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Adoption of Mobile Banking Services in Lebanon

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Abstract: With the rapid development of digital financial innovations, understanding the drivers of the acceptance of cutting-edge technologies becomes essential. This study investigates new factors that influence the adoption of mobile banking services—defined as digital financial services accessed via mobile devices such as smartphones and tablets—in Lebanon, with a particular focus on how infrastructure serves as a mediating variable. It examines the interactions between three key sectors: the banking sector including bank liquidity, quality management, and e-money; the economic sector encompassing exchange rates, purchasing power, and the digital economy; and the political sector covering government activities, policies, and stability. The research aims to offer a comprehensive understanding of the factors driving the uptake of mobile banking. A mixed-methods approach informed by critical realism was employed. Semi-structured interviews were conducted with 14 banking professionals to identify crucial political sector factors and to generate hypotheses about the role of infrastructure. Additionally, a survey was distributed to 200 participants to quantitatively evaluate these relationships. The findings prove that infrastructure significantly impacts the adoption of mobile banking services in Lebanon. In addition, key factors such as bank liquidity, quality management, e-money, exchange rates, and the digital economy show strong positive correlations with infrastructure. ANOVA tests confirmed that all investigated variables contribute meaningfully to adopting mobile banking in Lebanon.

Keywords: bank sector, economic sector, infrastructure, mobile banking services, political sector

1. Introduction

Lebanon's economy relies on the banking sector for financial stability and prosperity. However, over the past three years, interrelated economic, political, and financial crises have badly damaged it. The October 2019 economic and financial crises began a systemic breakdown, exacerbated by the global COVID-19 epidemic and the August 2020 Port of Beirut explosion. These developments have presented Lebanon's banking system and economy with unprecedented hurdles.

Lebanon's domestic currency, the pound, lost approximately 90% of its value during the 2019 crisis [1]. The Beirut explosion caused major infrastructure and economic damage, worsening the situation. Lebanese banks, facing a liquidity crisis, froze withdrawals and instituted informal capital controls, limiting depositors' deposits. Banks shifted client funds to the Central Bank, straining liquidity and depositor confidence, economists say. These trends have eroded public trust in financial institutions and severely reduced financial transactions, hindering economic recovery.

Banking trust must be rebuilt to restore financial stability and public confidence. Lebanese banks have developed digital services to retain consumers and improve banking experiences. Technological advances and smartphone use have made mobile banking a crucial innovation. Mobile banking lets clients transfer funds, pay bills, invest, and check balances without physical restrictions. This transition follows global trends where mobile banking has altered the banking business, improving user convenience.

Mobile banking usage in Lebanon is modest compared to other nations in the area, despite its global expansion. New data shows that just 28% of Lebanon's banking clients use mobile banking in 2023. Jordan and Egypt have higher adoption rates (52% and 61%, respectively) [2]. These figures reveal that Lebanon is behind in mobile banking and highlight the need to investigate structural and environmental causes.

Poor infrastructure, telecommunications, and financial institution mistrust hamper adoption. Mobile banking requires infrastructure, which includes internet connectivity, energy, and secure digital platforms. Lebanon's slow mobile banking uptake is also caused by socioeconomic issues such as inadequate digital literacy and unwillingness to change. These problems suggest that Lebanon's mobile banking penetration needs further study, especially in light of economic volatility and technological challenges. Despite the growing interest in mobile banking in Lebanon, there is a gap in the literature on how the banking, economic, and infrastructure sectors affect mobile banking adoption. Bank liquidity, electronic money (e-money), management quality, exchange rates, purchasing power, the digital economy, and infrastructure have not been adequately explored in the context of mobile banking adoption in Lebanon. This research addresses this gap by examining these understudied

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aspects that could help Lebanon's individual consumers adopt mobile banking services.

This study identifies the elements that drive mobile banking adoption in Lebanon, concentrating on infrastructure as a mediator. It provides actionable insights to help stakeholders improve mobile banking and recover public trust in banks.

This paper is structured into six main sections. Section II provides a comprehensive review of the existing literature relevant to the study. Section III outlines the research objectives and the specific research questions addressed by this work. The methodology employed, along with the hypotheses tested, is presented in Section IV. Section V presents the findings and results of the research. Finally, Section VI concludes the paper, summarizing the key insights and implications of the study.

2. Literature Review

In this section, the main recent research related to the adoption of mobile banking services will be presented and discussed.

2.1. Mobile applications and the evolution of mobile banking

Mobile app development in recent decades shows technological advancement. Mobile apps have evolved from simple services to multifaceted platforms. Mobile apps are revolutionized. Customer expectations and behavior, telecommunications, software, and hardware developments have driven this progression. The 1997 Nokia phone game "Snake," which came pre-installed, is a famous mobile app [3]. Due to market rivalry, changing consumer needs, mobile technology development, and consumers' rapid adoption of new technologies, researchers are increasingly interested in mobile apps as a new generation of technology-based services [4, 5].

Based on user-centric design and usefulness, mobile app developers and marketers are judged by their ability to attract and keep a large user base [6]. The banking industry has adopted mobile apps as a strategic channel for service delivery in the digital age. Clients can access their accounts and explore banking goods and services via mobile devices [7]. Smartphones, tablets, and SMS-based devices can get account alerts, browse bank statements, and manage transactions [8]. This technological change has improved financial services by bypassing physical limits, improving client convenience and efficiency [9]. Despite its benefits, mobile banking has drawbacks. It improves banks' cost-effectiveness and sustainability but exposes them to security dangers, network flaws, and consumer knowledge gaps. Malware assaults and harmful programming can compromise mobile banking systems. SMS banking threats include authentication data theft during transactions. In countries with poor infrastructure and unpredictable telecommunication networks, mobile banking is difficult to use [10]. Customer education and awareness are another major issue. Lack of information regarding mobile banking technologies often leads to hesitancy or incorrect use. Banks must spend on instructional efforts and customer support to improve digital literacy and mobile banking trust [11]. So mobile banking is a transformational but complicated breakthrough. Banks must balance user experience and risk mitigation as they evolve, especially in regions with infrastructure or technology limits.

2.2. Mobile banking services and adoption theories

Many theoretical models have been used to study mobile banking adoption variables. In Yogyakarta, Indonesia, the Technology Acceptance Model (TAM) was used to study digital banking customers. Social image, danger, and trust were also considered in this study. The findings showed that perceived trust and risk were more powerful in determining users' views and intentions to utilize digital banking than social image, perceived ease of use, and perceived utility [12].

