Portfolio Optimizers:
The Road to Financial Security or the Primrose Path?

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Richard D. Glass and Stan Marshall

Recently Charles Schwab aired an advertisement that portrayed a couple in their fifties explaining why they hired an investment advisor. Their reasoning was simple. Although investing is important, it is also boring and confusing. Since life is already sufficiently hectic, there is no reason to spend precious time learning about this dismal topic when you can hire a professional to do it for you.

That large numbers of participants invest blindly and need help in determining their asset allocations is widely accepted. A recent EBRI study[1] found that 45% of all workers have never determined their retirement income needs. John Hancock's Fifth Defined Contribution Plan Survey[2] showed just how little participants, even the college educated ones, know about investing. For example, 47% and 49% of the participants thought stocks and bonds could be found in money market funds respectively. Only 25% of the participants knew that the best time to transfer money into bond funds is when interest rates are expected to decrease.

Many plan sponsors believe that the vast majority of their 401(k) plan participants are unwilling to take the time to become knowledgeable about investing. This ignorance prevents participants from making informed asset allocation decisions and then monitoring their choices. These plan sponsors believe that participants want to be told how to invest their account balances. Companies that market asset allocation services to plan participants (with the endorsement of plan fiduciaries) have been formed to meet this perceived pent-up demand.

However, the fact that large institutional investors find value in hiring consultants to perform (and then explain) asset allocation studies does not necessarily mean participants will benefit from an apparently similar service. These services are based on mathematical models (portfolio optimizers), and, like any model, they have limitations. If participants don't understand these limitations (and they probably are not even aware that these limitations exist), they can easily misinterpret the results and overestimate the model's presumed predictive power.

The testimony to the limitations and uncertainties of optimizers came from Harry Markowitz himself when he discussed how he invests his retirement money:

> "I should have computed the historical covariances of the asset classes and drawn an efficient frontier. Instead, I visualized my grief if the stock market went way up and I wasn't in it—or if it went way down and I was completely in it. My intention was to minimize my future regret. So I split my contributions fifty-fifty between bonds and equities."[3]

Sophisticated institutional investors realize that optimizers are just another tool to be used in the process of developing an asset allocation. Unknowledgeable participants, on the other hand, will likely base their decisions solely on the recommendations without considering the very real possibility that the future will not be a rosy as the optimizer assumed it would be. This danger creates a fiduciary liability quagmire for the plan sponsor which appears to more than offset any benefit to the participants.

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[1] *1998 Retirement Confidence Survey* (Employee Benefit Research Institute).
[2] *Fifth Defined Contribution Plan Survey* (John Hancock Financial Services, 1997).
[3] As quoted in "Five Investing Lessons from America's Top Pension Fund" by Jason Zweig. *Money* (Jan. 1998).

Plan sponsors want their employees to have financially secure retirements. However, plan sponsors cannot change the fact that there is no "one-minute" answer to the question: How should I invest my money? Achieving retirement security requires the development and implementation of a sound investment strategy that includes monitoring the asset allocation on an ongoing basis. Participants must accept responsibility for their own retirement security. The only alternative is to hope to get lucky.

Before providing or making available asset allocation services to participants, plan fiduciaries must develop an understanding of what portfolio optimization models can and cannot do. Only by undertaking this intellectual exercise will the fiduciary gain the knowledge that will not only allow him to make an informed judgement as to the merits of offering such services, but also enable him to articulate his decision in a judicious fashion. The purpose of this article is to outline the issues surrounding the advisability of offering asset allocation services to participants.

Scientists develop models for several reasons. Model building enables scientists to formalize their understanding of what they have observed. They review observations, both their own and those of others, in order to create a story (i.e., the hypothesis or model) that incorporates and explains known data and apparent relationships. It is essential that the data used as the foundation for a model be reproducible and predictable. If scientists cannot agree on the observations and measurements that form the basis of a model, it is highly unlikely that the model will be taken seriously.

Once a model is constructed, scientists have the opportunity to assess both its robustness and shortcomings. One measure of robustness is the degree to which new observations fit into the model's framework. Another measure is the number of and type of exceptions to the model. The identification and analysis of exceptions is a valuable tool in the process of actually determining what is being observed and discovering if the model should be refined, drastically altered, or scraped altogether.

Another characteristic of a good model is its predictive value. If the system is disturbed or altered in a well-defined manner, a very specific outcome can often be foretold. Vaccinations are an example of this. Scientists, by understanding the immune response, have learned how to make effective vaccines to a wide variety of organisms. These vaccines protect practically all of us from everything from specific flu viruses to tetanus and polio.

Other models forecast a range of outcomes and assign, with a high degree of accuracy, specific probabilities to each of them. For example, if the genetic makeup of a couple is known, a geneticist can predict the likelihood that the couple's next child will be a boy with brown eyes and blond hair rather than a girl with green eyes and red hair.

