International Journal of Computing and Digital Systems
ISSN (2210-142X)
Int. J. Com. Dig. Sys. 13, No.1 (Mar-23)

http://dx.doi.org/10.12785/ijcds/130147

Fintech innovations, scope, challenges, and implications in Islamic Finance: A systematic analysis

Mustafa Raza Rabbani

[1] *Department of Economics and Finance, College of Business Administration, University of Bahrain, Sakhir, Kingdom of Bahrain.*

E-mail address: mrabbani@uob.edu.bh; raza005@gmail.com.

Received 24 Dec. 2021, Revised 23 Feb. 2022, Accepted 5 Mar. 2023, Published 16 Mar. 2023

Abstract: The present study provides a systematic review of the major topics related to Fintech and Islamic finance that are associated with Fintech and Islamic finance since their inception post financial crisis of 2008 and even before. Fintech is a phenomenon; a disruption and it provides an opportunity to the Islamic finance to show its full potential and provide a true sustainable, ethical, and alternative financial system to the world. The study identifies and systematically examines the relevant literature on innovative financial services engineered by Fintech, scope of the Fintech based innovations, challenges, and implications of Fintech for the Islamic finance industry. The study aims to (1) examine the state of art in the Fintech based innovations and its implications in the Islamic finance industry; (2) identify the gaps in the Islamic Fintech research and make suggestions for the further scope of the study; (3) provide a detailed overview of the Fintech based financial services and related unique issues and challenges related to its implications in Islamic finance industry. The novel proposition in this study includes enriching the Islamic fintech literature. The result of the study provides a theoretical foundation for future research in Islamic Fintech including the development of innovative financial services and its sharia compliance.

Keywords: Artificial Intelligence; Blockchain; Innovation; Islamic Finance; Fintech; Islamic economics; Systematic review

1. INTRODUCTION

The inevitable has happened as Financial Technology (Fintech) has taken the center stage and disrupted the core of the financial services industry [1]. Financial services industry is going through a massive transformation, and it has already embraced the most disruptive technology in the form of Fintech. Firms in the industry are faced with the challenges of developing new and innovative business models, enhanced customer experience and alternative approaches that result in the services transformation. Fintech startups are looking for new pathways and new partners to grab the massive untapped market share. Fintech has provided customers with what they have been asking for and more with cross country transfers being possible at the tip of their fingers. Cryptocurrency, Blockchain, Artificial Intelligence, Data Analytics, Machine Learning and so on are some of the Fintech services that have spurred the financial sector [2]. Bulk of information lying around uselessly is valuable now along with increased transparency during transactions, all of which result in higher efficiency. Fintech services such as P2P transfers, savings and investments have been the most adopted services [3]. Fintech has shown itself to be so vital that regulatory authorities have conducted surveys and taken measures to deal with Fintech [4]. Regulatory authorities are at pressure to develop policies to mitigate Fintech 's risk while enhancing the services provided by these systems. At this stage, we must say that Fintech has brought about a spur in the financial ecosystem and the incumbents are looking for innovative solutions to upgrade their established services [5]. Nonetheless, proper review and research in this direction is the need of the hour to bring new legislation and to understand the market dynamics to seize this opportunity and to curtail the risk brought about by Fintech is significant to maintain financial stability [6].

The financial sector has always been increasingly competitive and swift in adapting to the dynamic changes in its ecosystem since decades [7]. Earlier digitalization seeped its way into the financial sector and resulted in easeful provision of financial services to the customers. However, it didn't pose a substitution threat to the financial firms; instead, they were accepted as an

E-mail: mrabbani@uob.edu.bh; raza005@gmail.com.

innovative improvement to the financial sector. Now, customers demand and accept those financial institutions and banks that provide the most efficient, trustworthy, useful and quick services [8].With the innovation of Fintech, the dynamics of the financial services industry has completely rotated and moved to a more customer centric approach in contrast to the product centered approach earlier. Fintech has disrupted the global finance industry by its ease of access, minimized costs and highly efficient products and services [9]. Telecommunication services have started providing core banking services which has threatened the incumbents' market share [10]. Fintech has also enabled financial inclusion of the tech savvy generation who are otherwise left off the hook due to the stringent requirements of incumbent banks and financial institutions. As such, financial institutions are forced to either incorporate Fintech services or partner with Fintech startups for reaping the maximum benefits of this innovation [11], [12]. Adopting Fintech isn't just a ladder to the top but a necessity to sustain in the current financial ecosystem [13]. Traditional banks are faced with serious decisions to restructure their business models to incorporate Fintech [14].

