# Innovation in the financial sector: An analysis of the use of blockchain technology in financial institutions in Portugal

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## Abstract

In recent years, technological advancements and the history of fraud instances involving financial institutions have resulted in a surge in interest in blockchain technology. Consumers have shown increased interest in and demand for cutting-edge services including new investment options, quicker foreign transfers, and alternative payment methods.

The global financial system might undergo substantial changes as a result of DeFi (decentralized finance). Financial institutions should thus think about putting forward-thinking business ideas into practice and strategically positioning themselves in this quickly expanding market for digital assets.

In addition to assessing the potential advantages of implementation, this study will look into the ideas and methods employed by the banking industry in relation to blockchain adoption. Blockchain is a game-changing technology that could greatly increase financial industry transparency and trust. Among its main advantages are smart contracts, cost savings, enhanced security and efficiency, quicker transfer times and better information quality, and the development of new consumer services.

Regarding the methodology used, an online questionnaire survey was conducted to understand the willingness of financial institution customers to use services based on blockchain technology. The study sample consists of 168 respondents, and the survey results indicate that, in general, customers are receptive to the use of new services based on this technology. In other words, financial institutions observing these trends should follow the path of innovation and implement strategies that enable the adoption of blockchain technology to ensure the continued satisfaction and trust of their customers, strengthen their competitive position, and avoid being overtaken by the competition.

**Keywords:** Blockchain; Efficiency; Financial Institutions; Security; Technology.

## 1. Introduction

The topic was selected in light of the recent discovery that payment methods are becoming more varied and less traditional. Understanding how financial institutions may adopt and use blockchain technology into their everyday operations is crucial since it supports these new payment options.

Blockchain technology and decentralized finance (DeFi) are transforming global access to financial institutions by eliminating regional limitations. By eliminating the need for middlemen, these technologies enable individuals in developing countries without access to traditional banking services to get essential financial services including investments, savings accounts, and loans. Regardless of geographic limitations, anybody may participate in the digital economy with just a smartphone.

Blockchain is a revolutionary technology that has several advantages and has a direct influence on financial institutions. One of the main advantages of using this technology is security. Advanced encryption and a decentralized network protect information and transactions, greatly reducing the possibility of fraud and

cyberattacks. Transparency is still another important advantage since all of the records are maintained in an unalterable public ledger.

There are numerous applications for this technology in the financial sector. Simplifying and expediting cross-border payments while lowering related expenses is one example. Furthermore, enhancing KYC (Know Your Customer) procedures fortifies the defenses against terrorist financing and money laundering. By using smart contracts to automate contract compliance, the banking sector can save time and money. Finally, blockchain enables the transition to more efficient processes, improving the information quality.

This study aims to understand how blockchain technology can be successfully implemented in the financial sector, more specifically in financial institutions, and to assess whether it is indeed a tool with the potential to offer quality solutions to customers.

The main research objectives of this project are: to provide a theoretical framework on the evolution of the financial sector to identify when the use of blockchain technology began to gain prominence in the market, to understand the origin of blockchain and the fundamental concepts of its technology; to investigate institutional adoption, analyzing how various companies, governments, and other entities are using the technology; to understand how blockchain technology can be implemented in the banking sector; to address the importance of blockchain in defining the strategy of financial institutions; to analyze factors such as security and privacy; to assess consumer opinion regarding new services developed based on blockchain technology; and to identify the challenges inherent in implementing this technology.

To conduct this study, a theoretical framework (literature review) will be developed on the evolution of the financial sector, blockchain technology, its applicability in various sectors, and the barriers to its adoption. Following the review of the literature, a quantitative online survey will be conducted. The purpose of the poll is to learn how respondents feel about their likelihood of using blockchain-based services.

Participants' personal details, including age, gender, education, employment history, residence, and net monthly income, will be gathered as the first stage in the survey. The next set of questions ask about respondents' level of knowledge and opinion regarding new technologies, how often they use home banking and mobile applications to handle financial matters, how important certain factors are for handling financial matters, how well-versed they are in terms of blockchain, and how much customers accept financial institutions using blockchain to provide new customer services.

This study is structured into six main chapters. Next chapter presents the theoretical framework, reviewing literature on blockchain technology, its evolution in the financial sector, key theoretical concepts, applicability across industries, and its adoption in banking, including real-world cases and barriers to implementation. The third chapter details the research methodology, which follows a quantitative approach. The fourth chapter analyzes the data collected through an online survey, including sample characterization and the fifth chapter, econometric analysis of relevant variables and the discussion of results. The sixth chapter finally discusses the study's contributions and limitations, suggests areas for future research and presents the final conclusions.

## 2. Literature Review

The rise of digitalization, the emergence of technology companies in the financial industry, and the advent of blockchain have prompted financial institutions to adapt their traditional business models to retain customers (Lopes, 2024). While several sectors generate more revenue from digital channels than traditional ones, banking has yet to follow this trend. Because consumers who are more likely to utilize digital channels are frequently younger and have less money to spend, the value of digital assets under control stays lower (Vilhena & Navas, 2023; Navas, Sotomayor & Darame, 2025).

DeFi, a subset of decentralized banking, offers an alternative to conventional systems by using blockchain technology and smart contracts for financial services including lending, trading, and insurance (Li et al., 2022). In

order to protect digital data from manipulation, Haber and Stornetta developed the idea of blockchain in the 1990s (Phartyal & Davi, 2022).

Lopes (2024) asserts that Distributed Ledger Technology (DLT), which provides a decentralized registry where data is held among numerous entities without a central administrator, signifies the start of the Crypto age. One kind of DLT is blockchain, which arranges digital data into interconnected blocks to create an ongoing chain (Ressi et al., 2024). Every computer connected to the network of nodes downloads and synchronizes with the most recent blockchain data (Gaikwad, 2020).

Blockchain blocks may store a variety of transaction information, including the date, time, amount, and participants, claims Gaikwad (2020). Because each block's hash value is connected to the one before it, cryptographic techniques make sure that changing a block's content would render the entire chain incorrect (Ressi et al., 2024). On the other hand, because the central node has complete authority, centralized networks are susceptible to power abuses (Lopes, 2024). Multiple nodes make up a decentralized blockchain, which is more resilient to assaults; even if some nodes are hacked, the network can continue to operate (Phartyal & Davi, 2022). One essential component that guarantees blockchain data cannot be changed without rendering the entire chain invalid is immutability (Tripathi, Ahad, & Casalino, 2023).