Scientific models, then, attempt to describe physical and biological processes and structure from various perspectives--causal, static, and dynamic. Depending upon its degree of complexity, a model can attempt to explain what is there today, how it got there, and how it will evolve in the future. Models can also describe interrelationships with other objects or processes. Furthermore, the model can provide insights into how the subject under study can be modified so that its usefulness can be enhanced.

So what is portfolio optimization and how does it fit into the concept of scientific modeling just discussed? To begin with, portfolio optimization is a powerful tool for analyzing how the different asset classes can interact with each other. Given a specific set of input data (each utilized asset class's expected mean return and standard deviation and correlations between the different asset classes)

and constraints (limitations on amounts, if any, of each asset class) the optimizer will identify the most efficient portfolio among the universe of possible ones. "Most efficient portfolio" means the portfolio with the highest return for the level of risk specified or the portfolio with the lowest risk for the return specified.

Optimizers can generate a variety of reports including the likelihood that a portfolio will generate a specified minimum return, the magnitude of downside risk, the consequences of changing the constraints and/or adding or deleting asset classes. Portfolio optimization is an invaluable tool by which an investor can get an understanding of the investment process and the types of portfolios that may meet her needs. In fact, the mathematical nature of portfolio optimization appears to guarantee that all the requirements of a scientific model are met:

1. a very formal and thorough understanding of a set of relationships;
2. a tool for analyzing interrelationships;
3. the ability to ask and answer different questions;
4. the ability to make quantifiable predictions (as to portfolio returns and volatility).

A portfolio optimizer can indeed make detailed predictions. However, the optimizer's predictive ability must be broken down into two components: the optimizer's algorithms and the input data. For this section of the discussion, it is assumed that the algorithms (i.e., mathematical rules) underlying optimization models are sufficiently accurate to capture most real world situations. This statement simply means that the optimizer is an efficient number crunching machine--nothing more and nothing less.

(Scientific models are built so that they may be tested. If the model correctly describes a process, such as mixing chemicals A and B under a specified set of conditions, then the outcome of the reaction, chemical C, should be generated regardless of where in the world this process is done. In addition, chemists should be able to predict what products will be obtained if the conditions are changed and/or other chemical substances are mixed with A and B. Structuring models in this way allows the model itself to be tested. Unlike scientific models, however, portfolio optimizers have no predictive value in and of themselves. Their usefulness is their ability to manipulate data.)

A portfolio optimizer's worth to the average participant in a self-directed retirement plan, then, is its predictive value, and that is a function of the data it is crunching. The key questions are:

1. Will the future behavior of the asset classes have any correlation to the data that is inputted into the optimizer?
2. How much error in the input data (i.e., the difference in values of the projected versus actual means, standard deviations, and correlations) can the optimizer tolerate before its predictions become meaningless from a decision making perspective?

Unfortunately a major weakness of optimization models can be summarized by the old adage, "garbage in, garbage out."

Tables 1 and 2 show just how unreliable historical data can be when used to make predictions about future asset class returns. For example, Table 1 shows that for the ten year period from 1949 through 1958 (row two in the table), the S&P 500 had an annualized compound return of 20.06%. In the succeeding ten years (1959 through 1968, row three), however, the S&P 500 had a return of only half that amount (10.00%) representing a change in return of 10.6%. The last row of Table 1 shows the average magnitude of the changes in returns from each ten year period to the next.

Because timing (the length of the holding periods as well as the starting and ending years) can have an impact on studies like the one shown in Table 1, several similar studies were also done using different time periods. Tables 2a and 2b are a summary of these studies and clearly shows that the variation in returns from one period to the next can be observed regardless of the time period used.

Table 1: Annualized Compound Returns for Successive 10 Year Periods

Period	S&P 500	Ibbotson Small Stocks	Ibbotson Int.-term Govt Bonds	Ibbotson One Year Govt Bonds	T-bills
1939-1948	7.26%	18.57%	2.04%	0.69%	0.30%
1949-1958	20.06%	17.23%	1.61%	2.07%	1.68%
1959-1968	10.00%	20.73%	3.52%	4.49%	3.52%
1929-1978	3.16%	4.48%	6.47%	6.84%	5.94%
1979-1988	16.33%	18.93%	10.97%	10.40%	9.09%
1989-1998	19.19%	13.22%	8.74%	6.44%	5.29%
Average magnitude of change in return from one period to the next	9.15%	8.25%	2.40%	2.73%	2.52%

Source: *Stocks, Bonds, Bills, and Inflation 1999 Yearbook*. Ibbotson Associates, Chicago (annually updates work by Roger G. Ibbotson and Rex A. Sinquefield). Used with permission. All rights reserved.

For example, the results of the study shown in Table 1 can be seen in the first row in Table 2a. For the successive 10 year periods beginning in 1939 and ending in 1998 (1939-1948 followed by 1949-1958, etc.), the return of the S&P 500 changed an average of 9.15% from one period to the next. The second row of the table shows that for the successive 10 year periods beginning in 1938 and ending in 1997 (1938-1947 followed by 1948-1957, etc.), the return of the S&P 500 changed an average of 6.83% from one period to the next.

