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CHALLENGES, REQUIREMENTS, AND EVOLUTIONARY DIRECTIONS IN THE BANKING SYSTEM IN THE ERA OF THE DIGITAL ECONOMY

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INTRODUCTION

Justification, Relevance, and Significance of the Research Topic

The financial sector is experiencing significant global expansion, while the traditional banking system is undergoing continuous adaptation to meet the evolving demands of the market. In this context, banking institutions are faced with a major contemporary challenge: reconciling traditional customer behaviors with the imperatives of digitalization, alongside the need to enhance users' digital literacy. In contrast, entities operating within the financial technology (FinTech) domain are rapidly integrating into a dynamic digital ecosystem, benefiting from advanced technological infrastructures characterized by efficiency, flexibility, and a high degree of innovation.

The question is no longer whether financial technology will fundamentally transform the architecture of the financial system, but rather when and how rapidly the market will manage to fully restructure itself by leveraging the potential of emerging technologies. Financial institutions that have demonstrated early openness to digitalization and have strategically integrated technological solutions are best positioned to maintain a competitive edge and to dominate the global financial landscape in the long run. Digitalization is an ever-expanding phenomenon, having become an indispensable component of contemporary society. As a result, financial institutions are engaged in an ongoing process of modernization. However, the specific details and implications of these radical transformations should not be overlooked. Digitalization does not merely entail the implementation of innovative technologies; it also involves profound shifts within the banking system, financial companies, and, more importantly, within the organizational culture of every institution. Emerging technologies aim to automate various financial processes, leading to the launch of more efficient and cost-effective banking products and services. One of the primary objectives is to overcome informational asymmetries – and essential component of temporal pressures. Each entity contributes to this process to some extent, but banks, as emblematic institutions of the financial system, play a central role in driving digital transformation.

Essentially, banks are leveraging technology to enhance and optimize the services they have traditionally provided. Initially, online banking platforms allowed customers only to view account balances, followed by transactions history access, and eventually, digital payment systems were developed. Today, users benefit from personalized experiences powered by artificial intelligence (AI), and increasingly, by generative AI. Nevertheless, significant challenges persist, particularly due to the stark disparities in digital financial inclusion among countries. Therefore, the challenge facing the banking system is not limited to adapting to new societal demands, but also involves achieving universality by including populations in disadvantaged areas. Digital solutions must be financially accessible, user-friendly even for individuals with limited technical skills, and capable of effectively addressing a wide range of customer needs. At the same time, a new strategic direction for banks involves integrating sustainability into the digitalization process.

From a historical perspective, the evolution of the banking system can also be linked to technological progress and the emergence and development of financial technology. Although FinTech companies are currently considered a contemporary topic, their origins date back to 1838 with the invention of the telegraph. Subsequently, in 1866, the successful completion of the transatlantic telegraph cable marked another milestone. These two moments are relevant because they signify the beginning of

early digitalization – the onset of a new era of transformation that would unfold over several generations. As early as the 19th century, the process of globalization began to accelerate. Initially, Europe and America could only communicate via ships, a method both unreliable and susceptible to natural hazards. However, by harnessing these two innovations – the telegraph and the transatlantic cable – communication began to gain structure and efficiency (Nicoletti, 2017).

Ultimately, the demands for digital development in the financial-banking system align with both the current regulatory framework and broader macroeconomic influences. Undeniably, current limitations are closely tied to the issue of cybersecurity. Cyberattacks can affect both individuals and companies. For individuals, this may involve identity theft or unauthorized access to personal accounts, while for organizations, such attacks may result in significant financial losses or the compromise of sensitive data, potentially leading to business disruption.

Accordingly, this doctoral thesis centers on the challenges, requirements, and developmental directions of the banking system in the digital economy era – a topic of contemporary relevance and broad interest situated at the intersection of finance and technology, digital financial inclusion, and technological advancement. The thesis responds to the pressing need to investigate the profound transformations occurring in the banking sector in alignment with the general trend of digitalization. The relevance of the topic stems from the importance of examining how digital challenges impact cybersecurity, banking services accessibility, financial sustainability, and systemic financial stability.

Furthermore, the thesis makes an empirical contribution to the field of research through the proposal of a Digital Financial Inclusion Composite Index (DFICI) at the European Union level. This index serves to analyze the impact of digital financial inclusion on economic growth and financial stability within the European banking system. The DFICI adds value to the existing literature by providing clear econometric evidence regarding the implications of digital inclusion on the financial landscape. Particular attention is given to EU member states, which are addressed individually through comparative results derived from the index. These scores are relevant for understanding how disparities may exacerbate financial and economic inequalities among countries, as well as the trajectory they may follow.

In addition, the thesis addresses the extent of digitalization from a theoretical standpoint. It aims to clarify the differences among key concepts such as digitization, digital transformation, information system, and information technologies – even though the concept “digitalization” is more commonly used as an umbrella term encompassing the entire digital process.

The research topic is further supported by profound shifts in consumer behavior regarding banking services, legislative pressure, the need to enhance digital financial inclusion, and the emergence of new digital competitors. These particular factors are key drivers of fundamental change within credit institutions, compelling them to redefine their business models and methods of client interaction.

The significance of the research lies in its focus on identifying not only the benefits, but more importantly, the challenges and risks facing a banking system undergoing full digital transformation. The thesis proposes a comprehensive and integrated vision of financial-digital transformations in a technology-driven economic era. Ultimately, the proposed concrete solutions can contribute to strengthening the banking system. The strategy for sustainable digitalization of the banking sector is presented as a concrete proposal, encompassing a series of implementation solutions, including the complete digitalization of banking process, the launch of an extensive portfolio of banking products and services, and inclusion of digital financial education programs in rural areas. By harnessing these solutions, a favorable framework may be established for the integration of sustainability into everyday banking activities.