To join the network, nodes must adhere to a consensus procedure. While Proof of Stake chooses block makers based on the quantity of tokens owned, Proof of Work pits miners against one another to solve challenging puzzles and validate transactions (Gaikwad, 2020) (Lopes, 2024). In regulated private blockchains, the Proof of Authority process uses pre-selected validators (Islam, Merlec, & In, 2022).

Because private blockchains are centralized, they can process more transactions and reach consensus more quickly (Far & Asaar, 2024; Yang et al., 2020). Private blockchains are problematic because they lack a consensus method, but their performance and confidentiality are making them more popular in industries including banking, insurance, and logistics (Zhai, Shen, & Mao, 2024). Only authorized entities can access data in these systems (Zhai, Shen, & Mao, 2024).

Smart contracts are self-executing agreements built into computer programs that, when certain criteria are fulfilled, carry out actions automatically, doing away with the need for middlemen (Lopes, 2024; Hedge & Maddikunta, 2023). Their use of blockchain technology (Ante, 2021) offers a move toward programmable assets and more automated corporate transactions, increasing the likelihood of adoption (Ante, 2021).

But even with consumer protection measures in place, reliable profits are hampered by cryptocurrency volatility (Lopes, 2024). Because they are linked to fundamental assets like currencies or precious metals, which link them to the actual economy, stablecoins have become a viable alternative (Feng, Yuan, & Jiang, 2024; l'Etang, 2024).

Commercial banks are adopting digital currencies due to the shift away from cash, new technologies, and the growth of digitalization (Marszałek & Szarzec, 2021). However, this move to cashless transactions may worsen social inequality and financial exclusion, especially for households (Marszałek & Szarzec, 2021; Brandl, Hengsbach, & Moreno, 2024).

The invention of Bitcoin marked the first use of blockchain technology, as this research has already noted. However, as time has gone on, its use has spread beyond cryptocurrency to a variety of industries and commercial sectors due to increased interest and the perceived potential of more individuals (Casella et al., 2023). Beyond its significance in underdeveloped nations, blockchain technology is especially useful for remittance transfers, outperforming conventional techniques in terms of speed and accessibility at any time and to any location. According to Tripathi, Ahad, and Casalino (2023), this technology can provide value in a variety of industries. Blockchain is a useful tool for attaining sustainable supply chain management because of its special features, such traceability and transparency, which may help limit greenhouse gas emissions and the introduction of less sustainable items into supply networks (Duan, Pang, & Lin, 2024).

Online retail platforms are now able to communicate demand information with manufacturers, which in turn encourages them to enhance the quality of their products, thanks to the advancement of information technology and the availability of large volumes of customer data (Zhang, Zhu, & Ren, 2024). Artificial Intelligence (AI) has become a very helpful tool for more effectively handling complicated challenges. As AI continues to develop, some of the basic issues that blockchain systems encounter can be resolved thanks to its strengths in data analysis, pattern recognition, and automation (Lopes, 2024). The use of these two technologies is restricted to using blockchain as a distributed data storage solution and applying some degree of artificial intelligence to the data that is stored. In these cases, neither technology's full potential is being appropriately utilized for both parties' advantage (Ressi et al., 2024). The system's integrity is preserved by the significant decrease in transaction, administrative, and operational expenses as well as the guarantees of efficiency, security, real-time transaction speed, and quick document processing (Garg et al., 2021).

According to Deng (2020), long processing times, high prices, higher capital allocation, and inadequate security are the primary drawbacks of the conventional approach to cross-border transfers. First off, over 90% of cross-border transactions are related to the business-to-business (B2B) payment model, which contributes to the completion delays (Deng, 2020). It is crucial for institutions to implement robust controls and maintain an in-depth understanding of their customers and the transactions they conduct (Lopes, 2024). Financial organizations must thus make investments to enhance their Know Your Customer (KYC) procedures. All banks rely on the KYC procedure to confirm their customers' identities. To stop banks from being used for illicit purposes including money laundering, drug trafficking, financing terrorism, and other crimes, this verification is crucial. Patil and Sangeetha (2022) claim that manual KYC procedures are still the most common in use today. Nevertheless, it has several drawbacks, such as antiquated techniques, lengthier processing times, and security issues. Patil and Sangeetha (2022) support the notion that blockchain-based KYC verification can overcome the drawbacks of the manual approach since the technology offers important properties like security, immutability, and decentralization.

The retail banking sector in Portugal has experienced significant transformations, and the process has been further accelerated by the Covid-19 pandemic (Vilhena & Navas, 2023). The survey's findings, made in Portugal, indicate that, overall, respondents are content with the digital services provided by financial institutions. They perceive them as secure and exhibit a preference for Homebanking/Mobile Banking over traditional channels (Navas et al, 2025; Vilhena & Navas, 2023). Basdekidou and Papapanagos (2025) explore the intervening role in socioeconomic performance (SEP) of corporate environmental, cultural, and ethnic activities (ECEAs) and diversity, equity, inclusion, and social initiatives (DEISIs) on blockchain adoption strategy, particularly useful in the Western Balkans (WB), which demands transparency due to extended fraud and ethnic complexities. A serial mediation model was tested on a dataset of 630 WB and EU companies, and the research conceptual model was validated by CFA (Confirmation Factor Analysis), and the SEM (Structural Equation Model) fit was assessed. The authors confirmed the influence of technology, and environmental, cultural, ethnic, and social factors on blockchain adoption strategy and most of the hypotheses (21 out of 28) showed a strong correlation between the performance of sustainable entrepreneurship and the adoption of blockchain technology (Basdekidou and Papapanagos, 2025). Based on the findings, Basdekidou and Papapanagos (2025) concluded that the inclusion of green corporate activities and SEISIs initiatives, as mediating variables, strengthens the influence of blockchain adoption on SEP among firms operating in the multicultural and multi-ethnic areas.

