

Interventions of Modern Portfolio Theory and Behavioral Portfolio Theory from An Economic Lens

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Abstract: This research publication assesses the intersections of and differences within the Modern Portfolio Theory (MPT) and Behavioral Portfolio Theory (BPT) through the applications of portfolio return optimization and diversification. Through exploring some of the empirical data and case studies, this research publication concludes upon how the Behavioral Portfolio Theory is utilized to better explain real-world investment behaviors, while the Modern Portfolio Theory is utilized to dominate both institutional and quantitative investments. This research paper also strives to assess the role and implications of diversifying the investment performances, and explores the computational applications of blockchain technologies and algorithmic trading on financial literacy of youth. Ethical considerations like the accessibility gap in portfolio optimization as well as the lack of ESG filtering will be addressed in this paper, by discussing the ethical contradictions.

1. Introduction

Modern Portfolio Theory (MPT) and Behavioral Portfolio Theory (BPT) were developed during distinct financial eras, each responding to different challenges in investment management. MPT was introduced by Harry Markowitz in 1952, and emerged during a time when global economies were recovering from WW2, and financial markets were expanding. As investors gained access to more data and computational tools, MPT revolutionized portfolio construction by applying statistical methods to minimize risk for a given level of return, establishing the foundation for following financial theories, like the Capital Asset Pricing Model. However, as market volatility showed the limitations of MPT, Behavioral Portfolio Theory, which was introduced by Thales of Miletus, emerged in the 1990s. BPT incorporates insights from psychology, which shows how investors' decisions are influenced by emotions and biases as well. It proposed that people mentally separate their wealth into layers which represent different goals, rather than optimizing a single portfolio based on risk and return.

2. Analysis of the Modern Portfolio Theory

Modern Portfolio Theory (MPT), first introduced by Harry Markowitz in 1952, provides a framework for constructing diversified investment portfolios to maximize returns for a given

level of risk (Sturgeon, 2023). The theory quantifies risk using the standard deviation of returns and emphasizes diversification by investing in assets that are not perfectly correlated. MPT calculates the total variance of a portfolio using the formula: $\sigma_p^2 = \sum(w_i^2 \sigma_i^2) + \sum(w_i w_j \rho_{ij} \sigma_i \sigma_j)$ for $i \neq j$, where w_i is the weight of each asset, σ_i is its standard deviation, and ρ_{ij} is the correlation between assets i and j . By considering the covariance between securities, MPT reduces overall portfolio volatility and enhances risk-adjusted returns. In the context of real estate, MPT is used to distinguish between systematic (market-related) and unsystematic (asset-specific) risk, allowing developers and investors to optimize their asset allocation based on empirical data and quantitative modeling (Wen, 2023).

In Wen's study, MPT was applied to a real estate investment portfolio consisting of two asset types: Investment A and Investment B. Investment A had an expected return of 14%, a variance of 0.9%, and a beta of 1.2, while investment B offered an expected return of 10%, a variance of 0.5%, and a beta of 0.8 (Wen, 2023). The assumed market variance was 0.4%, and the correlation coefficient between the two investments was 0.2. These values were used to calculate each investment's total risk, which was then decomposed into its systematic and unsystematic components. For Investment A, the systematic risk was 0.576% and the unsystematic risk was 0.324%, meaning 64% of its total risk was attributed to market factors. For Investment B, the systematic risk was 0.256%, and the unsystematic risk was 0.244%, giving it a total market risk contribution of 51.2%. Using these inputs, Wen applied a mathematical model to find the optimal asset weights that minimize portfolio risk while maintaining a high expected return. The result was a portfolio weighted 30% in Investment A and 70% in Investment B. This allocation yielded an expected return of 11.2% with a total portfolio variance of only 0.2095%, which is significantly lower than the variance of either asset held individually. This demonstrates the power of diversification and the effectiveness of MPT in constructing real estate portfolios with superior risk-return profiles.

To support the effectiveness of the optimized MPT portfolio, Wen used historical monthly returns over a 10 year period, resulting in about 120 data points per asset. The average monthly return for investment A was 1.17%, and 0.83% for Investment B, with standard deviations of 2.8% and 2.2% respectively. The final portfolio, with 30% in A and 70% in B, achieved a mean return of 0.94% and a lower standard deviation of 1.45%. A paired t-test comparing this portfolio to hold Investment B alone gave a t-value of 2.47 and a p-value of 0.015, confirming the improved return was statistically significant at the 5% level. These results show that combining assets with low correlation ($\rho=0.2$) can lower risk and improve outcomes, just as MPT predicts (Wen, 2023). With interest rates and asset correlations stabilizing in 2022, Sturgeon notes that MPT-based diversification is becoming even more effective in today's market (Sturgeon, 2023).

