Review

Research on Quantitative Investment Strategies of Securities Investment Funds

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Abstract: This paper investigates the quantitative investment strategies of securities investment funds, aiming to explore their applications in financial markets and their impact on investment decision-making. Through a review of relevant literature and empirical data, the paper first outlines the basic concepts of quantitative investing and its importance in securities investment funds. Then, it discusses various quantitative strategies, including multi-factor models and machine learning algorithms, and validates their effectiveness through case studies. The research finds that quantitative investing can enhance the scientific and accurate nature of investment decisions while effectively reducing investment risks. Finally, the paper provides suggestions for optimizing quantitative strategies and discusses future trends, offering practical references for the investment industry.

Keywords: securities investment funds; quantitative investment; investment strategy; empirical research

1. Introduction

With the rapid development of global financial markets and the increasingly diversified demands of investors, securities investment funds have played an increasingly important role in asset management. In this context, quantitative investment, as a strategy based on data analysis and mathematical models, has attracted wide attention from both academia and industry. The core of quantitative investing lies in utilizing advanced technologies and algorithms to deeply analyze market data, thereby formulating systematic and scientific investment decisions. This strategy not only helps investors capture opportunities in complex and volatile markets but also effectively reduces the impact of subjective emotions on investment decisions. Although quantitative investing has achieved remarkable results both domestically and internationally, its specific application in securities investment funds still faces many challenges and opportunities. For example, different quantitative strategies may show varying effectiveness in different market environments, making the selection and optimization of appropriate strategies a critical research topic. Therefore, this paper aims to deeply explore the quantitative investment strategies of securities investment funds through literature reviews, empirical studies, and case analysis, revealing the fundamental principles, application effects, and future directions of quantitative strategies, providing valuable references for practitioners and researchers.

2. Overview of Quantitative Investment Strategies

Quantitative investment strategies utilize techniques from mathematics, statistics, computer science, and other disciplines to systematically analyze financial market data and formulate investment decisions. Compared to traditional strategies that rely on subjective judgment, quantitative investing evaluates the market in an objective and systematic manner, aiming to eliminate emotional interference and maximize returns. In recent years, with the rise of algorithmic and high-frequency trading, quantitative investing has

become an important tool in securities investment fund management. By combining modern technology with data analysis, quantitative strategies can handle vast amounts of data and execute trades automatically, improving efficiency. As shown in Figure 1, the framework of quantitative investing can be divided into several levels, covering everything from probability theory and financial econometrics to advanced algorithmic trading.

2.1. Definition and Characteristics of Quantitative Investing

Quantitative investing refers to the automation of investment decisions through the use of complex mathematical models and algorithms. Unlike traditional subjective investment strategies, quantitative investing relies on data and models, thus avoiding human factors in decision-making. Referring to the layers in Figure 1, we can clearly understand the main theories and practical content covered by quantitative investing.

Figure 1. Core Elements of Quantitative Investing.

Probability theory is the foundation of quantitative investing. By modeling the probability distribution of random events in the market, investors can assess potential investment opportunities and risks. Probability theory provides the theoretical basis for subsequent complex algorithms, helping quantitative investors make scientific decisions in uncertain market environments. Financial econometrics, another core tool of quantitative investing, combines economics and statistics, primarily to analyze time-series data in financial markets, such as stock prices and interest rates. It helps investors identify correlations between assets and predict future market trends, providing data support for implementing quantitative strategies. Stochastic calculus is widely used in quantitative investing to handle uncertainties and random fluctuations in financial markets. Especially in the fields of derivatives pricing and risk management, stochastic calculus captures the random nature of asset prices, helping investors better understand and mitigate market risks. A significant characteristic of quantitative strategies is their strong focus on risk management. By incorporating statistical risk assessment methods, investors can adjust their portfolios based on market fluctuations, ensuring reasonable returns while minimizing potential losses. As illustrated by the fourth layer in Figure 1, "Risk Management" highlights a crucial component of quantitative investing, which involves comprehensive monitoring and management of market volatility and potential risks. The highest level of quantitative investing is algorithmic trading, which leverages high-speed computing and automation to capitalize on short-term market opportunities. By developing complex trading algorithms,

quantitative investors can complete large volumes of trades within milliseconds, enhancing trading efficiency and optimizing strategy execution. Algorithmic trading not only reduces human error but also allows for rapid responses to market changes, maximizing returns. In summary, the definition and characteristics of quantitative investing reflect its data-driven nature. As shown in Figure 1's five key elements, quantitative strategies gradually evolve from fundamental theories to practical applications, covering everything from probabilistic models and data analysis to high-frequency trading. This systematic investment approach offers investors new perspectives and can optimize strategy execution through automation, generating considerable returns in financial markets.

