

Post-Modern Portfolio Theory

Introduction

Modern portfolio theory (MPT) and its mean-variance optimization (MVO) model for asset allocation are Nobel Prize-winning theories of global equilibrium, but are unreliable for the primary task to which the financial services industry applies them-building portfolios. Post-modern portfolio theory (PMPT) presents a new method of asset allocation that optimizes a portfolio based on returns versus downside risk (downside risk optimization, or DRO) instead of MVO.

The core innovation of PMPT is its recognition that standard deviation is a poor proxy for how humans 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. Risk is thus more complex than simple variance but can nonetheless be modeled and described mathematically.

PMPT points the way to an improved science of investing that incorporates not only DRO but also behavioral finance and any other innovation that leads to better outcomes.

History

In 1959, Harry Markowitz, the "father of modern portfolio theory," published *Portfolio Selection*, in which he proposed that investors expect to be compensated for taking additional risk, and that an infinite number of "efficient" portfolios exist along a curve defined by three variables: standard deviation, correlation coefficient, and return. The efficient-frontier curve consists of portfolios with the maximum return for a given level of risk or the minimum risk for a given level of return. The algorithm used to generate the curve is known as mean variance optimization (MVO), since what is being optimized is return versus standard deviation, or variance from the mean return. The work eventually won Markowitz a share of the 1990 Nobel Prize.

One of those he shared the prize with was William Sharpe, who extended Markowitz's work. Sharpe credits Markowitz for taking a personal role in helping shape the doctoral dissertation that led to the capital asset pricing model, or CAPM. In Sharpe's words: "The CAPM is built using an approach familiar to every micro economist. First, one assumes some sort of maximizing behavior on the part of participants in a market; then one investigates the equilibrium conditions under which such markets will clear." Later work from Sharpe gave us the information ratio, a version of which became known as the Sharpe ratio-the first major attempt to create a measure for comparison of portfolios on a risk-adjusted basis.

But MPT and CAPM were not originally created for the purpose to which our industry has adapted them - asset allocation. The theoretical foundation created by Markowitz and Sharpe was an equilibrium model that attempts to solve the investment problem for all investors simultaneously. To answer the question of how to build better portfolios-how to optimize-MPT is no longer the best (or only) tool for the job.

The term 'Post Modern Portfolio Theory (PMPT)' was created in 1991 by software entrepreneurs Brian M. Rom and Kathleen Ferguson to differentiate the

portfolio-construction software developed by their company, Investment Technologies, from those provided by the traditional Modern Portfolio Theory'. It first appeared in the literature in 1993 in an article by Rom and Ferguson in The Journal of Performance Measurement. It combines the theoretical research of many authors and has expanded over several decades as academics at universities in many countries tested these theories to determine whether or not they had merit. The essential difference between PMPT and the modern portfolio theory of Markowitz and Sharpe (MPT) is that PMPT focuses on the return that must be earned on the assets in a portfolio in order to meet some future payout. This internal rate of return (IRR) is the link between assets and liabilities. PMPT measures risk and reward relative to this IRR while MPT ignores this IRR and measures risk as dispersion about the mean or average return. The result is substantially different portfolio constructions.

Empirical investigations began in 1981 at the Pension Research Institute (PRI) at San Francisco State University. Dr. Hal Forsey and Dr. Frank Sortino were trying to apply Peter Fishburn's theory published in 1977 to Pension Fund Management. The result was an asset allocation model that PRI licensed Brian Rom to market in 1988. Mr. Rom heard someone at a conference use the term PMPT and began to use the term to market PRI's allocation model. Sortino and Steven Satchell at Cambridge University co-authored the first book on PMPT. This was intended as a graduate seminar text in portfolio management. A more recent book by Sortino was written for practitioners. The first publication in a major journal was co-authored by Sortino and Dr. Robert van der Meer, then at Shell Oil Netherlands. The concept was popularized by numerous articles by Sortino in Pensions and Investments magazine.

Sortino claims the major contributors to the underlying theory are:

- Peter Fishburn at the University of Pennsylvania who developed the mathematical equations for calculating downside risk and provided proofs that the Markowitz model was a subset of a richer framework.

- Atchison & Brown at Cambridge University who developed the three parameter lognormal distribution which was a more robust model of the pattern of returns than the bell shaped distribution of MPT.
- Bradley Efron, Stanford University, who developed the bootstrap procedure for better describing the nature of uncertainty in financial markets.
- William Sharpe at Stanford University who developed returns based style analysis that allowed more accurate estimates of risk and return.

Features of Post Modern Portfolio theory

Total Variability of Return

By using Modern Portfolio theory, the risk was defined as the total variability of returns around the mean return. It handled all uncertainty the same. “Risk was not symmetrical-it was severely skewed, with the greatest concern was that it was downside” as indicated by Brian M. Rom & Kathleen W. Ferguson, (1994).

The importance of skew lied in the fact that non-normal return series was its true risk which was distorted by Modern Portfolio Theory measure. In another study by Harlow, W.V.(1991) he mentioned that with the introduction of the Post-Modern Portfolio Theory, which was able to capture more accurate information towards the returns under consideration. “PMPT recognized that investment risk should be tied to each investor’s specific goals and that any outcomes above this goal did not represent economic or financial risk.” (Brian M. Rom & Kathleen W. Ferguson, 1994).