However, there are drawbacks to using MPT in real estate, such as challenges in acquiring standardized data, which can complicate risk and return calculations, particularly in developing markets. Additionally, investors may need to rely on professional managers due to the inherent complexity of real estate management. Despite these challenges, MPT offers a valuable framework for systematic risk management and asset allocation in real estate investments (Wen, 2023).

At the same time, recent shifts in the broader investment landscape have strengthened the appeal of MPT beyond real estate. With fixed income yields and interest rates now stabilized, balanced portfolios can produce returns from a variety of asset types in addition to stocks. This change makes it possible for strategies based on MPT to function more consistently again, since investors are no longer forced to allocate their capital to riskier stocks in order to reach return goals. With greater diversification benefits and more reasonable return expectations, the current investment climate indicates that MPT is well positioned to guide effective portfolio construction going forward (Sturgeon, 2023).

3. Analysis of the Behavioral Portfolio Theory

Behavioral portfolio theory (BPT) is an alternative to traditional investment models like the Modern Portfolio Theory (MPT) and the Capital Asset Pricing model (CAPM). Instead of only focusing on the risk and returns, BPT considers how real people actually think and feel about money, explaining real world behaviors by considering how people set goals and view money differently. BPT is split into 2 models: the Single Mental Account (BPT-SA), which is similar to MPT but uses expected wealth and downside risk instead of variance, and the Multiple Mental Account (BPT-MA), where investors separate their portfolios into multiple mental accounts, which correspond to specific aspiration levels (Shefrin, 2010). This can be seen from Oehler and Horn's 2020 study, where they applied BPT to data from 3,565 German households in the Deutsche Bundesbank Panel on Household Finances (Oehler & Horn, 2020). They applied both BPT and Merton's consumption-portfolio model (CPCM) to estimate relative risk aversion (RRA). Their regressions showed that households' risk-taking increases with wealth under both models, but BPT had a better statistical fit (Oehler & Horn, 2020). Their regression analysis revealed that households displayed decreasing RRA, meaning that as wealth increased, so did the proportion invested in risky assets ($\gamma > 0$ in $\ln(X_h) = \gamma \ln(W_h) + \varepsilon$) (Oehler & Horn, 2020). This pattern stayed consistent even when controlling for age, gender, income, and self-reported risk tolerance. This suggests that BPT's model better captures how households actually make investment decisions (Oehler & Horn, 2020).

4. Impact of Asset Allocation on BPT-Based Portfolios

Economists have established Behavioral Portfolio Theory as a stark contrast from the Modern Portfolio Theory in the sense that asset allocation is not derived from a single utility but from a layered portfolio structure (Shefrin, 2010). Investors practice mental accounting where they can separate their wealth into distinct accounts rather than treating it as a whole, where seemingly both risk-averse and risk-seeking behaviors can be seen (Shefrin, 2010). For instance, they may allocate one part of their portfolio to safe bonds, while placing another in high-risk, high-reward portfolios. This means that the diversification method based on BPT tends to be layer-specific

rather than portfolio-wide. Essentially, in contrast with the Modern Portfolio Theory, the Behavioral Portfolio Theory is built upon the preconception that investors build portfolios that are all representing a different mission and objective—for instance, safety, security, ambition, or legacy. The BPT also serves as an explanation as to why in the real world, some investors ignore correlation data or fail to rebalance portfolios, and why investors may choose to dedicate their wealth in one group of employer stock or real estate. Another group of economists identified how there are upper layers and lower layers. For instance, when investors may choose high risk and high return assets like growth stocks with high potential to succeed or decline as well as real estate, other investors may choose low risk and low return assets such as government bonds or savings accounts. This diversification strategy resembles how the MPT theory is segmented rather than holistic, with each layer having different logic and risk tolerance.

5. The Role of Diversification on MPT-Based Portfolios

According to the theory of MPT (Modern Portfolio Theory) that was introduced by Harry Marowitz, diversification allows investors to minimize portfolio risk without sacrificing their expected returns. Through creating a portfolio that lies on the efficient frontier, researchers can ensure the highest level of return based on the risk. For one, diversification can ensure lower unsystematic risk—this is because as based on the Warsaw Stock Exchange, a portfolio of carefully selected and low-correlated stocks tend to perform better in terms of risk-adjusted returns. Furthermore, researchers witnessed how a portfolio that consists of 3-5 diversified WSE stocks achieved a lower standard deviation compared to any individual stock (Grujic, 2016). Furthermore, the Sharpe ratio increased when diversification and risk-free assets were combined, enhancing performance for a given level of total risk. Even in less developed markets like Poland's WSE, portfolio construction through diversification results in lower volatility and more stable growth, reinforcing MPT's foundational role in investment strategy. Researchers also witnessed some of the limitations associated with the use of diversification by relying upon the Modern Portfolio Theory. For instance, one of the limitations lies in how this theory relies upon linear correlations and static models that may not hold during market stress. However, in contrast, applying AI and Machine Learning can help establish non-linear relationships between assets that can lead to greater diversification, incorporating a greater range of risks and market signals as well. (Adewale, 2024). In other words, neural networks and reinforcement learning can lead to greater diversification, made possibly through the construction of AI systems that can adjust to market shifts in real-time (Adewale, 2024).

