The International Journal of Digital Accounting Research
Vol. 23, 2023, pp. 47-68
ISSN: 2340-5058

Exploring a new business model for lending processes in the banking sector using Blockchain technology: An Italian case study

Giuseppina Iacoviello. University of Pisa, Italy, giuseppina.iacoviello@unipi.it

Elena Bruno. University of Pisa, Italy, elena.bruno@unipi.it

Abstract. Blockchain is a decentralized information technology (IT) architecture that has garnered significant attention across various sectors of the global economy. In the banking sector, blockchain was initially used for cryptocurrency trading and later expanded to encompass smart contracts, peer-to-peer transactions, and other banking services. In recent years, blockchain technology (BT) has been applied to streamline less standardized credit processes and to successfully support mortgage credit through decentralized recording on ledgers. Employing a qualitative research approach, this paper proposes a novel business model for small banks that utilizes new-generation information technologies to enhance loan profitability. While previous research has linked BT to lending processes, this study is the first to propose a BT application for reshaping traditional banking practices, especially for commercial banks. The research findings demonstrate that blockchain implementation offers advantages in containing information asymmetries, managing credit rationing, and driving business innovation.

Keywords: Information technology, blockchain, standardized lending process, small banks.

DOI: 10.4192/1577-8517-v23_3

Submitted February 2023
Accepted May 2023

1. INTRODUCTION

As next-generation information technologies such as big data, cloud computing, and mobile internet continue to gain popularity, society is undergoing a shift from traditional information systems to smart information systems. Bonsón and Bednárová (2019) suggest that blockchain technology (BT) is likely to play a critical role in the digital era, with significant implications for businesses and society.

BT has been widely adopted across numerous financial domains, including business services, financial asset settlement, prediction markets, and economic transactions (Casino et al., 2019). Its explosive growth and potential to disrupt the banking industry can be attributed to its data security features, use of flat money, smart contracts, digital payment capabilities, banking ledgers, and loan management schemes (AbiLab, 2020; Lardo et al., 2022; Yang et al., 2018; Peters & Panayi, 2016; Wu & Liang, 2017; Cocco et al., 2017; Gazali et al., 2017; Paech, 2017). The advent of BT has given rise to many new business models (Zhang et al., 2020; Rajnak & Puschmann, 2021) that utilize self-learning and predictive capabilities to generate personalized banking services by integrating customer knowledge with data (Larson & Chang, 2016). Security is a critical aspect of financial services, and the Internet of Things (IoT) is used in the payment, banking, and insurance industries to ensure safety and security (Mani & Chouk, 2018). Furthermore, machine learning (ML), a form of artificial intelligence (AI) technologies, helps banks serve customers faster and comply with regulatory requirements (Ji & Tia, 2022).

The Italian banking industry is grappling with several issues, including rising operational costs, an increasing number of fraudulent transactions, and difficulties in ensuring operational transparency (Kumar & Prakash, 2018). Therefore, the industry has adopted many technology-driven platforms to improve banking performance (Palmie et al., 2020). For example, Banco BPM has partnered with Cherry 106, a leading player in the credit assignment market, while Deloitte assists clients of Intesa Sanpaolo, Crédit Agricole, and Banca Mediolanum. Additionally, both Poste Italiane and Mps have developed their own document verification and support services platforms.

The application of BT has the potential to increase the transparency and traceability of banking transactions, leading to improvements in traditional banking processes

(Frizzo-Barker et al., 2020). Accenture (2018) reports that the global banking industry can save up to $20 billion by 2023 by leveraging innovative applications of BT.

Despite its potential for cost reduction, blockchain technology still restricts more traditional methods. The initial investment required for blockchain infrastructure and development is expensive, and it may not be practical for smaller financial institutions and banks to adopt this new technology (Arora & Nabi, 2022). Another obstacle to widespread blockchain adoption is the significant consumption of resources: To slow down the access rate of new blocks and prevent blockchain network from attack, the traditional consensus process consumes a lot of resources (e.g., computing power in Proof of Work and coinage in Proof of Stake), which is too costly for resource-limited IoT devices (Cao et al., 2019).

This study contributes to the theory of technology diffusion by examining the directional path of innovation adoption. It introduces a new methodological tool for analyzing the characteristics of innovation technologies in small commercial banks. The primary contribution of this paper is the development of a novel business model for mortgage lending that demonstrates how BT can drive disintermediation in financial services and serve as a catalyst for business model innovation.

The novel business model was developed through a literature review by using a qualitative approach with the pilot interview method. The following research questions were formulated based on the literature review:

RQ1. How could a new business model make mortgage lending profitable in an environment increasingly inclined to use BT?

RQ2. Does the new business model make it possible to mitigate the information asymmetry and credit rationing between lenders and borrowers?

We carried out the qualitative research through semi-structured interviews with the CEOs/business heads of the small banks in our case study.

The paper is structured as follows: Section 2 provides a literature review, covering basic aspects and background in banking to establish the conceptual context of the issue. Section 3 explains the research methodology used. In Section 4, we discuss the findings. Finally, the conclusions are presented, along with limitations and future directions for research.

2. LITERATURE REVIEW AND BACKGROUND: BANKING SYSTEM AND BLOCKCHAIN TECHNOLOGY

The term blockchain technology (BT) was initially introduced with the definition of the Bitcoin protocol in 2008 (Nakamoto, 2008), which defined the fundamental principles of the technology. Transaction data is stored in blocks that are tightly chained together, resulting in a distributed ledger technology (DLT) in numerous copies among network nodes.

The core of BT is the shared data book on each node of the decentralized system (Yermack, 2017), as illustrated in Figure 1.

