Mykolas Romeris University

ISSN 1822-8038 (online)
INTELEKTINĖ EKONOMIKA
INTELLECTUAL ECONOMICS
2022 , No 16(2), p. 26–43

THE USE OF FINTECH AND ITS IMPACT ON FINANCIAL INTERMEDIATION – A COMPARISON OF SAUDI ARABIA WITH OTHER GCC ECONOMIES

Dr. Shoaib Khan[1]

Department of Economics & Finance, CBA
University of Ha'il, Saudi Arabia
shoaibapu16@gmail.com

Abdulrahman Saad Abdullah Al-harby

Department of Mathematics, College of Science
University of Ha'il, Saudi Arabia.

DOI: 10.13165/IE-22-16-2-02

Abstract: *This study analyses the use of Fintech/digital finance in Saudi Arabia, comparing the use of various digital finance tools across other Gulf Cooperation Countries (GCC). The study uses the Global Financial Development Indicators Data from 2011, 2014, and 2018 published by the World bank. Graphical trend analysis, covariance, and correlation analysis are used to examine the role of digital payments, the use of the credit card, and use of the debit card to find out their impact on Fintech and the distribution of credit to the private sector. The results suggest that the use of financial technology is increasing in the GCC region, and the use of digital payments, debit cards, and credit cards have a linear dependence on each other and positively contribute to the distribution of credit to the private sector – hence, to financial intermediation in certain aspects. The results also show that Saudi Arabia is ranked four among six regional economies in terms of the use of digital finance. It is also observed that the country has potential for Fintech growth both in terms of supply and demand. To tap into this potential, regulators have introduced a regulatory sandbox to facilitate Fintech startups. Based on the evaluation, cooperation among traditional financial institutions, Fintech startups, technology companies, regulators, and academia could reduce the potential challenges and enhance Fintech in Saudi Arabia.*

Keywords: *Fintech, financial intermediation, Saudi Arabia*

JEL Classification: *G20, G 21, G29, Q25*

[1] Corresponding author

1. Introduction

Rapid technological development, innovation, and evolution are significantly changing the lives of individuals and businesses. Businesses related to financial services and financial institutions are also influenced by this evolution. Blockchain, Cryptocurrencies, Smart contracts and Artificial Intelligence (AI) significantly alter traditional financial business operations. The use of these technologies in the field of finance results in neologisms such as Fintech (using technology in finance), InsurTech (using technology in the insurance business), RegTech (use of technology for regulation), and so forth (Anagnostopoulos, 2018; Rahim et al., 2018; Vives, 2017). These developments have significantly improved traditional financial services businesses. In light of these changes, it is inevitable to examine the use, adoption, and development of technology in the financial sector. Like in other countries, in the Kingdom of Saudi Arabia the Fintech industry is also in the infancy stage. Therefore, the evaluation of the use of various technologies in the financial sector, the adoption of technology from the side of both supply and demand, regulation issues particularly related to Fintech startups, and the impact of Fintech on traditional financial intermediation have significant importance for practitioners, policymakers and other relevant stakeholders.

Technology concentrates on innovations in the communication process and information collection. Communication includes the distribution of services and relationships with customers, while information emphasizes the collection of data and its processing. In financial intermediation, the primary concern is the "functional perspective" of financial intermediaries. The functional perspective in the literature is explained operationally in terms of providing financial services by the financial intermediary (Merton, 1995; Merton & Bodie, 1995; Allen & Santomero, 1997). According to Allen and Santomero (2001), financial intermediaries traditionally played a significant role in minimizing market frictions such as information asymmetry and transaction cost. They further argued that there has been a significant decrease in cost related to market imperfection due to the technological revolution that also increases intermediation in the economy. These intermediaries, particularly banks, provide financing for information-intensive and illiquid securities (Khan et al., 2021; Flannery, 1994). Intermediaries other than banks include insurance companies, pensions, and mutual funds. These financial intermediaries remove the informational barriers and facilitate investors receiving benefits from the markets.

Historically, there has been an evolution in the nature and importance of financial intermediaries such as banks to non-banking capital companies, insurance companies, pension funds, and mutual funds. Banks, as ancient financial intermediaries, channel funds from households to the economy in the form of various types of individual and commercial loans, facilitating the receiving and transferring of payments and also providing other financial services. Financial intermediaries at the epicenter of the financial system perform the function of reallocating the resources of economic units with surplus funds (savers) to economic units with funding needs, i.e., borrowers (Allen & Santomero, 2001, pp. 273). However, the banking industry has faced significant disruption to their business since the 2007–2009 financial crisis due to a decrease in interest income, stricter compliance and regulation requirements along with damage to reputation due to the failure of large banks (Vives, 2019). In addition to these threats, the use of technology and digital platforms in the financial services industry has also disrupted the financial sector. With the development of these tools, traditional banking is moving toward less physical

interaction among its customers. These tools not only help to deliver services to the customer but are also helping to collect a huge amount of data. Fintech or technology companies related to the financial sector are using artificial intelligence to process this big data. This has resulted in the emergence of non-financial companies delivering financial services through new digital platforms that are transforming traditional finance into digital finance. These platforms either directly provide financial services by using advanced technologies or play the role of facilitators between traditional banks on the supply side and customers on the demand side. These developments in technology and Fintech are evolving traditional banking models.

The use of technology in the financial sector is termed Fintech. According to the Financial Stability Board (n.d.), this is defined as "technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services." Another simple definition is provided by Takeda and Ito (2021) "financial innovation realized by information technology (IT)." These developments are influencing several areas of financial services. Even though there is competition between Fintech startups and traditional banks, both are working on common grounds: where traditional banks are adopting and investing in digital technologies, Fintech is providing various new platforms to the banking industry. As a result, technological development has reduced the cost of financial intermediation (Philippon, 2019). For instance, in an *ex-ante* evaluation, Fuster et al. (2019) reported that Fintech lenders were processing mortgage lending applications 20% quicker than traditional lenders in the USA.

