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DIGITAL TRANSFORMATION OF SAUDI ARABIA'S BANKING: A COMPARATIVE STUDY



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ABSTRACT

Banks' digital transformation has become a growing and competitive research area in the last decade. This study aims to compare the digital transformation of the Saudi banking sector with that of developed and emerging Islamic countries by examining progress, digital solutions to banking services provided, and regulatory frameworks. To this end, a systematic review was conducted, analyzing 44 primary documents and seven websites collected through a 5-step process: scoping, planning, searching, selection, and eligibility. Next, a comparative analysis of these documents was conducted, analyzing the similarities and differences of the digital transformation processes addressed by Saudi Arabia, the U.S., the United Kingdom, and Malaysia. The findings revealed that Saudi Arabia and Malaysia have banking sectors of similar size, smaller than those of the U.S. and the U.K., although all of these sectors are of significant importance in the economies of their respective countries, as measured by their share in GDP. All countries have adopted similar digital technologies and offer very similar banking services. Concerning its regulatory frameworks, the U.K.'s sandbox approach is the most effective and inspiring. At the same time, the U.S. needs to catch up due to its regulatory complexities and differences in approach between federal and state jurisdictions. For their part, Saudi Arabia and Malaysia have developed their regulatory frameworks with approaches inspired by the U.K. model, although both differ in the degree of Sharia compliance.

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INTRODUCTION

The banking industry has paid much attention to digital change worldwide, and Saudi Arabia (KSA) is no exception. Due to the increase in high-risk operations within a deregulated corporate landscape, particularly in the United States, the conventional banking sector played a significant role in starting the global financial crisis in 2008. In reaction to the financial collapse, new legislation imposed more significant obligations on banks, restricting their competitive powers. Surprisingly, these increased duties facilitated the growth of innovative technology players in the form of fintech companies.

The growing influence of Fintech companies has caused concern in the banking industry, as banks must coexist with and compete with Fintech companies. Due to technological disruption, the structure of financial systems is expected to develop dramatically in the coming years. As a result, the digital transformation of banking is an urgent need, and banks will need to invest heavily in technology to compete with each other and new entrants.

This article aims to assess the digital transformation of banking in Saudi Arabia and compare it with that of the United States, the United Kingdom, and Malaysia. It tries to assess the influence of digital transformation in banking, find solutions provided by banks, and understand the regulatory frameworks that protect digital transformations. For qualitative research, a systematic review of the literature was used. This study contributes to understanding the impact of the digital transformation of banking in various countries and identifies best practices for other banks seeking digital transformation.

The article is organized as follows: Initially, a literature review is presented that offers critical ideas for comparison on topics such as traditional banking, electronic banking, Fintech, seeking digital transformation, and regulatory approaches. Second, the Materials and Methods section presents the systematic review procedure. The third part, Results, presents bibliographic findings for each motor theme. Fourth, the discussion section compares in depth the driving themes between countries. Finally, the study's conclusions, implications, and limitations are discussed.

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LITERATURE REVIEW

Key terminologies such as traditional banking, Fintech, digital transformation, and electronic banking must be defined to compare the digital transformation of banking in Saudi Arabia with other countries. The drivers of digital transformation must be recognized, as must the interaction between financial technologies and banking services.

Traditional Banking Sector

Traditional banks act as financial intermediaries, accepting deposits and channeling them into lending activities. There are two types of banks: retail or commercial banking and investment banking (Sangale & Salve, 2019). Retail banking focuses on managing customer accounts, receiving and delivering money, making payments and transfers, advising on investments, and lending money to customers. Investment banking offers services such as consultancy to corporate clients in mergers and acquisitions, management of private investment funds, client support in issuing and negotiating shares, and support for corporate financing. Rahim et al. (2021) and Rupeika-Apoga and Thalassinou (2020) argue that the digital transformation of banking has led to the application of new technologies to how banks provide their traditional financial services.

Fintech Concept

Fintech is a term that refers to digital and software innovations that automate and improve the delivery of financial products and services (Omarova, 2020). It can also refer to companies that use innovative technologies to solve problems in the financial market (Alam, 2021). The Financial Stability Board (FSB) defines Fintech as technologically enabled financial innovations that could create new business models, applications, processes, or products that significantly affect financial markets and institutions (Arner et al., 2015; Navaretti et al., 2018; Panetta, 2018; Rupeika-Apoga & Thalassinou, 2020).

Fintech innovations have created a technology ecosystem that includes mobile apps, social media, blockchain, biometrics, quantum computing, cloud computing, open source computing, APIs, big data analytics, machine learning, artificial intelligence, the Internet of Things (IoT), and cyber security. (Alam, 2021; Piri, 2018). This fact has enabled innovative access to traditional financial products and services (Chemmanur et al., 2020; Goldstein et al., 2019; Rupeika-Apoga & Thalassinou, 2020).

Transformation of Digital Banking

Fintech has led to a digital transformation of traditional banking, with banks investing in technological development or seeking alliances with Fintech companies to offer innovative and differentiated financial services (Rickinghall, 2022). This circumstance has simplified operations, improved competitiveness, and increased the variety and quality of services banks and financial institutions provide worldwide. Collaboration between banking firms and Fintech is expected to continue through joint ventures, mergers, and acquisitions (Wewege & Thomsett, 2020). The result of Fintech adoption is the emergence of electronic banking.

Electronic Banking

Electronic banking is essential for digital transformation. It includes taking deposits, lending, account management, financial advice, electronic bill payment, and other electronic payment products and services (Alkhalidi & Al-Sadi, 2016; Alsomali, 2015; Yahaya & Ahmad, 2018; Zhihui, 2021). They can be classified into telephone banking, internet banking, and mobile banking. Telephone banking allows customers to conduct retail banking transactions by connecting a touch-tone telephone to an automated banking system. Internet banking allows customers to access bank accounts through a website and carry out transactions with strict security controls. It is the most profitable technological means for greater productivity (Williams & Adekunle, 2013).

Mahad et al. (2015) and Yahaya and Ahmad (2018) highlight mobile banking as an innovative method of accessing banking services, allowing customers to make transactions, view account statements, check balances, transfer funds, pay bills, manage accounts, and get information. SMS services and mobile applications provided by banks enhance interaction and attract new customers, making them an essential part of customers' daily routines.

Driving Themes of Digital Transformation

Nasir et al. (2021) conducted a bibliometric review of the Fintech literature to identify key themes and research directions. They identified three key streams of study, including the driving themes of the Fintech literature, covering topics such as the regulatory framework for Fintech companies, disruptive innovations in the financial industry, and the digitization of banking services. This study provides a conceptual basis for examining these issues in the countries examined.

