You go where their tiger goes, not the other way around. It's attention bias.

Most entrepreneurs don't have financial advisors, because they don't have a lot of financial wealth. They have paper wealth, but it's not liquid wealth and they can't do anything with it. Entrepreneurs don't get the idea of diversifying because it is counter to the scientific culture of knowing what you're doing and sticking to that.

Larry Bernstein:

Myron Scholes, do you want to add to that?

Myron Scholes:

Let's say you have a great opportunity, which is very significant, then you want to overconcentrate.

If you're building your portfolio in an efficient market, if you don't have skills, then the diversification is a much better route to take. You take account that the reward as well as the uncertainty and how it fits into the rest of your portfolio.

Larry Bernstein:

Here is another question from John Cochrane for Myron:

John Cochrane:

Slow moving capital and time varying risks. We know that at times like 2008, 2009, there were lots of people who were scared to death and selling like crazy. Other people recognize this buying opportunity, but who should be selling like crazy in a time like that? Who's able to buy bargains; they seem awfully reluctant to do it.

Myron Scholes:

We all have debts, and we have a portfolio. Some of us have responsibilities to our family, some responsibilities to retirement; that's a debt. We have levered portfolios and when the markets go down, we should liquidate to reduce our risks so that we create more time diversification.

And you don't want to end up with huge risk at one point and no risk at another point. So that means you need to have intermediaries to buy assets when there's rational sales by people who

are forced to reduce because their risk is increasing, and their assets are disappearing, and their liabilities are fixed. The very wealthy step in because they buy from the ones who need to liquidate.

Andy Lo:

One of the things that you suggest is to try to keep the volatility of your portfolio constant. Myron's talking about over time as volatility changes, you need to engage in asset allocation strategies to keep that volatility constant.

Traders have implemented stop-loss policies. Academics really don't think that they're useful, why is it that all of these practitioners use stop loss policies? It must be that their assumptions are different. And this is critical to Myron's observation, if you believe that asset returns the mean and the variance change over time, then engage in the stop loss.

And when volatility of an asset goes up for whatever reason, investors freak out and they take money out of that asset because they're not prepared for that volatility. As Myron pointed out, typically people are happy to take risk, but they want to know that the risk that they take is what they're getting. Now the risk goes up by double, what do you do? You take some of your bet off and those of you who are in prop trading, you know this because you're required to do it, you've got a limited risk budget and so the volatility doubles, you got to take half of that off, right? What does that do? That drives down the stock price.

And that means there's a negative correlation between risk and reward. And Myron's point about keeping volatility constant basically means that when volatility goes up, you're going to sell. When volatility goes down, you're going to buy. And so effectively you're basically selling when the expected risk premium is lower and you're buying when it's higher, that turns out to add value. You can simulate that exact strategy of keeping the S&P constant by using a dynamic asset allocation strategy. And you'll find that it yields a higher return than buy and hold.

Larry Bernstein:

The most common recommended portfolio for retail investors is typically 60% equities and 40% bonds. Does that make sense?

Andy Lo:

If you're a financial advisor and your bread and butter is making fees from retail investors, you have to be able to present things that they can understand. And 60/40, everybody can understand that. It's a first order approximation and it's a particularly bad one in my opinion.

Harry Markowitz, Bill Sharpe and Jack Bogle say that you ought to hold these indexes. They're not the best, but they're pretty good approximation and they're cheap and it's less likely that you're going to get taken to the cleaners by unscrupulous financial advisors. That advice is probably not a bad first order approximation if the idea is to keep it simple.

Larry Bernstein:

One of the surprises that you highlight in your book is that several of the most important and novel papers in finance struggled to get published. Myron Scholes' paper on option pricing, Bill Sharpe's article on CAPM, why were the great articles of finance challenged to get published?

Andy Lo:

I'm not an expert on the history of science, but my guess the more original it is, the harder it is to get published because what you're doing is going against the grain and focusing on something that most other people either don't agree with or don't understand. And it takes time for that to get accepted.