Although Romania currently lags behind in both digital financial inclusion and sustainability, the beneficial effects could nonetheless materialize if the proposed plan is followed and additional funding sources are secured.

In conclusion, the justification, relevance, and significance of this doctoral thesis derive from the accelerated digitalization of the banking sector, the ambition to develop the composite DFICI index, and the strategic direction proposed for the sustainable digital transformation of financial institutions. The thesis seeks to provide a complementary and innovative contribution to existing research, while opening new avenues for analysis in the domain of digital transformation in the banking sector.

Contextualizing the Research Topic withing the Sphere of Multidisciplinary, Interdisciplinary, and Transdisciplinary Inquiry

In recent decades, the phenomenon of digitalization has undergone rapid expansion, becoming both increasingly complex and emergent. The integration of diverse perspectives is a sine qua non condition for a comprehensive understanding of this topic, which must be analyzed through financial, economic, technological, social, and legal lenses. This breadth of inquiry fosters a fertile environment for the development of multidisciplinary, interdisciplinary, and transdisciplinary dimensions.

The multidisciplinary dimension lies in the incorporation of concepts from distinct yet related fields, which are then processed to build a coherent analytical framework. In the present dissertation, finance has been correlated with information technology and economics. These domains of inquiry offer a broad methodological foundation, specific instruments, and diverse conceptual frameworks which, when integrated, contribute to a comprehensive understanding of the digitalization process within the banking system.

Interdisciplinarity emerges as an essential approach, as it enables the synthesis of information from multiple fields to generate new theoretical and practical insights. Accordingly, the doctoral thesis combines digital financial data (such as digital financial inclusion) with conventional financial data (e.g., financial performance), economic indicators (economic growth), technological factors (emergent technologies and their adoption within the banking sector), social aspects (individuals' access to digital banking services), and legal frameworks (regulations governing the financial and digital domains).

With regard to the transdisciplinary framework, it constitutes a fundamental element in transcending traditional boundaries of knowledge, offering a complex conceptual structure capable of responding to the most pressing challenges posed by the contemporary digital economy. The transdisciplinary endeavors undertaken in this thesis are reflected in the proposal of a sustainable digitalization strategy, the construction of a composite indicator for measuring digital financial inclusion (DFICI), and the analysis of its impact on the financial stability of the banking sector and on economic growth dynamics.

Therefore, the doctoral thesis entitled *CHALLENGES, REQUIREMENTS, AND DEVELOPMENTAL DIRECTIONS OF THE BANKING SYSTEM IN THE ERA OF THE DIGITAL ECONOMY* follows a clearly defined research trajectory, positioned at the intersection of finance, economics, technology, sociology, and legal studies. The research paper thus provides a concrete foundation for formulating viable and sophisticated solutions, tailored to address the complexity of challenges specific to a continuously evolving digital era.

Assessment of the Current State of Knowledge

The analysis of the current state of knowledge constitutes an essential stage within the scientific endeavor, providing a coherent framework for understanding the research topic and for delineating the theoretical and methodological elements of the study. It enables the identification of relevant contributors, the mapping of current research directions, and the highlighting of gaps in the existing literature, which objectively justify the theme of the thesis.

In the process of theoretical foundation, the review literature provides a solid basis for understanding the phenomenon of banking digitalization in the context of the technological, economic, and social transformations that define the digital economy era. The construction of the theoretical framework was based on a rigorous selection of both classical and contemporary scientific sources – academic works, peer-reviewed journal articles, institutional reports, and relevant legislative documents.

1. Classical Literature: Banking and Financial Conceptual Foundations

The established literature provides the conceptual pillars of the traditional financial-banking system. Căpraru (2014) offers a detailed descriprion of the structure and mechanism of banking activity, while Isărescu (2006) provides a macroeconomic perspective on the role of monetary policy and financial stability. Petria (2003) examines the interdependence between money, credit, institutions, and financial markets – a necessary foundation for analyzing digital transformations. From the sustainability perspective, Jeucken (2001) introduces ecological concerns into the banking model, laying the groundwork for the concept of *green banking*, which is further developed in this thesis.

2. Contemporary Literature: Digitalization, Systemic Crises, and Innovation

In recent years, the digitalization of the banking system has become a central topic in economic and financial literature. Berger (2021) and Ranjan (2024) emphasize that the COVID-19 pandemic has significantly accelerated digitalization processes, compelling banking institutions to rethink their operational models. Floridi (2014) provides an essential philosophical perspective through the theory of the *infosphere*, which redefines the relationship between humans, information, and technology in the context of the digital age.

3. Digital Financial Inclusion: Regional Convergences and Disparities

Sha'ban (2024) and Chakrabarty (2011) highlight the importance of digital financial inclusion in combating economic and social exclusion. This dimension is central to the present research, particularly through the construction of the DFICI indicator and the assessment of convergence among EU member states.

4. Emerging Technologies and the Digital Financial Infrastructure

Recent literature has intensely explored the applicability of disruptive technologies. Zile (2018) analyzes the impact of blockchain on efficiency and security, while Jo (2023) discusses the ethical implications of artificial intelligence in the financial sector. The works of Acar (2019) and Lindman et al. (2017) contribute to understanding FinTech integration and the use of blockchain within the banking ecosystem. In parallel, Williams (2021) and Xu et al. (2021) provide a conceptual framework related to the Digital Economy and Industry 4.0 and 5.0, explaining the dynamics of organizational transformation in digitalized ecosystems. Yuan (2021) underlines that economic digitalization acts as the main driver of the Fourth Industrial Revolution. In this context, technologies such as blockchain and artificial intelligence are on an upward trajectory, gaining increasing relevance.

