Research on the Investment Portfolio in Technology and Consumer Goods Industries

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Abstract. This research investigates investment portfolios in the U.S. technology and consumer goods sectors, employing Modern Portfolio Theory (MPT) and the Markowitz Model to analyze and compare their risk-return profiles. The study highlights that the technology sector demonstrates a high-risk and high-return profile, making it attractive for risk-seeking investors aiming for significant gains amidst market volatility. In contrast, the consumer goods sector, with lower volatility, appeals to risk-averse investors who prefer stable and predictable returns. Key findings strongly emphasize the importance of aligning investment choices with individual investor preferences, illustrating how specific industry characteristics can influence investment strategies. The research suggests that investment success is considerably enhanced when portfolios are tailored to match individual risk tolerance and investment goals. This strategic approach provides a robust framework for guiding investors to make informed decisions that reflect their personal preferences and financial objectives, thereby helping them navigate market complexities and enhance portfolio performance.

Keywords: Investment portfolio, technology sector, consumer goods sector, Markowitz Model, risk-return profile.

1. Introduction

In a comprehensive examination of investment strategies in the energy sector, researchers have leveraged advanced risk assessment models to analyze the dynamics of different energy markets. Focusing on the Japanese power sector, Bhattacharya and Kojima utilized portfolio risk optimization techniques to demonstrate how renewable energy mitigates investment risks linked to the volatility of fossil fuel prices and other cost factors [1]. Similarly, Milford et al. employed the Stochastic Energy Deployment System (SEDS) to integrate system dynamics with Monte Carlo simulations to evaluate the potential outcomes of different research and development (R&D) investment strategies in the energy industry, considering various uncertainties. Their findings highlight the importance of incorporating risk and uncertainty into decision-making to optimize resource allocation and achieve national technology goals effectively [2]. Expanding on these concepts, Madlener and Wenk applied the Mean-Variance Portfolio Theory to the Swiss electricity sector, utilizing Monte Carlo simulations and a Net Present Value (NPV) model to achieve a balance between risk and return in power generation technologies [3]. Their study aligns with the broader theme that effective risk management can significantly enhance investment strategies.

Further exploration into the clean energy market by Kuang revealed that, although clean energy stocks generally underperform relative to the broader equity market, they exhibit superior performance compared to fossil fuel stocks when considering risk-adjusted returns. This finding supports strategies that prioritize minimizing tail risks over merely reducing variance, specifically for investments in renewable energy project developers and operators who are best suited for investors with moderate risk tolerance [4]. Lastly, by applying behavioral finance and institutional theory, Masini and Menichetti's research into the renewable energy sector explored how non-financial factors such as beliefs, institutional pressures, and attitudes toward technology significantly influence investment decisions. Their findings, derived from a survey of European investors, illustrate the substantial impact these factors have on the diversity and proportion of renewable energy within investment portfolios [5]. This study underscores the complexity of investment decisions in the

energy sector, extending beyond traditional financial analyses to include behavioral and institutional dimensions.

In a detailed exploration of investment strategies within emerging markets, Demir and Gupta, along with Basu, utilized sophisticated econometric models to analyze investment dynamics. Demir employed a portfolio choice model to examine the impacts of financial liberalization on investment decisions in Argentina, Mexico, and Turkey. He found that firms increasingly favor short-term financial investments over fixed investments, attributing this preference to the higher returns and greater flexibility offered in the face of economic uncertainty [6]. Additionally, Gupta and Basu applied the Asymmetric Dynamic Conditional Correlation (DCC) GARCH model to delve into the Indian stock market. Their research provides more accurate estimations of future correlations between industry sectors, enhancing portfolio optimization and demonstrating that sector-specific diversification can significantly improve the return-to-risk ratio [7].

Arouri and Nguyen used econometric models to explore the relationship between oil price fluctuations and stock market returns across different sectors in Europe. They discovered that sector responses vary significantly based on their economic sensitivity to oil prices. Their findings concluded the strategic value of incorporating oil assets into investment portfolios, enhancing the risk-return profile due to the critical influence of oil price dynamics on sector-specific investment decisions [8]. Furthermore, Peng and Newell analyzed the role of infrastructure within Australian superannuation funds using listed and unlisted infrastructure indices. Their study assessed the performance and investment characteristics of infrastructure as an emerging asset class, revealing that such investments have yielded strong performance and offered significant diversification benefits [9]. These studies collectively highlight the importance of understanding and leveraging sector-specific dynamics and the external economic factors that influence them, thereby optimizing portfolio performance and stability across diverse asset classes.

By building upon the existing foundation of academic research, this paper analyzes and compares investment portfolios between the U.S. technology and consumer goods sectors, thereby enriching and expanding the theoretical basis in this area.