Existing literature highlights that Fintech companies are not only more effective than traditional financial services providers, but also possess enhanced efficiency. However, the literature suggests that the reason for performance variation could be due to the difference in the regulatory framework of traditional finance and Fintech companies. In a traditional financial system, the central bank highly regulates the banking sector to ensure financial stability in the economy. On the positive side of Fintech, digital technologies can be applied to solve compliance and regulatory issues, i.e., the regulation of technology or "RegTech" (Vives, 2017). In this regard, at early stages regulators are introducing the *regulatory sandbox* that can facilitate new technological financial services platforms to operate in a specific environment with special regulatory treatment. Hence, with these developments, the role of financial intermediaries as per intermediation theory is evolving in terms of operations and regulation.

Like other economies, to promote Fintech and facilitate the use of digital finance in Saudi Arabia, the Saudi Central Bank (SAMA) has also introduced the regulatory sandbox as a safe space to experiment with financial technology products to promote Fintech in the kingdom. Fintech is in its infancy globally, and Saudi Arabia is no exception. Therefore, this study will explore the answers to the following research questions concerning the evolution of traditional financial intermediation due to technological development by examining the progress of digital finance usage in Saudi Arabia.

1. What is the current status of digital finance platforms in terms of service availability and performance in Saudi Arabia compared to other Gulf Cooperation Countries (GCC) countries?

2. What is the current market situation of Fintech in terms of the supply and demand perspective of the relevant industry in the region?

3. What is the current progress of the regulatory sandbox in Saudi Arabia?

As per the authors' knowledge, no study has examined the use and progress of digital finance and Fintech platforms in terms of performance and regulation both from the supply and demand side. Hence, it is believed that the findings of this study will help existing and forthcoming Fintech platforms to formulate a customer-centered, growth-oriented strategy to meet the demands of financial intermediation in Saudi Arabia. Moreover, this will lend a hand to regulators in revising the regulatory sandbox policies and establishing the procedures for the success of experimental Fintech platforms in the future. Finally, the evaluation of the current status of Fintech and suggestions for the expansion of financial intermediation through digital financial platforms along with traditional institutions will support the achievement of the objectives of the financial sector development plan (FSDP) of Saudi Vision 2030.

2. Literature Review

In the traditional banking system, banks play the role of financial intermediaries in the market to minimize transaction cost and information asymmetry. Due to banks, there has been a significant reduction in transaction cost and information asymmetry (Allen & Santomero, 2001, p. 272). The development of the internet at the beginning of the current century also contributed to the significant decrease in transaction costs. According to Khan et al. (2021), households deposit their savings with banks and banks deliver these funds to borrowers in the form of loans or investments. Traditionally, the development of financial intermediaries/the financial sector, particularly banks, was considered a prerequisite for economic growth because this developed sector facilitates the process of saving for households and converting these savings into investments (Boujlil et al., 2020). Hence, banks play an important role as suppliers of capital in an economy. As per Hoffmann (2011), banks' profitability is dependent on the efficiency of the financial system, which results in an improved supply of capital in the markets to satisfy the demands of capital.

Traditionally, banks provided services such as deposits, lending, clearance of checks and payments, mortgage loans, insurance, consultancy, and so forth. However, with the development of digital technology, there are advancements in lending, payments, financial advising, and insurance (Vives, 2017). Vives further argues that even though a major portion of payments are still dominated by banks, Mastercard, and Visa, innovations in the payment system are coming from non-banking firms such as Google, Apple, or PayPal. According to Zhu et al. (2016), financial innovation has brought traditional financial and digital (internet-based) institutions together, which are not considered rivals but are complementary to each other. According to Philippon (2015), for the USA in the last 130 years, "the annual cost of intermediation is around 2% of outstanding assets; the unit cost of intermediation has increased over the past 30 years." Moreover, the advancement in technology and its use in the financial sector results in the cost reduction of financial intermediation (Philippon, 2019). The disruption in financial services due to technological advancement is initiated by both the supply and demand sides of financial services.

According to the Financial Stability Board (2019, p. 5), Application Programming Interfaces (API), cloud computing, smartphone, mobile banking from providers, and licensing, supervision, and competition from the regulatory perspective are the factors that have an impact on financial innovation on the supply side (also see Vives, 2019; Vucinic, 2020). Meanwhile, customers' preferences and expectations affect it on the demand side – hence, demand is more

customer-centric. This development in digital technology and the resulting changes in financial services are contributing to access to formal financial services. Additionally, other technological instruments that have a significant impact on financial services include trading systems, equity crowdfunding, digital advisory tools, peer-to-peer (P2P) lending, Blockchain, and cryptocurrencies (Philippon, 2016; Thakor, 2020).

According to Thakor (2020), Fintech broadly covers the areas of credit, deposits, investments, payments, settlements, trading, insurance, and digital currencies. Based on data from the Bank for International Settlements (BIS) 2018, Thakor (2020) reported that payments, settlements, and clearing services dominated Fintech services. These payments and settlements were performed using digital wallets (such as PayPal) and cryptocurrencies such as Bitcoin. According to Ernst and Young (2019), the global adoption rate of Fintech was 75% in 2019. It is further highlighted that, in terms of category, adoption payments and money transfers were at the top, with an adoption rate of 74%, followed by insurance, savings and investments, and budgeting and financial planning. Borrowing was adopted at a rate of 27%, the lowest of the Fintech categories in 2019.

As discussed earlier, one of the advantages of financial intermediation is to minimize information and transaction cost. Vives (2017, 2019) proposed that transactions and payments are more exposed to information processing; therefore, they could be affected by Fintech. The technological tools that usually use big data are Machine Learning (ML) and Artificial Intelligence (AI), as they can process information quickly and efficiently. Hence, the potential biggest disruption that Fintech could bring to financial services could be in the payments system (Thakor, 2020). Rysman and Schuh's (2017), study on innovations in payment services concluded that during the last four decades there has been significant digitization and innovation in payment systems, and reported that the three significant innovations are mobile payments, digital currencies, and real-time payments (also see Philippon, 2016). Mobile payments are already popular in emerging economies, particularly in Asia and Africa. According to Zhu et al. (2016), due to the development of the internet, the participation of technology and non-financial companies is increasing and challenging traditional financial institutions. They further elaborated that even the operations of traditional financial institutions are dependent on IT. Hence, Fintech startups, technology companies, and traditional financial institutions are indispensable to each other.

