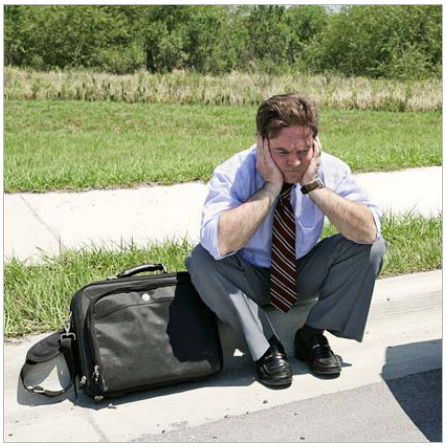
Kicking the Efficient Frontier to the Curb

Oct 9, 2014 / By Jim Otar, CFP

An investor strictly following modern portfolio theory would not be too happy right now. While he avoided some of the big dips, he would have missed all of the rallies over the last five years. The problem lies in using standard deviation—instead of actual market history—to build portfolios.



The concept of efficient frontier is one of the undisputed pillars of the current investment practice. First defined in 1952 by Harry Markowitz, it helped shift our focus from the performance of individual securities to the entire portfolio. Since then, academics extended its use to many other areas in investment planning including the "optimum" asset allocation.

However, the efficient frontier (EF) can often be inadequate in calculating the optimum asset allocation, especially when we have tools like "aftcasting" that can help us build more efficient portfolios based on clients' goals.

Discovering the typical efficient frontier

Let's remember the steps for the optimum asset mix using the EF:

- Take a portfolio with a specific mix of stocks and bonds.
- Calculate its compound annual return (CAR) over a specific time period—say, 10 years.
- Define risk as the standard deviation of monthly returns, and calculate this using standard statistical formulas.

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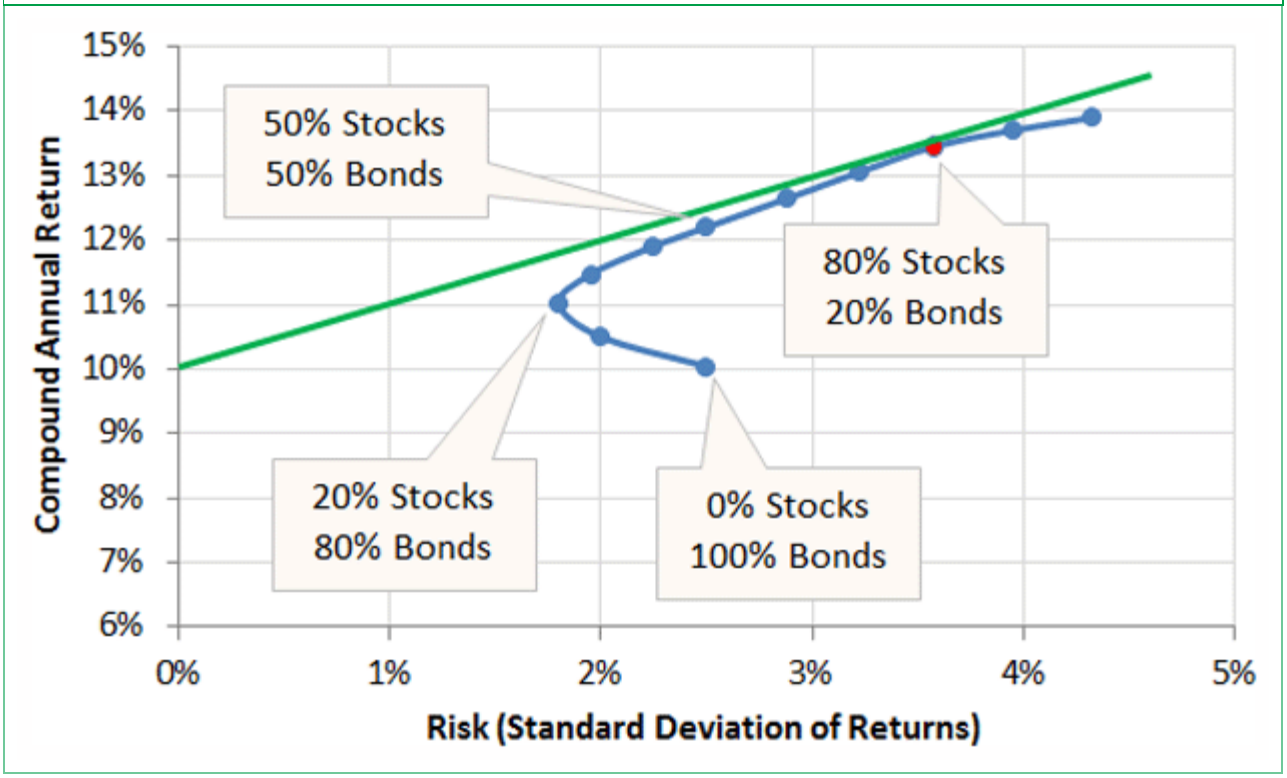
- Plot that point on a chart (see Figure 1). The vertical axis indicates the CAR; the horizontal axis represents the risk.
- Repeat the same calculation for various asset mixes and plot each point on the same chart.
- Connect all dots (the blue line).

