

# Financial Services in the Quantum Era | Overview and Prospects



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# Quantum



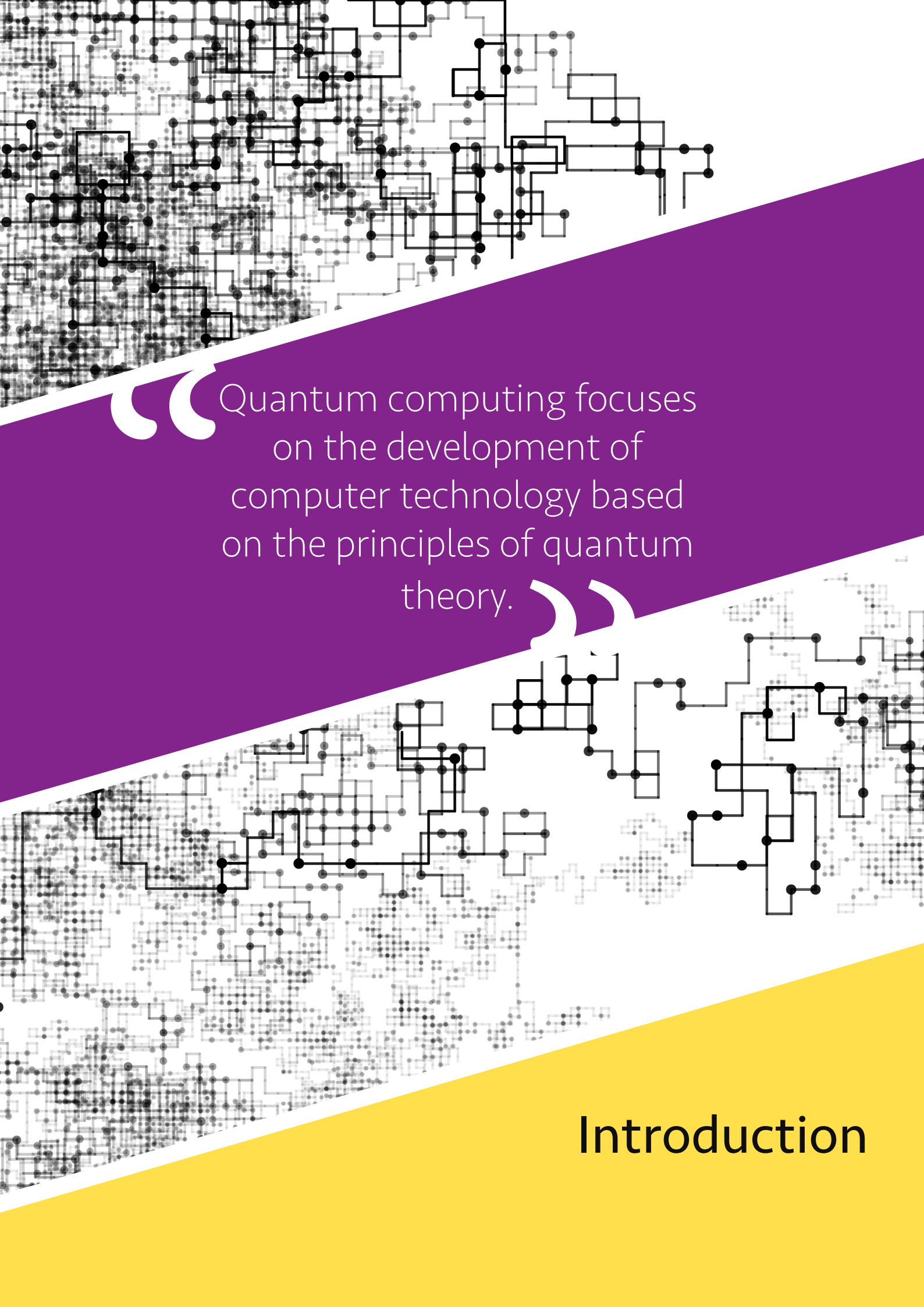
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Quantum computing focuses on the development of computer technology based on the principles of quantum theory.