Table 2b shows that the effects seen for 10 year holding periods can also be observed for 5 year holding periods. The words of John Allen Paulos seems to adequately summarize the observations shown in Tables 1, 2a, and 2b: "Stock prices seem to obey the laws that govern random phenomena, so its fair to infer that maybe they're random."[4]

Plan fiduciaries must ask: Will the inputs the asset allocation service provider uses accurately reflect the investment environment of the future? If the portfolio optimizer's inputs represent the output of a lousy crystal ball, is there any value to the average plan participant in the recommendations generated? After all, the average participant wants advice, not a tool whose use requires an informed and sophisticated investor and/or the help of a highly paid consultant.

[4] Paulos, John Allen. "Pick a Number, Any Number." *Worth* (April 1995).

Table 2a:
Summary of Studies of Changes in Return Between Consecutive Ten-Year Time Periods

Period	Number of Successive Periods	Average Magnitude of Change in Annualized Compound Returns from One Ten Year Period to the Next: S&P 500	Ibbotson Small Stocks	Ibbotson Int.-term Govt Bonds	Ibbotson One Year Govt Bonds	T-bills
1939-1998	Six	9.15%	8.25%	2.40%	2.73%	2.52%
1938-1997	Six	6.83%	11.28%	2.33%	2.69%	2.54%
1937-1996	Six	6.89%	5.94%	2.67%	2.63%	2.52%
1936-1995	Six	6.65%	12.58%	2.30%	2.57%	2.47%
1935-1994	Six	7.52%	11.99%	1.85%	2.43%	2.35%
1934-1993	Six	5.52%	10.01%	2.43%	1.98%	2.16%
1933-1992	Six	5.53%	6.13%	2.35%	1.77%	1.96%
1932-1991	Six	6.56%	8.14%	2.89%	1.86%	1.54%
1931-1990	Six	5.62%	9.03%	2.71%	2.11%	1.65%
1930-1989	Six	8.92%	6.57%	2.76%	2.21%	1.72%

Source: *Stocks, Bonds, Bills, and Inflation 1999 Yearbook*. Ibbotson Associates, Chicago (annually updates work by Roger G. Ibbotson and Rex A. Sinquefield). Used with permission. All rights reserved.

Table 2b:
Summary of Studies of Changes in Return Between Consecutive Five-Year Time Periods

Period	Number of Successive Periods	Average Magnitude of Change in Annualized Compound Returns from One Five Year Period to the Next: S&P 500	Ibbotson Small Stocks	Ibbotson Int.-term Govt Bonds	Ibbotson One Year Govt Bonds	T-bills
1934-1998	Thirteen	6.17%	15.41%	1.86%	1.64%	1.43%
1933-1997	Thirteen	5.47%	14.18%	1.78%	1.48%	1.42%
1932-1996	Thirteen	8.37%	18.42%	3.14%	1.57%	1.28%
1931-1995	Thirteen	7.16%	20.24%	2.38%	1.89%	1.39%
1930-1994	Thirteen	8.42%	15.15%	2.54%	1.88%	1.50%

Source: *Stocks, Bonds, Bills, and Inflation 1999 Yearbook*. Ibbotson Associates, Chicago (annually updates work by Roger G. Ibbotson and Rex A. Sinquefield). Used with permission. All rights reserved.

To get a better handle on this issue, it is necessary to understand how institutional investors use portfolio optimization studies. To begin with, sophisticated investors recognize how difficult it is to estimate the future performance of the different asset classes over the next month, yet alone the next year or the next five years. They understand why articles with titles like *A D+ for the Dismal Scientists? Even the Fed's Gurus Often Goof*[5] and *Dismal Days for the Dismal Science*[6] are written. William A. Sherden has succinctly summed up the state of predicting investment returns:

[5] Koretz, Gene. "A D+ for Dismal Scientists?" *Business Week* (Sept. 25, 1995).
[6] Linden, Dana Weschler. "Dismal Days for the Dismal Science." *Forbes* (April 22, 1996).

> "Despite recent innovations in information technology and decades of academic research, successful stock market prediction has remained an elusive goal...Overall, we have not made progress in predicting the stock market, but this has not stopped the investment business from continuing the quest, and making $100 billion annually doing so."[7]

Recent work by Meir Statman has also confirmed how difficult it is to outsmart the capital markets. He found that there is a statistically significant *negative* relationship between the sentiment of Wall Street strategists and the returns of the S&P 500. There is also a negative relationship between newsletter writers and future S&P 500 returns, but this relationship is not statistically significant.[8]

Before institutional investors develop their asset allocations, they ask questions such as:

1. When will small-cap stocks resurrect themselves?
2. Has value investing gone the way of the dinosaur, or is it in a state of prolonged hibernation?
3. Are low inflation and low interest rates here to stay? And, if so, how must the economic paradigm underlying the forecasting of the returns of the different asset classes be changed?
4. In a low inflation and a low interest rate environment, are current P/E multiples reasonable?

