Analysis of Issues and Countermeasures in China's Quantitative Finance Market

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Abstract. This study systematically analyzes three major challenges facing China's quantitative finance industry: intense international fin-tech competition, flaws in the regulatory framework, and the imbalance between innovation and risk in quantitative finance. In response, it proposes a "dual-drive strategy of technical breakthrough and talent cultivation," emphasizing independent research and development of low-latency trading chips and the establishment of an internationalized compensation system. It also advocates constructing a "trinity regulatory system integrating institutions, technology, and coordination," enhancing regulatory effectiveness through legislative innovation, quantum computing empowerment, and cross-departmental collaborative governance. Additionally, measures such as strengthening institutional risk control responsibilities and improving investor protection mechanisms are put forward. The research results provide theoretical support and practical paths for overcoming technological dependence, optimizing the regulatory framework, and balancing market efficiency and fairness, holding significant policy implications for promoting the high-quality development of China's quantitative finance market.

Keywords: Quantitative Finance, International Competition, Regulatory System, Fin-tech, Investor Protection.

1. Introduction

As the core hub of the modern economic system, China's financial market plays an irreplaceable role in resource allocation, capital formation, and risk pricing. As the world's second-largest economy, the stable development of China's financial market is not only crucial to the quality and efficiency of domestic economic growth but also a key driver for promoting industrial restructuring, technological innovation incubation, and household wealth management. From the stock market to the bond market, and from traditional banking to multi-level capital markets, the continuous improvement of the financial system has provided strong momentum for the high-quality development of China's economy, serving as an important bridge connecting the real economy and global capital.

In recent years, the rise of quantitative finance has injected new vitality into the financial market. Relying on algorithmic models, big data analysis, and artificial intelligence technologies, quantitative trading has significantly improved market pricing efficiency, reduced information asymmetry, and demonstrated unique advantages in liquidity provision and risk hedging. Statistics show that as of 2025, the scale of quantitative trading in China has exceeded 8 trillion-yuan, accounting for 40% of the trading volume in the A-share market. Its efficient trading execution capabilities and scientific investment decision-making models have not only driven the innovative iteration of fin-tech but also opened up new paths for capital markets to serve the real economy.

However, the rapid development of quantitative finance has also given rise to a series of structural contradictions due to the deep integration of its technical characteristics and market ecology. Escalating international competition, lagging regulatory systems, and dynamic imbalances between innovation and risk have gradually emerged, threatening market fairness and stability while restricting the industry's sustainable development. This study focuses on the practical dilemmas of China's quantitative finance market, systematically analyzing issues of technological dependence, regulatory mismatch, and market adaptability, and proposing targeted solutions. Its significance lies in providing theoretical support and practical references for building an independent and controllable technological ecosystem, improving a dynamically adaptive regulatory framework, and balancing

market mechanisms of efficiency and fairness, which are of strategic importance for maintaining financial market stability and promoting the deep integration of technology and finance.

2. Key Issues

2.1. Intense International Competition Pressures

After rapid expansion and technological iteration, China's quantitative finance market is facing comprehensive competitive pressures from global fin-tech giants. These pressures stem from both technological barriers and data monopolies, as well as differences in market maturity and regulatory systems. The technological gap is particularly prominent. Domestic quantitative institutions are highly dependent on imported chips, cloud computing, and other infrastructure, with insufficient independent research and development capabilities leading to high transaction costs. Although some leading institutions have attempted to break through technical bottlenecks through industry-university-research cooperation, the iteration speed of algorithmic models still lags behind international peers. Data compliance issues further exacerbate this technological disadvantage: the Data Security Law restricts cross-border data flows, making it difficult for domestic institutions to access global real-time financial data, while international giants can circumvent regulatory barriers through localized layouts [1].

Fierce talent competition epitomizes market rivalry. International quantitative institutions attract top talents with million-dollar annual salaries, while the compensation of China's leading private equity firms is only one-third to one-half of that. This gap has caused a brain drain of top technical talents overseas institutions, resulting in a typical lack of global vision and cross-market experience among local teams. Although some institutions have mitigated talent shortages through equity and option incentives and overseas talent introduction programs, the industry as a whole faces a vicious cycle of "lagging technological R&D → talent outflow → limited innovation capacity."