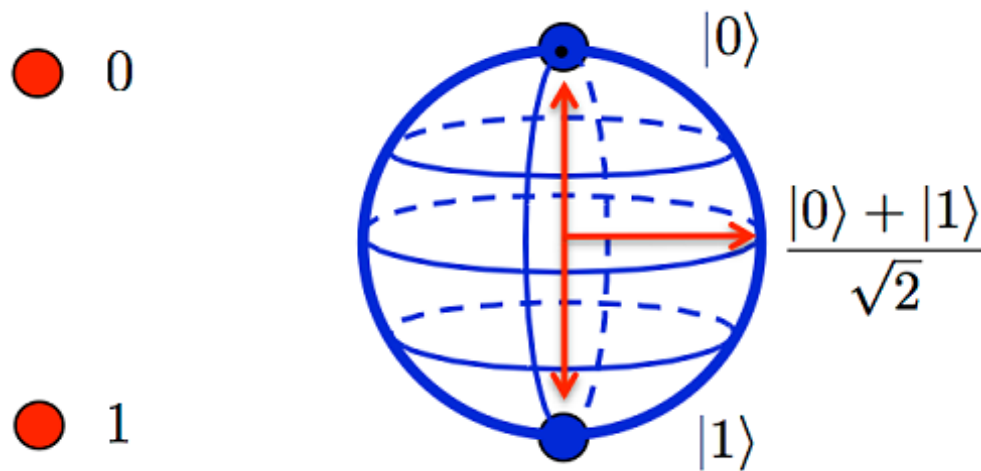
Introduction



Although it has become widely known in the recent years, it is worth noting that its roots dates back to the 1980s. As time goes by, computing engineers have demonstrated that this new era of computers was more than capable of solving complex problems faster than traditional computers, by using quantum algorithms. In terms of information processing, that particular ability has been the differentiating factor between quantum and classical computers.

More precisely, this new technology uses quantum bits, or qubits, which can exist as either one or zero or both at the same time, to transmit information. This capability is known as superposition and reflects the exponentially higher computing power and lower energy consumption, compared to traditional machines. In addition, quantum computers are better at sorting, simulating molecules, optimizing and finding prime numbers, and therefore, leading the pathway to a new era in ICT industry. [1]

**Figure 1. Classical Bit vs Qubit. CBInsights. (2016, October). What is Quantum Computing? A 5-minute primer**



## Classical Bit

## Qubit

1. Frankenfield, J, and Estevez, E. (2020, December). Quantum Computing. Investopedia.

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Quantum computers are expected in the upcoming years to gain more commercial use, which will mark a significant development in the field of modern computing. They will soon transform the way we work and communicate as their disruptive potential is found to exceed that of the Internet, smartphones and cloud computing, and will therefore profoundly change the way governments and economies operate. Both private and public companies are already trying to understand how quantum computers work, as they are considered the next generation of computers. The growth and innovation potential of quantum computing is predicted to be enormous, especially when combined with other advanced technologies such as Artificial Intelligence, Machine Learning, Internet of Things (IoT) and Cloud Computing. [2]



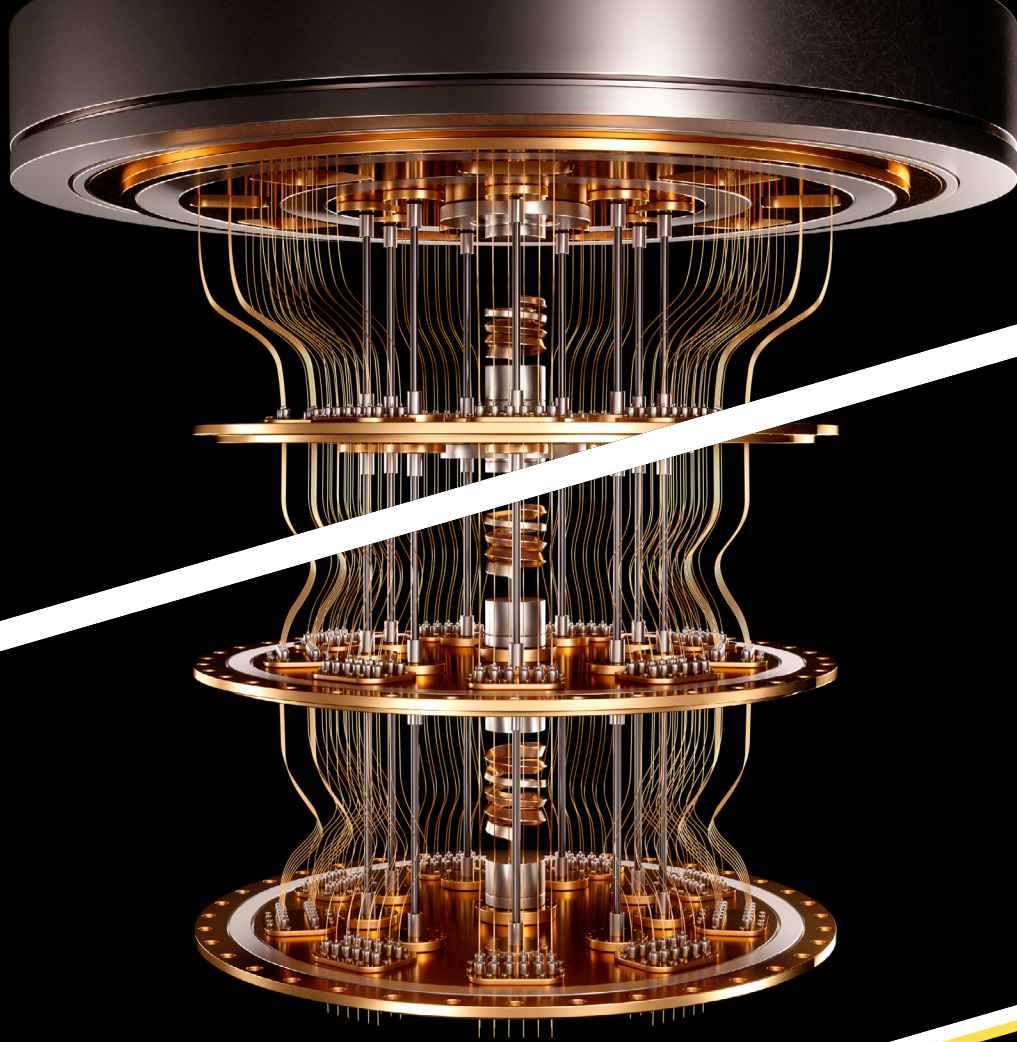
For many considerations, the sector that is anticipated to be most affected by quantum computing is that of financial services. First, financial institutions are still among the most aggressive companies that rapidly adopt advanced technologies and develop practical applications. Second, the profits for banks and financial companies will be up to almost USD 70 billion as technology matures in the coming decades. Finally, a growing number of financial companies are beginning to position themselves for a quantum future through hiring, investing and partnering with technology companies. [3]