Also, Sciarelli et al (2022) studies factors which affects the adoption of blockchain technology in innovative Italian companies (an extended TAM approach - Technology Acceptance Model) and results show that efficiency and security is an important driver of firms' decision-making process to adopt the technology. Moreover, the results show that perceived usefulness is a strong predictor of the intention to use blockchain in business processes (Sciarelli et al, 2022). Countries are studying the TAM for real applications across various services and sectors, such as blockchain adoption for authentication (Pham et al., 2025) and its use in combating corruption (Ayeboafo et al., 2025). Even sectors like healthcare are already making plans and guidelines on the construction and application of medical blockchain (Chen et al., 2025).

The European Union (EU) has recognized the need for a digital finance strategy to address regulatory gaps and help relaunch and modernize the European economy in the aftermath of the COVID-19 pandemic (Pavlidis, 2021).Pavlidis (2021) claims that the EU legislative initiatives seek to unlock the potential of crypto assets while mitigating the risks to financial stability, market integrity and consumer protection and this will lead to additional and better financial products for consumers, improving financial inclusion and financing of businesses. But, according to Linden and Shirazi (2023), findings reveal that such regulation will most likely not accelerate the adoption of crypto assets in the EU financial services sector, at least not sufficiently or as intended and some suggestions are made to improve the proposal.

Another issue very present in blockchain are the "attackers" that have successfully launched assaults on cryptocurrency exchanges on various occasions in recent years, causing large financial losses estimated to be in the millions (Tripathi et al., 2023). Sybil attacks, which include the creation of several fictitious nodes inside the blockchain network to sway choices and alter network consensus, are another frequent instance of network compromise that compromises the security and operation of the network (Li, 2022). To fully utilize blockchain technology's revolutionary potential while reducing the related legal and regulatory obstacles, governments, corporations, and regulators must work together effectively (Nembe et al., 2024).

Concluding the success of the adoption process, it is very important to avoid delays for companies and customers, current blockchains must increase their processing capacity; otherwise, the infrastructure of the sector would not be able to keep up with the increasing demand (Tripathi et al., 2023). Future trends rely on making it easier for people to switch from traditional to digital banking, technology is changing the financial environment. In addition, it is pushing economies in the direction of cashless transactions (Kour, 2023).

## 3. Methodology

The next stage is to compare the findings of the questionnaire survey with the literature research after developing the theoretical framework of blockchain technology and assessing its applicability across different sectors. The goal is not only to comprehend how blockchain technology can be successfully applied in the banking industry, but also to determine whether clients believe in its potential and if it is an essential tool for providing them with high-quality solutions.

The questionnaire survey, which consists of a series of questions aimed at a group of respondents, often representative of a population, is a tool for gathering data thought pertinent to the topic being studied. Additionally, this methodology aims to verify theoretical hypotheses and analyze the correlations these hypotheses suggest (Quivy, Campenhoudt & Marquet, 2019). It is important to mention that, in this study, no data was used to calculate the sample's representativeness.

To address the specific objectives outlined in the previous chapter, a questionnaire was conducted, consisting of three sections. The first section aims to provide a general characterization of the sample by including questions about the respondents' sociodemographic profile. The second section of the questionnaire seeks to understand the respondents' level of acceptance regarding new technologies. Finally, the third section aims to assess receptiveness to the digital transformation of the banking sector and the adoption of new products.

To facilitate the quantification of the data obtained, some questions were designed to allow short responses, with multiple-choice options (several choices) or binary answers ("Yes" or "No"). Additionally, the Likert scale was also used, where respondents are asked to indicate, on a numerical scale, their level of agreement or disagreement with the given statement (Joshi et al., 2015).

For data collection, an online survey was conducted using Google Forms platform. The survey was available from December 1, 2023, to February 1, 2024, through the following link: https://forms.gle/u6wcj4CQnesPRX8C7.

To facilitate the dissemination of the questionnaire, it was distributed via the Internet. Additionally, this method was chosen because the questionnaire addresses a topic related to the use of disruptive technology that operates exclusively through the Internet. For this reason, it makes sense that the sample is comfortable with using the

Internet, not only to understand its relationship with existing mobile applications provided by their banks but also to assess their level of acceptance of future blockchain-based proposals.

The survey was shared through Instagram and LinkedIn platforms. For this study, the target population included all Portuguese users of Instagram and LinkedIn, and a total of 168 valid responses were obtained. To validate the results of the questionnaire, a statistical analysis was conducted by calculating absolute and relative frequencies to obtain descriptive analyses of the results. Subsequently, cross-tabulations were performed between respondents' sociodemographic variables and certain relevant variables to test and draw conclusions about their relationships.

In this study, an objective analysis of the collected data is intended, which is why a scientific approach was chosen. The MS Data analysis software program was used for the analysis and processing of the information gathered from the questionnaire survey.

For each dependent variable (X1 to X11), a separate linear regression was estimated, with the sociodemographic variables (gender, age, educational qualifications, and monthly net income) as predictors. Gender was coded as 1 = female and 2 = male; age was treated as a continuous variable, while income is divided into several ranges (0–6 in ascending order), and academic qualifications were coded according to the respondents' highest level attained (0–7 in ascending order too; zero means other). Regarding independent variables, the Likert-type answers were direct (1–5 in ascending order), while the yes and no answers were treated as binary values (0 for no and 1 for yes).

All models were estimated using the ordinary least squares (OLS) method, which the Excel tool implements by minimizing the sum of squared residuals. Models were run individually and then summarized in a single comparative table to facilitate interpretation. Only statistically significant predictors at the 1%, 5%, or 10% level were reported, while non-significant variables were tested and excluded but mentioned apart. The sample consisted of 168 valid responses, after excluding incomplete questionnaires. Although Excel offers fewer diagnostic options than specialized econometric software, it provides adequate outputs (coefficients, t-statistics, $R^2$, significance levels) to support the exploratory nature of this research.

We are aware that Excel is a basic tool, with limited functionalities compared to specialized software (SPSS, Stata, R). However, it allows for the application of the OLS method sufficiently for the exploratory objectives of the study.

## 4. Findings and Analysis

As shown in Figure 1, 56 respondents (34.6%) are under 25 years old, 14 respondents (8.8%) are between 26 and 35 years old, 24 respondents (15.1%) fall within the 36 to 45 age range, 44 respondents (27.7%) are between 46 and 55 years old, 16 respondents (10.1%) are between 56 and 65 years old, and only 6 respondents (3.8%) are over 65 years old. After analyzing the respondents' age groups, it is concluded that the majority are under 25 years old, while the least represented age group consists of respondents over 65 years old.