The Transformation of Banking and Its Associated Technologies

Fintech developments in banking have been studied according to the Organization for Economic Cooperation and Development (OECD) approach, 2018, cited by Rupeika-Apoga and Thalassinou (2020). This partnership between services and technologies highlights the potential transactional benefits of distributed ledger technology (DLT) across financial services, the rise of automated advisors, and collaboration between traditional banks and lending platforms. DLT allows transactions to be cryptographically recorded and maintained by multiple bookkeepers, reducing transaction reconciliation costs, data discrepancies, and trade settlement times (Omarova, 2020). A.I. and DLT-based credit analysis algorithms are used for loan disbursement, and lending platforms have formed an increasing collaboration where banks place funds with lending companies to access new digital investment options (Palladino, 2018; Williams, 2020).

Approaches to Fintech Regulations

Omarova (2020) identified three Fintech regulatory approaches: Incorporation, Experimentation, and Adaptation. Incorporation is a strategy to increase individual agencies' regulatory perimeter and jurisdictional authority, while licensing legitimizes new fintech-driven business models. Regtech (adaptive approach) is a trend toward automating and simplifying regulatory processes that promise to improve the quality of regulatory data by replacing manual data collection and processing. Regtech can make regulatory and supervisory functions faster and cheaper, but it can also undermine regulators' face-to-face financial system supervision.

Sandboxing (Experimentation) is a regulatory approach that allows Fintech companies to test products and services in an isolated and controlled environment with the support of regulators to identify appropriate safeguards. Everhart (2020), Rupeika-Apoga and Thalassinos (2020), Khalid and Kunhivabab (2018), and Butor-Keler and Polasik (2020) have described the sandbox as a safe place to test potential innovations and act as a catalyst for future innovations. Sandboxes are becoming financial inclusion tools and the most efficient resources to regulate Fintech companies (Butor-Keler & Polasik, 2020).

This literature review offers an extensive overview of digital transformation in banking, examining traditional banks and Fintech interactions in various countries. It establishes a theoretical framework to analyze comparisons, but the digital transformation process needs to catch up worldwide. The objective is to provide a comprehensive perspective on digital transformation in various national contexts.

MATERIALS AND METHODS

This study employed a qualitative approach, specifically a Systematic Literature Review, to address the research questions. The methodology included five essential stages: scope, planning, search, selection, and eligibility. The systematic review identified 350,403 primary documents, of which 44 were ultimately selected for in-depth analysis.

Systematic Literature Search

Scope

This stage seeks to present a clear direction and purpose for the study by defining the objectives of the investigation. In the introductory section, the objectives were expressly established, complying with the requirements of this stage.

Planning

The research used four scholarly literature search engines: Ingenio, Semantic Scholar, Scilit, and Google Scholar. Ingenio, accessible through the virtual library of the Polytechnic University of Madrid, provides access to more than 180 bibliographic databases and web resources. Artificial intelligence is used in Semantic Scholar, created by Seattle's Allen Institute. Scilit, created by the multidisciplinary Institute for Digital Publishing in Basel, collects and indexes scientific information from CrossRef and PubMed daily. Google Scholar, a specialized Google search engine, retrieved a wide range of peer-reviewed articles and associated data.

The keywords and their synonyms were grouped into three categories: banking industry, financial technology, and countries, as shown in Table 1.

Table 1. Categories of Keywords

Banking Industry	Financial Technologies	Countries
Bank*	Fintech	United States, US, U.S.
Electronic bank*	Financial technology*	United Kingdom, UK, U.K.
Digital bank*	Innovation	Malaysia
Mobile bank*	Disruptive Innovation	Saudi, KSA
Internet bank*		
Online bank*		

Note: * represents a wildcard character.

Searching

Rough searches were performed with each search engine, combining keywords from various categories and the Boolean operators "AND" and "OR." These searches were refined using search engine filters, yielding 977 possibly relevant primary studies, as shown in Table 2.

Table 2. Rough Search and Refinement of Primary Studies.

Search Engines	Rough Search	Rough Docs.	Filters	Refined Docs.
Ingenio	16	28,541	Keywords in TITLE TYPE: Atricles peer-reviewd, book chapters, proceedings, books and theses TOPICS: Bank technology, bank industry, banking, financial services, banks, financial institutions, innovations, bank and banking	420
Semantic Scholar	16	243,000	FIELDS: Economics. Business, Computer Sciences	374

			FULL TEXT	
			THE FIRST 500	
Scilit	16	3,462	Keywords in TITLE	81
			FULL TEXT	
			COUNTRIES: US, UK, Malaysia	
Google Scholar	16	75,400	Keywords in TITLE	102
			Sort by RELEVANCE	
			THE FIRST 200	
			FULL TEXT	
Total		350,403		977

The refined primary studies were exported to the RefWorks bibliographic manager.

Screening

All 977 studies were assessed using the RefWorks duplicate detection process at this step, and 503 references were found to be in such a condition; therefore, they were removed, leaving 474 possibly relevant primary studies.

Subsequently, access to the full text of each document was verified, finding that 383 could not be accessed; therefore, they were omitted from the systematic search. So, 91 documents remained.

Eligibility

At this stage, the final decision was made based on the following eligibility criteria:

- The studies had to have a qualitative approach.
- They had to be in the U.S., U.K., Malaysia, or KSA.
- They had to address banking as a central issue along with Fintech technologies, electronic banking, or Fintech regulation.
- Studies must have been published since 2013. According to Nasir et al. (2021), Fintech topics have aroused great interest among researchers since that year.

Each primary study's title, abstract, introduction, background, discussion, and conclusions were assessed to ensure compliance with the eligibility criteria, and 44 primary studies agreed.

In summary, of the 977 potentially relevant primary studies identified during the systematic search process, 44 met all the eligibility criteria for this investigation. This procedure can be seen in Figure 1 as a flowchart created using the "Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA)" technique (Urrutia & Bonfill, 2010).

