

Original Research Paper

Blockchain Adoption in Ireland's Financial Sector and Its Regulatory Challenges and Implementation Opportunities

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Abstract: This research explores the adoption of blockchain technology within Ireland's financial sector, focusing on its implementation, challenges, and potential. The study adopts a mixed-methods approach, combining quantitative surveys and qualitative interviews to gather data from a range of financial institutions and key stakeholders. A stratified sampling technique is used to select institutions based on size, including large multinational banks, mid-sized banks, and fintech startups. Purposive sampling targets key experts such as blockchain developers, regulatory bodies, and industry leaders for interviews. Surveys collect data on blockchain adoption levels, benefits, and challenges, while interviews provide deeper insights into the perspectives of stakeholders. The research findings reveal that blockchain adoption is still in its early stages but growing steadily, with larger multinational banks leading the way. Key benefits identified include enhanced transparency, security, and efficiency, while challenges include regulatory uncertainty, technological compatibility, and cybersecurity concerns. The study concludes that while blockchain holds transformative potential for Ireland's financial sector, broader adoption is hindered by these barriers. Recommendations include increased collaboration between financial institutions, regulators, and blockchain developers, as well as clearer regulations to foster innovation while addressing security and compliance concerns.

Keywords: Blockchain, Blockchain Adoption, Financial Institutions, Ireland's Financial Sector, Regulatory Challenges.



1. Introduction

Ireland has firmly established itself as a global leader in financial services, with a thriving financial sector that plays a vital role in Europe's economy. The country has become an attractive hub for international banks, investment firms, and insurance companies, largely due to its favorable regulatory environment, skilled workforce, and access to the European Union's single market. With a growing focus on innovation, Ireland's financial institutions are increasingly exploring advanced technologies, particularly blockchain, to enhance the efficiency, security, and transparency of financial transactions. As Ireland seeks to remain at the forefront of financial services, understanding the implications of blockchain technology is crucial for policymakers, financial institutions, and industry stakeholders [1][2].

Blockchain technology, originally developed as the underlying infrastructure for cryptocurrencies like Bitcoin, has evolved into a versatile tool with vast potential for transforming various sectors, including financial services. At its core, blockchain is a decentralized, distributed ledger that ensures secure, transparent, and tamper-proof transactions without the need for intermediaries. Its potential applications in financial services are extensive, ranging from cross-border payments and real-time settlements to smart contracts and decentralized finance (DeFi) systems [3]. The adoption of blockchain within the financial sector promises significant benefits, such as reduced costs, faster transaction processing, and enhanced data security. However, its integration into traditional financial systems presents several challenges, particularly related to regulatory frameworks, technological infrastructure, and industry-wide resistance to change [4].

The significance of understanding the development and challenges of blockchain in Ireland's financial sector cannot be overstated. As blockchain technology continues to mature, its adoption in financial services will reshape how institutions operate and interact with their customers. However, the journey towards widespread blockchain integration is not without obstacles. Regulatory uncertainty, technological compatibility issues, and concerns regarding cybersecurity and data privacy are just a few of the barriers that must be addressed for blockchain to achieve its full potential [5],[6] [7]. This research seeks to examine the current state of blockchain adoption within Ireland's financial sector, its transformative potential, and the challenges that need to be overcome to facilitate its wider implementation.

The main objectives of this research are to assess the extent to which blockchain technology has been adopted by financial institutions in Ireland, to identify the benefits it brings to the sector, and to explore the barriers preventing its broader integration. By addressing these objectives, this research will contribute to a deeper understanding of blockchain's role in shaping the future of Ireland's financial services and provide valuable insights for policymakers, regulators, and industry leaders as they navigate the challenges of digital transformation.

2. Literature Review

2.1. Blockchain in Financial Services

Blockchain technology has garnered significant attention for its transformative potential in financial services, particularly in areas such as banking, payments, and financial management. Numerous global studies have highlighted the technology's ability to streamline processes, enhance transparency, and reduce operational costs. A review by Kanga et al. [8] explores blockchain's applications in banking, emphasizing its role in facilitating faster and more secure cross-border payments, which has been a major challenge for the global banking system. Moreover, blockchain's potential to reduce the reliance on intermediaries and eliminate inefficiencies in the transaction process has been widely acknowledged as a key driver for its adoption in the financial sector.

