

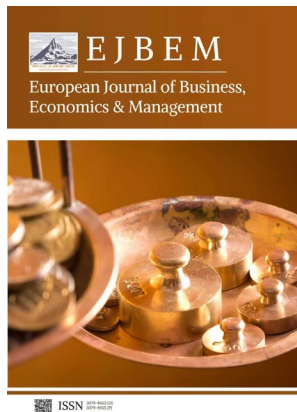
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The Push of Financial Technology Innovation on Derivatives Trading Strategy Optimization

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Abstract: The innovation of financial technology has significantly advanced the optimization of derivatives trading strategies. By leveraging cutting-edge tools such as quantitative trading algorithms, big data analytics, and blockchain technology, fintech enhances the speed, precision, and reliability of financial transactions. These technologies not only strengthen risk management capabilities but also improve market transparency, thereby fostering a more informed and efficient trading environment. In addition, fintech facilitates real-time monitoring of market conditions, enabling traders and institutions to respond swiftly to fluctuations and potential anomalies, which contributes to reducing market volatility. Moreover, the integration of automated and intelligent systems supports fairer market practices by minimizing human errors and information asymmetries. This paper aims to comprehensively examine the practical applications of fintech in derivatives trading, exploring how its deployment improves operational efficiency, strengthens market integrity, and stimulates innovation and growth within the derivatives market. Through detailed analysis of technological frameworks, trading mechanisms, and performance outcomes, the study provides insights into the transformative role of fintech in shaping modern derivatives markets and highlights potential avenues for further technological advancement and strategic adoption.

Keywords: financial technology; derivatives; trading strategy; big data; blockchain

1. Introduction

With the rapid advancement of science and technology, the financial sector has been undergoing profound transformations, particularly in the derivatives market, which has historically faced challenges such as inefficiencies, information asymmetry, and complex risk management issues. The emergence of financial technology, leveraging tools such as big data analytics, intelligent algorithms, and blockchain, has fundamentally reshaped trading mechanisms, improving transaction efficiency and enhancing market liquidity. These innovations also increase transparency by enabling real-time access to market information, facilitating more informed decision-making for market participants.

Furthermore, advanced risk management systems powered by fintech allow for dynamic monitoring and assessment of market exposure, reducing the likelihood of unexpected losses and systemic instability. The integration of algorithmic trading and automated execution platforms enhances operational precision while minimizing human errors, contributing to a fairer and more stable trading environment. Beyond efficiency and risk control, financial technology stimulates continuous innovation within the derivatives market by supporting the development of novel financial instruments, optimizing pricing models, and expanding access to a broader range of market participants [1].

This article aims to comprehensively examine the application of financial technology in derivatives trading, analyzing how technological innovations can optimize trading strategies, strengthen risk management, and drive the sustainable growth of the market. Through detailed exploration of technological frameworks, practical implementations, and market performance outcomes, this study seeks to highlight the transformative potential of fintech in shaping a more efficient, transparent, and resilient derivatives market.

2. Theoretical Basis of Financial Technology and Derivatives Trading

2.1. The Relationship between Financial Technology and Traditional Finance

Financial technology (FinTech) leverages advanced tools such as big data analytics, intelligent algorithms, blockchain, and cloud computing to enhance the efficiency and accessibility of traditional financial services, reduce operational costs, and create innovative pathways for conducting financial business. Compared with conventional financial models, fintech emphasizes technology-driven innovation and possesses the capability to overcome the temporal and spatial limitations inherent in traditional finance, providing a more convenient, timely, and efficient service experience [2].

While traditional financial services often rely on manual operations, physical documentation, and labor-intensive procedures, fintech employs automated, electronic, and algorithmic approaches to streamline processes such as transaction execution, settlement, and payment. This transformation not only accelerates operational workflows but also improves the accuracy and reliability of financial services. The relationship between fintech and traditional finance is therefore complementary and mutually reinforcing: fintech introduces technological efficiency and innovation into conventional frameworks, while traditional finance provides institutional experience, regulatory understanding, and market credibility that support the adoption of new technologies [3].

Across multiple sectors, fintech has demonstrated its ability to revolutionize established financial service models. For instance, blockchain technology has been increasingly utilized by financial institutions to facilitate faster, more secure cross-border payments, while the securities industry applies big data and intelligent algorithms to enhance investment decision-making, portfolio management, and risk control. The integration of fintech with traditional financial systems is gradually shaping a new paradigm of financial services that is more efficient, transparent, and intelligent, ultimately fostering broader market participation and innovation.

