Article

Unraveling Digital Transformation in Banking: Evidence from Romania

Alina Elena Ionașcu [1],*, Gabriela Gheorghiu [2], Elena Cerasela Spătariu [2], Irena Munteanu [1], Adriana Grigorescu [3,4] and Alexandra Dănilă [1]

[1] Department of Finance and Accounting, Faculty of Economic Sciences, Ovidius University of Constanta, 900001 Constanta, Romania; irena.munteanu@365.univ-ovidius.ro (I.M.); alexandra.danila@365.univ-ovidius.ro (A.D.)

[2] Department of Economics, Faculty of Economic Sciences, Ovidius University of Constanta, 900001 Constanta, Romania; gabriela.gheorghiu@365.univ-ovidius.ro (G.G.); elena.spatariu@365.univ-ovidius.ro (E.C.S.)

[3] Department of Public Management, National School for Political and Administrative Studies, 30A Expozitiei Bdl., 012104 Bucharest, Romania; adriana.grigorescu@snspa.ro

[4] Academy of Romanian Scientists, Ilfov Street 3, 050094 Bucharest, Romania

* Correspondence: alina.ionascu@365.univ-ovidius.ro

Abstract: This research probes into the digital transformation shifts in Romania and sets them against a backdrop of certain EU countries. Its primary objective is to spotlight digitalization's significance and assess its level of integration within the Romanian banking landscape. Our approach relies on a detailed examination of the adoption of digital banking instruments in Romania through correlation and ANOVA assessments. The ANOVA analysis of the DESI index and its associated dimensions reveals how Romania's digital transformation stands in relation to other EU member states. Our findings emphasize the numerous advantages Romanian banks have garnered from increasingly embracing digital innovations and artificial technologies. These perks span from optimized operations and efficiency to enhanced customer experiences and a sharpened competitive advantage. The research indicates a strong positive correlation between a bank's return on assets and its liquid assets to deposits and short-term funding ratios. This suggests that as digital integration deepens, there is a marked upturn in financial robustness. Additionally, the study sheds light on the perks of individuals adopting digital banking offerings and delves into factors that propel and impede the digital evolution in the banking arena. Overall, this paper presents valuable insights into Romania's digital banking trajectory and the sector's long-term viability.

Keywords: digitalization; banking industry; Romania; innovation; financial inclusion

1. Introduction

Digitalization in banking means integration and adoption of digital and latest technology to enhance operational capacity and performance, delivering better and faster customer services, and paperless transactions through different banking applications [1].

Previous studies in the banking field have shown that digitalization in the banking industry revolutionizes the operationalization of overall financial institutions [2]. Digital banking helps improve customer relationships and banking processes, providing a better experience for both customers and employees. Therefore, the performance of financial institutions enhanced dramatically all around the world. Romania is also transforming its banking industry to digital banking by adopting emerging technologies and innovations.

Other studies discussing the issue of banking digitalization acknowledge that new technologies will also further improve the quality of services and intensify the growth in the banking sector, as well as the economic growth of the country [3,4]. Banking automation and digitalization will continue due to ongoing innovation in the banking system and

also due to pressure from adjacent industries competing with the banking system in various segments.

Considering the COVID-19 epidemic effects, the traditional banking strategy has also been shaken. The crisis emphasized that it is no longer profitable to use traditional banking and therefore, it is required to rely on digital banking. As the pandemic accelerated the automation and digitalization of various processes in different market segments [2,5], the efforts for digital banking become faster than before, in order to embrace the new normal [6].

Artificial intelligence has also forced the banking sector to move forward with digital banking. The new methods of machine and deep learning enable banking and financial organizations to perform better and enhance their capabilities for devising investment strategies in profitable securities and instruments. Connectivity, automation, Big Data, and innovation are the directions in which digital banking will influence the way value is created in banking [7].

Understanding customer expectations forces banks to adapt their products and services. Interestingly, in Romania, the key component to be addressed in the development of financial services (in the post-Soviet context) is financial anxiety. Unlike in Western countries, in Central, Eastern, and South-Eastern Europe (CESEE), financial education is not always a panacea. In addition, financial security is not always the most important goal for consumers [8]. Therefore, other parties should be involved in the digitalization of the banking sector in Romania, such as the Romanian Government, the European Union, the World Bank, and some other financial institutions that are interested in stimulating the banking industry of Romania to behave digitally. Government stability and public authority initiatives can generate trust in the banking sector and moreover, political events can also have an impact on the financial markets [9]. Without government involvement, no policy can be implemented in any sector, so the suggestions for making policies and strategies by the Romanian Government for the adoption and transformation of a digital environment in the banking sector will be discussed further.

In this scenario, the goal of the current study is to scrutinize and understand the evolution of digitalization within the Romanian banking sector. We will introduce and discuss the new digital avenues of banking that have emerged in Romania, outlining their functional and operational procedures, as well as identifying the facilitators and obstacles encountered in the digitalization journey. Furthermore, given that individuals or customers constitute the central element in the banking sector, this paper intends to examine their attitudes towards digitalization, considering factors such as public accessibility to digital amenities (like the Internet and smartphones), customer familiarity with digital banking mediums, and the usage patterns of digital banking applications.

Proceeding forward, this research paper will inaugurate with an extensive and detailed literature review, which leans heavily on prior research pertaining to digital banking, with a special emphasis on the Romanian digital banking environment. Following the literature review section, we will articulate the hypotheses that guide this study. The methodology will delineate the research design, encompassing elements such as data collection procedures, data preparation, and the methods and techniques implemented for data analysis in this study. The section dedicated to data analysis and results will elucidate the research outcomes derived from the amassed data.

In the ensuing discussion segment, we will map the results in alignment with the insights garnered from the literature review. To conclude, the final segment will encapsulate the comprehensive findings of the study, offering pertinent recommendations to enhance the degree of digitalization in the Romanian banking sector.

2. Literature Review

2.1. Improved Banking Services through Digitalization

Digitalization involves transforming analog data into digital format and strategically integrating digital technologies into diverse areas such as business, societal structures, and everyday life [10].

The word "digitalization" is used by organizations, science, and media as a progress towards an integrated digital infrastructure [11]. The swift progression of technology has revolutionized not just the digital aspects of banking but also reshaped general business approaches and ways of engaging with customers [12]. Nowadays, companies belonging to a handful of different industries understand that making the switch towards a digitalized business model is a major challenge with a substantial impact on the ways they operate, plan, and forecast ahead [13–15]. A study conducted by Duan and Xiong [16] sustains their hypothesis that high-performing organizations are nearly five times more likely to rely on concrete data analytics rather than intuition compared to their lower performing counterparts. This assigns a heavy weight to the overall importance of data and digitalization.

The previous literature on digital transformation has primarily discussed changes in consumer behavior, strategic responses, dynamic capabilities, the value of creation, and the usage of digital technologies [17].

The primary goal of an integrated digital transformation business strategy in the banking sector is to delight customers by taking a customer-focused approach. This objective can be achieved by introducing cutting-edge digital products and services, as well as digitally enhancing current offerings [14]. Secondly, the rapid advancement of digitalization has offered the potential for cost reduction in data production and analysis and has enhanced the potential to not only streamline administrative processes but also enhance transparency and accountability [18].

Yet, the World Bank Organization (2021) recognizes that the advances in digitalization and data analytics offer a unique chance for parent–teacher organizations and individual stakeholders to engage more effectively with educational institutions, thereby elevating their accountability and responsiveness [18]. Thereby, organizations advancing digitalization will enable revenue optimization through cost reduction, but also positively influence the quality of education within applied sectors. This level of digital integration feasibility can also be assessed by banks, their internal organization, or the IT system [19,20].

The advent of digitalization is transforming the habits and preferences of banking customers. Increasingly, clients are accessing digital banking services through apps and machines without constraints of time or location. There is no doubt that technology plays a pivotal role in this context. The introduction of mobile banking not only simplifies how customers engage with financial institutions but also streamlines the banks' operational processes. As a result, digital banking services are being seamlessly managed through mobile technology [21].

Digital banking, including e-banking and mobile banking, enhances the efficiency and effectiveness of bank operations, thanks in part to customer engagement in digital services. Clients can now carry out financial transactions on their own, utilizing smartphones or personal digital devices, wherever and whenever required. A strategy focused on the digitalization of banking services represents one of the most recent and groundbreaking technological advancements in the banking sector [22,23].

Advancements in communication systems have been significant, ranging from telegraphs and written letters to video conferencing and conventional phone calls. Each has been instrumental in the digital transformation of the banking industry. From its inception, the banking sector has leveraged technology for transactions, initially via traditional banking channels across various branches. Customers utilized call centers and automated teller machines (ATMs), which were later supplemented by Internet banking and mobile devices for conducting transactions. These technological innovations have empowered the banking industry to transcend geographical limitations, enhancing channels for capital

distribution and ultimately contributing to greater efficiency and profitability for banks. Developments in social media and innovations of the latest socializing applications take the digital banking economy to the next level [21]. In this way, digital social networks are influencing the banking sector. Social media applications and platforms such as Facebook, Twitter, YouTube, and LinkedIn have strengthened shared communication on the Internet and enabled the banks to develop new business models by taking customer surveys and utilizing other demographical, qualitative, and quantitative data.

Another revolution in banking technology is the financial software and tools supplied by FinTech organizations. As Vives (2019) proves in his analysis, in this evolving landscape, the financial sector cannot help but be affected, with both investors and entrepreneurs anticipating that financial services will leverage innovation to address inefficiencies that have arisen post-crisis [24]. Other researchers argue that this represents a shift from the traditional status quo. In this context, the term "financial technology", more widely known as "FinTech", has come to encapsulate the role of technology in the field [25]. These tools are very innovative, flexible, reliable, and adaptable. In the beginning, FinTech solutions were seen as a threat to the banking sector, but they also made the industry more competitive through an increased competency level and intensification of highly qualified human capital that shaped this new model [21].

The transformation of digital technologies uses innovations such as cloud-based applications and big data. The concept of big data is intriguing and moves the banking businesses to the next level [26]. Furthermore, the advancement in technologies also enables the authorities to make changes regarding the regulations and policies applied in the banking sector. These regulations are also applied to FinTech organizations to secure the clients' data as they are the main players in banking digitalization. The cooperation between banks and FinTech companies helps the latter to create more competitive financial service products with the latest technologies and at a higher quality.

The importance of digitalization and artificial intelligence cannot be overstated in today's world. The manufacturing sector is moving towards the fourth-generation industry, also known as Industry 4.0 or the Fourth Industrial Revolution, which is defined as a new level of organization and control over the entire value chain of a product's life cycle and is focused on meeting increasingly specific customer needs. Talking about big data, technology, cyber security, the Internet of Things (IoT), and other topics is what Industry 4.0 is all about [27,28].

Although there are many opportunities presented by digital transformation in the banking industry, there are also several problems arising. Simple methods for carrying out many financial transactions as part of the banking industry's digital transition include mobile banking and online banking. Customers gain from these services, but they also face substantial challenges due to the threat and potential for cyberattacks. The digital revolution of the banking industry has created several important issues, including cyberattacks, financial fraud, hacking, phishing, and security awareness. Customers' understanding of cybersecurity may often be more ambiguous in several respects. While utilizing the digital platforms of the banks, they must be aware of safe technological practices. Banks' customers are increasingly becoming digital/cyber literate to cope with cyberattacks, phishing, and hacking, a huge obstacle for the banking industry [29].

2.2. Digitalization in the Romanian Banking System

Mobile phone usage has surpassed PC usage for accessing online banking services, facilitated by rapid advancements in mobile telephony and the Internet. These technologies have simplified the use of banking services. However, despite being a key engine of Romania's economy, the banking sector has not reaped substantial benefits from this trend towards digitalization. Therefore, although the use of the Internet is widespread in homes and everybody has access to networks with fast speeds and inexpensive rates, it is mostly used for communication and rarely to access online banking services [30].