Larry Bernstein:

You interviewed 12 great finance theorists and practitioners, were there any common themes?

Andy Lo:

Taxes was the first thing out of everybody's mouth. The second was the only free lunch was diversification. Sharpe suggested that you diversify internationally. Harry Markowitz suggested that you consider different asset classes. Jeremy Siegel, throw some bonds in there. Marty Liebowitz was adding inflation protection.

For the masses, the idea was to keep it simple. Focus on the breadth of investment opportunities.

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Jonathan Levin:

First of all, Myron, thank you for the invitation to speak. When Myron asked me to come in and just say something on the occasion of his birthday, it caused me to spend time reflecting on the incredible impact that Myron has had on academic finance, on the practice of finance, on the his colleagues, on his friends, on everyone that he has touched.

And it is profound. There are few people in our line of work who've had that kind of impact on the world and on the people around them. I stumbled on this fantastic interview that he did a few years ago with Darrell Duffie. And if you have a chance, it's on Stanford's GSBs website. It is just a wonderful video. I wanted to share with you like three things that just came across so strongly in that video and inspired me. First, we talk a lot around here about the relationship between theory and practice, The idea that you develop theories so they will get out and change practice, and then you look at what's going on in practice because that's what gives questions for theory.

That's the feedback loop at the center of academic finance and, and really everything that we do in business schools. I think everybody appreciates, if you had to say what discovery has had a profound impact on practice, Black-Scholes would be at the top of absolutely everyone's list, or certainly in your top five. And what I had not appreciated how much there was a two-way loop there. One of the things that I learned in hearing Myron talk about his work and his career in this interview with Darrell was that first, he started working with Fischer Black doing consulting for Wells Fargo in the late 1960s to figure out passive portfolios.

It was a precursor basically to the portfolios Vanguard introduced in the mid-seventies, and got him working with, with Fischer Black. And the idea that motivation to start working on option pricing came from students. It came from his students at MIT in a program called the Sloan Fellows Program. There's only three of these programs in the world. We have one of them here at Stanford GSB. There's one at MIT and one in London. And the Sloan Fellows, students who are experienced professionals were writing theses about trying to use the capital asset pricing model to price options using actual data that they had for OTC markets. And it was an unsatisfying analysis because they were looking at terminal values and trying to discount them back, and it just wasn't working. And so he realized this is, this is not going to cut it.

And he got talking with Fischer, and it was that practical problem that he was facing that led to the theory that led to the profound change on practice. What a cool example for all of us academics to see how that dynamic works.

The second thing that I took from this interview was Myron's theory about how research advances. There is this popular conception of great research, great innovation, great discovery, that it happens like eureka moments, just lightning strikes and then suddenly, special relativity or whatever it is, these incredible breakthroughs. And if you look at the history of finance and you said, what would be an example of an eureka moment? Like you put Myron pretty, close to the top of that list as like candidate for Eureka, but it's hard to think of anything else that would quite rise to that level.

In the Black-Scholes, there is a eureka idea, which is that you think in small time increments and then you go forward to a terminal condition as opposed to starting at the end and trying to discount back. In truth, there is a eureka moment. But he says that's not actually how his discoveries worked, that his discoveries worked basically because there was like amalgamation of ideas at Chicago, at MIT at the time that he was getting involved in finance and there was a form of connectivity. People were putting ideas together and remixing ideas and things were just in the air. And that is such a powerful idea.

It really struck me, particularly after the experience we had in the last two and a half years where we were all isolated and you didn't get any of that.

Why is it that we're sitting in this room? Why is it that we have universities where people sit in buildings together and talk to each other and interact? It's precisely to foster that sense of connectivity that leads people to make big innovations and breakthroughs. And I just love that even if you took the most striking example of a eureka moment, it wasn't that it was connectivity. Okay, the last point that I would say about this interview that Myron gave was how strongly Myron's defining characteristic is his extraordinary intellectual curiosity.