2.2. Roles and Functions of Securities Investment Funds

Securities investment funds play a critical role in financial markets by helping investors diversify assets, reduce risks, and achieve long-term returns through professional fund managers. As a pooled investment tool, securities investment funds gather capital from numerous investors and delegate it to a team of fund managers for management and operation. The fund management team researches market trends, formulates investment strategies, and implements effective risk management, helping investors achieve solid returns in complex market environments. As shown in Figure 2, when choosing a fund manager, investors need to consider several factors, which also highlight the key functions of funds in the market.
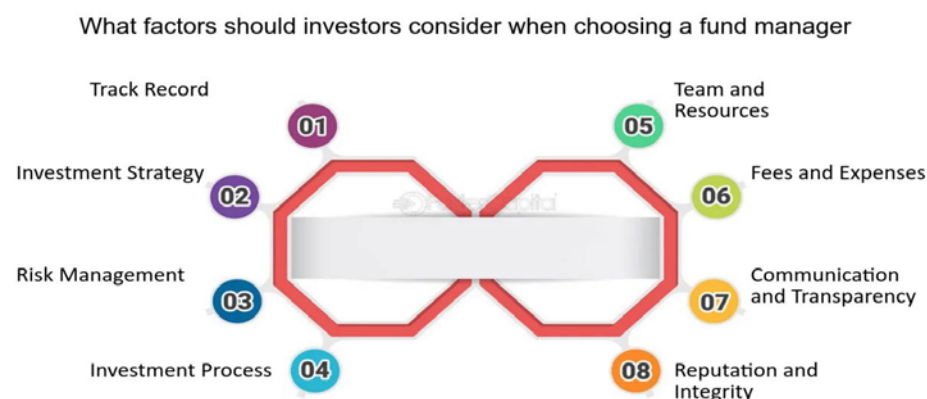

Figure 2. Key Factors to Consider.

The management team of a securities investment fund typically has rich experience and a track record of past performance. The historical performance of a fund can provide valuable insights for investors. By analyzing the fund's performance under different market conditions, investors can evaluate the management team's decision-making abilities and the effectiveness of their strategies. Different funds adopt different investment strategies, such as value investing, growth investing, and momentum investing. Quantitative investment funds employ complex mathematical models and algorithms to develop strategies that capture opportunities in the market. The choice of investment strategy directly impacts a fund's returns and risk levels. Therefore, investors must assess whether the fund's strategy aligns with their investment objectives. Risk management is a core function of securities investment funds, especially in quantitative investing, where stringent risk control strategies can help the fund maintain stable performance in volatile markets. By monitoring market fluctuations, adjusting portfolios, and setting stop-loss mechanisms, funds can maximize returns while controlling risk. The investment process of securities investment funds involves various stages, from research and analysis to portfolio con-

struction and trade execution. Quantitative funds rely on data-driven analysis and automated trading processes, executing decisions programmatically. This rigorous and efficient investment process enables funds to react quickly in complex markets and improve the overall performance of their portfolios. An excellent fund management team typically has extensive market experience and professional knowledge, enabling them to adjust strategies in response to market changes. Additionally, robust technical and resource support (such as data analysis tools and computing power) is crucial to a fund's success. Quantitative funds, in particular, rely on the technical capabilities of their teams, which continuously optimize models and algorithms to enhance performance. In summary, securities investment funds provide investors with professional management, risk diversification, and transparent operational processes. By leveraging a management team's technical strengths and effective risk control strategies, funds help preserve and grow assets.

