Financial Technologies and Digital Assets by Using Quantum Computing

Efe Büke
American Collegiate Institute

***Abstract*—The rapid evolution of financial technologies (FinTech) and digital assets—including cryptocurrencies, decentralized finance (DeFi), and tokenized capital markets—has created an unprecedented need for secure, scalable, and computationally efficient systems. This study examines the transformative potential of quantum computing in reshaping financial technology infrastructures and digital asset ecosystems. Traditional computational models, constrained by classical encryption limits and the exponential growth of financial data, face increasing inefficiencies in handling real-time risk assessment, portfolio optimization, and transaction verification. Quantum computing, with its capacity for superposition, entanglement, and parallel state evaluation, provides novel opportunities to redefine data security, financial modeling, and cryptographic mechanisms in the digital economy. The research explores how quantum algorithms—notably Quantum Approximate Optimization Algorithm (QAOA), Quantum Fourier Transform (QFT), and Grover's search algorithm—can enhance financial operations such as market forecasting, fraud detection, and asset pricing. Additionally, it investigates quantum-resistant cryptography to safeguard digital asset networks against the vulnerabilities introduced by future quantum decryption capabilities. By integrating hybrid quantum–classical frameworks, this approach enables the development of sustainable, adaptive, and transparent financial systems. The findings highlight quantum computing's potential to advance financial inclusion, increase transaction speed, and improve systemic resilience. As global financial markets transition toward quantum readiness, the convergence of FinTech and quantum innovation is expected to redefine how digital assets are managed, traded, and secured—marking a paradigm shift toward quantum financial intelligence.**

The digital transformation of finance has accelerated over the past decade, driven by advancements in blockchain, artificial intelligence, and decentralized finance (DeFi). However, as transaction volumes surge and digital asset ecosystems expand, existing computational frameworks face challenges in processing, securing, and optimizing complex financial operations [1]. The emergence of quantum computing offers a new computational paradigm that transcends classical limitations, introducing probabilistic and parallelized approaches for financial modeling, risk management, and cryptography [8].

Quantum computing operates on quantum bits (qubits), which can exist in multiple states simultaneously through superposition, allowing exponentially faster data processing. This property, combined with quantum entanglement, enables the exploration of vast solution spaces that would be computationally intractable for classical computers [2]. In finance, such capabilities could revolutionize algorithmic trading, portfolio optimization, asset valuation, and fraud detection by providing faster, more accurate, and adaptive models for decision-

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