2. Data and Methodology

2.1. Data

This research conducts a comparative analysis between the Technology and Consumer Goods industries of the United States. This study selects ten stocks from each sector to capture the essence of their market behavior. The chosen stocks representing the Technology sector include Apple Inc. (AAPL), Intel Corporation (INTC), Alphabet Inc. (GOOGL), Microsoft Corporation (MSFT), NVIDIA Corporation (NVDA), International Business Machines Corporation (IBM), Oracle Corporation (ORCL), Meta Platforms, Inc. (META), Adobe Inc. (ADBE), and Qualcomm Inc. (QCOM). For the Consumer Goods sector, the selected stocks comprise PepsiCo, Inc. (PEP), McDonald's Corporation (MCD), Procter & Gamble Co. (PG), Walmart Inc. (WMT), The Walt Disney Company (DIS), Costco Wholesale Corporation (COST), Johnson & Johnson (JNJ), Colgate-Palmolive Company (CL), Philip Morris International Inc. (PM), and NIKE, Inc. (NKE). These stocks are well-established market leaders and reflect the broader dynamics within their respective industries, providing a solid basis for a thorough sectoral comparison.

To capture a comprehensive view of market behavior over a substantial period, this study will adopt a data set covering five years, from January 1, 2019, to December 29, 2023. The data for the returns of these stocks was sourced from the Wharton Research Data Services (WRDS), renowned for its reliability and in-depth financial information. This data was augmented with market returns from the Federal Reserve Bank of New York, serving as a benchmark for broader market performance. Additionally, the United States Federal Funds Rate, obtained from Capital IQ, was employed as the risk-free rate, which is a standard practice in portfolio analysis, to calculate excess returns over this

risk-free benchmark. Through this approach, the study aims to reveal differences in the risk-adjusted returns of stocks across different industries.

2.2. Methodology

The analysis will apply the principles of Modern Portfolio Theory (MPT), formulated by Harry Markowitz in 1952, which guides investors in constructing portfolios to maximize expected return based on a quantified level of risk. Central to my methodology is the Markowitz Model, which seeks to identify the optimal balance between risk and return. The Markowitz Model employs the following fundamental equations to achieve this balance.

2.2.1. Expected Portfolio Return

$$E(R_p) = \sum_{i=1}^{n} w_i E(R_i) \quad (1)$$

This formula calculates the weighted sum of the individual assets' expected returns, where $E(R_p)$ is the expected return of the portfolio, w_i represents the weight of asset *i* in the portfolio and $E(R_i)$ is the expected return of asset *i*.

2.2.2. Portfolio Variance

$$\sigma_p{}^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i \, w_j \sigma_i \sigma_j \rho_{ij} \quad (2)$$

Portfolio variance is calculated by summing the product of the weights, standard deviations, and the correlation coefficient of all asset pairs, where $\sigma_p{}^2$ denotes the portfolio's variance, σ_i, σ_j are standard deviations, and ρ_{ij} represents the correlation between the returns of assets *i* and *j*.

Utilizing these equations, the study calculates and compares the Efficient Frontiers for the Technology and Consumer Goods sectors, highlighting the differences in their risk-return profiles and the potential for portfolio optimization within each sector.

3. Results and Discussion

3.1. Efficient Frontier

The most IT-intensive industries had already experienced significantly larger productivity gains than other industries in the 1990s, underscoring the inherent potential for growth in the technology sector—a trend that has continued to influence investment strategies up to the present day[10]. This growth potential is evidenced within the framework of the Markowitz Model as presented in Figure 1.

In Figure 1, the analysis of the investment portfolio for the Technology Industry shows it as having high-risk and high-return characteristics, consistent with historical performance trends. The Efficient Frontier displays a broad spectrum of potential returns, with the Optimal Portfolio achieving returns as high as 0.9986 at a risk level of 0.4614. Even the Minimum Variance Portfolio, which represents the least volatile investment within this sector, still indicates a significant risk level at 0.1545, with corresponding expected returns of 0.1120. This analysis not only reflects the sector's substantial return potential but also highlights the higher risks associated with capitalizing on the technological advancements and productivity improvements that have characterized this industry since the 1990s.

