Practical Applications

of

Post-Modern Portfolio Theory

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Executive Summary

- This paper applies principles of post-modern portfolio theory (PMPT) and observations from behavioral finance to an analysis of portfolio optimization.

- The purpose of this paper is to introduce refinements to modern portfolio theory (MPT) in order to increase the theory's usefulness for advisors who want their portfolio optimization efforts to improve investment results for clients.

- The first part of this article reviews concerns regarding expected returns, the definition of risk, diversification, and investor costs. The second section addresses these concerns with proposals for creating and maintaining portfolios through a more robust asset allocation model.

- The enhanced asset allocation model leverages the strengths of MPT; at the same time, the new model injects MPT with sophisticated computerized algorithms, propelling the fifty year-old theory to a new level of usefulness.

- Advances in technology also provide a way to execute allocations that eliminates many layers of expenses and costs associated with actively managed mutual funds.

- The article concludes with a brief case study in post-modern portfolio optimization.

Prologue
Modern portfolio theory: Profound improvements in investment portfolio management

Fifty years ago, the authors of MPT understood quite well the limitations of their work with respect to its ability to define and quantify risk. The reason that the founders of MPT did not use, for example, a downside deviation measure of risk was that modern computer technology wasn't available to them, and the calculations necessary to perform the mathematic functions for such subtle measurements were too complicated for the day. Trying to quantify risk at this level back then would have been like trying to make a watch wearing welder's gloves.

As a result, the mean-variance optimization model was utilized and has remained the workhorse of MPT, despite the unresolved problems and the significant advancement in computer technology.

In 1959, Harry Markowitz, the founding father of modern portfolio theory, published Portfolio Selection[i], in which he asserted that investors expect to be compensated for taking risk, and that an infinite number of "efficient" portfolios exist along a curve defined by three variables: standard deviation (risk quantified), correlation coefficient, and return. Every possible asset combination can be plotted in risk-return space, and the collection of all such portfolios defines a universe of possibilities in this space.

The efficient-frontier consists of the portfolios in this space with the maximum return for a given level of risk or the minimum risk for a desired level of return. The work on modern portfolio theory won Markowitz his share of a Nobel Prize. Merton Miller, along with Harry Markowitz and William Sharpe, were awarded the 1990 Nobel Prize in Economics for research on theories of "financial economics."[ii]

It would be difficult to overstate the influence of MPT's core principles on the manner in which investments are managed today. Insights into portfolio management from the research of Miller, Markowitz, Sharpe and their colleagues include:

Investors are risk adverse. The only acceptable risk is that which is adequately compensated by potential portfolio returns.

Markets are efficient. For the most part, markets are fairly priced. It is virtually impossible to know ahead of time (with any degree of certainty) the next direction of the market, as a whole, or of any individual security.

The portfolio, as a whole, is more important than individual security selection. The appropriate allocation of capital among asset classes (stocks, bonds, cash etc.) will have far more influence on long-term portfolio results than the selection of individual securities.

Investing should be for the long-term. Investment horizons of ten years or more are critical to investment success because it allows the long-term characteristics of the markets to surface.

Every level of risk has an optimal allocation of asset classes that will maximize returns. Conversely, for every level of return there is an optimal allocation of asset classes that can be determined to minimize risk.

Allocating investments among assets with low correlation to each other reduces risk if they're held long. Correlation is the statistical term for the extent to which two assets are similar to one another.

With the foundation of these insightful principles as a backdrop, we can turn to some challenges currently confronted by investment advisers.

Part One

Encroaching Upon the Limits of Modern Portfolio Theory

This section identifies five challenges to allocating and optimizing a portfolio with the assistance of MPT-derived software:

- Modern developments in technology and asset allocation theory
- Standard deviation as a measure of risk
- Inadequate diversification due to high correlation between popular asset classes
- Asset allocation criteria is limited to risk, return and correlation
- High trading and custodial costs

Developments in technology and asset allocation theory

In spite of the development of powerful new algorithms and software for portfolio optimization, the earlier, less sophisticated MPT-derived software remains more popular among investment advisers.[iii] Since the earlier version of the software is used more often, it will be beneficial to clarify the important practical challenges it poses.

The problem of the integrity of variables

MPT-derived allocation software requires a large number of input variables to execute the algorithms, which creates variable integrity issues.
To apply the MPT-derived optimization algorithm, using just 10 investment options, you will need to determine 65 different variables.

10 Expected Return variables
10 Standard Deviation variables
45 Correlation variables

Let us take each of these sets of variables individually.

Determining expected returns of asset classes: Mathematical derivation or educated guess?