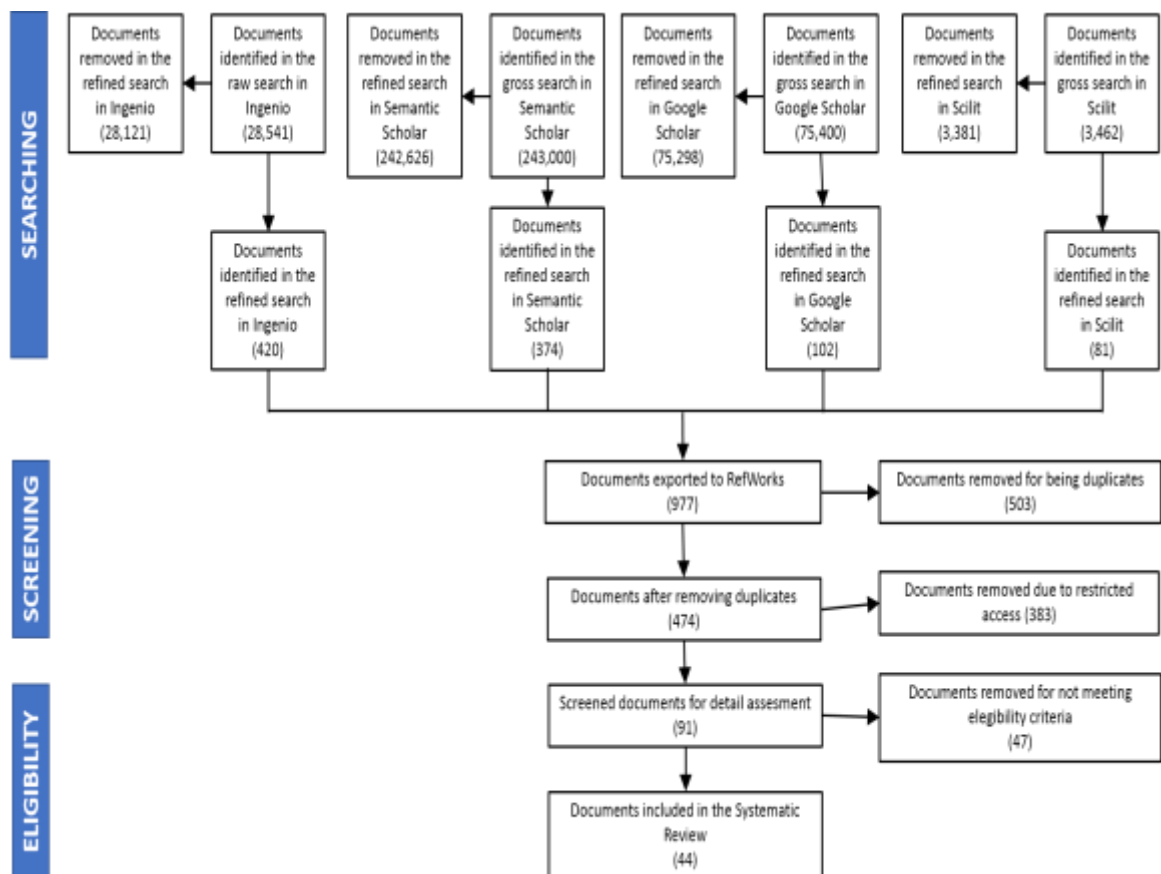


Figure 1. PRISMA flow chart

In addition, seven websites with primary data relevant to certain aspects of the research were selected. Thus, the research questions were answered using 50 primary sources.

General Description of the Selected Primary Documents

Table 3 classifies the chosen literature according to the type of the main study. It provides a comprehensive overview of the selected research papers, helping to identify the focus areas of each study.

Table 3. Type of Primary Studies

Type of Document	Quantity
Articles	32
Doctoral Dissertation	3
Book chapters	4
Proceedings	3
Books	1
Websites	7
Honor College Thesis	1
Total	51

Table 3 shows a wide range of selected sources. Peer-reviewed articles are the primary source, with a total of 32. This fact suggests that primary research is an essential source of information for the topic under investigation. Furthermore, three doctoral theses and four book chapters suggest that in-depth research and critical analysis are also necessary for the selected literature.

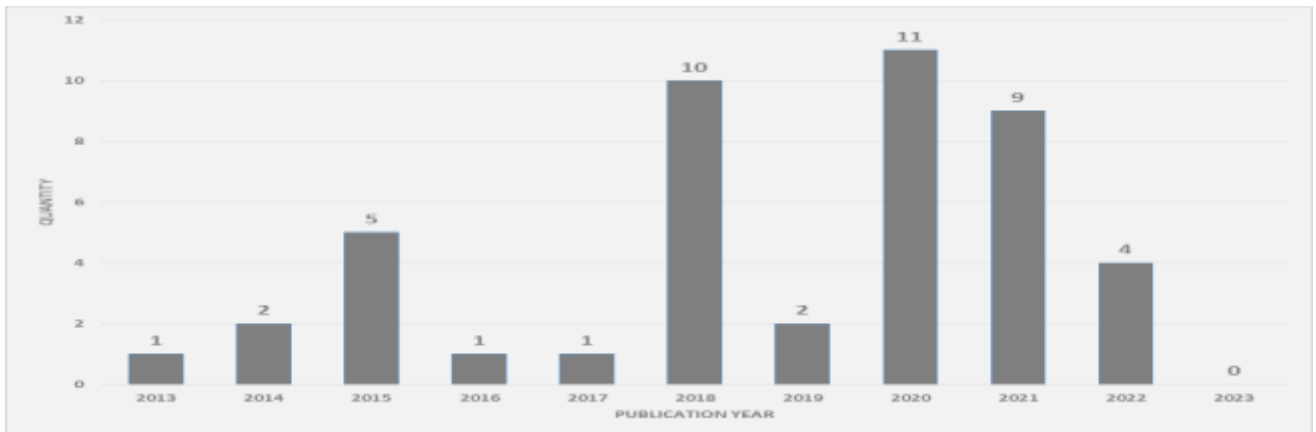


Figure 2. Distribution of Sources by Year of Publication.

Figure 2 shows that most of the selected articles were published in recent years, especially in 2018, 2020, and 2021. This finding suggests that this topic is an active and constantly evolving area of research. Furthermore, the presence of only one document in 2013 and only one in 2015 suggests that the topic may have experienced increased attention and interest in recent years. In general, the distribution of articles over the years supports the findings of Nasir et al. (2021).

Table 4 presents a classification of the selected documents according to the central themes and the countries where the research was carried out.

Table 4. Thematic and Geographical Classification of the Selected Literature.

	Count
Central Theme	
Banking and Fintech Companies	19
Fintech Technology and Banking Services	24
Regulations	19
Country	
USA	5
UK	6
Malaysia	31
KSA	24

Regarding the topics, Table 4 shows 19 documents focused on banking and Fintech companies, while 24 documents focused on Fintech technologies and banking services. Another 19 documents refer to Fintech regulation. In terms of countries, most of the articles focus on Malaysia, with a total of 31. Twenty-four articles were selected for KSA, 6 for the U.K., and 5 for the U.S.