Figure 1: A Typical Efficient Frontier Diagram to Determine the Optimum Asset Mix



Source: Retirement Optimizer

To determine the EF, draw a diagonal line—the green line on the chart above. The angle of this line is very specific. For each 1% additional risk, CAR rises by 1%. Investments closest to the EF are considered to be most risk-efficient. Make sure that it touches one of the points, indicated as a red dot.

In Figure 1, the asset mix at that particular red dot is the optimum: 80% stocks, 20% bonds. If you were to ride along the blue line further to the right—that is, take on higher risk—CAR does not increase as much and the asset mix becomes less efficient. If you were to pick an asset mix farther to the left, you would

take on higher risk—CAR does not increase as much and the asset mix becomes less efficient. If you were to pick an asset mix farther to the left, you would reduce the risk, but you would reduce CAR even more, making the portfolio less efficient.

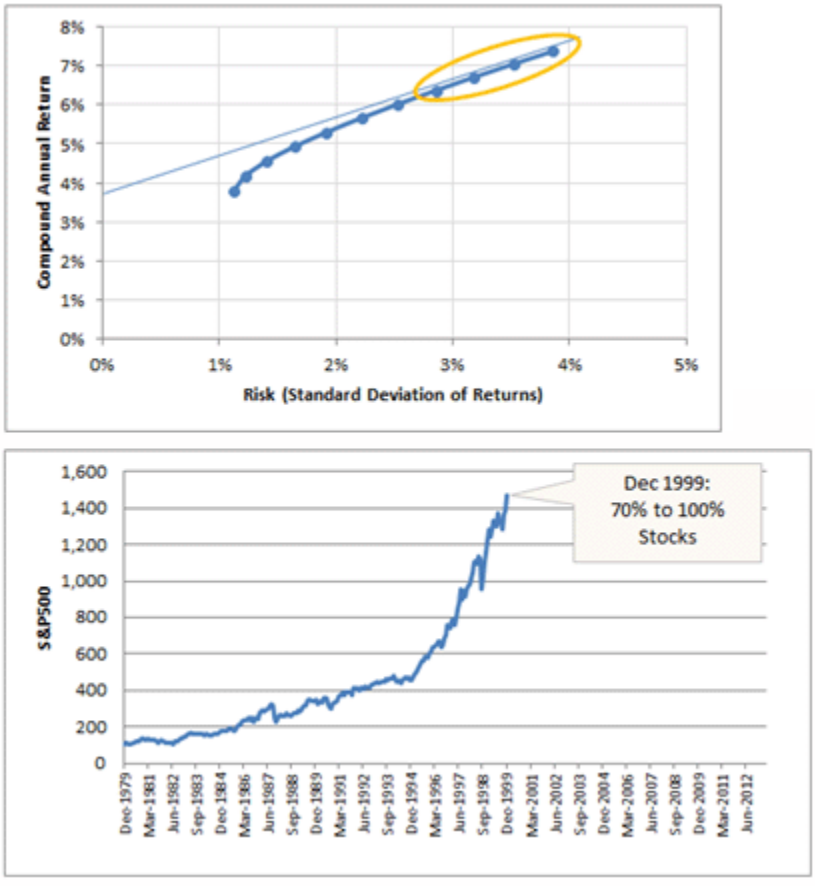
Recent history of the efficient frontier

Let's follow this logic since the end of the last secular bull market and see how it worked. Our proxy for equities is the S&P 500 index and the U.S. Aggregate Bond Index for fixed income. We start in 1999 and review the optimum asset mix of this fictitious portfolio no less than every three years. At each review, we use the 10-year history immediately preceding the review date.

Review in December 1999

Prior to 1999, both equities and bonds were steadily increasing in value for several years. The EF analysis, shown in Figure 2, indicates that we can use anywhere from 70/30 to 100/0 as the optimum mix.