In the theory of Post Modern Portfolio, the investor’s target rate of return was called the Minimum Acceptable Return. “Minimum acceptable return, represents the rate of return that must be earned, to achieve some important financial objective” (Brian M. Rom & Kathleen W. Ferguson, 1994). Because Minimum Acceptable Return is investor specific, it meant that there were an infinite number of efficient frontiers where one for each minimum acceptable

returns. This meant that Post-Modern Portfolio Theory was more accurately reflected the reality that there had different aims and an inclination for risk in different investors.

Downside Risk Optimization

Post-Modern Portfolio Theory presented a new method of asset allocation that optimizes portfolio based on returns versus downside risk called Downside Risk Optimization instead of Mean-Variance optimization.

By using the downside risk formula these three elements had been established.

1. Downside frequency - The frequency, expressed as a percentage, of returns below Minimal Acceptable Return.

2. Average downside deviation - The average size of the deviation below the Minimal Acceptable Return.

3. Downside magnitude - The worst-case scenario, represented by the return below Minimal Acceptable Return at the 99th percentile.

These three statistical methods had been combined into a single downside risk measure. Each of these measures is defined with reference to an investor-specific minimal acceptable return as shown by Pete Swisher, (2005). The result was expressed as a percentage, much like standard deviation, and the values themselves might even be similar.

There are several ways to view downside risk

View the downside risk is the annualized standard deviation of returns below the target. Another is the square root of the probability-weighted squared below-target returns. The squaring of the below-target returns has the effect of penalizing failures at an exponential rate.

There are two formulas for Downside risk.

Continuous form

$$t = \text{annual target return} \quad \sqrt{\int_{-\infty}^t (t-r)^n df(r)}$$

r = random variable representing the return for the distribution of annual returns $f(r)$.

$f(r)$ = normal or three parameter lognormal distribution.

Discrete form

$$3.464 \sqrt{\frac{E(t-r)^n}{n}}$$

3.464 = the square root of 12, the factor used to annualize the monthly downside risk.

E = mathematical Expectation operator

t = monthly target return

r = random variable representing operator monthly return

n = total number of monthly returns observed

The continuous form is more preferable because it permits the calculation to be made using annual returns. It helps investor to specify their investment target. While for discrete formulas, it requires monthly returns and in return investors to change the annual target into a monthly targets as indicated by Frank A. Sortino & Stephen E. Satchell, (2001).

Volatility skewness

Many researchers had stated that not all the distribution is normal. In Modern Portfolio Theory normal distribution is carried out. In using normal distribution to model the pattern of investment returns, it creates the investment that result with more upside than downside returns which looks as if it is more risky than they actually are, and vice versa for returns with more a prevalent

downside returns. It can be concluded that by using the Traditional Modern Portfolio Theory for measuring the portfolios it often distorts the investment reality. Fortunately, with the introduction of hedging and derivative strategies, asymmetrical are designed and used in Post-Modern Portfolio Theory. Volatility is another concept that was introduced by Post-Modern Portfolio Theory enthusiasts.

Vishal Mewasingh (2006) indicated that Post-Modern Portfolio Theory was able to capture significantly more true information.

Sortino Ratio

risk optimization sortino

Sortino Ratio was introduced by Sortino and Price (1994), and it is used to measure risk adjusted returns for the target and downside risk. It is a modified version of Sharpe ratio. It assists investment manager or investor to estimate portfolio risk. Sharpe ratio was developed by Nobel Laureate economist William Sharpe, this ratio measures risk adjusted performance. Richard Loth, (2010) indicated that the theory measured the excess return or called Risk Premium per unit for an investment stock per strategy. It quantifies the return (alpha) over the volatility (beta) that assumed in the portfolio.

Sortino Ratio	Sharpe ratio
$S = \frac{R - T}{DR}$	$S = \frac{E(R_p) - E(R_f)}{\text{std.dev.}[E(R_p) - E(R_f)]}$
<p>R = annual rate of return for the investment</p>	<p>R = asset return</p>
<p>T = required rate of return</p>	<p>R_f = return on a benchmark asset, such as risk free rate</p>
<p>DR = downside risk, square roof of the target semi-variance.</p>	<p>σ = Standard deviation of the asset.</p>

Source: Brian M. Rom & Kathleen W. Ferguson, (1994)

However, the modified version - Sortino ratio only comprised of downside risk as a deviation from the norm of minimum acceptable return. Compared to

Sharpe ratio which penalized both upside and downside volatility equally, Sortino ratio penalized only those returns falling below a user-specified target. Thus, measured risk adjusted return had treated risk more realistic than the Sharpe ratio.

Conclusion

The future is uncertain, and so are human beings. Remember the earlier quote from Sharpe: "First, one assumes some sort of maximizing behavior on the part of participants in a market." But behavioral research tells us that market participants do not exhibit maximizing behavior-investors are not rational. Investor irrationality wreaks havoc on attempts to build an equilibrium model, yet it is real-more real and more pertinent to successful investing than the mathematics of global equilibrium. PMPT provides fertile ground for an attempt to integrate behavioral finance into portfolio theory.

Here is a sample of these related veins of thought about PMPT from a presentation by analyst David Nawrocki. "Post-modern portfolio theory...is a closer match to investor behavior..." and "the appropriate response to a nonstationary world is to be adaptive through gradual adjustments to beliefs or expectations...You cannot forecast 20–30 years into the future but you can steer a path through the future with small-to-major adaptations for 20–30 years." By molding the mathematical tools of allocation to fit human behavior and by incorporating the inherently unstable or "nonstationary" nature of reality into portfolio theory, PMPT can provide genuinely useful insights to make us better advisors.

References

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