Rethinking Modern Portfolio Theory
New Lessons about Old Standards

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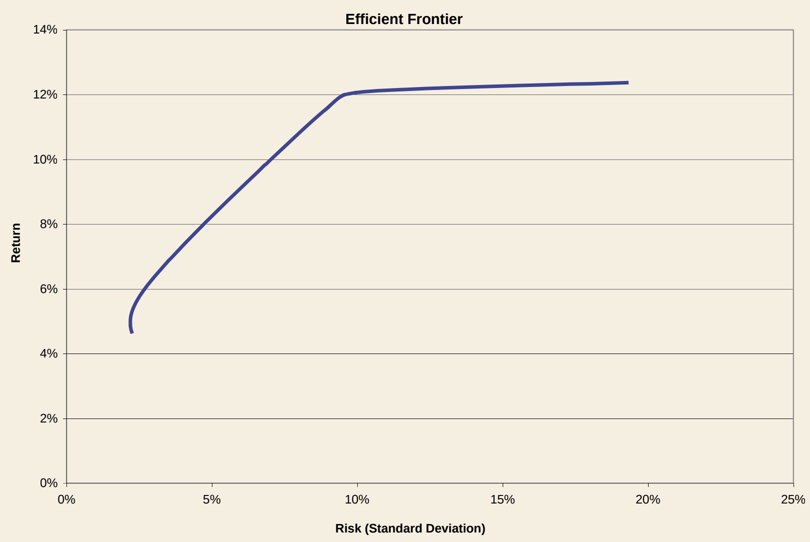
For more than 50 years, investment professionals have used modern portfolio theory (MPT), Harry Markowitz's model based on mean-variance optimization, to construct diversified portfolios of assets that aim to suit individual investors' needs in most market environments. Today MPT is a core component of the modern asset allocation process. Critical inputs of the model involve assumptions about asset class risks, returns, and correlations. As we shall show, however, investors often fail to adequately scrutinize these key MPT inputs, resulting in inefficient portfolio allocations. This is perhaps best illustrated by the financial storm of 2008, which, given the recent recovery trends, may seem far away. Still, despite recent double-digit equity market returns and slowly improving economic conditions, investors would be wise to take a critical look at MPT and learn from the portfolio construction lessons of 2008 in order to manage their investments more successfully in the future.

The Efficient Frontier and MPT

MPT allows an individual to build an efficient frontier of possible portfolios in which, for a desired level of risk, the potential return is maximized. By diversifying into low-correlation assets, an investor can maintain a high level of return while reducing the risk associated with that level of return. As we shall show, investors often under-scrutinize these key inputs and frequently this leads to inefficient portfolio allocations. This article examines a couple of these critical inputs, namely risks and correlations.

Figure 1 illustrates an efficient frontier where the x-axis measures the standard deviation of potential portfolios' returns and the y-axis is the average return of these portfolios for an observed time period. The curve plotted on the graph and the area beneath it represent all the possible portfolio combinations contained in the chosen asset class universe. The curve itself represents those portfolio allocations that generate the highest return for a certain level of risk. To create an efficient frontier, an investor needs to make assumptions about asset class risks, correlations, and returns.

FIGURE 1: EFFICIENT FRONTIER—INVESTMENT TIMING AND CASH FLOWS



MPT generally identifies risk as the volatility of asset returns, usually measured in terms of standard deviation. For example, an asset class that, over a 20-year period, has an average return of 8 percent and a standard deviation of 15 percent will, two-thirds of the time, experience a return somewhere between –7 percent and 23 percent. Standard deviation as "the measure of risk" has become so entrenched that it is now the dominant measure used within the investment industry. However, by simply focusing on only one measure of risk—standard deviation—investors can tend to understate the potential for less-than-average returns because performance is very sensitive to market entry and exit timing, period length, and portfolio cash flows. Understanding the impact of these considerations on standard deviation can lead investors to more-informed decisions about the desired level of risk or return variability they may expect within their portfolios.