6. Case Study Analysis Based on Investment Performance

One group of researchers revealed a comparative case study based on three forms of portfolios that have identical, but different expected returns—being, the Behavioral Portfolio Theory,

Mean-Variance Model, as well as the Naive diversification model. It was established that all three portfolios were designed to have the same expected return of 6% (Clark, 2014). However, there were prominent differences as well in regards to their risk exposure, coupled by psychological outcomes and impact on investors. For instance, investments in the BPT portfolio significantly reduced their downside risk due to the protective bottom layer, whereas the investments in the MPT portfolio expected investors to have larger losses in tail-risk scenarios (Clark, 2014). On the contrary, investments in the Mean-Variance and Naive Diversification Model performed poorly due to a lack of strategy that was mobilized and adapted. Out of all three, when analyzing and reviewing the performance evaluation, it is prominent to consider that the BPT portfolio demonstrated significant advantages whereby the investments represented a strong hedge against risk, in other words, showing downside risk protection. In comparison to this, the MPT portfolio exposes the entire portfolio to volatility, which can result in greater emotional distress. In essence, while the MPT portfolio shows greater statistical adherence and mathematical optimization, the BPT case studies showed greater portfolio optimization that was closely aligned with the goals of investors. This is because the MPT theory assumes that risk tolerance is constant, which can actually oversimplify how people actually behave with their money. In contrast, the BPT case studies demonstrate the value behind enhancing the perceived performance of investment portfolios.

7. Ethics, Discussion, Limitations

When considering the applications of MPT and BPT theory, it is also crucial to consider some of the ethical contradictions and limitations associated with this practice. First of all, it is crucial to consider that MPT portfolios require proper accessibility to financial advisors and investment advisors that are able to help them diversify their portfolios. However, this means low-income investors may not have the same line of privilege to access such services, portfolio and products, which broadens the gap in financial accessibility and literacy. In addition to this, the MPT theory ignores certain ethical factors such as ESG investing. Furthermore, if the primitive focus is on high-profit in maximizing the returns, then there may be dedicated attention towards certain companies that generate high yield, but have destructive impacts on our world, economy, and environment. For instance, companies like Chevron, Shell, and ExxonMobil have consistently established a great yield for investors due to the fact that gas is considered a necessity in the modern economy. However, because of this, huge sources of investments into companies that contribute to green-house emissions could pose a risk to the entire economy and environment, further accelerating issues such as global warming. Hence, a solution that can hedge this risk would be to integrate ESG scores to outweigh the investment performance to environmental and socio-economic factors where 'impact investing' can be prioritized to consider only the investments that create measurable impact on our world.

On the contrary, BPT recognizes that people don't always invest logically. They often set different aspirations and put money into separate mental accounts for each aspiration. But, when they do this, they tend to ignore how the investments in different mental accounts might affect each other. Ignoring these relationships can lead investors to create portfolios that are not well-diversified, resulting in lower returns or greater risk than portfolios built using mean-variance optimization, which carefully considers these connections. Because of this, BPT may lead to suboptimal outcomes, especially for investors focused on efficiency, long-term growth, or institutional-level strategies. This means that even though BPT tries to explain real-world behavior, the portfolios it describes aren't usually the most efficient compared to traditional models. BPT is also very complex, as it models multiple aspiration levels for each investor, such as avoiding poverty, maintaining security, and striving for wealth, which can vary greatly from person to person. This makes the theory difficult to apply and test using real-world data. Additionally, it also creates a conflict with describing how investors actually behave and how they should behave to make most efficient investment choices (Oehler & Horn, 2020).

8. Conclusion

In conclusion, the interplay between Modern Portfolio theory (MPT) and Behavioral Portfolio Theory (BPT) reveals that effective portfolio construction is not solely a matter of mathematical optimization, but also of understanding human behavior and real-world complexity. MPT provides a rigorous, data driven framework for minimizing risk through diversification, and has proven effective in both traditional markets and real estate applications. Its ability to quantify and reduce unsystematic risk, especially when enhanced by technologies like AI, makes it a powerful tool for constructing efficient portfolios. On the other hand, BPT offers a compelling psychological lens by accounting for how investors mentally separate their goals, tolerate risk unevenly, and behave inconsistently with rational models. While BPT may sacrifice some efficiency, it better reflects the layered motivations and emotional realities of real investors. However, both models face limitations, including MPT's accessibility gap with a lack of ethical filters, and BPT's complexity and occasional inefficiency. Ultimately, a hybrid approach, rooted in the analytical strengths of MPT and the human-centered insights of BPT, may offer the most effective path forward for designing portfolios that are not only optimized, but also inclusive, adaptive, and ethically grounded.

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