Myron is just fascinated by ideas and his enthusiasm is electric; it's contagious. And I think everyone here has worked with him in different capacities, has gotten to experience that, admired it and envied it. And it's reflected in the format of this event, which is unusual for an 80th birthday party, to have a book club that seems to be organized like an academic seminar which is a special thing.

I really appreciate the chance to celebrate you and to have this event here at the GSB and admire you so much. Thanks for giving us this opportunity to do this.

Larry Bernstein:

Our next guest is Myron's old business partner and my very good friend Victor Haghani, who currently runs a wealth and investment advisory firm called Elm.

Victor Haghani:

I'm going to talk about a critical and under-appreciated aspect of investing. Investing involves two decisions: There's the what, and there's the how much. Nearly 100% of financial market commentary is dedicated to the "what to buy or sell" question, and in my opinion, not enough attention is paid to the "how much should I buy or sell" question. I'm going to explain why I think the "how much" question is so important, at least as important as "the what" question!

I can tell you from my experience as a founding partner of LTCM – you know, the hedge fund that had quite a wonderful beginning, but not such a wonderful end—that the how much decision can be critically important. You can get the what decision right, but if you get the how much decision wrong, you're out of business. On the other hand, you can get the "what" decision wrong, but if you get the "how much" one right, you're fine. And you carry on. At LTCM I think we got the 'what' decision largely right, but not so much with the 'how much' decision.

It turns out that I wasn't alone in under-appreciating the importance of the "how much" question. Seven years ago, we ran an experiment where we went to groups of financially sophisticated young people, both at universities and at banks, and we offered them to play a game where we gave them \$25, and they could flip a coin that was biased to land on heads with a 60% probability.

And after a half an hour of flipping the coin, they could keep however much money they had grown the \$25 into subject to a cap of \$250. You can play it on our Elm Wealth website if you want—there's a link to it in the upper right-hand corner of our research page. We get like a hundred people coming there each week to play it.

We published a paper on it, and the results were crazy. 25% of the people went bust. Only 20% reached the \$250 dollar cap. It seemed to us that these young financially trained people didn't really have a toolkit for how to think about it.

So how should we answer the question of how much? Well, one way that I like to answer the question of how much is to say that you should make your choice such that it maximizes your personal expected utility. In economics, "Utility" is a measure of the happiness or satisfaction. If you're like most people, the more wealth you have, the less of an increase in utility you get from each extra dollar of wealth, that is, you have a marginally decreasing utility of wealth. That makes you normal, and it makes you risk averse. Having a marginally increasing utility of wealth, that is, wanting more wealth the more you have of it, is usually viewed as an abnormality, maybe even as a sign of addiction!

The decision that maximizes your expected utility can be very different compared to the choice that maximizes your expected wealth. For instance, in the 60/40 biased coin flipping experiment that we did, the strategy that would maximize your expected wealth is to bet a hundred percent of your wealth on every flip of the coin. That's the wealth maximizing thing to do. It doesn't seem like it is, because you're almost definitely going to go bust. It's absurd. Nobody would do it. But that's the wealth maximizing thing to do, because there's a tiny probability of winning every flip and the expected wealth from that outcome is higher than the expected wealth from any other strategy you could follow. By contrast, we get a much more sensible result when we look for the decision that maximizes our Expected Utility. For people with typical levels of risk aversion, and we've done some experiments and surveys that give us an idea of what's typical, what maximizes your expected utility is betting something like 10% of your wealth on each flip.

I'm guessing that some of you will have heard of the Kelly criterion, a formula derived by John Kelly, a researcher at Bell Labs, in 1956, that determines the optimal size for a bet. The Kelly bet-size is found by maximizing the expected value of the logarithm of wealth, which is equivalent to maximizing the expected geometric growth rate of your wealth. Because the Kelly Criterion leads to higher wealth compared to any other strategy in the long run, and by long run I mean the very, very, long run, it is considered by some to be superior to the approach of maximizing expected utility. I view it more as simply a special case of Expected Utility maximization, and one which most people, who do not have an infinite horizon, find way too risky. In the case of a 60/40 biased coin, the Kelly bet would be to bet 20% of wealth on each flip of the coin, a sizing which we have found very few people would find optimal. That said, it still would have been a better approach to playing our experimental game than any strategy pursued by our 60 subjects.