The existing literature also proposes that Fintech is also important for dispatching formal financial services to the majority of the population – i.e., financial inclusion. Studies have shown that mobile payment platforms – for instance, M-Pesa, operating in Kenya, Tanzania, and South Africa, and many others in different countries – have significantly contributed to this. Ozili (2018) reported that financial service users can significantly benefit from digital finance and financial inclusion. However, after the global financial crisis of 2008, the evolution of Fintech is seen as a potential factor for risk and financial instability among academics and practitioners. According to Arner et al. (2015), the change brought about by Fintech startups is creating challenges for regulators of market participation, and the suggestion is that it is too early to formulate rigid regulation. On the contrary, in the context of the traditional financial system authorities have imposed various regulations to control the inherent instability of the financial system, particularly from the central bank (Minsky and Kaufman, 2008). This disruption in financial system technological change is suggested to be controlled by Regulation Technology (RegTech). RegTech

refers to a sub-division of the Fintech sector that focuses on technologies that may facilitate the delivery of regulatory requirements more efficiently and effectively than existing capabilities (Anagnostopoulos, 2018). Researchers have inconclusive views about the regulation of Fintech, with Weihuan et al. (2015) suggesting regulating financial technology but pointing out that balanced regulation to achieve the sustainability of digital finance is challenging. Arner et al. (2015) suggested that RegTech will increase the workload of the regulatory agency, slow down innovation, and have limited benefits. Likewise, Anagnostopoulos (2018) argued that strict central bank regulation somehow contributed to the current technology and working environment of banks. It is also pointed out that banks, either due to their stable business or complicated regulation, are less innovative, and that policymakers are not concerned about the technological development but the application of that technology in financial services.

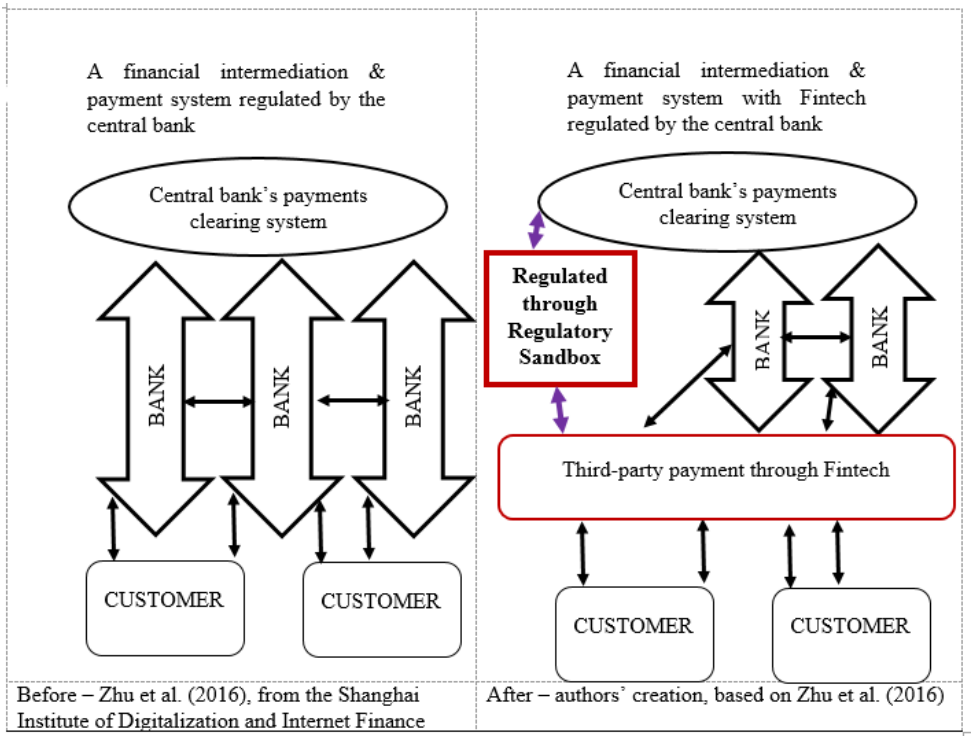


Figure 1. Model of payments and financial intermediation before and after the regulatory sandbox

According to Barefoot (2015), the process and players in Fintech are new and highly dependent on technology and data, and their novel products may become obsolete by the time regulators introduce regulation for the product. To address this, Arner et al. (2015) argue that the companies that develop financial technology can not only help the financial institutions to adopt

it but also facilitate regulators in regulating it. To support Fintech, create a suitable environment for its growth, and minimize obstacles, countries around the globe have adopted the regulatory sandbox concept. According to Bromberg et al. (2017), the objective of establishing a regulatory sandbox is to facilitate Fintech startups in receiving special treatment in regulation, which includes conditional relief from regulatory procedures with exemption from obtaining a financial services license. According to World Bank (2020) data, to provide a dynamic and evidence-based environment to test emerging technologies, regulators around the globe are using the regulatory sandbox idea for the development of Fintech. As per this data, around 56% of sandboxes were created between 2018 and 2019. As cited in Zhu et al. (2016), based on the model of payments and financial intermediation of the Shanghai Institute of Digitalization and Internet Finance, this study modifies their model into the model presented in Figure 1 for payments and financial intermediation in the presence of a regulatory sandbox.

In the traditional intermediation model, multiple customers and multiple banks interact with each other and the central bank plays the central role of completing and clearing payments. The central bank lays down the guidelines for the banks to keep stability in the financial system and to have trust in the payment system while protecting customers' interest and increasing their trust in the system. Boot et al. (2021) argue that the financial system transforms savings into investment, and financial intermediaries overcome information asymmetry and use communication to match supply and demand. In the traditional setup, storing and extracting information may consume more time, but the advancement of technology through the use of big data and AI can store and retrieve information very quickly. Moreover, in the above model, this study also endorses Arner et al. (2015), as Fintech startups not only provide services to customers independently or through financial institutions but can also facilitate the formation of regulation that can maintain financial stability and protect customers from exploitation.