A study on e-banking adoption in India added customer service, web design, assurance, preferential treatment, and information availability to the TAM. This model tried to improve customer behavior through brand attitude. Contrary to TAM's premise, perceived ease of use did not affect customer attitudes and intentions to utilize internet banking, but quality and perceived usefulness did. Saparudin et al. [13] used an enhanced Unified Theory of Acceptance and Use of Technology (UTAUT) model with trust to examine consumers' sustained mobile banking intention. This 402-person poll indicated that trust, performance expectancy, effort expectancy, and social influence greatly affected consumers' continuous intention to use mobile banking, with trust being the most important. Suhartanto et al. [14] examined Islamic mobile banking uptake using TAM and a religiosity-behavioral intention model. In a sample of 300 Islamic bank clients in West Java, Indonesia, religiosity, perceived usefulness, and simplicity of use influenced mobile banking uptake. Kumar et al. [15] extended the TAM to create a comprehensive framework to study mobile banking uptake in India. This model combined TAM constructs—perceived ease of use and usefulness—with four customer-oriented constructs: self-efficacy, subjective norms, trust, and personal innovativeness. Survey results from 203 potential users showed that these characteristics, together with the TAM dimensions, strongly influenced customers' mobile banking inclinations.

Nguyen and Nguyen [16] compared customer perceptions of Corporate Social Responsibility (CSR) and technology uptake in Vietnam and South Korea to propose a new model merging TAM with CSR. The results showed that CSR activities affected trust, perceived utility, and mobile banking intention in Vietnam but not in South Korea. Baabdullah et al. [17] added perceived privacy and security to the TAM and Task-Technology Fit (TTF) model in Saudi Arabia to influence mobile banking uptake. According to a self-administered questionnaire, perceived privacy, security, usability, and TTF positively influenced mobile banking usage. Upadhyay et al. [18] used the Unified Theory of Acceptance and Use of Technology (UTAUT) with perceived severity and self-efficacy to study consumers' mobile payment service behavior during the COVID-19 epidemic. Performance expectancy, effort expectancy, and perceived harshness greatly affected consumers' attitudes, which affected their behavioral intention and use behavior. Self-efficacy and facilitating situations similarly increased effort expectancy, but social influence did not. Rafdinal and Senalasari [19] used TAM and the Technology Readiness Index to analyze mobile payment app adoption during the COVID-19 outbreak in Indonesia. The Technology Readiness Index (TRI) components strongly influenced perceived utility and ease of use, which directly affected attitudes and intention to use mobile payment applications [20]. In their 2020 study, Merhi et al. [21] explored how age and gender affect mobile banking intentions. Age and gender influenced the link between trust, facilitating conditions, performance expectancy, and mobile banking use, with substantial differences between Lebanese and British respondents. Finally, Chawla and Joshi [22] examined how gender, age, education, and income affect mobile banking attitudes. They discovered that age, gender, and income moderated, but education did not. These studies demonstrate the complexity of mobile banking adoption and how individual, technological, and contextual factors affect it across regions and customer segments. To study mobile banking uptake and maintenance, researchers are using more models including TAM, UTAUT, and extended frameworks.

2.3. Banking sector

Banking drives economic growth through investment, credit, and infrastructure. Offering services like money storage, lending, and investing to individuals and corporations boosts economic growth. Banking involves taking public deposits and using them for lending or investing, using cheques or drafts. The industry manages, protects, and benefits from finances. External and internal business environments affect bank profitability in several ways. Identifying the fundamental elements affecting banking profitability is crucial. Sarwar et al. [23] found that liquidity, asset management quality, and capital adequacy affect profitability. Inflation and profitability were also linked by Sanyaolu et al. [24]. However, Onofrei et al. (2018) found that nongovernmental credit increased bank profitability, whereas inflation did not. Mahmud et al. [25] found that bank capital increases profitability. This study examines bank liquidity and managerial quality—two crucial factors. To adapt to changing technology, e-money is a key factor in banking profitability.

2.3.1. Bank liquidity

Liquidity refers to a bank's ability to meet its short-term financial obligations, ensuring that it can satisfy customer demands for withdrawals and payments. While liquidity is often associated with cash, it also includes assets that can be quickly converted into cash to meet such obligations. Maintaining adequate liquidity is essential for a bank's survival and operational stability. Research by Mahmud et al. [25] suggested that banks with lower liquidity tend to generate higher profits, likely due to more aggressive investment strategies. In a study of GCC (Gulf Cooperation Council) countries, Imani and Pracoyo [26] found that bank size and asset management were significant factors influencing performance, with liquidity playing a moderating role in the relationship between capital adequacy, asset quality, and profitability. Similarly, Al-Matari [27] emphasized that liquidity and effective management are vital for organizational expansion and profitability. Yusuf et al. [28] examined Lebanese banks and found that maintaining high liquidity ratios served as a precautionary measure against the country's economic instability, allowing banks to withstand crises.

2.3.2. Management quality

In today's competitive environment, management quality has emerged as a strategic necessity for companies aiming to maintain a competitive edge. A study indicated that quality management, particularly factors like customer focus, teamwork, and organizational environment, significantly impacts banking performance. In Egypt, a study explored the role of quality management in enhancing strategic agility within banks. The study found that quality management practices had a substantial influence on the ability of Egyptian banks to adapt to market changes, with senior management's commitment to quality playing a moderating role. Additionally, Tagger and Gupta [29] demonstrated that the implementation of total quality management principles, such as customer-centric strategies, positively affected the performance of banks. A study conducted in the UAE by Alhosni and Tariq [30] confirmed that mobile banking service quality had a direct and significant impact on customer satisfaction, underlining the importance of quality management in enhancing service delivery.

2.3.3. E-money

Technological advancements have introduced alternative payment methods such as electronic money (e-money), also referred to as digital money or mobile payments. E-money enables transactions without the need for physical cash or cheques and is increasingly used as a tool for streamlining banking operations. Research has shown that the adoption of electronic payments positively impacts bank performance. Gündoğdu and Taşkın [31] demonstrated a positive correlation between the use of electronic payments and bank profitability in Turkey. Similarly, studies in Nigeria [32] and Pakistan [33] found that the adoption of electronic banking, particularly mobile banking, significantly enhanced key performance metrics such as return on assets and return on equity. Furthermore, Lu [34] examined the effect of various cashless payment methods, excluding e-money, on the performance of Malaysian commercial banks and found that cashless payments positively influenced the banks' financial performance.

2.4. Economic sector

An economic sector refers to a category within an economy that specializes in a specific type of activity or industry. It consists of businesses that share common characteristics. Achieving sustained economic growth is a primary objective for most nations, though various factors complicate this process. This study focuses on three critical factors affecting economic development: exchange rates, purchasing power, and the digital economy.