Moving away from flipping a biased coin and a little more into the real world, the general answer to the question of how much risk to take is that it should depend on the expected return and risk of the investment being considered, and on your personal level of risk aversion. Under a stylized set of assumptions, a simple formula can be derived, which has become known as the Merton Share, in honor of Bob Merton who as far as I know was the first to derive it. The formula is: fraction of your wealth to invest in a risky asset is equal to the expected return of the risky investment above that of a safe investment, divided by the risk of the asset expressed as standard deviation of returns, but squared, and divided by your personal degree of risk aversion.

The formula will be more memorable if we take it for a spin, so let's see how it works for the case of a typical investor who is deciding how much of his portfolio to put in a stock market index fund and how much to put in a safe asset, like T-bills or tips. Let's say that he believes the expected return of stocks is 5% more per annum than the return on the safe alternative, and that he views the risk of stocks as being about 20% per year. For his personal risk aversion, we'll use a value of 2, which is the degree of risk aversion that would have him optimally betting 10% of his wealth on each flip of the 60/40 biased coin, that we started off discussing. Ok, we have all the numbers we need—so the fraction of his portfolio he should invest in stocks is equal to the excess expected return, 5% divided by the product of stock market risk of 20%, but squared so that's 0.2 times 0.2 or 0.04, and his personal degree of risk-aversion, which we have said is 2. So, we get 0.05 divided by 0.04 times 2, so that's 0.05 divided by 0.08, which is 62.5%. So, under these assumptions, this typical investor should want to have 62.5% of his portfolio in stocks and

37.5% in the safe asset. This just happens to be close to the typical 60/40 stock/bond allocation that has been so popular with investors over the years, but it's important to realize that this approach gives different answers as the expected return and risk of the stock market change over time, which they do. For example, what if stocks become 50% riskier, and so you believed that 30% was the right number to use for the prospective risk of the stock market? Let's also say that in this case stocks have already gone down in price, such that now you're thinking the expected excess return looking forward has increased from 5% to 6%. Well, applying the Merton share you'd get 0.06 divided by the product of 0.3 squared, which is 0.09, and the risk aversion parameter of 2, so that's 0.06 divided by 0.18, which is equal to 33%, a little more than half of the 62.5% allocation with return of 5% and risk of 20%.

This expected utility framework gets more powerful and useful when you start to apply it over many years of your lifetime, which is known as the problem of lifetime consumption and portfolio choice.

So, what kind of questions lend themselves to Expected Utility analysis? Well, any time where you're trading off expected money versus expected risk, and you need to put a price on risk, expected utility is the tool to reach for.

For instance, if you have a low basis asset that you don't really want to hold, but you also don't want to pay capital gains tax from selling it, how do you think about how much of that to liquidate? More generally, how do taxes affect your asset allocation, given, as Myron reminds us, that the government is our partner in profits but not losses.

What kind of investment approach makes more sense? Buy and hold, or a dynamic approach that you vary with changes in the expected excess return and risk of available investments? The expected utility perspective tells you that the dynamic approach makes more sense. What about options—do they make sense in your portfolio? What kind of and how much insurance makes sense to buy? House insurance, life insurance, health insurance? The decision to buy a home versus rent one can also be a risk versus return trade off. How much do you need to have in the bank to retire? How much can you spend in retirement? Should you buy an annuity?

How about bequest decisions? Giving money away sooner to your kids or to charities is good because it's growing and you're getting tax benefits sooner rather than later, but there's more risk to doing that.