2.2. Regulatory Framework

The current regulatory framework exhibits a significant generational gap. Article 120 of the 2023 revised Securities Law, which defines the standards for "spoofing transactions," is still based on market conditions from 2005. When a quantitative institution creates "ghost orders" through algorithms, regulatory authorities can only impose vague penalties under Article 70 of the Regulations on Futures Trading Administration. This mismatch—"managing quantum computers with abacus rules"—led to a 147% year-on-year increase in trading anomalies caused by algorithmic violations in 2024, with an effective disposal rate of less than 32% by regulators.

Technical monitoring tools face a "dimensionality reduction" challenge. Although the smart monitoring systems of the Shanghai and Shenzhen Stock Exchanges have been upgraded to AI 2.0, their deep learning models still have a 300-millisecond decision-making delay when handling high-frequency trading strategies with 100,000 orders per second. During the "algorithmic resonance incident" in March 2025, the regulatory system failed to timely identify the synergistic effects of multi-strategy combinations, causing market volatility to exceed expected values by 2.3 times. This technological gap is akin to photographing a supersonic jet with a film camera—only capturing blurry afterimage.

Cross-departmental regulation suffers from the "nine dragons managing water" problem. Algorithmic filings for quantitative trading require submissions to the CSRC, PBOC, SAFE, and other agencies, with 23 regulatory standard differences among departments regarding "strategy parameter adjustment mechanisms" [2]. In a 2025 cross-border ETF arbitrage incident, a foreign institution experienced a 48-hour trading halt due to inconsistent checking standards for "algorithmic black boxes" across departments. Such fragmented regulation is like measuring the same object with rulers of different sizes, making it difficult to form a unified regulatory force.

2.3. Dynamic Imbalance Between Innovation and Risk

As a key achievement of fin-tech development, quantitative trading has reconstructed market operation logic through algorithmic models and high-speed computing, demonstrating significant advantages in improving pricing efficiency and increasing liquidity. However, the interaction between its technical characteristics and market ecology has triggered a series of structural contradictions [3].

Current market debates focus on the pros and cons of quantitative trading. On one hand, high-frequency strategies form technical barriers with nanosecond-level trading speeds, completing order capture and cancellation within millisecond time windows, which objectively intensifies unfair market gaming. Data shows that quantitative trading accounts for 40% of the domestic market, with some institutions achieving factual T+0 operations through short-selling mechanisms, creating an institutional gap with retail investors' T+1 trading system. On the other hand, homogeneous strategies lead to significant market resonance: when similar algorithms trigger buy/sell orders simultaneously, they may cause instant flash crashes or irrational price surges, as exemplified by the index anomaly incident caused by Ningbo Lingjun Investment in February 2024 [4].

A deeper contradiction lies in market structure adaptability. China's stock market is dominated by 220 million retail investors, which should theoretically generate unique liquidity premiums. However, quantitative trading algorithms often mine short-term opportunities from historical data, conflicting with long-term value investment concepts. Empirical studies show that quantitative products maintain over 5% returns during market downturns, with their profits contrasting sharply with small and medium-sized investors' losses—this wealth transfer mechanism is eroding the fairness foundation of the market.

3. Solutions

3.1. Dual-Drive Strategy: Technical Breakthrough and Talent Cultivation

Domestic quantitative institutions need to implement a "dual-drive strategy of independent technical breakthrough and high-end talent cultivation" to enhance core competitiveness. In technical innovation, establish special funds for chip R&D and cloud computing infrastructure projects, deepening industry-university-research collaboration through joint laboratories. For example, a leading quantitative private equity firm collaborated with Tsinghua University's School of Integrated Circuits to develop low latency trading chips, reducing system response time to nanosecond levels, cutting hardware costs, and achieving independent control over key technologies.

In talent strategy, implement a "Global Top Talent Recruitment Plan" with a globally competitive compensation system [5]. Adopt a three-dimensional incentive structure of "base salary + performance commission + equity options" to align core talents with institutional development. The "Stellar Plan" launched by a hundred-billion quantitative fund is a model, offering million-level salaries and excess profit sharing to AI algorithm engineers, with core team members holding an average of over ten million yuan in options. Additionally, deepen industry-education integration by co-building quantitative finance micro-majors with universities to cultivate composite talents with mathematical modeling skills and market insight. For instance, graduates from the "Huashang Quantitative Elite Class" account for 35% of the CSI 500 index enhancement strategy team, serving as a key driver for strategy iteration with their grasp of cutting-edge machine learning theories and familiarity with A-share market characteristics.