5. Behavioral and Cultural Dimensions of Digitalization

Beyond its technological dimension, the literature also addresses the socio-cultural perspective of digitalization. Bylieva (2018) introduces the concept of *Homo Virtualis*, reflecting the transformations of economic behavior within the digital

environment. Koch (2015) examines collective involvement in crowdfunding projects, emphasizing the importance of transparency and trust in the digital economy. From the standpoint of ethics and security, Becker (2019) explores the challenges of privacy in the digital era – an essential aspect in the context of cyber risks identified by banking institutions.

6. The European Institutional and Regulatory Framework

The legislative framework plays a pivotal role in the transformation toward digitalization. Among the relevant regulations are:

- The PSD2 Directive, which promotes open banking and innovation in payment systems;
- Regulation (EU) No. 575/2013, concerning prudential requirements;
- Law No. 362/2018, regulating cybersecurity;
- Reports from European institutions, such as the European Central Bank (ECB, 2025), the Digital Decade Report (2025), and the European Council, which provide the normative foundation for digital transition and support the integration of sustainability into financial policies.

7. Complementary Sources and Practical Applications

Additionally, alternative and practice-oriented sources have been integrated, including:

- National banking reports (BNR, ARB, Raiffeisen Bank);
- International platforms (Investopedia, DHL Global Connectedness Index);
- Materials presented at international conferences.

These sources enabled the updating of theoretical knowledge and its anchoring in the current realities of the digital financial ecosystem. This integrated approach to the state of the art highlights the interdisciplinary and applicative nature of the thesis, providing a solid foundation for investigating the phenomenon of banking digitalization and its sustainable dimension.

To justify the relevance and originality of the scientific endeavor, it is essential to identify the existing gaps in the specialized literature – namely, those aspects insufficiently explored, addressed in a fragmented manner, or treated superficially in previous research. In this regard, the critical analysis of the reviewed sources has revealed the following underexplored directions:

- Although numerous studies examine digital banking and sustainability separately, the integration of these two dimensions within a unified analytical framework – namely, sustainable digitalization – remains scarce and only superficially addressed in current literature.
- While many works discuss digital financial inclusion, there is no consensus on how to quantify or compare it across countries or regions. The Digital Financial Inclusion Composite Index (DFICI) proposed in this thesis fills this gap through a structured and applicable approach for EU member states.
- Although the relationship between digital banking and institutional performance is often examined, dynamic panel models capturing financial stability over time are rare.
- Most studies focus on Western Europe, the United States, and Asia. There is a notable underrepresentation of banks from Romania and the SEE region regarding applied research on digital banking, cyber risks, and digital convergence.
- The majority of works address risks in generic terms (cybersecurity, fraud, regulation). Concrete mechanisms for identifying, preventing, and managing risks generated by emerging technologies (AI, blockchain, cloud computing) are treated fragmentarily and without an integrated framework.

- Few studies analyze how socio-cultural factors, digital literacy levels, and consumer behaviors influence the adoption of banking technologies – although these factors are crucial for understanding digital financial inclusion.

Considering these identified gaps, the need for comprehensive and integrative research becomes evident – one that provides a holistic perspective on the sustainable digitalization of the banking system, with a particular focus on digital financial inclusion, emerging risks, and adaptive strategies in the context of the new digital economy.

Scientific approach: purpose, research questions, objectives, and fundamental hypotheses

This doctoral thesis aims to conduct an in-depth investigation of the structural and functional transformations of the banking system generated by the transition toward a digital economy. In the context of an unprecedent acceleration of technological innovation, digital financial inclusion emerges as a key indicator of the banking system's capacity to integrate vulnerable population segments and to contribute to systemic stability and resilience. At the same time, the research seeks to formulate a strategic plan applicable to Romania, oriented toward the sustainable digitalization of the banking system, in accordance with the trends and commitments assumed at the level of the European Union.

Based on these directions, the following main research question is formulated, accompanied by a series of secondary questions designed to explore in detail the associated subdomains:

- Main research question:
  What are the challenges, requirements, and strategic directions for the evolution of the banking system in the context of the digital economy, and how does digital financial inclusion influence economic growth and the financial stability of the banking system in Romania and the European Union?
- Secondary research questions:

1. What are the main determinants of technology adoption in contemporary banking activity?
2. How can digital financial inclusion be measured and quantified across the member states of the European Union?
3. To what extent does the level of digital financial inclusion vary by geographical area and Eurozone membership, and what are the explanatory factors behind these differences?
4. What relationships can be identified between digital financial inclusion and micro and macroeconomic variables?
5. What types of risks are associated with the accelerated digitalization of the banking system, and through which mechanisms and technologies can these be effectively identified, managed, and prevented?
6. What specific solutions can be implemented in Romania to stimulate the banking digitalization process in line with the European sustainability objectives?

These research questions underpin a rigorous methodological approach, structured around one central objective and several specific objectives that guide the entire theoretical and empirical investigation.

Fundamental research objective:

- To determine the essential digital requirements for banking activity, identify the critical challenges associated with digitalization, and assess the

anticipated transformation directions, with the purpose of building a solid scientific foundation for the development of a sustainable and resilient digital banking system.