Given the power, flexibility and logic of using Expected Utility to guide our decisions under uncertainty, you might be wondering why you haven't heard of these ideas from your financial advisor, or read about them in the WSJ? During the break, I was talking with David Krebs, a famous economics professor here at Stanford, who's a real expert on this whole area, and his take on expected utility was, "it's too complicated."

Then there's the behavioral finance crowd who say that's not the way people make decisions. But what we're concerned with and trying to figure out is: how should people make decisions? I and my colleagues have been trying to make these ideas accessible to people in practical ways through our work at Elm, a wealth advisor and investment manager I founded about 11 years

ago. We use low-cost index funds and ETFs, dynamically adjust portfolios to changing market conditions, and keep fees and taxes as low as possible.

I'm also writing-- with my business partner and Elm CEO James White-- a book that's going to come out hopefully early next year called *The Missing Billionaires: A Guide to Better Financial Decisions*, that's focused on this topic as well.

This expected utility perspective of making your financial choices to maximize the expected utility you get from spending and giving away your wealth over your lifetime is entirely consistent with the whole discussion we just enjoyed with Andy Lo about his book: "In search of the perfect portfolio." Expected utility tells us that you shouldn't expect the market to give you extra return without taking more risk.

It also agrees with Andy's conclusions that diversification matters, taxes matter, fees matter, and the long-term real spending power of our wealth matters. And Expected Utility also agrees with the main idea that Myron contributed to the *Perfect Portfolio* book: that size matters-- in the sense of how much risk is the right amount to take-- and sometimes size matters a lot!

Larry Bernstein:

Our next speaker is Bruce Tuckman. Bruce is the former Chief Economist of the Commodities Futures Trading Commission, he is also my former colleague in Salomon's fixed income proprietary trading department, and one of my closest friends.

Bruce Tuckman:

Well, it's Myron's weekend and Larry gave me six minutes, so I thought I would do six derivative myths in six minutes.

Myth number one, that derivatives are weapons of mass destruction invented in the last 50 years by evil geniuses like Myron. So, two things: One, derivatives have been around for extremely long time. We have evidence of forward contracts on wooden planks and on barley in 19th and 17th centuries BC. We have contracts for differences, which we call futures in Renaissance Europe. We have very active stock options market in 17th century Amsterdam. And we have in 19th century German books payoff diagrams for options like we see call options and spreads.

Secondly, derivatives are used for legitimate business purposes. Some of the applications I teach in my class, airlines using commodity futures to hedge the cost of jet fuel, pensions hedging their liabilities with swaps, life insurers investing using CDS instead of corporate bonds. Asset managers hedging foreign investments with FX futures. Structured products, which include equity options to limit losses. And the last thing I'll say about this myth, there's a study over the last 20 years, S&P 1500 companies, more than half used derivatives. From 20% of the smaller companies and 90% in the largest.

Myth number two, that derivatives played a major role in the financial crisis of 2008. That's not right in my view.

The crisis was a result of leverage, mostly in non-derivative mortgage products and mortgage-backed securities. Interest rate swaps and credit default swaps on corporates had nothing, no significant role in the crisis. It is true that CDS on mortgages did cause losses, but they were very small relative to the non-derivative losses. The only significant exception to this, AIG which wrote CDS, it sold protection on mortgage back securities. But I'd say this was not a large part of the crisis. First, AIG's failure was equally due to its securities lending business as to its CDS. Second, by the time AIG failed, we've already had Countrywide, Bear, Indie Mac, Fanny, Freddie, and Lehman. So, it's not like AIG could cause a crisis.

Myth number three, there are \$600 trillion of globally outstanding OTC derivatives.

This is on the Bank of International Settlements website that that's the size of that market. And it's just a wild exaggeration. When you buy a bond and sell a bond, you've got nothing left. But when you do over the counter derivatives, you usually take a position derivative, and then you cancel out the risk with a similar but not identical derivative. And all these statistics that you read in the newspapers just add up all these amounts and don't offset the risk. The CFTC we had all the data of everybody's swap transactions. If you look at the universe that we look at \$267 trillion notional amount of outstanding of interest rate swaps, if you count that correctly, falls to about \$18 trillion of five-year bond equivalents.