Figure 2: 1999 Efficient Frontier



Source: *Retirement Optimizer*

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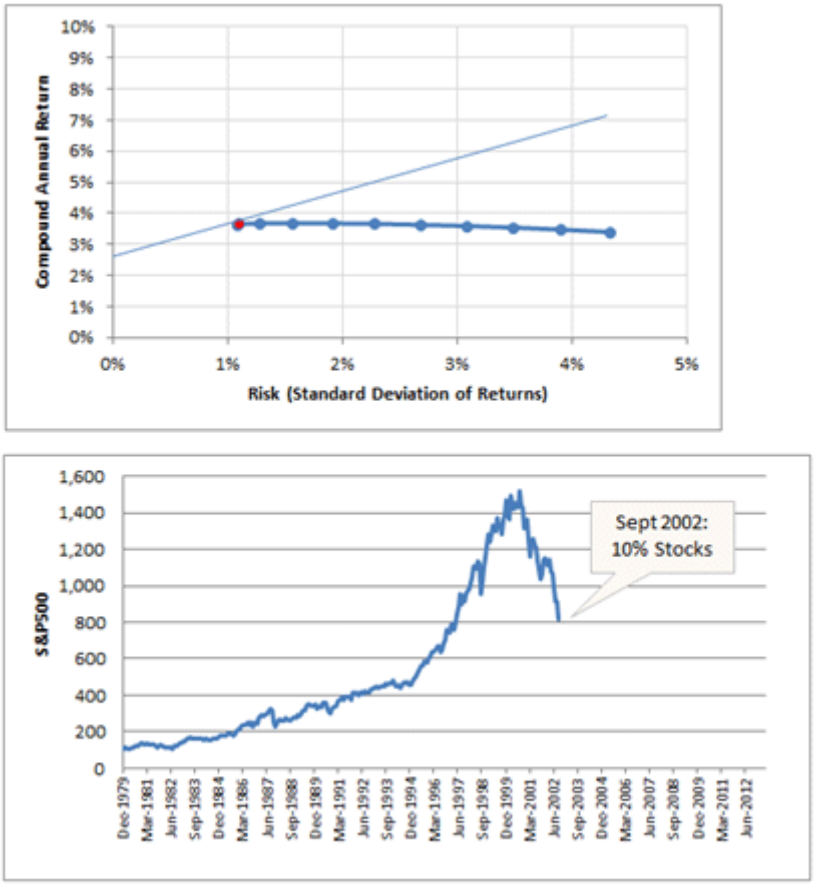
Review in September 2002

Our second review of the asset mix reveals something interesting: The EF did not work as implied in theory.

In the 1999 review, the EF indicated an optimum equity content of 70% to 100%. Then markets crashed, the worst multiyear decline since 1929.

In this review, the calculation includes the effect of this crash (Figure 3). Now the EF indicates an optimum asset mix of 10% stocks and 90% bonds. It appears as if the EF analysis were too late in its guidance.

Figure 3: 2002 Efficient Frontier



Source: Retirement Optimizer

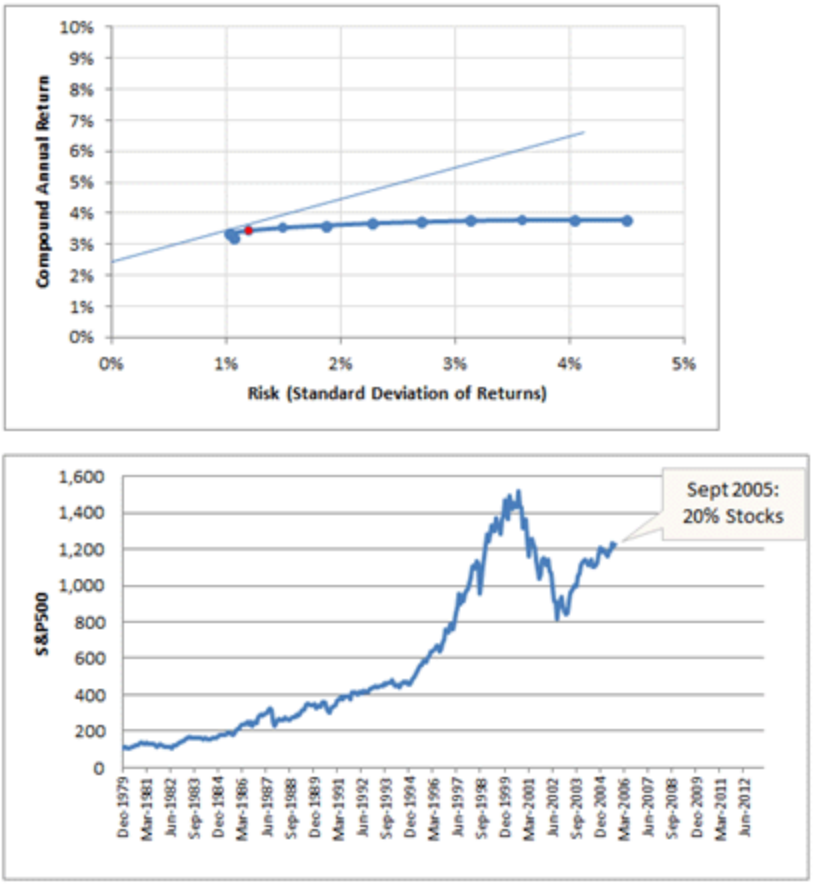
Review in September 2005

Our next review is even more puzzling. Between September 2002 and

Our next review is even more puzzling. Between September 2002 and September 2005, the equity index shot up by about 50%. As it turns out, the optimum mix of the last review did not work so well. We had only 10% in equities, missing a good bull run in the interim.