Specific research objectives:

- Objective 1: To investigate the structure and evolution of the digital economy, with a focus on the driving factors and their impact on both national and international contexts, from technological, economic, and financial perspectives.
- Objective 2: To analyze banking digitalization by exploring the differences between the digitalization of customer interaction and the digital transformation of internal processes.
- Objective 3: To examine the need for innovation in the banking system, including the exploration of digital investment vehicles and the regulatory risks associated with new financial products and services.
- Objective 4: To identify the determinants of digital financial inclusion and to construct a composite index for its measurement, using advanced statistical methods (PCA) applied to European data.
- Objective 5: To perform an economic analysis of the relationship between digital financial inclusion, economic growth, and banking system stability, based on panel regressions (EViews).
- Objective 6: To formulate a strategic plan for the sustainable digitalization of the Romanian banking system, derived from the analysis of European trends and the specific constraints of the local context.

Fundamental Research Objectives:

- Hypotheses 1: Technological progress, the regulatory framework, and consumers' digital behaviors represent structural factors that are highly relevant to understanding the transition toward a digital banking system.
- Hypotheses 2: Banking institutions exhibit varying levels of digitalization between their internal processes and the services offered to clients.
- Hypotheses 3: The level of digital maturity of banking institutions is reflected in the extent to which they integrate digital investment vehicles, with this integration being influenced by the presence of a favorable regulatory framework.
- Hypotheses 4: The level of digital financial inclusion differs considerably among EU member states, and the application of PCA enables the quantification and comparison of these differences.
- Hypotheses 5: Digital financial inclusion exerts a significant positive effect on economic growth and financial stability within the European Union.
- Hypotheses 6: In Romania, factors such as limited digital financial education and infrastructural inequalities may represent significant obstacles in the banking digitalization process, requiring reflection on appropriate intervention strategies.
- Hypotheses 7: Aligning banking digitalization strategies with the principles of sustainability may serve as a relevant direction for strengthening consumer trust and enhancing the competitiveness of financial institutions in an evolving digital environment.

Research methodology

Research procedure

Research represents an essential process of collecting, organizing, and analyzing information, aimed at achieving an in-depth understanding of a topic of interest. The scientific method involves the rigorous identification and testing of

possible solutions to a specific problem. Testing these solutions is indispensable for selecting the optimal option, grounded in objective arguments. In this context, the doctoral thesis aspects will be coherently integrated with the empirical ones, so that the results obtained will generate a concrete and valuable contribution to the development of the digital banking system.

In the first stage, a systematic analysis of the specialized literature will be carried out, followed by a review of the general bibliography, including both reference works (books and academic treatises) and recent scientific articles, institutional reports, and relevant empirical studies. Considering the dynamic nature of the topic – the digitalization of the banking system in the context of the digital economy – emphasis will be placed on updated sources, as the accelerated pace of technological transformation often renders information older than a year, or even a few months, analytically obsolete.

In the next stage, the thesis will include a detailed analysis of the national and European institutional framework, with the aim of identifying the strategic requirements and emerging regulations associated with the transition toward the digital economy. The research will seek to ensure the comparability of approaches regarding the digitalization of the banking system and to assess its adaptability to emerging technological trends, in order to formulate relevant conclusions from theoretical, normative, and practical perspectives.

Subsequently, the research involves the collection, processing, and analysis of statistical data through quantitative methods. In order to meet the specific empirical objectives, a composite indicator will be proposed to measure digital financial inclusion across the European Union member states. To construct this index, the Principal Component Analysis (PCA) method will be applied using SPSS software. To test the hypotheses concerning the relationship between digital financial inclusion and economic growth, on the one hand, and those with banking stability, on the other, panel regression models will be employed using EViews 10 software.

To ensure a high degree of accuracy and relevance of the results obtained, the data used in the empirical analysis will be drawn from internationally recognized databases such as Eurostat and the World Bank. These sources provide rigorous, internationally comparable statistical information, essential for validating conclusions and conducting comparative analyses between economies with different levels of digitalization and financial inclusion.

Research methods

Within the framework of this doctoral thesis, both quantitative and qualitative research methods were employed in a complementary manner, with the purpose of attaining a comprehensive and rigorous understanding of the banking digitalization process. The adoption of a mixed-methods approach offers the advantage of a multifaceted analysis, allowing for the correlation of empirical data with the conceptual and institutional dimensions of the phenomenon under investigation. Consequently, the research acquires methodological robustness and a solid scientific foundation, leading to the formulation of relevant and substantiated conclusions. The research methods applied are as follows:

1. Quantitative methods:
   - Quantitative analysis of the literature: Enabled the identification of the main research directions related to the fundamental concepts of digitization, digitalization, and digital transformation, as well as other associated notions relevant to the study of the digital economy and the banking system.
   - Case study: Used to highlight the characteristics of the national banking framework, focusing on the degree of digitalization of banking institutions, the

level of digital financial inclusion, and the strategic orientations toward sustainable digitalization.

- Anthropological method: Provided a socio-cultural perspective on the factors influencing the integration of technology within the banking system, through the analysis of behaviors, cultural values, and the population's familiarity with digital technology.
- Indirect observation: Involved examining the behavior of banking institutions and FinTech companies through secondary sources such as official reports, public statements, and publications issued by regulatory bodies or competent authorities.
- Discourse analysis: Applied to interpret the promotional messages of national and international banks, with the purpose of extracting the core narrative elements regarding digitalization, institutional vision, and communication strategies.
- Narrative study: Employed to interpret qualitative data derived from questionnaires or relevant case studies, reflecting the digitalization pathways of banks and the dynamics of technological progress within the sector.
- Critical analysis (SWOT): Offered a systematic assessment of the strengths and vulnerabilities associated with the digital economy, as well as the external opportunities and risks, contributing to a strategic overview of the ongoing banking transformation.