2.4.1. Exchange rate

The exchange rate refers to the value of one currency relative to another, which is influenced by both domestic conditions and external factors, including economic crises. In Lebanon, the financial crisis has severely impacted the banking sector, as the country faces a shortage of foreign currency and limitations on withdrawal capabilities. As a result, the Lebanese banking system is now characterized by multiple exchange rates: one set by the central bank, another by commercial banks, and a third on the black market. This disparity has led to fees imposed on customer withdrawals. Sitompul et al. [35] explored the impact of exchange rates and inflation on Islamic bank assets in Indonesia and found mixed results. Other studies have shown that exchange rate fluctuations can directly affect bank performance, particularly in terms of foreign exchange transactions. In contrast, Maduhansa [36] discovered a strong inverse correlation between Sri Lanka's banking industry's financial performance and changes in exchange rates.

2.4.2. Purchasing power

Purchasing power refers to an individual's ability to purchase goods and services based on their income and the prevailing price levels. In Lebanon, the financial crisis, high inflation, and unemployment rates have led to a dramatic decline in purchasing power. The economic downturn, exacerbated by the COVID-19 pandemic and the Beirut explosion, has led to widespread poverty and reduced access to basic goods and services [37]. As inflation continues to erode salaries and wages, the general population has become increasingly unable to afford goods and services, resulting in a shift toward basic necessities.

2.4.3. Digital economy

The digital economy refers to the integration of digital technologies in economic processes and transactions. As technology continues to advance, it is expected to bring about significant transformations in how economic systems operate, blurring the lines between the physical and virtual worlds [38]. Research by Mayer et al. [39] suggests that broadband access has different effects on GDP depending on the income level of the country. Governments

play a crucial role in fostering digital transformation by supporting initiatives that facilitate digital platforms, mobile payments, and digital skills training. The shift to digital technologies is expected to create new economic opportunities, although challenges related to financing, technical skills, and infrastructure remain.

2.5. Political sector

The political sector refers to the legal entities that comprise a state or government, encompassing both formal political systems and their interactions with nonpolitical subsystems such as the economy. Government entities are responsible for delivering services, managing resources, and contributing to economic development. According to the United Nations Development Programme [40], improvements in infrastructure quality and government expenditure on public services contribute significantly to economic growth. Babalola [41] found that government investment in infrastructure enhances productivity and drives economic development.

2.6. Infrastructure

Infrastructure is important for a country's growth because it supports economic activity by making it possible to provide basic services. High-quality infrastructure improves the performance of various sectors like banking, healthcare, and education. Chen et al. [42] examined how information and communication technology (ICT) could help Lebanese commercial banks perform better. He found that using ICT was directly related to higher bank profits. This study demonstrates the importance of technological improvements. But past studies have not examined the role of infrastructure on the use of mobile banking services. This study fills in the gaps by investigating the infrastructure's influence on the adoption of mobile banking. It adds to the body of knowledge by testing these relationships in the real world in Lebanon, where infrastructure and economic problems are always present.

3. Research Objectives and Questions

This study examines new consumer factors affecting mobile banking uptake in Lebanon. Lebanese banks can improve their tactics, reestablish confidence, and increase mobile banking use with the study's actionable findings. The main goal is to explore how infrastructure, a major mediating component, affects mobile banking adoption and how three key sectors—banking, economic, and political—influence this relationship. The study examines:

1) Banking Sector Variables:

- Bank Liquidity: Examining the influence of liquidity on mobile banking infrastructure investments.

Evaluating the impact of electronic money on mobile banking adoption by improving digital payment systems.

- Management Quality: Examining how operational efficiency and management practices impact infrastructure construction and maintenance.
- Exchange Rates: Examining how changes impact digital financial services stability and accessibility.

2) Economic Sector Variables:

Researching the impact of consumer purchasing power on infrastructure investments and mobile banking demand.

The study examines how the digital economy's growth and integration affect infrastructure and mobile banking usage.

3) Political Sector Variables:

- Assessing how government policies, activities, and stability impact infrastructure development and mobile banking uptake.

This study intends to fill research gaps and provide a complete understanding of the linked elements that affect mobile banking uptake in Lebanon. It also offers evidence-based advice to banks and regulators on infrastructure, consumer confidence, and financial inclusion.

Building on the objectives outlined above, the primary research question can be reformulated as follows:

RQ0: What are the key sectors influencing the adoption of mobile banking services?

To answer this question, the following sub-questions must be addressed:

1) RQ01: What are the key factors within the banking sector, related to infrastructure, that influence the adoption of mobile banking services?
    - Does bank liquidity influence investment in upgrading banking infrastructure?
    - How does management quality impact the maintenance and investment in infrastructure?
    - To what extent does the success of e-money rely on the quality of infrastructure?
2) RQ02: What are the key factors within the economic sector, related to infrastructure, that influence the adoption of mobile banking services?
    - Is there a relationship between exchange rates and infrastructure development?
    - How does purchasing power affect investment in infrastructure?
    - Does the digital economy influence investment in infrastructure?
3) RQ03: To what extent does infrastructure play a positive role in the adoption of mobile banking services?

4. Methodology and Research Hypotheses

The methodology for this research is designed to comprehensively explore the factors affecting the adoption of mobile banking services in Lebanon, specifically focusing on the role of the banking, economic, and infrastructure sectors. The study employs a mixed-methods approach, combining both quantitative and qualitative data collection techniques to provide a nuanced understanding of the research questions. By integrating both types of data, the research benefits from the strengths of each approach, ensuring a more comprehensive analysis of the subject matter.

4.1. Research design and approach

This research adheres to the critical realism paradigm, which posits that reality exists independently and objectively, similar to positivism, but emphasizes the importance of context in understanding phenomena [25]. Critical realism seeks to uncover the underlying mechanisms that drive observed events and actions. This framework is particularly relevant for this study, as it allows for an exploration of how various factors from the banking and economic sectors, as well as infrastructure, interact to influence the adoption of mobile banking services in Lebanon.

4.2. Mixed-methods design

The research utilizes a mixed-methods design to gather both quantitative and qualitative data. This approach enables the researcher to draw on the strengths of both methodologies, allowing for a more robust and comprehensive examination of the factors influencing mobile banking adoption. The quantitative data is collected through structured questionnaires, while the qualitative data is gathered through semi-structured interviews with key stakeholders in the banking sector.

Quantitative Data Collection: Mobile banking adoption data is collected via a standardized questionnaire. Mobile banking consumers and experts receive the questionnaire. The sample is convenient. The survey was given to available, willing participants, and gender, age, education, and banking experience were varied to ensure a broad sample. This tool is excellent for broad, generalizable insights regarding Lebanon's mobile banking adoption variables.