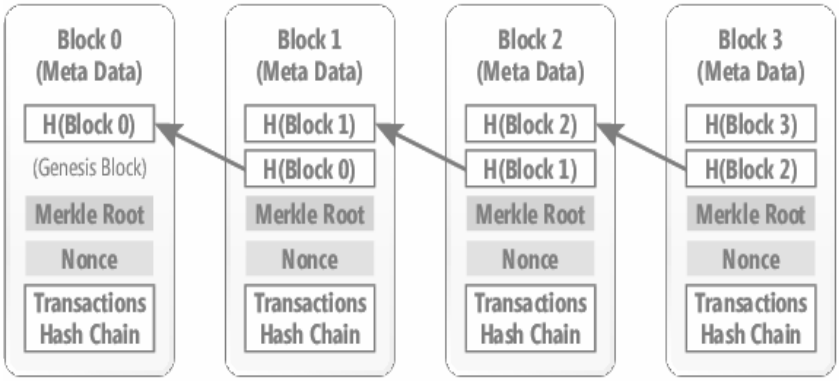

Figure 1. The structure of blockchain (Yermack, 2017)

Information is replicated across a high number of independent subjects, and the integrity and robustness of the data are ensured through a consensus algorithm that can take various forms (with Proof of Work, or PoW, being the most common). Therefore, the system's security is not dependent on a central entity considered trustworthy but instead established through the quality of the protocol utilized by the participants.

In this protocol, the highest probability of finding a solution to the problem lies in the computing power that each miner possesses. The Proof of Stake (PoS) protocol provides an alternative to PoW that is more cost-effective in terms of time and energy resources as it ensures a distributed consensus based on participation (Chiap et al., 2019).

Blockchain can be either public or private. In the case of permissionless blockchain, each participant can read, send, and receive transactions and participate in the

consensus process as a node. In the case of a permissioned blockchain, the operator places restrictions on participation and transactions that are allowed and performed. In the latter case, it is more accurately referred to as DLT.

DLT has numerous applications and can address several core process areas of the banking industry, including payment services (intra/interbank transfers, peer-to-peer payments, value-added services with cryptocurrency, etc.), finance (trading, post-trading, collateral management, etc.), credit (finalized credit, escrow, trade finance, loyalty programs, etc.), and Know-Your-Customer (KYC) functions in anti-money laundering (AML) (Cai et al., 2019; Mengelkamp et al., 2018; Kshetri, 2017; Guo & Liang, 2016).

Other areas of operation, such as time stamping and notarization services, the supply chain area, digital autonomous insurance services, and more, are vertical applications (ECB, 2017; ESMA, 2017).

In September 2015, nine of the world's largest banks (i.e., Barclays, Goldman Sachs, JPMorgan, State Street, UBS, Royal Bank of Scotland, Credit Suisse, BBVA, and Commonwealth Bank of Australia) joined forces with the New York–based financial technology firm R3 to create a framework for utilizing blockchain technology in the financial market (Crosby et al., 2016). The Global Payments Steering Group (GPSG), which includes UniCredit, Bank of America, and Santander, is another example of bank cooperation. XRP, created by Ripple2, is the cryptocurrency powering GPSG, enabling global payment and currency exchanges through a scalable and interoperable open-source infrastructure (Gad et al., 2022). In May 2016, Deloitte established its first blockchain lab in Dublin; since then, three of the largest banks in Ireland have been using a blockchain solution developed by Deloitte to validate employee credentials (Bonyuet, 2020).

In recent years, banks have been adapting their operational approach to this innovative technology by participating in international consortiums and industry initiatives (Abi, 2022; Fintech, 2021). It is worth noting the Corda platform, which is a decentralized database that provides a system for representing more elements such as dates, currencies, legal entities, and financial entities like cash, issues, and transactions. Corda follows a general philosophy of reusing proven software systems and existing infrastructure where possible (Hearn and Brown, 2016).

In the 2022 ABI Lab survey (ABI, 2022) on IT research priorities, 48% of banks that responded to the survey indicated blockchain and DLT as their top priorities. When we narrow the focus to larger banks, the figure rises to 77%. Figure 2 shows the application areas in which blockchain DLT projects have been initiated in the Italian banking sector.

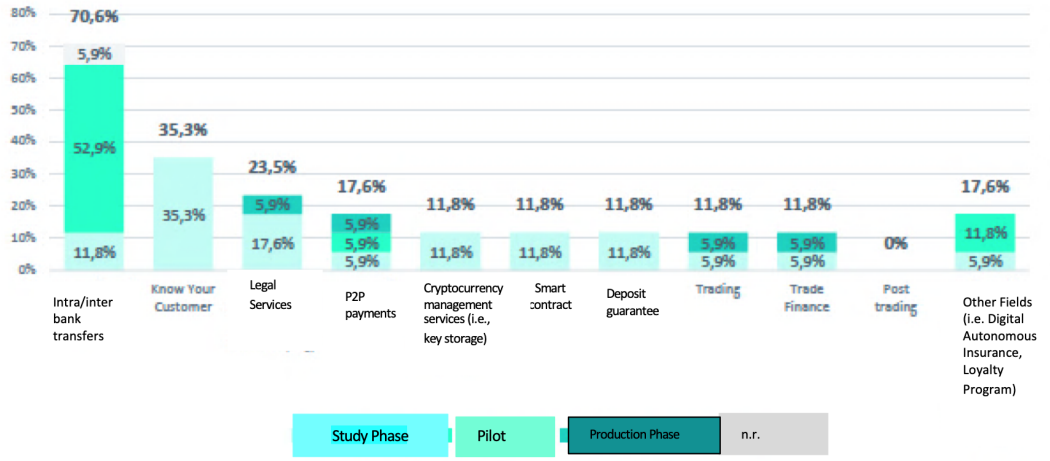

Figure 2. Application areas of Blockchain (ABILAB, 2021)

The 2021 fintech survey conducted by the Bank of Italy confirms the gradual growth of investment in innovation and digitization (Banca d'Italia, 2021).

For smaller banks, it is crucial to embed their business model with the development of alternative digital products, acquire advanced yet low-cost technologies, enter the digital channels of specialized companies or establish partnerships with fintech companies. Meanwhile, the ECB's (ECB, 2021) call to undertake a robust digital transformation and have appropriate mechanisms to ensure sustainable business models in the long term is very powerful.