3. An Overview of Fintech in Saudi Arabia

Saudi Arabia is one of the largest economies among the GCC, and one of the major emerging economies in the G20. According to the World Bank 2021 report, the total GDP of the country was 833 billion US dollars. According to SAMA, the total assets of the banks at the end of 2020 were 2,979 billion Saudi Riyal (SAR), which will increase to 4,553 billion SAR in 2030 as per the projection of the FSDP program charter for the year 2021. Hence, it is predicted that the financial sector has strong potential for growth and contribution to the kingdom's economy. The use of the latest technology in the financial sector is not new in the country. SAMA has introduced the Saudi Payment Network (SPAN; known as MADA in 1990) to electronically facilitate payments, make deposits, and encourage customers to use formal banking channels. As per SAMA, the initial objectives have been achieved, and the total point of sales (POS) has increased from 1,274 in 1993 to 721,060 at the end of 2020 (Saudi Central Bank, 2020).

Following in the footsteps of the UK and the USA, SAMA introduced the regulatory sandbox in 2019 to address the regulatory issues faced by innovators and financial institutions in the evolving financial landscapes. The primary objective was to provide a suitable environment for innovative firms to test their ideas. Since its inception, SAMA has issued experimental licenses to seven digital payment platforms, four digital savings platforms, nine crowdfunding platforms, and four micro-lending platforms under this regulatory sandbox (Saudi Central Bank, n.d.). To

further enhance the adoption of the latest technology for financial services, SAMA launched Fintech Saudi in 2018 with the Capital Market Authority (CMA), intending to transform Saudi Arabia into an innovative Fintech hub.

According to the Fintech Saudi (2021a, p. 16) annual report of 2020–2021, the average investment size in Fintech in the kingdom is $2.7 million, compared to the global average of $7.3 million. This report also highlights that the number of active Fintech startups in the country has increased from ten in 2018 to 82 at the end of 2021. Among these, 26% are fully active or operating under the testing license, 32% are at the pre-commercial stage, and 42% are at the registration stage. The survey by Fintech Saudi (2021b) in 2021 reported that 80% of individuals aged 16–39 have used Fintech solutions, and usage decreases to an average of 65% in the 40–60 age group. This survey further reported that, among Fintech solutions, E-payments dominated, occupying 69% of Fintech platforms. This was followed by insurance at 21%, 16% for online budgeting, and 14% for equity crowdfunding. With the emergence of Fintech, most customers rarely physically visit their banks. Moreover, one of the pre-requisites for the use of Fintech is access to technology – especially the internet. As per the World Bank, by the year 2020, 97.6% of the population had the access to the internet. Thus, from the points of view of users and the availability of resources, there is huge potential and room for growth in said sector, but with certain limitations. Figure 2 shows the number of Fintech and total startups in the GCC countries, as per *The Fintech Times* (2021) report on Fintech in the Middle East. These figures suggest that Fintech and the total number of startups in Saudi Arabia lag behind the United Arab Emirates (UAE) among GCC economies.

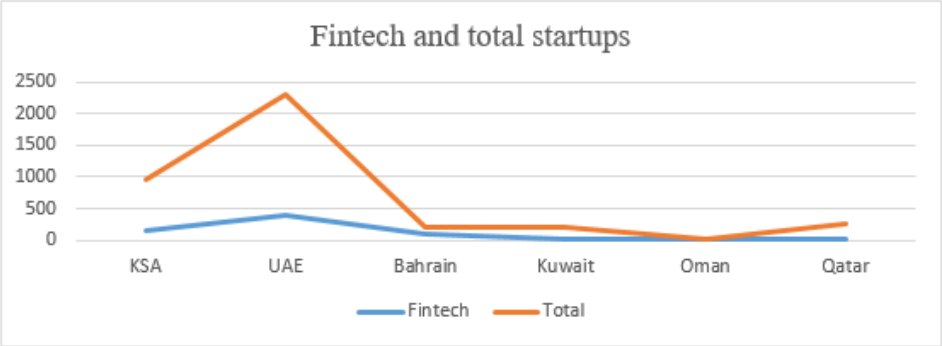


Figure 2. Fintech and total startups in the GCC economies
Source: *Authors' own depiction based on The Fintech Times (2021).*

4. Research Design and Data

To understand the use of digital finance and the development of Fintech in Saudi Arabia, this study employs graphical trend analysis, covariance, and correlation analysis to explore the linear dependence of various payment methods by using the data published by World Bank Global Financial Development Indicators (GFDI). The also evaluates the Fintech startups oper-

ating in Saudi Arabia in comparison to the findings from the GFDI. The data that was published in 2011, 2014, and 2017 is used to compare the use of digital finance tools in Saudi Arabia to the other GCC countries to explore the current status of financial technology adoption. Furthermore, the findings are used to examine the status of the ongoing progress of Fintech startups in Saudi Arabia.

4.1 Variables

Following the study of Ozili (2020) that explored the use of digital finance in Saudi Arabia, this study uses the variables from the World Bank GFDI. Variables are taken from all GCC countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE) for a meaningful comparison of the use of digital finance in Saudi Arabia among the regional economies. The variables used in the study are provided in Table 1. According to Fintech Saudi (2021a), payments dominate investment in the area of Fintech – around 93% of investments were made into payments related to Fintech platforms. Hence, the GFDI indicators study uses the variables that are related to financial service payments using financial technology during the period. This includes the percentage of the population within the 15-plus age group who use various digital/electronic platforms to make payments.