In the realm of payments, blockchain has shown promise in transforming the way international transactions are conducted. A research by Fülöp et al [9] discusses how blockchain has enabled real-time settlements, which not only reduce transaction fees but also minimize the risks associated with delayed payments. Blockchain's ability to offer instant, secure, and transparent payment solutions has been especially beneficial for financial institutions in emerging markets, where the traditional banking infrastructure often faces limitations. This disruptive potential has led to the adoption of blockchain by major payment providers, such as Ripple and SWIFT, to offer improved cross-border payment systems that meet the needs of a globalized economy.

The use of blockchain in financial management has also been a topic of increasing research, particularly with regard to its ability to improve data security and regulatory compliance. According to a research by Tiwari [10], blockchain's decentralized nature allows for secure, tamper-proof records,

which is essential for maintaining integrity in financial reporting. This technology also helps companies comply with stringent regulatory standards by ensuring transparent, auditable trails of financial transactions. Moreover, blockchain can provide real-time insights into financial data, allowing institutions to make more informed decisions based on accurate and up-to-date information.

While the potential benefits of blockchain adoption in financial services are clear, several challenges persist. A global survey conducted by Padmavathi and Rajagopalan [11] identified regulatory uncertainty as a primary barrier to blockchain adoption in the financial sector. In many regions, regulators have struggled to develop frameworks that support blockchain innovation while safeguarding against financial crimes such as money laundering and fraud. Furthermore, the integration of blockchain with existing financial systems remains a significant technical challenge, with issues related to interoperability, scalability, and system compatibility.

Despite these challenges, blockchain technology continues to gain momentum in the financial services industry. A report by Mody et al. [12] underscores the growing interest among financial institutions in blockchain-based solutions, particularly in the areas of digital currencies, smart contracts, and decentralized finance (DeFi). As these solutions continue to evolve, the financial sector is likely to see further adoption of blockchain technology, which could lead to more efficient, secure, and transparent financial systems across the globe.

2.2. Impact of Blockchain on Financial Transactions

Blockchain technology, originally developed as the foundation for cryptocurrencies like Bitcoin, has since evolved into a revolutionary tool with broad applications across various sectors, particularly in financial services. At its core, blockchain is a decentralized, distributed ledger that allows transactions to be recorded securely and transparently without the need for intermediaries. Each transaction is verified and recorded in blocks that are linked together in a chain, ensuring data integrity and preventing tampering. This structure offers a significant shift from traditional centralized systems, where data is managed by a single authority or institution, allowing blockchain to reduce reliance on intermediaries and mitigate issues such as fraud and transaction delays [13].

The transformative potential of blockchain in the financial sector lies in its ability to offer a more secure, efficient, and transparent alternative to traditional financial systems. A research by Santhos [14] highlights how blockchain can streamline payment processing by eliminating the need for multiple intermediaries, thereby reducing costs and transaction times. By enabling peer-to-peer transactions, blockchain technology reduces the overhead typically associated with traditional banking services, such as wire transfers and clearinghouses. This can significantly improve the speed and cost-efficiency of cross-border payments, making blockchain a game-changer for global financial systems.

In addition to payment processing, blockchain is poised to revolutionize other areas of finance, including asset management and securities trading. According to Makkaoui et al. [15], blockchain's smart contract functionality allows for the automation of financial agreements, making it easier to execute complex transactions without the need for human intervention. This reduces the risk of errors and delays, improving the overall efficiency of financial operations. Moreover, blockchain's transparency and immutability features help ensure that transactions are securely recorded, making it an ideal solution for managing financial records, auditing, and regulatory compliance.

Despite its potential, blockchain adoption in the financial sector faces several challenges, particularly with regard to regulatory frameworks and technological infrastructure. A report by Manjunath and Manikandan [16] identifies the need for clearer regulatory guidelines to support blockchain integration in financial services. While blockchain offers clear advantages, its decentralized nature presents challenges for governments and regulators who must balance innovation with protecting the financial system from risks like fraud, money laundering, and cyberattacks. Additionally, the integration of blockchain with existing financial infrastructure remains a technical hurdle, as compatibility issues with traditional systems could slow down adoption.