2.2. Derivatives Market Structure and Mechanism

The derivatives market focuses on trading instruments whose value is derived from underlying assets, including futures contracts, options, swaps, and other structured financial products. These markets are characterized by high leverage, complex structures, and elevated risk profiles, with participants ranging from institutional investors, hedge funds, and corporations to individual speculators [4].

Structurally, the derivatives market can be divided into exchange-traded markets and over-the-counter (OTC) markets. Exchange-traded markets operate on centralized platforms that provide standardized contracts and enforce open, transparent, and regulated trading, while OTC markets offer greater flexibility with customized contracts, albeit at higher risk due to lower transparency and counterparty risk. Derivatives contracts are generally classified as standardized contracts for exchanges or bespoke, compound contracts in OTC markets.

Price fluctuations in derivatives markets are influenced by a range of factors, including macroeconomic conditions, interest rate movements, and political developments. Market participants utilize derivatives for risk management, hedging strategies, arbitrage opportunities, and speculative operations to achieve capital appreciation. Regulatory authorities play a crucial role in maintaining market integrity by establishing trading standards, enforcing information disclosure requirements, implementing margin systems, and

monitoring compliance, thereby ensuring a fair, transparent, and robust derivatives trading environment.

3. Optimization of Derivatives Trading Strategies Driven by Financial Technology

3.1. Construction and Optimization of Quantitative Trading Model

Quantitative trading relies on mathematical models, statistical analysis, and computer algorithms to formulate and implement trading decisions. With the rapid advancement of financial technology, particularly in the fields of big data and artificial intelligence, strong technical support has been provided for the construction and refinement of quantitative strategies. Quantitative trading uses data analysis and algorithmic models, leveraging historical data and real-time market dynamics, to build a systematic strategy capable of predicting market trends and achieving profitable outcomes under changing market conditions [5].

The models commonly employed in quantitative investment include the mean-reversion model, momentum strategy model, and machine learning-based models. These models depend on sophisticated computational techniques to process extensive historical data, identify patterns in price movements, and generate actionable trading signals. To enhance the effectiveness of trading strategies, it is often necessary to repeatedly adjust the models and conduct backtesting simulations to verify their reliability and adaptability under various market conditions.

Take the mean-reversion model, for example, which is based on the assumption that market prices tend to fluctuate around a long-term average. When the market price deviates from this average, the model predicts a tendency for the price to revert toward the mean. This model can be described by the following formula:

$$S_t = \mu + \epsilon_t \quad (1)$$

Where S_t is the price at a given time, μ is the long-term mean of the price, and ϵ_t is the fluctuating part of the price, which is assumed to follow a normal distribution. In the optimization process of quantitative trading strategy, a core goal is to reduce the risk of the strategy and strive to increase the expected return. Conventional methods of risk optimization include the use of Mean-Variance optimization, which aims to maximize returns by reducing risk (variance) [6]. In this process, the return vector and covariance matrix of the asset can be expressed by the following formula:

$$\text{Maximize } E[R] - \frac{\lambda}{2} \cdot \text{Var}(R) \quad (2)$$

Where $E[R]$ is the expected return, $\text{Var}(R)$ is the variance of the return, and λ is the risk aversion coefficient. In the model optimization stage, the quantitative trading strategy will consider market liquidity, transaction costs and other factors, and continue to optimize the strategy parameters. With the improvement of data processing capacity and computing technology, quantitative trading can quickly process a large amount of data, improve the accuracy of market prediction and transaction efficiency. Therefore, the optimization of quantitative trading strategies not only relies on mathematical models, but is also closely related to the continuous innovation of fintech.

3.2. Application of Big Data in Derivatives Market

In the field of derivatives trading, big data technology has become a crucial tool for improving trading strategies and enhancing decision-making efficiency, relying on extensive information collection, processing, and analysis. Trading in this market generates vast streams of real-time and historical data, and big data technology enables the capture and analysis of these data in real time, uncovering potential patterns and market trends, thereby providing strong support for investors. With the aid of big data analytics, investors can more accurately understand market dynamics, adjust trading tactics, and improve both the precision and efficiency of their trading decisions [7].

