Lisbon School of Economics & Management
Universidade de Lisboa

MASTER

INTERNATIONAL ECONOMICS AND EUROPEAN STUDIES

MASTER´S FINAL WORK

DISSERTATION

BLOCKCHAIN ADOPTION IN EUROPEAN BANKING: STRATEGIC RESPONSES TO THE CRYPTOCURRENCY REVOLUTION

JOSÉ DAVID FERNANDES RODRIGUES

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GLOSSARY

AI – Artificial Intelligence

CBDC – Central Bank Digital Currency

DAO – Decentralized Autonomous Organization

DeFi – Decentralized Finance

DOI – Diffusion of Innovation

ESG – Environmental, Social, and Governance

LDA – Latent Dirichlet Allocation

NFT – Non-Fungible Toke

PESTEL – Political, Economic, Social, Technological, Environmental, and Legal

RBV – Resource-Based View

STM – Structural Topic Modelling

TAM – Technology Acceptance Model

ABSTRACT

Blockchain technology has sparked academic and institutional interest in the banking sector across Europe, particularly around digitalization, regulatory reform, and *FinTech*. However, research has stayed fragmented and overly technical, with little emphasis on taking a strategic and futurist approach to the uncertain impact of blockchain on frameworks of banking in Europe. This thesis aims to address that gap by studying how to prepare for the future of blockchain adaptation through a hybrid methodological framework comprised of structural topic modelling (STM), expert insight-based strategic foresight, and scenario planning.

A study of 1,308 police-reviewed academic publications from Scopus (2014–2025) was examined with structural topic modelling (STM), to extract latent themes in the banking and blockchain research literature. Through this process, four core topics were extracted: central bank digital currencies (CBDCs), decentralised network security, *FinTech*, and applications of artificial intelligence (AI). Expert domain evaluators were then asked to evaluate the four topics to develop an impact–uncertainty matrix, which prioritised two topics (CBDCs & AI) as both high impact and high uncertainty. Using these, I created four scenario narratives to develop future pathways for the future of banking in Europe – Digital Hegemony, Autonomous Finance, The Surveillance Economy, and Open Innovation Grid.

The results indicated that blockchain technology will not replace traditional banking, instead providing more hybrid infrastructures for banking within the oversight of financial authorities through decentralised new points of innovation. Trade-offs in the new hybrid banking systems were revealed by the scenario analysis through the acknowledgement of varying degrees of regulations, transparency, financial inclusivity, and systemic risk. This means that there will be important determinates that will shape the adoption of blockchain in banking in the future, such as regulatory clarity, interoperability, and ethical AI governance.

The thesis contributes to the literature by establishing a new interdisciplinarity framework of foresight that includes computational topic modelling with expert knowledge, scenario thinking, and illumination. It also provides strategic foresight for banking sector participants, including banks, policymakers, and *FinTech* stakeholders in

Europe and beyond, as they seek to approach the adoption of blockchain that is resilient and ethical.

KEYWORDS: Blockchain Adoption, European Banking Sector, Central Bank Digital Currencies (CBDCs), Artificial Intelligence in Finance, Decentralized Finance (DeFi), Structural Topic Modelling (STM), Scenario Planning, Financial Regulation, Strategic Foresight, *FinTech* Innovation.

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1. INTRODUCTION

The European banking sector is currently undergoing radical transformation by emerging technologies such as blockchain and artificial intelligence (AI). These technologies are undermining existing financial systems by changing how value is transferred, the basis upon which trust is established, and how financial services are regulated. The most notable of these technologies, blockchain, is a foundational technology that can provide decentralized governance, transparency, and state-of-the-art security. However, the adoption of blockchain and its interaction with traditional banking systems is unpredictable, inconsistent, and a source of concern regarding risks of institutional adaptation, coordination of public policy, and uncertainty of strategic futures.

Thus, while there is considerable academic and policy interest, much of the existing scholarship has focused on blockchain through a fragmented lens (primarily technical implementations or singular use cases). Holistic and prospective studies that demonstrate the systemic and transitional impacts of blockchain on banking are notable by their absence. This thesis is an attempt to remedy that issue by utilizing an analysis of empirical data and complimentary strategic foresight methodology.

The research investigates the core question: How will blockchain adoption in European banking evolve and service the strategic futures that may evolve, all subject to varying regulatory and technological conditions? To address the core question, a hybrid methodology is applied that combines Structural Topic Modelling (STM) with scenario planning based on expert opinion. Stratum analysis was undertaken using a corpus of 1,308 academic publications to identify themes drawn from blockchain and banking research. Subsequently, scenario planning took place whereby experts evaluated the themes on their perceived impact and uncertainty. The evaluations led to the selection of two priority areas in the 173 unique themes included in the publications reviewed. These areas included Central Bank Digital Currencies (CBDCs) and AI as a technology applied to finance.

The two priority areas became topics for four strategic scenarios: Digital Hegemony, Autonomous Finance, The Surveillance Economy, and Open Innovation Grid, each representing a plausible future reflecting satisfaction under different levels of regulatory control and technological sophistication.

The contribution of this study is a novel framework that assists financial institutions and policymakers in wide signal detection in anticipation of complex futures; identify systemic risks and facilitate responsible and inclusive innovation within the European financial ecosystem.

2. THEORETICAL FRAMEWORK

The following chapter provides a theoretical basis for the research on the adoption of blockchain technology in European banking and the strategic responses to the rise of cryptocurrencies. The primary objective is to identify and present the key conceptual frameworks, technological insights, and strategic theories that underpin the analysis conducted in later chapters.

The chosen methodology and theoretical framework are based on the interdisciplinary nature of the topic, which intersects financial innovation, strategic management, and technology adoption. The following chapter will, therefore, seek to explain how traditional banking institutions perceive, evaluate, and respond to the challenges and opportunities posed by blockchain and cryptocurrencies.

2.1. Blockchain and Blockchain as Infrastructure

Blockchain can be defined as a decentralized and distributed digital ledger system designed to record transactions securely, transparently, and immutably across a network of computers. It relies on cryptographic techniques and consensus mechanisms to ensure that network participants verify and agree upon data entries, eliminating the need for centralized oversight (Nakamoto, 2008). Each block in the chain contains a set of transactions, a timestamp, and a cryptographic hash of the previous block, creating a chronological and tamper-resistant chain of records (Yli-Huumo et al., 2016).

Speaking of blockchain as an infrastructure, it can be defined it as having a foundational role in enabling decentralized digital ecosystems. Tapscott and Tapscott (2016) describe blockchain as the "Internet of Value," emphasizing its capacity to facilitate peer-to-peer value exchanges without intermediaries. This infrastructure includes key components such as consensus protocols (e.g., Proof of Work, Proof of Stake), Merkle trees for data integrity, and distributed governance frameworks. It supports applications across financial services, identity verification, supply chain management, and more, offering enhanced security, auditability, and resilience (Catalini & Gans, 2016; Zheng et al., 2018).

2.2. Cryptocurrency and Cryptocurrency as Virtual Money

It can be defined cryptocurrency as a type of digital asset that uses cryptographic techniques to secure transactions and control the creation of new cryptocurrency units. It operates on decentralized blockchain networks and is usually not issued by any central authority. Cryptocurrencies are programmable, borderless, and often characterized by volatility and innovation in monetary design (Böhme et al., 2015).

Dodd (2017) argues that cryptocurrencies challenge the state monopoly over currency by introducing algorithmically governed, market-based monetary systems. Nonetheless, the absence of legal tender status and high volatility constrain their full substitution for conventional money (Arner et al., 2020). Still, their growing adoption in remittances, payments, and decentralized applications suggests a transformative potential in the evolving money landscape.

2.3. DeFi and DeFi Elements (Players, NFTs, Smart Contracts)

Decentralized Finance (DeFi) can be defined as a blockchain-based ecosystem that seeks to replicate and innovate upon traditional financial services using decentralized protocols, smart contracts, and token-based governance systems by eliminating intermediaries such as banks, enabling users to interact directly with financial applications built on decentralized networks like Ethereum (Schär, 2021).

As defined by Christidis & Devetsikiotis (2016), and later confirmed by Costa (2024) DeFi elements include a range of actors and tools. Key players involve users, developers, liquidity providers, and decentralized autonomous organizations (DAOs). On the other hand, smart contracts are self-executing agreements with encoded rules that manage assets and transactions automatically.

Furthermore, Non-Fungible Tokens (NFTs) are unique digital assets that can represent ownership of art, identity, or financial rights; they are increasingly integrated into DeFi as collateral or access tools (Dowling, 2022).

It can also be noted that platforms like Uniswap (decentralized exchange) and Aave (lending/borrowing protocol) form the infrastructural backbone of DeFi, enabling permissionless, global financial interaction (Moro-Visconti & Pirolo, 2022).

2.4. Scenario Planning and Strategic Foresight

Scenario planning is a preferred method of strategic discovery in settings characterized by significant uncertainty, complexity, and change. Unlike predictive methods, which identify a single probable future, scenario planning provides a structural framework for interrogating multiple plausible futures given critical uncertainties and key change drivers. This approach allows decision-makers to explore strategic decisions, highlight vulnerabilities, and build resilience by producing contrasting narratives that are all internally coherent (Schwartz, 1991; Godet, 2000).

The roots of scenario planning intersect with corporate foresight and policy foresight, where thinking about disruption is more valuable than being able to predict specific outcomes. Achieving this goal has been supported by the use of intuitive logic (Schwartz, 1991) and an–uncertainty matrix (Godet, 2000), which help institutions to scope potential scenarios that conceptualize the strategic implications of alternative trajectories. These frameworks have particular salience in the financial sector, where the intersection of regulatory dynamics, technology adoption, and geopolitical developments can colour results in complex ways.

