

Chapter 13

Quantum Computing: Transforming the Landscape of Financial Markets

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ABSTRACT

Quantum-computers can assist to resolve and answer particular problems and issues which are not solvable by binary computers or classical hardware. Considering the prompt response offered by quantum-computers hence has the possibility to assist any sector, market or division which utilizes estimations, such as financial markets. Initially, the quantum-computer applications for financial markets included, machine-learning, optimization and simulation issues which have been discussed by most of the studies. Therefore, in this study we aim to analyze the use-cases like risk management, portfolio management and pricing of derivatives to provide insight about the usefulness of quantum-computers in financial markets. This indicates that financial markets can benefit from quantum-computers in the upcoming years.

BACKGROUND OF QUANTUM COMPUTER

The integration of physics in solving complex issues within financial services dates back several decades. For instance, the Black-Scholes-Merton framework employs the Brownian motion approach to price financial instruments like European call options (Ederington & Guan, 2000; Nestler, 2017). The advent of quantum computing brings innovative capabilities for financial calculations and problem-solving, particularly in navigating uncertainty and optimizing artificial processes. Early adopters of quantum computers stand to benefit from these advancements by uncovering “Dynamic Arbitrage Opportunities” overlooked by competitors.

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Additionally, quantum computers enhance compliance, leverage behavioral data to improve customer service, and provide rapid responses to market volatility (Egger et al., 2020).

The primary advantage of quantum computers lies in their vast “Solution-space” compared to classical binary computers, despite their fragility (Hassija et al., 2020). Quantum computing's power exponentially increases with each additional qubit, far surpassing the capabilities of traditional computers that rely on multiplying transistors to tackle problems. This exponential power allows quantum computing to transform financial services operations, including client management, treasury and asset management, trading, and compliance and risk management.

Quantum computing's applications in financial services can be categorized into three main areas: (a) prediction and targeting, (b) trading optimization, and (c) risk profiling. Each category offers potential use cases, such as in insurance, banking, and financial markets (Pistoia et al., 2021). Quantum computers, supported by quantum mechanical phenomena, manage data through qubits, which are highly effective in handling probability distributions, data mapping, sample evaluation, and summarization. These capabilities lead to more precise calculations, reduced runtimes, and solutions to previously unsolvable problems (Marella & Parisa, 2020).

Modern financial service users demand personalized and rapidly adaptive services to meet their evolving needs (Jacobi & Brenner, 2018). Small and medium-sized financial institutions risk losing up to 25% of their customer base by offering non-customer-centric products. Developing an analytic framework that swiftly and accurately processes behavioral data to determine real-time customer needs is challenging. This limitation prevents financial institutions from providing prompt, personalized services and products, missing opportunities to grow their customer base and reach the 1.7 billion unbanked adults worldwide.¹

Fraud detection is another significant challenge, with financial institutions losing an estimated 10 to 40 billion USD annually due to poor data management and fraud practices. Current fraud detection methods yield an 18% false-positive rate, causing institutions to be overly cautious. This inefficiency extends the credit scoring process to as long as 12 weeks. With 70% of banking transactions now conducted online, customers favor systems that are quick and efficient.² Financial institutions that delay communication with customers risk losing them to more responsive, customer-focused competitors.

Quantum computing offers groundbreaking potential for expanding customer bases and enhancing forecasting models (Renduchintala et al., 2022). Quantum computers excel in data modeling, identifying trends, classifying data, and making predictions, which are currently impractical due to the complexities of intricate data networks.

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