Qualitative Data Collection: Lebanese bank managers and other professionals are interviewed semi-structured. Deliberate sampling selected 14 banking specialists. For relevant and informed perceptivity, participants were selected based on their managerial responsibilities, topic competence, and considerable Lebanese banking sector experience. This technique provides for in-depth conversations and flexibility in addressing infrastructure and political sector elements that affect mobile banking uptake. The semi-structured method lets the interviewer ask follow-up questions and alter the conversation to acquire deeper insights.

4.3. Data analysis

The collected data is analyzed using a combination of statistical and thematic analysis techniques. The quantitative data from the questionnaires is analyzed through descriptive and inferential statistical methods to identify patterns, relationships, and trends. The qualitative data from the interviews is analyzed using thematic analysis, where key themes and patterns are identified and analyzed to understand the underlying factors influencing the adoption of mobile banking.

4.4. Hypotheses development

Based on the objectives of the study and the theoretical framework derived from the literature, the following hypotheses are proposed (see Figure 1):

H1: Banks with higher liquidity levels are more likely to invest in infrastructure upgrades.

H2: Effective management quality has a positive impact on the maintenance and investment in infrastructure.

H3: There is a positive relationship between the success of e-money and the quality of infrastructure.

H4: The relationship between exchange rates and infrastructure is complex and multifaceted.

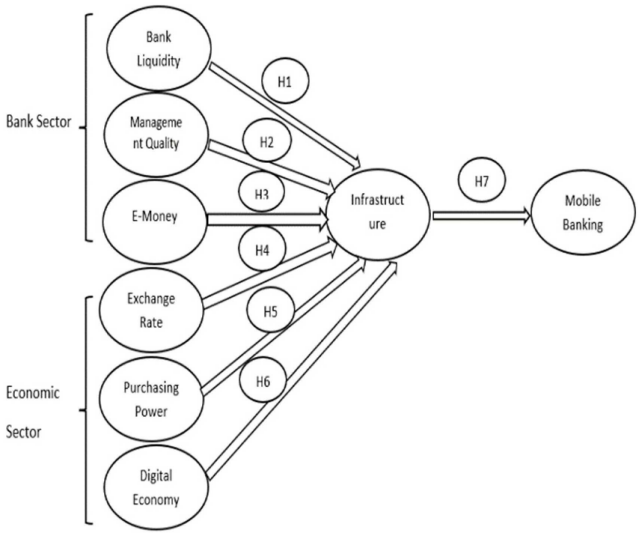
H5: The level of purchasing power significantly influences investments in infrastructure.

H6: The growth and development of the digital economy have a substantial effect on infrastructure investment.

H7: The availability and quality of infrastructure significantly influence the adoption of mobile banking, as reliable infrastructure enhances access to digital services, improves connectivity, and fosters financial inclusion.

As illustrated in Figure 1, the variable "Infrastructure" is regarded as a mediating variable due to its role as a transmission mechanism through which factors from the banking and economic sectors influence mobile banking adoption. Unlike a moderating variable, which interacts with other predictors to change the strength or direction of their effects, infrastructure follows a logical causal pathway: it is influenced by external factors (e.g., bank liquidity, exchange rate) and, in turn, directly impacts mobile banking. The infrastructure variable provides a clearer understanding of how structural and economic conditions shape digital banking adoption.

Figure 1
Research model



4.5. Validity and reliability

To ensure the validity and reliability of the study, the research instruments (questionnaires and interview guides) were carefully designed based on existing literature and expert input. Pre-testing of the questionnaire was conducted to refine the questions and ensure clarity and comprehensiveness. Additionally, triangulation is used to increase the validity of the findings by comparing data from multiple sources, including both qualitative and quantitative data.

This research design is aimed at thoroughly investigating the factors influencing the adoption of mobile banking services in Lebanon, with a particular focus on the role of the banking sector, economic conditions, political sector, and infrastructure. By using a mixed-methods approach, this study will provide a comprehensive understanding of the complex relationships between these factors and offer valuable insights for policymakers, banks, and other stakeholders in the Lebanese banking sector.

5. Results and Discussions

In this section, the key findings of the study will be presented and analyzed. The results will be discussed in two main parts: first, the outcomes of the qualitative study will be outlined, followed by an examination of the results derived from the quantitative analysis. This structured approach allows for a comprehensive understanding of the research findings, integrating insights from both methodological approaches.

5.1. Qualitative study

In this study, 14 interviews were conducted with key stakeholders from the banking sector. The interviews were carried out

in person and had an average duration of 45 minutes. Each interview consisted of 12 questions, beginning with inquiries about the interviewee's background and professional experience. Subsequent questions explored mobile banking services, the strategies adopted by banks to mitigate risks, and the impact of infrastructure on mobile banking. Additionally, questions were posed regarding the role of state institutions—such as their activities, laws, and policies—in fostering infrastructure development. Finally, the interviews addressed the current state of infrastructure in Lebanon and its implications for the adoption of mobile banking, with interviewees offering recommendations for improvement. The responses to each of the interview questions are summarized in Table 1.

This table effectively organizes the findings of the interviews, offering a clear and concise overview of the key themes discussed in relation to the adoption of mobile banking in Lebanon. The findings indicate that mobile banking services offer significant benefits for both banks and customers, with the key determinant being the availability and quality of infrastructure. The political sector—specifically, government activities, laws, policies, and government stability—plays a substantial role in shaping infrastructure development and investment. By strengthening the legal framework and fostering trust with consumers, the political sector can positively influence the adoption of mobile banking services. Based on the interview results, three new hypotheses that explore the connection

Table 1
Answer of the interview questions

Question Number	Question	Summary of Responses
Q1	Experience in the banking field, professional background, and career path.	All interviewees had backgrounds in economics, finance, business, or related fields. They had extensive experience in the banking sector, holding managerial positions or working as lecturers.
Q2	Most effective mobile services for the bank.	Mobile banking apps were identified as the most effective service for customers, offering bill payments, account management, and cash transfers. However, many users only use the app for information retrieval due to trust issues, lack of awareness, and high costs.
Q3	Consumer awareness regarding mobile banking services.	Methods to increase awareness include marketing campaigns, workshops, and offering incentives like discounts and fee waivers. However, most respondents agreed that banks in Lebanon currently do not prioritize educating consumers about mobile banking services.
Q4	Strategies to reduce perceived risks associated with online services.	Banks employ risk management strategies such as 24-hour customer support, software updates, transaction limits, and security audits to mitigate perceived risks related to online/mobile banking services.
Q5	The political sector and infrastructure concerning mobile banking services in Lebanon.	All interviewees agreed that Lebanon suffers from weak infrastructure, instability, and regulatory uncertainty, which hinder mobile banking adoption.
Q6	The effects of infrastructure on mobile banking services.	Strong infrastructure (electricity, reliable internet, security systems) is crucial for mobile banking's success. It facilitates financial inclusion, builds user trust, and encourages adoption.
Q7	The impact of government activities on the development and investment in infrastructure in Lebanon.	Government activities, including fiscal management, regulation, and crisis response, are essential for infrastructure development. Effective governance is needed for progress.
Q8	The impact of laws on the development and investment in infrastructure in Lebanon.	Legislation plays a critical role in infrastructure development by ensuring legal frameworks are in place, promoting investor confidence, and supporting project viability.
Q9	The impact of policies on the development and investment in infrastructure in Lebanon.	Policies significantly affect infrastructure development and investment. Efficient and consistent policy application influences the success and sustainability of infrastructure projects.
Q10	The impact of government stability on the development and investment in infrastructure in Lebanon.	Government stability is key to successful infrastructure projects. Stability ensures smooth financing, planning, and execution, while instability disrupts these processes.
Q11	The impact of available infrastructure on the decision to adopt mobile banking in Lebanon.	Interviewees agreed that the quality and availability of infrastructure are critical factors in the adoption of mobile banking services. Better infrastructure correlates with higher adoption rates, while poor infrastructure limits usage.
Q12	Recommendations to improve the current situation.	Government should invest more in critical infrastructure areas such as communication, technology, and electricity.