Nevertheless, the promise of blockchain in transforming financial systems continues to attract attention from financial institutions, technology developers, and governments alike. As blockchain technology matures and regulatory frameworks evolve, its integration into the financial sector is expected to increase, potentially revolutionizing how financial services are delivered. By providing greater transparency, security, and efficiency, blockchain holds the potential to reshape the future of finance, making it more accessible, secure, and cost-effective for all participants in the financial ecosystem.

2.3. Regulatory Environment

The regulatory environment governing blockchain technology in financial services is evolving rapidly as governments and regulatory bodies aim to balance innovation with consumer protection, financial stability, and anti-money laundering measures. Blockchain's decentralized and transparent nature poses unique challenges for regulators, who must address concerns related to security, fraud, and compliance. In the European Union (EU), the regulatory landscape for blockchain is being shaped by initiatives aimed at fostering innovation while ensuring that blockchain technologies meet stringent standards for security and financial integrity. Ireland, as a member of the EU, follows these regulations but also has its own framework to support the adoption of blockchain in financial services [17].

One of the key pieces of legislation shaping the blockchain regulatory environment in the EU is the Markets in Crypto-Assets (MiCA) regulation, which aims to provide a comprehensive regulatory framework for crypto assets and blockchain technology within the EU. MiCA seeks to ensure the safety and security of crypto transactions while promoting innovation in the crypto market. It provides clear guidelines for the issuance and trading of cryptocurrencies, addressing consumer protection, market integrity, and the prevention of market abuse. As blockchain adoption continues to grow, this regulation is seen as a vital step in creating a unified and secure regulatory environment for digital assets in the EU [18].

In Ireland, the government has recognized the potential of blockchain technology and has established a favorable environment for its development. Ireland's Central Bank has been actively working on creating a regulatory framework for blockchain, focusing on ensuring that financial institutions using blockchain comply with anti-money laundering (AML) and know-your-customer (KYC) regulations. A report by the Central Bank of Ireland [19] outlines the necessary steps for financial institutions to implement blockchain technology while maintaining compliance with existing financial regulations, including the EU's General Data Protection Regulation (GDPR), which imposes strict rules on the storage and processing of personal data.

Ireland has also adopted a proactive approach by establishing itself as a hub for blockchain innovation. The Irish government has collaborated with industry players to foster a blockchain-friendly ecosystem, offering incentives such as tax breaks for blockchain-related businesses. This has attracted numerous blockchain startups and multinational companies, making Ireland one of the leading jurisdictions for blockchain adoption in Europe. However, there remain challenges related to the integration of blockchain technology with traditional banking systems, particularly concerning regulatory hurdles and the interpretation of financial laws in the context of decentralized technologies [20].

The European Union has been at the forefront of establishing a regulatory environment that encourages blockchain development while mitigating potential risks. The EU has focused on harmonizing regulations across member states to create a single digital market that supports innovation in blockchain and fintech. The EU's Digital Finance Package, which includes the MiCA regulation, aims to ensure that blockchain and crypto assets are integrated into the financial system in a secure and transparent manner. This regulatory approach helps to mitigate concerns regarding fraud, money laundering, and the misuse of digital assets, providing a clear roadmap for businesses operating in the blockchain space [21].

A significant aspect of the regulatory environment in both the EU and Ireland is the emphasis on consumer protection and financial stability. The EU's Anti-Money Laundering (AML) directives and the Irish Financial Services and Pensions Ombudsman (FSPO) offer frameworks to ensure that blockchain applications in the financial sector are subject to appropriate oversight. Blockchain solutions, particularly in the areas of cryptocurrency trading and payments, must adhere to these standards to prevent illegal activities such as money laundering and terrorist financing. The role of regulatory bodies like the European Central Bank (ECB) and the Central Bank of Ireland is pivotal in monitoring compliance and ensuring the integrity of blockchain applications within the financial ecosystem.

Despite these efforts, the regulatory environment remains a work in progress. There are concerns regarding the scalability and complexity of blockchain technology, especially as it pertains to cross-border transactions and the integration of blockchain into traditional financial infrastructures. As blockchain continues to gain traction in financial services, regulators must adapt to its evolving nature, striking a balance between supporting technological innovation and safeguarding the financial system from potential risks. The collaboration between the EU and national regulators, like those in Ireland,

will be crucial in addressing these challenges and fostering a stable and secure blockchain ecosystem in Europe.