In Romania, the banking industry has a commendable level of digitalization (Table 1), demonstrating 60% of banking industry services being completely digitalized, and suggesting noteworthy growth in online banking competencies. On the other hand, the apparel sector indicates moderate digitalization with a proportion of 51%, signifying intense online shopping. The sector of groceries is lagging behind with a proportion of 33% of the industry, indicating a limited adoption of online shopping in this sector. The travel and entertainment sectors are using digitalization, revealing a strong and sound dependence on digital platforms. Table 1 shows the behavior of the Romanian population in 2022, highlighting the way they act when making transactions in different sectors. Some people made only fully digital payments, only physical payments, or only digital with human assistance payments, but some of them made both fully digital and physical transactions or digital with human assistance and fully digital operations. Overall, this data highlights the varying degrees of digitalization across industries in Romania and how these industries are directly or indirectly using digital banking for the provision of digital services to their customers.

Table 1. Digitalization per industry in Romania 2022.

Sector	Fully Digital	Physical	Digital with Human Assistance
Banking	60%	19%	13%
Groceries	33%	58%	90%
Apparel	51%	37%	12%
Entertainment	88%	40%	70%
Travel	69%	12%	19%

Source: Romanian Banks Association [31].

In regard to the financial industry, this has the potential to positively benefit overall financial inclusion. For instance, Transylvania Bank, one of Romania's leading financial and banking organizations by market capitalization, announced in 2022 that its move towards digital transformation has produced favorable outcomes. These benefits extend beyond economic gains to include positive environmental effects and advantages for the wider community. This digital shift has revolutionized how they provide financial services and interact with both current and potential customers [32]. Based on the positive impact, the bank has begun the journey to create Romania's inaugural entirely digital bank, built around "Idea Bank", a component of the group acquired in 2021. Environmental concerns and technological progress are the two biggest trends; therefore, banks in Romania focused on green loans [33].

Another key tool for digitalization is a strong online presence. Banks are leveraging social media platforms and apps to target specific audiences, not just for marketing strategies but also to cultivate customer relationships. The majority of commercial banks are engaging with their customers through various social media channels [34].

The data provided by Statista [35] shows us that 70% of Romanians use contactless bankcards, representing an acceptance of this payment method at a larger level. The second place is occupied by mobile banking apps with 65% of Romanians accessing banking services through their mobile phones or smartphones. Internet banking also has a significant impact on the use of digital banking with 53%, indicating a preference for access to online financial services. While mobile smartwatch payments and Revolut bank cards have adoption rates of 31% and 25%, respectively, these are less used as compared to other digital choices. Digital signatures have 11% usage and consultation with bank staff through messenger applications have comparatively poorer adoption rates, standing at 11% and 8%, respectively. Overall, the analysis reveals a significant level of digitalization in the Romanian Banking Industry (Figure 1) but also highlights the variations in acceptance of different digital financial products and services.
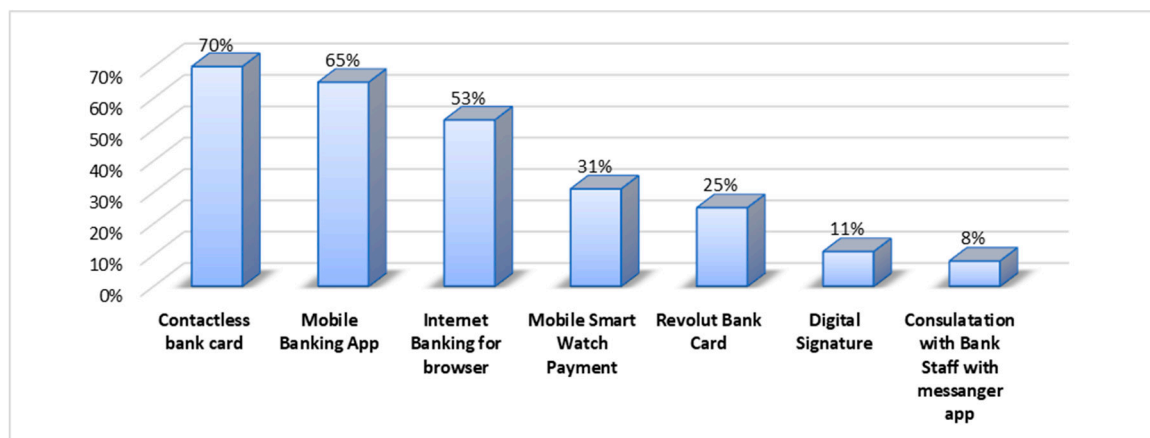
Figure 1. Romanians' use of digital financial products and services (%). Source: adapted by authors based on Statista data [35].

A study made by PPRO [36], a company specializing in digital payments infrastructure to banks and businesses revealed that, comparing the population's usage of digital payment cards and devices (Figure 2), Romania has a somewhat lower banked population of 63% compared to the world average of 67% and Eastern Europe and the CIS region at 72%. This shows that there still can be improvements to ensure the higher Romanian population has access to banking services. Moreover, credit card usage in Romania is particularly lower at 14% compared to the global average of 19% and Eastern Europe and the CIS region at 22%. Therefore, credit card penetration is less dominant in Romania, giving an opportunity for the development of this sector of banking.
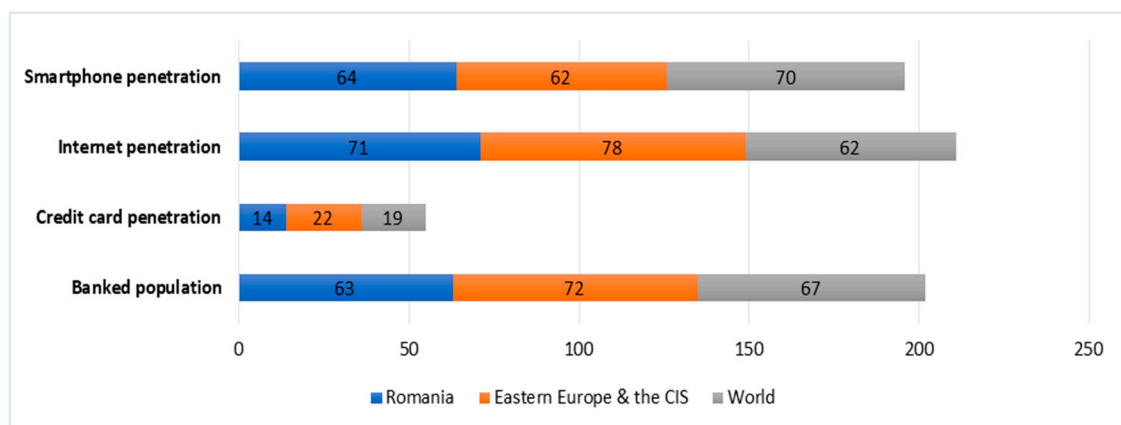

Figure 2. Comparative digital banking cards and smartphone usage in Romania (%). Source: adapted by authors based on PPRO study [36].

The prevalence of card usage in Romania is not significantly influenced by governmental policies, given the substantial number of employees who continue to receive their salaries in cash. Additionally, despite the option for the elderly to receive their pensions via card transactions, a considerable segment opts for cash disbursements through postal services. Therefore, personal preferences and prevailing business customs substantially dictate the dynamics of the payment environment.

On the other hand, Romania faced a larger Internet penetration rate of 71%, surpassing the global average of 62% and right behind Eastern Europe and the CIS region's average of 78%. This proposes that a greater amount of the Romanian population has access to Internet services, creating favorable and promising circumstances for the adoption of digital payment solutions in the Romanian banking industry. Lastly, with a smartphone

and mobile penetration rate of 64%, Romania is just behind the world average and on par with Eastern Europe and the CIS region. This indicates that a noteworthy percentage of the Romanian population keeps smartphones, which serve as an important and necessary tool for accessing digital payment services. Shortly, while Romania lags behind in credit card penetration, the higher smartphone and Internet proportions of the Romanian population indicate the potential for further growth in the digital banking payment ecosystem of the country.

The study made by PPRO [36] on e-commerce payments in Romania using digital means as compared to other methods (Figure 3) reveals the predominant approaches used by customers. Almost 23% of e-commerce transactions are performed by using digital wallets, indicating a substantial adoption of these useful and protected online payment platforms. Card-based payments represent 26% of total e-commerce transactions, indicating a liking for debit or credit card utilization in online shopping. Bank transfers account for 19% of payments, suggesting a significant portion of the Romanian population opting for direct fund transfers from their bank accounts using the Internet.
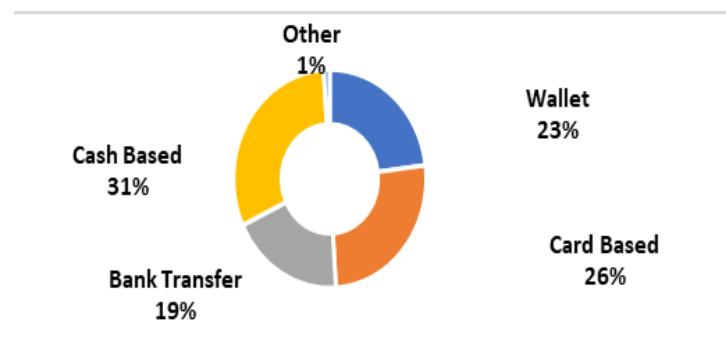

Figure 3. Payment methods in e-commerce (%). Source: adapted by authors based on PPRO study [36].

Even though Romania currently lags behind the EU average in the Innovation Index, its growing economy and support for entrepreneurship suggest that it has the capacity to be a significant player in the digital economy. Small- and medium-sized enterprises (SMEs) in Romania should weigh both the benefits and challenges posed by the country's business environment when strategizing for digital advancement and innovation [37]. In terms of innovation scores, Romania averaged 27.27 points from 2011–2022, with a low of 34.1 points in 2022 (ranking 49th among 132 countries in the GII Global Innovation Index 0–100 points) and a high of 40.3 points in 2013 (ranking 48th out of 142 countries). By contrast, Poland's average score for the same period was 40.16, ranging from 37.5 (ranking 38th out of 132 countries) in 2022 to 42 in 2017 (ranking 38th out of 127 countries). Hungary averaged 44.08 points, with a 2022 low of 39.8 (ranking 34th out of 132 countries) and a 2011 high of 48.1 (ranking 25th out of 125 countries), according to WIPO (World Intellectual Property Organization) [38]. On the other hand, the countries that achieved the highest innovation scores in 2022 were, in descending order, Switzerland, the US, Sweden, the UK, and the Netherlands, with scores ranging from 64.6 for Switzerland to 58.0 for the Netherlands.

Similarly, Table 1 directly highlights the capability of the banking sector to improve its innovation index in the future as part of one of the measuring criteria. Advancements in digital transformation have the potential to elevate Romania's banking sector to new heights in the years to come. Banks are increasingly adopting innovative products, services, and business models through digital means. Although achieving sustainable digital transformation is a lengthy process, banks are gradually implementing this approach to formulate enduring strategies. Digitalization and automation are also reshaping the banking infrastructure and the network of regional branches, further enabling Romania to integrate

more technological innovations [39]. For instance, ING Bank has fully digitalized bank branches, without any employees.

In the future, the multitude of bank branches will be reduced, and modernization, innovation, and digitalization will be the solutions to easily make the transition from traditional banking to digital banking [40].

The volume of electronically processed payment operations is slowly increasing every year in Romania (Table 2). In 2017, there were 91.45 million operations, which grew to 173.6 million in 2022. The values of transactions in Euro and Lei also show improvement, with growing amounts being credited to the accounts of both legal entities and individuals. It is a sign of larger adoption and reliance on electronic payments through digital modes of payments in Romania's financial landscape. The data were collected from Transfond, the owner and operator of the Automated Clearing House for interbank commercial payments [41].

