Available Online: 30 July 2025 DOI: 10.54254/3049-5768/2025.25504

The impact of quantitative trading strategies on insurance investment and risk management

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Abstract. Against the backdrop of continuous innovation in financial markets, quantitative trading strategies, characterized by data-driven decision-making, model-based analysis, automated execution, and controllable risk, have exerted a profound impact on insurance investment and risk management. This paper explores the application of quantitative trading strategies in the insurance industry, analyzing their role in optimizing insurance investment portfolios and enhancing risk management effectiveness. In the field of insurance investment, quantitative trading strategies accurately assess the risk-return characteristics of assets. By applying modern portfolio theory and integrating specific cases, these strategies achieve optimal asset allocation, significantly improving investment returns while effectively diversifying risks. In risk management, quantitative models leverage extensive historical data to identify potential risk factors, use metrics such as Value at Risk (VaR) and Conditional Value at Risk (CVaR) to precisely measure risks, and implement real-time monitoring with preset risk thresholds to ensure effective control and timely warning. Additionally, stress testing and scenario analysis are employed to enhance the risk resilience of insurance portfolios. This study indicates that even though using quantitative trading strategies in the insurance industry has challenges like poor data quality, risks from the models, lack of technical skills and talent, and changes in the market, we can expect future trends such as better technology use, new ideas, applying strategies across different markets and assets, flexible risk management, and working together with regulatory technology (RegTech). The rational adoption of these strategies will continue to improve the investment efficiency of insurance funds and risk management standards, facilitating the sustainable development of the insurance industry.

Keywords: quantitative trading strategies, insurance investment, asset allocation, risk management

1. Introduction

Against the backdrop of continuous innovation and development in financial markets, quantitative trading strategies have gradually become an important tool in the field of financial investment, relying on their rigorous mathematical models, big data analysis capabilities, and efficient automated execution [1]. As a vital component of the financial system, the insurance industry is characterized by large-scale funds, long investment cycles, and extremely high requirements for safety and stability. The investment management and risk management of insurance funds are directly related to the solvency and sustainable development of insurance companies. The introduction of quantitative trading strategies has brought new ideas and methods to insurance investment and risk management, exerting a profound impact on the operational models and development direction of the insurance industry.

This paper explores the specific application methods, effects, and challenges of quantitative trading strategies in the optimization of insurance investment portfolios and risk management. This study contributes to the stable development of financial markets by strengthening the solvency and sustainable development of insurance companies, fostering innovation and transformation in the operational models of the insurance industry, improving the investment efficiency and risk management capabilities of insurance funds in practice, and enhancing interdisciplinary research on the integration of quantitative trading strategies with insurance investments from a theoretical perspective.

2. Overview of quantitative trading strategies

2.1. Definition and characteristics of quantitative trading strategies

Quantitative trading strategies refer to investment methods that use mathematical models, statistical analysis, and computer algorithms to mine and analyze historical and real-time data in financial markets, identify market laws and investment opportunities, and formulate trading decisions accordingly [2]. Their remarkable characteristics include: Relying on massive financial market data, including prices, trading volumes, macroeconomic indicators, etc., to discover investment opportunities through data analysis. Constructing trading strategy models based on mathematical and statistical models, such as regression analysis, time series analysis, machine learning algorithms, etc., to reduce the influence of subjective human judgment [3]. Using computer programs to automatically issue and execute trading orders, which can quickly respond to market changes and improve trading efficiency. Setting strict risk control parameters and stop-loss mechanisms to effectively manage investment risks.

2.2. Types of common quantitative trading strategies

Types of common quantitative trading strategies are shown in Table 1:

Table 1. Types of common quantitative trading strategies

Strategy Type	Principle	Application Scenario
Trend Following Strategy	Based on the assumption that market trends continue, buying or selling when prices form upward or downward trends	Phases with obvious market trends
Mean Reversion Strategy	Assuming that asset prices fluctuate around the mean, taking reverse positions when the price deviates from the mean by a certain extent to expect price reversion to the mean [4]	Market environments with relatively stable price fluctuations
Statistical Arbitrage Strategy	Utilizing statistical relationships between assets to conduct hedging trades when price deviations from normal relationships are identified, aiming to capture price spread profits	Asset portfolios with stable price relationships
Machine Learning Strategy	Employing machine learning algorithms (such as neural networks, support vector machines, etc.) to learn from large datasets and identify patterns, thereby constructing trading strategies	Complex and volatile market environments

2.3. Development history and current status of quantitative trading strategies

Quantitative trading strategies originated in the 1970s. With the continuous development of computer technology and financial theories, their application scope and influence have expanded continuously. Early quantitative trading mainly relied on simple statistical models and technical analysis indicators. In recent years, with breakthroughs in technologies such as big data and artificial intelligence, quantitative trading strategies have become more complex and intelligent. Currently, the proportion of quantitative trading in global financial markets continues to rise. It is not only widely applied in stock and futures markets but also gradually penetrates into fields such as insurance investment, becoming an important means for financial institutions to improve investment efficiency and risk management levels.