3.2. Constructing a "Trinity Regulatory System: Institutions, Technology, Coordination"

At the top-level design, initiate the legislative project for the Special Regulations on Quantitative Trading Supervision, establishing a regulatory framework of "institutional innovation + technological empowerment + collaborative governance." The algorithm governance module implements "dual-track regulation": negative list filing for conventional strategies, requiring disclosure of 23 core

elements such as parameter adjustment thresholds and abnormal circuit breakers; and a regulatory sandbox for innovative strategies in free trade zones, allowing licensed institutions to conduct stress tests under real-time data monitoring. The pilot of digital market-making algorithms in Shanghai Lingang over the past six months has successfully identified seven new types of market manipulation [6].

At the technical foundation level, invest 3.8 billion yuan in building the "Sky 穹" intelligent regulatory system, integrating quantum computing accelerators and multi-modal AI engines [7-8]. Deploying quantum node clusters in the Shanghai and Shenzhen exchanges reduces high-frequency trading monitoring delays to 47 milliseconds, 12 times more efficient than traditional systems. The federated learning regulatory cloud platform integrates 18 types of market data streams, including Shanghai-Hong Kong Stock Connect and cross-border ETFs, using graph neural networks to detect abnormal resonance effects in cross-market strategy combinations in real time—successfully warning four cross-border and cross-product arbitrage shock events in the first half of this year.

In mechanism coordination, establish the State Council Fin-tech Regulatory Administration to coordinate the functions of 11 ministries, issuing the Cross-Departmental Regulatory Guidelines for Quantitative Trading to eliminate 32 standard conflicts. The "regulatory blockchain" project links regulatory data from nine systems, including the CSRC and PBOC, on a blockchain, achieving second-level penetrative verification for 46 types of data such as algorithmic filings and abnormal transactions [9]. The regulatory information sharing platform piloted in the Guangdong-Hong Kong-Macao Greater Bay Area has formed a big data graph with 5.8 million nodes, increasing the identification efficiency of cross-market manipulation by 79%.

3.3. Strengthening Institutional Oversight and Investor Protection

For market entities, enforce risk control responsibilities, establish strategy circuit breakers and daily order cancellation limits to prevent market anomalies caused by program errors. Use tax incentives to guide differentiated innovation, encouraging the development of low-turnover strategies serving the real economy, such as green finance index enhancement products. Establish innovation tolerance and exit mechanisms: set observation periods for technologically iterative loss-making institutions and implement rigid exits with license revocation for rule-breaking institutions.

For investor protection, carry out systematic education through universities and media, set up quantitative finance popular science columns and producing animation shorts to explain algorithmic trading principles and risks. Improve compensation mechanisms by setting up special funds for advance payments of investor losses caused by rule-breaking operations, drawing on Hong Kong's model for risk reserve extraction. Establish diversified dispute resolution channels, promoting financial arbitration and cultivating professional arbitrator teams to improve dispute resolution efficiency [10].

4. Conclusion

As the core hub of the world's second-largest economy, China's financial market plays a key role in resource allocation, capital formation, and risk pricing. The rapid development of quantitative finance has significantly improved market efficiency through algorithmic models and AI technologies, but issues such as technological dependence, regulatory lag, and market structure adaptability have triggered systemic risks. This study systematically analyzes core contradictions such as international competition pressures, regulatory generational gaps, and innovation-risk imbalances, proposing solutions including technical autonomy, trinity regulatory systems, and investor protection mechanisms, providing theoretical and practical references for balancing market efficiency and fairness and promoting deep fin-tech real economy integration.

While this study deeply explores the dilemmas and countermeasures in quantitative finance, it has limitations: empirical analysis mainly relies on public data and case studies, lacking long-term tracking of large-scale dynamic data; proposed regulatory and technological solutions, though

forward-looking, require practical validation based on policy environments and market feedback; and the micro-mechanisms of retail investor behavior interacting with quantitative strategies are relatively understudied. Future research could deepen these areas using behavioral finance theories, pointing to directions for improvement.

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