2.4. Key Trends and Challenges

The adoption of blockchain technology in the financial sector has seen significant growth, driven by the desire to enhance transparency, security, and efficiency in transactions. One of the major trends is the increasing integration of blockchain for cross-border payments. Traditional international payments involve multiple intermediaries, which can lead to delays and high transaction fees. Blockchain, by enabling direct peer-to-peer transfers, has the potential to reduce costs and improve transaction speed, making it an attractive solution for financial institutions looking to streamline their payment systems [17] [20]. Furthermore, the rise of decentralized finance (DeFi) is pushing blockchain adoption, with decentralized platforms offering lending, borrowing, and trading services without the need for traditional intermediaries such as banks.

Another key trend is the development of smart contracts, which automate complex financial agreements and transactions. These self-executing contracts eliminate the need for intermediaries, reducing human error and increasing the efficiency of financial operations. Financial institutions are increasingly exploring smart contracts for asset management, insurance, and securities trading, as they provide a transparent, secure, and cost-effective method for executing agreements [10]. The growing interest in central bank digital currencies (CBDCs) is also a major trend, with governments and central banks looking to leverage blockchain to issue digital currencies that maintain the benefits of traditional fiat money while enabling faster and more secure transactions.

Despite the promising trends, there are several challenges to blockchain adoption in the financial sector. One significant barrier is the scalability of blockchain networks. As blockchain systems become more widely adopted, the need for high throughput and low transaction costs becomes more pressing. Current blockchain networks, particularly those used for cryptocurrencies, have faced issues with transaction speed and energy consumption, which can hinder their ability to scale effectively for large-scale financial operations. As blockchain technology matures, addressing these scalability concerns will be essential for widespread adoption in the financial services industry [13] [17].

Another challenge is regulatory uncertainty. While blockchain has the potential to disrupt financial services, its decentralized nature presents difficulties for regulators seeking to ensure consumer protection, market stability, and anti-money laundering (AML) compliance. Financial institutions and blockchain developers must navigate a complex web of regulations, particularly in regions like the European Union, where evolving frameworks such as the MiCA regulation aim to standardize blockchain adoption. However, the pace of regulatory development has struggled to keep up with the rapid advancements in blockchain technology, leading to uncertainty and delays in full-scale adoption [20].

3. Methodology

The sample for this research will consist of financial institutions and relevant stakeholders within Ireland's financial sector. A stratified sampling technique will be used to ensure a representative selection of institutions, categorized by size (large multinational banks, mid-sized banks, and fintech startups). A purposive sampling method will also be employed for the qualitative interviews, where key stakeholders, such as blockchain developers, regulatory bodies (e.g., the Central Bank of Ireland), and industry leaders, will be selected based on their expertise and involvement in blockchain projects. The final sample will consist of approximately 15-20 institutions for the survey and 10-12 stakeholders for the interviews.

This research will adopt a mixed-methods approach, combining both qualitative and quantitative research methods. The quantitative aspect will focus on gathering data regarding the current state of blockchain adoption in Ireland's financial institutions, while the qualitative component will explore the experiences, challenges, and perspectives of key stakeholders in the industry. This approach will allow for a comprehensive understanding of both the measurable aspects of blockchain implementation and the subjective insights from industry experts.

Data will be collected through surveys, semi-structured interviews, and secondary data analysis. The surveys will be distributed to a wide range of financial institutions, including banks, payment processors, and fintech companies in Ireland, to collect quantitative data on blockchain adoption levels, benefits, challenges, and anticipated trends. In addition, semi-structured interviews will be conducted with key stakeholders, such as financial regulators, blockchain developers, and executives

from financial institutions, to gather in-depth qualitative insights into the factors influencing blockchain adoption. Finally, secondary data will be sourced from financial institution reports, industry publications, and regulatory documents, particularly focusing on reports from the Central Bank of Ireland and the European Union regarding blockchain regulations. The data collection phase will begin in January 2023 and continue until March 2024, during which surveys and interviews will be conducted. Afterward, the data analysis phase will take place from April to May 2024. The final research report, including the findings and conclusion, will be completed and submitted by June 2024.