between the political sector and infrastructure development can be proposed:

H8: Government activities significantly influence the development and maintenance of infrastructure.

H9: The implementation of effective laws and policies significantly influences infrastructure development, maintenance, and sustainability.

H10: Government stability positively affects the development and investment in infrastructure.

These new hypotheses offer additional insights into the relationship between the political sector, infrastructure, and the adoption of mobile banking services in Lebanon.

5.2. Quantitative study

A 35-question structured questionnaire was created to cover all variables in accordance with the qualitative study's aims, hypotheses, and conclusions. Participants' gender, age, education, occupation, experience, and bank account information are presented in the first portion of the questionnaire. The second part examines mobile banking adoption factors. This component comprises seven divisions based on the number of variables in the study: bank liquidity, quality management, e-money, exchange rates, purchasing power, digital economy, and infrastructure. Each segment had five variable-related questions. This Google Forms questionnaire was sent to a convenience sample of Lebanon bank clients by email and social media. No financial incentives were offered for voluntary participation. 200 completed questionnaires with no missing values yielded 200 eligible replies for analysis. Thus, the survey response rate is 100%, computed by dividing the number of valid questionnaires (200) by the total number of collected questionnaires (200). Respondents are grouped by gender, age, education, experience, occupation, and bank account ownership. Table 2 shows respondents' socio-demographic characteristics, including gender, age, education, professional experience, employment status, and bank account ownership.

Table 2
Respondents' profile

Category	Subcategory	Percentage
Gender	Male	52.5%
	Female	47.5%
Age	18–25	14.5%
	26–35	41.5%
	36–45	30%
	46–55	10.5%
	55+	3.5%
Education Degree	Bachelor	72%
	Master	23.5%
	PhD	4.5%
Years of Experience	Less than 5 years	13.5%
	Between 5 and 10 years	58%
	Between 10 and 15 years	18%
	More than 15 years	10.5%
Occupation	Employed	95.5%
	Unemployed	4.5%
Bank Account	Yes	72%
	No	28%

The following statistical tests were used in this study:

1) Cronbach's alpha to assess the internal consistency and reliability of the questionnaire.
2) Pearson correlation to evaluate the strength and direction of the correlations among the various variables.
3) ANOVA to determine whether significant differences existed among the group means. It is also used to verify the impact of independent variables on mobile banking usage.

5.3. Reliability analysis

The results of the reliability test, as indicated by the Cronbach's alpha coefficient, are summarized in Table 3. Cronbach's alpha values are used to assess the internal consistency and reliability of the measurement scale. The values presented suggest that the reliability of the variables is generally high, with all individual variables exceeding the commonly accepted threshold of 0.6, except for the "Exchange Rate" variable, which falls below this threshold.

Table 3
Cronbach's alpha coefficient

Cronbach's Alpha	Number of Items	Variable
0.862	5	Bank Liquidity
0.426	5	Management Quality
0.806	5	E-Money
0.246	5	Exchange Rate
0.950	5	Purchasing Power
0.906	5	Digital Economy
0.868	5	Infrastructure
0.934	35	Total

The overall Cronbach's Alpha for the entire scale is 0.934, which indicates excellent internal consistency, suggesting that the items in the measurement scale are highly correlated and likely measure the same underlying construct. Specifically, the values for "Bank Liquidity," "Purchasing Power," "Digital Economy," and "Infrastructure" all demonstrate strong internal consistency. Even some Cronbach's Alpha values are less than 0.6, which demonstrates lower internal consistency for certain indicators like Exchange Rate. However, the overall reliability of the scale remains high with Cronbach's Alpha equal to 0.934. Thus, these values suggest that some indicators may require refinement in future studies, but the overall instrument is robust.

5.4. Pearson correlation

The correlation between the three variables of the bank sector—Bank Liquidity, Quality Management, and E-Money—and the infrastructure variable is presented in Table 4. In this table, the following variables are used to identify the dependent variable:

1) Ease of Access to Mobile Banking (EAM) represents the complexity level of navigating and using mobile banking services without technical or infrastructural barriers.
2) User Satisfaction of Mobile Banking (USMB)
3) Trust in Mobile Banking Transactions (TMBT) shows the users' confidence in the security, reliability, and privacy of digital financial activities performed using a mobile application.

Table 4
Bank sector and infrastructure – Pearson correlation

Variable	EAM	USMB	TMBT	EUMB	AMB
Bank Liquidity (BL)					
BL1	0.897**	0.877**	0.890**	0.877**	0.725**
BL2	0.865**	0.842**	0.857**	0.842**	0.669**
BL3	0.881**	0.882**	0.923**	0.902**	0.705**
BL4	0.644**	0.652**	0.651**	0.625**	0.484**
BL5	0.834**	0.838**	0.878**	0.858**	0.594**
Quality Management (QM)					
QM1	0.946**	0.923**	0.939**	0.923**	0.755**
QM2	0.953**	0.940**	0.951**	0.930**	0.755**
QM3	0.969**	0.976**	0.976**	0.947**	0.759**
QM4	0.979**	0.967**	0.976**	0.957**	0.773**
QM5	0.977**	0.956**	0.970**	0.956**	0.775**
E-Money (EM)					
EM1	0.954**	0.932**	0.947**	0.932**	0.759**
EM2	0.895**	0.884**	0.878**	0.874**	0.665**
EM3	0.894**	0.878**	0.855**	0.870**	0.730**
EM4	0.954**	0.932**	0.947**	0.932**	0.759**
EM5	0.977**	0.956**	0.970**	0.956**	0.775**

4) Encouragement to Use Mobile Banking (EUMB) reflects the external or institutional factors such as marketing, incentives, and bank communication that motivate users to adopt mobile services.
5) Adoption of Mobile Banking (AMB) evaluates the degree to which users' needs are met by the mobile banking experience. Thus, he can adopt it to perform their banking transactions.