One of the key variables required in the MPT-derived optimization algorithm is the expected return. In order to initiate the algorithm, you must provide an expected return input. Unfortunately, MPT provides no objective way to determine expected return. If we do not have an accurate expected return, how reliable can MPT be in determining the optimal asset allocation of a portfolio?

The truth is, if we knew the expected return we would not need the algorithm to optimize the portfolio in the first place. No one can know these expected returns with certainty. But provide the expected return input you must. The necessity of providing a subjective input in order to run an objective algorithm pushes the investor to revert to two questionable practices, i.e., mean reversion and trend following.

The fallacies of trend following and mean reversion

Consider the ways advisers determine the return they expect on various investments. Some investment advisers use the average historical return of each asset class over a long-term period of time, perhaps 60 to 80 years. Others may consider that time frame too long, and will use historical average returns on each investment over the last 20 years, thinking that this tighter time frame is more representative of current markets and current monetary and fiscal policies. Choose whatever time period you like; using a historical average return is, in essence, to follow a trend with no empirical justification.

Another common strategy for determining expected return is to create a committee in order to arrive at a consensus estimate. In practice it becomes clear that a committee is no guarantee against subjective influences on decision-making. There is a strong tendency for committees to develop a default estimate that assumes mean reversion.

For instance, if large growth stocks have generated higher than average returns in the recent past, it will be prudent to utilize an expected return below the long-term average for the near term outlook. This process continues for each asset class, reducing the deliberative process to a recurring assertion of mean reversion — the notion that all investment returns will eventually revert to the mean or long-term average return.

The confused logic at the bottom of these two very tempting tendencies of thought can be shown with the example of the flip of a coin. Suppose you are betting on the flip of a coin and heads comes up 10 times in row … what do you do next? Bet heavily on tails, in effect assuming mean reversion, bet on heads, in effect following the trend … or what? Answer: it doesn't matter. The next flip has the exact same odds as any other flip: 50/50. The past results, whatever they were, can tell you nothing predictive about the results of the future.[iv] Heads are as random as tails, and whether the market follows a trend or reverts to the mean is an event just as random as the result of the flip of a coin.

The problem with non-standardized methods for determining an input variable such as estimated return is this: The practitioner is left with inconsistent outcomes. How reliable can a portfolio optimization algorithm be if there is no core methodology for determining such a key variable as the expected return? The question of consistency comes up again on the other side of the return / risk equation.

Standard deviation as a measure of risk

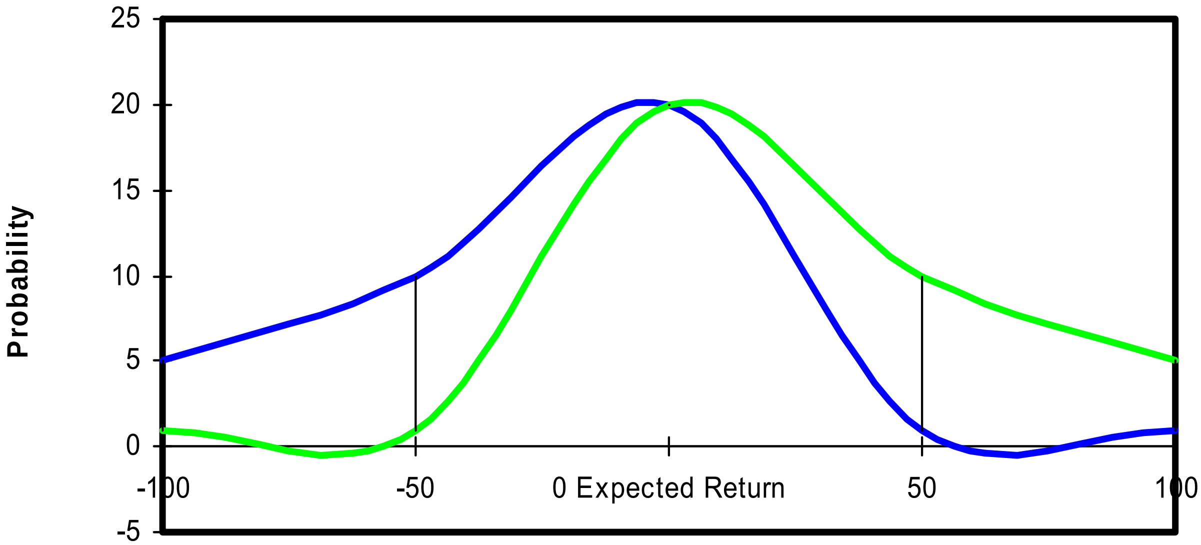
Risk and the Real-Life Investor

The definition of risk as standard deviation leads to unreliable conclusions when thinking about avoiding risk. Using standard deviation as a measure of risk assumes a symmetrical return distribution and assumes, absurdly, that unexpected gains are as risky as unexpected losses.