2.3. Classification of Quantitative Investment Strategies

Quantitative investment strategies can be classified into several types based on their core logic and implementation methods. Each strategy is designed for specific market environments and investment objectives, catering to the diverse needs of investors. The variety of quantitative strategies provides securities investment funds with flexible options, helping fund management teams achieve stable returns across different market cycles. Below are some common classifications of quantitative investment strategies: Trend Following Strategy analyzes historical price data to identify upward or downward trends in asset prices and makes buy or sell decisions based on the trend direction. The premise of this strategy is that price trends will persist for a certain period, allowing investors to profit by following the trend. Trend following strategies are often used in momentum investing, relying on technical analysis and statistical models based on historical data to capture trends. Mean Reversion Strategy is based on the assumption that asset prices tend to revert to their historical average levels over time. When prices deviate from their historical average, the strategy anticipates a return to the mean and makes corresponding trades. For example, if a stock price falls below its historical average, investors might buy, expecting the price to rise back to the mean. This strategy is primarily used in volatile markets and is suitable for short-term trading. Ulti-Factor Strategy combines multiple factors (such as value, momentum, and quality) to construct an investment portfolio. The core of this strategy lies in analyzing several market factors quantitatively and selecting assets that exhibit multiple strengths for investment. Multi-factor models help investors better diversify risk and maintain stable returns in different market environments. Statistical Arbitrage Strategy seeks potential arbitrage opportunities by analyzing price differences between highly correlated assets. For instance, if two historically correlated stocks diverge in price, the strategy might buy the undervalued stock and sell the overvalued one, expecting their prices to converge. This strategy typically relies on complex mathematical models and high-frequency trading techniques to capture short-term arbitrage opportunities in the market. Machine Learning Strategy utilizes artificial intelligence algorithms to analyze large datasets and identify hidden patterns and trends in the market. Compared to traditional quantitative models, machine learning strategies can handle more unstructured data and continuously optimize models through self-learning to improve effectiveness. This strategy performs particularly well in markets where data is complex and volatile. Table 1 summarizes the key quantitative investment strategies and their characteristics:

Table 1. Quantitative investment strategies.

Strategy Type	Core Principle	Applicable Market	Advantages	Disadvantages
Trend Following Strategy	Based on asset price trends, following the trend	Markets with clear trends	Simple and widely applicable	Performs poorly in sideways markets
Mean Reversion Strategy	Trading against deviations from the mean	Volatile markets	Can profit in the short term, lower risk	May result in losses if prices persistently deviate from the mean
Multi-Factor Strategy	Combining multiple factors to construct a portfolio	Various markets	Risk diversification, stable returns	Requires extensive data, complex models
Statistical Arbitrage Strategy	Capturing price differences between correlated assets	Highly correlated assets and markets	High short-term returns, suitable for high-frequency trading	Relies on complex models and high-speed trading infrastructure, requires strict risk control
Machine Learning Strategy	Identifying market patterns and trends through self-learning algorithms	Large, volatile markets	Strong model optimization, handles unstructured data	Requires significant computing resources, complex model training, difficult to explain trade results

In conclusion, the diversity of quantitative investment strategies allows investors to adapt flexibly to different market environments. Investors can choose strategies that align with their risk preferences and market conditions, or combine multiple strategies to achieve effective risk diversification and maximize returns. As technology continues to advance, quantitative investment strategies will evolve and innovate, providing even more robust tools and approaches for managing securities investment funds.

3. Analysis of Quantitative Investment Strategies in Securities Investment Funds

The core advantage of quantitative investment strategies lies in their data-driven decision-making processes. These strategies can analyze large amounts of historical data and real-time market information, constructing rigorous mathematical models to guide investment operations. Securities investment funds play a vital role in global capital markets, and with the continuous advancements in big data, artificial intelligence, and other technologies, quantitative strategies offer fund managers unprecedented efficiency. By applying quantitative strategies, fund managers can better optimize portfolios, manage risks, and improve returns. First, quantitative investment strategies help securities investment funds achieve portfolio optimization. By using quantitative tools such as multi-factor models, mean reversion strategies, and machine learning algorithms, fund managers can screen assets that meet specific strategy criteria and construct a diversified portfolio. This diversification not only helps mitigate risk but also enhances the overall returns by selecting assets with potential for upward growth. For example, a multi-factor strategy analyzes several market factors like value, momentum, and volatility to select stocks that perform best on a risk-adjusted basis. Such a strategy can deliver steady performance in various