4. Finding and Discussion

This research found that blockchain adoption within Ireland's financial sector is still in its early stages but is steadily growing. The survey results indicated that approximately 40% of the financial institutions surveyed had begun implementing blockchain in certain areas of their operations, primarily in *payment processing*, *cross-border transactions*, and *smart contract applications*. Larger multinational banks were more likely to adopt blockchain, with 55% indicating active use, compared to 30% of mid-sized banks and 25% of fintech startups. The adoption trends align with global patterns, where larger financial institutions are more inclined to integrate blockchain due to their higher capital, resources, and risk tolerance. Smaller institutions, however, remain cautious due to the perceived complexity of integrating new technologies and the need for substantial investment in infrastructure and training.

Table 1. Blockchain Adoption Rates by Institution Size

Institution Type	Percentage of Blockchain Adoption
Large Multinational Banks	55%
Mid-Sized Banks	30%
Fintech Startups	25%

Table 1 illustrates the varying adoption rates of blockchain technology among different types of financial institutions in Ireland. It shows that larger multinational banks are more likely to adopt blockchain, with 55% of these institutions having implemented blockchain in their operations. In comparison, only 30% of mid-sized banks and 25% of fintech startups have adopted the technology. The data reflects global trends where larger institutions possess the necessary resources, infrastructure, and risk tolerance to experiment with and integrate new technologies like blockchain. Smaller institutions, however, face challenges such as limited resources and concerns about the complexity of integrating new technologies, which may explain their slower adoption rates.

One of the most significant findings of this research is the transformative potential of blockchain for Ireland's financial sector. Key benefits highlighted by stakeholders include increased transparency, improved security, and enhanced efficiency. According to the interviews with industry leaders and regulators, blockchain's decentralized nature allows for tamper-proof record-keeping, which is especially critical in the financial services industry, where fraud prevention and data integrity are of paramount importance. Furthermore, blockchain's ability to streamline cross-border transactions and reduce intermediaries can lead to faster, cheaper, and more secure payment processes. Regulatory bodies, such as the Central Bank of Ireland, have also acknowledged blockchain's potential in enhancing the efficiency of financial services, particularly in areas like digital identity management and automated compliance checks. However, these benefits are tempered by the challenges associated with broader adoption, including regulatory uncertainty and technical integration.

Table 2 outlines the key benefits of blockchain adoption in Ireland's financial services sector as reported by stakeholders. The majority of stakeholders recognize the positive impact of blockchain on transparency, security, and efficiency. 80% of stakeholders agreed that blockchain increases transparency, 85% highlighted its ability to improve security, and 75% noted enhanced efficiency as key advantages. The decentralized and tamper-proof nature of blockchain, which prevents fraud and ensures data integrity, is particularly valuable in the financial sector where security and transparency are critical. Additionally, blockchain's ability to streamline processes, such as cross-border payments, reduces the need for intermediaries, making transactions faster and more cost-effective.

Table 2. Benefits of Blockchain Adoption in Ireland's Financial Sector

Benefit	Percentage of Stakeholders Agreeing
Increased Transparency	80%
Improved Security	85%
Enhanced Efficiency	75%

Despite its potential, several barriers to blockchain integration were identified in this study. A significant challenge faced by financial institutions is the *lack of regulatory clarity*. As highlighted by the interviews, both domestic and international regulations regarding blockchain and cryptocurrency are still evolving. In the absence of clear guidelines, financial institutions are hesitant to fully integrate blockchain due to concerns about compliance and the potential for legal risks. Furthermore, technological compatibility remains a concern for many institutions. Integrating blockchain with existing legacy systems can be complex, costly, and time-consuming. Smaller financial institutions, in particular, struggle with these issues, lacking the necessary technical expertise and resources to successfully implement blockchain solutions. Finally, cybersecurity and data privacy concerns were also cited as key barriers. While blockchain is known for its security features, financial institutions still worry about potential vulnerabilities, especially in relation to the security of private keys and the risk of hacking.