And if you think about that, the treasury market is \$25 trillion. The corporate bond market is \$15 trillion. So, it's a reasonably sized market.

Myth number four, banks use derivatives and interest rate swaps to take big bets on interest rates. So that's not right. If you look at the data of every bank's position, the interest rate risk that the banks have interest rate swaps is basically 0% of equity. It's really nothing. And half of interest rate swaps used by banks is to facilitate the customer loan business. So that's a big use of swaps for banks.

Myth number five, interest rate swaps are over the counter swaps are customized to meet client needs.

There's a big idea that the reason why we need over the counter markets and swaps as opposed to futures, which are so liquid and so easy to trade. Swaps are needed because they're customized for customers. And this is just not true.

The dealers have said this for a long time, and when they look at the data from 60 to 80% of IRS notional amount could be replaced in futures or standardized swaps. That's something we might want to think about.

Myth number six, that CCPs central counterparties basically eliminate systemic risk.

You've got a central counterparty, it stands between, you have derivative on one side, derivative of the other side, and instead of facing each other, you face the central counterparty.

So why is that not really eliminating all risk? First, we've really put our eggs in one basket, right? If you look at the London Clearing House, it's just enormous relative to any other CCP. We've got this one place we've really got to watch enormously, carefully. And secondly, I just want to tie it into what happened earlier this week in the UK with pension funds. It used to be before Dodd-Frank that a bank could make a decision, this is a safe counterparty. For example, I've got a pension fund. It's got liabilities, it has some core bonds that it receives fixed and swaps to hedge out liabilities. That pension funds is really safe. I'm not going to charge the margin. And that part of the derivative world in my view is very safe.

What happened earlier this week is that rates went up dramatically. When the value of the liabilities fall, the value of the assets fall. So that's good. The pensions are still hedged, but they've received fixed on swap. So, they now have a loss on their swap that they've got to make margin calls related to their swap contracts. But they're not getting any margin back from the pensioners when their liabilities are going down. So, in the guise of reducing counterparty risk in the system, we've introduced this liquidity risk that was big enough for the UK to have to intervene. That's it. Six minutes.

Larry Bernstein:

Bruce that was an incredible six-minute performance, and a model for the podcast.

Let's move to the man of the hour. My old boss and Nobel Prize winner Myron Scholes who will discuss how to make the optimal portfolio with a constraint to minimize carbon emissions.

Myron Scholes:

Thank you for your thoughts and explanations of your research interests. I obviously enjoyed John Levin's comments. The comments of Tuckman, Haghani, and Lo were wonderful. Andy mentioned the importance of empirical finance. As a young professor, I knew that the combination of theory and empirical research would make for a stronger finance research agenda than one alone. The same is true of the marriage of ideas from practice and academics. Ideas lead to new theories or augmentation of old theories. Empirical research tests theory and models and leads to new or augmented theory. Andy is correct that what that is what led me to spend time to reinvigorate the Center for Research and Security prices and build huge data files of stock price and accounting information that became so important to finance were the first big data proponents. The discussions augmented my belief that the dynamics of innovation is to make processes faster, more individualized, and more flexible under uncertainty. We move from a static hardwired hardware approach to a more flexible software approach that changes as we learn more through testing our models and approaches. This is the major force in finance.

I was going to discuss my paper written with my colleague, Ashwin Alenkar on Carbon Emissions and Asset Management. I will only have time to summarize its findings. Two major current approaches that portfolio managers use to be active in reducing CO2 emissions given the ESG movement in Europe and the United States, our first, exclude firms or underweight firms with poor ESG scores such as coal, oil and gas producers from their portfolios. The hope is that this increases the cost of capital to these firms by reducing their stock prices but not to a clear end result.