2. Quantitative methods:

- Statistical analysis: Used in the stage of consolidating and processing relevant indicators, which subsequently served as the foundation for constructing a composite indicator of digital financial inclusion – DFICI (Digital Financial Inclusion Composite Index). This index was developed through the application of the Principal Component Analysis (PCA) method using SPSS software, in order to reduce data dimensionality and retain the essential variance withing the set of variables.
- Econometric analysis: Applied to investigate causal and correlational relationships between DFICI and significant macroeconomic variables, such as the economic growth and financial stability indicators in the banking sector. By employing panel regression models, the analysis enabled the quantification of the impact of digital financial inclusion on the economic performance and resilience of the European banking system.
- Graphical method: Integrated to visualize the regional distributions and disparities of the DFICI score, as well as to graphically illustrate regression, GPD evolution, and other relevant correlations. Visual representations contributed to an intuitive and comparative interpretation of the research findings.
- Trend analysis: Focused on the dynamics of the main indicators analyzed, identifying the development trajectories of digital financial inclusion and banking performance. This method allowed for the observation of the temporal evolution of DFICI, GDP, and other variables, providing a longitudinal perspective on the studies phenomena.

In conclusion, by adopting a mixed-methods approach that combines quantitative and qualitative techniques, the thesis provides a comprehensive and in-depth perspective on the banking digitalization process in the digital era. The qualitative methods facilitated the development of a solid theoretical framework and contributed to the contextualization of the discussed phenomena. Simultaneously, the rigor of the research derives from the quantitative methods, which enabled the application of statistical and econometric tools for the purpose of conducting an extensive empirical analysis.

The approach used in data analysis

To ensure that the research rests on a solid scientific foundation, the study commenced with an extensive phase of data collection, processing, and analysis, drawing upon a wide range of bibliographic sources characterized by a high degree of internationality and multidisciplinary. This approach enabled the construction of a comprehensive theoretical framework, appropriately aligned with the dynamic and cross-cutting nature of the research topic. Accordingly, the review encompassed specialized books, scholarly articles, reports, academic courses, laws and regulations, digitally published papers, and press releases. Furthermore, variables that best describe digital financial inclusion within the European Union were identified and selected for processing using specialized software tools.

The data processing instruments employed in the research include:

- The reading and synthesis sheet, used for summarizing and systematizing information extracted from the academic literature and other relevant bibliographic sources.
- The SPSS software, applied for descriptive statistical analysis through the implementation of Principal Component Analysis (PCA).
- The EViews software, utilized for conducting panel regression models.
- Spreadsheet applications, used for centralizing data underpinning the PCA and for creating charts and diagrams related to various topics addressed in the research.

Consequently, the data processing approach was designed to meet the scientific standards of a rigorous investigation and to generate meaningful contributions to the academic literature.

Main research findings

The doctoral thesis formulates a multidimensional conceptual and applicative framework for understanding and evaluating digitalization in the banking sector, integrating technological, economic, and public policy perspectives. Through the use of robust methodological tools (composite indicators, panel regressions), the results demonstrate that banking digitalization is not merely a technological process, but a driver of economic transformation, social inclusion, and financial sustainability.

A particular tangible outcome of the research is the construction of an original composite indicator – DFICI (Digital Financial Inclusion Composite Index) – developed on the basis of a robust methodological framework and a multicriteria selection of variables. The calculation of the DFICI score provided comparative insights into the level of digital financial inclusion across EU member states, highlighting both convergence trends and existing disparities. Geographic differences were found to be closely linked to factors such as financial literacy, digital infrastructure, and individuals' openness to the use of digital financial resources. The empirical analysis revealed that EU member states with higher DFICI scores are also those that exhibit a more rapid adoption of new technologies. In the case of Romania, the country ranks below the European average in terms of digital financial inclusion as measured by the DFICI. Moreover, Romania underperforms in other dimensions related to the use of digital services, with significant disparities persisting between rural and urban areas.

Through economic methods (panel regression analysis), significant positive correlations were identified between DFICI and key indicators of economic growth, as well as with the financial stability of the banking system, suggesting a relationship of strategic interdependence. These results validate the hypothesis that digital

financial inclusion directly contributes to strengthening financial stability and promoting economic development.

Another major outcome concerns the integration of the sustainability dimension into the analysis of digital transformation, illustrating how digitalization can support ESG objectives through enhanced energy efficiency, green financial products, and transparent governance. A comprehensive theoretical framework for the concept of green banking was developed as part of this analysis.

Furthermore, the research proposes an integrated strategic plan for the sustainable digitalization of the Romanian banking system, structured around five main directions:

1. Complete digitalization of banking processes.
2. Development of an expanded portfolio of sustainable digital banking products.
3. Strengthening public-private partnerships in support of digitalization.
4. Implementation of digital financial education programs in vulnerable areas.
5. Promotion of long-term strategic visions anchored in the context of digital and green transformation.

The findings demonstrate that the success of banking digitalization depends on the coherent integration of technology, regulation, and financial education within a framework of responsible and sustainable innovation.

The study also introduces the Design Thinking methodology as a practical approach for addressing problem-solving processes in the banking sector – whether in the creation of redesign of banking products and services, or in response to organizational challenges. The importance of a user-centered approach is emphasized, highlighting the need to assess the impact of strategic and operational decisions on the customers experience.

Finally, the outcome of this research has been disseminated through the publication of seven scientific papers in peer-reviewed journals indexed in international databases and through participation in over seventeen international scientific conferences.