Table 2. Volume of electronically processed payments in Romania (no. of transactions).

Year	SENT Multiple Payment Component Lei	Change (%, Year by Year)	SENT Instant Payment Component Lei	Change (%, Year by Year)	SENT Multiple Payment Component Euro	Change (%, Year by Year)
2017	91,450,060	n/a	n/a	n/a	518,224	n/a
2018	105,886,325	15.78	n/a	n/a	614,138	18.50
2019	119,412,086	12.77	58,515	n/a	767,413	24.95
2020	135,272,184	13.28	720,010	1130.47	911,143	15.77
2021	161,890,262	19.67	3,007,264	317.66	1,133,378	19.60
2022	173,600,173	7.23	13,502,114	348.98	1,245,420	8.99

Source: Transfond [41].

During the COVID-19 pandemic, the Romanian banking sector appeared solid in terms of financial soundness, compared to the average of the European Union banking sector, but the delay in digital user adoption in Romania has had a slightly negative impact on the Romanian banking industry. Although banks realized that digitalization is no longer optional to growth, there has been a significant lag between consumer adoption levels [39]. The lingering question is, how can we boost the adoption of digital technology at the national level?

Monitoring customer trust in Romania's banking sector is crucial, given the traditional financing models and the continued low levels of financial intermediation. Building trust requires offering customized, comprehensive banking services while also meeting the demand for various banking products and services. Additionally, trust can be fostered through greater financial and social inclusion, in line with the requirements of the European Cohesion Policy [42].

In Romania, the banking infrastructure has undergone significant changes as the sector has transitioned to digital integration. When it comes to prudential regulation, the Romanian banking system ranks highly in European comparisons. The establishment of robust and cautious management systems enhances the sector's ability to manage risks effectively [39].

2.3. Financial Inclusion and DESI

The concept of financial inclusion is the idea that people and businesses have access to secured financial products and services that are customer-oriented and provided in a rational and sustainable way [39]. But financial inclusion is a much broader topic, which includes not only access to these services, but also issues related to financial education, quality of life, economic welfare, and macroeconomic development of the economy.

The need to reevaluate educational frameworks to align with the digital age is increasingly important, making human capital investments more essential than ever [43]. Often,

Romania's educational system places more emphasis on equipping students for current and past job markets, rather than preparing them for future career opportunities [37].

Financial inclusion is also promoted by the most important institutions such as the World Bank and International Monetary Fund as a strategy for development cooperation [44–46] and it is believed that digital innovations promote higher financial inclusion levels [15,47]. Additionally, it has encouraged all financial institutions to collaborate and communicate through digital platforms, redefining the added value [48,49]. Thus, the economic development of the country can also be evaluated through the assessment of the digital services offered by banks, companies, or state institutions [47]. Other authors believe that digital financial inclusion will lead to the development of the informal economy and will also reduce poverty rates [50].

To increase the level of digitalization or to avoid crises of any kind, government involvement through its authorities in an emerging market, such as Romania, should be mandatory [51]. A survey's findings showed a noticeable rise in the use of digital services throughout the pandemic, with most respondents agreeing that they had a better performance using digital than traditional banking services. Additionally, since the complexity of customer purchasing decisions has increased, price is no longer the sole determining factor [52]. This is another strong argument for placing the customer at the center of the development process [53].

As much for policymakers as well as for commercial bank executives, assessing and responding to the risks of a digitalized financial services environment is a challenge [54]. As a result of digital disruption, businesses are undergoing profound changes worldwide, creating new opportunities and putting behind long-lasting business models [55].

A recent study carried out by the Romanian Banks Association with the support of the Romanian Banking Institute, regarding the degree of financial inclusion, shows that the reasons why Romanians do not yet want to open a bank account are: "the desire not to track income/expenses, the lack of usefulness of an account, reduced income and the collection of income in cash" [31]. In this situation, there is a necessity to formulate a national legal framework to induce and stimulate bank account opening, and the use of digital services by discouraging cash payments. It is very important to promote the digitalization of the banking process by delivering online services for opening bank accounts through video call identification, as recently completed by some of the Romanian banks. Moreover, as per another study carried out by McKinsey & Co. (Bucharest, Romania), the Romanian banking industry has emerged as a leader in the digital services offered but is "still lagging behind due to the gap between ICT and Digital Challengers Countries", but the study's predictions state that the digital economy will triple its value until 2030, as the digital usage will continue to grow [56]. Nevertheless, banks should consider the importance of digital activities that must be adopted to improve processes and performance and face the competitive market [57,58].

DESI is a composite index that measures and tracks the digital transformation trends, using the following dimensions: connectivity, human capital, digital technology integration, Internet usage, and digital public services. DESI Index allows us to make a general performance assessment monitor its progress over time and consider which areas can be improved in the future [59].

The index evaluates the digital infrastructure of a region, including the availability of fast and ultrafast broadband Internet. A well-established digital infrastructure is a prerequisite for digital transformation in banks as it enables seamless online banking experiences. DESI measures the digital skills of the population. A population with higher digital literacy is more likely to adapt to and benefit from the digital transformations in the banking sector, such as using mobile banking apps or online banking services efficiently.

The DESI index assesses how well businesses are integrating digital technology into their operations. For banks, this can mean the implementation of digital solutions, such as AI for customer service, data analytics for personalized services, or blockchain for secure and transparent transactions.

The DESI also considers the digitization of public services. When banks digitally transform, they often collaborate with or complement digital public services, creating a more interconnected and efficient digital ecosystem.

As banks digitally transform, they facilitate and support an increase in e-commerce and other online activities, which are components measured by the DESI. For instance, through the provision of secure online payment systems.

DESI includes an evaluation of R&D in the digital sector. Banks involved in digital transformation often invest in R&D to develop new technologies and solutions, which can contribute to a higher DESI score for a region.

A study conducted by Skare et al. [60] using the DESI to investigate the link between digital transformation and SMEs' access to finance agrees that business risks appear when EU SMEs have limited access to finance. Access to finance for low-income individuals and SMEs is strongly related to digital transformation in the FinTech sector; therefore, promoting financial inclusion is mandatory [61]. Therefore, digital finance is increasing the financial inclusion of SMEs [62].

Another study using DESI to assess digitalization in the financial sector states that digital transformation exerts a positive and statistically meaningful influence on the growth and evolution of financial markets and establishments. Emphasizing the various facets of digitalization, the study underlines the significant impact of human capital proficient in digital skills, as well as the realms of e-business, e-commerce, and e-government in amplifying the complexity and effectiveness of financial processes. The analysis delineates the immediate and prolonged repercussions of digitalization, illustrating that both e-commerce and e-government harbor a sustained positive effect on financial markets and institutions, respectively, over a long duration [63].

2.4. Research Motivations

The primary incentives for conducting this research include achieving cost-efficiency that benefits both banks and customers and streamlining transaction processing and customer inquiries through automation, which not only potentially diminishes the necessity for extensive human resources but can also minimize expenses for customers.

The COVID-19 pandemic hastened the uptake of digital banking alternatives, as conducting banking activities in person turned challenging or risky. Banks had to quickly adapt to remote operations, online customer engagements, and contactless transactions to safeguard the uninterrupted flow of business operations.

Digital banking has the potential to facilitate financial inclusion for the unbanked or under-banked segments of the Romanian population. By leveraging online services and mobile banking solutions, banks can expand their reach to underserved or remote areas, fostering greater accessibility to financial services. The transition to digital banking is essential in a competitive landscape to draw in new clientele. Banks are swayed by worldwide financial and technological trends. Staying abreast of these developments is vital for maintaining a competitive edge internationally.

Studying the correlation between Z-scores and other financial metrics in the banking sector is vital for financial stability and liquidity management [64], investment strategy and policy formulation, performance evaluation, strategic planning, and innovation; hence, banks can innovate and adapt their business strategies to enhance their performance metrics, thereby potentially improving their Z-scores. Analyzing the correlation between the Globalization Index and various financial variables is pivotal in comprehending the broader impact of globalization on the banking sector, helping various stakeholders, including banks, investors, and policymakers, in making informed decisions and strategies.

By looking at a country's DESI score, one can obtain an indication of how ripe the environment is for digital transformation in the banking sector, and how well such transformations might be received by the population and integrated into the broader digital economy. DESI evaluates the availability of fast broadband Internet, measures the digital skills of the population, assesses how businesses are integrating digital technology into

their operations, considers the digitalization of public services which are often linked to digital banking transformation, and evaluates R&D in the digital sector, which is a must for banks. An ANOVA analysis of DESI would offer multifaceted insights into the digital transformation landscape of the Romanian banking sector within a broader European context, aiding in informed decision-making, strategy formulation, and fostering innovation and growth.

2.5. Research Gap

In light of the existing body of literature, numerous studies have been conducted on the digital transformation of the banking sector. However, there seems to be a gap in research when understanding the risk, performance, and stability of the Romanian banking system. Few studies were conducted on this topic, so we identified it as missing information. Our analysis uses more indicators to gain a better understanding and access complementary information. Furthermore, the utilization of variance analyses using the DESI aims to examine the disparities across various European nations, emphasizing Romania, to illustrate the impact of digitalization more distinctly on bank performance. This understanding is vital in facilitating informed decisions and fostering a robust financial landscape. DESI was not primarily designed to evaluate the digitalization of the banking sector, but it can certainly be leveraged in research to offer valuable insights into the broader digital economy and society, thus indirectly aiding in assessing the digital readiness and performance of the banking sector.

Consequently, this study aims to address a perceived gap in the existing literature. It conducts an analysis not merely based on banking performance metrics, but also by contrasting the DESI of various European countries with that of Romania.

The ongoing research has established the following research questions:

1. Which variables are correlated with the stability of the banking sector? It is projected that with the escalation in digitalization, there will be a corresponding increase in the efficacy, efficiency, and performance of banking operations. Some studies revealed that digitalization is linked to the amount of net commission income in the case of large banks [2], and also, as online and mobile banking transactions grow, they have an impact on net profit [7], and the use of digital services increases the perceived usefulness and trust in the banking sector [23]. When considering the influence of digitalization on performance, it is important to observe that the heightened utilization of Internet banking and the increased security of bank servers have had a positive impact on the performance of banks, measured by ROA and ROE [5,57].

2. Is there a discernible relationship between economic growth and levels of digitalization? It is hypothesized that regions or nations with advanced levels of digitalization will witness improved economic outcomes, including heightened GDP growth and augmented production. Understanding the dynamics of global economic growth with respect to the digitization of the financial sector is crucial [3]. Enhancing financial accessibility has a positive impact on economic growth, while simply having greater access to banking services does not necessarily spur economic growth [40]. Digitalization in the banking sector is correlated with a positive increase in GDP per capita, indicating that digital financial inclusion has the potential to expedite economic growth [46]. The digital economy has played a significant role in fostering economic growth in Central and Eastern Europe [56,57].