**Figure 1:** Distribution of ages of interviewees.
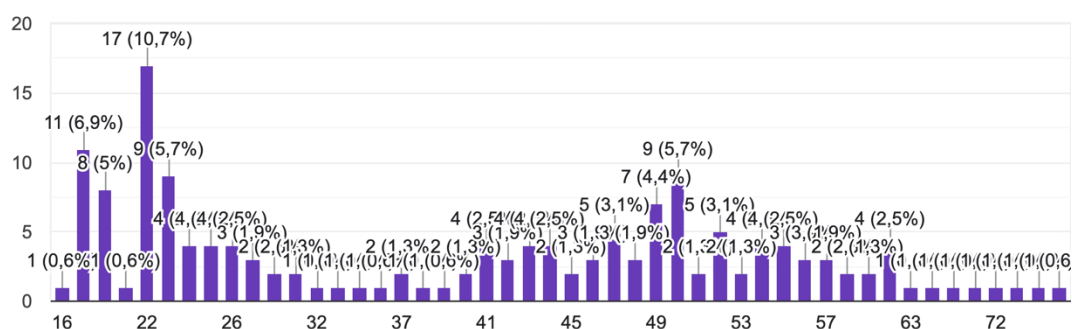
Of the 168 people who participated in the study, 99 are female and 69 are male. This means that the majority (58.9%) of the respondents are female, while 41.1% are male. Regarding the respondents' academic qualifications, 32.9% (n=55) have completed secondary education, 45.5% (n=76) hold a bachelor's degree, 11.4% (n=19) have obtained a master's degree, 5.4% (n=9) have completed a postgraduate degree, 0.6% (n=1) hold a PhD, 0.6% (n=1) have only completed basic education, and 1.8% (n=3) have other academic degrees. Around 71.4% (n=120) of the respondents are employees, 7.1% (n=12) are self-employed, 18.5% (n=31) are students, 2.4% (n=4) are retired, and 0.6% (n=1) are unemployed. Approximately 4.3% (n=7) earn less than €500, 11.6% (n=19) earn between €500 and €999, 26.2% (n=43) receive between €999 and €1,499, 15.2% (n=25) earn between €1,499 and €1,999, 14% (n=23) receive between €1,999 and €2,499, 14% (n=23) earn more than €2,500, and 14.6% (n=24) have no income. Regarding the respondents' level of knowledge about new technologies, the majority, 57.7% (n=97), stated that they have an intermediate level of knowledge. The minority, 1.2% (n=2), reported having no knowledge of new technologies, around 23.8% (n=40) indicated having basic knowledge, and 17.3% (n=29) claimed to have advanced knowledge. Table 1 provides a more detailed view of the descriptive statistics for the sociodemographic variables.

**Table 1:** Descriptive statistics for sociodemographic factors

| Metrics | Gender | Age | Qualification | Income |
|---|---|---|---|---|
| Mean | 1.4083 | 36.4438 | 3.503 | 3.1183 |
| Standard Error | 0.0379 | 1.3696 | 0.1114 | 0.1489 |
| Median | 1 | 40 | 4 | 3 |
| Mode | 1 | 22 | 4 | 3 |
| Standard Deviation | 0.493 | 17.8044 | 1.448 | 1.9359 |
| Sample Variance | 0.243 | 316.9983 | 2.0967 | 3.7478 |
| Kurtosis | -1.8806 | -0.7208 | -0.4366 | -0.9453 |
| Skewness | 0.3765 | -0.0507 | 0 | -0.2091 |
| Range | 1 | 77 | 7 | 6 |
| Minimum | 1 | 16 | 0 | 0 |
| Maximum | 2 | 77 | 7 | 6 |
| Count | 168 | 168 | 168 | 168 |
| Confidence Level(95,0%) | 0.0749 | 2.7038 | 0.2199 | 0.294 |

Regarding gender, the median and the mode of 1 both confirm that the majority of respondents are female, as the mean is over 1.5. The median age is forty, the mode is twenty-two, and the average is thirty-six. Given that the questionnaire was primarily distributed to the academic community, the mode of 22 indicates that the majority of respondents were younger. However, the median of 40, the wide range of 16 to 77, and the nearly symmetrical skewness (-0.05) suggest that the sample also contains a significant number of older participants. The majority of respondents have a bachelor's degree as their major, as shown by qualifications close to 4 (mean, median, and mode). According to the near three (mean, median, and mode) measures of income, the average respondent makes between €999 and €1499 (€14,000 and €21,000 a year). Details about classification attributed to various factors for the treatment of financial matters are detailed in Table 2, using a scale from 1 (not important) to 5 (very important).

**Table 2:** Classification of the treatment of financial matters.

| Variable | Classification | Absolute Frequency | Relative Frequency |
|---|---|---|---|
| Personalized service | Not important | 2 | 1.2% |
| | Slightly important | 14 | 8.3% |
| | Indifferent | 16 | 9.5% |
| | Important | 81 | 48.2% |
| | Very important | 55 | 32.7% |
| Efficiency | Not important | 0 | 0.0% |
| | Slightly important | 1 | 0.6% |
| | Indifferent | 2 | 1.2% |
| | Important | 43 | 25.6% |
| | Very important | 122 | 72.6% |
| Ease of use of digital platforms | Not important | 0 | 0.0% |
| | Slightly important | 0 | 0.0% |
| | Indifferent | 6 | 3.6% |
| | Important | 61 | 36.3% |
| | Very important | 101 | 60.1% |
| Speed | Not important | 0 | 0.0% |
| | Slightly important | 2 | 1.2% |
| | Indifferent | 0 | 0.0% |
| | Important | 53 | 31.5% |
| | Very important | 113 | 67.3% |
| Fees and costs | Not important | 0 | 0.0% |
| | Slightly important | 6 | 3.6% |
| | Indifferent | 15 | 8.9% |
| | Important | 36 | 21.4% |
| | Very important | 111 | 66.1% |
| Reputation of the financial institution | Not important | 0 | 0.0% |
| | Slightly important | 2 | 1.2% |
| | Indifferent | 15 | 8.9% |
| | Important | 58 | 34.5% |
| | Very important | 93 | 55.4% |
| Proximity to the financial institution | Not important | 1 | 0.6% |
| | Slightly important | 11 | 6.5% |
| | Indifferent | 51 | 30.4% |
| | Important | 54 | 32.1% |
| | Very important | 51 | 30.4% |
| Security | Not important | 0 | 0.0% |
| | Slightly important | 1 | 0.6% |
| | Indifferent | 0 | 0.0% |
| | Important | 17 | 10.1% |
| | Very important | 150 | 89.3% |