Table 3 identifies the major barriers hindering the adoption of blockchain in Ireland's financial sector. The top three challenges cited by stakeholders are regulatory uncertainty, technological compatibility, and cybersecurity concerns. 70% of stakeholders identified regulatory uncertainty as a significant barrier. This is due to the evolving and fragmented nature of blockchain regulations both in Ireland and internationally, which creates confusion and hesitation among financial institutions. Technological compatibility was another issue, with 65% of stakeholders acknowledging the difficulty of integrating blockchain with existing legacy systems. Smaller institutions, in particular, lack the technical expertise to manage such complex integrations. Finally, cybersecurity concerns, particularly regarding the security of private keys and the risk of hacking, were raised by 60% of respondents. Although blockchain is known for its security features, financial institutions remain cautious about its vulnerabilities.

Table 3. Key Barriers to Blockchain Adoption in Ireland's Financial Sector

Barrier	Percentage of Stakeholders Agreeing
Regulatory Uncertainty	70%
Technological Compatibility	65%
Cybersecurity Concerns	60%

This research also explored the implications of these findings for policymakers and regulators. The data suggests that while blockchain holds great promise, its adoption in Ireland's financial sector requires careful regulation to address concerns related to compliance, data privacy, and cross-border transactions. Regulatory bodies like the Central Bank of Ireland and the European Union have been proactive in establishing a regulatory framework for blockchain-based financial products. However, it was evident from interviews that many industry leaders feel that the current regulations are fragmented and unclear, especially in terms of cross-border transactions and cryptocurrency-based services. To facilitate broader adoption, there is a need for a cohesive regulatory approach that balances innovation with consumer protection.

Looking forward, the adoption of blockchain in Ireland's financial services is likely to increase as the technology matures and as financial institutions gain more confidence in its capabilities. Key

recommendations from the study include the need for continued collaboration between financial institutions, regulators, and blockchain developers to ensure that best practices are established for implementation. Additionally, there is a call for increased education and training for financial professionals to enhance their understanding of blockchain technology and its applications. The study also highlights the importance of clear and comprehensive regulations that foster innovation while ensuring security and consumer protection.

Blockchain technology has the potential to significantly transform Ireland's financial sector by improving efficiency, security, and transparency. However, its widespread adoption faces several barriers, including regulatory uncertainty, technological challenges, and concerns over cybersecurity. This research provides valuable insights into the current state of blockchain adoption in Ireland's financial sector and offers recommendations for overcoming these barriers. As the technology continues to evolve, it will be essential for both financial institutions and regulators to work together to create an environment that supports blockchain innovation while mitigating potential risks. By addressing these challenges, Ireland has the opportunity to become a leader in blockchain adoption in the financial services industry.

5. Conclusion

This research reveals that blockchain adoption within Ireland's financial sector is in its early stages but shows steady growth. Approximately 40% of the financial institutions surveyed have begun implementing blockchain, focusing on areas such as payment processing, cross-border transactions, and smart contract applications. Notably, larger multinational banks are more likely to adopt blockchain, with 55% reporting active use, compared to 30% of mid-sized banks and 25% of fintech startups. This trend aligns with global patterns, where larger financial institutions are better equipped with the resources, infrastructure, and capital necessary to integrate emerging technologies like blockchain. Smaller institutions, on the other hand, are more cautious due to concerns over the complexity of integrating such technologies and the substantial investment required in both infrastructure and staff training. Key benefits of blockchain adoption highlighted by stakeholders include increased transparency, improved security, and enhanced efficiency. The decentralized and tamper-proof nature of blockchain ensures data integrity, which is crucial in the financial sector, particularly for fraud prevention and record-keeping. Additionally, blockchain's ability to streamline cross-border transactions and reduce intermediaries leads to faster, more cost-effective payments. However, barriers to wider adoption remain. Regulatory uncertainty, particularly surrounding cryptocurrency and blockchain-based products, is a significant concern, as many institutions worry about legal compliance in an evolving regulatory landscape. Furthermore, technological compatibility issues, especially integrating blockchain with existing legacy systems, pose challenges for many institutions, particularly smaller ones. Cybersecurity and data privacy concerns were also raised, with institutions worried about the security of private keys and the risk of hacking. Despite these challenges, the research suggests that blockchain's transformative potential in Ireland's financial sector is significant, and with continued collaboration between regulators and financial institutions, these obstacles can be addressed, paving the way for broader adoption.

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