As defined by standard deviation, risk is very sensitive to period length, entry timing, and cash flow, but these sensitivities often aren't highlighted. As an example, table 1 shows two retirees, Investor A and Investor B. They have the same characteristics: They made the average U.S. wage,[1] they are eligible to receive maximum allowable Social Security benefits,[2] they have managed to save three times their final salaries for retirement, they have invested their savings in a 60/40 split between equities (represented by the S&P 500 Index) and fixed income (represented by the Barclays Capital U.S. Aggregate Bond Index), and they will need the same amount of replacement income, 78 percent, during the 20-year retirement each intends to experience. The only difference is that Investor A retired in 1976 and Investor B retired in 1985. The average returns and standard deviations of their portfolios are very similar: Investor A is expected to get an average return of 13.2 percent with a standard deviation of 10.2 percent; Investor B is expected to get an average return of 12.2 percent with a standard deviation of 11.2 percent. Table 1 illustrates these investors' experience over their 20-year retirements.

Investor B fortunately retired in 1985 and therefore ended retirement with a sizeable account balance; Investor A unluckily retired in 1976 and ended retirement with a sizeable negative balance. Why? Investor A, retiring in 1976, experienced low-to-negative real returns in the beginning of the drawdown period. This early negative impact resulted in a full depletion of the retirement savings within 10 years. Investor B, retiring in 1985, experienced high real returns for much of the drawdown period. As a result, the retirement savings balance remained positive, despite three straight years of negative real returns at the end of the drawdown period. This example shows how standard deviation and average return estimations hide these underlying timing risks; nothing in the design of these portfolios hedged against the market entry or cash flow risks that resulted in these divergent results.

In our example we also assumed that the portfolios of Investor A and Investor B had at least benchmark index performance. Investors generally assume that they will receive benchmark-like returns—that they will make "ideal" decisions when investing. However, ideal decision-making is not the rule, it's the exception. DALBAR, in its 2009 Quantitative Analysis of Investor Behavior, examines mutual fund investor behavior over the past 20 years. The results, as of December 31, 2008, are shown in Figure 2.[3]

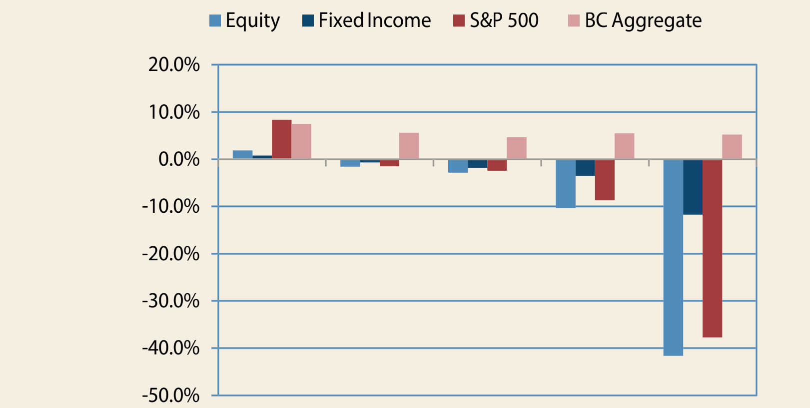
For every observed period, individual investor portfolios, whether equity or fixed income, returned less than the benchmarks. This is the result, at least partly, of incomplete information and psychological inclinations. Imagine what Retirees A and B in 1976 and 1985 might have experienced if benchmark returns were not employed in our analysis? Imagine what the baby boomer generation must be experiencing, retiring as they are in the face of such unfortunate financial times?

By simply focusing on standard deviation—and not taking into account other risks such as entry timing, period length, and cash flow—investors probably have taken on more risk than necessary, especially in retirement accounts. Investors need to acknowledge these additional risks because they emphasize the