The table shows Pearson correlation scores, with values above 0.5 indicating a strong positive relationship between the respective variables.

From Table 4, it can be concluded that there is a strong positive relationship between the variables of bank liquidity, quality management, and e-money and the infrastructure. Specifically:

Bank liquidity demonstrates a strong positive correlation with infrastructure across all variables, indicating that higher liquidity levels are associated with better infrastructure.

Quality management shows a similarly strong positive correlation with infrastructure, emphasizing that well-managed banking institutions are likely to invest in and benefit from improved infrastructure.

E-money also exhibits a robust positive relationship with infrastructure, suggesting that investments in electronic money services are closely tied to the availability and quality of infrastructure.

The results showed that the three independent variables of the model—bank liquidity, quality management and e-money—are mostly supplied by the banking industry.

The correlation between the three economic sector variables—exchange rates, purchasing power, and the digital economy—and infrastructure is provided in Table 5. The Pearson correlation values greater than 0.5 indicate a strong positive relationship, while scores ranging from 0.3 to 0.5 suggest a moderate positive relationship.

From Table 5, it can be concluded that:

1) Exchange rates and digital economy demonstrate a strong positive correlation with infrastructure, indicating that changes in exchange rates and advancements in the digital economy are strongly associated with improvements in infrastructure.
2) Purchasing power shows a moderate positive correlation with infrastructure, suggesting that the purchasing power of consumers has a somewhat lesser but still relevant impact on the infrastructure.

Table 5
Economic sector and infrastructure – Pearson correlation

Variable	EAM	USMB	TMBT	EUMB	AMB
Exchange Rates (ER)					
ER1	0.900**	0.881**	0.894**	0.881**	0.730**
ER2	0.928**	0.908**	0.921**	0.908**	0.740**
ER3	0.929**	0.909**	0.923**	0.909**	
ER4	0.926**	0.906**	0.919**	0.906**	0.749**
ER5	0.944**	0.923**	0.937**	0.923**	0.739**
Purchasing Power (PP)					
PP1	0.526**	0.515**	0.522**	0.515**	0.465**
PP2	0.523**	0.511**	0.519**	0.511**	0.463**

(*Continued*)

Table 5
(*Continued*)

Variable	EAM	USMB	TMBT	EUMB	AMB
PP3	0.516**	0.505**	0.512**	0.505**	0.481**
PP4	0.526**	0.515**	0.522**	0.515**	0.480**
PP5	0.527**	0.515**	0.523**	0.515**	0.377**
Digital Economy (DE)					
DE1	0.977**	0.956**	0.970**	0.956**	0.775**
DE2	0.951**	0.929**	0.944**	0.929**	0.757**
DE3	0.954**	0.932**	0.947**	0.932**	0.759**
DE4	0.995**	0.973**	0.944**	0.973**	0.757**
DE5	0.974**	0.957**	0.981**	0.967**	0.773**

Table 6
Infrastructure – Pearson correlation

Variable	EAM	USMB	TMBT	EUMB	AMB
Infrastructure					
Ease of Access	1	0.988**	0.954**	0.978**	0.757**
User Satisfaction	0.988**	1	0.965**	0.980**	0.741**
Trust in Transactions	0.954**	0.965**	1	0.975**	0.752**
Encouragement to Use	0.978**	0.980**	0.975**	1	0.741**
Adoption	0.757**	0.741**	0.752**	0.741**	1

Table 6 presents the correlation between infrastructure and the AMB services. The Pearson correlation scores are all above 0.5, indicating a strong positive relationship between the infrastructure and the AMB services.

Based on the results from Tables 4, 5, and 6, it can be concluded that the infrastructure plays a crucial role in the AMB services. A strong positive relationship between the infrastructure and all dimensions of mobile banking adoption is evident. Furthermore, the bank and economic sectors significantly influence infrastructure, with purchasing power showing a moderate relationship with infrastructure. In summary, the results highlight that both the bank and economic sectors have a significant statistical influence on the infrastructure, which in turn, plays a key role in the adoption of mobile banking services. However, the moderate correlation between purchasing power and infrastructure suggests that other factors may also contribute to infrastructure development, warranting further exploration.

5.5. ANOVA test

ANOVA test results for the three bank-related variables—bank liquidity, quality management, and e-money—are shown in the tables below. The significance level, which should be less than 0.05, is the most crucial component of this table.

For the bank liquidity:

Table 7
ANOVA test – bank liquidity and infrastructure investment

ANOVA						
	Model	Sum of Square	df	Mean Square	F	Sig.
1	Regression	184.509	1	184.509	2352.586	000
	Residual	15.529	198	078		
	Total	200.038	199			

The results of the ANOVA are significant: Sig. = 000, and F = 2352.586. The model receives important information from the bank liquidity as an independent variable, with a significance level of $p < 0.05$.

For the quality management:

Table 8
ANOVA test – management quality and infrastructure maintenance and investment

ANOVA						
	Model	Sum of Square	df	Mean Square	F	Sig.
1	Regression	184.509	1	184.509	2352.586	000
	Residual	15.529	198	078		
	Total	200.038	199			

The threshold of significance is substantial and below 0.05. F = 5850.938 and Sig. = 000 are displayed in the table. To sum up, quality management is an independent variable that gives the model important information.

For the e-money:

Table 9
ANOVA test – e-money and infrastructure quality

ANOVA						
	Model	Sum of Square	df	Mean Square	F	Sig.
1	Regression	189.774	1	189.774	3660.705	000
	Residual	10.264	198	052		
	Total	200.038	199			

The threshold of significance is substantial and below 0.05. F = 3660.705 and Sig. = 000 are displayed in the table. So, the e-money gives the model important information as an independent variable.

By highlighting the major infrastructure-related elements in the banking industry that affect the uptake of mobile banking services, the findings in Tables 7, 8, and 9 directly address RQ01. In particular, the table shows that bank liquidity has a positive impact on investments made to upgrade banking infrastructure, demonstrating that banks with sound financial standing are better able to devote resources to technological advancements. It also emphasizes how important management quality is, demonstrating how strong leadership improves infrastructure maintenance and strategic investment. The results also show a strong positive correlation between the infrastructure and the success of e-money, suggesting that robust and well-designed systems are necessary for the broad adoption of digital financial services. All of these findings point to the significance of infrastructure, managerial efficacy, and financial stability in encouraging the use of mobile banking.