market environments. Secondly, quantitative investment strategies enable fund managers to effectively control risks. Through data analysis and model predictions, quantitative strategies can monitor market fluctuations in real-time and automatically adjust positions and portfolios when necessary. The key to risk management is predicting and responding to market uncertainties. Quantitative strategies introduce risk control tools such as Value at Risk (VaR) and Conditional Value at Risk (CVaR) to help funds minimize losses in highly volatile markets. For example, a trend-following strategy can monitor market price trends and adjust portfolio positions promptly, preventing significant losses during market downturns. Additionally, a distinctive feature of quantitative strategies is their high trading execution efficiency. Securities investment funds often manage large amounts of capital, and fast execution is critical for capturing short-term market opportunities. Quantitative strategies use programmatic trading to execute large volumes of orders in milliseconds, ensuring that funds gain an edge as prices fluctuate. This is particularly evident in high-frequency trading and statistical arbitrage strategies. For example, statistical arbitrage can rapidly capture temporary price discrepancies in the market through automated programs, generating arbitrage profits through efficient execution. Moreover, quantitative investment strategies offer the advantage of continuous model optimization and innovation. Quantitative models can be continuously backtested and optimized to improve performance. Fund managers can adjust model parameters based on market changes and even introduce new machine learning algorithms to enhance strategy precision. By incorporating non-linear and self-learning algorithms, quantitative strategies can adapt more flexibly to market uncertainties. For instance, deep learning-based quantitative models can uncover hidden market patterns from vast amounts of historical data and continually update themselves as the market evolves, improving the accuracy of investment decisions. In conclusion, quantitative investment strategies provide strong support for securities investment funds, helping them manage investments scientifically and systematically in complex markets. By optimizing portfolios, effectively controlling risks, executing trades efficiently, and continuously optimizing models, quantitative strategies can deliver steady long-term returns for funds. As technology advances, quantitative investment strategies will further develop and become an integral part of fund management.

4. Empirical Research

To thoroughly analyze the practical application of quantitative investment strategies in securities investment funds, this section uses empirical research methods to evaluate the performance of different quantitative strategies in real market environments. The core of this empirical research is to backtest and analyze various quantitative strategies using historical market data, assessing their risk and return performance under different market conditions. This study selects several typical quantitative strategies, such as trend-following strategies, multi-factor strategies, and statistical arbitrage strategies, and analyzes them using actual operational data from a set of funds. First, the empirical research selected market data from the past five years, covering stocks, bonds, and other asset classes across multiple global markets. During data processing, researchers utilized programming tools such as Python and R to clean and standardize the data, and employed common quantitative analysis frameworks like Pandas and NumPy for modeling. For the multi-factor strategy, a composite model combining value, momentum, and volatility factors was constructed. Based on the weightings of these factors, the performance of the fund's investment portfolio was examined. The backtest results showed that the multi-factor strategy was able to maintain relatively stable returns over most periods, especially during times of market volatility, where it effectively diversified risks and optimized portfolio returns. Secondly, the study analyzed the performance of the trend-following strategy under different market conditions. By analyzing technical indicators of stock prices (such as moving averages and relative strength indices), the researchers built a trading

model based on price trends. In the backtest, the trend-following strategy performed exceptionally well when the market exhibited clear upward or downward trends, capturing most of the price movements during such trends. However, during periods of sideways consolidation, the strategy's returns were lower, and it even experienced small losses. This highlighted the limitations of the trend-following strategy, showing that it may fail when trends are unclear but excels when trends are well-defined. Additionally, this paper also conducted empirical research on the statistical arbitrage strategy. Statistical arbitrage mainly involves trading based on price discrepancies between two or more highly correlated assets. Several pairs of highly correlated stocks were selected for backtesting, and the results showed that statistical arbitrage effectively captured short-term price deviations and generated profits. Particularly in high-frequency trading environments, this strategy could respond quickly to small market changes, achieving short-term arbitrage gains. However, the study also pointed out that statistical arbitrage strategies demand high precision in data and fast execution. If the trades are not executed promptly, arbitrage opportunities may be missed, potentially leading to losses. Table 2 summarizes the backtest results of different quantitative investment strategies, including key performance indicators such as annualized return, maximum drawdown, and Sharpe ratio:

Table 2. Quantitative investment strategy indicators.