3. Impact of quantitative strategies on insurance investment portfolios

3.1. Optimizing asset allocation

Quantitative trading strategies can analyze massive market data to more accurately assess the risk and return characteristics of various assets, thereby optimizing the asset allocation of insurance investment portfolios. Traditional asset allocation methods often rely on historical experience and subjective judgment, while quantitative strategies can use modern portfolio theories, such as Markowitz's mean-variance model, combined with methods like Monte Carlo simulation, to construct investment portfolios that maximize returns at a given risk level or minimize risks at a given return level [5].

During the period from 2021 to 2023, the Fangzheng Fubang CSI Insurance Index Fund adopted a quantitative stock selection (multi-factor model) and an event-driven risk monitoring mechanism, while strictly tracking the benchmark index. It successfully achieved that the A-share class outperformed the performance benchmark for three consecutive years, with annual excess returns of 2.31% (2021), 2.90% (2022), and 2.54% (2023). In 2024, Taiping Asset Management's Quantitative Products

No. 26 and No. 25 utilized derivatives to hedge market risks and adopted a "quantitative hedging + industry neutral" strategy, effectively controlling market risk exposure and reducing the portfolio's volatility by over 30%. Their returns over the past month in 2024 reached 19.33% and 16.84% respectively, ranking among the top three in the insurance asset management product performance rankings.

3.2. Enhancing investment returns

Quantitative trading strategies capture short-term market fluctuations and arbitrage opportunities, which can bring additional returns to insurance investment portfolios [6]. Taking statistical arbitrage strategies as an example, insurance companies can use such strategies to trade asset pairs with stable price relationships. When the prices of asset pairs deviate from their normal relationships, the undervalued asset is bought, and the overvalued asset is sold, with positions closed after prices return to equilibrium.

Taiping Asset Management's Quantitative 26 and Quantitative 25 products, which adopt a quantitative multi-asset rotation strategy (covering dynamic allocation of gold, stocks, and bonds), ranked among the top three in the industry in terms of returns over the past month, standing out among the 1,339 asset management products managed by 29 insurance asset management companies, with returns of 19.33% and 16.84%, respectively. Meanwhile, the Guohua Xingyi Insurance Asset Management's Guohua Xingyi Precision for Gold 1 product, through its low-frequency quantitative stock selection strategy and strict control of industry risk exposure, has achieved annualized returns of 80.23%, 160.73%, and 51.34% since the beginning of the year, the last six months, and the last year, respectively.

3.3. Diversifying investment risks

Quantitative trading strategies can build diversified investment portfolios and apply hedging techniques to effectively diversify the risks of insurance investments. By allocating assets across different categories, industries, and regions, the portfolio's dependence on single assets or market factors is reduced [7]. Derivative instruments such as stock index futures and treasury bond futures are used for hedging to offset systematic market risks. The risk diversification methods are shown in Table 2:

Table 2. Risk diversification methods

Risk Diversification Method	Specific Operation	Effect
Asset Class Diversification	Allocating multiple assets such as stocks, bonds, and alternative investments	Reducing the impact of single-asset volatility on the portfolio
Sector Diversification	Investing in assets across different industry sectors	Mitigating the impact of sector-specific risks on the portfolio
Regional Diversification	Investing in assets across different geographic regions	Diversifying risks from regional economic fluctuations
Hedging Techniques	Using derivatives to hedge against systematic risks	Reducing losses from overall market declines

4. Impact of quantitative trading strategies on risk management

4.1. Risk identification and measurement

Quantitative trading strategies provide more precise tools for risk identification and measurement in insurance risk management. Traditional risk assessment methods are often relatively rough, while quantitative models can analyze massive historical data to identify various potential risk factors and use risk measurement indicators such as VaR and CVaR for quantitative risk assessment [8].