If questions like these cannot be answered with any degree of certainty, and they cannot, it is impossible to feed precise, perhaps even reasonable, inputs into an optimizer. However, what can be done is to run various asset class return scenarios through optimizers and analyze the outputs. These studies give the informed institutional investor some idea of how, under each return scenario, their portfolios will perform, and thus how their organizations' needs will or will not be fulfilled. Sophisticated institutional investors, then, use portfolio optimizers in the hope of gaining additional insights and not to be told how to invest their funds.

In 1938 John Maynard Keynes expressed a similar belief:

> "It seems to me that economics is a branch of logic...Progress in economics consists almost entirely in a progressive improvement in the choice of models...But it is of the essence of a model that one does not fill in real values for the variable functions. To do so would make it useless as a model...because, unlike the typical natural science, the material to which it is applied is, in too many respects, not homogenous through time...economics is essentially a moral science and not a natural science. That is to say, it employs introspection and judgments of value."[9]

That 401(k) participants are not interested in such investment issues is universally accepted. They just want to earn the growth rate (i.e., the compound annual rate of return) that a retirement planning calculator has indicated is required to achieve their retirement security. Most participants have no idea what portfolio optimizers or expected mean returns are, and furthermore, they do not care.

When a plan sponsor endorses (and permitting an organization to solicit participants is an endorsement) a vendor of asset allocation services, participants expect the advice they get to have value. Further, to participants, "having value" means they can expect to achieve a sufficient growth rate if they follow the expert's advice (recommended contribution level and asset allocation).

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[7] Sheridan, William. *The Fortune Sellers* (John Wiley & Sons, 1998).
[8] Statman, Meir. "Investor Sentiment." Presented at the *Using Behavioral Finance to Improve Investment Decisions Conference* (Association for Investment Management and Research, 1999). See also "Bullish or Bearish?" *Financial Analysts Journal* (May/June 1998) by Statman and Roger G. Clarke.
[9] Keynes, John Maynard. "Economic Model Construction and Econometrics." *The Philosophy of Economics*. Edited by Daniel M. Housman. (Cambridge University Press, 1994).

This expectation should not be surprising. Most communications materials are written at a junior high or lower level because investment communicators maintain that participants cannot understand concepts like mean, standard deviation, and correlation. If these concepts cannot be grasped, it is not reasonable to expect participants to appreciate a more advanced concept like the probability of a portfolio achieving a certain return. In fact, it is quite likely that most plan fiduciaries, let alone participants, do not realize the magnitude of the difference that can occur between an asset class's mean return and compound annual return during a given period (Table 3).

Table 3: Mean versus Annualized Compound Returns by Decade

Period		S&P 500	Ibbotson Small Stocks	Ibbotson Int.-term Govt Bonds	T-bills
1930-1939	Mean Return	5.34%	15.39%	4.64%	0.56%
	Annualized Compound Return	-0.05%	1.38%	4.58%	0.55%
1940-1949	Mean Return	10.30%	25.30%	1.83%	0.41%
	Annualized Compound Return	9.17%	20.69%	1.83%	0.41%
1950-1959	Mean Return	20.84%	19.51%	1.37%	1.87%
	Annualized Compound Return	19.35%	16.90%	1.34%	1.87%
1960-1969	Mean Return	8.69%	19.32%	3.54%	3.89%
	Annualized Compound Return	7.81%	15.53%	3.48%	3.88%
1970-1979	Mean Return	7.50%	15.52%	7.07%	6.32%
	Annualized Compound Return	5.86%	11.49%	6.98%	6.31%
1980-1989	Mean Return	18.19%	17.00%	12.17%	8.92%
	Annualized Compound Return	17.55%	15.83%	11.91%	8.89%
1990-1998	Mean Return	18.75%	15.34%	8.44%	4.96%
	Annualized Compound Return	17.89%	13.56%	8.25%	4.95%

Source: *Stocks, Bonds, Bills, and Inflation 1999 Yearbook*. Ibbotson Associates, Chicago (annually updates work by Roger G. Ibbotson and Rex A. Sinquefield). Used with permission. All rights reserved.

When a plan sponsor makes available to participants investment advice via an asset allocation service, care must be taken in describing those services. Of course participants will be told that an expert is going to advise them on what is the best or optimal portfolio for them based upon their own unique circumstances. However, to protect themselves, plan sponsors must describe in unambiguous detail the limitations of portfolio optimizers.

For example, Tables 4a and 4b show just how sensitive optimizers are to inputs. The optimizer was programmed to create a portfolio with an expected mean return of 10%. No constraints were put on the allocation, i.e., there were no ranges (minimum or maximum amounts) established for the five asset classes used. Three sets of inputs were used. They were the historical data (returns, standard deviations, and correlations) from three periods: 1926-1998, 1979-1998, and 1994-1998.