Table 1. Variables

Variables	Detail
DP	Percentage of users aged 15+ who use digital payment modes for payments
PCG	Private credit by deposit money banks (percentage of GDP)
PSDC	Domestic credit to the private sector (percentage of GDP)
DC	Percentage of users aged 15+ who use debit cards, digital payments
CC	Percentage of users aged 15+ who use credit cards, digital payments

Source: *Adopted from Ozili (2020) study and data taken from World Bank (GFDI)*

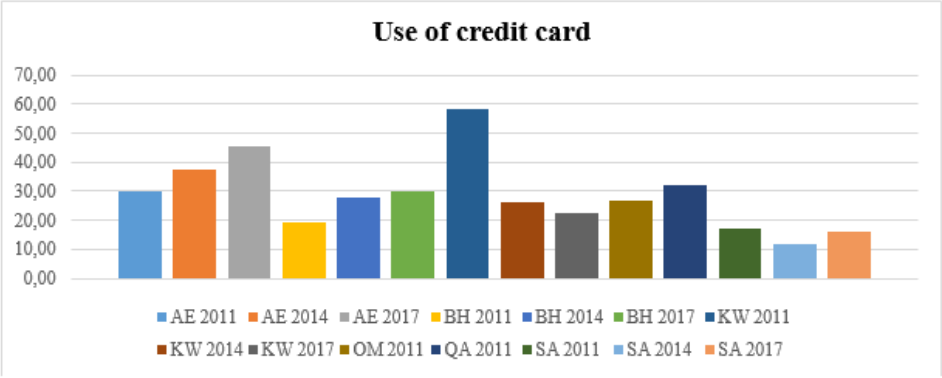
4.2 Methodology

This study adopts a similar methodology to Ozili (2020), and uses graphical, covariance, and correlation analysis to provide a quick understanding of the linear relationship and co-movement of the financial indicators. The Pearson correlation coefficient is used to measure correlations, highlighting the linear relationship between two variables and the strength of the relationship, while covariance is used to find out the direction of the relationship – i.e., how two variables move together (Ozili, 2020; Gujarati, 2009).

5. Results and Discussion

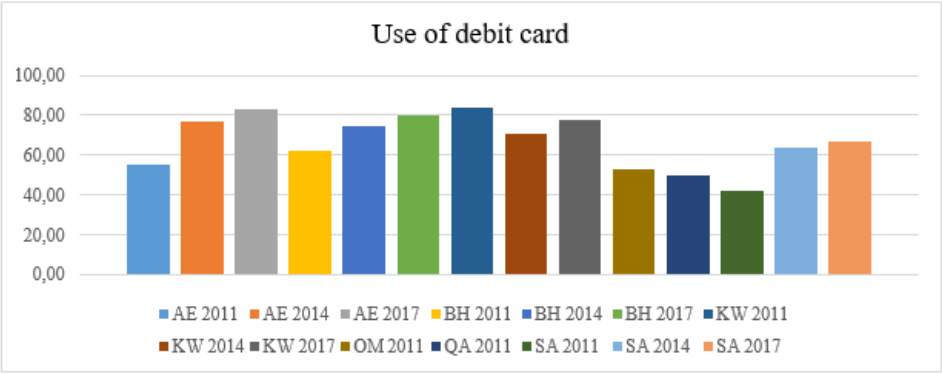
5.1 Graphical and trend analysis

Figure 3 presents the graphical analysis of the use of credit cards for payment purposes. Out of the six GCC economies, data from Oman and Qatar is available in the GFDI only for 2011. Other countries' data is available for 2017 at the latest. In 2017, Bahrain had the highest percentage of credit card use, followed by the UAE. In Saudi Arabia, 17% of the 15-plus population used credit cards for payments. Although the use of credit cards increased compared to 2014, the proportion was still low compared to the other regional economies. The use of debit card graphical analysis for the 15-plus age group among the GCC countries is given in Figure 4. These results show that the use of the debit card for payments is very common in GCC countries. The average proportion of the use of the debit card for payment is more than 75% for Bahrain, Kuwait, and the UAE, while Saudi Arabia had 67%, the lowest proportion among all GCC countries. No data is available for Qatar and Oman. Figure 5 reports the percentage of the population using digital modes for payment purposes in the GCC.



Notes: AE denotes United Arab Emirates, BH denotes Bahrain, KW denotes Kuwait, OM denotes Oman, QA denotes Qatar, SA denotes Saudi Arabia.

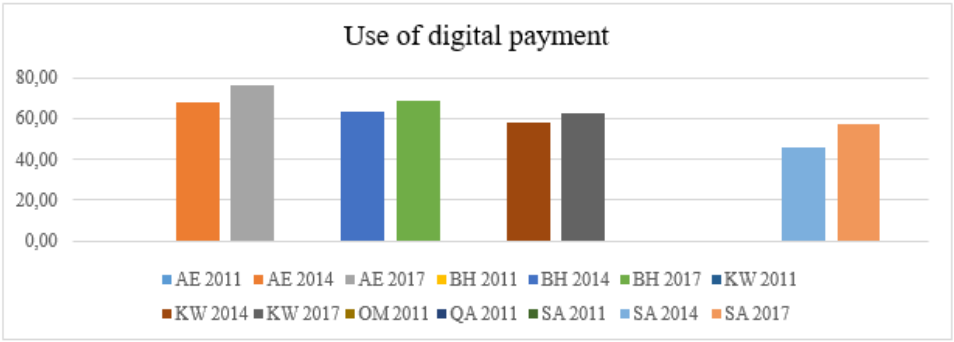
Figure 3. Graphical analysis of the use of credit cards among GCC countries



Notes: AE denotes United Arab Emirates, BH denotes Bahrain, KW denotes Kuwait, OM denotes Oman, QA denotes Qatar, SA denotes Saudi Arabia.

Figure 4. Graphical analysis of the use of debit cards among GCC countries

Digital/electronic payment data is available for only four countries for the years 2014 and 2017 – the UAE, Bahrain, Kuwait, and Saudi Arabia. The results show that Saudi Arabia lagged behind all these countries, with around 50% of the population using electronic modes of payments while the others had proportions of 60% and more.



Notes: AE denotes United Arab Emirates, BH denotes Bahrain, KW denotes Kuwait, OM denotes Oman, QA denotes Qatar, SA denotes Saudi Arabia.