In the derivatives market, big data integrates diverse information sources, including market data, macroeconomic indicators, corporate financial reports, media information,

and social network dynamics. By employing data mining techniques and sentiment analysis, it effectively identifies hidden risks and potential opportunities. For example, forward-looking forecasts based on historical market trends can assist investors in formulating more precise operational strategies for futures or options trading, reducing subjective judgment biases. Additionally, the ability to process real-time data swiftly ensures that trading strategies can rapidly adapt to market fluctuations, mitigating potential losses caused by delayed responses [8].

In the domain of risk management, big data technology demonstrates unique advantages. It enables traders to monitor market movements continuously, adjust portfolios in real time, allocate capital efficiently, detect potential risk factors promptly, and prevent unnecessary losses arising from significant market shifts. Table 1 below summarizes several major applications of big data in the derivatives market and their corresponding optimization effects, highlighting tangible results in market trend prediction, risk management, and trading strategy enhancement.

Table 1. Application effect of big data in derivatives market.

Application field	Optimization effect	result
Market trend forecasting	Improve the accuracy of trading strategies	Prediction success rate increased by 15%
Risk management	Dynamically adjust risk exposure to reduce losses	Risk loss is reduced by 20%
Trading strategy optimization	Improve market response speed and quality of trading decisions	25% increase in transaction efficiency

3.3. The Potential of Blockchain in Derivatives Trading

Blockchain technology has demonstrated significant advantages in financial derivatives trading, particularly in enhancing transaction transparency, reducing costs, and improving compliance. By leveraging its decentralized structure, blockchain records each transaction in detail, ensuring a high level of data transparency and security. The application of this technology helps mitigate information asymmetry in the market, allowing all participants to access transaction information simultaneously and thereby strengthening market confidence.

Blockchain also reduces the reliance on intermediaries typically required in traditional transactions, such as clearing houses and banks, which often contribute to higher costs and longer processing times. With blockchain adoption, all parties can settle funds directly, and transaction records are updated in real time on an open and secure ledger. This not only lowers transaction costs but also significantly enhances operational efficiency in the market.

Smart contracts within blockchain systems play a critical role in derivatives trading. These contracts autonomously execute agreed-upon terms without the need for third-party intervention, substantially increasing execution efficiency and accuracy. In derivatives operations, smart contracts automatically manage payment and delivery processes according to predefined rules, effectively minimizing human errors and delays. They also ensure the legitimacy of both parties and the validity of the contract, reducing the likelihood of disputes [9].

As blockchain technology continues to evolve, the derivatives market is expected to enter a new era characterized by greater efficiency, transparency, and robustness, fostering innovation and attracting a broader spectrum of investors. Figure 1 below illustrates the potential applications and benefits of blockchain in derivatives trading:

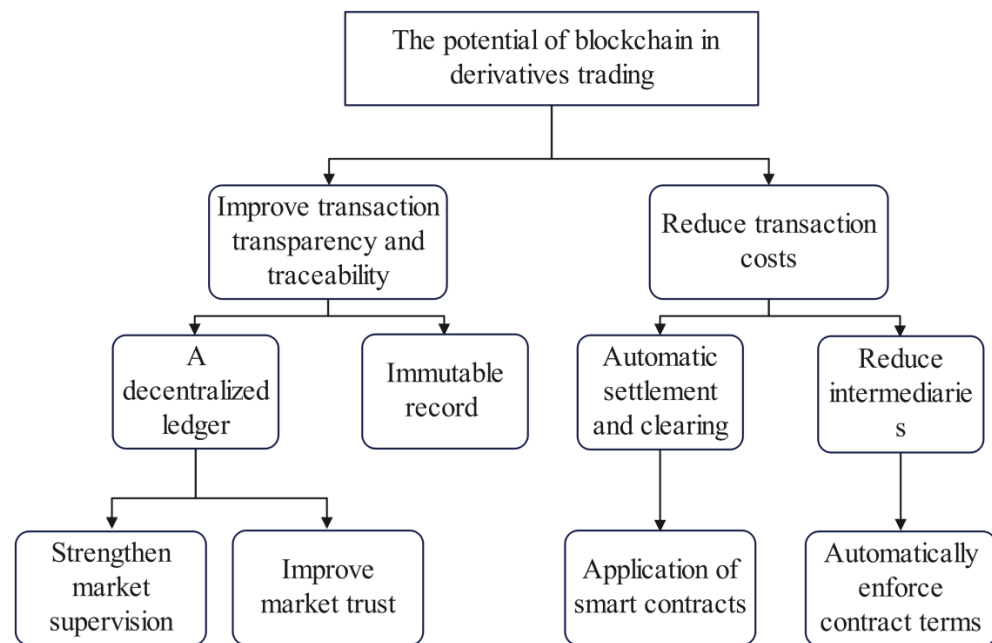


Figure 1. Potential applications of blockchain in derivatives trading.