3. Material and Methods

This chapter outlines the techniques used to collect, prepare, and analyze the data in this research. Figure 4 also outlines the whole process using a line diagram.
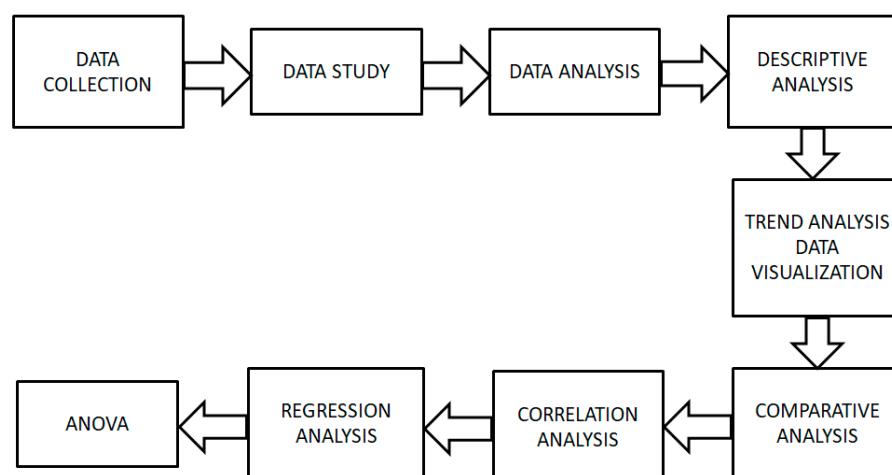
Figure 4. Research methodology scheme.

- Data Collection. The data were collected from various online resources that are publicly available and from some paid databases to ensure comprehensive reporting of digital and banking indicators. Online databases, the Global Economy website, the National Bank of Romania, Transfond annual reports, Mc Kinsey reports, and the World Bank were used as secondary data sources in order to meet our research objective, as they are reliable and up-to-date.
- Data Study. After the collection of data, a careful review was made to ensure its accuracy and relevance to the research. Any outlier in the data or missing data has been rectified to maintain its integrity. The data were organized in such a way that it can be used for further analysis.
- Data Analysis. Microsoft Excel was employed for data analysis as the primary tool, together with the following analysis method.
- Descriptive Analysis. An analysis of descriptive statistics was performed to describe and summarize major characteristics and insights of the collected data.
- Trend Analysis Data Visualization. To see the historical patterns and trends in the data and changes over time, a trend analysis was conducted using MS Excel 16.0. Different visualization techniques such as line graphs and bar and pie charts were employed to present the trends efficiently, enabling the identification of possible future developments and directions.
- Comparative Analysis. To compare different variables of country groups, comparative analysis was performed within the dataset. This analysis involved identifying similarities, differences, and patterns between different digital and banking indicators with the help of MS Excel.
- Correlation Analysis. To observe the associations between various digital and banking indicators, correlation analysis was conducted. To assess the strength and trend of the associations, correlation coefficients were calculated. Interdependencies among the variables have been also reflected through these analyses to monitor patterns. The study was conducted for 21 years of data points, from 2000–2020.
- Regression Analysis. It is employed to investigate the influence of various variables on the financial stability of the banking sector in Romania. The variables used in the analysis were consistent with those in the correlation analysis and covered the same time period.
- ANOVA. One-way analysis of variance (ANOVA) test has been performed to analyze differences in digital indicators for 7 European countries: Bulgaria, Croatia, Hungary, Poland, Romania, Slovak Republic, and Slovenia, for the period 2017–2022. Data were collected from the European Commission, using the 4 dimensions of the DESI Index.

3.1. Significances of ANOVA

ANOVA, or analysis of variance, is a statistical analysis technique that is used to investigate the differences among group means in a sample. It assesses whether there are statistically significant differences between the means of three or more independent (unrelated) groups.

Conducting an ANOVA allows us to assess how Romania stands in terms of digital transformation compared to other European countries, which can offer key insights into the areas where Romania is excelling or lagging. The results could have implications for policymaking, potentially guiding efforts to foster a more favorable environment for digital transformation in the Romanian banking sector, based on best practices or lessons learned from other countries.

ANOVA can help identify if there are statistically significant differences across different countries, which can provide a broader understanding of the digitalization progress in the European region.

For the Romanian banking sector, understanding how they fare in the DESI can guide resource allocation, helping to focus efforts on areas where improvement is requested.

The analysis can act as a stimulus for innovation by highlighting the areas where there is significant variation between countries, potentially identifying untapped opportunities for digital transformation.

Understanding the DESI through ANOVA analysis can also provide insights into customer preferences and behaviors, which can be used to enhance customer services and offerings in the banking sector.

Comparing DESI of different countries, as our study aims to, can provide insights into how Romania is performing relative to other countries, which could be useful for global benchmarking.

3.2. Significances of Correlational Analysis

Correlation analysis is a statistical technique used to measure the strength and direction of the linear relationship between two or more variables. It provides valuable insights into the associations between variables and has several significant benefits. Correlational analysis is a versatile tool that can provide valuable insights into various aspects of the banking sector's digital transformation, helping to guide decisions and strategies at multiple levels. It helps in identifying whether there are significant relationships between different variables, such as the impact of digitalization on banking performance metrics. Once correlations are established, it becomes possible to use the values of one variable to predict values of another, aiding in strategic planning and decision-making. In banking, understanding correlations can be critical in risk management. For instance, identifying variables that are correlated with higher risks (such as Z-score that measures the likelihood of bankruptcy) can enable banks to take preventive measures. Banks can use correlational analysis to make informed decisions about where to allocate resources for maximum impact, potentially improving profitability and customer satisfaction. From an academic perspective, correlational analysis can contribute to the existing body of knowledge, inspiring further research in the area.

3.3. Significances of Regression Analysis

Regression analysis is used to understand how multiple independent variables are related to a dependent variable. It enables the creation of predictive models, analyzing the impact of multiple variables simultaneously, creating forecasts. For example, it can help banks to optimize strategies or governments to design effective policies. Hence, multiple regressions can inform decisions and can be highly useful in assessing the financial stability and health of the banking sector. Regression analysis provides insights into which specific banking metrics have a significant impact on the Z-score. Banks can use this analysis to assess their own financial health and make adjustments as necessary. Policymakers, such as central banks, can be better informed about the factors that influence the stability of the

banking sector. Performing regression analysis on various banking variables in relation to the Z-score is a valuable tool for understanding and enhancing financial stability of the banking system, whether from regulatory, policy, or internal bank management perspective.

4. Data Analysis and Results

The availability of data, which were published by the World Bank through The Global Findex Database [65] narrows the view of the studied period. The Global Findex Database has been available since 2011, with this being collected only every 3 years, confining the data points to 2011, 2014, 2017, and 2021. For further advances in the study, we are looking forward to new available data sets, as the World Bank is one of the most comprehensive and regulated sources of supply side information.

When examining the use of various banking services in Romania compared to other regional countries (Table 3), 2021 data indicates that 69% of Romanians possessed a bank account. This figure is lower than in neighboring countries, with Slovenia leading at a staggering 99%.

Table 3. Bankarization level between 2011–2021.

Bank Account Ownership (%)							
Year	Bulgaria	Croatia	Hungary	Poland	Romania	Slovak Republic	Slovenia
2011	53%	88%	73%	70%	45%	80%	97%
2014	63%	86%	72%	78%	61%	77%	97%
2017	72%	86%	75%	87%	58%	84%	98%
2021	84%	92%	88%	96%	69%	96%	99%
Debit or Credit Card Ownership (%)							
Year	Bulgaria	Croatia	Hungary	Poland	Romania	Slovak Republic	Slovenia
2011	47%	81%	63%	43%	32%	71%	93%
2014	57%	76%	61%	52%	47%	71%	93%
2017	70%	74%	70%	80%	50%	77%	94%
2021	72%	73%	79%	84%	55%	90%	97%
Debit or Credit Card Usage (%)							
Year	Bulgaria	Croatia	Hungary	Poland	Romania	Slovak Republic	Slovenia
2014	36%	59%	48%	42%	27%	64%	71%
2017	37%	60%	55%	74%	26%	68%	82%
2021	50%	60%	73%	81%	42%	83%	90%

Source: World Bank [65].

In terms of debit or credit card ownership in the same year, Romania lagged behind with only 55% of its population having one. This is in contrast to Bulgaria's 72% and Croatia's 73%. Once again, Slovenia topped the chart with 97%.

Furthermore, when considering the actual usage of debit or credit cards for transactions, only 42% of Romanians used these services in 2021. This stands in contrast with Bulgaria at 50%, Croatia at 60%, Poland at 81%, and Slovenia again dominating the leaderboard at 90%.

Despite advancements in Romania's banking sector in areas like bank account accessibility and debit/credit card ownership and usage, the country still ranks at the bottom within the EU.

When examining digital banking (Table 4), one factor to consider is the utilization of mobile phones or the Internet to review account balances [54]. In 2021, 40% of Romanians employed this method, which was lower than several regional countries: Bulgaria with 46%, Croatia with 56%, and Hungary with 71%. Slovenia, once again, led the region, with 67% of its population using smartphones to check their bank account balances, as reported by The Findex Database from the World Bank.

Table 4. Digital banking level.

Made or Received a Digital Payment (% Ages 15+)							
Year	Bulgaria	Croatia	Hungary	Poland	Romania	Slovak Republic	Slovenia
2014	52%	76%	67%	65%	43%	75%	88%
2017	65%	83%	71%	82%	47%	82%	96%
2021	75%	87%	86%	93%	64%	95%	97%
Made or Received a Digital Payment, Primary Education or Less (% Ages 15+)							
Year	Bulgaria	Croatia	Hungary	Poland	Romania	Slovak Republic	Slovenia
2014	19%	49%	39%	32%	17%	23%	70%
2017	34%	59%	50%	46%	21%	44%	89%
2021	61%	71%	66%	62%	33%	68%	88%
Made or Received a Digital Payment, Secondary Education or More (% Ages 15+)							
Year	Bulgaria	Croatia	Hungary	Poland	Romania	Slovak Republic	Slovenia
2014	67%	86%	79%	72%	55%	87%	93%
2017	77%	93%	80%	88%	59%	90%	98%
2021	81%	94%	92%	94%	70%	96%	99%
Made or Received a Digital Payment, Income, Poorest 40% (% Ages 15+)							
Year	Bulgaria	Croatia	Hungary	Poland	Romania	Slovak Republic	Slovenia
2014	37%	68%	61%	56%	30%	67%	82%
2017	77%	93%	80%	88%	59%	90%	98%
2021	62%	77%	78%	89%	50%	88%	93%
Made or Received a Digital Payment, Income, Richest 60% (% Ages 15+)							
Year	Bulgaria	Croatia	Hungary	Poland	Romania	Slovak Republic	Slovenia
2014	62%	81%	71%	71%	52%	81%	92%
2017	78%	87%	77%	84%	59%	87%	97%
2021	84%	94%	92%	96%	72%	99%	100%

Source: World Bank [65].

When examining the adoption of various digital banking services, Romania registered a digital payment usage of 64% in 2021. This was lower than several neighboring countries, including Bulgaria at 75%, Croatia at 87%, the Slovak Republic at 95%, and Slovenia at a notable 97%. Analyzing the data in the context of educational levels reveals that in 2021, Romanians with primary education or less utilized digital banking tools at a rate of 33%, whereas those with secondary education or higher had a usage rate of 70%. This trend is consistent with the patterns observed in the other countries selected for this study. Additionally, a deeper dive into the data on digital payment usage based on income levels suggests that individuals with higher incomes tend to adopt digital payments more frequently.

Another aspect of digital banking explored in this study is the use of mobile phones or the Internet for utility bill payments [55]. The 2021 data indicates that 34% of Romanians used these platforms for such payments. This was marginally higher than Bulgaria's 31%, yet lower than Croatia's 43%, Hungary's 54%, Poland's 70%, and the Slovak Republic's 72%.

The findings highlight that Romania's progress in banking digitalization, as gauged by the uptake of debit/credit cards, bank account ownership, and the use of digital platforms for account transactions, generally trails that of neighboring nations. Yet, it is significant to mention that Romania has shown consistent growth over time, with a notable increase in the adoption of these digital banking services.