The probability of experiencing an unexpected gain however, is not what an investor considers risk. The probability of an *unexpected loss* is the type of risk investors are concerned about. In other words the possibility of *making* money unexpectedly isn't risky: *Losing* money is risky.

The use of standard deviation (SD) as a measure of risk assumes all investment returns follow a bell shaped (symmetrical) curve. Yet seldom does any investment return distribution resemble the classic "bell curve." Most investment return distribution graphs are skewed either positively (like the green curve below in **Figure 1**) or negatively (like the blue curve in **Figure 1**).

Figure 1 Return On Investment



If I were to analyze each of the investments represented by the green distribution curve and the blue distribution curve using MPT I'd consider them both equal (remember MPT's standard deviation assumes all investments have a symmetrical bell shaped curve). Both these investments have the same expected return and standard deviation so, assuming a bell shaped curve, they would be considered equal.

Now consider the following: What if I did *not* assume a symmetrical return distribution? What if I did not use standard deviation to measure risk at all, and instead only considered the possibility of losing money as risk. Research in Behavioral Finance supports common sense here in asserting that this is a reasonable assumption[v] (More on this in a moment).

Clearly, I would determine that the investment represented by the blue return distribution graph (**Figure 1**) is the more risky investment, since it has a much higher probability of losing $50 than does the investment represented by the green return distribution graph.

Another decision I may have made under MPT using SD to measure risk is that both investments were too risky because they both had too large an SD. Again if, instead, downside loss was my measure of risk, I would have kept the green indicator and discarded the blue.

Both investments have the same SD because they are equally volatile. That is, they both deviate from the expected return equally. Yet these are not equal investments: Green’s volatility is upside-biased and blue’s volatility is downside-biased.

Using SD as a measure of risk under MPT, I would have overlooked a great investment simply because it had unexpectedly positive upside returns, since upside volatility gets penalized the same as downside volatility. The idea that unexpected gain is as risky as unexpected loss shows the limits of the theoretical construct to appropriate what risk really means to the real-life investor.

Behavioral Finance: The psychology of investing

The systematic study of investor behavior is called Behavioral Finance, and researchers in this field have developed a rich view of risk as it manifests in the decision-making of real-life investors[vi]. An overview of the relevant findings on risk follows:

FEAR OF LOSS IS EXPONENTIAL. Anxiety over a loss increases exponentially as the magnitude of the loss increases.

UPSIDE MARGINAL UTILITY LEAKAGE. Happiness over a gain decreases as the magnitude of the gain increases. The investor's utility or "usefulness" for very high returns is not much higher than for merely good returns (there is utility "leakage").

JUMP DISCONTINUITY. There is a sudden leap in anxiety when returns go below a threshold, such as zero. This is called a "jump discontinuity" in the utility curve because the investor's utility for the returns "jumps" downward when the return is even the smallest fraction below zero (or the investor's minimum acceptable return).

RISK IS ASSYMETRICAL. The way we feel about losses is not the mirror image of how we feel about gains. The shape of the utility curve is different on the left than it is on the right.

RISK IS SITUATIONAL AND INVESTOR SPECIFIC. Standard deviation assumes every investor in the world views risk identically. Yet we know that people vary, and that even the same person views risk differently in different scenarios.

RISK IS RELATIVE TO A PERSONAL BENCHMARK, OR MAR (MINIMALLY ACCEPTABLE RETURN). This benchmark is not the mean or average return. Investors have goals they want to achieve and a rate of return that will accomplish those goals. The MAR, is therefore an investor-specific "hard target" such as 6 percent or 7 percent. Returns below the MAR are what investors fear.

Standard deviation as a measure of risk is not consistent with the way the concept of risk actually operates in investment decisions. To the degree that it assumes that risk can be measured by standard deviation, MPT will fail to account for the psychological or behavioral aspects of investor decision-making. A portfolio optimization algorithm that incorporates an investor's concerns about losing money would be more appropriate than MPT's standard deviation.

Markowitz himself said that "downside semi-variance" would build better portfolios than standard deviation. But as Sharpe notes, "in light of the formidable computational problems...he bases his analysis on the variance and standard deviation."[vii] Back in 1959, Markowitz did not have a Dell laptop with an Intel Core 2 Duo T7200, 2 GHz clock speed, 120 Gb hard drive and Microsoft Excel software.

High correlation between popular asset classes

Facing the correlation problem for better diversification

Correlation is a statistical term that describes the relationship between two investments in terms of the rise or fall of those investments relative to each other. Correlation enables an investor to determine how similar two investments are to each other.