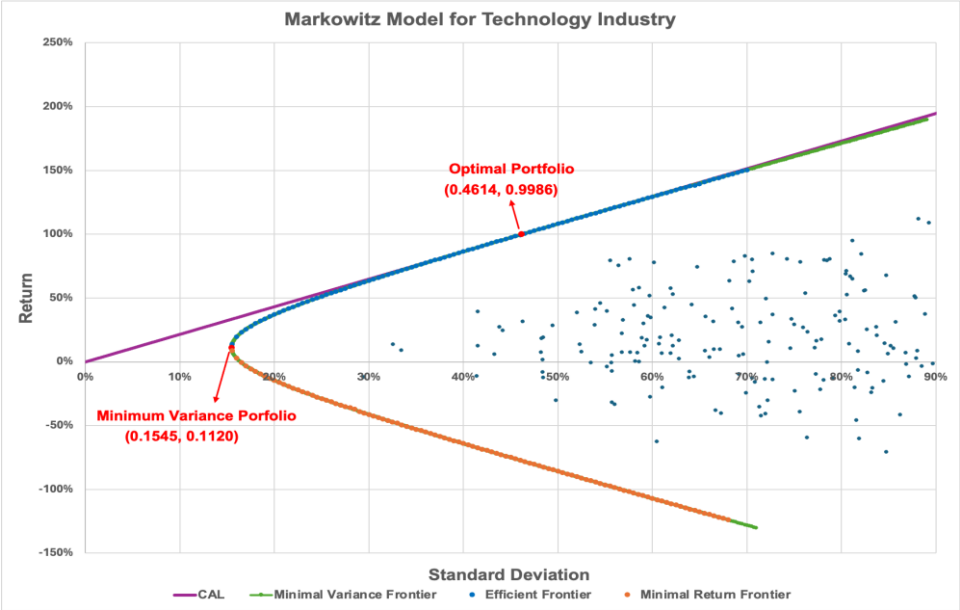


Figure 1: Markowitz Model for Technology Industry.

In comparison, the Consumer Goods Industry offers a contrasting investment profile. In Figure 2, its Efficient Frontier reveals a more contained range of returns, suggesting a less aggressive growth trend compared to the Technology sector. The Optimal Portfolio caps at a lower return of 0.3167 for a risk level of 0.2119. Similarly, its Minimum Variance Portfolio is marked by lower risk and return than that of the tech sector, at 0.1292 and 0.1178 respectively. These figures suggest that while consumer goods portfolios are characterized by lower volatility and more predictable outcomes, the potential for significant return increases with additional risk is not as pronounced as in the technology sector. This is supported by the findings from FF5F model simulations during the period of 2019.5-2020.12, where the coefficients of all MKT-RFs being less than 1 indicate that the consumer goods industry's returns are less volatile than the market average [11].

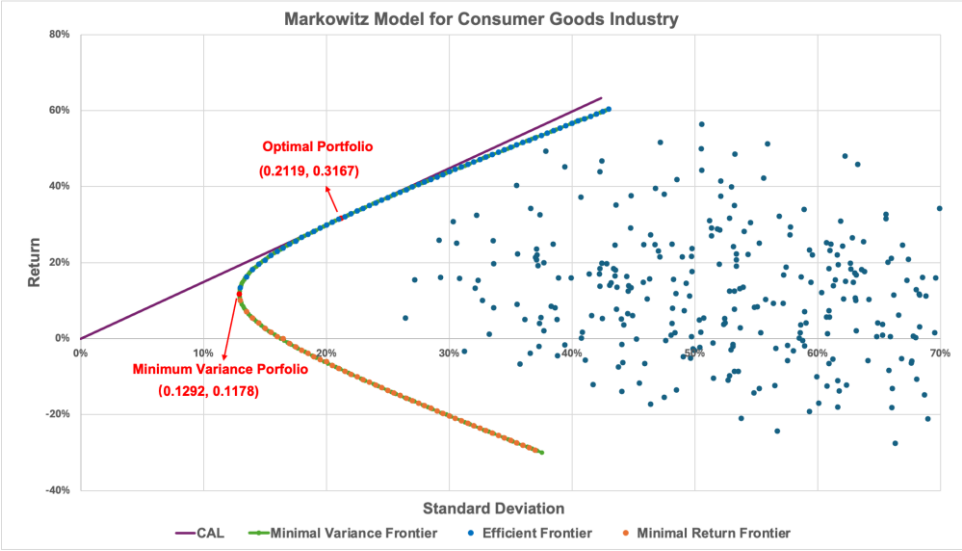


Figure 2: Markowitz Model for Consumer Goods Industry.

3.2. Minimum Variance Portfolio

In Table 1, the minimum variance portfolios of the Technology and Consumer Goods Industries show marked differences in their risk-return dynamics and asset allocation. The Technology portfolio adopts a strategic mix of long and short positions, with a notable long in MSFT (0.5908) and significant short positions including AAPL (-0.2422) and ADBE (-0.2054), reflecting a targeted approach to balance risks and capture growth. This results in a higher standard deviation of 0.1545,

suggesting increased volatility. On the other hand, the Consumer Goods portfolio, with a conservative stance, holds strong long positions, particularly in CL (0.3412) and WMT (0.2899), while maintaining fewer short positions. This strategy yields a slightly higher return of 0.1178 with a lower standard deviation of 0.1292, fitting the industry's risk-averse profile. Moreover, the Consumer Goods portfolio's Sharpe Ratio of 0.9113 is higher than the Technology portfolio's 0.7247, which demonstrates its superior risk-adjusted performance, thereby indicating a more efficient asset allocation in a market that prizes stability.