For portfolio management, "Dajia Asset Management" uses the Barra structured risk model, which assigns risk based on 30 industry variables and 10 risk factors (such as marketization, volatility, and liquidity, among others). This model effectively controls industry exposure and individual stock deviations, strictly keeping the tracking error within 5. During the period of Size factor retracement in 2017, with the optimization capability of the Barra model, the institution successfully controlled the excess return retrace within 5%, significantly outperforming the 30% retracement range of some quantitative portfolios in the market during the same period. During the market style switch in 2024, the model effectively avoided the risk of decline in excess returns due to extreme market volatility by strictly adhering neutral constraints.

4.2. Risk control and early warning

Quantitative trading strategies can monitor the risk status of investment portfolios in real time and issue early warning signals promptly based on preset risk thresholds, enabling insurance companies to take corresponding risk control measures. By setting stop-loss rules, position limits, etc., they prevent further expansion of investment losses. Quantitative models can also simulate and evaluate the effectiveness of different risk control measures to select the optimal risk control plan [9].

Tai Ping Asset Quantitative No.26 has a unique architecture that combines industry-neutral strategies with a three-level risk control valve. The defense chain consists of the pullback valve (-2% trigger to reduce positions), the amplitude valve (11% trigger to isolate), and the liquidity valve (limit orderslt<300 lots/order dropped). During the micro-cap stock crash in February 2024, the system automatically triggered the liquidity valve to pause smallcap stock trading and urgently increased the derivatives hedging ratio from 60% to 85%, ultimately controlling the maximum annual drawdown at -4.92 and keeping the annualized volatility as low as 3.5%, which is 180 million yuan less loss than similar market products. While Fangsheng Fubang CSI Insurance Index Fund adopts a risk management system combining multi-factor quantitative stock selection with event-driven monitoring. Dynamically tracking 12 indicators, including major shareholder's equity reduction, individual stock capital flow, and listed company public opinion, the system successfully warned of abnormal capital outflow of an insurance stock in 2024, avoiding a subsequent 15% decline by reducing positions 3 days in advance. Specifically, the data shows that during the period of2021-2023, the excess return was stable between 2.31% and 2.90%, and the maximum tracking error was controlled within 5%. In terms of public opinion monitoring, the system once captured negative news of listed companies in real time and reduced positions on the same day, reducing portfolio losses 2.3%.

Quantitative trading strategies can assess the risk-bearing capacity of insurance investment portfolios under extreme market conditions through stress testing and scenario analysis. By simulating different market scenarios such as financial crises and economic recessions, they analyze the value changes and potential losses of investment portfolios, helping insurance companies formulate response strategies in advance and enhance risk resistance. The scenario types are shown in Table 3:

Table 3. Scenario types

Scenario Type	Simulation Content	Function
Financial Crisis Scenario	Simulating stock market crash, substantial fluctuations in bond yields, etc.	To assess the portfolio's losses under extreme market conditions
Economic Recession Scenario	Simulating macroeconomic deterioration such as GDP decline and rising unemployment rate	To analyze the portfolio's sensitivity to economic recession
Policy Change Scenario	Simulating policy factors such as interest rate adjustments and changes in tax policies	To evaluate the impact of policy changes on the portfolio

5. Challenges and future trends

5.1. Faced challenges

Quantitative trading strategies rely heavily on data, and the accuracy, completeness, and timeliness of data are crucial to strategy effectiveness. However, in practice, data suffer from issues such as noise and missing values, and the acquisition cost of some data is high, limiting the application effect of quantitative strategies [10]. Quantitative models are constructed based on historical data. As market environments and economic situations continue to change, models may fail to accurately reflect future market conditions, leading to model invalidation. Additionally, the setting and selection of model parameters are subjective, which may affect strategy effectiveness. Quantitative trading requires advanced computer technology and professional quantitative analysis talent. Currently, the insurance industry has relatively insufficient technical reserves and talent cultivation in this regard, restricting the application and development of quantitative trading strategies [11]. Financial markets are complex and changeable. Factors such as adjustments in regulatory policies and changes in market participants' behaviors may affect the effectiveness of quantitative trading strategies.