Additionally, the findings show that the data supports the following three hypotheses. There is a definite correlation between financial capacity and infrastructure development, as evidenced by the acceptance of H1, which claims that banks with higher liquidity levels are more likely to invest in infrastructure upgrades. The importance of strong leadership in maintaining and improving banking infrastructure is highlighted by the confirmation of H2, which states that effective management quality has a positive impact on infrastructure investment and maintenance. Lastly, the results support H3, which suggests a positive correlation between the success of e-money and the caliber of infrastructure, showing that strong infrastructure is a vital component that facilitates the efficient deployment and use of digital financial services. These findings highlight how important managerial, financial, and infrastructure elements are in determining how widely mobile banking services are used.

The tables below present the ANOVA test results for the variables related to the economic sector: exchange rates, purchasing power, and digital economy.

For the exchange rates:

Table 10
ANOVA test – exchange rates and infrastructure

ANOVA						
	Model	Sum of Square	df	Mean Square	F	Sig.
1	Regression	185.790	1	185.790	2581.796	000
	Residual	14.248	198	072		
	Total	200.038	199			

According to the table, $F = 2581.796$ and Sig. = 000. In summary, the model receives important information from the exchange rates as an independent variable.

For the purchasing power:

Table 11
ANOVA test – purchasing power and infrastructure investment

ANOVA						
	Model	Sum of Square	df	Mean Square	F	Sig.
1	Regression	108.718	1	108.718	235.722	000
	Residual	91.320	198	416		
	Total	200.038	199			

The significance criterion is less than 0.05, which is noteworthy. The table shows that Sig. = 000 and $F = 235.722$. In conclusion, the purchasing power as an independent variable provides the model with a significant amount of information.

For the digital economy:

Table 12
ANOVA test – digital economy and infrastructure investment

ANOVA						
	Model	Sum of Square	df	Mean Square	F	Sig.
1	Regression	194.043	1	194.043	6408.672	000
	Residual	5.995	198	030		
	Total	200.038	199			

Notably, the significance threshold is below 0.05. Sig. = 000 and $F = 6408.672$ are displayed in the table. To summarize, the model's independent variable that yields data is the digital economy.

The findings demonstrated that the three independent variables of the economic sector—exchange rates, purchasing power, and the digital economy—provide the model with important information.

Through the identification of important infrastructure-related economic sector factors that impact the uptake of mobile banking services, Tables 10, 11, and 12 provide findings that directly address RQ02. The findings show a significant correlation between exchange rates and the development of infrastructure, indicating that currency stability may have an effect on the viability and cost of making investments in technology infrastructure. Additionally, the table demonstrates how purchasing power has a significant impact on infrastructure investment because increased consumer spending capacity motivates the public and private sectors to improve connectivity and digital services. Lastly, by emphasizing that a greater reliance on digital platforms raises the demand for dependable and cutting-edge infrastructure, the analysis validates that the expansion of the digital economy has a positive impact on infrastructure investment. These observations highlight the critical role that macroeconomic variables play in determining the climate in which mobile banking is adopted.

Additionally, the findings show that the data supports the following three hypotheses. Exchange rate fluctuations can have a direct or indirect impact on infrastructure investment decisions, as supported by the acceptance of H4, which claims that the relationship between exchange rates and infrastructure is intricate and multifaceted. Stronger consumer spending power increases demand for improvements to both digital and physical infrastructure, supporting H5, which states that purchasing power has a significant impact on infrastructure investments. Lastly, the results support H6, which suggests that the expansion of the digital economy has a significant impact on infrastructure investment, highlighting the fact that reliable, contemporary infrastructure becomes more and more necessary as digital economic activity grows. These widely accepted theories support the idea that infrastructure development and economic conditions play a significant role in determining the uptake of mobile banking.

Finally, the table below presents the results of the ANOVA test related to the infrastructure.

For the infrastructure (moderate variable):

Table 13
ANOVA test – infrastructure and mobile banking adoption

ANOVA						
	Model	Sum of Square	df	Mean Square	F	Sig.
1	Regression	156.198	1	156.198	10477.505	000
	Residual	4.443	298	015		
	Total	16.641	299			

The threshold of significance is substantial and below 0.05. According to the table, Sig. = 000 and F = 10477,505. As a moderate variable, infrastructure, in summary, gives the model important information.

Table 13 offers convincing proof in answer to RQ03, which looks at how much infrastructure contributes to the uptake of mobile banking services. The findings provide compelling evidence in favor of the idea that infrastructure is a key component that makes digital financial access possible. The results specifically show how important infrastructure quality and availability are to improving user experience and TMB platforms. Examples of this infrastructure include internet dependability, mobile network coverage, and digital device accessibility. Additionally, the findings support H7, which asserts that infrastructure quality and availability have a major impact on mobile banking adoption since dependable infrastructure promotes financial inclusion, increases connectivity, and facilitates access to digital services. This demonstrates that robust infrastructure is not only helpful but also necessary to promote the broad use of mobile banking services.

6. Research Contributions

The main theoretical advances of the research are described in this section. The main contributions are:

Business science advancement: This research addresses an understudied subject and advances business science. It reveals new elements that influence customer decisions to embrace mobile banking services, providing significant insights into Lebanon's mobile banking drivers.

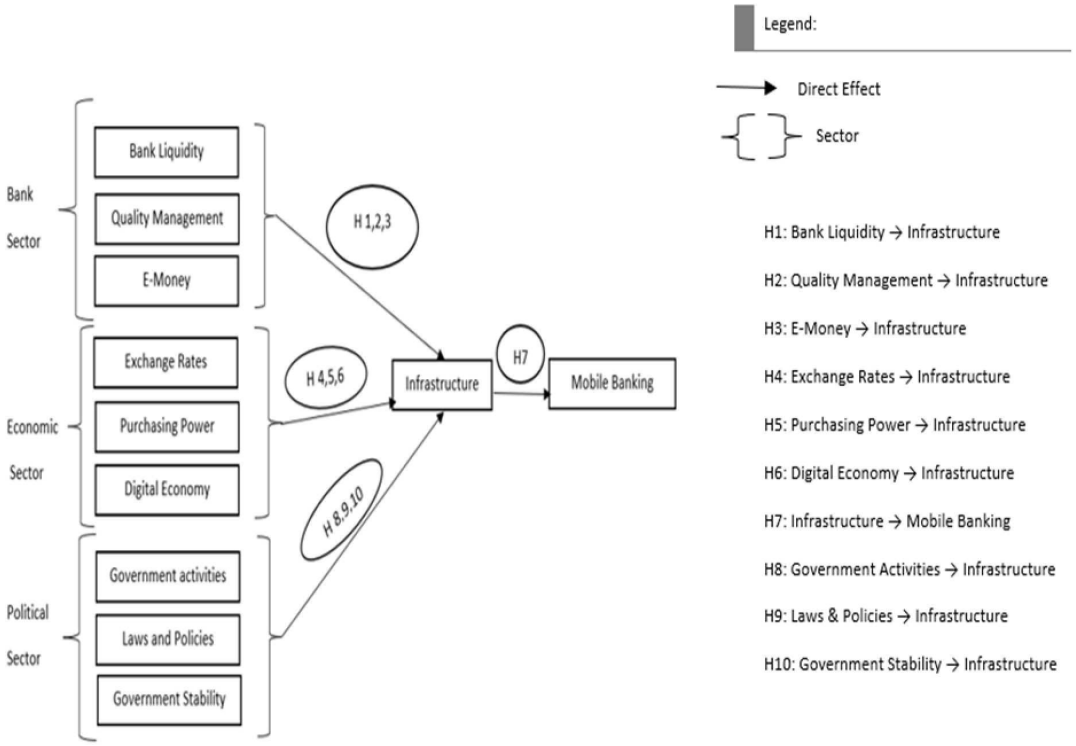
Research hypothesis development: The study systematically developed hypotheses to answer research issues. It examined three categories of independent variables: bank liquidity, quality management, and e-money, economic sector dimensions (exchange rates, purchasing power, and digital economy), and political sector dimensions. Infrastructure as a mediating element and mobile banking services as the dependent variable were examined. The research used mixed techniques to manipulate and analyze these factors, revealing their correlations.