RESULTS

This section examines the findings of a systematic review of selected articles. The investigation focused on the research questions, and the driving themes for the digital transformation identified by Nasir et al. (2021) were used to find answers. These subjects involve banking features, technology, and services implemented by banks, as well as aspects that distinguish the regulatory systems in each of the countries analyzed (see Appendices A, B, and C for a summary of the comparisons).

The Banking Sector

United States

With approximately \$22.9 trillion in total assets (7.3 percent of US GDP), U.S. banking is one of the largest in the world, according to the International Monetary Fund ([IMF], 2022). The top three banks in the U.S. are Citigroup, JP Morgan Chase, and Bank of America. The Federal Reserve ("the Federal Reserve"), the Federal Deposit Insurance Corporation (FDIC), the Office of the Comptroller of the Currency (OCC), and the Securities and Exchange Commission (SEC) have regulatory authority over banking. The 2008 global financial crisis in the U.S. led to significant regulatory changes, including new laws such as the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) and the Jumpstart Our Business Act (JOBS). (DeYoung, 2014; Magnuson, 2018; Piri, 2018; Saeed, 2014).

United Kingdom

The banking sector is one of the most significant contributors to the U.K. economy, accounting for over 40% of all finance sector jobs. It has experienced significant growth since 1990, with total assets reaching \$9.8 trillion (6.9% of UK GDP), according to the IMF (2022). The four largest banks in the nation are HSBC, Barclays, Lloyds Bank, and RBS, and the FCA and the Bank of England oversee this industry.

Kornelakis et al. (2022) highlight the digital shift in U.K. banking, which has resulted in job losses and collective bargaining problems and has resulted in the termination of national discussions between key banks and Unite the Union. Employers drive the digital transformation, while the union is informed of planned changes and branch closures.

Malaysia

Banking in Malaysia, which includes Malayan Banking, CIMB Group Holding, and RHB Bank, has total assets of \$714 billion and accounts for 3.7% of GDP (IMF, 2022). Thanks to comprehensive legislation, a vast Fintech ecosystem, an active Islamic financial community, and government support for Islamic economic growth, Indonesia is the leading economy in the Islamic world. The banking sector in Malaysia is governed by the Banking and Financial Institutions Act 1989 (BAFIA), administered by Bank Negara Malaysia (BNM). The Financial Services Act 2013 (FSA), the Islamic Financial Services Act 2013 (IFSA), and the Money Services Business Act 2011 (MSBA) establish laws for a variety of industries, including commercial and retail banking, investment banking, and financial technology companies. However, current regulations fail to address Fintech-related activities in the Islamic financial industry, as there is no special legislation to ensure Sharia compliance (Ab Razak et al., 2020).

BNM established the Sharia Committee Governance Guidelines for Islamic Financial Institutions in 2005 to strengthen Sharia governance standards. Islamic banks in Malaysia offer Sharia-compliant financial products, while conventional banks offer Sharia-compliant and traditional financial products. RHB Bank operates entirely under Sharia, while Maybank and CIMB Bank offer Sharia products and services that pay and charge interest as part of certain loans and deposits, as long as they comply with Sharia guidelines.

Saudi Arabia

Saudi Arabian banking has around \$683 billion in total assets, equivalent to 3.2% of the country's GDP (IMF, 2022). Saudi Arabia, the world's largest Islamic financial market, excels in electronic banking (Alotaibi, 2015; Susilawati et al., 2021). Eight conventional banks, four significant Islamic banks, a few international institutions, and Saudi banks, including the Arab National Bank and the National Commercial Bank, offer electronic banking services (Alotaibi, 2015). All Saudi banks, including international ones, must adhere to Shariah compliance and offer Islamic products and services. On the other hand, foreign banks can offer standard services to non-Muslim consumers (Alabdian, 2017).

The Saudi Arabian Monetary Authority (SAMA) regulates the country's banking and has established online banking rules to protect customers from fraud. Foreign banks in KSA may offer non-Sharia products but often apply Islamic banking principles to Saudi retail customers. Saudi American Bank is leading the shift from domestic commercial banking to international banking (Alkhalidi & Al-Sadi, 2016).

Financial Technologies

United States

Plaid (2021) reports that 88% of the general public in the U.S. has adopted fintech technologies, above the global average of 64%. Mobile payment applications have gained popularity for online transactions, while acceptance in the United States

is lower due to more advanced payment infrastructure. ApplePay, for example, uses the United States' current banking and credit card networks (Clements, 2021; Yadav, 2020). Lending Club and Prosper, for example, use novel technologies to modernize loan acquisition (Clements, 2021; Anderson, 2019; Gao, 2022). Artificial intelligence is powered by robotic advisors, leading traditional institutions like J.P. Morgan to create robotic advisor services (Williams, 2020; Morgan, 2022). Machine learning transforms American banking by automating document processing and real-time credit data, detecting fraud, and reducing costs (Piri, 2018).

United Kingdom

Fintech has accelerated its digitization process in the United Kingdom, generating competitive pressures for banks (Mazure, 2022). According to Fintech Global (2021), a significant number of U.K. Fintech companies use banking software as digital customer relationship management systems; the adoption of these services by the general public is 86%. Open banking, machine learning-artificial intelligence, APIs, cloud computing platforms, and chatbots-virtual assistants are some disruptive technologies (Kornelakis et al., 2022; Williams, 2020; Williams & Adekunle, 2013). Banks have had to engage with Fintech companies in their digital transformation, and collaborations have grown in the last decade, opening corporate bank frontiers to market contacts (Hornuf et al., 2021).

Malaysia

Malaysian consumers are becoming more aware of financial technologies (Fintech), with 75% adopting them for daily financial activities (Alam, 2021; Rahim et al., 2021). BNM leads a policy to promote an ecosystem of cashless payment financial products and open data (Rahim et al., 2021). Other mobile payment technologies, such as Visa Checkout, Masterpass, CIMB Pay, Maybank Pay, MOL Pay, Samsung Pay, and Alipay, require a bank account (Yahaya & Ahmad, 2018). Innovations in banking and payment systems have substantially impacted the Malaysian fintech sector (Khalid & Kunhibavab, 2018; Normalini & Ramayah, 2015; Rahim et al., 2021).