At the core of this approach is the idea of weak signals – slim, fragmented pieces of information that may point to impending changes before they become visible. According to van Veen and Ortt (2021), weak signals are not simply the result of being new or ambiguous; rather, their "weakness" relates to their distance from the perceiving agent's cognitive framework, which makes it difficult to recognize and interpret them. This consideration emphasizes the role of perceptual and interpretive filters exercised by organizational foresight and reinforces the legitimacy of using more complex means of environmental scanning and sense-making.

While quantitative approaches around conducting thematic trends like Structural Topic Modelling (STM) may be useful in helping researchers pick up on weak signals and positional changes, the generative strength of foresight is using the multiple dimensions of change – technological, institutional, and societal – within a structured set of scenarios. This idea combines the 'foresight' to integrate the ethical, regulatory, and governance dimensions that need to occur in relation to these fast-moving fields, like digital finance and artificial intelligence (Schulze et al., 2021; Zeng et al., 2021).

In sum, scenario planning provides a bridge between strategic imagination and anticipatory governance. Its goal is not to predict the future, but to prepare institutions for a range of potential trajectories, enabling more robust and responsible decision-making under uncertainty.

3. LITERATURE REVIEW

The following chapter provides a comprehensive review of the academic literature and key debates on the topic, helping us to frame the study of blockchain adoption in the European banking sector. By tracing the evolution of technological, regulatory, and institutional dynamics, it can be established a contextual basis for understanding the strategic implications of emerging digital infrastructures such as blockchain, cryptocurrencies, and decentralized finance (DeFi).

The literature review reflects the chronological transformation of Europe's financial system and the theoretical underpinnings relevant to financial innovation.

3.1 The European financial system and its technological evolution

Prior studies states that the European financial system has undergone some major changes, especially in the past 20 years, clearly driven by a mix of fast-moving financial tech (*FinTech*), new regulations, and bigger shifts in the economy and society. Europe's financial scene used to be disaggregated but has moved at a fast pace through standardization and digitalization. This stands as a major challenge to traditional *FinTech*, as it has shaken up traditional banking in a notorious way while also helping more people access financial services across the EU.

According to Orăștean et al. (2024), countries in northern Europe are leading the *FinTech* change, as they possess the digital infrastructure and regulatory support to guarantee efficiency; on the other hand, the global south and east represent a bigger challenge, as the adoption has been slower mainly due to regional inequality.

These tech changes are not just surface-level; they are impacting how stable and profitable banks are. Campanella et al. (2020) analysed data from 1,250 EU banks, founding that innovation affects everything from leverage ratios to how banks are structured and how much they earn. At the same time, regulations have had to evolve to keep up with this trend. Valkanov (2023) assesses how RegTech (tech for ensuring financial systems follow the rules) has become essential.

As so, it can be stated that the aforesaid changes are facilitating the alignment of the financial world with the EU´s bigger goals for the "Digital Decade", focusing on transparency, data protection, and risk management.

May (2004) also notes that demographic shifts and the rise of the European Monetary Union have de evident that financial services need to modernize to keepup with future demands.

Taking the aforementioned into consideration, it canb be concluded by stating that Europe´s financial system is constantly evolving through a tight interplay of technology, shifts in the economy, and regulatory matters, evidencing the fact that there will be a need for strategy creation to properly embrace innovation without jeopardizing EU standards of safety, inclusion and fairness.

3.2 Fundamentals of Blockchain and its relationship with the banking sector

As discussed before, it can be stated that blockchain is rapidly becoming a important change source in banking´s digital transformation, as it offers a decentralized and secure way to manage transactions without having to rely on traditional banking intermediaries, ensuring better transparency, lower changes of fraud and fewer operating costs; as it runs on distributed ledgers (Shah et al., 2024).

For banks that have long relied on centralized systems and top-down structures, blockchain opens new opportunities, as it helps to streamline processes from cross-border payments and trade finance to verifying digital identities. Keerthana (2024) points out that blockchain not only speeds up transactions but also cuts down reconciliation delays and strengthens cybersecurity, translating into a big shift for day-to-day banking as-is.

Nonetheless, it is still worth noting some challenges that might impose scalability issues, vague regulations, and the challenge of fitting blockchain into old-school banking systems, which are slowing down adoption and standardization. Kloba et al. (2023) mention that banks need solid frameworks to roll out blockchain tech, which means that there is a real need to balance innovation with compliance and customer trust.

Taking into consideration global scales, blockchain´s impact looks somewhat different depending on the region concerned. Aderemi et al. (2024) note that while some countries the U.S. are embracing blockchain and integrating it into mature financial systems, other nations like Nigeria use it to enhance their financial inclusion, proving that this technology can adapt to diverse needs and environmental conditions.

It can be concluded that blockchain can be seen in a double prism, as it can represent both a disruptor and an enabler. It is changing the old way of doing things, but also helping build something better, more efficient, more secure, and more adaptable. The key will be figuring out how to manage the tech, the rules, and the infrastructure all at once.

3.3 Cryptocurrencies as disruption: threat or opportunity

Delving into cryptocurrencies as a disruptive agent, it can be stated that this phenomenon has burst onto the global financial scene, stirring up a mix of excitement and concern. Designed to be a decentralized alternative to traditional money, cryptocurrencies like Bitcoin are changing the ways we think about value, trust, and financial control.

Raymaekers (2015) points out that while cryptocurrencies offer a whole new way to move money, they are still being hampered in their adoption due to unclear regulations, scalability problems, and a lack of mainstream user embracement. Nonetheless, the blockchain technology behind them has caught the interest of major financial players, who see its potential to reshape how transactions are done. This is causing an ongoing debate about what cryptocurrencies really mean for the future of finance, as on one hand, it challenges the financial status quo; and on the other, it opens doors to new innovations. Kasula (2024) highlights this tension, as she notes that cryptocurrencies can be risky for established markets, but they also give traditional banks a chance to step up their game in areas like payments, service quality, and customer connection.

Some authors as Chonnoo (2024) expand this analysis, mentioning the fact that as more cryptocurrencies and central bank digital currencies (CBDCs) enter the picture, there is a possibility that traditional banking services lose their monopoly on currency control and transaction processing; this could represent a major threat for the traditional banking sector, but it could also benefit consumers by means of wider financial access and lower operational costs.

Exploring other countries and realities, and focusing on India, Chakravaram et al. (2021) explore how these trends are playing out in real-time. Their research shows that while there are macroeconomic risks, crypto also holds serious potential to fuel *FinTech* innovation in emerging markets.

In conclusion, cryptocurrencies represent a powerful disruptor. Whether they turn out to be a revolution or a passing trend will depend on how fast regulations are able to

manage and catch up, how the technology evolves, and how well traditional institutions adapt to this fast-changing landscape – or threat –.

3.4 Relevant strategic and technology adoption theories

Studying the relevant strategic and technology theories is relevant if we try to fathom how innovation takes root in banking and finance. The main ones are the Resource-Based View (RBV), Technology Acceptance Model (TAM), Diffusion of Innovation (DOI), and Institutional Theory. Each brings a different angle to the table.

Starting with RBV, this theory states that companies can get a lasting edge over competitors by making the most of what they already have, things like tech infrastructure and skilled people. In Kenya, for instance, Odhiambo and Mang'ana (2022) found that the way banks adopt technology plays a crucial role in boosting their competitive performance. So, internal resources really do matter.

On one hand, Institutional Theory explains how external forces, like regulations or cultural norms, influence *FinTech* adoption. In Saudi Arabia, Eskandarany (2024) shows how banks align with regulatory standards not just to comply but to earn legitimacy in the market. It is not just about doing things right; it is about being seen as doing things right.

TAM and DOI, on the other hand, focus more on the user's perspective. By trying to assess why people chose to adopt new technologies, we are able to say that it comes down to factors like how easy the technology is to be used, how useful it seems, and how noticeable the benefits are. Bureshaid et al. (2021) combined these two models and found that adoption is not just about the technology itself; perceived risks and consumer habits play a big part too.

The aforementioned theories exemplify that adopting new tech is not just about having the right tools, it is also about the people using them and the environment they operate in. Whether it is about strategy or individual behaviour, they help explain how financial institutions move forward in a fast-changing digital world.

It can be concluded the chapter stating that as seen before, it is clear that vver the past decade, blockchain technology has emerged as a key driver of transformation in the financial sector. Beyond its role in enhancing operational efficiency, transactional

integrity, and cost reduction (Shah et al., 2024), its disruptive potential extends into new forms of financial intermediation. Keerthana (2024) highlights how blockchain improves cybersecurity and transparency while also facilitating cross-border transactions and strengthening fraud prevention mechanisms. Nonetheless, significant barriers remain, including scalability limitations, interoperability challenges, and regulatory uncertainty (Kloba et al., 2023). As seen, a particularly innovative development is Decentralized Finance (DeFi), which operates through smart contracts and autonomous protocols that eliminate traditional intermediaries. DeFi reimagines financial services as open, programmable, and user-centric systems. Bakare et al. (2024) emphasize its ability to democratize access to credit, investment, and liquidity, while Moro-Visconti and Cesaretti (2023) note the structural challenge this poses to conventional banking architecture. However, the model carries important risks, including exposure to smart contract vulnerabilities and regulatory gaps (Uppaluri, 2024).