TABLE 1: COMPARATIVE HISTORICAL RETURNS

Investor A: 1976				
	Year	Return	Inflation	Balance
1	1976	20%	0%	$28,493.07
2	1977	–3%	6%	$22,310.43
3	1978	4%	8%	$17,899.99
4	1979	12%	11%	$14,341.18
5	1980	20%	14%	$12,891.94
6	1981	0%	10%	$8,749.90
7	1982	25%	6%	$7,176.90
8	1983	17%	3%	$4,803.01
9	1984	10%	4%	$1,616.27
10	1985	27%	4%	($208.97)
11	1986	17%	2%	($2,396.10)
12	1987	5%	4%	($4,779.63)
13	1988	13%	4%	($7,705.54)
14	1989	25%	5%	($11,954.65)
15	1990	2%	5%	($13,138.48)
16	1991	24%	4%	($17,240.32)
17	1992	7%	3%	($19,327.19)
18	1993	10%	3%	($22,034.71)
19	1994	0%	3%	($22,725.72)
20	1995	30%	3%	($28,804.35)
Investor B: 1985				
	Year	Return	Inflation	Balance
1	1985	27%	0%	$53,572.86
2	1986	17%	2%	$54,610.01
3	1987	5%	4%	$48,652.20
4	1988	13%	4%	$46,483.64
5	1989	25%	5%	$49,324.81
6	1990	2%	5%	$42,938.91
7	1991	24%	4%	$46,344.51
8	1992	7%	3%	$42,872.21
9	1993	10%	3%	$40,194.25
10	1994	0%	3%	$33,176.26
11	1995	30%	3%	$37,584.77
12	1996	15%	3%	$37,799.19
13	1997	24%	2%	$41,399.83
14	1998	20%	2%	$45,488.05
15	1999	12%	2%	$46,722.50
16	2000	–1%	3%	$42,935.89
17	2001	–4%	3%	$38,334.21
18	2002	–9%	2%	$32,265.25
19	2003	19%	2%	$35,928.53
20	2004	8%	3%	$36,853.93

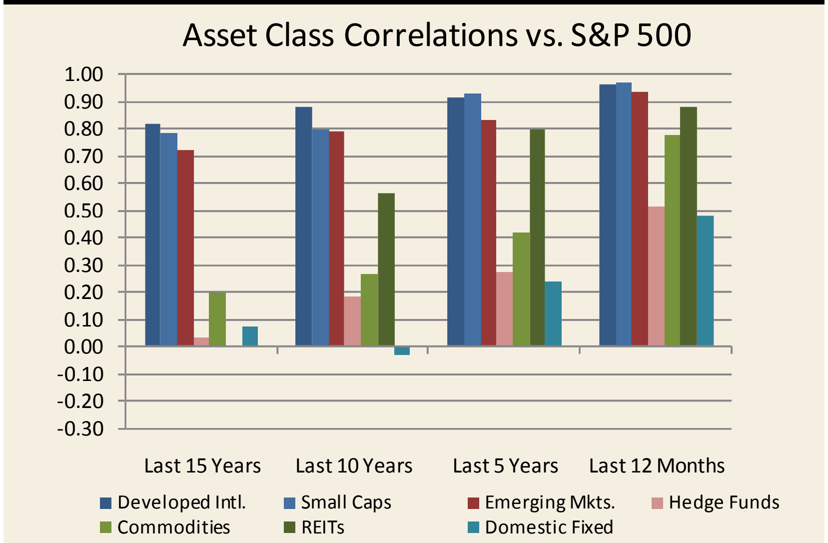
FIGURE 2: AVERAGE INVESTOR RETURNS



	20 Years	10 Years	5 Years	3 Years	1 Year
Equity	1.9%	-1.6%	-2.8%	-10.4%	-41.6%
Fixed Income	0.8%	-0.7%	-1.8%	-3.6%	-11.7%
S&P 500	8.4%	-1.5%	-2.4%	-8.7%	-37.7%
BC Aggregate	7.4%	5.6%	4.7%	5.5%	5.2%

Source: DALBAR (2009)

FIGURE 3: MULTIPLE ASSET CLASS COMPARISON



very real potential for achieving below-average results and likely could lead to very different investor choices.

Revelations about Correlations

Correlation between asset classes is another key input within MPT. Like risk, correlation warrants a deeper investigation than what normally is undertaken by investors. Correlation measures how two asset classes move in relation to each other over time and normally is shown through the correlation coefficient. The correlation coefficient ranges from –1 to 1: 1 means that two assets move in tandem, 0 means that there is no relationship in movement, and –1 means that they move in opposite directions. To create a more efficient portfolio, MPT dictates that a portfolio should consist of asset classes that are not highly correlated. This creates a hedge for different market environments—if one asset is down, another asset (if it has low correlation) may be down less or (if it is negatively correlated) even up. Correlations, however, should require further scrutiny because they are subject to period dependency, globalization trends, and market stress. Additionally, correlations are neither predictors of performance nor good predictors of future correlations. Although sophisticated investors generally realize that correlations have a large impact on the output of MPT, they perhaps are not always aware of how large that impact may actually be.