Regarding the respondents' level of confidence in making payments over the internet, only 2.4% (n=4) rated their confidence level as very low, while 4.2% (n=7) rated it as low. Additionally, 19.6% (n=33) classified their confidence level as neutral, 53.6% (n=90) rated it as high, and finally, 20.2% (n=34) reported having a very high level of confidence in making online payments. It is observed that 98.2% of respondents (n=164) consider the use of mobile applications a valuable tool for managing financial matters. In contrast, 1.8% of respondents (n=3)

hold an opposing view and do not believe in their usefulness for facilitating financial management. It is also observed that 91.1% of respondents (n=153) use a mobile application to manage financial matters related to their bank account. On the other hand, 8.9% (n=15) do not use any mobile application for such purposes. Regarding the main reasons why respondents do not use homebanking, approximately 35.3% (n=6) stated that they do not use this functionality due to security concerns, 35.3% (n=6) do not use it because they do not have a bank account, 5.9% (n=1) mentioned lack of knowledge as the reason, and 23.5% (n=4) cited other reasons. Regarding respondents' preferred payment methods for making payments or transfers, approximately 41.3% (n=69) prefer using ATMs, 31.7% (n=53) favor mobile applications, 23.4% (n=39) use Homebanking, and 3.6% (n=6) prefer cash (coins and banknotes). It can be concluded that most respondents prefer using ATMs for payments. On the other hand, it is evident that cash payments have been increasingly less utilized, with only 3.6% of the sample favoring this method.

It is possible to draw some conclusions regarding respondents' knowledge of certain blockchain-related topics. Out of 168 responses, 7.5% (n=12) of respondents are familiar with the term DLT, 46.9% (n=75) recognize the term Blockchain, 91.9% (n=147) are familiar with the concept of cryptocurrencies, 28.1% (n=45) understand the term smart contracts, 27.5% (n=44) comprehend the concept of Fintechs, 6.9% (n=11) are aware of the term DeFi, 20% (n=32) understand the concept of asset tokenization, and 18.8% (n=30) are familiar with the term Stable Coins. It can be concluded that blockchain technology and the concept of cryptocurrencies are the most well-known topics among respondents.

One of the survey's questions sought to gauge respondents' thoughts on the prospect of the banking industry becoming entirely digital in the future, doing away with the necessity for physical branches. About 31% of respondents (n=52) think this situation is feasible, whilst 69% of respondents (n=116) do not think it is possible.

It is possible to observe respondents' opinions on the use of an application developed by their own bank to monitor cryptocurrency market activity, alerting them to good buying or selling opportunities. Around 56.9% of respondents (n=95) expressed interest in this new service from their bank and stated that they would use it. However, 43.1% of respondents (n=72) are still not comfortable investing in this market and stated that they would not use such an application.

Regarding respondents' opinions on acquiring cryptocurrencies if their bank offered its own cryptocurrencies or assisted them in incorporating them into their portfolio, 63.1% of respondents (n=106) responded positively to this possibility. In contrast, 36.9% of respondents (n=62) stated that even with their bank's support, they would still not consider the proposal advantageous.

When asked about the possibility of using a cryptocurrency developed by their bank to significantly improve the efficiency, speed, and security of transfers, 68.5% of respondents (n=115) considered it a good initiative. However, 31.5% of respondents (n=53) stated that they would not use a cryptocurrency developed by their bank, even if it substantially enhanced transaction efficiency.

The objective is to understand whether respondents who previously answered negatively believe their opinion might change in 10 years. When faced with this temporal perspective, 71.7% of respondents (n=43) acknowledged the possibility of reconsidering and using a cryptocurrency developed by their bank to enhance transaction efficiency in the future. However, 28.3% of respondents (n=17) maintained a firm stance on this topic, believing that their opinion will remain unchanged over the next decade.

Regarding the perceived security of blockchain-based financial products, if banks were to take a more active and intelligent role in managing their clients' portfolios, 66.5% of respondents (n=107) stated that they would feel more confident in the process. However, 33.5% of respondents (n=54) indicated that the bank's involvement would not change their stance, and they would still prefer not to make such investments.

Regarding the potential adoption of a bank-developed application aimed at improving the speed of international transfers at no additional cost, 92.1% of respondents (n=152) stated they would be willing to use it, while only 7.9% (n=13) expressed disinterest in this solution.

The final question of the survey aimed at assessing respondents' opinions on whether they would consider switching to a competitor if their bank did not offer the previously mentioned services. The results show that approximately 67.3% of respondents (n=111) indicated that they would switch banks under these circumstances. On the other hand, 32.7% (n=54) stated that this factor would not influence their relationship with their current bank and would not prompt them to seek alternatives.

To have a better understanding of these variables, table 3 presents the descriptive statistics for classification of the treatment of financial matters. Security emerges as the most valued attribute (mean = 4.89, 89% "very important"), followed by efficiency and speed (means around 4.7). In contrast, proximity to the financial institution was the least valued factor, with a mean below 4. This pattern highlights the strong customer preference for digital convenience and reliability over physical presence.