From a theoretical standpoint, these developments have been examined through multiple conceptual lenses. The Resource-Based View (RBV), as assessed by Odhiambo and Mang'ana (2022), provides insights into how banks can leverage internal capabilities to adopt blockchain effectively. Institutional Theory, explored by Eskandarany (2024), examines how external pressures, such as regulation and social norms, shape financial technology adoption. Likewise, the Technology Acceptance Model (TAM) and the Diffusion of Innovation (DOI) theory have been used by scholars such as Bureshaid et al. (2021) and Bazyar (2024) to understand user behavior and perceived risks in the adoption of digital tools. Leading researchers in this space, such as A. Kumar, S. Gupta, and P.K. Ozili, have contributed critical perspectives on regulatory frameworks and the socioeconomic implications of blockchain adoption, particularly in emerging markets.

In parallel, the growing complexity and uncertainty of financial systems have brought scenario planning into focus as a strategic tool for navigating change. Schwartz's (1991) work introduced intuitive logics, a narrative-based approach to envisioning multiple futures. In contrast, Godet (2000) proposed a more systematic method grounded in tools such as impact–uncertainty matrices, which are also employed in this study. Both perspectives agree that scenarios are not predictive tools, but frameworks for improving resilience and preparedness.

Furthermore, research by Mietzner and Reger (2005) emphasized the value of foresight methods in high-volatility, innovation-driven sectors such as finance. In recent years, computational tools like Structural Topic Modelling (STM) have expanded foresight methodologies. Schulze et al. (2021) and Rutkowski et al. (2022) demonstrate how STM and automated content analysis allow researchers to extract latent patterns from large textual datasets without sacrificing analytical depth. Zeng et al. (2021) further integrate this approach by linking artificial intelligence governance to the United Nations' Sustainable Development Goals, arguing for a model of foresight that combines technical feasibility with ethical and societal considerations.

Costa and Aparicio (2025) provide a scenario generation process specifically oriented toward assessing the possible ramifications of integrated artificial intelligence (AI) for society and the economy. Their scenario generation process combines qualitative foresight activities with quantitative modelling, and provides a structured way to construct future scenarios based on possible trajectories of AI development. The authors identify three interconnected domains - employment transformation, income structure, and institutional quality - as important areas where AI technology has the potential to create systemic change. In their scenario analyses, Costa and Aparicio create stress-test scenarios to elucidate how differences in policy responses, technologies that are diffusing, and socio-economic context result in substantially different outcomes for society and the economy. Their approach is particularly relevant for AI futures literature, since it offers a replicable methods suite for thinking ahead about the impacts of different AI futures on `developed' and `emerging' economies. This approach reflects a wider interest in moving beyond relying on deterministic projections towards more diverse and flexible planning approaches to resilience resilience in AI governance scholarship; as so we will be delving into this methodological approach in the subsequent chapters.

In conclusion, the evolution of blockchain and DeFi poses challenges that go beyond technology, calling for strategic and foresight frameworks that integrate risk, innovation, and responsibility. This thesis contributes to this evolving discussion by combining empirical modelling, expert input, and narrative-based foresight in an effort to support more robust decision-making in an increasingly complex and uncertain European financial landscape.

4. METHODOLOGY

This chapter outlines the methodological framework employed to explore the future of blockchain adoption in the European banking sector. Recognizing the complexity and uncertainty surrounding this evolving field, the research adopts a qualitative, exploratory, and forward-looking approach. Central to this design is integrating Structural Topic Modelling (STM) – an automated content analysis technique capable of extracting thematic structures from large textual datasets – with expert-informed strategic foresight tools.

The methodology unfolds in several stages. First, a comprehensive dataset of academic publications was constructed using Scopus, targeting peer-reviewed literature on blockchain applications in banking. STM was then applied to identify latent topics and thematic trends across the corpus, providing an empirical foundation for further strategic analysis. These data-driven insights were evaluated by domain experts using an impact–uncertainty matrix, which helped prioritize the most disruptive and unpredictable themes – namely, Central Bank Digital Currencies (CBDCs) and AI Applications in Finance.

These prioritized topics served as the basis for constructing four strategic scenarios using a hybrid foresight methodology inspired by the frameworks of Schwartz (1991) and Godet (2000). This chapter details each step of the methodological process – from data selection and preprocessing to topic modelling, expert evaluation, and scenario development – while also addressing the limitations and assumptions underlying the research. In doing so, it lays a transparent and robust foundation for the scenario-based analysis presented in the next chapter.

It is also important to state that STM was chosen over other NLP techniques for three main reasons. First, because it goes beyond simple word counts by uncovering hidden themes across large sets of texts, which is crucial for an exploratory study on blockchain in banking. Second, unlike classical models, STM can make use of document-level metadata, making it possible to track how topics change over time and across different contexts, which is something that can be considered essential for a forward-looking analysis. Finally, compared to newer methods like Word2Vec or BERT, STM provides results that are easier to interpret and reproduce, since it outputs clear lists of keywords that can be directly linked to frameworks such as PESTEL or the impact–uncertainty

matrix. This makes STM a method that balances technical rigor with transparency, ensuring that the insights are both reliable and useful for building strategic scenarios.

4.1 STM-Driven Strategic Foresight in Blockchain Adoption

This study employs a qualitative, exploratory, and forward-oriented research design to investigate the evolving landscape of blockchain adoption within the European banking sector. Its exploratory character stems from the need to uncover emerging themes and patterns in a theoretical domain, making it particularly appropriate for the use of automated content analysis techniques, specifically Structural Topic Modelling (STM). STM facilitates the identification of underlying topics across a large body of academic literature while also incorporating metadata at the document level, such as publication dates and keywords, to analyse topic frequency and trends over time (Rutkowski et al., 2022). This methodological approach strengthens the qualitative analysis by integrating interpretive insights with algorithmic precision.

The forward-looking aspect of the research is realized through a strategic, scenario-based framework inspired by established futures studies methodologies, especially those developed by Schwartz and Godet (Gándara Fierro, 2015). A key element of this framework is the impact-uncertainty matrix, which consolidates expert evaluations of each STM-generated topic's potential strategic relevance and associated uncertainty. This matrix functions as a prioritization tool, highlighting the most influential and unpredictable themes that are likely to influence future developments in the banking sector.

By combining automated topic modelling with expert-driven prioritization, through surveys addressed at specialists in contact with the banking and finance sector, the research adopts a hybrid methodological approach that balances empirical data analysis with strategic foresight. This integration enables the formulation of plausible, data-informed future scenarios (Schulze et al., 2021). Moreover, the study enhances methodological transparency and reproducibility while ensuring that its findings are not only theoretically grounded but also applicable.

4.2 Data Corpus and Selection Criteria

The dataset used for our current study was extracted from the Scopus database using a search query – as shown below:

TITLE-ABS-KEY ("Blockchain" AND ("Banking" OR "Bank")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "DECI") OR LIMIT-TO (SUBJAREA , "SOCI")).

The query used guaranteed a corpus on blockchain applications within the banking sector, filtered by relevant disciplinary domains such as Economics, Business, Decision Sciences, and Sociology and limited to documents published in English.

A total of 1,308 documents were retrieved from the database, covering the period from 2014 to 2025. It is visible a dip in 2025 publications, likely due to incomplete indexing at the time of data extraction. Also, it can be noted that the dataset exhibits a broad scope of orientations, with different kinds of publications under various formats, including journal articles (38.1%), conference papers (32.0%), book chapters (17.4%), and books (4.7%). It then can be drafted that this distribution points out at a dynamic and evolving research field that spans both theoretical discourse and practical experimentation.

Scopus was selected for its large coverage of high-quality, peer-reviewed academic literature, also because of its robust indexing of metadata, and its integration of citation analytics. All these features make it an ideal source for constructing a credible and diverse corpus suitable for Structural Topic Modelling (STM). To enhance the quality of the STM analysis, text preprocessing steps were applied, including standardization to lowercase, removal of stop words, and tokenization of abstracts and titles although these are elaborated further in the methodology section (refer to section 4.3).

The inclusion of peer-reviewed sources to the dataset guarantees academic rigor, and to note its relevance for identifying the dominant discourses and strategic themes in blockchain adoption within the banking industry. Furthermore, the presence of diverse keywords such as “digital banking,” “*FinTech*,” “decentralized finance,” “machine learning,” and “smart contracts” signals a wide range of thematic concerns that align with both technological feasibility and strategic banking imperatives, reinforcing the corpus’ alignment with this thesis’ goals.

Regarding the evolution of relevant research over time, it can be stated that over the past ten years, there has been a notable increase in the amount of study on blockchain in

banking, especially after 2017, when publications on the subject started to increase significantly. In line with the growing institutional interest in blockchain technology, cryptocurrency laws, and the larger trend of digital transformation in financial services, this momentum persisted and peaked in 2023. However, rather than a fall in actual research effort, it can be stated that the steep decline in 2025 is probably the result of insufficient indexing of recent papers. As shown in Figure 1 below:

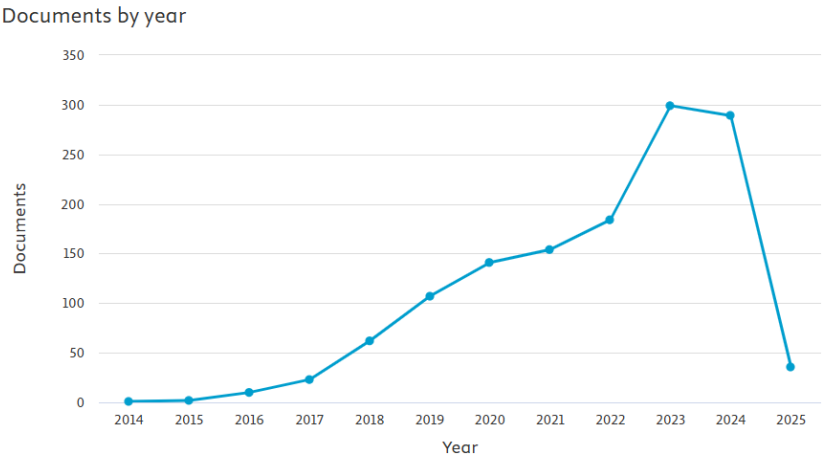

Figure 1. Documents by year

In terms of the geographic distribution of the research, India surpasses both China and the United States as the leading contributor to blockchain research in banking. This points to a significant academic and institutional push for blockchain applications in digital banking infrastructure and financial inclusion, which is consistent with the government's efforts to incorporate digital financial solutions and India's larger *FinTech* boom. Due to their legislative debates, business adoption plans, and technological developments in decentralized finance (DeFi) and central bank digital currencies (CBDCs), the United States and China, two significant global financial centers, contribute significantly to blockchain research. This distribution draws attention to a difference: emerging areas like India are investigating blockchain-driven banking innovations to address issues of financial accessibility and efficiency, while Western economies are concentrating on integrating blockchain into established financial institutions. Figure 2 shows the following:

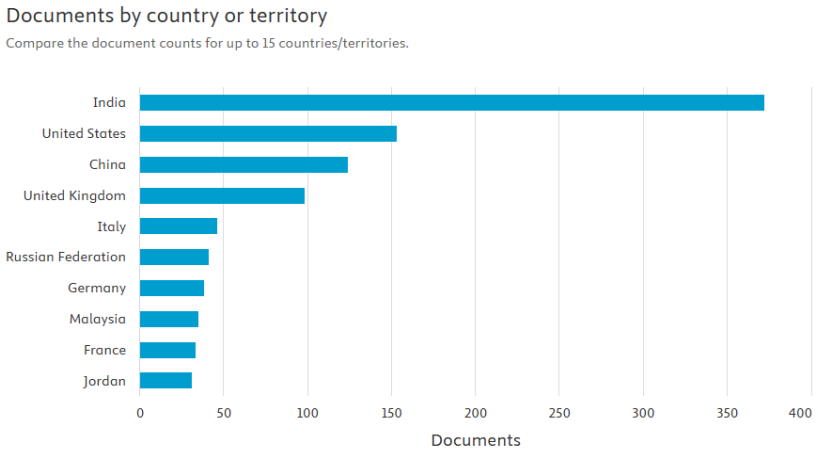

Figure 2. Documents by country or territory

Additionally, a multidisciplinary approach regarding the research areas and academic focus is seen in the study fields related to blockchain in banking, with the most important ones being Computer Science (18.9%), Business and management (18.3%), and Decision Sciences (15.5%); all of this implying that the ongoing debate it´s more related to blockchain´s strategic ramifications and banking decision-making frameworks rather than assessing whether blockchain technology is technically feasible or not. Also, it is worth because Economics (14.6%) represents a significant subject area, showing how interested people are starting to feel about the financial implications of blockchain adoption, especially concerning monetary policy, banking efficiency, and financial stability. As our study lies at the nexus of company strategy, economic impact, and technology evolution, this distribution shown in Figure 3 confirms its applicability.

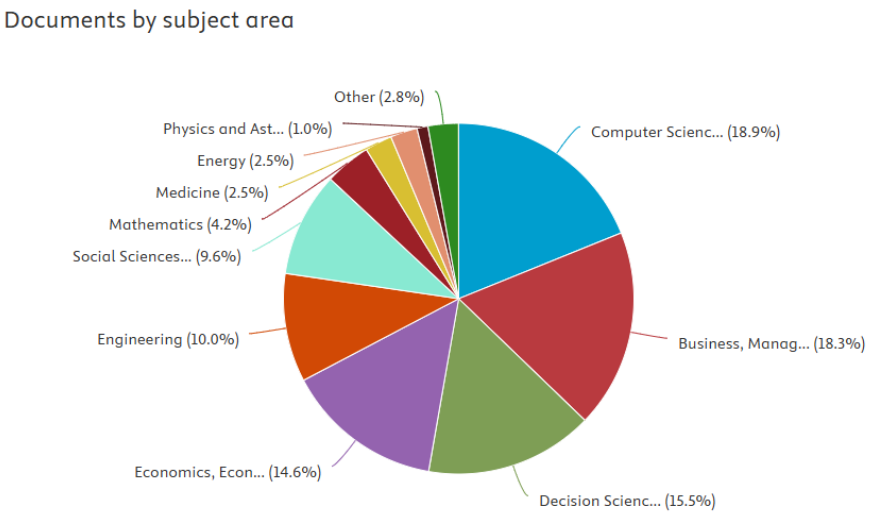

Figure 3. Documents by subject area

As for the key research and institutions chosen, prominent scholars in this area, like A. Kumar, S. Gupta, and P.K. Ozili, have shaped the scholarly conversation on blockchain in financial services with their numerous contributions. Finding well-established theoretical frameworks and empirical data that either confirm or refute the viability of integrating blockchain technology into banking operations may be made easier with the help of their efforts. Furthermore, the participation of multiple writers with comparatively equal contributions suggests that blockchain in banking is still a developing topic without a single leading thought leader, which makes it a promising area for additional research. The distribution of the chosen author can be reviewed in Figure 4 below.

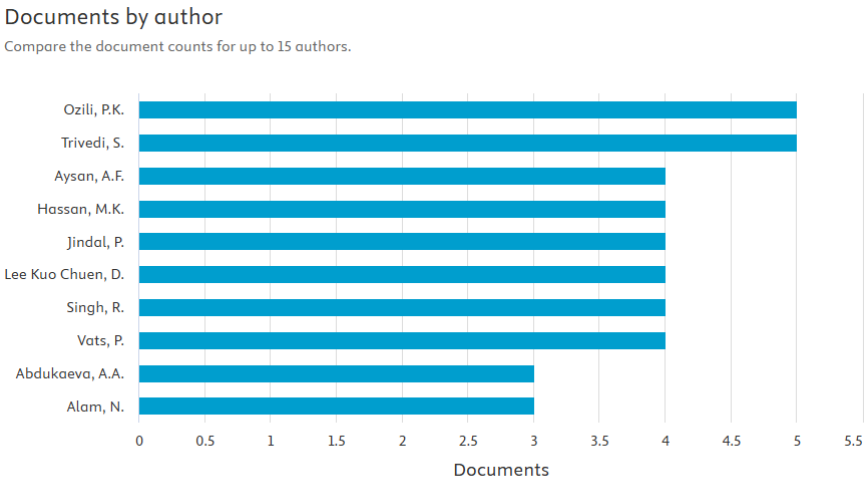

Figure 4. Documents by author

Regarding the type of documentation used, it can be stated that the kinds of documents generated in this field also provide information about how advanced the research is, as the blockchain stage in the banking area is still being explored and discussed in academic and professional webs, as evidenced by the fact that journal articles (38.1%) and conference papers (32.0%) make up most publications. It can be noted that the important number of conference papers indicates that many concepts are still in the experimental stage, with academics and industry players testing hypotheses, putting forward frameworks, and honing their methods. A shift towards more consolidated information is also indicated by book chapters (17.4%) and books (4.7%), which suggest an expanding corpus of literature that may provide regulatory agencies and financial institutions with a starting point for their work, as shown in the distribution can be viewed in Figure 5, below.

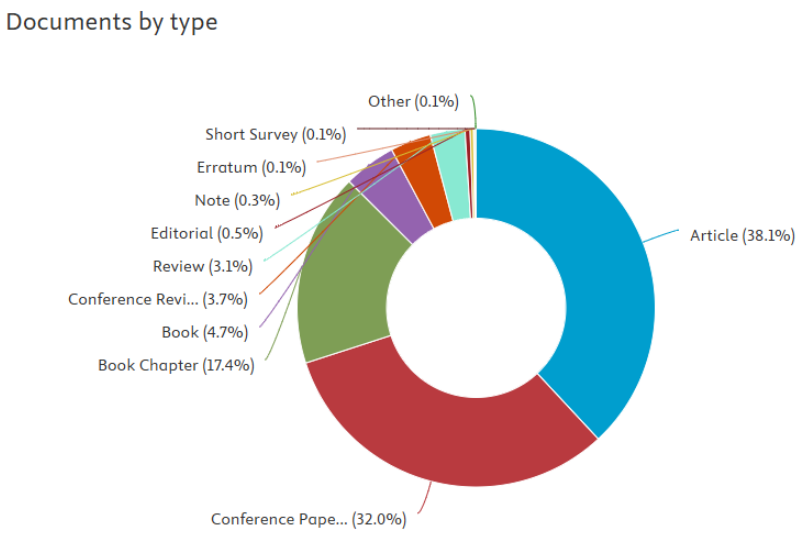

Figure 5. Documents by type

4.3 Application of Structural Topic Modeling (STM)

To explore the thematic nuances of blockchain adoption in the banking sector, we have decided to apply the Structural Topic Modelling (STM), implemented via the Latent Dirichlet Allocation (LDA) algorithm using Python's sklearn library. This decision can be justified by stating that STM is particularly effective for exploratory qualitative research, as it uncovers hidden patterns and semantic structures within large bodies of text, making it ideal for tracking dominant themes and how they evolve over time (Blei, Ng, & Jordan, 2003). This method aligns closely with the study's exploratory goals, offering a rigorous, scalable way to examine academic discourse on blockchain in banking.

The dataset included 1,308 peer-reviewed academic publications drawn from the Scopus database. These documents were filtered by relevant disciplines such as Economics, Business, and Sociology and limited to English-language publications from 2014 to 2025. A unified text was created for each document by merging the Author Keywords, Title, and Index Keywords fields. The text was then processed through a structured cleaning process: converting all text to lowercase, removing numbers, punctuation, and stop words, and normalizing whitespace. This can be justified by stating that these preprocessing steps are vital for reducing noise and improving the clarity and

quality of the topic modelling results, allowing the algorithm to focus on semantically meaningful patterns.