Table 1: Minimum Variance Portfolio Weights and Performance Metrics.

Technology Industry	Weight	Consumer Goods Industry	Weight
AAPL	-0.2422	PEP	0.0896
INTC	-0.0409	MCD	-0.0176
GOOGL	-0.0597	PG	-0.0573
MSFT	0.5908	WMT	0.2899
NVDA	-0.0321	DIS	-0.0522
IBM	0.2116	COST	0.0843
ORCL	-0.0108	JNJ	0.1431
META	-0.0662	CL	0.3412
ADBE	-0.2054	PM	0.1471
QCOM	-0.0098	NKE	-0.1210
Return	0.1120	Return	0.1178
Standard Deviation	0.1545	Standard Deviation	0.1292
Sharpe Ratio	0.7247	Sharpe Ratio	0.9113

3.3. Optimal Portfolio

In Table 2, the optimal portfolio for the Technology Industry showcases a dynamic strategy with major long positions in MSFT (2.0830) and IBM (1.5576), alongside significant short positions in INTC (-0.5725) and ADBE (-0.8950). This bold positioning reflects a high annualized return of 0.9986 and a strong Sharpe Ratio of 2.1641, which indicates robust risk-adjusted performance, despite a higher standard deviation of 0.4614. Conversely, the Consumer Goods portfolio adopts a tempered stance, most notably with a prominent long position in COST (0.9228) and a notable short in DIS (-0.3412). This results in a more moderate annualized return of 0.3167, with a reduced standard deviation of 0.2119. While its Sharpe Ratio of 1.4947 denotes a commendable risk-adjusted return, it does not reach the heights of the Technology portfolio, reflecting a strategy that prioritizes lower risk over maximum returns.

Table 2: Optimal Portfolio Weights and Performance Metrics.

Technology Industry	Weight	Consumer Goods Industry	Weight
AAPL	0.7893	PEP	0.0467
INTC	-0.5725	MCD	0.2780
GOOGL	0.2279	PG	-0.1540
MSFT	2.0830	WMT	0.0661
NVDA	0.7341	DIS	-0.3412
IBM	1.5576	COST	0.9228
ORCL	0.2518	JNJ	-0.2601
META	-0.1438	CL	-0.0451
ADBE	-0.8950	PM	0.6448
QCOM	0.0940	NKE	-0.1360
Return	0.9986	Return	0.3167
Standard Deviation	0.4614	Standard Deviation	0.2119
Sharpe Ratio	2.1641	Sharpe Ratio	1.4947

In essence, the technology sector is marked by higher volatility and the potential for significant returns, aligning with risk-seeking investors. Conversely, the consumer goods sector appeals to investors favoring stability and moderate, more reliable returns. These investment profiles reflect the underlying attributes of each industry, offering diverse pathways to align with individual investment strategies and risk preferences.

While the divergent nature of these sectors offers valuable insights, it is important to recognize the constraints of this study's methodology. The research was limited by its reliance on market capitalization as the sole criterion for stock selection when constructing industry portfolios. This approach did not incorporate a detailed fundamental analysis of each company, which could affect the robustness of the portfolio construction. For a more detailed evaluation of investment potential, future research should adopt a more comprehensive method that evaluates broader financial metrics and company-specific factors. Such an approach could reveal undervalued stocks or highlight companies with stronger growth prospects than what is indicated by market capitalization alone [12].

4. Conclusion

In conclusion, the technology and consumer goods sectors present distinct investment profiles suitable for different investor strategies. The technology sector, characterized by its high-risk and high-return potential, is optimal for risk-seeking investors who are comfortable with significant market fluctuations and have a long-term investment horizon. This sector offers the prospect of substantial gains, driven by ongoing technological advancements and digital transformation, as evidenced by its performance on the Efficient Frontier. On the other hand, the consumer goods sector caters to risk-averse investors, providing more stable and predictable returns with lower volatility. This makes it an attractive option for conservative investors seeking reliable gains, especially during turbulent economic times, highlighting the strategic value of choosing the right sector based on personal investment goals and risk tolerance.

The strategic allocation of stocks from these sectors in an investment portfolio can significantly influence the risk-return profile. For technology stocks, a diversified approach that includes both aggressive growth stocks and more stable, established companies can optimize returns while managing risk. In contrast, a portfolio focused on consumer goods might emphasize companies with strong brand loyalty and consistent dividend payments, providing steady income and reducing overall portfolio volatility.

Ultimately, the decision to invest in these sectors should correspond to an investor's financial goals, risk tolerance, and investment horizon. This tailored approach helps in creating a portfolio that not only meets specific financial objectives but also aligns with personal risk preferences, enhancing the likelihood of achieving investment success.

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