Investment in Fintech has seen a rapid rise in the latter half of the last decade due to its increasing fame and efficiency. Implementing financial technology for financial services has resulted in cost effectiveness, customer ease and efficiency (Iman, 2020). The growth of Fintech is driven by high demand, cost pressure and technological advancement. With technological advancement comes the associated risk which banking professionals worldwide are trying to mitigate (Gomber et al., 2018). Fintech has the capacity to radically change the financial service ecosystem and this potential makeover must be noted in terms of its risk and functionality [6]. While Fintech is rising at a huge pace and might completely change the financial world in the next few years, this invites a lot of risks that the financial sector may not be able to deal with. Apart from the most common risks like cyber risk, compliance risk and regulatory risks [17].

Islamic Finance is still in its early stages [18]; Although, its consistent performance during and after the global financial crisis of 2008 has established it as the major contender to its conventional counterpart [19]. After the global financial crisis, customers lost confidence in the conventional financial system and due to the ethical nature of financing, Islamic finance seized this opportunity and established itself as the more stable and robust financial system [13]. Although, the size and volume of Islamic financial system is still very small in contrast to the conventional financial system [20], [21]. However, Fintech has disrupted the financial ecosystem and Islamic financial institutions ad banks can be the biggest profiteers [22]. In fact, Fintech has provided the equal ground on which the Islamic financial institutions and banks can compete with the conventional financial institutions [23]. Equalizing with its conventional counterpart or outracing them seemed like an unattainable dream until the discovery of Fintech [24]. With Fintech emerging IFIs have a great opportunity in hand to tie the competition. IFIs and Islamic banks have always struggled to reduce cost because of the nature of their services but Fintech has provided them with a way out [25]. Islamic banks need to become more agile and incorporate Fintech in their operations to not only reduce costs but to provide customers with a convenient and easy form of banking. By adopting Artificial Intelligence (AI), Blockchain, Big data. automation and predictive analytics IFIs can benefit greatly by effectively reducing cost while attaining efficiency which has been one of the biggest impediments [26].

In this paper we provide how research on Fintech and its adoption can be diversified to provide the more meaningful information and contribution to the existing literature. It is increasingly important to generate research finding which is equally important to the research community, governments, policy makers, business and that can be replicated and strewn by the researchers and scholars outside the finance community. The present study aims to; (1) examine the state of art in the Fintech based innovations and its implications in the Islamic finance industry; (2) identify the gaps in the Islamic Fintech research and make suggestions for the further scope of the study; (3) provide a detailed overview of the Fintech based financial services and related unique issues and challenges related to its implications in Islamic finance industry.

Remainder of the paper is organized as follows. Section two discusses the evolution of Fintech, why Fintech is needed at all and its scope and role in Islamic finance? Sections three provides an overview of the Fintech based financial innovations like, Cryptocurrency, Crowdfunding/P2P lending, big data, Blockchain etc. and sharia compliance of those innovations. Section four analyses the unique issues related to Fintech in general and related to Islamic Fintech. Finally, in section five, we conclude, provide the future scope of study and policy implications.

2. RESEARCH METHODOLOGY

To investigate the initial issues related to the development of academic literature in financial innovations in the Islamic finance industry, we began by conducting the systematic literature review (SLR). SLR is one of the most widely adopted method of literature study where extensive literature survey is performed to determine the state of art of a research topic.

2.1 Research question

The research question is this study is:

RQ1. What are the Fintech innovations, its scope, challenges, and its implications for the Islamic finance industry?

For answer the RQ1, an effort has been made to study all related available literature on Fintech innovations and Islamic finance. The related databases were visited, articles identified, and obtained to provide a comprehensive overview of the published articles.