Next, vectorization was carried out using Term Frequency-Inverse Document Frequency (TF-IDF), with the vocabulary capped at the 1,000 most informative terms. Extremely rare terms (appearing in fewer than five documents) and overly common ones (present in more than 90% of documents) were excluded. This filtering helps maintain a balance between generalizability and specificity, ensuring that the topics generated are both coherent and distinct.

The LDA model was used to extract four main topics. This number was selected through testing, ensuring that the topics were not only statistically insignificant but also meaningful to be interpreted. Each topic is summarized by its top ten keywords, which offer insight into the core themes emerging from the academic literature:

- Topic 1: supply, bank, digital, currency, central, blockchain, chain, cryptocurrency, cryptocurrencies, money
- Topic 2: blockchain, security, smart, data, systems, decentralized, privacy, distributed, contract, network
- Topic 3: financial, banking, *FinTech*, blockchain, technology, digital, sector, finance, industry, Islamic
- Topic 4: international, conference, learning, machine, business, detection, fraud, insurance, investment

Together, these topics reflect the evolving conversations around blockchain in the financial sector, from digital currencies and *FinTech* innovation to cybersecurity and fraud detection.

To deepen the academic relevance of the identified topics, our study has also applied the PESTEL framework, examining Political, Economic, Social, Technological, Environmental, and Legal dimensions, helping link each thematic cluster to broader forces that shape future scenarios.

- Topic 1 aligns with the *Economic* and *Legal* categories, reflecting trends in digital currencies, central bank policies, and innovations like Central Bank Digital Currencies (CBDCs) and stablecoins.

- Topic 2 speaks to *Technological* and *Legal* challenges, including cybersecurity, decentralized infrastructures, smart contracts, and data privacy, core components of the digital backbone for banking institutions.
- Topic 3 spans both the *Economic* and *Social* dimensions. It highlights *FinTech* developments, the push for financial inclusion, and broader sectoral shifts, including insights into Islamic banking practices.
- Topic 4 is more diffuse but overlaps with *Technological* and *Business Strategy* themes. It touches on artificial intelligence, fraud detection, Insurtech, and algorithm-driven investment areas that represent a frontier of innovation and risk management.

In order to understand how these topics have shifted over time, we have applied a temporal analysis. STM topic proportions were grouped by publication year (2014 - 2025) to track the rise and fall of thematic interest. The results show us a clear upward trend for Topics 1 and 3, indicating a growing academic focus on digital currencies and *FinTech* from early feasibility studies to current concerns around strategy and regulation.

Topic 2, once dominant due to its technical focus on decentralization and security, now appears to be stabilizing or even declining slightly. This suggests that many of these technological questions have matured and are now taken as foundational. In contrast, Topic 4, linked to AI, fraud, and risk, though still insignificant in presence, is gaining attention, pointing to a new and emerging area of scholarly inquiry.

Considering that together, these STM-generated topics and their PESTEL alignments form the pillars of the present thesis's strategic analysis, as they serve as the empirical base for building the *impact-uncertainty matrix:* a foresight tool used to prioritize which issues are both disruptive and unpredictable. This matrix, discussed further in Section 4.4, blends automated topic modelling with expert evaluations to identify the two most critical themes for scenario building.

Covering the evolution of topics over time, the figure below illustrates the results retrieved from the aforementioned model:

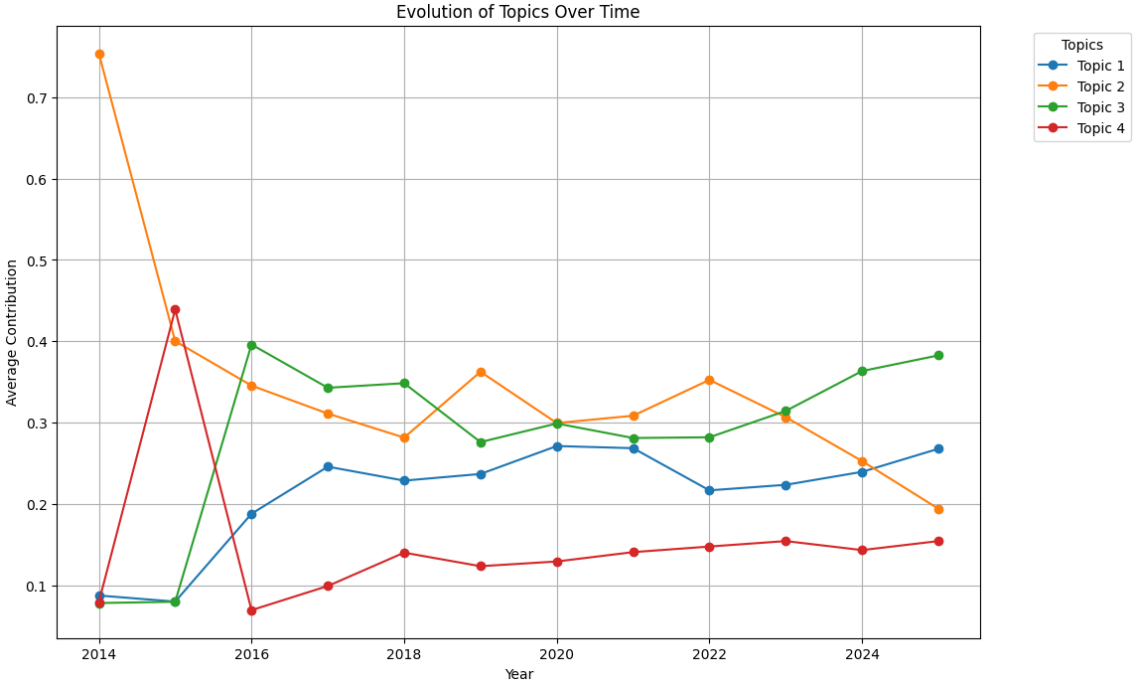

Figure 6. Evolution of Topics Over Time

On one hand, the timeline presented in Figure 6 shows how research priorities around blockchain in banking have evolved from 2014 to 2025. Topic 2 (orange), which focuses on core blockchain infrastructure decentralization, privacy, and smart contracts can be pointed out as the starting point, by dominating early discussions, reaching an average contribution of nearly 75% in 2014. However, it can be noted that its influence declines over the following years. This pattern suggests that early research was driven by questions of technological feasibility and implementation.

On the other hand, Topic 3 (green) which revolves around *FinTech* innovation, digital finance, and the broader transformation of the banking sector, gains momentum over time. By 2025, it can be noted that it will become the most prominent theme. This upward trend can translate into a shift in academic focus: from how blockchain works to how it is being embraced within financial institutions and its broader societal effects.

Furthermore, topic 1 (blue), covering central banking, digital currencies, and monetary policy reforms, can exemplify a more moderate but increasing trend. This reflects a growing academic interest in the regulatory and macroeconomic aspects of blockchain, especially in relation to the development and potential adoption of Central Bank Digital Currencies (CBDCs).

Lastly, Topic 4 (red), which captures intersections with AI, machine learning, fraud detection, and Insurtech, remains the least prominent. Nevertheless, it shows a slow and steady rise. While still emerging, its existence exemplifies a growing recognition of blockchain's potential, particularly in areas involving financial risk and automation.

Taken together, it can be noted that these trends point to a broader thematic shift: from early technical exploration to a more nuanced focus on strategy, policy, and institutional transformation. This evolution exemplifies the growing maturity of blockchain research within the banking domain and lays the basis for identifying the most disruptive and uncertain themes in the next phase of our analysis.

4.4 Selection of Strategic Topics - Explanation of How the Impact vs. Uncertainty Matrix Was Constructed

To identify which STM-derived topics translate into the most valuable for the present study, we have applied an impact uncertainty matrix – which is a widely recognized tool in strategic foresight, especially useful for studying complex and fast-changing environments (Van der Heijden, 2005) – as our main objective was not mainly to rank topics based on algorithmic output, but to boost data quality through insights from experts on the field.

After identifying four main topics through STM, each was given a clear and descriptive label to make interpretation easier. These labels were based on the top-ranked keywords in each topic, analysed through the PESTEL framework, and tuned to reflect the dominant themes. The final topic labels were:

- Topic 1: Central Bank Digital Currencies and Monetary Innovation
- Topic 2: Blockchain Security and Decentralized Networks
- Topic 3: *FinTech* and Digital Transformation in Finance
- Topic 4: AI Applications in Finance and Fraud Detection

As mentioned, we have engaged professionals with diverse expertise in different fields, such as blockchain, traditional banking, *FinTech*, DeFi, and regulatory compliance, to evaluate the strategic relevance of each topic. These experts were asked to score each topic on two dimensions: potential impact on the financial sector and degree

of future uncertainty, using a 1-5 Likert scale. To enhance the numerical ratings, in some cases, participants also provided qualitative explanations for their evaluations.

When the scores were averaged, all four topics were perceived as highly impactful, with impact scores ranging from 4.2 to 5.0. However, the uncertainty levels showed greater variation. As shown in Figure 7, Topics 1 and 4, which focused on CBDCs and AI in financial services, stood out in the upper-right quadrant of the matrix. This quadrant indicates areas of both high impact and high uncertainty, making them the main candidates for scenario development.

Topic 4 received especially high uncertainty ratings due to numerous factors: rapid innovation in generative AI, unclear regulatory pathways, and ongoing debates about ethical risks in algorithmic decision-making. Topic 1 also ranked high on uncertainty, with expert feedback highlighting issues such as central bank control, the geopolitical implications of CBDCs, and unresolved questions about design and implementation.