5.2. Future development trends

With the continuous development of technologies such as artificial intelligence and blockchain, quantitative trading strategies will deeply integrate with these technologies. For example, artificial intelligence algorithms can be used to improve model prediction capabilities and adaptability, and blockchain technology can enhance data security and credibility. In the future, quantitative trading strategies will be applied in more financial markets and asset categories, such as green finance and digital currencies, expanding the scope and channels of insurance investment. Quantitative risk management models will place greater emphasis on dynamic adjustment and real-time monitoring, optimizing risk control strategies in a timely manner according to market changes to improve the risk management level of insurance investment. Regulatory authorities will strengthen supervision of quantitative trading, and meanwhile, insurance companies will use regulatory technology tools to better meet regulatory requirements, achieving a balance between compliant operations and innovative development.

6. Conclusion

The introduction of quantitative trading strategies has brought new opportunities and changes to insurance investment and risk management. In the investment dimension, quantitative strategies can optimize asset allocation, enhance investment returns, and diversify investment risks; in the risk management dimension, quantitative strategies help identify and measure risks more accurately, achieve effective risk control and early warning, and enhance the risk resilience of insurance investment portfolios through stress testing and scenario analysis. However, the application of quantitative trading strategies in the insurance industry also faces many challenges, including data quality, model risk, shortages of technology and talent, and changes in market environment. In the future, with continuous technological progress and gradual improvement of market environments, quantitative trading strategies in the field of insurance investment and risk management will demonstrate trends such as technological integration and innovation, cross-market and cross-asset applications, dynamic risk management, and collaborative development with regulatory technology. Insurance companies should actively address challenges, seize development opportunities, strengthen technical and talent reserves, reasonably apply quantitative trading strategies, continuously improve the efficiency of insurance investment and the level of risk management, and achieve the stable appreciation of insurance funds and the sustainable development of the insurance industry.

However, this study acknowledges several limitations. Firstly, the study primarily relies on theoretical analysis and literature reviews, lacking empirical case studies from specific insurance institutions. Secondly, the discussion on the technical details and model construction of quantitative trading strategies is relatively limited, failing to delve into the applicability and optimization methods of different quantitative models in insurance investment.

Future research can conduct empirical research on specific insurance institutions to analyze the application effects of quantitative trading strategies in actual investment portfolios, including investment returns, risk control levels, and cost-effectiveness. Additionally, in-depth research and development of quantitative models suitable for insurance investment may be carried out, especially in optimizing models for handling illiquid assets, long-term investments, and complex risk structures.

References

[1] Xu, R., Tian, W. T., & Hu, X. F. (2025). Research on the Risk Impact and Regulatory System Construction of Quantitative Trading. *Financial Regulation Research*, *2*(2), 74-92. DOI: 10.13490/j.cnki.frr.2025.02.004.

[2] Zheng, L. C. (2025). Analysis of Quantitative Investment Strategies Based on Shanghai Gold Weighted Price. *Economic Research Guide*, 4, 70-73.

[3] Song, F., Tian, C. L., & Feng, C. W. (2025). Research on Stock Quantitative Investment Based on Deep Reinforcement Learning. *Journal of Nanjing Normal University (Natural Science Edition)*, *48*(1), 85-92.

[4] Zheng, L. C. (2024). Gold Investment and Quantitative Trading. *Economic Research Guide*, 24, 70-73.

[5] Zheng, L. C. (2024). Research on Quantitative Investment Strategies Based on China Silver Group. *Economic Research Guide*, 22, 80-83.

[6] Wan, L. (2024). Research on Risk Management of Programmatic Trading System in L Company's Quantitative Fund Project. Zhejiang University. DOI: 10.27461/d.cnki.gzjdx.2024.000407.

[7] Deng, S. W. (2024). Research on Quantitative Trading Strategies and Risk Early Warning of Gold Futures [D]. Guangzhou University. DOI: 10.27040/d.cnki.ggzdu.2024.001339.

[8] Huang, Y. (2022). Brief Discussion on Risk Management of Quantitative Trading. *China Money Market*, 4, 27-29.

[9] Ma, Y. N., Ma, W. X., & Wang, L. J. (2021). Quantitative Investment Risk Management in Capital Markets. *China Collective Economy*, 8, 85-86+145.

[10] Yuan, L. (2020). Research on Operational Risks of Quantitative Trading Strategies. *Business Culture*, 32, 122-124.

[11] Xu, B., He, Y. J., Wen, J. C., & Li, X. X. (2024). A Survey on the Application of Deep Reinforcement Learning in Quantitative Trading of Financial Markets. *Chinese Journal of Intelligent Science and Technology*, *6(*4), 416-428.