The EF, shown in Figure 4, now indicates an optimum equity holding of 20%.

Figure 4: 2005 Efficient Frontier

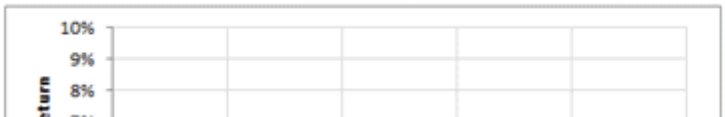


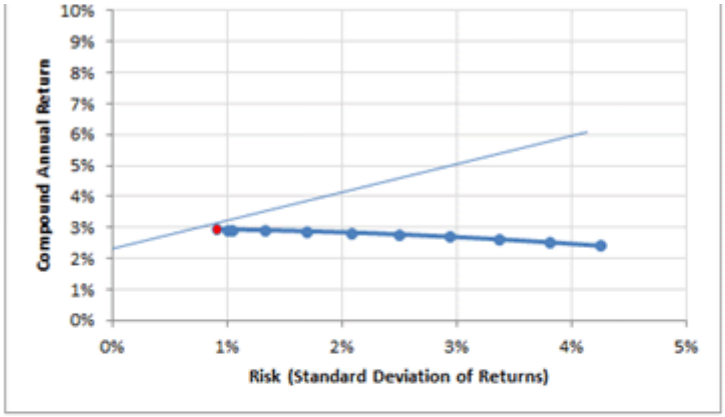
Source: Retirement Optimizer

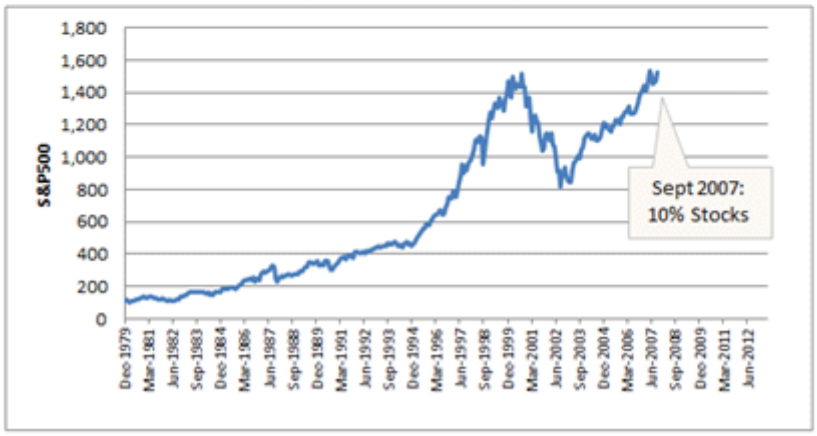
Review in September 2007

At this time, markets appear a bit wobbly. Therefore, we don't wait for three years. We analyze the asset mix after two years. Now the EF analysis shows the optimum equity allocation as 10% (Figure 5).