2.2 Search Process

First, the journal portals, databases, and scientific publications were determined to review in the study. It was ensured to use only good quality articles to be used in the review. To ensure the quality of the articles reviewed only articles indexed in Scopus, Web of Science (WoS), IEEE explore and Science direct were considered for review. Second, the popular PICOC strategy was used to make it more scientific and protocol review. PICOC strategy is popularly known as the population, intervention, comparison, outcome, and context [5], [27]. The keywords, such as 'Fintech, 'innovations', 'challenges', 'Islamic finance', 'Islamic Fintech', 'trends', 'problems', were used to retrieve the relevant articles.

2.3 Implementation

To abate the biasness in the article selection process, a preset inclusion and exclusion criteria were determined, such as including only articles published in English language and excluding articles published in other languages. Other criteria used was that the selected articles were matched based on the research question and duplicate articles were removed. The study also used the 'Mendeley reference manager', for arranging, managing references, and generating bibliography of the cited articles in the text. Figure 1 shows the methodology used in the study.

The methodology used for the study is presented in the Figure 1:

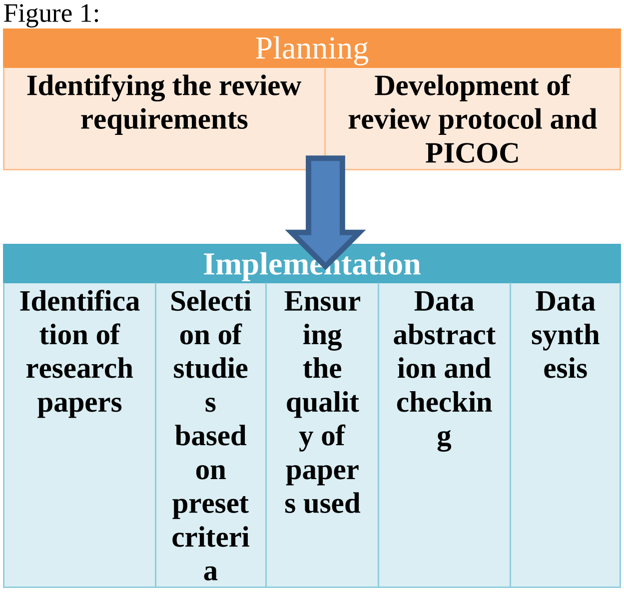

Figure 1: Methodology used in the study. Source: Author's own architecture.

Selecting a Template (Heading 2)

3. The Evolution of Fintech and a Step Towards Financial Inclusion and Sustainable Finance

3.1 What is Fintech?

Fintech is the combination of two words - Finance and Technology [28]–[30]. Hence, the use of technology in providing banking products and services is what constitutes of Fintech (Anagnostopoulos, 2018; Y. Li et al., 2017). In addition to the core banking services such as transfers, savings, investments and insurance, the main purpose of Fintech is improving and automating the use of financial services [34], [35]. Fintech initially started out by being applied only in the finance sector but now there is a widespread use of Fintech across different sectors ranging from hospitality to education. Since the crash of the financial sector in 2008, Fintech started gaining momentum. Fintech has facilitated greater integration between countries and less dependency on the traditional players of the finance sector. Thus, resulting in Fintech being called a "disruptive" innovation. Cryptocurrency may not be something you have heard for the first time; it is always making headlines. Cryptocurrency is a result of Fintech and is also one of the most debatable topics in Finance literature. These virtual currencies have had a drastic market capitalization from $10.62BN in 2013 to $237.1BN in 2019 indicating the success of this Fintech service (Statista, 2020) Ease of access, convenience and lower costs have portrayed Fintech as an attractive innovation to the consumers.

Fintech has given opportunities for smaller regions to level with other nations by building Fintech hubs. Underbanked segment of the society is being included as part of the Fintech revolution with developing countries such as China (69%) and India (52%) actively adopting this service (Ernst & Young, 2017) Ever since the demonetization in India, there has been a surge in users of digital payment platforms. Although China has an increasing adoption rate of Fintech, USA is leading on a global level with investment in Fintech up to $9.4BN in the first half of 2019 (The Global Fintech Index, 2020) However, to succeed in Fintech, it takes active encouragement from the government and respective authorities to remove hurdles, inspire talent and implement lenient policies.