According to Andoni et al. (2019), the benefits of blockchain technology include cost efficiency and revenue improvement. Banks can reduce their transaction fees and ensure better record-keeping systems with universal online identification systems. Other benefits include enhanced compliance and reduce operational risk by minimizing fraud (Umalkar, 2016). Blockchain technology can update ledgers immediately and automatically, leading to shorter timelines (Kim & Laskowski, 2018). The high-quality data eliminates the risk of errors and duplication (Martin-Bariteau, 2018), resulting in complete and reliable stored data (Reyna et al., 2018). Additionally, blockchain offers fewer regulatory controls and opportunities for

better financial infrastructure and sustainably developed efficient and secure systems (Accenture, 2018)

In summary, blockchain technology will enhance the system's resilience by helping banks authenticate, merge, and trade economic statements, validate agreements, retain reviews, and audit tracks, and deter money laundering (EBA, 2017; ECB, 2019)

Blockchain supports the banking industry by facilitating lower fees on fund transfers and faster settlement systems through the DLT. During the COVID-19 pandemic, most people needed loans for their housing, transportation, and other personal needs. Blockchain technology has helped eliminate gatekeepers in the loan application process, resulting in lower interest rates and faster loan origination times (Kouzinopoulos et al., 2018; Cocco et al., 2017). Therefore, it is expected to change how individuals and societies interact (He, 2021).

Despite its benefits, blockchain technology's security remains a concern due to its nature as a DLT. The critical vulnerabilities with DLT occur outside the blockchain, at endpoints where individuals and businesses access blockchain-based platforms. The need for public and private keys to access data presents a strong chance for hacker attacks to exploit the system, particularly when vendors have weak security systems (or untested/flawed code). This risk is further compounded when other partners expose blockchain credentials (Hughes et al., 2019).

From the beginning, blockchain technology has been closely tied to fintech. Peters and Panayi (2016) argue that blockchain is a Fintech 2.0 innovation that focuses on the underlying technology for the financial sector and not its application scenarios. It offers a solution to operational inefficiency, fraud and error risks, and delays in financial transactions (Kumari & Devi, 2022). They also note the potential uses of BT for credit information systems in terms of information ownership and data sharing. Similarly, MacDonald et al. (2016) argue that blockchain technology is more than a new IT application by banks. Based on financial intermediation theory and new institutional economics, the authors contend that blockchain has the potential to decentralize and disintermediate several areas of banking activity (Patel et al., 2022).

Over the past decade, various paradigms and schools (Gassmann et al., 2016) have attempted to define and explain business model innovation. The Activity System

School (also known as the IESE/Wharton School) defines a business model as a set of activities, resources, and capabilities that enable a firm to create value and capture a share of it (Zott et al., 2011). Therefore, a change in the distribution of these activities, resources, and capabilities that is aimed at creating and capturing economic value results in business model innovation. Seebacher and Maleshkova (2018), in line with the Cognitive School ideology (Baden-Fuller & Morgan, 2010), define the business model as a structural template that describes the underlying business logic for value creation and delivery.

Based on these observations, this paper proposes that blockchain technology, by facilitating disintermediation in financial services, represents a significant means for business model innovation and can help alleviate information asymmetry and credit rationing between lenders and borrowers.

3. METHODOLOGY

The methodology used in this work is the case study, which has been recognized as particularly suitable for examining how and why questions (Yin, 2017; Van Maanen, 2006; Eisenhardt, 1989). A qualitative approach was considered useful in the first step of the research, aimed at describing and interpreting the logic of the financing process. The case was chosen to fill theoretical categories and provide examples of "polar types" (Eisenhardt, 1989). As Pettigrew (1990) observed, given the limited number of cases that can typically be analyzed, it makes sense to choose cases such as extreme situations and polar types in which the process of interest is "transparently observable." Previous studies have adopted a case study approach to present models aimed at improving the understanding of internal processes (Bisogno et al., 2015; Bruno & Iacoviello, 2020), provide evidence of a phenomenon (Azevedo et al., 2011; Akkermans & Vos, 2003), or propose conceptual frameworks useful for measuring performance (Aramyan et al., 2007). According to Domegan and Fleming (2007), qualitative research aims to explore and discover issues related to the problem at hand, as very little is known about the problem. Overall, case research provides an excellent means of studying emergent practices (Voss et al., 2002).

The chosen case study, Alfa Bank, was deemed useful, functional, and instrumental in achieving the research objective. Alfa Bank has maintained a significant presence in Italy and has played a role in promoting the country's social and economic development through significant financing operations. The bank's cultural

emphasis on customer and shareholder relations provides insight into aspects of innovation related to corporate and risk governance structures and corporate performance objectives (Al Kemyani et al., 2022).

A comprehensive literature review was conducted before qualitative and semi-structured interviews were carried out to identify all the relevant domains (Zomorodi & Lynn, 2010). An unstructured questionnaire was used to enable the experts to provide open-ended responses and to allow plenty of room for elaboration on the topic under investigation (Pereira & Alvim, 2015).

A set of questions was initially based on an analysis of existing literature, assuming that they would be most appropriate for understanding the benefits of implementing BT in the banking sector. Some questions were openly linked to the benefits of implementing blockchain, while others focused on the benefits of applying blockchain to traditional banking operations.

We identified experts from Alpha and its IT office who were closely associated with blockchain application initiatives. We asked these experts to participate in a pilot interview. Out of eight experts contacted, only five granted appointments to conduct semi-structured interviews. These experts have varied backgrounds: Vice-President of the Board of Directors, Chief Lending Officer and Payment Service Function, Chief Risk Manager, and a technical expert in the IT function.