Figure 5: 2007 Efficient Frontier







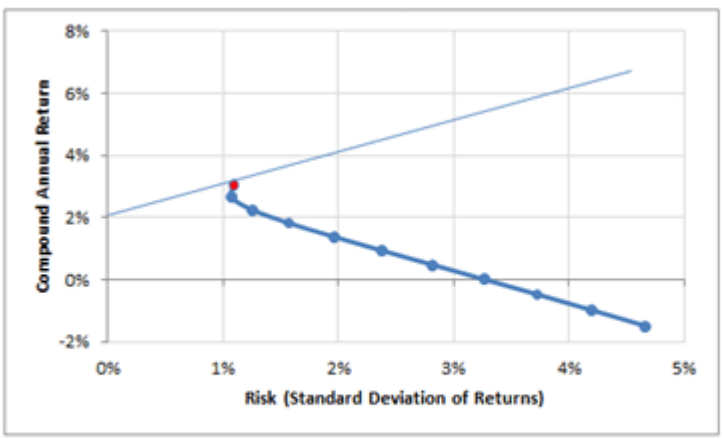
Source: Retirement Optimizer

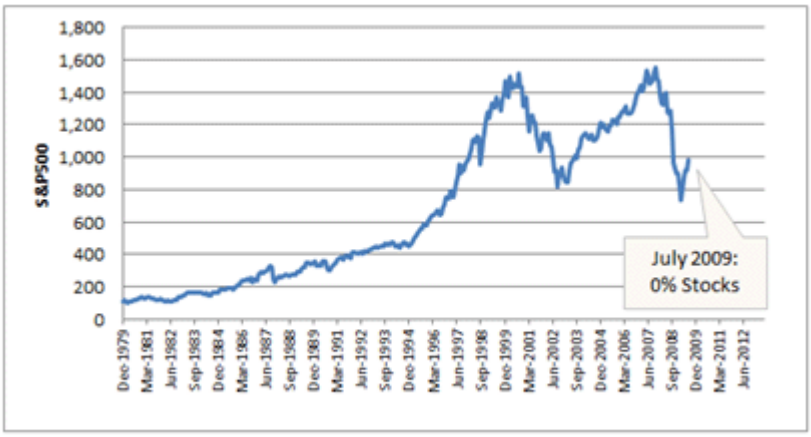
Review in July 2009

After the last review, markets crashed (credit crisis). We were able to avoid some large losses during the credit crisis because we had only 10% in equities.

In this review, shown in Figure 6, the EF analysis indicates 0% allocation to equities. So, we sell all stocks holdings to comply with it:

Figure 6: 2009 Efficient Frontier





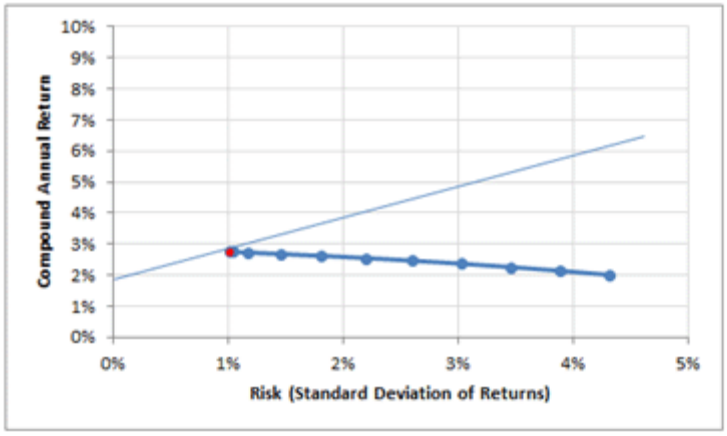
Source: Retirement Optimizer

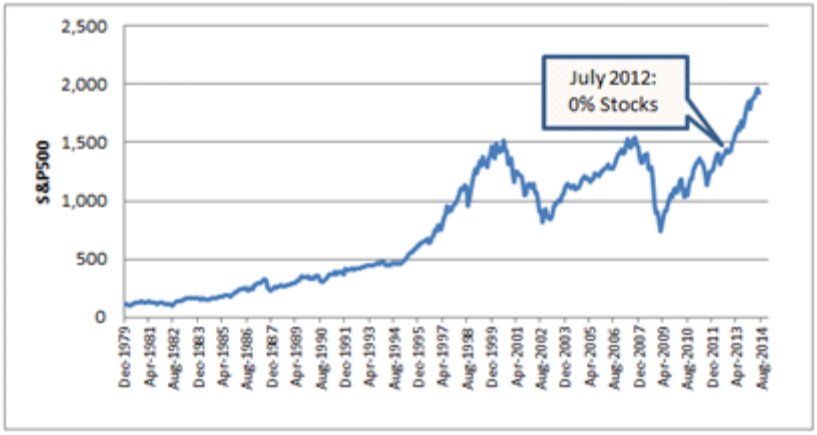
Review in July 2012

It was very unfortunate that we followed the EF analysis and allocated 0% to equities after the 2009 review. Between July 2009 and July 2012, the S&P 500 shot up by about 34%.

Lo and behold, in this review, the EF analysis still indicates a 0% allocation to stocks (Figure 7).