Figure 5. Graphical analysis for using digital modes of payment among GCC countries

5.2 Test of dependence (covariance) for different methods of payments

Covariance analysis was used to establish the time-varying linear movement or dependence of digital payments, debit card and credit card use in GCC countries. *Covariance* measures the amount of linear dependence between two random variables; a positive covariance means two random variables move in the same direction, while opposite directions implies negative covariance (Wooldridge, 2015, p. 680). Table 2 presents the use of credit cards in these economies. The covariance analysis suggests that the use of credit cards in Saudi Arabia is associated with all GCC economies except Bahrain and the UAE. These results are similar to the results of Ozili's (2020) study on the use of digital finance in the UK, USA, India, and Nigeria. Based on a similar interpretation, the results of this study suggest that an increase in the credit card payment system in Saudi Arabia will positively increase the use of credit cards in Kuwait, Qatar, and Oman.

Covariance analysis of the use of the debit card in GCC economies is presented in Table 3. The covariance analysis of debit card use in the region suggests that there is a negative linear relationship between the use of debit cards in Saudi Arabia, the UAE, Kuwait, and Bahrain.

Table 2. Covariance analysis for Credit Cards among GCC countries

	AE	**BA**	**KU**	**OM**	**QA**	**SA**
AE	39.85396	26.86231	−91.2439	69.44862	84.2932	−1.32298
BA	26.86231	20.36169	−71.8357	37.74124	45.8084	−4.48209
KU	−91.2439	−71.8357	256.2507	−117.453	−142.559	19.47791
OM	69.44862	37.74124	−117.453	157.4721	191.1316	12.12689
QA	84.2932	45.8084	−142.559	191.1316	231.9858	14.719
SA	−1.32298	−4.48209	19.47791	12.12689	14.719	5.757956

Source: *Authors' calculation from GFDI data of 2011, 2014, and 2017 (Notes: AE denotes United Arab Emirates, BH denotes Bahrain, KW denotes Kuwait, OM denotes Oman, QA denotes Qatar, SA denotes Saudi Arabia.)*

These results are similar to the findings of Ozili (2020), suggesting that if the use of the debit card increases in one economy it will decrease in another economy. Hence it can be assumed that the use of the debit card in inter-country markets is less developed in the region. The covariance analysis of the use of digital payments among GCC economies is given in Table 4. The results show a positive linear co-movement dependence among all economies, which means that the use of electronic payments among all the economies is well developed and is showing a developing trend. The data on Qatar and Oman is not available on GFDI for the use of credit cards. However, in other economies, it can be inferred that the use of financial technology is not only increasing in the domestic markets but also has a significant impact on cross-border payments in the GCC regional economies.

Table 3. Covariance analysis of uses of debit cards among GCC

	AE	BA	KU	OM	QA	SA
AE	138.9827	87.90061	−46.0431	196.7849	183.7921	127.8324
BA	87.90061	55.89696	−26.9514	134.7043	125.8104	80.32857
KU	−46.0431	−26.9514	30.74836	8.0104	7.481511	−46.0639
OM	196.7849	134.7043	8.0104	624.4578	583.2278	163.4475
QA	183.7921	125.8104	7.481511	583.2278	544.72	152.6558
SA	127.8324	80.32857	−46.0639	163.4475	152.6558	118.4673

Source: *Authors' calculation from GFDI data of 2011, 2014, and 2017 (Notes: AE denotes United Arab Emirates, BH denotes Bahrain, KW denotes Kuwait, OM denotes Oman, QA denotes Qatar, SA denotes Saudi Arabia.)*

Table 4. Covariance analysis for digital payments among GCC countries

	AE	BA	KU	OM	QA	SA
AE	1167.855	1067.529	972.536	0	0	841.475
BA	1067.529	976.5717	889.5462	0	0	766.9348
KU	972.536	889.5462	810.297	0	0	699.0683
OM	0	0	0	0	0	0
QA	0	0	0	0	0	0
SA	841.475	766.9348	699.0683	0	0	613.0749

Source: *Authors' calculation from GFDI data of 2011, 2014, and 2017 (Notes: AE denotes United Arab Emirates, BH denotes Bahrain, KW denotes Kuwait, OM denotes Oman, QA denotes Qatar, SA denotes Saudi Arabia.)*

5.3 Correlation analysis

The pairwise correlation of the variables is presented in Table 5, and the results show that all variables are positively correlated with each other and the relationships are significant. The use of all digital finance or alternative financial instruments, such as the use of debit, credit cards, and electronic/digital payments, have a positive influence on each other. Moreover, the use of these methods also shows a positive impact on the proportion of private credit by depositing money to banks, and domestic credit to the private sectors increases as a proportion of GDP. These results predict that the use of financial technology is increasing in the GCC, resulting in financial deepening. The use of financial technology is also positively contributing to the increase of deposits and converting these deposits into credit for the private sector.

To examine the progress and use of digital finance and the dependence of variables in the case of Saudi Arabia, the pairwise correlation is calculated and presented in Table 6. These results indicate that the use of credit cards is negatively associated with other variables, showing that the use of financial technology is negatively affecting the use of credit cards in Saudi Arabia unlike the results of other GCC economies given in Table 5. Additionally, the use of alternative payment tools such as electronic payments and debit cards, financial access to private sectors, and deposits, have a positive influence on each other. Hence, the graphical analysis, covariance, and

correlation analysis indicate that the use of alternative finance/financial technology is increasing in the GCC. Digital finance tools or Fintech are growing in the region and are contributing positively to the financial services sector. These results also indicate that the use of digital finance and its related financial services sectors in Saudi Arabia are relatively less developed compared to the other GCC economies, especially Bahrain, the UAE, and Kuwait, even though it is the largest economy in the region.