The impact-uncertainty matrix (as seen below) integrated expert input with STM results, our objective with this was not mainly to note what matters for the field but also to help prioritize what needs to be explored further in scenario planning. It ensures that the selected themes are not only based on real data but also aligned with the strategic blind spots and possibilities shaping the future of finance.

Figure 7. Impact-Uncertainty Matrix for Strategic Topic Selection

On the other side, Topics 2 and 3, while still considered influential, were rated as having lower levels of uncertainty. Topic 2 (Blockchain Security and Decentralized Networks) was viewed as increasingly stable, which can be attributed to the maturing of foundational technologies and growing standardization within the banking industry. Topic 3 (*FinTech* and Digital Transformation in Finance) was similarly seen as evolving along a more predictable path, following a well-established innovation curve within the financial sector.

These findings justify our decision to choose Topics 1 and 4 as the central axes for scenario development. This choice is in scope with widely accepted foresight practices, which recommend focusing on themes not only high in strategic impact but also marked by significant uncertainty, as these are the issues most likely to define future disruptions and opportunities.

In this sense, STM helped review the main themes in the literature, but expert input was crucial to make sense of them in practice; as the experts added context that the model alone could not capture, such as regulatory uncertainty, adoption challenges, or geopolitical risks. Their feedback not only confirmed the relevance of the algorithmic results but also pointed to areas the data might have missed, making the final topic selection more balanced and grounded.

For transparency and to support methodological reproducibility, both the expert profiles and the complete questionnaire are provided in the appendices.

4.5 Construction of Strategic Scenarios

The use of strategic scenarios in our research is based in their proven ability to explore multiple plausible futures, especially when dealing with elevated levels of uncertainty and complexity. As foresight scholars like Peter Schwartz (1991) and Michel Godet (2000) emphasize, scenarios are not meant to predict the future. Instead, they help illuminate a range of possible outcomes and equip decision-makers with the tools to navigate them effectively. This approach aligns directly with the goal of this thesis: to understand the long-term implications of blockchain adoption in European banking.

The methodology adopted for our study takes a hybrid framework approach, blending Schwartz's intuitive logic with Godet's structural analysis. The process started by identifying key themes using Structural Topic Modeling (STM), which showed four distinct topic clusters. These were then assessed as aforementioned by domain experts through an impact uncertainty matrix, helping pinpoint the two most strategically significant topics:

- Topic 1: Central Bank Digital Currencies and Monetary Innovation
- Topic 4: AI Applications in Finance and Fraud Detection

Both topics appeared in the upper-right quadrant of the matrix, indicating high impact and high uncertainty, making them the right choice for scenario development. Their inclusion reflects the major unknowns surrounding the regulation, adoption, and societal impact of CBDCs and AI in finance.

These two topics now form the axes for constructing four future scenarios. The first axis considers different ways for the institutionalization and public uptake of CBDCs, ranging from centralized, state-led models to more pluralistic ecosystems where CBDCs coexist with decentralized alternatives. The second axis looks at how AI might unfold in financial services, spanning a spectrum from tightly regulated, ethics-informed implementation to unrestrained algorithmic automation with far-reaching economic and ethical implications.

By combining these axes, our study generates four distinct and possible scenarios, each presenting a different set of challenges and opportunities for the banking sector. This scenario framework offers structured yet adaptable scenarios for anticipating disruption, helping decision-makers prepare for a range of futures rather than a single predicted outcome.

In conclusion, it can be stated that this chapter has laid out a methodological approach to investigating the strategic implications of blockchain adoption in European banking by means of blending automated content analysis through Structural Topic Modelling (STM) with expert evaluations using an impact–uncertainty matrix, the study adopts a mixed-methods framework that balances between data-driven scale and strategic insight.

STM helped surface dominant themes from a wide-ranging corpus of peer-reviewed academic literature, revealing patterns and long-term shifts across disciplines and over time. At the same time, the expert survey added contextual intelligence, offering practitioner perspectives on the possibility, relevance, and uncertainty of the identified topics. This combination of algorithmic precision and expert judgment gives the analysis both depth and credibility.

Such a hybrid method is especially well-suited to research that sits at the crossroads of technological innovation and strategic foresight, an area where relying on either purely qualitative or quantitative tools alone would fall short. As noted in foresight studies (Mietzner & Reger, 2005), combining data analytics and participatory interpretation strengthens scenario development's reliability and real-world utility.

Through this process, the study identified two central topics for deeper exploration:

- Central Bank Digital Currencies and Monetary Innovation, and
- AI Applications in Finance and Fraud Detection.

These topics were not chosen arbitrarily; they emerged from a rigorous, multi-step evaluation process, ensuring that the scenarios developed in the next chapter are grounded in both current academic thinking and strategic concerns voiced by industry experts.

5. RESULTS - SCENARIO CONSTRUCTION AND ANALYSIS

This section will show the results drafted from our study, taking a methodological step-by-step approach.

5.1 Introduction to Scenario Building

In fast-moving, high-uncertainty fields like blockchain and artificial intelligence in finance, traditional forecasting methods often struggle to keep up. They are built for linear trends, not for the kind of unpredictable shifts that come with emerging tech, changing regulations, and complex socioeconomic forces; as such, we consider that scenario building makes for a suitable choice. Rather than trying to predict a single future, scenario analysis helps stakeholders explore multiple plausible futures and consider various strategic options (Schwartz, 1991). Based on strategic foresight, this method supports more adaptive and resilient decision-making, especially in sectors facing constant disruption (Van der Heijden, 2005).

This chapter uses a scenario-based approach to map out possible long-term trajectories for blockchain adoption in European banking. The analysis centers on two key topics that were identified through Structural Topic Modeling (STM) and validated by experts as both highly impactful and highly uncertain:

- Topic 1: Central Bank Digital Currencies and Monetary Innovation
- Topic 4: AI Applications in Finance and Fraud Detection

These topics were not just chosen for their academic relevance, they also reflect broader macro-environmental forces that are reshaping the financial landscape (Maier et al., 2018). On one side, CBDCs could redefine monetary authority, regulatory structures, and the very mechanics of payment systems. On the other hand, the rise of AI in finance raises critical questions about automation, data governance, ethics, and accountability in algorithmic decision-making. Together, these themes capture two of the most transformative shifts facing modern banking: the reimagining of currency regimes and the evolution of decision-making systems.

To explore how these forces might interact, this chapter introduces a *2×2* scenario matrix. The matrix maps out the extremes of uncertainty for each topic, ranging from centralized control over digital currencies to decentralized alternatives and from tightly

regulated, ethics-driven AI to more autonomous, unregulated systems. This results in four distinct scenarios, each offering a unique perspective on how the future might unfold for banks, regulators, *FinTech*, and consumers across Europe.

The aim here is not to predict which future will happen but to stimulate forward-thinking and help strategic actors prepare for a world where disruption is the norm. By surfacing potential risks, opportunities, and inflection points, these scenarios support more informed, agile, and resilient strategy development in an era of systemic transformation.

5.2 Definition of Scenario Axes and Uncertainties

Building meaningful and analytical scenarios starts with one essential step: clearly defining the key axes of uncertainty. Each axis represents a strategic area where future developments are hard to predict and highly consequential. Following widely recognized foresight frameworks, particularly those of Schwartz (1991) and Godet (2000), this study identifies two such axes, selected based on the earlier thematic analysis and expert evaluations:

1. The future of Central Bank Digital Currencies (CBDCs) and Monetary Innovation
2. The trajectory of Artificial Intelligence (AI) Applications in Finance

Both axes were chosen because they appeared in the high-impact, high-uncertainty quadrant of the impact–uncertainty matrix. This means they hold significant potential to reshape the European banking sector, yet their future directions remain uncertain, making them ideal focal points for scenario development.

The first axis, centered on CBDCs and Monetary Innovation, represents a lot of possible options. On the one hand, we have the scenario of centralized dominance where state-issued digital currencies are the norm; on the other hand, there is a more diverse monetary landscape where CBDCs coexist with decentralized finance (DeFi) solutions and private stablecoins. This axis reflects ongoing and unresolved debates in both policy and academia. Researchers such as Bindseil (2020) and Eichengreen (2022) have analysed central banks' challenges, from ensuring interoperability and privacy to maintaining financial stability. Other key factors shaping this axis include the regulatory alignment across EU member states, adoption rates among users and businesses,

technological readiness, and broader geopolitical tensions, particularly in a post-Brexit Europe.

The second axis centres on how AI is integrated into financial services, going from heavily regulated, ethics-first approaches to more autonomous and unregulated implementations. We consider that this is not just about technical capabilities but also about how those capabilities are governed and perceived by society. The EU's AI Act, for example, focuses on transparency, fairness, and accountability, anchoring one end of this spectrum. The other end is shaped by global market pressures pushing for rapid innovation, often with less regulatory oversight. As Zeng et al. (2021) noted, while AI promises powerful optimization in finance, it also introduces risks such as algorithmic bias, black-box decision-making, privacy violations, and cybersecurity threats. This axis will depend on variables like regulatory enforcement, AI talent pipelines, competitive pressures, and public trust in AI systems.

When these two axes intersect, they create four distinct scenario quadrants, each representing a different, possible strategic context by 2035. These scenarios are not predictions; they are exploratory frameworks designed to help institutions plan for a range of futures, challenge assumptions, and stress-test strategies in the face of uncertainty.

A visual representation of the *2×2* scenario matrix is provided below. It sets the ground for the following narratives, each capturing a unique combination of monetary innovation and AI evolution and what that could mean for European banking in the years ahead.