We sent a two-page questionnaire in advance to ensure that all topics were covered, and the interviewees were properly prepared. The questionnaire contained the set of subjects to be covered during the interviews and indicated the specific data required. The interviews were conducted face to face at the expert's convenience in their respective offices over the course of three afternoons and were completed by using Google Meet. All the conversations were audio-recorded and analyzed separately for further research. During the discussions, we explored issues related to the historical development of the bank, its main competitive factors, and technological infrastructural investments.

4. EMPIRICAL RESEARCH: AN ITALIAN CASE STUDY

Alpha Bank is a small bank with a territorial focus, present in North-Central Italy. Despite adverse economic factors, including the COVID-19 pandemic, the war in non-EU Eastern European countries, and restrictive monetary policies by the ECB,

Alfa made a high profit of EUR 3.7 million thanks to strategic corporate governance policies, especially in credit intermediation.

In the past two decades, Alpha has shown a strong interest in technological development and the digitization of financial transactions. Specifically, Alpha has been exploring blockchain technology for almost five years. Although it does not have a dedicated structure for the digitization of operating processes, it has put together a team of experts from all the areas of the bank to analyze the possible impacts and benefits of applying BT to financial business models, as outlined in the bank's 2022 business plan. Regarding distribution channels, data from 2022 shows a growing use of digital services in terms of customers, products, and sales. There are approximately 10.3 million customers who use multiple channels, 6.5 million who use the banking app, and 57,600 who use the online subsidiary. Approximately 75% of the products offered are available on the multichannel platforms. Sales through remote channels, due in part to the outbreak of COVID-19, have risen to 26.4% of the total number (up from 9.2% in 2019). In parallel, the bank has continued to extend its target cybersecurity model.

In this context, BT offers an effective tool to respond to the COVID-19 emergency by allowing the sharing of real-time transaction monitoring procedures among all the concerned parties (Evans, 2018). This includes measures such as the acceleration of the use of smart working, the strengthening of infrastructures to access the market to handle high peaks in online activities, and a series of specific actions to enhance remote operations. The inherent security of the blockchain network, which is ensured by both encryption and chaining of blocks, makes it incredibly difficult to manipulate and tamper with the data entered into the ledgers. The immutable record eliminates the risk of manual errors, increases efficiency, and reduces the possibility of regulatory violations (Shah & Jani, 2018).

The mortgage lending process in the blockchain is described in Figure 3. The innovative business model involves reshaping traditional banking activities by offering prospective borrowers a tool for efficiently providing both hard and soft information and equipping prospective lenders with the tools to soundly assess creditworthiness and risk levels.

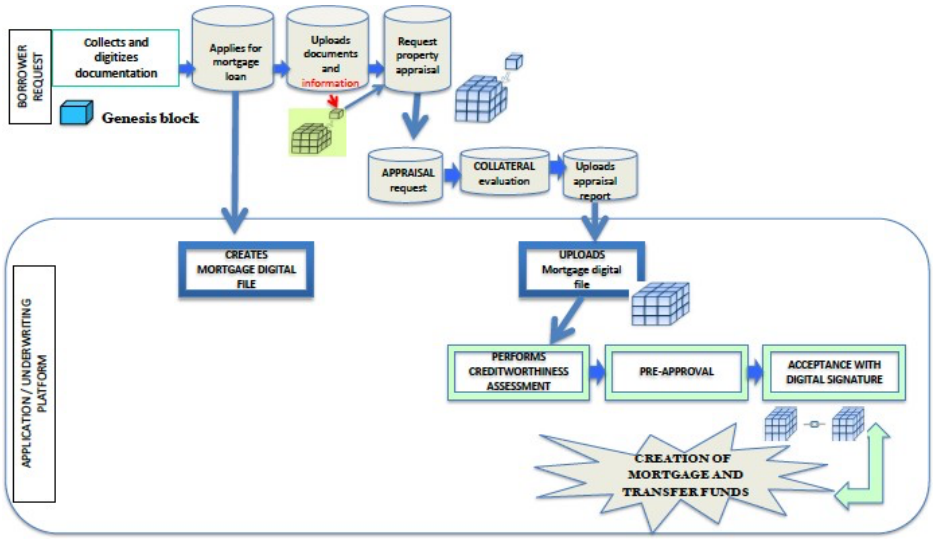

Figure 3. Blockchain and mortgage lending process (Own elaboration)

These tools are instantiated in an online-based platform, which facilitates easy digitization and codification of creditworthiness information by using AI/ML techniques (Shahbazi & Byun, 2022). This platform can be outsourced to different entities, such as an application and underwriting platform (see Figure 3).

Thus, banks that conduct credit assessment activities in consumer or P2P lending could offer their expertise and resources as a service for mortgage lending as well.

The process inputs and outputs are stored in a DLT registry, while paper documents are stored in another database where they are identified by a unique hash code. This approach allows any entity participating in the mortgage origination phase, or even the subsequent servicing, to access the same source of information.

Figure 3 proposes a new business model where the green block contains soft information. Because of their grounding in the local community, small banks hold the softest information, which makes their participation valuable to ensure the accuracy of the applicant's creditworthiness assessment.

Once the borrower information (hard and soft) necessary for the creditworthiness assessment and relating to the property valuation has been collected and made available in digital format, an AI/ML tool makes a pre-approval decision. If the credit application is rejected, the process ends. If pre-approved, the process advances to the second phase: the loan.

While the banking system contains both soft and hard information and data, BT involves decentralization and distributed processing at the bank level, thus allowing any bank to participate in the network. Bank employees act as nodes in the network and are responsible for distributed consent. The distributed altruistic nodes in the network guarantee a reliable system, providing intelligent identity and verification of financial information for faster and more efficient creditworthiness assessment. Shared consensus ensures efficient governance and transparency in underwriting. Approved loans are cryptographically signed and remain unchanged over time as the network maintains strict control over data, classification, and reporting.