Table 5. Pairwise correlation between the digital finance variables

	Credit card	Debit card	DP	PCG	PSDC
Credit card	1				
Debit card	0.8277***	1			
DP	0.3427	0.6657***	1		
PCG	0.6339***	0.7819***	0.4592**	1	
PSDC	0.443*	0.6369***	0.3937*	0.7953***	1

Source: *Authors' calculation from GFDI data of 2011, 2014, and 2017 (***, **, * present level of significance at <1%, 5%, and 10% respectively.*

Table 6. Pairwise correlation between the digital finance variables for Saudi Arabia

	Credit card	Debit card	DP	PCG	PSDC
Credit card	1				
Debit card	−0.4896	1			
DP	−0.4208	0.9970**	1		
PCG	−0.1236	0.9258	0.9522**	1	
PSDC	−0.1236	0.0.9258	0.9522	1***	1

Source: *Authors' calculation from GFDI data of 2011, 2014, and 2017 (***, **, * present level of significance at <1%, 5%, and 10% respectively.*

From the GFDI data, it has been observed that payments dominate the use of financial technology and there is a significant decrease in physical cash payments. Likewise, as per the Fintech adoption survey by Fintech Saudi in 2021, Fintech has significantly disrupted payments in Saudi Arabia. This survey reported that 91% of respondents know about alternative modes of payments and 69% are using electronic or digital payments, making it the largest contributor to the adoption of Fintech in the country. The survey also highlighted that 65% of individuals and companies give top priority to payments and seek more support in this area (Fintech Saudi, 2021b). Apart from traditional banks adopting financial technology, SAMA has issued permissions to seven banking and non-banking firms in the area of digital payments under the umbrella of a regulatory sandbox. The following companies are operating under said regulation: Sure, foodics, Skyband, Saudi Fintech company (Alinma pay), and the digital international cash

company AZM Fintech CO. As this permission is for an experimental period, financial data or information about the success, failure, or challenges faced by these firms are yet to be identified. The permitted Fintech companies are predominantly in the area of crowdfunding, followed by payments. Based on the analysis of GFDI data used in the study and the results reported by the Fintech Saudi 2021 survey, it can be concluded that the country has huge potential on the demand side, and the number of permitted companies depicts the interest in the area of Fintech from investors, contributing significantly to the supply side. Additionally, the country has the resources and infrastructure to enhance the adoption and development of Fintech. On the other hand, the same survey pointed out that the availability of a number of individuals with relevant skills and experiences is the main barrier that the industry faces.

Apart from SAMA, the CMA has also issued experimental licenses under the Fintech Lab initiative to 16 companies in the area of Robo-advisory, equity crowdfunding, offering investment in debt instruments, social trading, and real estate (Capital Market Authority, n.d.).

6. Conclusion

This study evaluates the use of digital finance/financial technology in Saudi Arabia. It uses the graphical/trend analysis with covariance and correlation analysis of various digital payments tools by using the GFDI data published by the World Bank in 2011, 2014, and 2017. To examine the progress of digital finance in Saudi Arabia, a comparison is made against the GCC countries. The findings suggest that the use of financial technology has increased across the whole GCC, and different payment methods, such as the use of digital payments, debit cards, and credit cards, have a significant positive association with each other. Moreover, these factors are also contributing to the growth of credit to the private sector in proportion to GDP in the region. The covariance and correlation analysis suggests that the use of technology is positively contributing to various financial services such as payments through debit and credit cards. This association could contribute to the enhancement of these financial services, and could further positively influence the other types of financial services such as the growth of credit to the private sector.

Hence, it is predicted that financial technology is also contributing to financial intermediation through non-bank Fintech startups. This means that the use of technology in the financial sector not only increases the access of individuals to financial services, but also increases access to formal financing for small and medium enterprises. Among six GCC economies, based on the availability of data, it is concluded that Saudi Arabia ranks fourth in the adoption of Fintech. However, it is observed that Fintech is in its early stage of take-off in the country compared to the more developed economy. In this regard, the two regulators, SAMA and CMA, have permitted various Fintech startups to enter the market under the umbrella of a regulatory sandbox. Based on the findings of this study, it is suggested that regulators should facilitate more Fintech startups focusing on financial services rather than payments.

The success, failure, or challenges faced by these Fintech startups are yet to be identified. However, based on the experience of other economies it is suggested that collaboration between industry, academia, and regulatory bodies is desired. Moreover, there should be cooperation between traditional financial institutions, technology firms, and Fintech startups to address current and potential issues in the relevant field. It is assumed that the findings of this study will lend a hand to Fintech startups and traditional financial institutions in observing the current status of

the industry along with its future potential. Moreover, these findings will also help policymakers and regulators to formulate Fintech growth-enhancing policies to align their objectives with the FSDP of vision 2030 in the country. Development in the financial sector will also diversify the economic sectors and decrease the dependence of the economy on the oil sector.

Even though the use of digital finance is growing and the market has growth potential from the sides of both supply and demand, currently the industry is in its infancy in the country. The evaluation of the use of digital finance and regulatory issues, with more comprehensive data on other advanced financial products provided by Fintech companies with advance methodological frameworks, is suggested in the future.

Funding

This research has been funded by the Scientific Research Deanship at the University of Ha'il-Saudi Arabia through project number GR-22 047.

References

1. Allen, F., & Santomero, A. M. (1997). The theory of financial intermediation. *Journal of Banking & Finance*, *21*(11–12), 1461–1485. https://doi.org/10.1016/S0378-4266(97)00032-0
2. Allen, F., & Santomero, A. M. (2001). What do financial intermediaries do? *Journal of Banking & Finance*, *25*(2), 271–294. https://doi.org/10.1016/S0378-4266(99)00129-6
3. Anagnostopoulos, I. (2018). Fintech and regtech: Impact on regulators and banks. *Journal of Economics and Business*, *100*(Nov–Dec), 7–25. https://doi.org/10.1016/j.jeconbus.2018.07.003
4. Arner, D. W., Barberis, J., & Buckley, R. P. (2015). The evolution of Fintech: A new post-crisis paradigm. *Georgetown Journal of International Law*, *47*, 1271.
5. Barefoot, J. A. (2015). Disrupting fintech law. *Fintech Law Reporter*, *18*(2), 1–18.
6. Boot, A., Hoffmann, P., Laeven, L., & Ratnovski, L. (2021). Fintech: What's old, what's new? *Journal of Financial Stability*, *53*, 100836. https://doi.org/10.1016/j.jfs.2020.100836
7. Boujlil, R., Hassan, M.K. and Grassa, R. (2020). Sovereign debt issuance choice: Sukuk vs conventional bonds. *Journal of Islamic Monetary Economics and Finance*, *6*(2), 275–294. https://doi.org/10.21098/jimf.v6i2.1104
8. Bromberg, L., Godwin, A., & Ramsay, I. (2017). Fintech sandboxes: Achieving a balance between regulation and innovation. *Journal of Banking and Finance Law and Practice*, *28*(4), 314–336.
9. Capital Market Authority. (n.d.). *FinTech Lab*. Retrieved from https://cma.org.sa/en/Market/fintech/Pages/default.aspx
10. Ernst & Young. (2019). *Global FinTech Adoption Index 2019*. Retrieved from https://www.ey.com/en_sa/ey-global-fintech-adoption-index
11. Financial Stability Board. (n.d.). *FinTech*. Retrieved from https://www.fsb.org/work-of-the-fsb/financial-innovation-and-structural-change/fintech/
12. Financial Stability Board. (2019). *FinTech and market structure in financial services: Market developments and potential financial stability implications*. Retrieved from https://www.fsb.org/wp-content/uploads/P140219.pdf