4. The Role of Fintech Innovation in Promoting Derivatives Trading Strategy Optimization

4.1. Improve Transaction Efficiency and Market Response Speed

With the innovation of financial technology, particularly through the advancement of algorithmic trading, artificial intelligence, and big data analytics, these high-tech tools have greatly enhanced transaction efficiency in the derivatives market and strengthened the ability to respond rapidly to market dynamics. Traditionally, derivatives trading was often hindered by time delays, inefficient information processing, and slower trade execution. The development of fintech has significantly accelerated information exchange and processing, while intelligent trading systems further increase the speed and accuracy of order execution, resulting in a more responsive market environment. For example, in quantitative trading, trading strategies automatically analyze market data through algorithms and execute orders within extremely short timeframes.

Studies indicate that algorithmic trade execution can be approximately ten times faster than traditional manual operations. In futures trading, for instance, high-frequency trading (HFT) strategies have reduced transaction times from several seconds to mere milliseconds. This substantial improvement in timeliness enables traders to react instantly to market fluctuations and seize short-lived opportunities [10].

Table 2 below illustrates the application effects of fintech innovations across various derivatives markets, emphasizing improvements in transaction efficiency and market response speed. The introduction of fintech has enabled derivatives trading platforms to substantially reduce trade delays, accelerate order matching, and enhance market depth, thereby creating a more agile and efficient trading environment.

Table 2. The improvement of transaction efficiency in derivatives market by fintech innovation.

Technological innovation	marketplace	Transaction execution time	Order matching speed	Transaction cost
High Frequency Trading (HFT)	Futures market	0.01 second	0.1 second	Reduce by 20%
Automated trading system	Options market	0.05 seconds	0.2seconds	15% reduction

Big data analysis	Equity derivatives	0.2 seconds	0.5second	Reduce by 10%
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4.2. Enhance Risk Control and Reduce Market Volatility

The use of advanced technologies, such as quantitative models, big data analytics, and intelligent algorithms, has significantly improved the effectiveness of risk management in derivatives trading, while also helping to reduce market volatility. These technological tools enable investors to monitor market changes in real time, identify hidden risks, and adjust their positions according to established risk control plans, thereby mitigating the impact of major market shocks.

Consider the "value-at-risk" (VaR) model, which is widely applied to measure and manage the market risk of derivatives portfolios. This model assists investors in assessing risk exposure by estimating the maximum potential loss at a specified confidence level. For instance, if a portfolio has an expected return of 2% and a standard deviation of 5%, the VaR at a 99% confidence level can be calculated using the following formula:

$$VaR = \mu - Z_{\alpha} \cdot \sigma \quad (3)$$

Where μ is the expected return, σ is the volatility, and Z_{α} is the critical value of the standard normal distribution (e.g., for 99% confidence, $Z_{\alpha} \approx 2.33$). If VaR is -7% according to the calculation, it means that with 99% confidence, the portfolio will not lose more than 7% in the future period. Relying on this data, investors can implement measures, such as adjusting positions or using hedging strategies, to mitigate potential investment risks. Through big data and machine learning algorithms, market dynamics prediction and risk management are effectively implemented. For example, in futures trading, traders use machine learning models (such as random forests, SVMs) to analyze market data, news, and economic indicators to predict price movements.

4.3. Promote Market Transparency and Fairness

With continuous innovation in financial technology, particularly the integration of blockchain and big data, the transparency and fairness of the derivatives market have been significantly enhanced. Blockchain technology provides a decentralized transaction recording system, in which all transaction data are publicly accessible and immutable. This ensures that transaction information remains transparent, traceable, and tamper-proof, allowing all market participants to obtain consistent data simultaneously. As a result, information asymmetry is effectively reduced, market participants' trust is strengthened, and the possibility of manipulation or insider operations is minimized, thus ensuring a fair and equitable trading environment.

For instance, in futures trading, several platforms have adopted blockchain technology to record transaction data in detail. The immutability and openness of this data make all trading activities visible to market participants, thereby improving transaction transparency. A representative example is the Bakkt platform, which utilizes blockchain technology to achieve transparent futures contract trading. By making all transaction information publicly accessible, the platform enables participants to fully understand each trade and reinforces market fairness.