Saudi Arabia

Electronic banking adoption has greatly enhanced traditional banking services in KSA, with Fintech adoption reaching 80% in the 16-39-year-old population (Entrepreneur et al., 2021). As Alotaibi (2015) and Alsomali (2015) state, the Saudi Arabian Monetary Agency (SAMA) has supervised advanced banking payment systems for more than two decades. These systems include the Saudi System for Rapid Money Transfers (SARIE), the Saudi Network for Payments (SPAN), and the Saudi Payment System (SADAD). SARIE includes automated clearing houses, check clearing, and the Electronic Transfers Network. SPAN connects ATMs and POS terminals, extending services beyond the Kingdom through networks such as GCC Net Member Switches. SADAD is a centralized electronic billing and payment system in Saudi Arabia, simplifying the process of paying bills and debts efficiently.

Abuhusain (2020) claims that A.I. and big data have impacted Saudi banks' credit decisions and results. Traditional approaches are often used to assess the interests of loan applicants, but Saudi banks are now using A.I. and big data to improve their loan analysis techniques. Fintech innovations increase the likelihood that A.I. and big data will have decision-support capabilities in this area.

Customer Service Delivery

United States

Banks in the U.S. offer critical banking services such as electronic financial transfers, ATM and point-of-sale transactions, and preauthorized transfers and payments (Williams, 2020). Credit collaboration between banks and peer-to-peer lending platforms is a noteworthy development, with banks being the actual lenders of these loans (Anderson, 2019; Clements, 2021; Williams, 2020). Mandatory measures are being established to guarantee equal access to credit and non-discriminatory credit practices.

Robotic advisory services that use artificial intelligence and machine learning to provide investment advice are becoming increasingly popular among fintech services in the U.S. (Williams, 2020). JP Morgan Chase has integrated them into its offers (Morgan, 2022).

United Kingdom

The U.K. banking sector has experienced a significant increase in the use of online banking services, which offer features such as electronic funds transfer, pre-authorized transfers and payments, placing deposits, checking account balances, requesting details of transactions, P2P lending, and robotics advisory services (Rupeika-Apoga & Thalassinou, 2020; Williams, 2020; Williams & Adekunle, 2013). These developments have enabled customers to manage their finances better.

Malaysia

Malaysia's Fintech industry has recently experienced significant growth, with mobile banking and payment systems pivotal in driving financial inclusion (Khalid & Kunhibavab, 2018). Fintech services such as online banking, debit cards, and robo-advisors are also rising (Alam, 2021; Rahim et al., 2021). Malaysian banks are taking innovative approaches to provide broader financial services while reducing costs and increasing customer satisfaction (Rehman & Zabri, 2020; Yadav, 2020). The Investment Account Platform (IAP) was established in 2015 and combined the credit-scoring skills of Islamic banks with the power of technology to transfer cash from investors to companies (Miskam et al., 2018). However, robo-advisor

services in Malaysia currently do not seek to comply with Sharia principles (Ab Razak et al., 2020).

Saudi Arabia

The Saudi government is working to strengthen the electronic banking environment in Saudi banks (Alkhalidi & Al-Sadi, 2016; Alsomali, 2015). These services include ATM transactions, bank account management, cash provision, point-of-sale transactions, preauthorized transfers, electronic money transfers, online payments, and mobile payments (Alotaibi, 2015). Online deposits can be made over the phone or the Internet, and online financial advisory services are becoming more accessible. Despite security concerns and potential risks, electronic banking tends to improve the performance and capacity of banks.

Fintech Regulatory Framework

United States

The U.S. government is developing its own Fintech regulatory response due to the organization of the financial regulatory system (Clements, 2021; Magnuson, 2018; Piri, 2018). The Federal Reserve System, the Financial Industry Regulatory Authority (FINRA), the Consumer Financial Protection Bureau (CFPB), the Federal Deposit Insurance Corporation (FDIC), the Office of the Comptroller of the Currency (OCC), and the Commodity Futures Trading Commission (CFTC) have been crucial regulators of the U.S. economy since the financial crisis of 2007–2009. The OCC is responsible for fintech enforcement and regulation, while the CFPB protects clients and upholds federal consumer finance regulations (Clements, 2021; Omarova, 2020). The FDIC oversees banks, savings banks, bank holding companies, non-bank finance corporations, and state-chartered banks that have joined the Federal Reserve System in all states.

Financial institutions are under pressure from the Dodd-Frank Act of 2008 and the JOBS Act of 2012 to follow the rules, including auditing and electronic reporting of suspicious behavior, currency transactions, bank account information, and international financial institutions (Piri, 2018). The Government Audit Office (GAO) has warned that these regulations could encourage or inhibit innovation in the financial industry (Magnuson, 2018; Piri, 2018; Thomas, 2018).

The OCC faces legal challenges from state regulators, consumer advocacy groups, and community banks regarding the legal authority to create fintech licenses. Despite opposition from state banking regulators, the OCC announced its intention to accept applications for national banking licenses from non-depository Fintech companies (Piri, 2018; Thomas, 2018). Fintech licensing would provide a legitimate option for larger fintech companies but has been criticized as only benefiting those with the capital and experience to pursue it. However, the experimental model (sandbox) is compatible with several states and regions (Clements, 2021). The U.S. has yet to implement its national regulatory sandbox, but some states are moving to create state or regional fintech sandboxes. The "Financial Services Innovation Act of 2016" (FSIA) created a federal regulatory sandbox, but the OCC has rejected it. Arizona was the first state to create a fintech sandbox in 2018; many others have since. The U.S. Treasury Department needs to be faster to adopt the sandbox approach due to its fragmented financial oversight structure.

In banking terms, the U.S. payments industry must navigate a complex electronic funds transfer (ETF) system, including ATM transfers, telephone bill payment services, POS terminals, and preauthorized transfers. (Clements, 2021; Williams, 2020). U.S. regulatory frameworks for fintech lending include state lender licenses, consumer protection laws, privacy statutes, anti-money laundering laws, banking rules, usury laws, and individual securities regulations (Clements, 2021). To ensure that banks are the "true lenders" of the loans, the CFPB and the U.S. Treasury Department advocated lowering barriers to sector expansion and systematizing the "good when done" principle. Finally, Islamic financial institutions in the U.S. operate under the same regulations as conventional banks but must adhere to specific guidelines aligned with Sharia principles (Susilawati et al., 2021).