Figure 7: 2012 Efficient Frontier



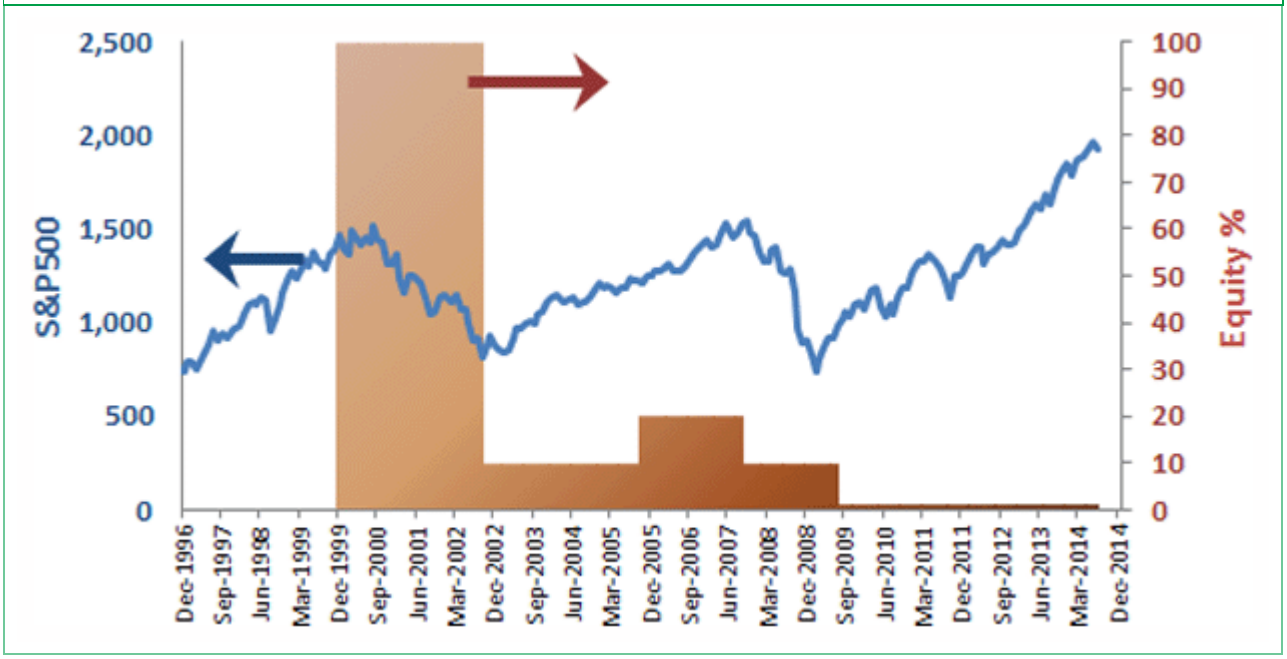


Source: Retirement Optimizer

At the time of writing (August 2014), the index was up 87% since July 2009. Anyone with any amount of assets would be pretty upset missing this totally. In almost all cases, EF acted as a very bad market-timing tool—nothing more, nothing less.

In Figure 8, we overlaid the optimum equity allocation (resulting from the EF analysis) over the S&P 500 Index for easier visualization.

Figure 8: EF's Optimum Equity Allocation vs. S&P 500



Source: Retirement Optimizer

There are many reasons for this shortfall. But the fundamental problem is that EF is based on the standard deviation of returns, which in turn uses the Gaussian math. This implies that markets always follow a normal distribution curve and that recent history will continue to repeat in the future only within these limits of "normalcy."

However, markets occasionally behave abnormally, and that is when big money is lost (or made). That means most of the research and conclusions using Gaussian tools are irrelevant and unrealistic.

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Aftcasting

For better optimum asset allocation, we use actual market history, which we call "aftcasting" (as opposed to "forecasting"). We do not use Monte Carlo simulators or any other non-Gaussian tools.

Aftcasting displays the outcome of all historical asset values of all portfolios on the same chart, and it gives a bird's-eye view of all outcomes for a given scenario since 1900. It provides the success and failure statistics with exact historical accuracy because it includes the actual historical equity performance, inflation, and interest rate, as well as the actual historical sequencing/correlation of these data sets. It has no loss of memory of market extremes like Gaussian models do.

Aftcasting has two additional important benefits for optimization. The first one is about the time horizon, and the second one is the withdrawals.

1. **The shorter the time horizon, the larger the impact of volatility.** Even though volatility is one of the two inputs of the EF analysis, it does not have the capability of optimizing for various time horizons. It just provides one specific asset mix until the next review. On the other hand, aftcasting allows optimizing for specific time horizons.

2. **The factors that impact the optimum asset mix are distinctly different in accumulation and distribution stages.** During the accumulation stage, the volatility of returns is important and sequence of returns is not. During the distribution stage, it is exactly the opposite: The sequence of returns is very important, and the volatility of returns has only a marginal impact.

Aftcasting allows optimizing for both the accumulation stage and the distribution stage separately because it incorporates additions to and withdrawals from assets. Table 1, below, summarizes properties of each:

Table 1: Optimization Goals for Portfolio Regimes

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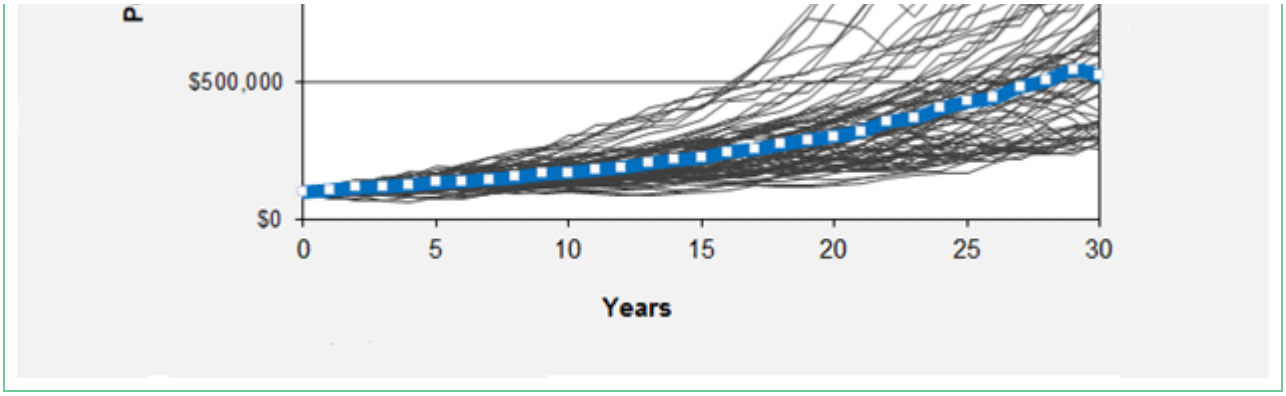
Portfolio Regime	Capital/Cash Flow	What do we optimize for?
Accumulation	cash might be added to portfolio	maximize the median portfolio value
Distribution	cash is withdrawn from the portfolio periodically	maximize the sustainable withdrawal rate

Source: Retirement Optimizer

In our analysis below, we use the historical S&P 500 Index for the equity portion of the portfolio. For the fixed-income portion, we have a conventional bond ladder portfolio held until maturity with no capital gains or losses. It yields (after costs) 1% higher than the historical interest rate for a six-month CD. The asset mix is rebalanced annually only if the target mix deviates by more than 3%.

Figure 9 depicts aftcast for an accumulation portfolio. Each of the gray lines on the chart represents one specific starting year since 1900. The heavy blue line represents the median portfolio where half of the gray lines are above it and the other half are below. Notice the asymmetry of the density around the median. You will likely not see this with any Gaussian models (such as Monte Carlo simulations).

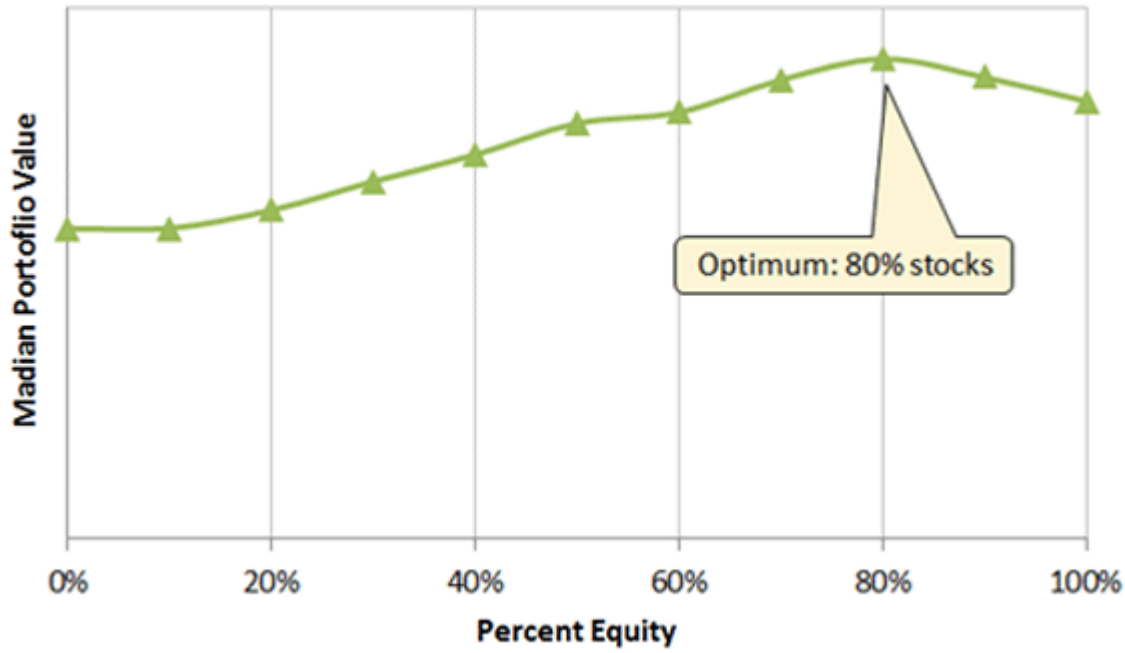
Figure 9: The Aftcast of a Hypothetical Accumulation Portfolio



Source: Retirement Optimizer

For accumulation portfolios, we calculate the value of the median portfolio value at various asset mixes. Figure 10 shows the optimum asset mix is where the median is highest:

Figure 10: Optimum Asset Mix for a Hypothetical Accumulation Portfolio With a 30-Year Time Horizon



Source: Retirement Optimizer

For distribution portfolios, we calculate the sustainable withdrawal rate (allowing a 10% probability of failure) at various asset mixes for different time horizons. Figure 11 shows the optimum asset mix is where the sustainable withdrawal is highest:

Figure 11: Optimum Asset Mix for a Hypothetical Distribution Portfolio With a 30-Year Time Horizon

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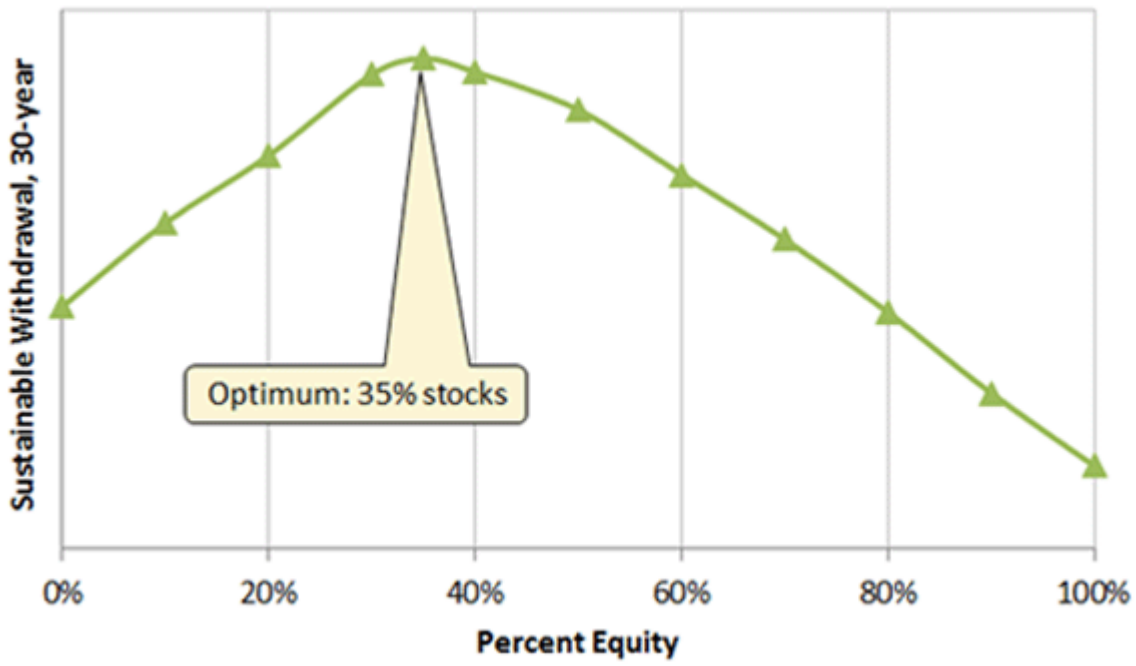

Source: Retirement Optimizer

Table 2 summarizes our findings for an optimum asset mix of fixed income and equities for both kinds of portfolios:

Table 2: Optimum Asset Mix for Accumulation and Distribution Portfolios

	Optimum Asset Mix Equity % / Fixed Income %	
Time Horizon	Accumulation	Distribution
10 years	30/70	0/100
20 years	60/40	25/75
30 years	80/20	35/65

Source: Retirement Optimizer

If the time horizon is not exactly what is shown on the table, interpolate the optimum asset mix.

Example: Bob is 50 years old. He is saving for his retirement until age 65. What is his optimum asset mix?

What is his optimum asset mix?

Answer: Bob has a 15-year accumulation time horizon. According to Figure 13, his optimum asset mix is 45% equities and 55% fixed income, which is halfway between the 10-year and 20-year optimums.

If your client is in the distribution stage and his withdrawals are smaller than the perpetual withdrawal rate (about 2%), you can then treat his portfolio as an accumulation portfolio.

If your client is in the distribution stage and his withdrawals are larger than sustainable, then whether or not you are using the optimum asset mix does not make much of a difference on the portfolio's longevity. In these scenarios, you need to look at guaranteed lifelong income solutions, usually offered by insurance companies.

Finally, the optimum asset mix should be reviewed when there is a change in the client's life events or his financial picture. Keep in mind, your client's personal risk tolerance always supersedes the optimum asset mix.

Jim Otar, CFP, is a financial planner, a professional engineer, a market technician, a financial writer, and the founder of retirementoptimizer.com. His past articles on retirement planning won the CFP Board Article Awards in 2001 and 2002. He is the author of Unveiling the Retirement Myth – Advanced Retirement Planning Based on Market History and High Expectation and False Dreams. You can reach him at jim@retirementoptimizer.com.

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