A positive correlation means that the two investments tend to rise and fall together over time. A negative correlation indicates that the investments act differently, and when one investment is rising, the other tends to fall. Correlation value is on a scale from 1 to -1. A value of 1 indicates perfect positive correlation, or poor diversification, since it means that the two investments behave exactly alike.

A correlation of -1 indicates perfect negative correlation, or good diversification, since this means that the two investments behave exactly opposite to each other. Similarly, a correlation of zero means they act randomly with respect to one another, which is to say there is no correlation.

To reduce the risk of loss through diversification it is necessary to identify investments with low or even negative correlation to each other. The lower the correlation between A and B the more our risk of loss is reduced in an environment that causes one of the investments to go down.

The danger of “correlation convergence”

Consider the following example: The domestic equity asset classes that most investors recognize as the norm for allocating assets are the following:

- Large capitalization (cap) growth stocks
- Large cap value stocks
- Mid-cap growth stocks
- Mid-cap value stocks
- Small cap growth stocks
- Small cap value stocks.

Over the past 20 years especially, these equity asset classes have become highly correlated, (see **Figure 2** below). When the correlation among asset classes converges on 1, we lose the value of diversification to reduce risk (losses).

Figure 2

Correlation of Standard Domestic Equity Classes*

	Large Growth Stocks	Large Value Stocks	Small Growth Stocks	Small Value Stocks	Midsize Growth Stocks	Midsize Value Stocks
Large Growth Stocks	1.000					
Large Value Stocks	0.799	1.000				
Small Growth Stocks	0.822	0.653	1.000			
Small Value Stocks	0.689	0.792	0.853	1.000		
Midsize Growth Stocks	0.924	0.720	0.944	0.772	1.000	
Midsize Value Stocks	0.754	0.953	0.712	0.888	0.739	1.000

**Correlation Coefficient Dec-1986 to Jun-2007*

□ ***shaded red*** *= highest correlation* □ ***shaded green*** *= lowest correlation*

Traditional allocations = Russell Indexes

Figure 2 provides the correlation matrix for the domestic asset classes most investment advisors recommend to clients today. These asset classes have become highly correlated (as they are moving fairly close to 1). If you examine the green and red highlighted cells, you’ll notice the cell that is shaded red represents the worst or highest correlation (closest to 1) among any two different investments in the matrix.

Research shows that, in a down market, when diversification is most important, these asset classes become even *more* highly correlated. Various explanations have been given for the increased convergence of correlation variables. A herd mentality (especially in down markets) has been documented.[viii] It has also been hypothesized that the recent years of relatively low stock market volatility have contributed to this increase in correlation.

In my opinion, another reason for correlations among domestic asset classes converging upon the coefficient 1, i.e., correlation convergence is in part the increased availability and speed of information technology.

Discussion of the sources of correlation convergence among domestic asset classes may continue for years; yet, one thing is certain. All other variables being equal and held constant, allocating assets among a group of investment choices with low correlation to each other will reduce the risk of loss to a greater extent than allocating among a group of investment choices that are more highly correlated. This is the benefit of diversification.

The problem with limiting asset allocation criteria to risk, return and correlation

The need for a more robust and comprehensive model

In *The Volatility of Correlation Important Implications for the Asset Allocation Decision*),[ix] William J. Coaker demonstrates the instability of correlation variables and concludes that, "rather than rely on historical correlations, a more comprehensive and dynamic approach is needed in making asset allocation decisions."

Coaker's findings reflect that fact that the investment environment is constantly changing in a random fashion. Investor utility and the securities markets are affected by much more than return and risk (standard deviation). Economic and capital market factors that affect the markets include, for example:

- money supply
- capacity utilization
- GDP growth
- inflation
- dividend yields
- interest rates
- unemployment
- etc.

These variables and others need to be brought into the portfolio re-balancing decisions. Once again, a more robust and comprehensive model is needed to make asset allocation and re-balancing decisions.

MPT-derived portfolio optimization software lacks objectivity

Any investment adviser who regularly uses MPT asset allocation software soon confronts its idiosyncrasies. The software tends to allocate assets to the one or two best investment options only, (in terms of risk adjusted returns), recommending that all or virtually all assets be placed in the one or two investment options, depending on the level of risk to be maintained.

This is why MPT asset allocation software comes with a module for "freezing" or limiting the minimum and/or maximum allocation to every asset class.

For example, by freezing certain minimum required investments, you then guarantee a greater number of asset classes in the portfolio. In addition, it has become commonplace to think of a client's attitude toward risk as being some combination of stocks and bonds. That is, one may describe a client as having a 60/40 stock/bond comfort level with risk. This client might then be considered a moderate risk-taker.