Methodological constrains and study limitations

Every scientific endeavor inevitably entails a series of constraints that must be acknowledged in order to establish the premises for future research. Naturally, the present doctoral thesis is no exception, as several limitations inherent to the research process have been identified.

A primary limitation stems from the partial accessibility of data. For the application of the Principal Component Analysis (PCA) method, several impact factors were selected and operationalized through relevant indicators. However, in the process of collecting data for each European Union member state and for each year within the analyzed periods, significant gaps were identified. For instance, France provided only partial data to the European Commission for the year 2020. Similarly, the unavailability of certain data was also observed in databases managed by the World Bank and Eurostat, which led to the restriction of the investigated period due to the absence of complete data serios for specific indicators. Moreover, the use of panel regression models requires the fulfillment of conditions related to multicollinearity, multiple roots, and cross-sectional dependence; deviations from these assumptions may directly influence the robustness and validity of the results.

Another significant limitation concerns the accelerated dynamics of banking digitalization. Consequently, the result obtained may exhibit variations over a relatively short time span. Technology is characterized by a rapid and continuous evolution, while market behavior tends to adapt as swiftly as possible. Therefore, continuous research updates are essential to ensure the relevance of future analyses.

Furthermore, the development framework of banking digitalization through sustainability relies on an idealized vision, which may encounter practical challenges during implementation. Such challenges may arise from a stringent legal environment, geographic disparities in digital infrastructure, or even institutional resistance to change among banking entities and other key market actors.

In conclusion, the limitations identified within this study open new research avenues, offering opportunities for more comprehensive and up-to-date analyses that may extend the investigation to multiple international markets. Nevertheless, the doctoral thesis maintains its scientific rigor and relevance within the investigated field, representing a solid and well-founded reference point for subsequent research endeavors.

Structure and content of the doctoral thesis

The structure and content of the doctoral thesis entitled *CHALLENGES, REQUIREMENTS, AND EVOLUTIONARY DIRECTIONS OF THE BANKING SYSTEM IN THE ERA OF THE DIGITAL ECONOMY* are rigorously constructed around a multidimensional approach to banking digitalization, emphasizing the interactions among the digital economy, financial inclusion, financial stability, and the sustainability of the banking system. The thesis is organized into five major chapters, each fulfilling a distinct role in the theoretical foundation, empirical analysis, and formulation of strategic directions for the Romanian banking sector, in correlation with European trends. A structured synthesis is presented below.

Chapter 1 – *THE DIGITAL ECONOMY AND THE TRANSFORMATION OF THE FINANCIAL-BANKING SYSTEM* – establishes the theoretical and conceptual framework of the thesis. It examines the factors that led to the emergence of the digital economy, highlighting its defining characteristics and underlying principles. The analysis of key specialized concepts – specifically digitization, digitalization, and digital transformation – is essential for understanding the overarching approach of the thesis. Furthermore, the chapter identifies both the advantages and challenges associated with the implementation of digitalization within the economy.

Chapter 2 – *DIGITAL FINANCIAL INCLUSION AND MICRO AND MACROECONOMIC CORRELATES* – explores the depth of the digital financial inclusion concept by identifying its determinants and relevant variables. Ultimately, the chapter proposes a composite indicator for measuring digital financial inclusion in the European Union member states (DFICI). This indicator is employed to analyzed correlations between digital financial inclusion, economic growth, and the financial stability of the banking system through panel regression models, robustness tests, and empirical validation. The chapter thus provides the quantitative foundation of the research, offering empirical evidence on the impact of the digitalization on economic performance and banking stability.

Chapter 3 – *THE CURRENT STAGE AND EVOLUTIONARY DIRECTIONS OF BANKING SECTOR DIGITALIZATION* – presents an in-depth overview of the banking sector in Romania and Europe, highlighting both its current state and future prospects. The chapter emphasizes two dimensions of banking digitalization: the digitalization of banking processes and the transformation of customer experience through digital technologies. It also examines the applicability of digitalization in risk management, with the aim of minimizing exposure. Risks, benefits, and emerging technologies are analyzed – ranging from process automation to the use of big data and artificial intelligence in credit risk assessment. The emphasis lies on the technical-procedural dimension and on how digitalization reshapes the banking business model.

Chapter 4 – *CHALLENGES AND OPPORTUNITIES IN THE DIGITALIZATION OF THE BANKING SYSTEM* – addresses critical aspects of banking digitalization, beginning with Romania's lag in digitalization compared with other European countries. This chapter also outlines the legislative framework, providing a comprehensive view of the research context necessary for drawing informed conclusions. It further discusses the presence of digital technology companies and the competitive dynamics between these firms and banks. Additionally, the chapter analyzes the competition between traditional banks and FinTechs, as well as the integration of sustainability within new digital banking models, including from an ESG perspective.

Chapter 5 – *DEVELOPMENT STRATEGIES THROUGH BANKING DIGITALIZATION* – presents a forward-looking vision for the future of banking services. The chapter has both an applied and prospective character. It opens with a concise overview of the evolution of digital banking services, followed by a discussion on the new digital investment vehicles offered by banks to their clients. For a more detailed analysis, the chapter examines the applicability of the design thinking method in developing digital banking products, as well as the methodology underlying the launch of central bank digital currencies (CBDCs). The chapter concludes with the formulation of an integrated strategy for the sustainable digitalization of the Romanian banking system, encompassing public policies, financial education, and collaborative initiatives between the banking sector and state institutions.

The doctoral thesis concludes with a synthesis of the findings and personal contributions, highlighting the main implications of the results and outlining potential directions for future research.