We used several variables for our analysis listed in Table 5. The correlation analysis in Table 6 shows the association between digitalization and several aspects of the banking sector in Romania over the years. The results revealed a strong positive correlation between banking system Z-scores and other variables such as bank return on equity, bank return on

assets, bank liquid assets to deposits, and short-term funding, suggesting that as digitalization improved in the country, it can be noticed an enhancement in the financial condition and stability of the banking industry over a period of time. Furthermore, the positive correlation between banking system capital and the Z-score shows that as digitalization progresses, there is an upsurge in the capitalization of banks. However, the negative relationship between bank non-interest income to total income and banking Z-score advocates that as digitalization improves, there may be a decrease in non-interest income due to self-digital services and non-cash transactions. These outcomes highlight the progressive correlation between digitalization and key financial indicators of the banking sector in Romania, contributing to its overall efficiency and stability.

Table 5. Variables used for the analysis.

Variable	Definition	Source
Variables Used in Correlation and Regression Analyses		
Banking system Z-scores	Z-score of Romania banking sector	The Global Economy
Bank return on assets, in percent	Romanian banks' return in percentages	The Global Economy
Bank return on equity, in percent	Romanian banks' return on equity	The Global Economy
Bank non-interest income to total income, in percent	Bank incomes other than interest income in percentages	The Global Economy
Internet users, percent of population	Romanian users of Internet in percent of total population	The Global Economy
Mobile phone subscribers, per 100 people	Romanian number of mobile phone subscribers	The Global Economy
Economic growth: the rate of change in real GDP	Romania's economic growth rate in real GDP	The Global Economy
Banking system capital, percent of assets	Romanian banks' capital percent of total assets	The Global Economy
Bank liquid assets to deposits and short-term funding	Romanian banks' liquid assets	The Global Economy
Variables Used in ANOVA testing		
Human capital	2017–2022 Digital Economy and Society Index of Human Capital	European Commission
Connectivity	2017–2022 Digital Economy and Society Index of Connectivity	European Commission
Integration of digital technology	2017–2022 Digital Economy and Society Index of Integration of Digital Technology	European Commission
Digital public services	2017–2022 Digital Economy and Society Index Digital Public Services	European Commission

Source: authors synthesis.

Table 6. Correlation among banking Z-score and different returns with progress in digitalization over the years.

Indicators	Correlation Coefficients
Bank return on assets, in percent	0.8
Bank return on equity, in percent	0.5
Bank liquid assets to deposits and short-term funding	0.8
Banking system capital, percent of assets	0.4
Bank non-interest income to total income, in percent	−0.6

Source: research results.

The Globalization Index measures the extent to which a country is integrated into the global economy. It typically takes into account various variables that reflect a country's level of economic, social, and political globalization.

Globalization often leads to expanded markets and opportunities, potentially increasing the profitability (and thus ROE) of banks that can successfully navigate the international market [66]. Similar to ROE, globalization can potentially enhance ROA through increased business opportunities and efficiencies. However, the diversification of assets across borders can also bring new risks, potentially affecting ROA [67].

In a globalized environment, banks have more opportunities for diversification, potentially affecting their liquidity positions [64,68]. Globalization encourages increased capital flows, potentially affecting the capital structures of banks [69].

Globalization often spurs technological advancements and facilitates the integration of technology into daily life. In a globalized society, there is usually a higher penetration of Internet usage as countries aim to stay connected and competitive. Countries with a high Globalization Index often have better-developed infrastructures, including widespread Internet connectivity. This can mean that a larger proportion of the population has access to the Internet, either through public initiatives or private enterprise [70].

The correlation analysis in Table 7 between the Globalization Index and various banking indicators in the context of digitalization in Romania's banking sector revealed a negative correlation between the Globalization Index and banking system Z-scores, saying that as globalization in the world grows, it poorly relates to the stability and soundness of the banking system. On the other side, positive relationships are observed among the Globalization Index and return on equity as well as bank return on assets, indicating that a higher degree of globalization may be connected with better productivity for banks in Romania. The weakly positive correlation between bank non-interest income to total income indicates a moderate relation due to digitalization and globalization.

Table 7. Correlation of Romania's Globalization Index and different banking variables.

Indicators	Correlation Coefficients
Banking system Z-scores	−0.18
Bank return on assets, in percent	−0.22
Bank return on equity, in percent	−0.17
Bank non-interest income to total income, in percent	0.19
Internet users, percent of population	−0.11
Mobile phone subscribers, per 100 people	0.15
Economic growth: the rate of change in real GDP	−0.09
Banking system capital, percent of assets	0.66
Bank liquid assets to deposits and short-term funding	−0.29

Source: research results.

Interestingly, the Globalization Index demonstrates slightly negative relationships with Internet users and mobile phone subscribers, representing that the progress in these digital facilities within Romania's banking sector might be insignificantly related to the growing globalization.

Moreover, a weak negative correlation between the Globalization Index and the rate of change in real GDP suggests a slight and moderate relationship with overall economic growth in the banking sector. The indicated correlation coefficients imply that globalization may be related to different facets of digitalization within Romania's banking sector. When devising policies and strategies, it is vital to take these connections into account to maximize the potential advantages of globalization, while ensuring that digitalization in the banking industry aligns with Romania's economic and financial objectives.

The regression analysis was conducted using data from the Romanian banking sector, with banking system Z-scores as the dependent variable and several independent variables, including the Globalization Index, bank return on assets, bank return on equity, bank non-interest income to total income, Internet Users, mobile phone subscribers, economic growth, banking system capital, and bank liquid assets to deposits and short-term funding.

First, the regression statistics reveal several important insights. The multiple R of approximately 0.9867 indicates a very strong positive correlation between the dependent variable (banking system Z-scores) and the combination of independent variables. This suggests that these independent variables collectively have a significant impact on the health and stability of the Romanian banking system.

The R-squared (R^2) value of 0.9735 is particularly noteworthy. It implies that approximately 97.35% of the variation in banking system Z-scores can be explained by the

independent variables included in the model. This high R-squared value signifies that the model is exceptionally effective at capturing the factors influencing the stability and performance of the Romanian banking sector.

The adjusted R-square, though slightly lower at 0.9536, remains strong and accounts for potential model complexity. This adjusted value indicates that even when considering the number of independent variables, the model still provides a robust explanation of the variance in banking system Z-scores.

The standard error of about 0.6066 represents the average deviation of data points from the regression line. A lower standard error suggests that the model fits the data well, indicating that the selected independent variables provide a good fit for predicting banking system Z-scores in the Romanian banking sector.

The ANOVA results demonstrate that the regression model is highly significant. The F-statistic of 48.9516 with a very low *p*-value (4.3395×10^{-8}) suggests that the model as a whole is statistically significant. This means that at least one of the independent variables included in the analysis significantly influences the banking system Z-scores within the Romanian banking sector.

In summary, the regression analysis (Table 8) indicates that the selected independent variables play a crucial role in explaining the variation in banking system Z-scores in the Romanian banking sector. The model is highly effective, with a very high R-squared value, suggesting that it can be a valuable tool for understanding and predicting the health and stability of Romania's banking system.

Table 8. Regression statistics.

Regression Statistics				
Multiple R				0.986653
R-Square				0.973484
Adjusted R-Square				0.953598
Standard Error				0.60655
Observations				22
ANOVA				
	Df	SS	MS	F	Significance F
Regression	9	162.0851	18.00945	48.95163	4.34×10^{-8}
Residual	12	4.414836	0.367903		
Total	21	166.4999			

Source: research results.

Table 9 contains the coefficients and related statistics for each independent variable in the regression model. The interpretation of these coefficients is the following:

Intercept: The intercept represents the value of the banking system Z-scores when all independent variables are zero. In this case, it is 13.70. A statistically significant intercept suggests that even in the absence of the considered factors, there is still a significant base value for banking system Z-scores.

Globalization Index (0–100): The coefficient for the Globalization Index is 0.01. However, its *p*-value is 0.82, which is quite high. This suggests that the Globalization Index is not statistically significant in explaining the variation in banking system Z-scores in the Romanian banking sector. The 95% confidence interval (−0.05 to 0.06) also includes zero, reinforcing its lack of significance.

Bank return on assets: The coefficient is 3.75, and the low *p*-value of 0.00 indicates strong statistical significance. This suggests that bank return on assets is a significant factor in explaining variations in banking system Z-scores. An increase in bank return on assets is associated with an increase in banking system Z-scores.

Table 9. Regression coefficients.

	Coefficients	Standard Error	t Stat	*p*-value	Lower 95%	Upper 95%
Intercept	13.70	3.49	3.93	0.00	6.10	21.30
Globalization Index (0–100)	0.01	0.02	0.24	0.82	−0.05	0.06
Bank return on assets, in percent	3.75	1.07	3.50	0.00	1.41	6.08
Bank return on equity, in percent	−0.29	0.12	−2.41	0.03	−0.56	−0.03
Bank non-interest income to total income, in percent	−0.03	0.06	−0.54	0.60	−0.17	0.10
Internet users, percent of population	0.02	0.01	1.62	0.13	−0.01	0.06
Mobile phone subscribers, per 100 people	−0.04	0.02	−1.67	0.12	−0.08	0.01
Economic growth: the rate of change in real GDP	−0.07	0.04	−1.73	0.11	−0.17	0.02
Banking system capital, percent of assets	0.02	0.17	0.13	0.90	−0.34	0.38
Bank liquid assets to deposits and short-term funding	−0.03	0.02	−1.46	0.17	−0.08	0.02

Source: research results.

Bank return on equity: The coefficient is −0.29, and the *p*-value is 0.03, indicating statistical significance. A negative coefficient implies that a decrease in bank return on equity is associated with higher banking system Z-scores. This might indicate that a lower return on equity is related to higher stability or regulatory compliance.

Bank non-interest income to total income: The coefficient is −0.03, with a *p*-value of 0.60. This variable does not appear to be statistically significant in explaining the variation in banking system Z-scores.

Internet users: The coefficient is 0.02, but the *p*-value is 0.13, which is relatively high. This suggests that the number of Internet users as a percentage of the population may not be a statistically significant factor in explaining the banking system Z-scores in Romania.

Mobile phone subscribers: The coefficient is −0.04, with a *p*-value of 0.12. Similar to the Internet users variable, it does not appear to be statistically significant in this context.

Economic growth: The coefficient is −0.07, with a *p*-value of 0.11. While it is not highly statistically significant, there is a suggestion that a decrease in economic growth is associated with higher banking system Z-scores.

Banking system capital: The coefficient is 0.02, with a very high *p*-value of 0.90. This suggests that banking system capital as a percentage of assets is not statistically significant in explaining variations in banking system Z-scores in the Romanian banking sector.

Bank liquid assets to deposits and short-term funding: The coefficient is −0.03, with a *p*-value of 0.17. Similar to other variables, this does not seem to be statistically significant.

In summary, the significant variables that seem to have an impact on the banking system Z-scores in the Romanian banking sector are "Bank Return on Assets" and "Bank Return on Equity." Other variables like the Globalization Index, Internet users, mobile phone subscribers, and banking system capital do not appear to be statistically significant in this context, as their coefficients have high *p*-values. Even though these digitalization variables seem to have low or no statistical significance, it could be due to their lagged effect. Digitalization implies higher costs for companies or banks, that are spread out over time. Among banks' assets, the digitalization process plays a crucial role, as software programs and licenses represent valuable intangible assets.

DESI is an index that measures the digitalization level in a country or region. As banks adopt digital technologies, they become more vulnerable to cyber-attacks. This could be a risk of hacking, data breaches, or other cyber-attacks that can have a direct impact on a bank's risk profile. Digitalization helps to improve banking operations, which can lead to cost savings over time and streamline processes, which can enhance metrics like return on assets (ROA) and return on equity (ROE). Moreover, improved digital services can attract customers and enhance their experience leading to higher revenues and customer retention. Nevertheless, digitalization is a useful tool that enables banks to diversify their revenue

streams. This diversification can contribute to stability, as overreliance on a single source of income is reduced. A well-implemented digital infrastructure can make a bank more resilient. For example, cloud-based solutions can improve disaster recovery capabilities, ensuring the continuity of banking operations during these adverse events. Therefore, banks should be interested in DESI evolution over time.