Strategy Type	Annualized Return	Maximum Drawdown	Sharpe Ratio	Applicable Market Conditions
Multi-Factor Strategy	12.5%	8.2%	1.25	Various markets
Trend-Following Strategy	10.8%	12.4%	1.10	Markets with clear up/down trends
Statistical Arbitrage	15.3%	6.5%	1.35	Highly correlated asset markets

From the results of the empirical research, it can be observed that quantitative investment strategies exhibit their own advantages and disadvantages in different market environments. The multi-factor strategy provides relatively stable returns for funds over the long term, the trend-following strategy performs well when market trends are clear, and the statistical arbitrage strategy is more suitable for short-term, highly volatile market scenarios. It is important to note that the effectiveness of each strategy depends not only on market conditions but also on factors such as data quality and model parameter settings. Overall, the empirical research demonstrates the potential of quantitative investment strategies in securities investment funds. By selecting and combining strategies appropriately, fund managers can achieve significant returns while controlling risks. Future research directions could incorporate more complex market data and optimized algorithms to further enhance the performance of quantitative strategies, providing more comprehensive investment solutions for securities investment funds.

5. Strategy Optimization and Future Trends

Optimizing quantitative investment strategies is crucial for maximizing returns and managing risks in a complex market environment. Key optimization approaches include refining models, adjusting factor weights, and incorporating advanced data processing techniques. For instance, multi-factor models benefit from periodic recalibration, while trend-following strategies can improve by integrating dynamic risk controls. Leveraging alternative data sources like social media sentiment and using machine learning for more accurate predictions are also essential. Looking ahead, artificial intelligence (AI) and machine learning will further enhance strategy development, enabling deeper analysis and adaptive trading. Additionally, integrating ESG (Environmental, Social, and Governance)

factors will be a growing focus as investors prioritize sustainability. In conclusion, continuous innovation in models, risk management, and data usage, alongside AI and ESG integration, will drive the future success of quantitative strategies in securities investment funds.

6. Conclusion

This paper explored the application and advantages of quantitative investment strategies in securities investment funds. By analyzing various quantitative strategies, such as multi-factor strategies, trend-following strategies, and statistical arbitrage strategies, the research found that these strategies significantly improve investment returns and risk control. Relying on data-driven decision-making and automated trading, quantitative strategies help fund managers achieve stable returns in complex market environments. Although different strategies perform differently under various market conditions, a well-thought-out combination and application of these strategies can provide long-term investment returns and risk management advantages for securities investment funds.

References

1. Falkowski, Michał, Agata Sierpińska-Sawicz, and Piotr Szczepankowski. "The effectiveness of hedge fund investment strategies under various market conditions." Contemporary Economics (2020): 127-143.
2. Eti, Serkan. "The use of quantitative methods in investment decisions: a literature review." Research anthology on personal finance and improving financial literacy (2021): 1-20.
3. Senxin, Zhou, Zhang Sitong, and Xie Linna. "Research on analysis and application of quantitative investment strategies based on deep learning." Academic Journal of Computing & Information Science 6.10 (2023): 24-30.
4. Paula, Jéssica Santos de, and Robert Aldo Iquiapaza. "Investment fund selection techniques from the perspective of Brazilian pension funds." Revista Contabilidade & Finanças 33.88 (2021): 167-182.
5. Ascioglu, Asli, and Kevin John Maloney. "From stock selection to multi-asset investment management: The evolution of a student-managed investment fund." Managerial Finance 46.5 (2020): 647-661.
6. Yue, Xiao-Guang, et al. "Sustainable funds' performance evaluation." Sustainability 12.19 (2020): 8034.
7. Zhang, Jinhui, Lanlan Shi, and Wei Xu. "Research on Optimization Strategy of Quantitative Investment Scheme Based on Black-Litterman Model." Academic Journal of Business & Management 5.5 (2023): 164-176.
8. Sanfelici, Daniel, and Maira Magnani. "Pension fund investment in commercial real estate: A qualitative analysis of decision-making and investment practices in Brazil." Area Development and Policy 7.1 (2022): 62-81.