The reduction of costs, which Alpha Bank quantified at EUR 800 million, for loans contracted in calendar year 2021, had a positive impact on profitability levels. As of 31 December 2021, customer financing reached approximately EUR 402 billion (+1.7% compared with 2019), reflecting favorable business and private loan trends (+18%). This demonstrates Alpha Bank's support for the Italian economy, accompanied by the digitization of operating processes.

However, several factors do not favor the development of blockchain technology, such as the trade-off between costs and benefits in the reengineering of processes in public administration and the creation of judicial archives. Other challenges include allocating responsibilities for implementing digital platforms and defining rules for accessing and using information by users, as well as exercising control over the correct and safe management of information.

5. DISCUSSION

By drawing on financial intermediation theory and new institutional economics, it is possible to argue that blockchain technology will decentralize and disintermediate various aspects of banking activity. Although banking itself may not fundamentally change, banks might.

We propose a model for the re-specialization of banking activity in an era of disruptive technologies. Our model extends the use of blockchain to small banks, which are often excluded from using technology platforms due to the high investment costs. The extension of the model to small banks is justified because of their strong territorial roots that enable them to have soft information, which is considered strategic for building lasting customer relationships. Their contribution could prove very useful in consolidating and expanding the information block

regarding soft information. The adoption of a blockchain system eliminates the need for trusted third parties (TTPs) such as governments, banks, and insurance companies. It enables managing exchange transactions through the use of a centralized registry designated by users to validate and record transactions in a trust-based scenario. By contrast, a blockchain system manages an exchange process by using a distributed digital ledger, where data is entered based on common rules and technology standards by a geographically distributed network of nodes in a trustless scenario. This means that information is replicated across a high number of independent parties, and data consistency is ensured through a consensus algorithm that can be of different types, the most commonly used being "proof of work." The security of the system is not dependent on a central entity considered trustworthy but rather established by the goodness of the protocol used by the participants.

The main contribution is the creation of a more robust database system that allows banks participating in the network to modify information collectively in a decentralized manner without centralized control. Borrowers are classified into risk classes and have the same right and mode of access to transactions and default records.

The answer to the first question could be that blockchain technology is going to reduce the role of bank intermediaries, as blockchain algorithms replace the traditional role of banks and become an intermediary for facilitating smart financial transactions. Regarding credit profitability, it is expected that the connected bank systems through big data will provide a strong technology platform to offer more cryptographically secure and efficient services around the globe.

To answer the second question, we consider the single most important value-generation criteria for testing our model to be whether it improves mortgage finance accessibility for underserved segments, i.e., "False negative" applicants, whose true creditworthiness level is misjudged under the traditional system.

The proposed model would increase access to finance for three main reasons:

1. to create a connected bank system with both large and small banks participating,
2. to use relevant soft information about applicants, which is codified by sophisticated AI/ML techniques, and

3. to ensure individual lenders can directly assess the applicant's creditworthiness. In addition, blockchain technology facilitates faster verification and authentication, thereby reducing uncertainties and improving financing efficiency. The risk-sharing benefits of establishing such an innovative system are also significant.

Regarding operational efficiency, blockchain offers several benefits, including reduced risks and costs. Some of these benefits concern:

1. Operational risk. The use of DLT, such as blockchain, reduces the risk of fraud and fraudulent transactions by using asymmetric cryptography to encrypt data. Each node in the distributed system demonstrates that the consensus algorithm can withstand outside attacks, thus guaranteeing that blockchain data cannot be falsified or counterfeited, which results in a high level of security.

2. Reputational risk. Blockchain reinforces trust and provides high data quality by offering adequate protection and control. It eliminates the risk of errors and duplication, reducing the risk of borrower complaints and adhering to the principles of banking transparency laws.

3. Anti-money laundering (AML) risk. Blockchain helps move the banking system toward greater resilience by supporting a range of activities, including:

    a. authenticating statements made by customers,

    b. validating contractual agreements,

    c. preserving audit trails.

As a result, BT discourages money laundering. Moreover, it can utilize AI and ML algorithms to prevent and detect illegal transactions by analyzing strings of data to identify signs of any illicit activity. These tools can improve transaction monitoring efficiency, and in case suspicious transactions are detected, they can be blocked pending further investigation.

4. Credit risk. BT improves the creditworthiness process, transparency, and immutability data, thereby increasing transaction speed and significantly reducing transaction costs. It also enhances collateral traceability through the use of initial and variation margins, enabling the sharing of information

for better evaluation of changes in borrowers' financial positions and providing better auditability and transparency. Blockchain technology eliminates 'double data' entry by ensuring that each transaction added to the blockchain is not reusing inputs from previous transactions.

6. CONCLUSIONS, LIMITATIONS AND FUTURE DEVELOPMENTS

In the context of data protection, BT is presented as the biggest technological innovation since the Internet. It empowers consumers and promotes greater transparency in banking operations and services. In addition, it provides inherent protection against threats to confidentiality and information integrity in a shared environment, thus alleviating perceived risks and boosting the public's confidence in the banking system. By promoting collaboration among banks in a shared environment, BT resolves issues related to managing problematic assets and facilitates more informed decision making, effective policy implementation, and the governance of loans management processes. The combination of faster and more information-rich access, democratized control, and highly interoperable shared and secure platforms with "permissioned" access and distributed contact scripts are key elements of an innovative banking sector–wide asset management approach that can help restore investor confidence and drive industrial and economic growth. The successful implementation of the shared technology process requires a thorough technology and regulatory assessment, increased awareness of the target market, meticulous planning of human and technological resources, and solid expertise in IT. Banks deal with confidential customer information, which requires strict data protection regulations. In Italy, banks are guided by the Bank of Italy regulation and ECB guidelines on data protection and governance. Nevertheless, the Italian banking system still has a low awareness of cybersecurity, which exposes banks to data security threats and cybercrime. Traditionally, banks have not been culturally inclined to use distributed and decentralized data storage and processing systems. Therefore, it is crucial to strengthen the regulatory framework for information security and cybercrime.