Looking into the DESI report made by the European Commission [59], surprisingly, cash-based dealings still hold an extensive share of 31%, meaning that a significant number of customers prefer paying for their online shopping with the cash-on-delivery option. Other payment methods comprise only 1% of total e-commerce transactions. Overall, this data indicates the variety of payment preferences of Romanians regarding card payments, bank transfers, digital wallets, cash-based transactions, and other methods.

The evolution of the Digital Economy and Society Index (DESI) between 2017–2022 (Figure 5) indicates Romania's performance with other countries in the region comparatively.
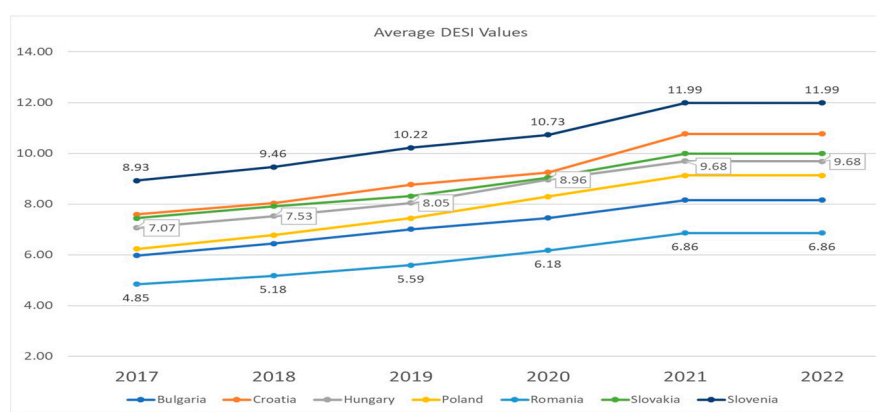

Figure 5. The evolution of Digital Economy and Society Index between 2017–2022 (%). Source: adapted by authors based on DESI annual reports [59].

With respect to Internet connectivity, the rank of Romania is consistently high from 2017 to 2022, with DESI scores of 11 or 12 throughout every year, representing a strong digital adoption and infrastructure. However, Romania is lagging behind with low digital public services, with DESI scores ranging from 4 to 8, suggesting wide room for improvement in this area for providing advanced digital services to the general public. DESI score for human capital development ranges from 2 to 8 representing the moderate level of progress in developing digital skills and knowledge. Lastly, when it comes to the examination of the integration of digital technology, Romania's DESI score varies from 3 to 7, signifying a comparatively slower pace of transforming and integrating digital technology across sectors compared to other countries in the region. Overall, while Romania displays a strong point in Internet connectivity, there are areas such as human capital development, integration of digital technology, and digital public services, where the country could attempt further growth to catch up with its counterparts in the region.

Figure 6 provides a summary of economic growth trends from 2017 to 2022 for the specified nations. In 2020, all these countries experienced a decline in GDP growth, a result of the significant impact of the COVID-19 pandemic. Notably, Slovenia and Croatia exhibited the most substantial GDP growth in 2021 and 2022. Romania had a 5.8% GDP growth in 2021 and 4.8% GDP growth in 2022, while Croatia scored a 13.1% GDP growth in 2021 and 6.3% in 2022. By contrast, Slovakia had a 4.9% GDP growth in 2021 and a 1.7% GDP growth in 2022. A comparison of Figures 5 and 6 reveals a consistent trend: as digitalization levels increase, GDP growth also demonstrates higher levels.
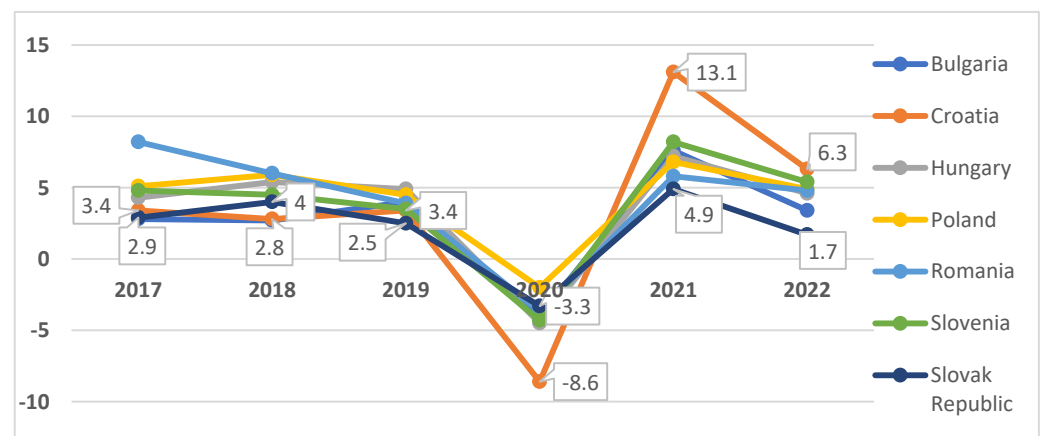
Figure 6. The evolution of GDP growth between 2017–2022 (%). Source: adapted by authors based on World Bank Database.

The Internet connectivity index ANOVA analysis (Table 10) with other regional nations indicates that Romania has a quite high level of Internet connectivity in the digital banking sector. Even though a *p*-value > 0.05 shows there is no significant difference among means, a 9.76 average connectivity score suggests the country has made noteworthy development in digitizing its banking industry and ensuring reliable and continued Internet access for customers. This high connectivity index score shows the adoption and transformation of digital banking channels, easing online transactions, and improving access to monetary services for the public.

Table 10. ANOVA connectivity index.

Groups	Count	Sum	Average	Variance		
Bulgaria	6	44.38492	7.397487	2.302606		
Croatia	6	42.07063	7.011772	4.401979		
Hungary	6	54.54782	9.091303	4.874987		
Poland	6	44.66352	7.44392	3.652504		
Romania	6	58.54061	9.756768	2.306411		
Slovakia	6	48.42273	8.070455	2.893962		
Slovenia	6	57.01519	9.502532	3.797442		
ANOVA						
Source of Variation	SS	Df	MS	F	*p*-value	F crit
Between Groups	44.69824	6	7.449707	2.152216	0.071717	2.371781
Within Groups	121.1495	35	3.461413			
Total	165.8477	41				

Source: research results.

The ANOVA analysis (Table 11) conducted on the digital public services scores for Romania and other regional countries shows significant differences in the level of digitalization in this segment. Romania's average digital public services score for the last 6 years of 3.34 indicates a relatively low level of digitalization in providing online services to the public compared to other regional countries. The ANOVA test results (*p*-value < 0.001) demonstrate a statistically significant difference in scores of digital public services among the countries. This recommends that Romania has some room and space for further improvement and advancement in terms of offering advanced digital services to its people as these services can help to improve digitalization in banking.

Table 11. ANOVA digital public services.

Groups	Count	Sum	Average	Variance		
Bulgaria	6	63.10481	10.51747	2.365043		
Croatia	6	64.1956	10.69927	2.180258		
Hungary	6	69.31001	11.55167	2.124861		
Poland	6	65.8692	10.9782	2.974844		
Romania	6	20.06779	3.344632	1.236113		
Slovakia	6	65.86613	10.97769	1.930252		
Slovenia	6	85.3421	14.22368	3.629517		
ANOVA						
Source of Variation	SS	Df	MS	F	*p*-value	F crit
Between Groups	398.7584	6	66.45974	28.29641	4.75×10^{-12}	2.371781
Within Groups	82.20444	35	2.348698			
Total	480.9629	41				

Source: research results.

Another ANOVA analysis (Table 12) of digital human capital index scores for different countries, including Romania, reveals significant disparities in digital human capital development. Romania's average digital human capital score of 7.17 shows moderate progress in evolving digital skills and knowledge among its population compared to other regional countries. The ANOVA test outcomes show digital human capital scores statistically significant differences among the countries also presenting differences in the development of digital capabilities. Romania might need to emphasize additional efforts to enhance its digital human capital through education and training initiatives to catch up with other European countries that have greater scores.

Table 12. ANOVA digital human capital index.

Groups	Count	Sum	Average	Variance		
Bulgaria	6	46.64253	7.773755	0.036383		
Croatia	6	73.274	12.21233	0.211817		
Hungary	6	55.84807	9.308012	0.0916		
Poland	6	51.56102	8.593503	0.189835		
Romania	6	43.0026	7.1671	0.080649		
Slovakia	6	61.30018	10.2167	0.352645		
Slovenia	6	63.2063	10.53438	0.105154		
ANOVA						
Source of Variation	SS	Df	MS	F	*p*-value	F crit
Between Groups	108.9147	6	18.15245	118.9675	8.64×10^{-22}	2.371781
Within Groups	5.340412	35	0.152583			
Total	114.2551	41				

Source: research results.

Also, ANOVA test outcomes (Table 13) indicate a statistically significant difference in the integration of digital technology scores between the countries, showing variations in the integration level of digital technologies. Romania might need to boost its efforts in integrating digital technology to run at the pace of other regional countries that have higher scores in this aspect. Further investments in digital infrastructure and technology adoption may contribute to enhancement in the digital banking sector in Romania as well.

Table 13. ANOVA integration of digital technology.

Groups	Count	Sum	Average	Variance		
Bulgaria	6	18.72318	3.12053	0.155645		
Croatia	6	41.18677	6.864462	2.117885		
Hungary	6	24.12301	4.020502	0.293002		
Poland	6	26.00022	4.33337	0.665328		
Romania	6	20.47188	3.41198	0.273902		
Slovakia	6	35.21639	5.869398	0.45892		
Slovenia	6	47.72972	7.954953	1.019799		
ANOVA						
Source of Variation	SS	Df	MS	F	*p*-value	F crit
Between Groups	122.2475	6	20.37458	28.61322	4.06×10^{-12}	2.371781
Within Groups	24.92241	35	0.712069			
Total	147.1699	41				

Source: research results.

5. Discussion

Valuable insights are revealed through the analysis in this research paper between digitalization and Romanian banking indicators. The hypothesis states a positive correlation between digital indicators and banking indicators, showing that with an increase in digitalization performance, the efficiency of corresponding banking operations also improves. The data and analysis presented in the research report back this hypothesis, validating a substantial level of digitalization in the Romanian banking sector.

According to the data, an enormous proportion of the population in Romania employs many digital financial products and services. Contactless bank cards have gained extensive acceptance, with 70% of people utilizing them for payments. Mobile banking apps and Internet banking for browsers are also extensively utilized modes of payment, with acceptance rates of 65% and 53%, respectively. These statistics show a liking for online access to financial services. While mobile smart-watch payments and Revolut bank cards have lower adoption rates at 31% and 25%, respectively, they still contribute to the digitalization of the banking industry. On the other hand, digital signatures and consultation with bank staff through messenger apps have comparatively lesser acceptance rates at 11% and 8%, respectively.

When Romania is compared with other regions with respect to digital payment methods, it is observed that it lags behind in terms of credit card penetration, with a lower percentage compared to the Eastern Europe and the CIS region and the global average. However, Romania increased high Internet and smartphone penetration rates, representing promising conditions for the implementation of digital payment solutions. This proposes that while credit card practice may be less prevalent, the potential for further expansion of the digital payment network in Romania is significant.

A diverse range of payment preferences has been revealed through the analysis of e-commerce payments in Romania. Digital wallets and card-based payments are widespread ways and means, accounting for a substantial share of transactions. Bank transfers also found a significant share of payments, whereas cash-based dealings still grip a significant portion. This data highlights the diverse payment preferences of Romanian consumers in the e-commerce sector.