Table 4a: Portfolios Generated Targeting a 10% Return*

Portfolio	Input Period	S&P 500	Ibbotson Small Stocks	Ibbotson Int.-term Govt Bonds	Ibbotson One Year Govt Bonds	T-bills
A	1926-1998	39.27%	12.65%	48.08%	0.00%	0.00%
B	1979-1998	20.11%	0.00%	0.00%	42.10%	37.79%
C	1994-1998	25.45%	0.00%	0.00%	0.00%	74.55%

*Portfolios generated using Ibbotson Optimizer 7.0 using the historical data shown in Table 4b and the correlations between the asset classes as inputs.

Table 4b: Optimizer Inputs*

		Percentage of portfolio in each asset class				
Portfolio		S&P 500	Ibbotson Small Stocks	Ibbotson Int.-term Govt Bonds	Ibbotson One-Year Govt Bonds	T-bills
A	Mean Return	13.17%	17.39%	5.47%	4.74%	3.82%
	Standard Deviation	20.26%	33.78%	5.73%	3.67%	3.22%
B	Mean Return	18.45%	17.58%	10.09%	8.47%	7.21%
	Standard Deviation	13.08%	18.90%	7.43%	3.72%	3.01%
C	Mean Return	24.75%	14.13%	6.47%	5.64%	4.96%
	Standard Deviation	14.16%	16.44%	8.34%	1.95%	0.65%

*The correlations between the asset classes are also used as optimizer inputs but are not shown here.

As can be seen in Table 4a, the resulting three asset allocations differ dramatically. To some plan sponsors and participants, the allocations might even be unacceptable for of lack of sufficient diversification due to the exclusion of certain asset classes or the overweighting of others. “Is it prudent for a 30 year old to put almost 75% of her money in T-bills? Or “does it make sense to exclude small-cap stocks?” are just two questions that immediately pop-up.

These questions raise the issue if ranges should be specified for the different asset classes. Other questions arise, such as: What percent of the allocation should result from unemotional mathematics versus what percent should come from human judgement? Who are the individuals who are creating the constraints? Is human judgement the fine tuning device or is the optimizer the tuner? If the answer is the latter, is the use of the optimizer justified when its limitations are considered?

Two other obvious questions are: Which data set makes the most sense to use?; and How does the expert arrive at her inputs? After all, the inputs are the expert’s prediction of the future, and in today’s world of global economic restructuring, can one realistically hope to glean from the past much insight about the future.

Tables 5a and 5b show the sensitivity of optimizers to even slight changes in inputs. Portfolio B is the optimal portfolio based on the historical data from 1979 to 1998. The inputs for Portfolios D and E are the same as B except that the expected mean return for the S&P 500 are increased and decreased by 1 percent respectively. Portfolios F and G also have the same inputs as A except that

the expected mean return for one-year government bonds are increased and decreased by 1% respectively.

Table 5a shows that even a 1% change in the expected mean return of an asset class can have a dramatic effect on the output of an optimizer. Table 5b goes on to show that a variation in return for a single year (1995) can cause such a change. Almost any participant, and probably most plan sponsors, would be surprised at how these changes in input dramatically affect the allocations generated by optimizers.

Table 5a: Sensitivity of Optimizer to Inputs*

		Percentage of portfolio in each asset class				
Portfolio	Inputs Used	S&P 500	Ibbotson Small Stocks	Ibbotson Int.-term Govt Bonds	Ibbotson One-Year Govt Bonds	T-bills
B	1979-1998	20.11%	0.00%	0.00%	42.10%	37.79%
D	Increasing S&P 500 expected mean by 1%	19.54%	0.00%	0.00%	31.72%	48.75%
E	Decreasing S&P 500 expected mean by 1%	20.57%	0.00%	0.00%	54.43%	25.00%
F	Increasing One-Year Government Bonds expected mean by 1%	14.04%	0.00%	0.00%	53.56%	32.39%
G	Decreasing One-Year Government Bonds expected mean by 1%	23.52%	0.00%	5.03%	0.00%	71.45%

*Portfolios generated using Ibbotson Optimizer 7.0

Table 5b: Sensitivity of Optimizer to Returns in a Single Year*

Year	Annual S&P 500 Returns	Modified S&P 500 Returns	Year	Annual S&P 500 Returns	Modified S&P 500 Returns
1979	18.44%	18.44%	1989	31.49%	31.49%
1980	32.42%	32.42%	1990	-3.17%	-3.17%
1981	-4.91%	-4.91%	1991	30.55%	30.55%
1982	21.41%	21.41%	1992	7.67%	7.67%
1983	22.51%	22.51%	1993	9.99%	9.99%
1984	6.27%	6.27%	1994	1.31%	1.31%
1985	32.16%	32.16%	**1995**	**37.43%**	**17.25%**
1986	18.47%	18.47%	1996	23.07%	23.07%
1987	5.23%	5.23%	1997	33.36%	33.36%
1988	16.81%	16.81%	1998	28.58%	28.58%
			Mean	**18.45%**	**17.45%**

*Portfolios generated using Ibbotson Optimizer 7.0

"If it is so difficult to predict future asset class returns, and if the allocations generated by optimizers are so sensitive to their inputs, how much value can we realistically expect to get from a portfolio optimizer?" is the question all plan sponsors should ask before employing an asset allocation service provider. They should recall John Bogle's conclusion that "There is no evidence in the record of mutual fund managers showing that they have improved their performance by anticipating market changes and changing their cash positions."[10]

Unfortunately it is all to easy to dismiss the above discussion as alarmist humbug. After all, Nobel prizes were awarded to Harry Markowitz and William Sharpe for their work in laying the foundations of modern portfolio theory, and both these men are actively involved in bringing asset allocation services to plan participants.