Although previous research has linked blockchain technology to the mortgage lending process, this study proposes a new application of blockchain technology to reshape traditional banking activity with mortgage lending.

A limitation of our research is that it only covers the origination stage of the mortgage value chain, and the servicing of mortgage lending generated loans is not

analyzed. Additionally, the dynamics of a secondary market for mortgage-backed security shares are not explored.

As one of the few papers analyzing the application of blockchain technology to reshape the traditional credit system, this study highlights several interesting topics for future research. For example, the cost of obtaining corporate information in the blockchain platform and the possibility of incorporating collateral information from the offline world are not considered and, thus, warrant further investigation.

7. REFERENCES

AbiLab (2020). Principali trend di evoluzione e priorità di investimento e ricerca ICT delle banche italiane. Rapporto AbiLab 2020 Roma. https://www.abilab.it/-/eventi/webinar-rapporto-abi-lab-2020-04. Accessed 16 January 2022.

ABI (2022). Report. Forum ABI Lab 2022, investimenti tra innovazione e sicurezza. https://www.abilab.it/web/guest/-/eventi/forum-abi-lab-2022/1.3. Accessed 6 January 2023

Accenture (2018). Building the future-ready bank. https://www.accenture.com/t20180618T183913Z__w__/bg-en/_acnmedia/PDF-80/Accenture-Banking-Tech-Vision-Perspectives-McIntyre-Transcript.pdf Accessed 6 January 2023.

Akkermans, H., & Vos, B. (2003). Amplification In Service Supply Chains: An Exploratory Case Study From The Telecom Industry. *Production and Operations Management,* 12, 204-223. https://doi.org/10.1111/j.1937-5956.2003.tb00501.x

Al Kemyani, M.K., Al Raisi, J., Al Kindi, A.R.T., Al Mughairi, I.Y., & Tiwari, C.K. (2022). Blockchain applications in accounting and finance: qualitative Evidence from the banking sector. *Journal of Research in Business and Management*, 10(4), 28-39. https://www.hct.edu.om/pdf/business/published-papers/students/4Al%20Kemyani.pdf.

Andoni, M., Robu, V., Flynn, D., Abram, S., Geach, D., Jenkins, D., & Peacock, A. (2019). Blockchain technology in the energy sector: A systematic review of challenges and opportunities. *Renewable and Sustainable Energy Reviews,* 100, 143-174. https://doi.org/10.1016/j.rser.2018.10.014

Aramyan, L.H., Oude Lansink, A.G.J.M., van der Vorst, J.G.A.J., & van Kooten, O. (2007). Performance measurement in agri-food supply chains: a case study. *Supply Chain Management,* 12(4), 304-315. https://doi.org/10.1108/13598540710759826

Arora, S., & Tawheed, N. (2022). Blockchain Adoption in Banking Systems: A Boon or Bane?. In Applications, Challenges, and Opportunities of Blockchain Technology in Banking and Insurance, edited by S. L. Gupta, Pooja Kansra, and Gagan Kukreja, 19-42. Hershey, PA: IGI Global. https://doi.org/10.4018/978-1-6684-4133-6.ch002

Azevedo, S.G., Carvalho, H., & Machado, C.V. (2011). The influence of green practices on supply chain performance: A case study approach, Transportation Research Part E: *Logistics and Transportation Review*, 47(6), 850-871. https://doi.org/10.1016/j.tre.2011.05.017

Baden-Fuller, C., & Morgan, M.S. (2010). Business models as models. *Long range planning*, 43(2-3), 156-171. https://doi: 10.1016/j.lrp.2010.02.005

Banca d'Italia (2021). Indagine fintech 2021. https://www.bancaditalia.it/pubblicazioni/indagine-fintech/2021/2021. Accessed 10 October 2022.

Bisogno, M., Nota, G. Saccomanno, A., & Tommasetti A. (2015). Improving the Efficiency of Port Community Systems through Integrated Information Flows of Logistic Processes. *The International Journal of Digital Accounting Research*, 15, 1-31. https://ssrn.com/abstract=2560421. doi:10.4192/1577-8517-v15_1

Bonsón, E., & Bednárová, M. (2019). Blockchain and its implications for accounting and auditing. *Meditari Accountancy Research,* 27(5), 725 - 740. https://doi.org/10.1108/MEDAR-11-2018-0406

Bonyuet, D. (2020). Overview and Impact of Blockchain on Auditing. *The International Journal of Digital Accounting Research*, 20, 31- 43. https://doi:10.1016/j.lrp.2010.02.005

Bruno, E., & Iacoviello, G. (2020). Corporate governance and performance: A study of the reform of cooperative credit system in Italy [Special issue]. *Corporate Ownership & Control*, 18(1), 370-381. http://doi.org/10.22495/cocv18i1siart11

Cai, M., Li, M., & Cao, W. (2019). Blockchain based data distribution and traceability framework in the electric information management system. *Procedia Computer Science,* 162, 82-87. https://doi.org/10.1016/j.procs.2019.11.261

Cao, B., Li, Y., Zhang, L., Zhang, L., Mumtaz, S., Zhou, Z., & Peng, M. (2019). When Internet of Things meets blockchain: Challenges in distributed consensus. *IEEE Network*, 33(6), 133–139. https://doi:10.1109/MNET.2019.1900002

Casino, F., Dasaklis, T. K., & Patsakis, C. (2019). A systematic literature review of blockchain-based applications: Current status, classification and open issues. *Telematics and Informatics*, 36, 55–81. https://doi:10.1016/j.tele.2018.11.006

Chiap, G., Ranalli, J., & Bianchi, R. (2019). Blockchain: tecnologia e applicazioni per il business. Milano: Hoepli.

Cocco, L., Pinna, A., & Marchesi, M. (2017). Banking on blockchain: Costs savings thanks to the blockchain technology. *Future internet*, 9(3), 25. https://doi.org/10.3390/fi9030025

Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). Blockchain technology: beyond bitcoin. *Applied Innovation Review*, 2, 6–19. https://scet.berkeley.edu/wp-content/uploads/BlockchainPaper-1.pdf Accessed 7 March 2023.