Table 1; Definition of Fintech

DEFINITIONS OF FINTECH	AUTHOR
Financial Technology or Fintech denotes companies or representatives of companies that combine financial services with modern, innovative technologies.	[36]
Fintech is a new financial industry that applies technology to improve financial activities.	[37]
Fintech can also be considered as “any innovative ideas that improve financial service processes by proposing technology solutions according to different business situations, while the ideas could also lead to new business models or even new businesses.	[38]
An economic industry composed of companies that use technology to make financial systems more efficient.	[39]
Fintech is a service sector, which uses mobile-centered IT technology to enhance the efficiency of the financial system. An economic industry composed of companies that use technology to make financial systems more efficient.	[40]

DEFINITION OF ISLAMIC FINTECH	AUTHOR
Any Fintech in a Muslim market demography that delivers an unmet financial need and or financial inclusion objective.	[41]
Any Sharia compliant Fintech fund investing in digital infrastructure or economic development anywhere in the world.	[42]
The use of Fintech utilities: KYC / AML, Blockchain and DLT, Cyber, Payments, Big Data & Machine Learning in Islamic Finance	[43]’[44]
Islamic Fintech is based on the ethos and value of Sharia, and it can lead the finance world across the globe.	[45]
Digital Islamic banking is a technology of providing Islamic banking products and services through online services using tools Fintech industry.	[24]

3.2 Why Fintech?

Ever since the global financial crisis in 2008, people have resented financial institutions because of the major collapse of the entire sector [46]. Although, people lost trust in financial systems who were supposed to financially back consumers, banks still had an upper hand [47]. They entirely dominated the industry for years because they were unconquerable. However, due to stricter regulations and compliance, banks had to struggle between providing services at a reasonable rate and meeting the compliance standards. Interest rates started to soar, and other hidden fee charged to customers who had no choice but to accept the system because there weren’t any alternatives [48], [49]. There was no choice for the customers even though there was deep rooted anger for not being able to control their finances [50]. There was a pressing need in the community for a strong contender against financial institutions. The descending trust in banks brought about a necessity for Fintech. Fintech has since then evolved and enabled integration of under-banked and unbanked in its radar [51], [52].

Fintech is not a trend anymore; in fact, it is a necessity currently. People are ready to trust Fintech over traditional banks because the former provide greater benefits and the latter have already disappointed [53]. Now, with the COVID19 pandemic, online platforms and digital payments have flourished. In Bahrain alone, 28% of the population use Benefit Pay app and its use has ascended by a 1000% during the pandemic [54]. Apart from the need of Fintech for contactless payments, there are numerous reasons as for the Fintech trend and massive popularity of Fintech based financial services and emergence of Fintech as a phenomenon post financial crisis of 2008 [55]–[57].

- Fintech is accessible from and to any nook and corner of the world due to the strength of the internet. Hence, internet is known as the bridge to connect people similarly Fintech lowers the barrier of entry for small scale businesses to the financial world [58].
- Although, traditional banks have online channels, they still can’t beat the cost at which services are offered by Fintech. The automation, ease, high customer satisfaction and low cost combined makes Fintech an untouchable force [59].
- Fintech services are safer than incumbent banks because these firms do not pay heed to cybersecurity as much as Fintech companies do. This is because Fintech firms are principally built on technology and therefore take high security measures whereas banks tend to take it lightly [60].
- Fintech investments and adoptions are a boost to the economy with new careers and higher acceptance of commoners. Fintech adoption reached a 64% in 2019 and with investments of $39.6Bn in 2018 [61].

- Fintech is known to promote social welfare by enabling women to enjoy banking benefits, reducing poverty, and empowering small sized businesses who find it the hardest to raise finance. Fintech services like crowdfunding and P2P have provided a platform for such individuals. Financial Inclusion would've been impossible for traditional banks but Fintech has made it possible [62].
- Finally, Fintech has provided a way of converting big data to useful information which can be used to study patterns, trends and predict irregularities. This helps firms to build suitable policies to achieve their goals (Sun et al., 2020).