United Kingdom

The FCA, the British financial regulatory authority, plays a vital role in regulating Fintech companies. The Prudential Regulation Authority (PRA) oversees organizations that must hold a banking license to function. According to Rupeika-Apoga and Thalassinou (2020), there is no particular regulatory framework for Fintech firms. The United Kingdom has implemented a regulatory sandbox, known as the "regulatory sandbox," to allow Fintech companies to innovate and test products, services, and business models without being restricted by regulatory constraints (Butor-Keler & Polasik, 2020; Everhart, 2020; Rupeika-Apoga & Thalassinou, 2020; Thomas, 2018). Since 2016, the FCA has been the most visible Fintech regulatory sandbox, offering a safe environment for innovation and driving investment (Clements, 2021; Omarova, 2020; Thomas, 2018). Malaysia, Denmark, Lithuania, the Netherlands, Poland, and Australia have also implemented regulatory sandboxes to protect clients from Fintech risks. Islamic financial institutions, consisting of banks and non-banks, are present in the U.K. and provide financial products and services that conform to Sharia principles (Susilawati et al., 2021). They operate under the same regulatory framework as mainstream banks but must comply with Sharia guidelines.

Malaysia

Malaysia, a leader in Islamic finance, has been recognized as an "Emerging Fintech Hub" (Ab Razak et al., 2020; Susilawati et al., 2021). Its comprehensive regulations, diverse Fintech environment, supportive Islamic financial community, and government commitment promote the Islamic economy. The Financial Services Act of 2013 (FSA), the Islamic Financial Services Act of 2013 (IFSA), the Money Services Business Act of 2011 (MSBA), and the Capital Markets and Services Act of 2009 (CMSA), as well as rules and regulations issued by the BNM and S.C., govern the regulation of Malaysian fintech

startups (Bank Negara Malaysia [BNM] and the Securities and Exchange Commission [S.C.]) (Alam, 2021).

BNM introduced a regulatory sandbox in 2016, following the U.K. model, to provide Fintech companies with a controlled environment for experimentation, emphasizing customer protection and financial inclusion (Alam, 2021; Khalid & Kunhibavab, 2018).

Saudi Arabia

In the Kingdom of Saudi Arabia, fintech companies must adhere to Sharia law, emphasizing equity, fairness, and transparency (Mohamed & Yildirim, 2021). Islamic law governs Islamic finance, restricts excessive risk-taking, and requires licensing, anti-money laundering measures, and Sharia requirements. Albarrak and Alokley (2021), Alotaibi (2015), and Alsomali (2015) recommend establishing Sharia compliance requirements, supervisory boards, and standardizing Sharia governance for Islamic Fintechs.

The fintech industry is governed by regulatory authorities like SAMA, CMA, and Fintech Saudi, with SAMA focusing on innovation, consumer protection, and risk management (Khan & Abdulrahman Saad, 2022). Fintech Saudi, founded by the Saudi government, aims to promote growth, innovation, and financial inclusion through partnerships with SAMA and CMA on regulatory and supervisory matters.

Modified regulations apply to electronic payment services, and legislation governing peer-to-peer payment providers and debt-based crowdfunding has been passed. Sharia compliance, regulatory organizations such as SAMA and CMA, and projects such as Saudi Fintech encourage innovation, financial inclusion, and adequate supervision in the KSA Fintech industry (Susilawati et al., 2021).

DISCUSSIONS

This section compares the characteristics of digital transformation in KSA's banking to those in the U.S., Malaysia, and the U.K. It examines the size, importance, and digital transformation of banking technologies and services, as well as the regulatory environment and Sharia law compliance by banks and Fintech companies. It provides a clear and easy understanding of KSA's functions and characteristics for each banking market under consideration.

The banking sector in KSA is substantial in the country's economy, with total assets estimated at more than \$683 billion, or approximately 3.2% of GDP. Compared to other countries, the United States and the United Kingdom have some of the world's largest banks, with total assets of roughly \$22.9 trillion and \$8.5 trillion, respectively. Malaysia has total assets worth \$714 billion, or 3.7% of GDP. The banking contribution to KSA's GDP is comparable to Malaysia's but lower than that of the U.S. and the U.K. In absolute and relative terms, the banking industries in the U.S. and the U.K. are substantially larger.

Financial technologies and the banking services derived from them are transforming how people manage their money. In the U.S., U.K., Malaysia, and KSA, the adoption rate for fintech banking ranges from 75% to 88%. Fintechs have created solutions such as ATMs, POS terminals, mobile banking, and Internet banking to handle deposits, payments, transfers, and account management. In the U.S. and U.K., the Internet and mobile banking are the most widely used technologies, while in Malaysia and KSA, online transactions and ATM use are more common. Robo-advisor services, which use A.I. and big data technologies, are becoming more popular in the U.S. and U.K. In Malaysia and KSA, adoption is slower due to a need for more awareness.

Fintech companies and traditional banks increasingly partner to provide loans through P2P lending platforms. Collaboration between P2P platforms and traditional banks is limited in Malaysia and KSA, though it allows users to get loans more efficiently and at lower interest rates.

Banking in the U.S., U.K., Malaysia, and KSA is experiencing unique circumstances that require adjustments to accommodate new challenges. In the U.S., the government is committed to maintaining tight regulation of the banking system to prevent a repeat of the excesses that led to the 2008 global financial crisis. In the U.K., banks are grappling with the challenges of digital transformation and redundancies resulting from the closure of branches. The government's approach is to promote financial stability despite these difficulties.

Malaysia is promoting economic growth and development through its Islamic financial system. At KSA, banking is undergoing a transition to keep pace with digital changes and maintain stability. Banks are creating new and innovative services and promoting financial and technological innovations, thus supporting the social and economic development goals set out in Saudi Vision 2030.

A few significant governing bodies are in charge of Malaysia's, the KSA's, and the U.K.'s regulatory frameworks. At KSA, SAMA and CMA are in charge of ensuring the stability and security of the financial system. The FCA and PRA oversee U.K. banking, while the BNM and S.C. oversee Malaysia's regulatory system. In the U.S., the banking supervisory system is complex, with multiple regulatory bodies at both the federal and state levels. Despite these disparities, these four countries prioritize the safety and soundness of the financial system, as well as the regulation and supervision of their different banking sectors.

The Fintech regulatory framework, regulatory approach, regulatory authorities tasked with regulating Fintech activity, specific legislation, and Sharia compliance positions taken by Fintech companies in these countries are under discussion.