It is also noteworthy that quantum computers are gaining more and more attention from many players, including big technologies, start-ups, governments and the media. More precisely, over the last few years, deals on quantum computing-focused startups have increased consistently and set a new record in 2020 with 37 deals. With USD 278.5 million in total disclosed funding, PsiQuantum is the most well-funded start-up in the industry.

2. Vernacchia, S. (2019). The Future of Quantum Computing in the Middle East. PwC.

3. Bobier, J. F., Binefa, J. M., Langjone, M., Kumar, A. (2020, October). It's time for financial institutions to place their quantum bets. Boston Consulting Group.

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# SECTION 1

The Evolution of  
Quantum Computing

The effect of the Covid-19 pandemic has shown that precise and timely risk management remains a major challenge facing financial institutions. Even before the events of 2020, financial and economic crises have occurred in the last two decades, resulting in rapid shifts in how banks and other market participants measured and priced the risk of various asset groups. Although it is still focused on conventional computing, it led to the introduction, of increasingly complex and real-time risk models powered by artificial intelligence. The advent of quantum computing may change the game, but there is far way to go, before carrying out the technology on a scale. Financial institutions are just beginning to get access to the necessary hardware and build the quantum algorithms they need.

Many activities in financial services, from securities pricing to portfolio optimization, require the ability to analyze a variety of possible results. Banks use algorithms and models to measure statistical probabilities, which had been fairly effective during the 2008 crisis, but not infallible because of the seemingly low-probability events happened more often than expected. In a data-heavy world, more and more powerful computers are critical to calculate probabilities accurately. With that in mind, many banks are turning to a new generation of processors in order to exploit huge quantities of data faster. [5] Therefore, quantum computing can reshape financial markets, but it is still difficult to predict precisely how and when, while we illustrate below three basic areas that this transformation might look like in the near future:

- **Reshaping security**

Quantum computers would have enough power to crack what is called today's "strong" computer encryption keys in the next five to ten years. All information transmitted on public networks now or in the future is vulnerable to drop without quantum-safe cryptography and security. When a working quantum computer with sufficient capacity becomes available, even encrypted data that is secure today can be stored for later decryption. This means that in today's connected world, the first countries to make significant breakthroughs in quantum computing will have a decided advantage, both economically and militarily. Quantum computing security is basically the safest type of cryptography known because of its ability to respond to threats in ways that disclose intrusions before a breach happens, thus transmitting information without a separate method of transmission.

- **Enhancing modelling and risk management**

Computers would be able to run calculations at speeds that exceeds the one of the existing algorithms due to the blazingly high processing speeds of quantum computing. For example, IBM published a paper that showed that traditional Monte Carlo simulations used in the prediction of investment portfolio risk were quadratically accelerated. These methods may be extended to a broad variety of approaches in risk management. The big tech has based asset pricing on quantum computers, an application that is applicable to virtually every form of company in financial services. It will not be long before such applications can be extended to a wide range of real-world use cases, with the strength of quantum computing increasing exponentially.

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For example, being able to quote the prices of complex financial products in real-time has seismic consequences for the customer service levels that can be achieved, not to mention changes in financial institutions' operating efficiencies. And having such enormous power behind machine-learning algorithms could change the way security mispricing and profitable business opportunities are discovered dramatically. Nonetheless, virtually all the effort to ensure that such enthusiasm can be transformed into action is still ahead of us and getting to the revolutionary moment will not be straightforward. It is a truly daunting job to construct a quantum computer capable of outperforming classical computers, and possibly one of the great challenges of the century. A number of important problems will have to be dealt with before we achieve this stage. This means that it is only possible to test the technology in terms of its potential rather than any demonstrated capability. [35]

To sum up, the consequences of quantum computing will transform financial services in the near future. In order to help minimize risk and optimize returns from complex portfolios of instruments, banks and financial institutions, such as hedge funds now seem to be most promising in quantum computing. The pace at which significant changes take place will significantly increase, while human interaction can only be relied on to ratify flagged-up solutions.

35. International Banker, (2020, October). Can quantum computing transform financial services?

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