**Table 3:** Descriptive statistics for classification of the treatment of financial matters

| Variable | Mean | Median | Mode | Std. Dev. | N |
|---|---|---|---|---|---|
| Personalized service | 4.03 | 4 | 4 | 0.85 | 168 |
| Efficiency | 4.70 | 5 | 5 | 0.55 | 168 |
| Ease of use of digital platforms | 4.57 | 5 | 5 | 0.61 | 168 |
| Speed | 4.66 | 5 | 5 | 0.58 | 168 |
| Fees and costs | 4.50 | 5 | 5 | 0.70 | 168 |
| Reputation | 4.44 | 5 | 5 | 0.72 | 168 |
| Proximity | 3.85 | 4 | 4 | 0.94 | 168 |
| Security | 4.89 | 5 | 5 | 0.35 | 168 |

## 5. Discussion

In this chapter, an analysis of the variables will be conducted to examine their relationships and understand how the sociodemographic variables of the questionnaire (gender, age, educational qualifications, and monthly net income) influence the respondents' answers to the remaining questions. Table 4 is derived from the linear regression performed in MS Data Analysis based on the questionnaire survey responses. Only statistically significant variables for the model will be presented, while non-significant variables will not be included. The Regression analysis tool performs linear regression analysis by using the "least squares" method to fit a line through a set of observations.

**Table 4:** Linear regression analysis.

| Dependent variable | R2 | Intercept | | Gender | | Age | | Academic qualifications | | Monthly net income | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Coef. | t-Stat | Coef. | t-Stat | Coef. | t-Stat | Coef. | t-Stat | Coef. | t-Stat |
| X1 ** | 0.06 | 2.70 *** | 12.49 | 0.22 ** | 2.07 | -0.01 ** | -1.99 | 0.02 | 0.65 | 0.02 | 0.68 |
| X2 *** | 0.15 | 0.96 *** | 20.63 | -0.04 | -1.56 | 0.01 *** | 4.59 | 0.02 *** | 2.73 | -0.03 *** | -4.05 |
| X3 ** | 0.07 | 1.49 *** | 3.25 | -0.09 | -0.44 | -0.08 | -1.10 | -0.08 | -1.10 | -0.12 * | -1.77 |
| X4 *** | 0.13 | 2.34 *** | 8.65 | -0.30 ** | -2.33 | 0.01 | 1.64 | 0.08 * | 1.71 | 0.08 ** | 1.98 |
| X5 *** | 0.08 | 4.95 *** | 16.76 | -0.30 ** | -2.13 | 0.01 | 0.29 | -0.12 ** | -2.37 | -0.03 | -0.77 |
| X6 ** | 0.07 | 4.96 *** | 27.60 | -0.05 | -0.67 | 0.01 *** | 2.71 | 0.01 | 0.07 | -0.01 | -0.40 |
| X7 * | 0.05 | 4.95 *** | 27.98 | -0.07 | -0.77 | -0.01 ** | -2.56 | 0.01 | 0.22 | 0.01 | 0.39 |
| X8 ** | 0.06 | 4.28 *** | 16.58 | -0.16 | -1.33 | -0.01 | -0.29 | 0.09 ** | 2.14 | 0.05 | 1.25 |
| X9 ** | 0.06 | 5.04 *** | 22.27 | -0.08 | -0.74 | -0.01 ** | -2.28 | -0.10 *** | -2.73 | 0.06 * | 1.74 |
| X10 * | 0.05 | 0.57 *** | 3.18 | 0.15 ** | 2.06 | -0.01 | -0.52 | -0.05 * | -1.89 | 0.01 | 0.56 |
| X11 * | 0.05 | 1.04 *** | 9.57 | -0.02 | -0.62 | -0.01 ** | -2.48 | -0.01 | -1.15 | 0.03 ** | 2.43 |

Number of observations: 168

Notes:

X1 — Level of knowledge regarding new technologies

X2 — Respondents' perception of the usefulness of mobile banking applications to facilitate the handling of financial matters

X3 — Reason for not using homebanking

X4 — Preferred payment method for making payments or transfers

X5 — Ranking the importance of personalized service for dealing with financial matters

X6 — Ranking the importance of ease of use of digital platforms for dealing with financial matters

X7 — Ranking the importance of speed in dealing with financial matters

X8 — Ranking the importance of fees and costs for dealing with financial matters

X9 — Ranking of the importance of the reputation of financial institutions in dealing with financial matters

X10 — Acceptability of acquiring cryptocurrencies if the bank offers its own cryptocurrencies, or helps its customers to have them in their portfolio

X11 — Acceptability of using a mobile application created by the bank to improve efficiency, speed, and security in transfers, facilitating cross-border transfers and currency conversion.

\* — Statistical significance at 10%; \*\* — Statistical significance at 5%; \*\*\* — Statistical significance at 1%

Coef. = Coefficient

Gender signals: 1 — feminine; 2 — masculine

Table 4 presents the results of a multiple linear regression analysis with 168 observations, assessing the impact of sociodemographic variables (gender, age, academic qualifications, and monthly net income) on different dependent variables related to financial technology and banking perceptions. The explanatory power of the models varies, with the highest $R^2$ value (0.15) observed for X2, which represents the perceived usefulness of mobile banking applications. Other models exhibit relatively low $R^2$ values, suggesting weak explanatory power. However, statistically significant variables still provide valuable insights.

The intercepts for all dependent variables are statistically significant at the 1% level, indicating that even in the absence of the independent variables, there is a baseline level of response for each dependent variable. Regarding gender, males report higher levels of knowledge about new technologies (X1), as evidenced by a positive and significant coefficient (0.22, $p < 5\%$). On the other hand, gender has a negative impact on the significance of customized banking services (X5) (-0.30, $p < 5\%$) and the chosen payment method (X4) (-0.30, $p < 5\%$), suggesting that men are less inclined to value personalized service and favor certain payment methods. Additionally, gender has a positive and significant effect (0.15, $p < 5\%$) on the acceptability of cryptocurrencies given by banks (X10), indicating that men are more willing to purchase cryptocurrencies through banks.

The amount of knowledge about new technologies is negatively impacted by age (X1) (-0.01, $p < 5\%$), indicating that older respondents had lower levels of expertise. In a similar vein, older respondents place somewhat less weight on financial institution reputation (X9) (-0.01, $p < 5\%$) and transaction speed (X7) (-0.01, $p < 5\%$). Furthermore, older individuals show less acceptance of mobile banking applications for transfers (X11) (-0.01, $p < 5\%$). However, age positively affects the perceived usefulness of mobile banking applications (X2) (0.01, $p < 1\%$), suggesting that older respondents recognize their utility.