Before pooh-poohing these concerns, plan sponsors must ask three questions. The first one is: How bad can the recommendations of an asset allocation service be in a bull market? The answer is probably not bad at all. In bull markets it is difficult to botch up. Following the winners, diversifying some, and increasing contributions are the ingredients of a winning formula for investment success.

How much money can a participant lose due to the advice he received during a bear or a highly volatile and apparently trendless market is the second, and much more important, question. The current bull market has been around for years so the inexperienced participant cannot imagine what her emotions will be like when returns stagnate or start falling with no end in sight. At that time participants will ask: Why am I in stocks (or bonds), and why should I stay in them when they are losing money?

Perhaps the most important question is: If participants start to retire without sufficient nest-eggs, and they have religiously followed the recommendations of the asset allocation vendor, will the vendor and/or plan sponsor be held liable?

Winning Noble prizes for developing investment theory does not guarantee the ability to exploit that theory in the real world. Long Term Capital and its two Noble laureates amply demonstrated that. When all is said and done, perhaps the most fundamental issue underlying offering asset allocation services is this: Why does a plan sponsor feel that a highly sophisticated methodology used to show how portfolios will react under different economic scenarios can be converted into a highly reliable forecasting tool?

Asset allocation vendors don't own the goose that lays the golden egg—the perfect optimizer. There is a vast chasm between what portfolio optimization models are and what participants, vendors, and plan sponsors want them to be. Plan sponsors should not provide participants with advice before exploring the value and the accuracy of that advice. Ironically just reading the financial press will make anyone suspicious of those who feel they can size-up the future. If optimizers blow up like portfolio insurance did, lawsuits will abound.

Imagine a participant's attorney asking representatives of both the asset allocation vendor and plan sponsor questions such as:

1. If asset allocation methodology is so well established, as suggested by your marketing materials, could you explain why Clements and Hendry wrote in the preface to their book, *Forecasting Economic Time Series*[11],

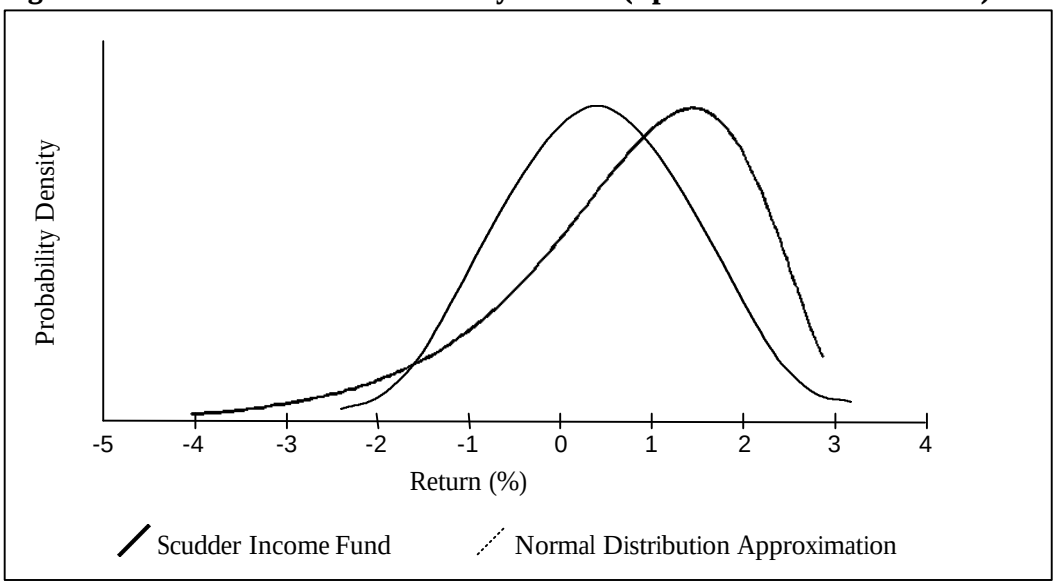
[10] Sheridan, William. *The Fortune Sellers* (John Wiley & Sons, 1998).
[11] Clements, Michael P. and Hendry, David F. *Forecasting Economic Time Series* (Cambridge University Press, 1998).

> "Our focus on forecasting began in 1991 when Dave Hendry...found a dearth of theory to explain the systematic mis-forecasting that had occurred in the mid and late 1980s. The literature on statistical forecasting also argued that there was a marked discrepancy between theory and practice...