By the same token, a conservative risk-taker may be defined as a 20/80 stock/bond allocation. Likewise, an aggressive risk taker is pegged as an 80/20 stock/bond investor and a 100% stock investor may be labeled very aggressive. This conception of risk has lead to the bond allocation being frozen at 20%, 40%, 60%, etc. within the optimization software. The MPT algorithm however, does not support this attempt to subjectively influence the "efficient frontier."

High trading and custodial costs

The Trouble with Mutual Funds

Although mutual funds offer a package of professional management and diversification, they also have significant problems, including high fees, hidden costs, uncertainty of holdings and uncertainty of taxes.

Volumes have been dedicated to explaining and uncovering the costs of mutual funds,[x] and there is little to add to the comprehensive critique provided by the writing career of John Bogle, father of The Vanguard Family of Index Funds. Nevertheless, there are a few points that are germane to this discussion.

Many individual investors diversify their investments by putting their money in one or several mutual funds. Typically, actively managed equity based mutual funds without commissions (no-load mutual funds), pay about 1% each year inside the fund, to manage and operate the fund. In addition, transaction costs to buy and sell the stocks that the fund owns adds another (undisclosed) 1% to an investor's cost to hold that investment.

When investors decide to liquidate their shares, and managers sell shares to provide cash for the redemptions, the fund may sell stocks for a gain. That sale triggers a taxable event. Now every investor must pay a share of the taxes from that gain, (whether the investor has been a shareholder for ten years or ten days). That tax cost can be an additional 1.5% of your investment each year. Add it all up and the annual cost of mutual fund investments can easily be 3.5% or more, not including any load fees, if the fund was purchased through a broker and a commission was charged for the purchase.[xi]

In general, the individual investor has little understanding of the impact of these fees on net return. "Just 43% of investors said they understood their adviser's fee structure 'completely' or 'fairly well,' according to a survey by Boston-based State Street Corp.'s investment management arm, and Knowledge@Wharton[xii], a business journal at the Wharton School of Business.

Fortunately, there are a number of services that can provide assistance in this area. One particular source that I recommend investors examine when reviewing their mutual fund holdings (or prospective holdings) is a website: http://www.personalfund.com. Here you can put in the name or symbol of your mutual fund to discover the true cost of ownership.[xiii]

Mutual Funds and Fear of the Unknown

Another problem with mutual funds stems from an investor's fear of the unknown, what has been observed in Behavioral Finance as, "aversion to ambiguity."[xiv] With the explosion of investment vehicles such as derivatives, aversion to ambiguity has caused investors to demand more transparency in their portfolios.

Arguably the greatest uncertainty problem that mutual funds cause is taxes. Mutual funds pass through all of the income and capital gains to shareholders; yet, *they cannot pass along losses*. In addition, shareholders typically aren't aware of these tax consequences until late in the year. Many funds wait until December 31st to make their capital gains distributions known. That doesn't give the investor enough time to make adjustments.

PART TWO
Toward an Improved Portfolio Optimization Model

Our analysis suggests that an improved model and its application would include four essential features:

- The optimization algorithm would be more robust, and eliminate the need to estimate the expected return for each asset class.
- A more relevant measure of risk, like downside loss, would replace standard deviation.
- The optimization model would be applied to asset classes that have truly low correlation to one another.
- The model would be applied using fee-sensitive investment vehicles to mitigate management and transaction costs as much as possible.

A more robust model eliminates estimating expected returns

In the ideal optimization algorithm, the asset allocation decisions would be directly tied to influential economic and capital market factors. Asset allocation and re-balancing would rely on a more comprehensive set of factors than risk, return and correlation. The model would be objective, with subjective inputs limited as much as possible.

A more relevant measure of risk: Downside loss

Insights and observations into the psychology of investing can enhance the practitioner's understanding and measure of risk. A core innovation of PMPT is its recognition that standard deviation is a poor proxy for how human beings experience risk. Risk is an emotional condition — fear of a bad outcome such as fear of loss, fear of underperformance, or fear of failing to achieve a financial goal. The optimal asset allocation model would consider "the possibility of loss" as the measure of risk.

Asset classes that have truly low correlation to one another

The standard approach for diversification among U.S. stocks is this: Buy some large growth stocks (or a large growth stock mutual fund) and some large value stocks (or large value mutual fund). In addition, buy some medium size growth stocks and value stocks (or similar mutual funds). Finally, to really diversify, you'll need some small growth and small value stocks as well.

Unfortunately, these investments have become too similar to each other (see **Figure 2** above) to reduce risk. This type of investment diversification is similar to a New York City street vendor who sells only umbrellas. To diversify he decides to add raincoats as well. Yes, he has diversified, but he hasn't reduced his risk of losing money when the sun is shining. Just as the New York City street vendor would be much better off with umbrellas and sunglasses, an investor should diversify his or her asset mix in such a way that the asset classes he/she uses are not too similar to each other.