The U.S. and KSA use an onboarding approach to enable Fintech innovation in a regulated environment. In the U.S., fintechs are required to obtain a federal banking license, and various regulatory bodies oversee granting these licenses. In KSA, Fintech companies are required to obtain a license from SAMA. Licensing for fintech banking differs between the U.S. and KSA, as the U.S. has a standardized procedure, and the KSA has a more flexible approach. Both countries require

Fintech companies to meet prudential requirements such as minimum capital and risk management, but both procedures seek to balance the principles of promoting Fintech innovation, protecting financial stability, and providing consumer security.

With marked differences, all these countries have opted for an experimental approach. The U.K. has set up a sandbox that allows companies to conduct restricted fintech trials with less oversight. This U.K. sandbox has served as an inspiration for others. Malaysia has established a UK-inspired regulatory sandbox, allowing Fintech firms to test innovative technologies with fewer barriers. At KSA, a Fintech innovation sandbox works alongside the ability to obtain a banking license. Fintechs in the KSA can conduct restricted sandbox tests or apply for a more significant banking license. This integrated approach tries to stimulate innovation under regulated conditions.

Due to the fragmentation of regulatory authorities, Fintech regulation varies significantly in the U.S., U.K., Malaysia, and KSA. Fintech regulation in the U.S. is divided among multiple agencies, making coordination difficult (Federal Reserve, SEC, FINRA, CFPB, FDIC, OCC, CFTC, and FBP). In contrast, the U.K., Malaysia, and KSA concentrate regulatory tasks on one or two main authorities. The FCA and PRA oversee Fintechs in the U.K., while BNM and S.C. oversee the entire Fintech sector in Malaysia. Finally, SAMA, CMA, and Fintech Saudi regulate Fintechs and run a regulatory sandbox.

In short, consolidating regulatory responsibilities into one or two agencies allows for more coordinated and flexible regulation of Fintech, better positioning them to respond to the rapidly developing Fintech industry.

The U.K. regulatory model for Fintech is the most progressive and inspires other emerging countries. In the US, Fintechs are regulated by the Dodd-Frank Act, the JOBS Act, lender licenses, consumer protection laws, privacy statutes, anti-money laundering laws, banking laws, usury laws, and securities regulations. In the U.K., there are no specific laws regulating Fintech companies, so they follow the FCA guidelines. In Malaysia and the KSA, there are also no specific laws to regulate Fintech, but these are governed by the same laws that regulate banking (BAFIA, FSA, IFSA, and MSBA in the case of Malaysia, and the Electronic Payment Services Act and the Prevention of Money Laundering). Money and Financing of Terrorism in KSA the U.K. fintech regulatory model seems to be better compared to the U.S., as it encourages innovation and the development of new financial solutions, and the fact that the FCA is the leading financial regulator in the U.K. makes it easy for companies to comply with regulations and obtain the necessary licenses. In the U.S., the excessive number of laws and regulatory bodies, an outdated licensing strategy, and conflicts between federal and state jurisdictions generate significant complications that negatively affect innovation and the future development of Fintech.

Sharia compliance is an essential aspect of the banking and Fintech sectors in Malaysia, KSA, the U.S., and the U.K., as it is a significant source of laws and regulations in these countries. In Malaysia, Islamic banks offer financial products that comply with Sharia principles, while conventional banks may or may not adhere to Sharia rules. In KSA, there are large Islamic banks that strictly comply with Sharia regulations, along with conventional banks. In terms of Fintech, both Malaysia and the KSA have specific regulations to ensure Sharia compliance in the industry.

In Malaysia and the KSA, regulators have established guidelines for Fintechs based on Sharia principles covering consumer protection, prevention of money laundering and terrorist financing, and risk management. Overall, Sharia compliance is a crucial aspect of the banking and Fintech sectors in Malaysia and KSA, as Sharia is a significant source of laws and regulations in these countries.

U.S. and U.K. banking is conventionally oriented, but Islamic financial institutions operate within their jurisdictions that provide Sharia-compliant products and services. Islamic financial principles govern these institutions and help Muslims participate in the financial system following the teachings of the Quran.

CONCLUSIONS

This article analyzes the results of a study on the digital transformation of Saudi banks compared to those of the U.S., U.K., and Malaysia. Based on the findings, the following conclusions can be drawn:

The digital transformation of banking is happening fast in the U.S., U.K., Malaysia, and KSA. These countries have different regulatory systems in terms of structure, scope, and jurisdiction, but all aim to ensure the stability and security of the financial system while promoting innovation and economic growth.

The U.S. government is focusing on keeping banking highly regulated to avoid the excesses of the 2008 global financial crisis. In the U.K., banks are grappling with digital transformation and job cuts due to bank closures. Malaysia promotes economic growth and development through its Islamic financial system, while KSA banking is shifting from local commercial banks to multinational banks.

Malaysia and KSA have the world's most developed Islamic financial markets, with Islamic banks in Malaysia offering Sharia-compliant products while conventional banks may offer non-Sharia-compliant products. In the U.S. and the U.K., Islamic financial institutions operate within their jurisdictions and provide Sharia-compliant products and services, but they must also comply with the rules governing conventional banks.

Fintech banking services are used at similar rates in the U.S., U.K., Malaysia, and KSA, ranging from 75% to 88%. ATMs, POS terminals, and mobile and internet banking are examples of similar solutions offered by Fintech. Although robo-advisor technology transforms how people manage their wealth and assets, its application in Malaysia and KSA is relatively limited. Fintech companies and traditional banks are working to provide loans, with P2P lending platforms developing as alternatives in the U.S. and U.K. and more regional collaboration between P2P platforms and traditional banks in Malaysia and KSA.

The licenses for fintech banking in the U.S. and KSA differ in rigor and standardization. The U.S. has a standardized licensing process, while the KSA requires a license from SAMA to conduct banking activities. SAMA's licensing procedures are more discretionary than those in the U.S. but aim to promote fintech innovation and protect financial

stability and consumer safety.

The U.K. has a pioneering sandbox for fintech regulation that facilitates limited experimentation with fewer regulatory hurdles. Malaysia has a similar sandbox modeled after the U.K. approach, while KSA operates a Fintech innovation sandbox alongside banking licensing. The U.S. lacks a formal Fintech sandbox due to diverging views between federal jurisdictions that favor licensing approaches and states that promote the sandbox model. The U.K. regulatory model for Fintech is very progressive and could offer valuable insights for emerging countries such as Malaysia and the KSA as they work towards effective Fintech regulation.