Big data technology has also made crucial contributions to promoting market transparency and fairness. By analyzing vast amounts of market information, big data enables fintech systems to uncover underlying market patterns and behavioral trends, thereby supporting informed investment decisions. Through such analyses, investors and regulators can better assess whether trading practices align with market fairness principles. For example, the Alpha Strategy Fund employs big data analytics to monitor derivatives market activities in real time, detect potential price manipulation or irregular trading behavior, and provide analytical reports to regulatory authorities for timely warnings. This data-driven monitoring framework effectively restrains market manipulation and enhances the fairness of the derivatives trading ecosystem.

4.4. Promote Innovation and Development of Derivatives Market

The acceleration of financial technology innovation has driven the continuous evolution and development of the derivatives market, especially in product design, trading models, and market structure. With the convergence of blockchain and smart contract technologies, decentralized finance (DeFi) trading platforms have emerged as a new form of financial infrastructure. In traditional derivatives trading, intermediaries such as centralized exchanges and clearinghouses often increase costs and complexity. In contrast, decentralized trading platforms powered by blockchain enable direct interaction between counterparties, reducing transaction costs and improving execution efficiency.

For example, in decentralized options markets, investors can issue and trade options directly through smart contracts without relying on traditional financial intermediaries. This not only lowers transaction expenses but also enhances transparency and automation in the trading process. On the MakerDAO platform, smart contract-based derivative products have been introduced, promoting the intelligent and automated execution of futures and options contracts while improving overall transaction efficiency.

Furthermore, the deep application of fintech has played a vital role in fostering innovation within the derivatives market, particularly through the advancement of quantitative trading. Leveraging machine learning, big data analytics, and algorithmic modeling, quantitative traders can perform real-time market analysis, predict price movements, and design more accurate and adaptive trading strategies. For instance, in the futures trading sector, quantitative models are employed to refine contract pricing mechanisms. By integrating historical and real-time market data, trading strategies achieve a high degree of automation and precision, significantly enhancing market liquidity, operational efficiency, and overall activity.

Through these technological advancements, the derivatives market has transitioned toward a more transparent, efficient, and innovation-driven ecosystem, providing investors with a fairer and more reliable trading environment.

5. Conclusion

Fintech innovations are profoundly reshaping the structure and operation of the derivatives market. Through the integration of big data, machine learning, artificial intelligence, and blockchain technology, the market has achieved remarkable progress in trading efficiency, risk control, and transparency. These technologies have optimized the mechanisms of information transmission and risk assessment, significantly reducing the occurrence of unfair trading behaviors and market manipulation. As financial markets become increasingly digitalized and data-driven, fintech is providing a solid foundation for the modernization and sustainability of derivatives trading.

The application of big data enables regulators, institutions, and investors to monitor market fluctuations and transaction trends in real time. By identifying hidden risks and detecting abnormal price patterns, data-driven analytics promote more accurate market predictions and risk warnings. This not only enhances the scientific basis of investment decision-making but also helps to establish a fairer and more transparent trading environment. Meanwhile, the adoption of machine learning algorithms has optimized trading strategies and pricing models, allowing market participants to dynamically adjust their positions in response to rapid market changes, thereby maintaining overall market stability.

Blockchain technology, on the other hand, has reconstructed the trust mechanism of the derivatives market. Its decentralized, transparent, and tamper-proof features ensure the authenticity and traceability of transaction data, enabling all participants to share the same information at the same time. This technological foundation effectively curbs asymmetric information and manipulative behavior, fostering a fair and credible trading ecosystem. Moreover, the integration of smart contracts has automated key processes such as

clearing and settlement, reducing operational risks and transaction costs while improving efficiency.

In the long term, fintech will continue to drive the structural transformation and sustainable development of the derivatives market. As emerging technologies mature, such as quantum computing, privacy-preserving data analysis, and cross-chain interoperability, the future derivatives market will achieve higher levels of intelligence, precision, and inclusiveness. These advancements will promote the rationalization of investor behavior, strengthen market resilience, and enhance the ability of the financial system to resist external shocks.

Overall, fintech has not only optimized trading mechanisms and risk management systems but also injected new vitality into the innovation and governance of the derivatives market. Its continuous evolution will further deepen the integration between technology and finance, promote the diversification of financial products, and ensure the long-term stability and healthy development of the global derivatives industry.

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