The ideal portfolio optimization model would apply its asset allocation techniques to equity and fixed income asset classes with low correlation. The use of asset classes with substantially lower correlation would likely improve the risk adjusted return results of any asset allocation algorithm[xv].

An investment that mitigates management, trading and tax costs

The ideal approach to asset allocation and optimization would allow for the use of fee-sensitive investment vehicles. As we have seen, an investor using managed equity mutual funds can lose 3% – 4% of his assets annually to a combination of management fees, transaction expenses and taxes. This is before any commissions, 12b-1 fees, or advisory services.

From theory to practice: A case study in post-modern asset allocation

This case study traces the steps taken to implement the suggested enhancements in asset allocation modeling touched upon in this analysis. The goal was to develop and test a model that would improve the risk-adjusted returns for long-term investors. At the end of the case study, the reader will find risk and return results for the period from January 1, 1997 through September 30, 2007.

Selecting an asset allocation model

The first step was to select an asset allocation / portfolio optimization model. We selected a linear programming allocation algorithm developed by Richard Oberuc in his book, *Dynamic Portfolio Theory and Management.*[xvi] This appeared to be a flexible, robust model that:

- Can be set to a threshold of zero, providing a measure of risk in place of standard deviation that considers returns under zero as risk.[xvii]. The downside risk measure effectively deals with non-symmetric (skewed) return distributions as well.

- Does not require the use of expected returns and the covariance matrix required by MPT. This dramatically reduces the number of inputs required and potential errors.

- Employs a more comprehensive approach to determining initial optimal asset allocation and on-going re-balancing decisions. This is accomplished by regularly evaluating and re-evaluating capital and economic market factors.

A comprehensive and robust model

We applied Oberuc's asset allocation and optimization algorithm in conjunction with the effects of more than a dozen various market and economic factors to maneuver the portfolio holdings through time — *without* econometric models, mean reversion or sector rotation and without becoming trend followers or market timers.

The key is to determine which macro-economic factors affect the markets and how. There is no magic formula for determining a reasonable number of economic factors. Deciding on which factors will be operative is the result of disciplined research. That is, researching various books, papers and articles with the intent to identify empirical evidence of statistically significant relationships — between changes in a particular economic factor, and corresponding changes in the prices of various asset classes.

The anchor to the entire process is simply the goal to provide the strongest possible portfolio performance for the individual investor, given his or her acceptable level of risk.

Then we set about developing our model via a process of trial and error; always working with data that was pre-back test data, in this case, pre-1997 data. After we were satisfied with our proposed model, we applied it to the test period data January 1, 1997 through September, 30, 2007.

A more relevant measure of risk

We measured risk by the chances of return going below zero, rather than standard deviation, we used a downside risk measure to deal with non-symmetric (skewed) return distributions. We used a threshold of 0, i.e., we understood risk as going below zero.

Correlation

Low correlation between assets low correlation was objectively verified. Today, it is popular to segment the market into categories based on fundamentals and capitalization, (large value, large growth, mid-value, mid-growth, small value, small growth) to represent the whole market. In order to obtain consistently low correlation between asset classes, we keyed our segmentation not to capitalization but rather to fixed income, real asset and industry specific asset classes. For example, our categories included but were not limited to, energy, real estate, financials, basic materials, health care and technology (**Figure 3**). By comparing the matrix in **Figure 2** compared to **Figure 3** it becomes quite obvious that we allocate to asset classes with lower correlation.

Figure 3

Correlation of Alternative Equity Index Classes*						
	Technology	Energy	Financials	Healthcare	Materials	Real Estate
Technology	1.000					
Energy	0.341	1.000				
Financials	0.514	0.432	1.000			
Healthcare	0.536	0.331	0.586	1.000		
Materials	0.527	0.583	0.640	0.508	1.000	
Real Estate	0.286	0.334	0.522	0.343	0.489	1.000

**Correlation Coefficient Dec-1986 to Jun-2007*

□ ***shaded red*** *= highest correlation* □ ***shaded green*** *= lowest correlation*

The cell that is shaded green represents the best or lowest correlation (furthest from 1) amongst any two investments in the respective matrixes.

Costs

In order to reduce costs associated with actively managed mutual funds. We applied the model using ETFs where possible.