Domegan, C., & Fleming, D. (2007). Marketing research in Ireland: Theory and practice. Gill & Macmillan.

EBA (2017). Discussion paper on the EBA's approach to financial technology (Fintech). http://eba.europa.eu/sites/default/documents/files/documents/10180/1919160/ Accessed 10 October 2022.

ECB (2017). The potential impact of DLTs on securities post-trading harmonisation and on the wider EU financial market integration, 78 s. e 117. https://vdocuments.mx/the-potential-impact-of-dlts-on-securities-post-trading-distributed-ledger-technologies.html?page=3. Accessed 10 October 2022.

ECB (2019). Lending and payment systems in upheaval: The fintech challenge. Bruxelles. February. https://www.ecb.europa.eu/press/key/date/2019/html/ecb.sp190226-d98d307ad4.en.html. Accessed 10 October 2022.

ECB (2021). Vigilanza bancaria della BCE: priorità di vigilanza per il periodo 2022-2024. December 2021. https://www.bankingsupervision.europa.eu/banking/priorities/html/ssm.supervisory_priorities2022~0f890c6b70.it.html. Accessed 10 October 2022.

Eisenhardt, K.M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, 14(4), 532–550. https://doi.org/10.2307/258557

ESMA (2017). Report. The Distributed Ledger Technology Applied to Securities Market, n. 50-1121423017-285.https://www.esma.europa.eu. Accessed 10 October 2022.

Evans, O. (2018). Blockchain technology and the financial market: an empirical analysis. *Actual Problems of the Economy*, 211, 82–101. https://mpra.ub.uni-muenchen.de/99212/2/MPRA_paper_99212.pdf

Fintech (2021). Fintech survey. https://www.bancaditalia.it/pubblicazioni/indagine-fintech/2021/index.html?com.dotmarketing.htmlpage.language=1&dotcache=refresh. Accessed 15 October 2022.

Frizzo-Barker, J., Chow-White, P.A., Adams, P.R., Mentanko, J., Ha, D., & Green, S. (2020). Blockchain as a disruptive technology for business: A systematic review. *International Journal of Information Management,* 51, 102029. https://doi: 10.1016/j.ijinfomgt.2019.10.014

Gad, A.G., Mosa, D.T., Abualigah, L., & Abohany, A.A. (2022). Emerging Trends in Blockchain Technology and Applications: A Review and Outlook. *Journal of King Saud University - Computer and Information Sciences*, 34(9), 6719-6742. https://doi.org/ 10.1016j.jksuci.2022.03.007

Gassmann, O., Frankenberger, K., & Sauer, R. (2016). Exploring the Field of Business Model Innovation: New Theoretical Perspectives. Palgrave Macmillan.

Gazali, H.M., Hassan, R., Nor, R.M., & Rahman, H.M.M. (2017). Re-inventing PTPTN study loan with blockchain and smart contracts. In: ICIT 2017–8th International Conference on Information Technology, Proceedings, 751–754. https://doi:10.1109/ ICITECH.2017.8079940

Guo, Y., & Liang, C. (2016). Blockchain application and outlook in the banking industry. *Financial innovation*, 2(1), 1-12. https://doi.org/10.1186/s40854-016-0034-9

Hassani, H., Huang, X., & Silva, E.S. (2018). Banking with blockchain-ed big data. *Journal of Management Analytics*, 5(4), 256-275. https://doi:10.1080/23270012.2018.1528900

He, Q. (2021). Application of blockchain technology in commercial banks. In: E3S Web of Conferences, 235, 03070. EDP Sciences. https://doi:10.1051/e3sconf/202123503070

Hearn, M., & Brown, R.G. (2016). Corda: A distributed ledger. Corda Technical White Paper. https://corda.net/content/corda-technical-whitepaper.pdf. Accessed 5 May 2023.

Hughes, L., Dwivedi, Y. K., Misra, S. K., Rana, N. P., Raghavan, V., & Akella, V. (2019). Blockchain research, practice, and policy: Applications, benefits, limitations, emerging research themes and research agenda. *International Journal of Information Management,* 49, 114-129. https://doi.org/10.1016/j.ijinfomgt.2019.02.005

Ji, F., & Tia, A. (2022). The effect of blockchain on business intelligence efficiency of banks. *Kybernetes,* 51(8), 2652-2668. https://doi.org/10.1108/K-10-2020-0668

Kim, H.M., & Laskowski, M. (2018). Toward an ontology-driven blockchain design for supply-chain provenance. *Intelligent Systems in Accounting, Finance and Management,* 25(1), 18-27. https://doi.org/10.1002/isaf.1424

Kouzinopoulos, C.S., Spathoulas, G., Giannoutakis, K.M., Votis, K., Pandey, P., Tzovaras, D., & Nijdam, N.A. (2018). Using blockchains to strengthen the security of internet of

things. International ISCIS Security Workshop, 90-100. Springer, Cham. https://doi.org/10.1007/978-3-319-95189-8_9

Kshetri, N. (2017). Can blockchain strengthen the internet of things? *IT professional,* 19(4), 68-72. https://doi:10.1109/MITP.2017.3051335

Kumar, K., & Prakash, A. (2018). Developing a framework for assessing sustainable banking performance of the Indian banking sector. *Social Responsibility Journal,* 15(5), 689-709. https://doi.org/10.1108/SRJ-07-2018-0162

Kumari, A., & Devi, N.C. (2022). The Impact of FinTech and Blockchain Technologies on Banking and Financial Services. *Technology Innovation Management Review,* 12(1/2). https://www.timreview.ca/article/1481

Lardo, A., Corsi, K., Varma, A., & Mancini, D. (2022). Exploring blockchain in the accounting domain: a bibliometric analysis. *Accounting, Auditing & Accountability Journal,* 35(9), 204-233. https://doi.org/10.1108/AAAJ-10-2020-4995