3.3 Inefficiency of the existing system and the rise of Fintech

The common misconception of Fintech is that Fintech is only confined to the latest developments in Fintech such as the digital wallet and online payments. However, Fintech is an extensive concept and has been prevailing since the 1950s [31], [60]. Cryptocurrency, Artificial intelligence (AI), Blockchain, RegTech, InsureTech, Big Data etc. are some of the latest and the most disruptive additions to the chain [64], [65]. Fintech 's main purpose has been reach, ease and cost efficiency (Arner et al., 2020; Kasthuri, 2018; Kim et al., 2016). Technology was initially incorporated in the finance world with credit cards and debit cards to reduce dependency on carrying cash [68]. The technological drive continued with ATMs, systematized data keeping, online stock trading and down to Fintech products such as P2P, blockchain, crowdfunding and such today [69]. Although, most individuals own a bank account, there are certain regions where people have savings in cash and not bank accounts mainly due to barriers set by the regulators which is impossible for certain market segments to pass. Financial inclusion has been one of the most charming attributes of Fintech with students and unprivileged community benefitting from banking services which were otherwise not available to them [70].

Additionally, the 2008 global financial crisis caused by the real estate sector resulted in major damage to the efficiency of the finance sector [46], [71]. As the financial market fell, banks faced bankruptcy and liquidity crisis with high risk of Non-Performing Loans. Banks have faced a high decline in cost efficiencies since then. Although measures have been taken to stabilize the cost, it has never reached the pre 2008 level [72]. Having lived through this financial instability, it is unlikely for Gen Z and Millennials to have complete confidence in the banking system [73]. As per Fenergo, 12 of the world's leading banks were penalized for violations of Anti-Money Laundering (AML), Know Your Customers (KYC) and sanctions regulations in 2019. The 2019 forfeits of $36BN is the second greatest recorded fines in history [74]. Moreover, only a small percentage of consumers believe that their banks would honor their commitments. 21% of consumers believe that banks have their customers' best interests at heart [75]. That's a whopping 79% who have no faith in the banking system [76]. The CEO of Fenergo, Marc Murphy states "In today's climate there is no other option but to leverage next generation technology to achieve a more effective and streamlined approach to regulation that allows financial institutions to approach regulatory compliance in a 'business as usual' manner". The competitive advantage that banks have had over Fintech was mainly the trust factor which has been diminishing since the Global Crisis. Fintech startups leveraged the disadvantages of the incumbents into gaining a market share for themselves. Fintech offers transparency with the use of Blockchain where all the transactions are available to everybody in the chain with less likely occurrences of money laundering. Fintech provides a platform for individuals to raise money without the intervention of banks using P2P lending platforms. Fintech has also resulted in the younger generations being able to receive loans and make investments with the help of lower costs and other means of obtaining data to determine credit worthiness of individuals without the need of providing a collateral [63].

Even though Fintech has been prevalent during the 1950s, factors such as financial exclusion, cost inefficiency and lack of confidence due to the global crisis paved the way for Fintech 's popularity.

3.4 How Fintech is helping banks in delivering financial services?

While Fintech is seen as a disruptive force and a threat to banks, it's hard to overlook the benefits it brings along. Fintech not only aids consumers but also the banks which are pushed to adopt the latest technologies to stay alive in the game resulting in effective and efficient performance. Fintech provides banks with various opportunities to improve their offerings while attaining cost efficiencies [77], [78]. There are a host off available literature exploring the impact of Fintech on the financial performance of banks [79]–[83] and its impact on ease of delivering the financial services [9], [79], [82], [84].

Big data and data analytics have given Fintech a great advantage in terms of assessing credit worthiness, analyzing customer preferences and behavioral patterns. 74% of financial businesses are mainly interested in data analytics [85]. Banks can greatly benefit from this by tailoring products and services based on customer preferences (Alam et al., 2021). New products developed based on this data would have a low failure rate due to statistical predictions. Customers are always looking for speedy and helpful assistance which is effortlessly provided by chatbots and *robo-advisors*. 34% of financial firms consider investing in AI indicating its potential in customer satisfaction and cost cutting. These automated assistances also help in gathering data about potential clients and additionally aid in promoting new banking products or services [87], [88]. Mobile banking is another unmissable innovation which has made banks step up their game by providing options of opening a bank account, loan formalization or insurance agreement at the comfort of your homes. 51% of financial firms are willing to finance in mobile developments [76]. These highly effective modes of service delivery not only help banks in reducing their cost inefficiencies, but most importantly improves customer retention [89]–[91]. Customer retention is extremely crucial for banks especially when the financial ecosystem is highly competitive and it's easier to lose customers than gain. Like how losing customers can result in losses, higher customer retention rate increases profitability [32], [92].