Results of case study

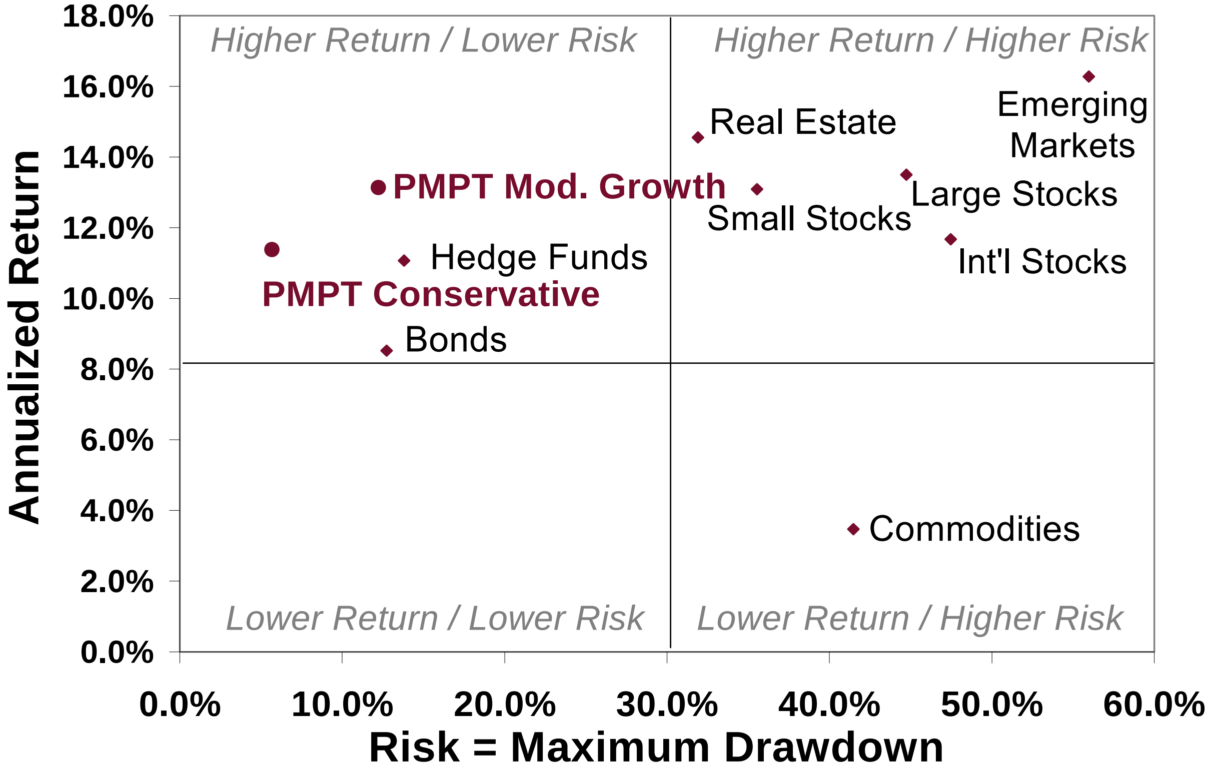
The chart below presents the risk-and-return results of two model portfolios relative to a portfolio of 100% stocks (S&P 500) and a portfolio of 60% stocks and 40% bonds (LBGC).

Important insights in the data

The risk adjusted returns for the PMPT portfolios below were favorable to a portfolio of 100% stocks or 60%/40% stocks/bonds, regardless of how you measure risk. It is important to note the horizontal graph uses drawdown as a measure of risk, rather than the typical risk/return graph, which uses standard deviation.

Notice also the PMPT M*oderate* Growth portfolio's standard deviation versus the standard deviation of the 60/40 stock/bond portfolio. The 60/40 portfolio has a lower standard deviation while PMPT *Moderat*e Growth has a much lower drawdown. This means that PMPT's returns are more volatile but the volatility is skewed to the upside … the *good* volatility.

Risk-Return Comparison
PMPT Dynamic Models vs. Indexes (Jan 97 – Sep 07)



LEGEND

Bonds = Lehman Aggregate Bond Index**;** **Commodities** = DJ AIG Commodity Index; **Emerging Mkts** = MSCI Emerging Markets Free Index; **Int'l Stocks** = MSCI EAFE Index; **Hedge Funds** = Credit-Suisse Tremont Hedge Fund Index**;** **Int'l REITs** = S&P/Citgroup World REIT; **Large Stocks** = S&P 500 Index Total Return; **Small Stocks** = Russell 2000 Index

The Case Study's Model Portfolios Compared to S&P and a 60/40 Stock/Bond Blend

Statistical Measure PMPT Jan 97- Dec 07	PMPT Moderate Growth	PMPT Moderate Conservative	S&P 500	60/40 Stock-Bond Portfolio
Compound ROR	12.70%	11.15%	8.15%	7.68%
Standard Deviation	12.22	7.61	14.9	11.25
Sharpe (5%)	0.64	0.79	0.27	0.28
Sortino (5%)	0.90	1.25	0.28	0.32
Best Month	12.64%	7.46%	9.78%	8.19%
Worst Month	(11.24)%	(5.03)%	(14.46)%	(10.98)%
% Positive Months	65.91	65.15	62.12	62.12
Maximum Drawdown	(11.70)%	(5.92)%	(44.73)%	(21.36)%
Months in Max Drawdown	2	5	25	25

Data net of trading and custody fees and gross of investment advisory fees.