Correlation is very sensitive to time period selection (meaning both the length of the time period and the actual period selected). As shown in figure 3, correlations can be very different depending on the time period selected. Over the past decade ending September 30, 2009, investments in domestic fixed income exhibited a slightly negative 10-year correlation with the S&P 500 Index. However, the five-year correlation through September 30, 2009, was a positive 0.24. Which is the more-correct correlation coefficient to employ? If an investor is looking to invest over a 10-year time horizon, perhaps the 10-year correlation is more useful. However, perhaps the investor believes that the last five years of return history are more indicative of future correlations and so the five-year correlation would be a better choice. Obviously this choice has significant implications for the asset allocation process.

For example, using an efficient frontier generator, we consider two portfolios that were both created to meet a return objective of 11 percent over 25 years. Both sample portfolios were constructed around the Barclays Capital U.S. Aggregate Bond Index, MSCI EAFE Index, and S&P 500 Index. In our analysis we ran two simulations, one using 25-year annual returns, 25-year standard deviations, and 25-year correlations, and the other using 25-year annual returns, 25-year standard deviations, and 10-year correlations. In particular, the 25-year correlation between the S&P 500 Index and MSCI EAFE Index was 0.65, whereas the 10-year correlation was 0.98. Table 2 shows the optimal portfolio results; depending on the correlation selected, the S&P 500 Index allocation could be half of the portfolio or nonexistent.

This example also illustrates another issue with correlation: globalization. Increased interdependence of international financial markets has resulted in higher correlations between domestic and international asset classes, thus reducing the effectiveness of diversification as protection against general market risks. As shown in figure 4, over the past 15 years, emerging market stocks and the S&P 500 Index have had a correlation coefficient of 0.72; over the past 12 months, the correlation coefficient has been 0.93. Similarly, developed international stocks have experienced higher levels of correlation with the S&P 500 Index over the past 12 months resulting in a correlation coefficient of 0.97. If the main goal of diversification is to find low-correlation assets, globalization trends seem to be working against this goal. This example leads to one conclusion: Investors need to be mindful of the changes and trends in asset class correlation when creating portfolios.

Additionally, correlations tend to break down in times of market stress, with 2008 being a great example of "fat tail" risk impacts on correlation. As shown in figure 5, during the last three months of 2008, almost all of the major asset classes reached a correlation coefficient of at least 0.9 with the S&P 500 Index. This illustrates that generally the only thing that goes up in major market corrections is correlation. Indeed, from a diversification standpoint there was nowhere to hide in the major financial markets.

Investors need to be aware that diversification, in and of itself, is not a foolproof method to prevent market losses.

TABLE 2: OPTIMAL PORTFOLIO COMPOSITION DEPENDING ON CORRELATION

	25-Year Correlation	10-Year Correlation
S&P 500	46%	0%
MSCI EAFE	29%	63%
BC Aggregate	25%	37%