Validated new conceptual model: This study found links between bank, economic, and political sectors and mobile banking uptake. This model shows how infrastructure upgrades might boost mobile banking usage by enabling their availability and quality.

This research explores the interconnectivity of the bank, economic, and political sectors in the context of mobile banking usage, introducing new theoretical approaches. The findings help create a new theoretical model that incorporates these three sectors as fundamental determinants of mobile banking infrastructure, opening new research opportunities.

Figure 2 shows the new applicable model, which includes these industries and infrastructure and mobile banking services. Figure displays the conceptual structure. It shows how infrastructure affects mobile banking uptake by sector. The model focuses on finance, economics, and politics. These places have separate characteristics that affect infrastructure growth, making mobile banking easier.The three hypotheses (H1, H2, and H3) about bank liquidity, quality management, and e-money affect infrastructure availability. These considerations demonstrate how mobile banking platforms can aid their finances and operations.

Figure 2
New applicable research model



Economy indicators include currency rates, buying power, and digital economy growth. The indicators correspond to hypotheses H4, H5, and H6. Strong infrastructure requires stable economies and established technologies. Mobile banking works better in connected digital economies.

According to H8, H9, and H10, government acts, laws, regulations, and stability affect infrastructure. A stable regulatory framework that fosters digital infrastructure investment makes users trust mobile banking technologies more.

In addition to some contributions below:

1) Allowed the persons in managerial positions to focus on and pursue strategies for intervention in the investment and development of infrastructure.
2) Highlighted to stakeholders in the government that strong laws and policies that protect banks' digital work contribute to digital banking.
3) Emphasized the role of infrastructure to enhance the quality of services provided to customers and their role to rebuild trust with the customer.
4) Increase the number of authorizations given by the Central Bank of Lebanon that allow banks to create digital banks.
5) Political decisions should be taken to re-empower the banking field and rebuild trust in this sector.

6.1. Conclusion

Lebanon's banking industry is vital to the economy, but the crisis has weakened it. High-quality customer services, notably mobile banking, are needed to resuscitate this industry and restore public trust, especially with the rise of digital technology. Understanding mobile banking adoption characteristics is a priority for researchers and practitioners. This research examines mobile banking adoption factors to add to the literature. This study addresses knowledge gaps and sheds light on adoption decisions through expert interviews and a comprehensive literature analysis. The empirical investigation validated seven hypotheses and generated three more via expert interviews. The data show that mobile banking services boost bank competitiveness and sustainability, especially during crises. Mobile banking can serve as a strategic tool for banks to maintain market relevance and strengthen customer loyalty, particularly during periods of economic instability. However, further research is needed to explore additional relationships between mobile banking and other sectors, such as the economic and political domains. For instance, addressing financial challenges, such as creating job opportunities to improve income levels, could positively impact bank transactions and the adoption of mobile banking services.

6.2. Recommendations

This report suggests many ways to improve mobile banking and boost adoption:

1) Regularly Assess Customer Challenges: Banks should invite users to provide comments and enhance mobile banking services.
2) Assess and change services to meet client demands and improve satisfaction.
3) Train Staff: Develop and implement programs to teach staff how to use new mobile banking technologies.
4) Teach clients about mobile banking perks and features through culturally varied awareness campaigns and workshops.
5) For mobile banking success, invest in infrastructure development and updates.
6) Add New Technologies: Use advanced banking apps to make mobile banking more appealing.
7) Encourage Adoption: Offer targeted promotions and incentives for mobile banking.
8) Fund research and advocacy efforts advancing mobile banking legislation and regulations.
9) Work with the government on infrastructure: Expand fiber-optic networks nationwide for stronger internet and faster mobile banking.
10) Create national cybersecurity policies to protect banks and mobile banking systems.
11) Work with the government to arrange mobile banking continuity during crises or system failures.
12) Improve Banking Infrastructure: For reliable and accessible services, government initiatives should prioritize mobile banking infrastructure.

By addressing these recommendations, both the banking sector and the Lebanese government can work together to overcome current challenges, enhance mobile banking services, and foster a more secure, efficient, and inclusive digital financial ecosystem. While the findings are context-specific to Lebanon, they may offer insights for other emerging economies facing similar infrastructural and financial challenges.

6.3. Limitations

The lack of current and trustworthy data specific to the Lebanese banking sector, especially in light of the ongoing economic and financial crisis, was a major limitation that hindered the authors' ability to conduct a more thorough statistical analysis or capture recent developments. Additionally, the lack of academic literature specifically focused on Lebanon and language barriers made it difficult to establish a strong local framework for comparison, and restricted access to banking professionals and stakeholders for interviews or surveys due to institutional hesitations and the current climate of uncertainty limited the incorporation of qualitative perspectives. Finally, it was challenging to make sure that all findings remained timely and relevant due to the nation's fast changes in financial regulations and digital infrastructure. Notwithstanding these drawbacks, the article seeks to provide insightful analysis and lay the groundwork for larger, future research projects.

Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest relevant to this work.

Data Availability Statement

The data that support this work are available upon reasonable request to the corresponding author.

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Author Contribution Statement

Rayan Othman: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Visualization, Project administration, Funding acquisition. **Ghalia Nassreddine:** Conceptualization, Validation, Writing – review & editing, Supervision, Project administration, Funding acquisition.

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