OVERVIEW

The doctoral thesis focuses on the challenges, requirements, and directions of evolution of the banking system in the era of the digital economy, exploring a highly complex and rapidly transforming domain – the digital banking ecosystem. The research also examines the increasing pressures faced by banks in relation to digital financial inclusion, cybersecurity, and the integration of sustainability within digitalization processes, highlighting the dynamics and interdependencies among these critical dimensions.

From the introductory stage – through the formulation of research objectives and hypotheses – the thesis aimed to identify, analyze, and evaluate the structural changes generated by the digitalization of the banking system, while introducing innovative and value-added insights into understanding the fundamental transformations induced by the transition towards a digital economy. The thesis postulates that digitalization can no longer be regarded as a mere technological option; rather, it has become a sine-qua-non condition for the resilience of credit institutions.

The fundamental objective of this doctoral thesis – to determine the essential digital requirements for banking activities, to identify the key challenges associated with digitalization, and to assess the anticipated directions of transformation in order to provide a scientifically grounded framework for the sustainable and resilient development of the digital banking system – was achieved through the fulfillment of six specific objectives. Each objective contributed significantly to answering the main and secondary research questions, while also supporting the validation of the research hypotheses. The following sections outline the main results and contributions of the author, analyzing the degree of achievement of each specific objective.

Objective O1, formulated in the introductory part, focused on investigating the structure and evolution of the digital economy, emphasizing the triggering factors and their impact on both national and international contexts from a technological, economic, and financial perspective. This objective was achieved by defining key concepts and analyzing the factors shaping the digital economy, with a focus on banking transformation. The author's contribution lies in developing a conceptual framework linking digital transformation with financial, social, and organizational dimensions, contextualized specifically for Romania in relation to the European environment. In pursuing O1, **Hypothesis I1** was validated, confirming that technological progress, the regulatory framework, and consumer digital behaviors are structural determinants of the transition toward a digital banking system.

Objective O2 – the analysis of banking digitalization through the exploration of differences between customer-facing digitalization and internal process transformation – was achieved by examining the current state of digitalization withing banks and identifying asymmetries between client-centered services and internal operational processes. Consequently, **Hypothesis I2** was validated, supporting the idea that banks exhibit different levels of digitalization across internal processes versus customer services.

Objective O3 – analyzing the need for innovation withing the banking system, including the exploration of digital investment vehicles and the regulatory risks associated with new financial products and services – was fulfilled through an analysis of national and European legislation, the challenges arising from emerging risks, and

recently introduced financial instruments. The author's contribution consists in systematizing digital investment vehicles based on risk, accessibility, and utility, as well as examining the application of the Design Thinking method in addressing banking sector challenges. In this context, **Hypothesis I3** was validated: the digital maturity level of banking institutions is reflected in their capacity to integrate digital investment vehicles, influenced by the existence of a favorable regulatory framework.

Objective O4 – identifying the determinants of digital financial inclusion and constructing a composite indicator to measure it using advanced statistical methods (PCA) applied to European data – was achieved through the processing of international databases using SPSS software. The Digital Financial Inclusion Composite Index (DFICI) was developed, enabling the measurement and comparison of digital financial inclusion levels across EU member states. Accordingly, **Hypothesis I4** was validated, showing that the level of digital financial inclusion varies significantly among EU countries and that PCA methods allow for the quantification and comparison of these differences. The author's contribution reflected in the creating of an original measurement instrument applicable in both academic and institutional contexts.

Objective O5 – conducting an econometric analysis of the relationship between digital financial inclusion, economic growth, and banking system stability based on panel regressions (EViews) – was achieved through the selection and processing of representative dependent, independent, and control variables. A positive and statistically significant correlation was demonstrated between DFICI scores for EU, countries and both economic growth and financial stability, validating **Hypothesis I5**, which states that digital financial inclusion exerts a significant positive effect on economic growth and financial stability within the European Union. The author's contribution lies in applying robust panel regression methods to examine the link between DFICI and two key pillars – GDP and the banking Z-Score.

Objective O6 – formulating a strategic plan for the sustainable digitalization of the Romanian banking system, based on the analysis of European trends and local contextual constraints – was achieved by providing an in-depth assessment of the Romanian and European banking sectors, analyzing technical approaches to risk management, and proposing a concrete roadmap toward sustainability. This plan supports **Hypotheses I6 and I7**, addressing the challenges faced by Romania and emphasizing the role of sustainability and trust in strengthening banking competitiveness.

Summarizing the results achieved and the validation of the hypotheses, the thesis presents the following key contributions, grouped into three dimensions: theoretical-conceptual, methodological, and empirical.

Theoretical and Conceptual Contributions:

- Conceptual clarification of the digital economy and its impact on the banking system, through the rigorous delineation of *digitization*, *digitalization*, and *digital transformation*, and their implications for banking operational and strategic models.
- Redefinition of *digital financial inclusion (DFI)* in an integrative manner, encompassing access, active use, quality of interaction, and users' digital competence.
- Integration of sustainability into the analysis of digital banking transformation, linking ESG objectives with digital banking and assessing the positive impact of emerging technologies on banking efficiency and transparency.

- Strengthening the theoretical framework regarding banking risks in the digital era by reconfiguring the typology of risks (technological, cyber, reputational) and extending risk management functions through advanced digital tools.
- Systemic approach to the transformation of commercial banks, emphasizing the complex relationship between digitalization, financial innovation, and consumer behavioral change.