To deliver relevant conclusions about macroeconomic forecasting, analyses must be based on assumptions pertinent to the economies to be forecast. This forces the analysis to contend with non-constant, evolving processes for which estimated econometric models are far from being facsimiles. It transpires that conclusions which can be established formally for constant-parameter stationary processes and correctly specified models often do not hold when those unrealistic assumptions are relaxed."

2. Your recommendations are based upon (a) your asset allocation model which you believe can model the real world and (b) the appropriateness of your data inputs. Your model is based upon mean-variance optimization (which assumes returns are normally distributed), but the returns of many of our investment options do not have normal distributions (see the example in Figure 1)[12]. How is your model affected when the returns of the funds you are optimizing are skewed, sometimes considerably?

Figure 6: Scudder Income Fund Monthly Returns (April 1991 to December 1996)



Source: Figure 6 is based on an excerpt from *The Streetlight Syndrome: Old and New Ways of Thinking About Risk* presented by Phil Fortuna of Scudder Kemper Investments at the *Using Behavioral Finance to Improve Investment Decisions Conference* (Association for Investment Management and Research, 1999). Used by permission.

[12] Mean-variance optimization assumes that fund returns are distributed evenly around the mean (a "normal" distribution). Figure 1 compares this assumption (the dotted curve) to the actual returns of a fund (the solid curve). Notice how the actual distribution strays considerably from the assumption. For a discussion of normal versus skewed distributions, see Chapter 1 in *The Math Behind Wall Street* by Nicholas Teebagy (Four Walls Eight Windows 1998). Figure 1 is based on an excerpt from *The Streetlight Syndrome: Old and New Ways of Thinking About Risk* presented by Phil Fortuna of Scudder Kemper Investments at the *Using Behavioral Finance to Improve Investment Decisions Conference* (Association for Investment Management and Research, 1999). Used by permission.

3. Does the use of portfolio optimizers offer any real advantages to asset allocation over the common sense approach Ben Graham advocated years ago in *The Intelligent Investor?*

   > "We have suggested as a fundamental guiding rule that the investor should never have less than 25% or more than 75% of his funds in common stocks, with a consequent inverse range between 75% and 25% in bonds. There is an implication here that the standard division should be an equal one, or 50-50[13]...
   >
   > ...For reasons already given we feel that the defensive investor cannot afford to be without an appreciable proportion of common stocks in his portfolio, even if he must regard them as the lesser of two evils—the greater being the risks attached to an all bond portfolio."[14]

4. Why do you feel that you can predict with a high degree of accuracy the future returns of the different asset classes? After all, Werner De Bondt has shown that even economists have no insight into the future.[15] Robert Shiller has also shown that much of the S&P 500's return comes, not from fundamentals, but from human emotion.[16] Are you playing market psychiatrist?

5. What will be the recommended holding time for each allocation—6 months, 1 year, 5 years—or will the holding period fluctuate depending upon conditions?

6. How do you differentiate noise in the market from the beginnings of new trends? How do you differentiate your process from market timing or tactical asset allocation?

7. What percent of your model's output is a product of algorithms you follow slavishly and what percent is based upon human judgement? Can this ratio change? How is the ratio determined?

So far this paper has centered on the inputs that describe the asset classes and the investment options from which a participant builds his portfolio—expected mean returns, standard deviations, and correlations. Another input that goes into creating the recommended asset allocation is the participant's risk tolerance level.

A participant's risk tolerance is suppose to be determined by her score on a questionnaire. Once a participant's risk tolerance level is known, according to theory, it is possible to select the appropriate portfolio among those that lie on a previously constructed efficient frontier. Participants like this approach because it relieves them of the responsibility of making investment decisions. In fact, they feel that their investment portfolio has been constructed in a scientific fashion by experts.

Unfortunately this approach is not as clean as it appears (to the eyes of participants and many plan sponsors). Some of the many questions that must be answered are:

1. Since each vendor uses its own risk tolerance questionnaire, and these questionnaires vary quite a bit (both in number and types of questions), what is the likelihood that these different

[13] Graham, Benjamin. *The Intelligent Investor*. (Harper and Row, 1993).
[14] Ibid.
[15] De Bondt, Werner F. M. "What do Economists Know About the Stock Market?" *The Journal of Portfolio Management* (Winter 1991).
[16] Shiller, Robert. "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?" *American Economic Review*. (June 1993).

questionnaires will arrive at the same or similar risk tolerance level for a given participant? Which questionnaire, then, is the most accurate in its assessment?[17]

2. What is the conceptual basis underlying your risk tolerance questionnaire? Who developed the questionnaire and what are their backgrounds? Are there other approaches to developing risk tolerance questionnaires? What are their advantages? What results do they generate?

3. How should a person's risk tolerance level be defined? Can it really be determined?

4. Does a person's risk tolerance level change over time and if so, how often should it be recalculated?

5. Is a person's answer to a question a function of how the question is framed?[18] For example, "Can you emotionally tolerate a drop of 15% in your account?" versus "As a long term investor, is a paper loss of 15% a concern to you if you feel that the loss will be recouped in 3 or 4 months?"