This article may be helpful for other researchers interested in the impact of digital transformation in the banking and finance sectors. The comparative study carried out in this article provides valuable information on how traditional banking is evolving towards more digital models and how banks are adopting new technologies to improve their efficiency and compete with Fintech companies. Furthermore, this article also highlights the challenges traditional banks face in this digital transformation process, which may be helpful for other researchers interested in exploring innovative solutions to these challenges. The article can inspire new research on various topics related to digital transformation in banking, such as similar comparative studies in other countries or regions, to analyze how banks are adopting digital technologies and adapting to market changes. It addresses the innovative solutions that banks are implementing to face the challenges of digital transformation and informs us about the impact of Fintech in the financial market and how it is changing the rules of the game for traditional banks. It also presents some information regarding research on how financial regulators can adapt to digital transformation and ensure that the financial market remains safe and stable. This article can also help professionals in general and finance professionals in particular by providing information on how digital transformation is changing the financial market and how they can adapt to these changes.

Furthermore, this article has several implications for investors, including the need to digitally transform to coexist with Fintech companies, invest in technology to improve efficiency, work with Fintech companies, and adapt the rules to foster innovation and fair competition. This article can help investors understand how the digital revolution is transforming the financial market and how it may affect investments. Banks must understand the need to digitally adapt to compete with fintech companies, invest in technology to improve efficiencies, and engage with fintech companies.

However, it should be noted that this study may have some limitations, such as the fact that it focuses on comparing the digital transformation of banking in KSA with other countries, which may limit its applicability to other contexts. The study focuses mainly on the technological and regulatory aspects of digital transformation. It does not consider other important factors, such as cultural and organizational aspects, and does not address the ethical and social issues of the digital transformation of banking in KSA.

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APPENDICES

Appendix A: Comparison of the Banking Sector between Countries

Theme	Subtheme	United States	United Kingdom	Malaysia	Saudi Arabia
Banking	Total Assets	USD 22.9 Tn	USD 9.8 Tn	USD 714 Bn	USD 683 Bn
	% of GDP	7.3%	6.9%	3.7%	3.2%
	Major banks	Bank of America, JP Morgan Chase, and Citigroup.	HSBC, Barclays, Lloyds Bank, RBS	Malayan Banking, CIMB Group Holding, and RHB Bank	Arab National Bank, National Commercial Bank, Al-Rajhi Bank, Investment Corporation and Bank Al Jazira, and Riyadh Bank.
	Regulator	Federal Reserve ("the Fed"), Federal	Financial Conduct Authority (FCA),	Bank Negara Malaysia (BNM)	Saudi Arabian Monetary Authority

Theme	Subtheme	United States	United Kingdom	Malaysia	Saudi Arabia
		Deposit Insurance Corporation (FDIC), Office of the Comptroller of the Currency (OCC), Securities and Exchange Commission (SEC).	Prudential Regulation Authority (PRA)		(SAMA)
	Sharia Compliant	In the jurisdiction of the US and UK there are several Islamic financial institutions (banks and non-banks), which comply with the principles of the Sharia as long as they do not conflict with the regulations applicable to conventional banks.		More flexible compliance. Malaysian and foreign banks have greater flexibility to comply with Sharia in accordance with conventional financial practices.	Strict compliance. All Saudi banks must comply with Sharia. Foreign banks have some flexibility in offering conventional products to non-Saudi retail or corporate clients.

Appendix B: Comparison of the Financial Technologies and Banking Services between Countries

Theme	Subtheme	United States	United Kingdom	Malaysia	Saudi Arabia
Technologies	Disruptive Technologies	Mobile payments, lending p2p, roboadvisor, machine learning	ATM, AI-ML- Robo-advisors, open banking API, cloud computing, chatbots-virtual assistants	Mobile payment, QR code payments, and e-wallets, debit cards, cashless payment environment, open banking, AI, chatbots-virtual assistants, internet banking, mobile banking, Investment Account Platform	Internet banking, ATM, POS, mobile payments, AI, big data, robo-advisory, open banking, SARIE, SPAN, SADAD
Customer Services	Services	Electronic funds transfer, cash supply (at ATMs), Point-of-Sale (POS) transactions, preauthorized transfers and payments, P2P loans (in collaboration with lending platforms)	Electronic funds transfer, preauthorized transfers and payments, P2P lending, robo-advisor	Mobile payments, QR code payments, account Management (at internet and mobile banking),	Account management, cash supply, POS transactions, preauthorized transfers, electronic fund transfer, online payments, mobile payments, online deposits, online investment advisory, online loans
	Overall Adoption rate	88%	86%	75%	80% (age group 16-39 years old)

Appendix C: Comparison of Regulatory Framework between Countries

Theme	Subtheme	United States	United Kingdom	Malaysia	Saudi Arabia
Fintech Regulatory Framework	Approach	Incorporation: national licensing / chartering. Experimentation: state and regional sandboxes	Experimentation: Sandbox	Experimentation: Sandbox, inspired in UK model	Incorporation: national licensing / chartering. Experimentation: sandbox.
	Supervisory structure	Fragmented: national, regional and state. Multiple: national and state jurisdictions, not free from conflicts	Authorities with national jurisdiction	Authorities with national jurisdiction	Authorities with national jurisdiction
	Regulatory Offices	Federal Reserve, SEC, FINRA, CFPB, FDIC, OCC, CFTC, FBP, state bodies	Financial Conduct Authority (FCA, non-credit intermediary financial companies), Prudential Regulation Authority (PRA, entities that require a banking license)	Bank Negara Malaysia (BNM), Security Commission (SC), Malaysia Digital Economy Corp[oration (MDEC)	SAMA, Capital Market Authority (CMA), Fintech Saudi
	Legal framework	Dodds-Frank, JOBS, lender licenses, consumer protection laws, privacy statutes,	There are no specific laws.	There are no specific laws for Fintech	Electronic Payment Services Act SAMA and CMA

Theme	Subtheme	United States	United Kingdom	Malaysia	Saudi Arabia
		anti-money laundering laws, banking laws, usury laws and securities regulations			guidelines
	Islamic Fintech firms	There are 9 Islamic Fintech firms, which comply with the principles of the Sharia as long as they do not conflict with the regulations applicable to conventional banks.	There are 27 Islamic Fintech firms, which comply with the principles of the Sharia as long as they do not conflict with the regulations applicable to conventional banks.	In general, FSA, IFSA, MSBA and MSBA applies Securities Commission (SC) Fintech Directive 2016	Strict adherence with Sharia principles SAMA, CMA and Fintech Saudi guidelines, covering aspects such as consumer protection, prevention of money laundering and terrorist financing, and risk management

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