Final Summary

Advances in computer technology, research in portfolio management and behavioral science allow us to carefully reconsider the founding framework of MPT. These advances, and the development of a profession dedicated to investment management, are beginning to challenge the status quo. For example, now we understand that:

- It may be dangerous to our client's financial health to subjectively make adjustments to asset allocation software.

- Equating risk with standard deviation implies that clients are indifferent to an investment's upside volatility or downside volatility. This violates logic, when we know investors are much more concerned with unexpected losses.

- Certain asset classes are showing signs of increasing correlation convergence. Our clients can't reduce their risk through diversification without investing in asset classes with low correlation.

- The economy, investment markets, and investor utility are all affected by more than risk, return and correlation. Therefore, asset allocation models need to be robust enough to consider additional capital and economic factors and apply them to asset allocation and re-balancing decisions.

- Finally, managed mutual funds have a total fee structure (including pass through taxes) that if reduced or eliminated could improve client returns.

Post-Modern Portfolio Theory and research in Behavioral Finance have pointed the way to applications and technologies that can improve investment results and catapult the MPT principles to a new level of usefulness. These improvements are available today for professional investment advisors to apply in order to improve the lives of those who rely on them to reach their financial objectives, you can:

- Use an allocation optimization algorithm that can be applied objectively with limited subjective involvement
- Apply a measure of risk based on the possibility of loss
- Use a more robust model for determining and re-balancing a portfolio's optimal asset allocation as capital market and economic factors change.
- Allocate portfolios among low correlated assets to better reduce risk (chance of loss) through diversification
- Reduce the cost of investing by allocating portfolios among investments other than expensive mutual funds.

[i] Harry M. Markowitz, *Portfolio Selection*,(New Haven, CT: Yale University Press, 1959).

[ii] For details of the 1990 Nobel Prize in economics and its three winners, go to www.nobelprize.org

[iii] John Rekenthaler, *Strategic Asset Allocation: Make Love, Not War, Journal of Financial Planning*, September 1999. Also see Harold Evensky, *Wealth Management*, (McGraw Hill Companies: New York, 1997), chapter 9.

[iv] See *Post-Modern Portfolio Theory*, by Pete Swisher, and Gregory W. Kasten, FPA Journal, September of 2005. See also, Market Timing, December 1, 2005, Revised: September 1, 2006 at: http://homepage.mac.com/j.norstad/finance/rtm-and-forecasting.html

[v] Frank Sortino, *Alpha to Omega*, in *Managing Downside Risk in Financial Markets.*

[vi] See *Post-Modern Portfolio Theory*, by Pete Swisher, and Gregory W. Kasten, FPA Journal, September of 2005 . See also, *Market Timing*, December 1, 2005."

[vii] Harry M. Markowitz, *Portfolio Selection*, (New Haven, CT: Yale University Press, 1959).

[viii] See Charles Ellis, *Winning the Losers Game*, McGraw Hill Professional, 2002.

[ix] See William J. Coaker II, *The Volatility of Correlation Important Implications for the Asset Allocation Decision*, Journal of Financial Planning. http://www.fpanet.org/journal/articles/2006_Issues/jfp0206-art7.cfm

[x] John Bogle's most comprehensive work on mutual funds is, *Bogle on Mutual Funds: New Perspectives for the Intelligent Investor*, (Dell Publishing, 2000).

[xi] See Richard Rutner, *The Trouble with Mutual Funds*, (North America Press, 2004), currently out of print.

[xii] http://knowledge.wharton.upenn.edu/category.cfm?cid=1

[xiii] This website has received many favorable reviews. For example: *Consumer Federation of America*: "This site provides investors with

important information that could potentially save them thousands of dollars."

[xiv] Hersh Shefrin, Be*yond Greed and Fear*, (Oxford University Press).

[xv] Emphasizing Low-Correlated Assets: The Volatility of Correlation *by William J. Coaker II, (Journal of Financial Planning, September 2007.*

[xvi] Richard Oberuc, *Dynamic Portfolio Theory and Management: Using Active Asset Allocation to Improve Profits and Reduce Risk*, (McGraw-Hill Companies).

[xvii]See, *Post-Modern Portfolio Theory*, by Pete Swisher and Gregory W. Kasten, FPA Journal, September, 2005. See also, Richard Oberuc, *Dynamic Portfolio Theory and Management: Using Active Asset Allocation to Improve Profits and Reduce Risk*, (McGraw-Hill Companies).

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