Since the 2008 global crisis, banks have been unable to reach pre crisis efficiency rate. With automation and digitalization, costs can be drastically reduced. Artificial Intelligence is known to increase savings for banks by up to 25% [93]. Most consumers prefer mobile banking and conduct most of the banking transaction through their cell phones. There is less necessity of numerous physical locations which is a great cost cutting measure [94]. Personalizing products as per customer preferences has proven to reduce costs. Products, services, and processes are simplified with the help of Fintech, costs are incurred only on those products and services that have a high possibility of being accepted by customers. Providing these services at the right time is what cracks the deal and Fintech provides banks with just that.

In addition to cost efficiencies, customer retention and additional revenue, Fintech is immensely useful in detecting fraudulent behavior. With behavioral patterns of customers being under the microscope, it is easy to notice any irregularity in these patterns for banks to be alerted [95]. The predictive model of Fintech based innovation such as, big data can help catch money launderers and assist audits to detect threats and frauds [63]. Any unusual activity can be easily distinguished due to established patterns and predictions [96]. Banks can follow compliance standards and adhere to it effectively with the help of such notable Fintech innovations. Overall, banks have a lot to gain in this Fintech revolution if they open their minds to see Fintech as an opportunity rather than a threat.

Figure 1 below, depicts the technological area of investment-the most important area of Fintech for the investment in future. It can be observed that 'data analytics' is the most preferred area of investment in Fintech based projects, followed by the mobile banking and mobile payment services, and artificial intelligence respectively [17].

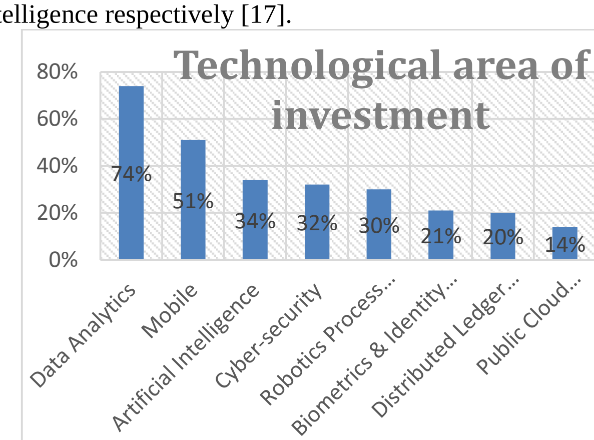

Figure 2: Technological area of investment
Source: PwC Global Fintech Survey, 2017 [17].

3.5 *Whether Fintech is a competitor or partners for the bank?*

Fintech and banks, despite being pitted against each other almost always, have proven to be interested in working together in recent years. Banks have realized that resisting Fintech and driving them away isn't helpful in the long run instead a strong partnership could be the key to success and sustainability. 65.3% of bank executives view Fintech firms are partners as compared to a 27.7% who see them as competitors [97]. This indicates that banks have broadened their thinking approach. Different sectors that have emerged with a lot of publicity will find themselves relying on banks to survive in the long term [93]. Other than that, for the banks to succeed in the future, they tend to be dependent on Fintech based innovations by starting a self-administered Fintech innovation center or collaborating with a Fintech firm. Moreover, banks' large capital puts Fintech in a position to allocate bigger resources into finding new solutions and developing improved products [98].

It would be naïve to believe that Fintech pose ultimately zero threat or competition to the incumbents. There is a level of competition that has led us to believe that Fintech is a disruptive technology. Fintech startups have grabbed some of the banks' market but they have also made things easier for banks which is why there in an increased rate of collaboration between the two [99], [100]. Banks mainly figure out what can be worked out internally and where there's a need to collaborate with Fintech [101]–[104]. Additionally, geographic location and level of development in countries also play a role in signifying the level of competition [84]. But bank officials believe there is a space for working together in partnership as the goal would be to enhance products and improve customer satisfaction [105]. Fintech cannot necessarily be a threat or an opportunity, it is basically a blend of both [60]. Fintech is the much-needed push that the traditional banks were lacking to cater to the growing needs of millennials population in terms of innovative tech-based financial services. Fintech is a necessity for very bank in this generation to provide their customers with excellent service [106]. Although, cryptocurrency, Blockchain, crowdfunding, robo-advisors, etc. have the potential to completely substitute banking products and services, these innovations are treated more like a healthy competition which would lead to the prosperity of financial institutions [62], [107].