6. Which measurement of risk should the risk tolerance questionnaire assess—standard deviation, downside risk, the likelihood of the participant's portfolio being able to generate an inflation-adjusted income during retirement, or perhaps a combination of the above.

7. Should the risk that is measured be a function of the person's time horizon?

8. Does the participant understand investments sufficiently well to answer the questions intelligently? Are the questions worded in such a fashion as to counter the participants biases? If the plan sponsor is concerned about the participants' knowledge of investing, should risk tolerance questionnaires even be given?

9. Should risk tolerance questionnaires be given out before or after participants have gone through educational programs?[19]

10. Does a plan sponsor have an obligation to review the allocations that participants are using? For example, a young participant can be overly concerned over losing money and put her total portfolio in a stable asset fund. Should a fiduciary advise her that her selection may be imprudent?

Arriving at the appropriate risk tolerance level to input into the portfolio optimizer is a challenge. In fact, a person's risk tolerance level might be so "soft and fuzzy" and fluid that quantifying it in a universally acceptable fashion may not even be achievable. No plan sponsor or vendor should use an assessment yardstick whose validity rests on extremely shaky ground.

If a plan sponsor or vendor feels that the issues surrounding optimizers—what they are and are not, the accuracy of the inputs, and the appropriateness of the output—are sufficiently well established so as to withstand lawsuits from unhappy participants, then the next challenge is one of communications. Personal data has to be gathered from the participant, the risk tolerance questionnaire must be taken, input must be processed, and then the recommended asset allocation

[17] See "Rating Risk Questionnaires." *Plan Sponsor* (Nov. 1998) by Tina Ruyter.
[18] Tversky, Amos, and Daniel Kahneman. "The Framing of Decisions and the Rationality of Choice." *Science* (January 30, 1981).
[19] See "Chapter 7: The Psychology of Choice and the Assumptions of Economics" in *Quasi Rational Economics* by Richard H. Thaler (Russell Sage Foundation, 1991).

has to be returned to the participant, presumably with commentary to maximize the likelihood of implementation. Since asset allocation services claim to be advice-driven, channels for ongoing communication must be established.

Individuals, who on their own seek investment and financial planning advice, meet regularly with their advisors. During these sessions, each of which can easily last an hour or two, a strong interpersonal relationship can be developed. The advisor, by watching the client's facial expressions and body movements and listening to the client's questions and comments, can tell if the client is comfortable with the recommendations and the reasons for them. Concerns can be immediately addressed. The value of human interaction is readily appreciated.

Since one-on-one meetings have limited use in the self-directed retirement plan market (too many participants, too few qualified advisors, and too little time), vendors are recommending the Internet as the communications vehicle. Why asset allocation vendors assume that workforces who do not using recordkeepers' Web sites will embrace theirs is not clear and may be just wishful thinking. After all, the percent of 401(k) plan participants using their current vendors' Web sites that is bantered around at conferences is just 3-10%. Furthermore, most inquiries are only for fund performances and to check account balances.

Even if participants are willing to use the Internet, its effectiveness as a communications tool has yet to be determined. For example, how do you communicate advice over the Internet? It is one thing to e-mail documents, but it is something else to write the advice in language that the average participant will understand. What happens if a participant does not understand the advice or has questions? Will the participant have the writing skills and investment knowledge to query the advisor? Even if she does, will she take the time to do it? The communication problems become compounded if the risk assessment includes, as it probably will, non-401(k) assets and needs, such as educating children.

Plan sponsors complain that participants do not read the current short, attractive, and colorful materials they pass-out. Why, then, is it realistic to expect most participants to read lengthy market reports, investment commentaries, and pay attention to rebalancing notices or recommendations for asset allocation changes when they appear on a Web site or arrive via e-mail?

Unless asset allocation vendors can make a believable argument for using the Internet as the primary or sole channel of communications, plan sponsors have little reason to believe that their participants will be able to effectively use an asset allocation service. Using the Internet to look-up an inn at which to stay on a ski vacation is quite different than using the Internet as the means for high level communications. After all, how many participants are skilled at writing English? Computer literacy cannot be equated with the ability to articulate relatively unfamiliar and sophisticated concepts in written language.

The importance of asset allocation is not being challenged. The issues that plan sponsors must face are simple:

1. Should portfolio optimizers, with all their limitations, be used for a purpose—advice generation—for which they were never intended?

2. Can risk tolerance questionnaires accurately assess the risk profile of participants, and even if they do, how should the results affect the choice of the portfolio used to fund retirement needs?

3. Is it realistic to assume, based on current participant behavior and literacy levels, that the Internet can be the primary channel of communications and advice giving for the average participant in a self-directed retirement plan?
4. Is well-intentioned, but inappropriate, advice better than no advice at all?

The answers to these questions will determine the success or failure of asset allocation services.