Larson, D., & Chang, V. (2016). A review and future direction of agile, business intelligence, analytics and data science. *International Journal of Information Management*, 36(5), 700-710. https://doi.org/10.1016/j.ijinfomgt.2016.04.013

MacDonald, T.J., Allen, D.W., & Potts, J. (2016). Blockchains and the boundaries of self-organized economies: Predictions for the future of banking. In Banking beyond banks and money, 279-296. Springer, Cham. http://doi.org/10.2139/ssrn.2749514

Mani, Z., & Chouk, I. (2018). Consumer resistance to innovation in services: challenges and barriers in the internet of things era. *Journal of Product Innovation Management,* 35(5), 780-807. https://doi.org/10.1111/jpim.12463

Martin-Bariteau, F. (2018). Blockchain and the european union general data protection regulation: The CNIL's perspective. Blockchain. Working Paper Series, 1. http://dx.doi.org/10.2139/ssrn.3275783

Mengelkamp, E., Gärttner, J., Rock, K., Kessler, S., Orsini, L., & Weinhardt, C. (2018). Designing microgrid energy markets: A case study: The Brooklyn Microgrid. *Applied Energy*, 210, 870-880. https://doi.org/10.1016/j.apenergy.2017.06.054

Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. Decentralized Business Review, https://bitcoin.org/bitcoin.pdf. Accessed 15 january 2023.

Paech, P. (2017). The governance of blockchain financial networks. *Modern Law Rev*., 80(6), 1073–1110. http://dx.doi.org/10.2139/ssrn.2875487

Palmié, M., Wincent, J., Parida, V. &, Caglar, U. (2020). The evolution of the financial technology ecosystem: An introduction and agenda for future research on disruptive

innovations in ecosystems. *Technological Forecasting and Social Change,* 151, 119779. https://doi.org/10.1016/j.techfore.2019.119779

Patel, R., Migliavacca, M., & Oriani, M. (2022). Blockchain in Banking and Finance: A bibliometric review. *Research in International Business and Finance,* 62, 101718. https://doi.org/10.1016/j.ribaf.2022.101718

Pereira, R.D.D.M., & Alvim, N.A.T. (2015). Delphi technique in dialogue with nurses on acupuncture as a proposed nursing intervention. *Escola Anna Nery,* 19, 174-180. https://doi: 10.5935/1414-8145.20150024

Peters, G.W., & Panayi, E. (2016). Understanding modern banking ledgers through blockchain technologies: Future of transaction processing and smart contracts on the internet of money. Banking beyond banks and money, 239-278. Springer, Cham. https://doi: 10.1007/978-3-319-42448-4_13

Pettigrew, A. (1990). Longitudinal field research on change: Theory and practice. *Organization Science,* 1(3), 267-292. https://doi.org/10.1287/orsc.1.3.267

Rajnak, V., & Puschmann, T. (2020). The impact of blockchain on business models in banking. *Information Systems and e-Business Management,* 19(3), 809-861. https://doi.org/10.1007/s10257-020-00468-2

Reyna, A., Martín, C., Chen, J., Soler, E., & Díaz, M. (2018). On blockchain and its integration with IoT. Challenges and opportunities. *Future generation computer systems,* 88, 173-190. https://doi.org/10.1016/j.future.2018.05.046

Seebacher, S., & Maleshkova, M. (2018). A model-driven approach for the description of blockchain business networks. Proceedings of the 51st Hawaii international conference on system sciences. 10.24251/HICSS.2018.442

Shah, T., & Jani, S., (2018). Applications of Blockchain Technology in Banking and Finance. *Technical Report,* 160617200028. https://doi: 10.13140/RG.2.2.35237.96489

Shahbazi, Z., & Byun, Y.C. (2022). Machine Learning-Based Analysis of Cryptocurrency Market Financial Risk Management. IEEE Access, 10, 37848-37856. https://doi: 10.1109/ACCESS.2022.3162858

Umalkar, M., MacNeil, A., & Light, D. (2016). What every CEO should know about blockchain. What every CEO should know about blockchain. file:///C:/Users/pgarg/. Downloads/Accenutre-Outlook-Blockchain-POV.pdf Accessed 15 April 2019.

Van Maanen, J. (2006). Ethnography then and now. Qualitative Research in Organizations and Management. *An International Journal,* 1(1), 13-21. https://doi.org/10.1108/17465640610666615

Voss, C., Tsikriktsis, N. and Frohlich, M. (2002). Case research in operations management. *International Journal of Operations & Production Management*, 22(2), 195-219. https://doi.org/10.1108/01443570210414329

Wu, T., & Liang, X., (2017). Exploration and practice of inter-bank application based on blockchain. In: ICCSE 2017–12th *International Conference on Computer Science and Education*, 219–224. https://doi: 10.1109/ICCSE.2017.8085492

Yermack, D. (2017). Corporate governance and blockchains. *Review of finance*, 21(1), 7-31. https://doi.org/10.1093/rof/rfw074

Yin, R.K. (2017). Case Study Research and Applications. Design and Methods, VIth ed., Thousand Oaks (California): Sage.

Zhang, L., Xie, Y., Zheng, Y., Xue, W., Zheng, X., & Xu, X. (2020). The challenges and countermeasures of blockchain in finance and economics. *Systems Research and Behavioral Science,* 37(4), 691-698. https://doi.org/10.1002/sres.2710

Zomorodi, M., & Lynn, M.R. (2010). Instrument development measuring critical care nurses' attitudes and behaviors with end-of-life care. *Nursing research,* 59(4), 234-240. https://doi: 10.1097/NNR.0b013e3181dd25ef

Zott, C., Amit, R. H., & Massa, L. (2011). The Business Model: Recent Developments and Future Research. *Journal of Management,* 37, 1019-1042 http://dx.doi.org/ 10.1177/0149206311406265