13. Fintech Saudi. (2021a). *Fintech Saudi Annual Report 2021*. Retrieved from https://fintechsaudi.com/wp-content/uploads/2021/09/FintechSaudi_AnnualReport_20_21E1.pdf
14. Fintech Saudi. (2021b). *Saudi Arabia National Fintech Adoption Survey: Results 2021*. Retrieved from https://fintechsaudi.com/wp-content/uploads/2021/08/Fintech_Adoption_Survey_English.pdf
15. The FinTech Times. (2021). *FinTech: Middle East & Africa 2021*. Retrieved from https://thefintechtimes.com/country-reports/
16. Fuster, A., Plosser, M., Schnabl, P., & Vickery, J. (2019). The role of technology in mortgage lending. *The Review of Financial Studies*, *32*(5), 1854–1899. https://doi.org/10.1093/rfs/hhz018
17. Gujarati, D. N. (2009). *Basic Econometrics*. New Delhi: Tata McGraw-Hill Education.
18. Hoffmann, P. S. (2011). Determinants of the Profitability of the US Banking Industry. *International Journal of Business and Social Science*, *2*, 255–269.
19. Khan, S., Bashir, U., & Islam, M. S. (2020). Determinants of capital structure of banks: evidence from the Kingdom of Saudi Arabia. *International Journal of Islamic and Middle Eastern Finance and Management*, *14*(2), 268–285. https://doi.org/10.1108/IMEFM-04-2019-0135
20. Merton, R. C. (1995). A functional perspective of financial intermediation. *Financial Management*, *24*(2), 23–41. https://doi.org/10.2307/3665532
21. Merton, R. C., & Bodie, Z. (1995). A conceptual framework for analyzing the financial system. *The global financial system: A functional perspective*, 3–31.
22. Minsky, H. P., & Kaufman, H. (2008). *Stabilizing an unstable economy* (Vol. 1). New York: McGraw-Hill.
23. Ozili, P. K. (2020). Comparing digital finance in the UK, US, India and Nigeria. *Financial Internet Quarterly (formerly e-Finanse)*, *16*(4), 1–11. https://doi.org/10.2478/fiqf-2020-0023
24. Philippon, T. (2015). Has the US finance industry become less efficient? On the theory and measurement of financial intermediation. *American Economic Review*, *105*(4), 1408–1438. https://dx.doi.org/10.1257/aer.20120578
25. Philippon, T. (2016). *The fintech opportunity* (Working Paper No. 22476). National Bureau of Economic Research. https://doi.org/10.3386/w22476
26. Philippon, T. (2019). *On fintech and financial inclusion* (Working Paper No. 26330). National Bureau of Economic Research. https://doi.org/10.3386/w26330
27. Rahim, S. M., Mohamad, Z. Z., Bakar, J. A., Mohsin, F. H., & Isa, N. M. (2018). Artificial intelligence, smart contract and Islamic finance. *Asian Social Science*, *14*(2), 145. http://dx.doi.org/10.5539/ass.v14n2p145
28. Rysman, M., & Schuh, S. (2017). New innovations in payments. *Innovation Policy and the Economy*, *17*(1), 27–48. http://dx.doi.org/10.1086/688843
29. Saudi Central Bank. (n.d.). *Permitted Fintechs*. Retrieved from https://www.sama.gov.sa/en-US/Regulatory%20Sandbox/Pages/Permitted-Fintechs.aspx
30. Saudi Central Bank. (2020). Distribution of Points of Sale Terminals by Bank [Data set]. Retrieved from https://www.sama.gov.sa/en-US/EconomicReports/Pages/report.aspx?cid=116

31. Takeda, A., & Ito, Y. (2021). A review of FinTech research. *International Journal of Technology Management*, *86*(1), 67–88. https://doi.org/10.1504/ijtm.2021.115761
32. Thakor, A. V. (2020). Fintech and banking: What do we know? *Journal of Financial Intermediation*, *41*, 100833. https://doi.org/10.1016/j.jfi.2019.100833
33. Vives, X. (2017). The impact of FinTech on banking. *European Economy*, *2017*(2), 97–105.
34. Vives, X. (2019). Digital disruption in banking. *Annual Review of Financial Economics*, *11*, 243–272. https://doi.org/10.1146/annurev-financial-100719-120854
35. Vucinic, M. (2020). Fintech and financial stability potential influence of FinTech on financial stability, risks and benefits. *Journal of Central Banking Theory and Practice*, *9*(2), 43–66. https://doi.org/10.2478/jcbtp-2020-0013
36. Weihuan, Z., Arner, D. W., & Buckley, R. P. (2015). Regulation of digital financial services in China: Last mover advantage. *Tsinghua China Law Review*, *8*(1), 25–62. https://dx.doi.org/10.2139/ssrn.2660050
37. Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach*. Cengage learning.
38. World Bank. (2020, November 1). *Key Data from Regulatory Sandboxes across the Globe* [Brief]. Retrieved from https://www.worldbank.org/en/topic/fintech/brief/key-data-from-regulatory-sandboxes-across-the-globe
39. Zhu, X., Song, B., Ni, Y., Ren, Y., & Li, R. (2016). Digital finance—from traditional finance to digital and internet finance. In *Business trends in the digital era* (pp. 161–190). Springer, Singapore. https://doi.org/10.1007/978-981-10-1079-8_9