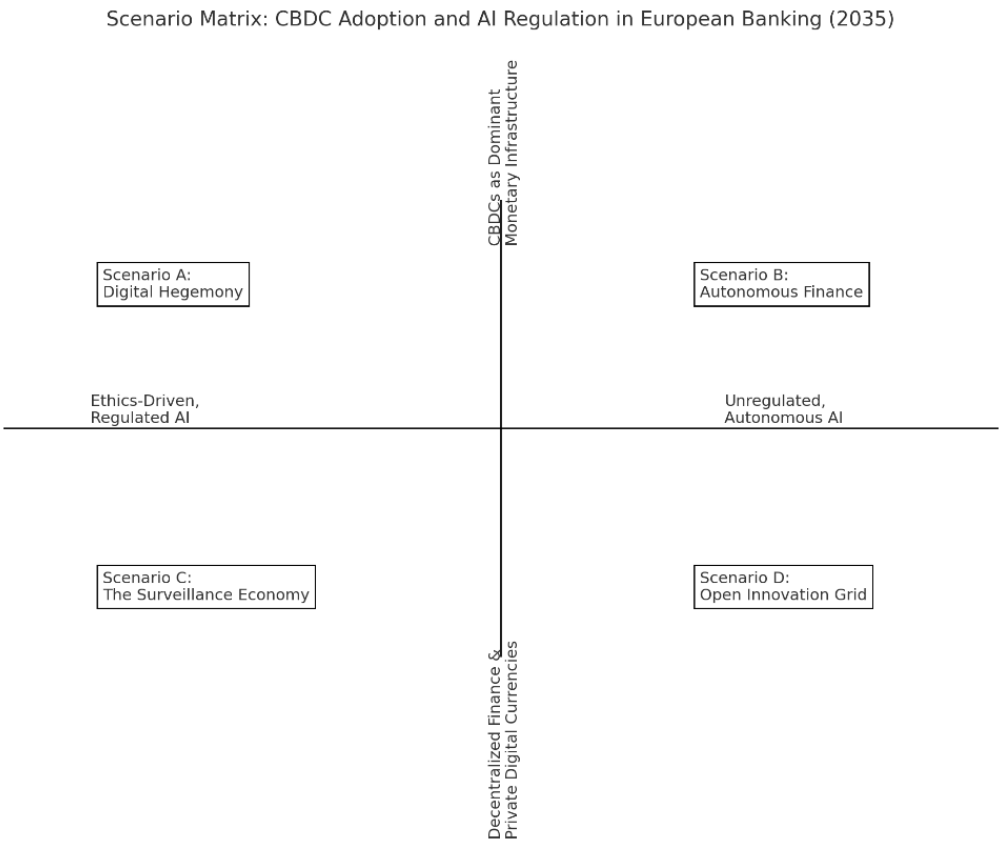

Figure 8. Scenario Matrix: CBDC Adoption and AI Regulation in European Banking (2035)

5.3 Scenario Narratives

This section presents four developed scenario narratives, each based on the *2×2* matrix introduced earlier.

We consider that together, they offer an exploration of what the European banking system might look like by 2035, depending on how two key uncertainties unfold: the future of Central Bank Digital Currencies (CBDCs) and the integration of Artificial Intelligence (AI) in finance.

Using insights from Structural Topic Modeling (STM), expert feedback, and ongoing academic discussions around *FinTech*, regulation, and digital ethics, with each narrative provides a possible and distinct vision of the future.

Scenario A: *Digital Hegemony*

(High CBDC Centralization - High AI Regulation)

By 2035, Europe will have fully rolled out a standardized, interoperable CBDC system, managed by the European Central Bank (ECB) and coordinated across member states. Traditional banking infrastructure has been overhauled, with CBDCs replacing older payment systems and introducing features like programmable money, real-time audits, and automated tax collection.

AI is everywhere but heavily regulated. Financial algorithms must meet strict transparency and accountability standards under frameworks like the EU AI Act and ESG regulations. All automated decisions are explainable, and consumer data is rigorously protected.

Key Drivers: European monetary sovereignty, harmonized regulation, public trust in institutions, and AI accountability laws.
Strategic Implications:

- Banks benefit from state-backed innovation, but face tight compliance demands.
- *FinTech* firms operate within clear but strict rules.
- Regulators enjoy macro-level visibility but may limit experimentation.

Opportunities: Inclusive infrastructure, public-private innovation partnerships, increased financial stability.
Risks: Slower innovation cycles, limited privacy, exclusion of more agile DeFi actors.
Early Signals: ECB is scaling its CBDC pilots and pan-European AI auditing protocols.

- **Scenario B:** *Autonomous Finance*

(Low CBDC Centralization - Low AI Regulation)

In this future, CBDC efforts have stalled, held back by political disagreements, low public trust, and the rise of private stablecoins and DeFi ecosystems. Digital transactions are now dominated by decentralized platforms offering seamless, borderless financial services.

AI systems drive nearly every part of finance, from credit scoring to investment management, but operate with minimal oversight. Algorithms function autonomously, often without transparency or ethical checks. While innovation moves fast, so do the risks.

Key Drivers: Regulatory lag, market-led digital finance, global competition, AI performance gains.
Strategic Implications:

- Traditional banks face disintermediation unless they adapt quickly.
- Regulators struggle to keep pace with tech evolution.
- Trust becomes a market asset.

Opportunities: Frictionless finance, global expansion, cost-efficiency. Risks: Cyber vulnerabilities, algorithmic discrimination, exclusion of underserved populations.
Early Signals: AI-first neobanks, institutional use of DeFi liquidity pools.

- **Scenario C:** *The Surveillance Economy*

(High CBDC Centralization - Low AI Regulation)

Here, CBDCs are the norm across the Eurozone and are used for most public and private transactions. However, while the monetary system is tightly centralized, AI oversight is weak. Financial systems collect vast amounts of behavioural and transactional data, used for profiling, predictive analytics, and surveillance.

Governments and financial institutions leverage AI to monitor compliance and enforce policy, but critics warn of overreach. Debates over privacy, consent, and digital rights dominate public discourse.

Key Drivers: National security priorities, state-corporate surveillance alliances, digital identity mandates.
Strategic Implications:

- Banks function as extensions of state oversight.
- Consumers trade convenience for privacy.
- Political expression and financial behaviour begin to intertwine.

Opportunities: Advanced fraud detection, seamless tax enforcement, anti-corruption mechanisms.

Risks: Loss of civil liberties, innovation chilling, democratic erosion. Early Signals: Mandatory CBDC wallet usage, opaque AI-based decision systems.

- **Scenario D:** *Open Innovation Grid*

(Low CBDC Centralization - High AI Regulation)

This scenario imagines a diverse digital finance ecosystem where CBDCs, private stablecoins, and DeFi platforms coexist. The ECB plays a role in public infrastructure, particularly in welfare and wholesale banking, while consumers enjoy a range of currency options.

Meanwhile, AI is fully integrated into financial services but within a strong regulatory framework that emphasizes transparency, fairness, and user agency. Participatory design, independent audits, and ethical certification processes are embedded across the EU.

Key Drivers: Consumer empowerment, cross-sector innovation, regulatory collaboration, ethical AI leadership.
Strategic Implications:

- Banks function as connectors between traditional and decentralized systems.
- Regulators gain legitimacy through trust and transparency.
- Consumers benefit from both innovation and protection.

Opportunities: Ethical leadership in *FinTech*, inclusive digital ecosystems, innovation with integrity.
Risks: Fragmented standards, slower adoption curves, complexity in cross-platform interoperability.
Early Signals: AI ethics certifications, expansion of *FinTech* sandboxes, DeFi-CBDC integration pilots.

These four scenarios offer divergent yet plausible visions of how Europe's banking future could unfold. They do not claim to predict what will happen, but they do help us think more strategically about what could, should, or must be addressed in policy, innovation, and governance.

5.4 Comparative Analysis of Scenarios

To assess the strategic implications of the four developed scenarios, this section presents a comparative analysis across five key dimensions: financial inclusion, regulatory control, innovation capacity, systemic risk, and data privacy and ethics. These dimensions are not arbitrary; they are rooted in the key themes that emerged from the literature review and expert evaluations earlier in the study. Each represents a central lever likely to shape how European banking evolves over the coming decade.

The analysis reveals trade-offs and synergies by systematically comparing how each scenario performs across these five areas. It highlights where progress in one domain might come at the cost of another and where certain futures offer a more balanced path forward.

This comparative lens provides stakeholders, policymakers, financial institutions, or *FinTech* innovators actionable insights. It helps clarify the types of environments in which different strategic choices are most likely to succeed or face resistance, supporting better preparation for diverse and uncertain futures.

Comparative Matrix of Future Scenarios in European Banking (2035)

Dimension	Digital Hegemony	Autonomous Finance	Surveillance Economy	Open Innovation Grid
Financial Inclusion	High	Medium	Medium	High
Regulatory Control	Strong	Weak	Strong	Balanced
Innovation Capacity	Moderate	Very High	Low	High
Systemic Risk	Low	High	Medium	Medium
Data Privacy & Ethics	High	Low	Very Low	High

Figure 9. Comparative Matrix of Future Scenarios in European Banking (2035)

We consider that utilizing a comparative matrix helps to bring into focus the strategic trade-offs that define each future scenario. Taking Scenario A, for instance, we conclude that it delivers strong financial stability and broad inclusion but does so by limiting innovation flexibility. Scenario B, on the other hand, shows rapid innovation and market dynamism but at the expense of increased risk and weakened consumer safeguards. Scenario C reassures regulatory power but raises concerns about civil liberties and surveillance overreach, while Scenario D aims for a balanced approach promoting both innovation and ethical oversight, though complex governance structures and technical interoperability hurdles may slow its progress.