In terms of the correlation analysis, the financial health and stability of the banking industry observed a positive relation with the progression in digitalization. Strong positive associations are found between banking system Z-scores and other banking indicator variables such as return on equity, bank return on assets, bank liquid assets to deposits, and short-term funding. These outcomes recommend that digitalization can contribute to the overall stability and efficiency of the banking industry in Romania.

Further correlation analysis discloses the association between the Globalization Index and several banking variables. Whereas a negative correlation between the Globalization

Index and banking system Z-scores suggests a weak relation between the strength of the banking organization, return on assets, and return on equity presents positive correlations with the Globalization Index. This advocates that a higher globalization level may lead to increased profitability for banks in Romania. Furthermore, a weak positive correlation between bank non-interest income to total income suggests the need to work on these indicators to improve performance and profitability. Interestingly, slightly negative correlations between the Globalization Index and Internet users, as well as mobile phone subscribers have been found in the analysis, showing a weak relationship between growing globalization and the progress of these digital services in the banking industry. Also, a weak negative correlation is observed between the Globalization Index and the degree of change in real GDP, leading to minor variations of overall economic development in the banking sector as globalization progresses.

The Romanian banking sector's Z-scores appear to be primarily influenced by "Bank Return on Assets" (ROA) and "Bank Return on Equity" (ROE) as the regression analysis shows. In this context, other factors such as the Globalization Index, Internet users, mobile phone subscribers, and banking system capital do not exhibit statistical significance, as indicated by their high p-values. Hence, further studies are recommended subject to data availability to analyze the connection between digitalization and ROA and ROE. Digitalization can streamline operations, reduce costs, and improve efficiency.

The research paper also examines the performance of Romania in the Digital Economy and Society Index (DESI) in comparison with other countries in the region. Romania registers higher ranks in Internet connectivity, demonstrating a strong and sound digital infrastructure. However, the country is behind in human capital development, digital public services, and the integration of digital technology; these areas offer opportunities for progress to compete with counterparts in the respective region.

The Internet connectivity index analysis specifies that Romania has a high level of Internet connectivity in comparison with the EU-selected countries, which is very supportive of the digitalization of the banking industry. Although ANOVA did not find a significant difference among means, Internet connectivity offers a solid and sound footing for further digital advancements and innovation within the banking business, as it has one of the highest scores for 2017–2022 when compared with the analyzed countries.

On the subject of digital public services, Romania's performance is somewhat lower compared to other countries in the region. The analysis recommends that efforts should be made to expand the accessibility and quality of digital public services, as they play a vital part in improving the overall digital environment and providing a unified experience for users.

The research paper highlights that there is a necessity for developing digital skills and knowledge among people to enable them to use digital banking services. While statistics show some progress in Romania in this sector, there is still room for improvement. Improving digital education and training programs can lead to a more digitally skilled workforce and consumers, fostering innovation and productivity.

Another important aspect in this study that has been discussed is the integration of digital technology across sectors in order to gain economic sustainability. Data-driven strategies and innovations in business processes considerably influence customer engagement, with the effects of data-driven approaches surpassing that of innovation. Furthermore, customer engagement markedly impacts a company's competitive edge [71]. The statistics show that when the banking industry adopted a high level of digitalization, other industries displayed varying digital adoption. The digital prowess of an organization should be shaped by digital innovation, which in turn can enhance the strategic performance of the business [72]. Digitalization also encourages environmentally sustainable behaviors, which improves corporate social responsibility [73,74]. This advocates the need for stimulating digital transformation across all sectors and encouraging the growth of digital technologies to drive economic growth and effectiveness.

Theoretical and Practical Implications

Research on the digital transformation of the Romanian banking sector can have several theoretical implications, including shedding light on broader concepts and contributing to the academic understanding of various fields.

The research provides a deeper understanding of how consumers' banking behaviors and preferences are changing with the advent of digital technology. This can potentially help in the development of more consumer-centric banking products and services. Also, it helps in understanding how digital transformation can lead to improved operational efficiencies and higher profitability for banks.

Moreover, our study discusses the regulatory implications of digital transformation. It can propose new regulatory frameworks that can ensure the safe and responsible growth of digital banking in Romania. However, another crucial aspect to note is the potential of digital transformation to ignite innovation within the banking sector, offering a significant competitive edge to those banks that rapidly integrate new technologies.

The research might delve into the larger societal impacts of the digital transformation of the banking sector, including its effects on job markets, economic growth, and societal well-being. Therefore, it examines how digital transformation can aid in increasing financial inclusion in Romania, particularly in remote and rural areas where traditional banking services might be limited.

The research provides theoretical insights into how the developments in the Romanian banking sector align with the broader trends and indicators as noted in the DESI. Our study highlights the theoretical implications of understanding how the Romanian banking sector compares with other European or global counterparts in terms of digital transformation, and what lessons can be learned from these comparisons.

In summary, research on the digital transformation of the Romanian banking sector has the potential to advance various theoretical domains, ranging from digital transformation theories to innovation, organizational change, customer behavior, and regulatory frameworks. These theoretical implications can provide valuable insights not only for academia but also for policymakers, practitioners, and stakeholders in the banking industry.

According to our research findings, digitalization exerts a favorable impact on bank returns. While the adoption of digital solutions may initially incur added expenses, Romanian banks are poised to reap long-term benefits by expediting customer query resolution. The digital transformation of Romanian banks presents the potential to curtail costs related to personnel and physical spaces, given the shift towards digital operations. These cost savings are expected to translate into augmented profits, reflected in elevated ROA and ROE metrics.

6. Conclusions and Limitations

This extensive examination of data and theories related to the digital transformation in Romania's banking sector yields significant observations and results concerning the effect of digitalization on numerous banking metrics. The findings endorse the favorable correlation between digital advancements and heightened stability, profitability, and efficiency within the banking sector. Furthermore, this study illuminates areas where Romania could further enhance its digital banking infrastructure, including fostering digital human capital, enhancing digital public services, and more seamless integration of digital technologies. Consequently, Romania will be able to target the potential advantages of digitalization across all sectors, especially the banking sector.

The research limitations consist of the data availability and the analysis of one domain (i.e., the banking field). In the future, these limitations allow us to extend the research to study the impact of digitalization on other sectors connected to the banking industry such as the state authorities and institutions or companies. Data completeness and reliability can affect our study, as can the limited time for data collection (digitalization is a new process). These limitations encourage researchers to make further analyses and explore the reasons for low digitalization among individuals in order to diminish the gap.

Our forthcoming research aims to assess the global population's level of digital proficiency, financial literacy, and organizational resilience effects on economic sustainability in the financial sector.

References

1. Windasari, N.A.; Kusumawati, N.; Larasati, N.; Revira Puspasuci, A. Digital-only banking experience: Insights from gen Y and gen Z. *J. Innov. Knowl.* **2022**, *7*, 1–10. [CrossRef]
2. Potapova, E.A.; Iskoskov, M.O.; Mukhanova, N.V. The Impact of Digitalization on Performance Indicators of Russian Commercial Banks in 2021. *J. Risk Financ. Manag.* **2022**, *15*, 452. [CrossRef]
3. Khalatur, S.; Tvaronavičienė, M.; Dovgal, O.; Levkovich, O.; Vodolazska, O. Impact of selected factors on digitalization of financial sector. *Entrep. Sustain. Issues* **2022**, *10*, 358–377. [CrossRef] [PubMed]
4. Calderon-Monge, E.; Ribeiro-Soriano, D. The role of digitalization in business and management: A systematic literature review. *Rev. Manag. Sci.* **2023**, 1–43. [CrossRef]
5. Versal, N.; Erastov, V.; Balytska, M.; Honchar, I. Digitalization Index: Case for Banking System. *Stat. Stat. Econ. J.* **2022**, *102*, 426–442. [CrossRef]
6. Maixe-Altes, J. The Digitalization of Banking: A New Perspective from the European Savings Banks Industry before the Internet. *Enterp. Soc.* **2019**, *20*, 159–198. [CrossRef]
7. Cho, S.; Lee, Z.; Hwang, S.; Kim, J. Determinants of Bank Closures: What Ensures Sustainable Profitability in Mobile Banking? *Electronics* **2023**, *12*, 1196. [CrossRef]
8. Ianole-Calin, R.; Hubona, G.; Druica, E.; Basu, C. Understanding sources of financial well-being in Romania: A prerequisite for transformative financial services. *J. Serv. Mark.* **2021**, *35*, 152–168. [CrossRef]
9. Vancea, D.P.C.; Aivaz, K.A.; Duhnea, C. Political Uncertainty and Volatility on the Financial Markets—The Case of Romania. *Transform. Bus. Econ.* **2017**, *16*, 457–477.
10. Rogers, D. *The Digital Transformation Playbook Rethink Your Business for the Digital*; Columbia University Press: New York, NY, USA, 2016; pp. 45–60.
11. Gartner Glossary. Digitalization. IT Glossary. Available online: https://www.gartner.com/en/information-technology/glossary/digitalization (accessed on 20 May 2023).
12. Popa, I.C.; Luca, G. Digitization of Banking Services before and after the Pandemic. *Financ. Chall. Future* **2022**, *1*, 163–173.
13. Butler, T.; Hackney, R. Understanding Digital Eco-innovation in Municipalities: An Institutional Perspective. *Eur. Conf. Inf. Syst.* **2015**, *23*, 1–15.
14. Chanias, S.; Myers, M.D.; Hess, T. Digital transformation strategy making in pre-digital organizations: The case of a financial services provider. *J. Strateg. Inf. Syst.* **2019**, *28*, 17–33. [CrossRef]
15. Salampasis, D.; Mention, A.-L. FinTech: Harnessing Innovation for Financial Inclusion. In *Handbook of Blockchain, Digital Finance, and Inclusion*, 1st ed.; 2018; Volume 2, Chapter 18. Available online: https://www.gbv.de/dms/ilmenau/toc/1009337076.PDF (accessed on 12 August 2023).
16. Duan, L.; Xiong, Y. Big data analytics and business analytics. *J. Manag. Anal.* **2015**, *2*, 1–21. [CrossRef]
17. Kraus, S.; Durst, S.; Ferreira, J.J.; Veiga, P.; Kailer, N.; Weinmann, A. Digital transformation in business and management research: An overview of the current status quo. *Int. J. Inf. Manag.* **2023**, *63*, 102466. [CrossRef]
18. Pazarbasioglu, C.; Mora, A.G.; Uttamchandani, M.; Natarajan, H.; Feyen, E.; Saal, M.; Digital Financial Services. World Bank, 1–54. Available online: https://pubdocs.worldbank.org/en/230281588169110691/Digital-Financial-Services.pdf (accessed on 26 August 2023).
19. Bain&Company. Customer Loyalty in Retail Banking: Global Edition 2014. Available online: https://media.bain.com/Images/DIGEST_Customer_loyalty_in_retail_banking_2014.pdf (accessed on 5 May 2023).
20. Venkatraman, N.; Henderson, J.C.; Oldach, S. Continuous strategic alignment: Exploiting information technology capabilities for competitive success. *Eur. Manag. J.* **1993**, *11*, 139–149. [CrossRef]

21. Ajupov, A.A.; Ahmadullina, A.A.; Belyaev, R.M.; Sizova, A.I. Assessment of the Level of Development of Digital Technologies in the Banking Sector. *Helix-Sci. Explor. Peer Rev. Bimon. Int. J.* **2019**, *9*, 5248–5251. [CrossRef]

22. Balkan, B. Impacts of Digitalization on Banks and Banking. In *The Impact of Artificial Intelligence on Governance, Economics and Finance, Volume I. Accounting, Finance, Sustainability, Governance & Fraud: Theory and Application*; Bozkuş Kahyaoğlu, S., Ed.; Springer: Singapore, 2021; pp. 33–50. [CrossRef]