Engage with firms is the second approach and cajole them to the carbonize and reduce carbon emissions. Passive investment managers take this approach for they are constrained to stay at the benchmark, which includes carbon emitters. This approach has vague and uncertain outcomes. We propose and model a third approach. The portfolio manager optimizes the portfolio as usual to select investments to maximize the expected return of the portfolio for a given level of risk or given objective such as a passive objective, and then buy carbon credits to offset the carbon emissions of the companies in the portfolio. The portfolio is carbon-neutral and not the contents of the portfolio.

The market prices of carbon credits exist and are traded in an active secondary market. Market prices determine the cost to make the portfolio net carbon neutral. At today's prices to offset the carbon emission of the S&P 500 portfolio, such as the Vanguard ETF would cost about seven basis points. This is a known cost. For less developed market portfolios, the cost would be upwards to 35 basis points at current carbon credit prices. The portfolio manager would offer two portfolios in our view, one optimized, but without any carbon offsets at all, and the other, a clone that differs from the first portfolio and uses credits to entirely offset the carbon emissions of the common portfolio for a known cost. Investors then would choose a convex combination of these two spanning portfolios to satisfy their own utility or preferences as the decarbonization, given the cost of credit and the prices that they are willing to pay to reduce carbon emissions. This is the first best solution.

Firms move to decarbonize by producing their own carbon offsets called white carbon by changing production methods, inventions, et cetera. This takes time and it will not occur instantaneously. These new innovations are a growth engine for the global economy. Other firms might invest in producing offsets they sell as carbon credits to others by planting forests or expanding the use of plants in the ocean. Their green carbon and blue carbon credits that compete with white carbon in providing a reduction in the global CO₂ emission landscape. These credits sell in the over-the-counter credit markets. Although a young market, over 350 million metric tons of carbon credits were sold in the voluntary credit market in 2021 that theoretically would neutralize \$4.3 trillion investment in the S&P 500 portfolio. Although carbon credits are only a band-aid, as the transition to a greener economy moves ahead, it is a necessary band-aid that will slow down the bleeding and is a great alternative until we achieve our goal of carbon neutrality or decarbonization. When the price of carbon credits increases more credits are made, and companies are incentivized to move more quickly to decarbonize. Excluding firms is not costless or cost effective. Constraints are costly if they have value showing up in loss returns or increased portfolio volatility because of reduced diversification. The annual loss return in the S&P 500 ESG portfolio was over 1% a year, less than the unconstrained S&P 500 and with higher volatility. Exclusion is uncertain and no one benefits, and it is costly. Portfolio managers alternatively can build carbon neutral portfolios with no one costs. Because the market prices of carbon credits exist, they can assess and manage the credits that they acquire for their investors. Investors will know the costs and will assess their own benefits to reduce CO₂ emissions of their portfolios and do so cost effectively when compared to other alternatives. Why? Because carbon credits are priced in the market. This, in our view, is an alternative that should be considered by portfolio managers and has superior outcomes than either the current approach of excluding firms or cajoling managers to reduce carbon credits.

Larry Bernstein:

Thanks to Andy Lo, Jonathan Levin, Victor Haghani, Bruce Tuckman, and Myron Scholes for joining us today.

If you missed last week's session, please check it out.

Our speaker was Robert Sapolsky who is a Professor of Biology and Neurology at Stanford. Robert is the author of numerous books including *Why Zebra Don't Get Ulcers* and *Behave*.

Robert believes that you have no free will. Your behavior is dictated by a complex combination of factors that include your genes, hormones, glucose levels, the environment and epigenetic events. Robert argued that there is no little man in your head making decisions. It is a complex mess.

Our speaker next week will be Stanford economist Paul Oyer who will discuss his new book *An Economist Goes to the Game: How to Throw Away \$580 million and Other Surprising Insights from the Economics of Sports*. Paul will discuss which sports your kids should play. Why South Koreans dominate women's golf. And when should Michael Jordan take the last shot or pass the ball to another player?

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I would like to thank our audience for your continued engagement with these important issues, good-bye.