FIGURE 4: INTERNATIONAL VS. DOMESTIC MARKETS

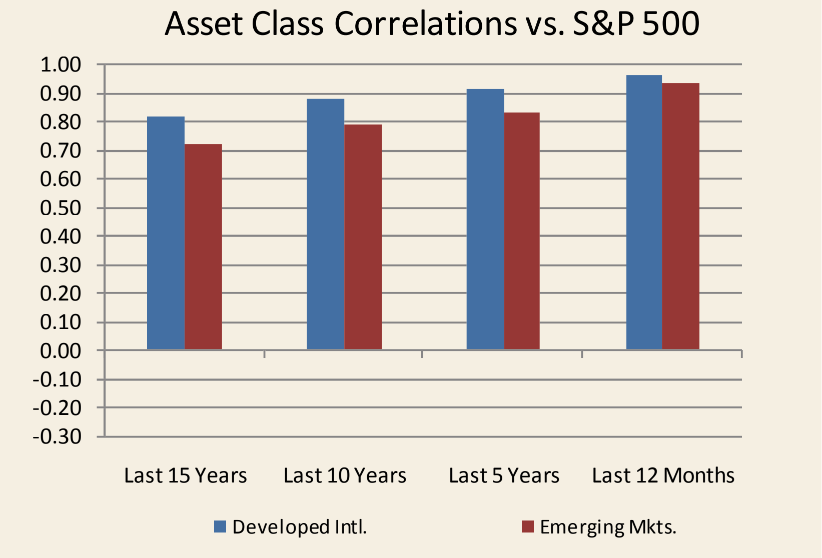
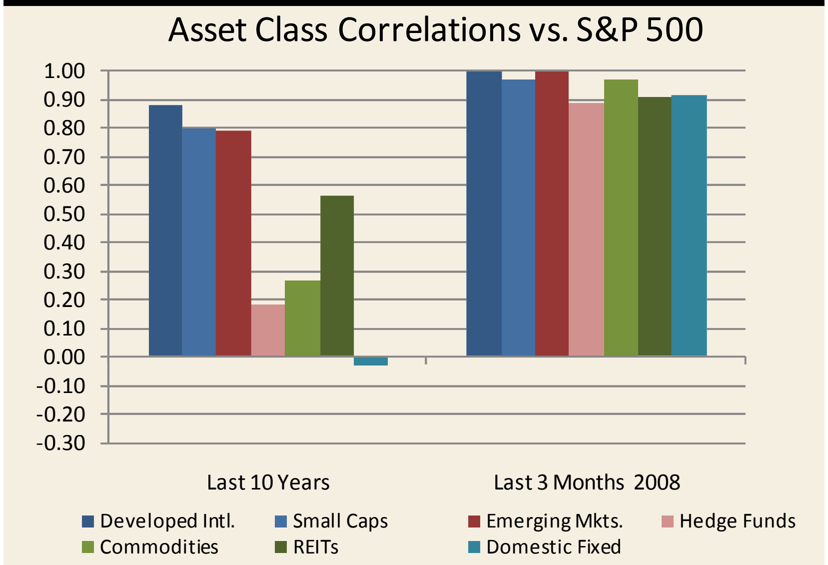


FIGURE 5: HISTORICAL CORRELATIONS



And finally, in addition to issues of period selection (meaning both the length of the time period and the actual period selected), globalization, and market stress, correlation also requires greater scrutiny from a performance perspective. Just because two asset classes are highly correlated does not mean their performances necessarily will be similar. Correlation simply states how likely it is that two asset classes will move in the same direction; it says nothing about the magnitude or the volatility of such moves. For example,

TABLE 3: HISTORICAL PERFORMANCE OF S&P 500, EAFE, AND EM	S&P 500	EAFE	EM
10-Year (annualized)	–0.2%	2.9%	11.7%
5-Year (annualized)	1.0%	6.6%	17.7%
3-Year (annualized)	–5.4%	–3.1%	8.3%
YTD as of September 30, 2009	19.3%	29.6%	64.9%

as of September 30, 2009, developed international equities and the S&P 500 Index had a 10-year correlation of 0.88; emerging market equities and the S&P 500 Index had a correlation of 0.79. Despite the high correlation with the S&P 500, the performance of these assets over that time period was quite different from the performance of the S&P 500. As table 3 shows, over the past 10 years, the S&P 500 Index returned –0.2 percent, the MSCI EAFE Index returned 2.9 percent, and the MSCI EM Index returned 11.7 percent.

In sum, many issues surrounding correlation need to be considered before settling on which correlation coefficients to employ in MPT optimizations, and even after the correlations are selected there are several caveats to keep in mind.

The Lessons Learned

MPT, though a valuable financial tool, is not without drawbacks. Specifically, because MPT's output is only as good as its inputs, input selection is extremely important. As we've illustrated, investors should understand that risk is much more than just the volatility of returns and that correlations are indeed not constant but quite mutable. Failing to truly understand these inputs leads to inefficient allocations and missed investment return horizon goals. However, risk and correlation are only part of the MPT picture. I&W

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Endnotes

1 Social Security Administration, National Average Wage Index 1951–2007.

2 Social Security Administration, Social Security Bulletin: Annual Statistical Supplement, 2008.

3 See Dalbar, 2009 Quantitative Analysis of Investor Behavior, available at http://www.qaib.com.

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