By comparing these divergent paths, we conclude that our analysis equips stakeholders with a multidimensional perspective for evaluating future strategies, policy frameworks, and investment choices, as it reinforces a central idea: the importance of anticipatory governance where regulation and innovation grow together, not in opposition. This type of policymaking will be crucial for shaping a sustainable, inclusive, and adaptable *FinTech* future in Europe.

5.5 Implications for Strategy and Policy

The four scenarios developed in this study paint a diverse picture of what the future of European banking might look like, each shaped by different combinations of blockchain and AI integration. While the specifics vary, these futures offer a strategic lens for banks, policymakers, *FinTech*'s, and consumers navigating a rapidly changing financial landscape. Grounded in scenario logic and enriched by topic modelling and expert insights, these narratives are not meant to dictate one "right" path but to uncover strategic priorities that hold up across multiple plausible outcomes.

The main takeaway for banks is clear: build adaptable digital infrastructure. The future is unlikely to be entirely centralized or decentralized, so systems must be flexible enough to operate across CBDC networks and DeFi platforms. Scenario A highlights the value of working closely with regulators to co-design programmable money and automated compliance systems. In contrast, Scenario B warns of the real threat of disintermediation in unregulated, AI-first environments.

Regardless of the scenario, banks will need to develop strong internal AI governance, ensuring their systems are explainable, fair, and ethically sound, even in the absence of external regulation (Zeng et al., 2021). Forming partnerships with *FinTech*'s, AI startups, and open-source communities, as seen in Scenario D, will also be key to staying competitive in more hybrid or pluralistic ecosystems.

The scenarios emphasize the need for anticipatory and harmonized regulation. Where regulation lags behind innovation, as in Scenario B in where the result is heightened systemic risk, deeper inequality, and eroded trust. Policymakers must act quickly to align CBDC governance, clarify the legal standing of digital assets, and enforce clear standards for AI fairness, transparency, and accountability.

Scenario C stands out as a cautionary tale: while centralized systems can offer control and security, they also risk sliding into surveillance-heavy financial governance. Policy frameworks must therefore, strike a balance supporting innovation while upholding democratic rights and civil liberties.

The outlook for *FinTech*'s varies dramatically depending on the regulatory context. In highly regulated environments like Scenarios A and D, success will depend on the ability to move quickly within ethical and legal boundaries, including AI certifications, compliance agility, and integration with public infrastructure.

In more open scenarios like Scenario B, there is more room to innovate but also more reputational and legal risk. Across all futures, firms that embed responsible innovation from the start, prioritizing data stewardship, user-centric design, and interoperability, will be best positioned to scale sustainably and earn long-term trust.

Consumers will experience these futures in fundamentally diverse ways. In ethical, inclusive environments like Scenarios A and D, users benefit from stable infrastructure, clear oversight, and choice in digital money systems. But in fragmented or opaque futures (B and C), risks multiply, ranging from financial exclusion to surveillance and manipulation.

Across all scenarios, ensuring that consumers maintain agency, privacy, and digital literacy will be essential. These are not just user experience issues; they are foundational to the social legitimacy of financial transformation.

Taken together, these scenarios highlight a core insight: the future of finance must be built with resilience by design. That means embedding flexibility, ethical safeguards, and stakeholder inclusion into the very architecture of tomorrow's systems. These principles will form the basis of the final recommendations and concluding reflections in the next section.

In conclusion, this chapter by stating that we have examined the future of European banking through the optics of strategic foresight, exemplified by four different scenarios shaped by two critical uncertainties: the evolution of Central Bank Digital Currencies (CBDCs) and the integration of Artificial Intelligence (AI) in finance. Using insights from the Structural Topic Modelling (STM) developed, expert input, and scenario planning theory, the analysis makes one thing clear: we consider that in a landscape defined by

rapid change, decision-makers need more than static forecasts; they need strategic imagination and preparedness.

The scenarios of Digital Hegemony, Autonomous Finance, The Surveillance Economy, and the Open Innovation Grid act as narrative frameworks that reveal the deeper trade-offs at stake: inclusion vs. control, innovation vs. risk, and transparency vs. surveillance. They do not offer predictions but instead highlight how different combinations of policy, technology, and market dynamics could reshape the financial sector by 2035.

In this way, it can be concluded by stating that scenario planning emerges not as speculative fiction but as a discipline of strategic learning, a method for navigating the volatility and complexity that define today's *FinTech* transformation.

This chapter concludes the scenario construction and analysis phase of the thesis. The closing chapter will reflect on what these findings mean for theory, policy, and future research and explore how this methodological framework could be extended to other technologies and sectors navigating similar uncertainty.

6. CONCLUSION

This thesis set out to answer a central and forward-looking question: *How will the adoption of blockchain in the European banking sector unfold?* By integrating Structural Topic Modeling (STM), strategic foresight techniques, and expert-informed scenario planning, this research has demonstrated that blockchain adoption in European banking will neither follow a single trajectory nor unfold uniformly across the sector. Instead, its future will depend on how institutions, regulators, and technological innovations interact under high uncertainty and rapid change conditions.

The analysis points to a likely multi-speed adoption pathway shaped by two dominant and uncertain forces: Central Bank Digital Currencies (CBDCs) institutionalization and the integration of Artificial Intelligence (AI) into financial services. These two themes – identified through STM and prioritized using expert-driven impact–uncertainty matrices – provided the foundation for four strategic scenarios that capture the diversity of outcomes: Digital Hegemony, Autonomous Finance, The Surveillance Economy, and Open Innovation Grid.

From these scenarios, several key findings emerge:

1. Blockchain will not replace the traditional banking system but reshape it. Rather than leading to total decentralization, blockchain is more likely to be swallowed into existing institutional frameworks, particularly through initiatives such as CBDCs and regulated DeFi interfaces. The shift will be evolutionary rather than revolutionary, integrating distributed technologies into a layered financial architecture.
2. Regulatory clarity and interoperability will determine the pace and scope of adoption. Use cases like digital identity, smart contracts, and cross-border payments hamper policy harmonization across the EU and beyond.

   It can also be noted that without it, innovation risks becoming fragmented, delaying scalable implementation. Scenarios such as Autonomous Finance illustrate the risks of regulatory lag, while Digital Hegemony highlights the benefits – and trade-offs – of coordinated governance.
3. AI will act as a catalyst or constraint. Whether blockchain-based banking remains transparent, secure, and inclusive will depend in large part on how AI is governed.

Unregulated AI systems, as envisioned in The Surveillance Economy and Autonomous Finance, could erode consumer trust and widen inequality. In contrast, well-regulated AI, as modelled in the Open Innovation Grid, enables innovation without sacrificing ethics or accountability.

4. Hybrid systems will define the future. The most plausible outlook is a hybrid configuration, not full decentralization or full centralization. In such a system, public infrastructures like CBDCs coexist with private stablecoins and permissioned blockchain networks. Traditional banks will serve as interoperability nodes – connecting regulated environments to more open ecosystems.
5. Strategic foresight is essential for resilience. Our research shows that blockchain adoption in banking cannot be fully anticipated through straightforward forecasting. Instead, scenario-based thinking reveals hidden interdependencies, helps institutions stress-test their strategies, and supports more robust, future-ready policymaking.

For regulators in Europe, *FinTech*, and banks, the implications drafted from the present study that blockchain usage will be more strategic and less disruptive. For banks, the imperative will be to act as interoperability hubs to integrate CBDCs, stablecoins, and permissioned blockchains with existing infrastructure; on the other side, regulators need to satisfy the obligation of providing regulatory clarity across the EU, while responding to technical change; also, simplification of rules for digital identity, cross-border payments, and smart contracts would reduce fragmentation and allow for scalable innovation and for *FinTech*, the promise lies in applying AI and blockchain to construct new financial services. This leads then to some policy proposals: (1) accelerating EU-wide regulatory harmonization to avoid jurisdictional fragmentation, (2) establishing AI ethics and accountability frameworks for financial services, and (3) promoting controlled experimentation with CBDCs and regulatory sandboxes to test innovations safely under supervision. Taken as a whole, these measures can allow Europe to reconcile innovation and stability in order to ensure blockchain adoption fosters competitiveness, consumer confidence, and financial stability.

In sum, the future of blockchain in European banking will be shaped by a dynamic interplay between technological capacity, institutional strategy, and regulatory evolution.

Adoption is inevitable, but its direction, speed, and societal consequences remain open. By anticipating multiple futures, this thesis equips decision-makers with the tools to navigate complexity and build banking systems that are not only technologically advanced but also ethical, inclusive, and resilient.

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APPENDICES

Appendix A – Google Forms Questionnaire

This appendix presents the complete questionnaire used in the data collection process. The form was created using Google Forms and consists of multiple-choice and open-ended questions aimed at assessing the participants' knowledge and perspectives on blockchain and AI applications in finance.

https://github.com/JoseFernandes-12/TFM---Jos-Fernandes/blob/main/GoogleForms.pdf

Appendix B – Summary of Google Forms Responses

This section provides a summary of the responses collected through the Google Forms survey. The responses are aggregated to show distributions, trends, and key indicators derived from participant inputs.

https://github.com/JoseFernandes-12/TFM---Jos-Fernandes/blob/main/RespostasGoogleForms.xlsx

Appendix C – Python Source Code for Topic Modeling and PESTEL Mapping

The following Python code was used to analyze the documents collected during the study. It includes data reading, text cleaning, topic modeling with LDA, and a custom mapping to the PESTEL framework.

You can access the full source code here:

TFM---Jos-Fernandes/CódigoPython.py at main · JoseFernandes-12/TFM---Jos-Fernandes · GitHub

Appendix D – Contains all of the previous links.

https://github.com/JoseFernandes-12/TFM---Jos-Fernandes