Academic qualifications play a significant role in several aspects. Higher academic qualifications lead to greater perceived usefulness of mobile banking applications (X2) (0.02, $p < 1\%$). Education level also influences the preferred payment method (X4) (0.08, $p < 10\%$) and the importance of fees and costs (X8) (0.09, $p < 5\%$). However, higher education levels decrease the perceived importance of personalized banking services (X5) (-0.12, $p < 5\%$) and slightly reduce the acceptance of cryptocurrencies via banks (X10) (-0.05, $p < 10\%$).

Monthly net income is also a determining factor. Higher income is associated with a lower perceived usefulness of mobile banking applications (X2) (-0.03, $p < 1\%$), suggesting that wealthier individuals may already have alternative financial management solutions. However, these individuals attribute greater importance to the reputation of financial institutions (X9) (0.06, $p < 10\%$) and show greater acceptability of mobile banking applications for transfers (X11) (0.03, $p < 5\%$). Higher-income respondents are also less likely to cite reasons for avoiding home banking (X3) (-0.12, $p < 10\%$) and place less value on personalized banking services (X5) (-0.03, not significant).

In conclusion, the data shows clear trends in banking choices and the use of financial technology according to sociodemographic characteristics. Elderly respondents found mobile banking apps more helpful, although younger and male respondents are more tech-savvy. Larger income respondents place a larger value on financial institution reputation and are more receptive to mobile banking apps, whereas more education is associated

with a greater emphasis on fees and expenses. Furthermore, there are differences in bitcoin adoption by education and gender, with more educated respondents exhibiting a little amount of hesitancy and men exhibiting higher openness. These findings provide insights into how different demographics engage with digital banking services and financial technology, highlighting potential areas for tailored strategies in the financial sector.

To assess potential heteroscedasticity, we regressed the squared residuals on the set of sociodemographic variables used in the original specification (Breusch–Pagan type procedure). The regression revealed a non-significant F-test ($p > 0.05$) and limited explanatory power ($R^2 < 0.05$), indicating that heteroscedasticity is not an issue in our model. Nonetheless, there were indications of heteroscedasticity ($p < 0.05$) for two variables, X6 and X9. The gender variable's binary design, which divides the sample into two subgroups (male and female) and might highlight differences in residual variance between groups, may be to blame for this result. In practice, this outcome indicates that the dispersion of responses for these constructs differs slightly between men and women, even though the overall explanatory power of the models remains weak. To ensure robustness, we verified that the use of heteroscedasticity-consistent (HC) standard errors did not materially affect the significance or direction of the coefficients.

The excluded variables were: 1) Using a mobile application to handle bank account-related matters, 2) Degree of trust when making payments online, 3) Importance of efficiency in dealing with financial matters, 4) Importance of proximity to the financial institution when dealing with financial matters, 5) Importance of security when dealing with financial matters; 6) Opinion on the possibility of a future of exclusively digital banking, completely dispensing with the presence of physical branches, 7) Opinion on the use of an automated software application developed by the bank to monitor cryptocurrency activity, alerting customers of good buying or selling opportunities, 8) Opinion on the use of a cryptocurrency developed by the bank, if this would ensure a significant improvement in the efficiency, speed and security of transfers, 9) Opinion on trust when marketing products developed on blockchain technology, if the bank had more active and intelligent management of its customers' portfolios, and 10) Opinion on a possible move to the competition if the bank does not offer a mobile application with the intention of improving efficiency, speed and security in transfers, facilitating cross-border transfers and conversion between different currencies.

The exclusion of these variables from the final model suggests that they did not show statistically significant relationships with the dependent variables under analysis. Their omission does not, however, imply that they are not pertinent to a larger conversation about financial behavior and developments in digital banking. The impact of user behavior in mobile banking is one possible consideration with reference to the omitted factors. The exclusion of utilizing a mobile application for bank account-related tasks may suggest that respondents' opinions of financial digitalization are not greatly impacted by their overall usage of these apps. This may indicate that mobile banking is already widely used and is not a significant factor in explaining response variances. Furthermore, it is significant that the level of confidence in online payments and the significance of security in handling financial concerns are not included. Their removal may imply that other variables, such age, income, or the overall image of digital banking, better capture these issues, which are frequently mentioned as major difficulties for digital financial transactions.

Additionally, the lack of statistical significance for the significance of proximity to the financial institution and efficiency in handling financial matters may suggest that these factors are already deemed important by most respondents or that their influence is lessened by other, more readily measurable factors. Similarly, the fact that the perspective on the prospect of a future with just digital banking was left out indicates that respondents' opinions on the demise of physical branches had no bearing on their financial activity or preferences for online banking. Additionally, several characteristics that are not included pertain to cryptocurrencies and blockchain technology, such as the desire to embrace a cryptocurrency issued by the bank, the usage of an automated cryptocurrency monitoring system, and faith in blockchain-based goods. Their absence could suggest that

respondents still find certain subjects too specialized or divisive, which could result in irregular or non-statistically significant trends.

Finally, the lack of statistical significance in the respondents' view on a potential shift to a competitor bank if the bank does not have a mobile application may indicate that respondents are not always motivated to change banks based just on the availability of mobile apps. Retention may be more strongly influenced by other elements including reputation, trust, and customer service. Overall, these factors are still pertinent for qualitative conversations on customer behavior and developments in digital banking, even though they were eliminated for statistical reasons. Future studies might examine if their effects alter depending on a person's financial situation or demographic group.

The research question guiding this study concerns how blockchain technology can be successfully implemented in financial institutions and whether it has the potential to provide quality solutions to customers. Customers place the highest value on security, efficiency, cheap costs, ease of use of digital platforms, and financial institutions' reputation, according to Table 2's descriptive data. These goals are quite similar to the main characteristics of blockchain technology, which include transparent and safe transaction records, lower costs due to disintermediation, and more effective payments and transfers. Therefore, it appears from the data that blockchain-based solutions immediately address the factors that consumers find most important when interacting with financial institutions.

Table 4 presents a regression analysis which contributes to the research topic by identifying the sociodemographic groups that are most likely to adopt blockchain-related innovations. The results indicate that consumers' inclination to use digital financial solutions, like cryptocurrencies and mobile apps supported by banks, is influenced by a few factors, including age, income, and educational qualification. Younger responders and those with higher incomes are especially receptive to innovations, whereas other categories exhibit more conservative viewpoints. These results show that blockchain may provide clients with high-quality solutions, but in order to enhance acceptability and confidence, its implementation plan should take demographic variation into account.