Methodological contributions:

- Development of an original composite index – DFICI (Digital Financial Inclusion Composite Index) – based on a solid multicriteria framework, with variables selected from official sources and validated through robust statistical methods.
- Methodological substantiation of DFICI construction, including variable selection, data normalization and aggregation (e.g., PCA, weighted scoring), and rigorous validity testing.
- Application of panel econometric models to analyze the relationship between digital financial inclusion, economic growth, and banking stability, using fixed and random effects, and statistical validation tests (Hausman, autocorrelation, heteroscedasticity).
- Development of methodological structure for international comparative analysis within the EU, based on synthetic indicators and correlations among structural and financial variables.

Empirical contributions:

- Comprehensive overview of the Romanian and European banking systems in a rapidly changing environment, highlighting post-pandemic trends and regional differences in digitalization levels.
- Application of DFICI in comparative analysis among EU member states, revealing disparities and correlations with economic and financial factors.
- Identification of significant positive correlations between DFICI and GDP growth, suggesting that digital financial inclusion fosters economic expansion.
- Demonstration of the positive relationship between DFICI and banking system stability, supporting the notion that digitalization, when coupled with inclusion, can reduce systemic risk.
- Identification of structural challenges and digitalization opportunities in Romania, including digital divides, cyber risks, and fintech positioning.
- Proposal of a strategic plan for the sustainable digitalization of the Romanian banking system, with concrete measures such as universal digital banking, sustainable financial products, public-private partnerships, and digital financial education.
- Proposal to integrate Design Thinking into banking decision-making processes to foster innovation and enhance client engagement.

Based on the three analytical dimensions – digital financial inclusion, sustainable digital banking development, and financial system stability – the following strategic recommendations are formulated:

1. Enhancing digital financial inclusion:

a. Expand digital and financial infrastructure through public-private partnerships and targeted investments, especially in rural or underdeveloped areas.
b. Promote digital and financial literacy through national programs targeting vulnerable groups, with strong collaboration between banks, regulators, and the education system.

c. Encourage innovation in digital financial products and access channels using Design Thinking to design customer-centric solutions.

2. Advanced sustainable digital banking:

a. Implement systemic and integrated digital transformation of banking operations, minimizing paper-based processes and adopting modular Banking-as-a-Service platforms aligned with ESG goals.
b. Launch sustainable digital banking products linked to ESG indicators, such as green digital portfolios and sustainability-linked loans or savings products.
c. Adopt responsible digital governance, integrating ethics, cybersecurity, algorithmic transparency, and data protection within strategic management.

3. Strengthening banking stability in the digital context:

a. Implement predictive analytics and AI-based systems for proactive risk management and cyber resilience audits.
b. Promote adaptive regulatory and supervisory frameworks (RegTech and SupTech) to address fintech, DeFi, and digital currencies.
c. Foster systemic cooperation among banks, fintech, regulators, and academia through innovation sandboxes and European frameworks for digital harmonization.

For digitalization to become the driving force behind a sustainable and inclusive transformation of the banking sector, an integrated approach is essential – one that combines technological progress with social inclusion, economic sustainability, and financial stability. The recommendations presented may serve as a foundation for public policies, banking strategies, and research initiatives aimed at ensuring a fair and resilient digital transition.

Regarding the limitations of the research, although a rigorous methodological approach was pursued, this thesis nonetheless encounters several constraints which, however, could lay the groundwork for further studies. First and foremost, the accessibility of statistical data represented a genuine challenge. For the construction of the Digital Financial Inclusion Composite Index (DFICI), data were collected from international sources; however, there were instances where data series were incomplete, as was the case for France or Malta in the Eurostat datasets. Furthermore, a certain degree of subjectivity can be observed in the selection of variables included in the PCA analysis. Although the relevant literature was reviewed and the impact factors were identified, the author's influence on the decision of the selected indicators remains visible. Even the exclusion of certain indicators due to the unavailability of data may be regarded as a limitation.

Moreover, the digital domain is characterized by volatility. This implies that digitalization is a dynamic process, and the result obtained today may quickly lose relevance. Consequently, the empirical findings are pertinent at this point in time but should be reviewed, reanalyzed, and updated in the future to ensure that the research conclusions remain relevant. Another limitation arises from the impossibility of generalizing the results beyond the European Union. The empirical analysis focuses exclusively on EU countries, and extending it to other states would require the development of a new composite indicator for measuring digital financial inclusion.

Given the aforementioned limitations, further research is needed to address and mitigate them. Accordingly, several future research directions can be identified:

- The extension of the empirical research to a global level represents an important step for the DFICI indicator, which could be refined and presented in an updated form.

- Econometric modelling concerning cyber risks in the banking sector could become a valuable research topic, potentially leading to the creation of an indicator assessing cyber resilience within credit institutions.
- The development of an evaluation matrix to assess the impact of central bank digital currencies (CBDCs) on cryptocurrencies, which could provide insights into whether investment behavior is affected or client interest in the investment area increases.
- The expansion of research on digital sustainability in banking, focusing not only on Romania but also on the European Union and other emerging regions with a growing interest in green banking.
- The elaboration of a study focusing on digital and financial-digital education in Romania, which could include the creation of a measurement tool for assessing the level of financial and digital literacy, as well as a long-term development plan.

Ultimately, the doctoral thesis *CHALLENGES, REQUIREMENTS, AND DIRECTIONS OF EVOLUTION OF THE BANKING ECOSYSTEM IN THE ERA OF THE DIGITAL ECONOMY* converges toward the formulation of an integrated strategic vision regarding the challenges faced by banks, the requirements to which they must respond in order to adapt to accelerated changes, and the future directions of development within a digitally driven economic environment.

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