23. Alalwan, A.A.; Dwivedi, Y.K.; Rana, N.P.; Simintiras, A.C. Jordanian Consumers' Adoption of Telebanking: Influence of Perceived Usefulness, Trust and Self-Efficacy. *Int. J. Bank Mark.* **2016**, *34*, 690–709. [CrossRef]

24. Vives, X. Competition and stability in modern banking: A post-crisis perspective. *Int. J. Ind. Organ.* **2019**, *64*, 55–69. [CrossRef]

25. Murinde, V.; Rizopoulos, E.; Zachariadis, M. The impact of the FinTech revolution on the future of banking: Opportunities and risks. *Int. Rev. Financ. Anal.* **2022**, *81*, 102103. [CrossRef]

26. Obaid, T.; Aldammagh, Z. Predicting Mobile Banking Adoption: An Integration of TAM and TPB with Trust and Perceived Risk. *SSRN* **2021**. [CrossRef]

27. Pereira, C.S.; Durão, N.; Moreira, F.; Veloso, B. The Importance of Digital Transformation in International Business. *Sustainability* **2022**, *14*, 834. [CrossRef]

28. Gupta, R. Industry 4.0 Adaption in Indian Banking Sector—A Review and Agenda for Future Research. *Vision* **2023**, *27*, 24–32. [CrossRef]

29. Johri, A.; Kumar, S. Exploring Customer Awareness towards Their Cyber Security in the Kingdom of Saudi Arabia: A Study in the Era of Banking Digital Transformation. *Hum. Behav. Emerg. Technol.* **2023**, *2023*, 2103442. [CrossRef]

30. Sbarcea, I. Banks Digitalization—A Challenge for the Romanian Banking Sector. *Stud. Bus. Econ.* **2019**, *14*, 221–230. [CrossRef]

31. Romanian Banks Association. 2022. Available online: https://www.arb.ro/despre-arb/educatiafinanciara-in-romania/ (accessed on 2 April 2023).

32. Banca Transilvania. Sustainability Report. Available online: https://www.bancatransilvania.ro/files/app/media/relatii-investitori/prezentari-roadshows-ri/Prezentari%20generale/Raport-sustenabilitate-2022.pdf (accessed on 27 August 2023).

33. Danila, A.; Horga, M.G.; Oprisan, O.; Stamule, T. Good Practices on ESG Reporting in the Context of the European Green Deal. *Amfiteatru Econ.* **2022**, *24*, 847. [CrossRef]

34. Nițescu, D.C. Banking Business and Social Media-A Strategic Partnership. *Theor. Appl. Econ.* **2015**, *22*, 121–132.

35. Statista. Digital Financial Services and Products Used in Romania in 2020. Available online: https://www.statista.com/statistics/1136699/romania-digital-financial-services-and-products-used/ (accessed on 4 May 2023).

36. PPRO. Payments and e-Commerce in Romania. Available online: https://www.ppro.com/countries/romania/ (accessed on 5 May 2023).

37. Jercan, E.; Nacu, T. Digital transformation and innovation of the European SMEs. How Romania replies to the digitalization phenomena? *Theor. Appl. Econ.* **2023**, *XXX*, 238–252. Available online: https://store.ectap.ro/suplimente/Theoretical_&_Applied_Economics_2023_Special_Issue_Summer.pdf#page=238 (accessed on 22 August 2023).

38. WIPO. Global Innovation Index. Available online: https://www.wipo.int/global_innovation_index/en/ (accessed on 26 August 2023).

39. Ciurlau, L.; Florea Ianc, M.M. Modernization and restructuring in the Romanian banking system under the impact of globalization. *Ann. "Constantin Brâncuși" Univ. Târgu Jiu Econ. Ser.* **2020**, *3*, 137–142.

40. Manta, A.G.; Badareu, G.; Bădîrcea, R.M.; Doran, N.M. Does Banking Accessibility Matter in Assuring the Economic Growth in the Digitization Context? Evidence from Central and Eastern European Countries. *Electronics* **2023**, *12*, 279. [CrossRef]

41. Transfond. Statistics. Available online: https://www.transfond.ro/en/communication/statistics (accessed on 6 May 2023).

42. Iacob, R. Trust and Transparency: Perspectives upon the Communication of the National Bank of Romania during the Financial Crisis. *Manag. Dyn. Knowl. Econ.* **2018**, *6*, 129–144.

43. Sall, M.C.A.; Burlea-Schiopoiu, A. An Analysis of the Effects of Public Investment on Labor Demand through the Channel of Economic Growth with a Focus on Socio-Professional Categories and Gender. *J. Risk Financ. Manag.* **2021**, *14*, 580. [CrossRef]

44. Sharma, U.; Changkakati, B. Dimensions of global financial inclusion and their impact on the achievement of the United Nations Development Goals. *Borsa Istanb. Rev.* **2022**, *22*, 1238–1250. [CrossRef]

45. Gabor, D.; Brooks, S.H. The Digital Revolution in Financial Inclusion: International development in the fintech era. *New Political Econ.* **2017**, *22*, 423–436. [CrossRef]

46. Khera, P.; Ng, S.; Ogawa, S.; Sahay, R. Is Digital Financial Inclusion Unlocking Growth? (1 June 2021). *IMF Working Paper* No. 2021/167. Available online: https://ssrn.com/abstract=4026364 (accessed on 8 August 2023).

47. Hasan, M.M.; Yajuan, L.; Khan, S. Promoting China's Inclusive Finance through Digital Financial Services. *Global Bus. Rev.* **2022**, *23*, 984–1006. [CrossRef]

48. Yıldırım, A.C.; Erdil, E. The effect of COVID-19 on digital banking explored under business model approach. *Qual. Res. Financ. Mark.* 2023, *ahead-of-print*. [CrossRef]

49. Schipor, G.; Duhnea, C. The Consumer Acceptance of the Digital Banking Services in Romania: An Empirical Investigation. *J. Balk. Near East. Stud.* **2021**, *7*, 57–62.

50. Kelikume, I. Digital financial inclusion, informal economy and poverty reduction in Africa. *J. Enterprising Communities People Places Glob. Econ.* **2021**, *15*, 626–640. [CrossRef]

51. Vancea, D.P.C.; Duhnea, C. Capital Flows in Romania: Evolutions, Consequences and Challenges addressing the Central Bank Policy. *Transform. Bus. Econ.* **2013**, *12*, 318–331.

52. Schipor, L.; Duhnea, C. Corporate Social Responsibility of the Romanian Banking Sector during the COVID-19 Crisis. *Rom. Econ. J.* **2022**, *25*, 121–133.

53. Omarini, A. The Digital Transformation in Banking and the Role of FinTechs in the New Financial Intermediation Scenario. *Int. J. Financ. Econ. Trade* **2017**, *1*, 1–6.

54. Gail, K. *The Digital Revolution in Banking*; Group of Thirty: Washington, DC, USA, 2014; Occasional Paper No. 89; pp. 1–25.

55. Tornjanski, V.; Marinkovic, S.; Savoiu, G.; Čudanov, M. A Need for Research Focus Shift: Banking Industry in the Age of Digital Disruption. *Econophysics Sociophysics Other Multidiscip. Sci. J. (ESMSJ)* **2015**, *5*, 11–15.

56. Filip, A.; Kmen, M.; Tisler, O. Digital Challengers on the Next Frontier: Perspective on Romania; McKinsey&Company: 2022. Available online: https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/digital-challengers-on-the-next-frontier-perspective-on-romania (accessed on 16 April 2023).

57. Doran, N.M.; Bădîrcea, R.M.; Manta, A.G. Digitization and Financial Performance of Banking Sectors Facing COVID-19 Challenges in Central and Eastern European Countries. *Electronics* **2022**, *11*, 3483. [CrossRef]

58. Coryanata, I.; Ramly, E.H.; Puspita, L.M.N.; Halimatusyadiah, H. Digitalization of Banking and Financial Performance of Banking Companies. *Int. J. Soc. Serv. Res.* **2023**, *3*, 366–371. [CrossRef]

59. European Commission. Digital Economy and Society Index (DESI). DESI Country Profile. 2022. Available online: https://digital-strategy.ec.europa.eu/en/policies/desi-romania (accessed on 5 May 2023).

60. Skare, M.; Obesso, M.; Ribeiro-Navarrete, S. Digital transformation and European small and medium enterprises (SMEs): A comparative study using digital economy and society index data. *Int. J. Inf. Manag.* **2023**, *68*, 102594. [CrossRef]

61. Hua, X.; Huang, Y. Understanding China's fintech sector: Development, impacts and risks. *Eur. J. Financ.* **2021**, *27*, 321–333. [CrossRef]

62. Shofawati, A. The role of digital finance to strengthen financial inclusion and the growth of SME in Indonesia. *KnE Soc. Sci.* **2019**, *3*, 389–407. [CrossRef]

63. HA, L.T. Effects of digitalization on financialization: Empirical evidence from European countries. *Technol. Soc.* **2022**, *68*, 1–16. [CrossRef]

64. Mourad, H.; Fahim, S.; Burlea-Schiopoiu, A.; Lahby, M.; Attioui, A. Modeling and Mathematical Analysis of Liquidity Risk Contagion in the Banking System. *J. App. Math.* **2022**, *2022*, 5382153. [CrossRef]

65. Demirgüç-Kunt, A.; Klapper, L.; Singer, D.; Ansar, S. *The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19*; World Bank Publications: Washington, DC, USA, 2022.

66. Beck, T.; Demirgüç-Kunt, A.; Levine, R. Financial Institutions and Markets across Countries and Over Time: The Updated Financial Development and Structure Database. *World Bank Econ. Rev.* **2022**, *24*, 77–92. [CrossRef]

67. Kose, M.A.; Prasad, E.S.; Taylor, A.D. Thresholds in the Process of International Financial Integration. *J. Int. Money Financ.* **2011**, *30*, 147–179. [CrossRef]

68. Demirgüç-Kunt, A.; Huizinga, H. Bank activity and funding strategies: The impact on risk and returns. *J. Financ. Econ.* **2010**, *98*, 626–650. [CrossRef]

69. Houston, J.F.; Lin, C.; Ma, Y. Regulatory Arbitrage and International Bank Flows. *J. Financ.* **2012**, *67*, 1845–1895. [CrossRef]

70. Norris, P. *Digital Divide: Civic Engagement, Information Poverty, and the Internet Worldwide (Communication, Society and Politics)*, 1st ed.; Cambridge University Press: Cambridge, UK, 2001. [CrossRef]

71. Hajishirzi, R.; Costa, C.J.; Aparicio, M. Boosting Sustainability through Digital Transformation's Domains and Resilience. *Sustainability* **2022**, *14*, 1822. [CrossRef]

72. Nassani, A.A.; Yousaf, Z.; Grigorescu, A.; Oprisan, O.; Haffar, M. Accounting Information Systems as Mediator for Digital Technology and Strategic Performance Interplay. *Electronics* **2023**, *12*, 1866. [CrossRef]

73. Idowu, S.O.; Vertigans, S.; Burlea, A.S. (Eds.) Corporate Social Responsibility in Times of Crisis: A Summary. In *CSR, Sustainability, Ethics & Governance, Corporate Social Responsibility in Time of Crisis*; Springer: Berlin/Heidelberg, Germany, 2017; pp. 154–196. [CrossRef]

74. Huang, H.L.; Liang, L.-W.; Su Chu, Y.-C. The Impact of Corporate Social Responsibility and Corporate Governance on Bank Efficiency. Comparative Analysis of Consolidated and Nonconsolidated Banks. *J. Econ. Forecast.* **2022**, *XXV*, 105–127.