When combined, the descriptive and regression studies show that financial services can successfully incorporate blockchain technology. Financial institutions may create technically sound and socially responsive blockchain-based products by addressing the different levels of openness across demographic groups and aligning with consumers' key interests. This supports the claim that blockchain is a tool that has the potential to significantly enhance customer satisfaction and service quality in addition to being a technological advancement.

## 6. Conclusion

In addition to addressing the financial sector's progress, this research sought to give a broad overview of the main theoretical ideas behind blockchain technology. The study also aimed to determine whether clients of financial institutions would be willing to employ services based on this technology by means of a questionnaire survey. The current study provides a thorough examination of the ways in which sociodemographic factors—such as age, gender, educational attainment, and monthly net income—affect people's understanding and usage of modern financial technology. The study advances knowledge of technology adoption trends across various demographic groups by elaborating on these linkages.

Although previous studies have mostly focused on the technical capabilities of blockchain systems, our results show that consumer perceptions of security, effectiveness, and trust are just as important to the success of blockchain adoption in financial institutions. This study also adds to the existing literature the acceptance of the technology by showing that demographic factors affect the willingness to adopt blockchain-based services and highlights the necessity of incorporating demographic heterogeneity into frameworks like the Unified Theory of Acceptance and Use of Technology (UTAUT) and TAM.

The study confirms the existing literature that link demographic factors to financial behaviors and usages, using linear regressions, and it may be used as a basis for further research, offering a strong framework for examining comparable data in many circumstances. More in-depth research on technological innovation in the financial industry and its obstacles may be possible if important determinants for the adoption and usage of financial technology, such as cryptocurrencies and mobile banking apps, are identified. The results, which show notable variations in financial technology usage and expertise by age and gender, might influence digital education programs and public policy. Knowing which groups need additional assistance and education can help drive the promotion of digital inclusion more successfully.

From a managerial perspective, the results provide insights for financial institutions planning to integrate blockchain into their services. When creating blockchain-based solutions, banks should give top priority to the aspects that clients appreciate most like security, efficiency, and cost reduction. In order to engage certain client segments, especially older users or those with lower levels of digital literacy — who could be more hesitant to embrace disruptive technology — it can also be required to employ specialized communication tactics. The findings highlight how crucial it is for regulators and legislators to ensure that blockchain regulation promotes digital inclusion while also fostering trust, openness, consumer protection and security.

Financial institutions could offer more inclusive products and services by recognizing that different demographic groups use and acceptance of the technology to differing degrees. For example, advertising can be designed to inform and draw in older people if younger people are more likely to adopt new technology. They also can use data on behaviors, preferences on payment methods and personalized customer service to enhance their marketing strategies. By segmenting their audience based on demographic and behavioral data, institutions can increase customer satisfaction and encourage them to adopt new products and services. Determining the factors that affect the adoption of new financial technology might help different populations become more financially empowered. Workshops and targeted training programs may be created to improve financial literacy and boost self-assurance while utilizing digital tools for money management.

This study's information was gathered from online sources, which is one of its limitations. This suggests that some banks might be further along in their blockchain implementation but were overlooked because they did not have access to the information. An additional constraint pertains to the sample that was employed in the questionnaire survey. The results cannot be extended to the entire population since the survey was distributed online, and a convenience sample was used for the study. Furthermore, the results might not be as representative of the variety of views and practices present in other groups because the majority of respondents are Portuguese.

Obtaining a more representative sample of responders that includes more individuals from other nations and locations is one recommendation for future study. A thorough investigation of the application of blockchain technology in corporate banking (commercial banks and investment banking) would also be pertinent, given that the technique employed in this study was centered on comprehending the viewpoints of retail banking clients. The aim would be to understand the perspectives of business owners regarding the adoption of this technology by financial institutions.

Based on the conducted study, it is concluded that, in general, respondents consider online banking services to be secure. Most of the respondents state that home banking is an effective tool for managing financial matters, and it is their preferred method for making payments or transfers. Regarding the most valued factors when dealing with financial matters, security emerged as the most consensual aspect among respondents, being considered the most important feature by all participants, who rated it as extremely important. Blockchain and cryptocurrencies stand out as the terms most familiar to respondents. On the creation of a bank-owned app to track cryptocurrency market activity and alert clients to favorable buying or selling opportunities, there were differing views. Even though over 50% of the participants thought this project was feasible, others expressed little interest in the idea of using it to make bitcoin investing easier. Similar patterns were seen in the purchase

of cryptocurrencies to improve transfer efficiency—while a small minority showed no interest, a sizable portion thought their views may shift over the course of the following decade.

When asked if they would have more faith in blockchain-based financial products if banks took a more proactive and astute approach to portfolio management, the majority of respondents gave a favorable response. Regarding the potential adoption of a bank-developed application to improve the speed of international transfers at no additional cost, the overwhelming majority indicated they would use it. Furthermore, when questioned about the possibility of competitors offering such services, many respondents stated they would consider opening an account with a competing institution or even switching banks entirely if their current bank did not provide these services. Security and the use of an application to speed up transfers are essential and highly regarded characteristics among respondents when handling financial problems, based on the positive answers about the adoption of blockchain technology by financial institutions. These revelations demonstrate this revolutionary technology's enormous potential.

It is encouraged that banks keep a careful eye on these developments and organize creative blockchain implementation projects to speed up KYC procedures, ease transfers, develop smart contracts, and investigate other uses. These advancements are required to keep rival financial institutions from outperforming them and to offer value-added services that preserve client loyalty and confidence. By using blockchain technology, financial institutions can increase their competitiveness and guarantee the ongoing satisfaction and trust of their clients.

This study also shows that blockchain has an excellent opportunity to improve the quality of services in the financial industry, but its success hinges on matching technology to client needs and modifying implementation tactics to suit a range of demographics. These ramifications broaden the scholarly discourse on blockchain adoption as well as the realistic implementation roadmap for financial institutions.

## Acknowledgments

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## Ethical Statement

master dissertation and the current paper. No additional ethical approval was required in accordance with institutional standards since the survey was non-invasive and did not cover any sensitive subjects.