4. FINTECH INNOVATIONS

Innovation in finance is just like innovation in any other sector, that is, creating a new product or service or an entirely new process of providing existing products or services [108]. Innovations in finance have been existing way before Fintech entered the market. Take for instance, an ATM was one of the most remarkable financial innovations which made life so much easier for customers. It is practically impossible to picture life without an ATM, queuing up in banks and planning days ahead to withdraw money during the working hours of the bank [109]. Similarly, records were kept and calculated manually in banks before calculators. Then arrived, online banking which has led to the most convenient means of banking experience for customers. Currently we are in the era of Fintech where automation and digitalization has led to highest proficiency with least human involvement. Fintech based innovations has disrupted the entire finance sector and it has already replaced the traditional financial services with the new, innovative, convenient and cost effective financial services [110], [111].

All the innovations and disruptions are welcome in Islam as long it is not against the sharia principles [112]. Fintech is a disruptive financial innovation which do not violate any principle laid down by the sharia and it is very much in accordance with the ethos and principles of sharia [113], [114]. Islamic finance industry has already embraced Fintech and Fintech based innovative financial services to compete with its conventional counterpart by providing the sharia compliant, ethical and inclusive financial services[57], [115], [116]. Since Islamic finance is based on the principles of ethics and morality and Islamic Fintech based social financial services such as *Zakat, Qardh-Al-Hasan, awqaf* etc. are going to play a maasive role in fight against the economic adversities of the pandemic. Islamic Fintech based financial services got acceptance after the global financial crisis of 2008 and COVID-19 pandemic is expected to bring stability and provide ground to emerge as the major competitor to the conventional financial system[117], [118]. In the next section, we will discuss about some of the disruptive Fintech based innovations and its implications for the Islamic finance industry.

4.1 Blockchain

A Blockchain is basically an indefinite set of data structures that are linked together, usually through a process called cryptography [119]. Each data structure record in the Blockchain contains the cryptographic hash of its predecessor, a timestamp of when the new record was formed and some data which is usually transactional [120]. A Blockchain works by decentralizing all the data, this means every single entity that has recorded some transactional data in the Blockchain also has a copy of all records that are part of the Blockchain [121]. You can think if it as a ledger where all the transactions made by a group of people are recorded. Now imagine every single person in that group having a transactional record in the ledger, also having a copy of the ledger. Blockchain has a massive number of applications most notably in the financial sector including-

- Sending & receiving payments across international border.
- Since every person involved in the Blockchain has a copy of the ledger, there is no need for the middleman (banks) that usually require a considerable amount of time to send receive money across international borders.
- Customer Identity Verification.
- Implementing a single ledger that contains the identity of all customers/potential customers allows the banks to speed up the user identity verification process of their customer and help in identifying fraudsters.
- Better record keeping:
  The financial industry needs to keep trillions of bank records ranging from stock market transactions to personal transactions of their customers. Using a single ledger to record all this information would help in better record keeping, unify records across banks

and prevent any unintended alterations to the records [122], [123].

These distinguished benefits that banks could access by adopting Blockchain ledger technology has resulted in a rise in Blockchain investments. As a result, Blockchain market is booming rapidly with an estimation of 15.9Bn worth spending by 2023 contrasted to 1.5Bn in 2018 [124] and financial sector is the one contributing to the largest portion with 60.5% of worldwide market for Blockchain [125]. Banks are speeding up to develop this technology within their structures to enjoy efficient and organized record-keeping. Globally, organizations have shown interest in Blockchain technology and about 10% are in experimentation stage or installing it [125]. Some of the noteworthy firms that have invested in Blockchain are Chain Inc., Post Trade Distributed Ledger Group, Digital Assets Holdings, R3, Ripple, etc. [126]. In addition to that, World Economic Forum, Citibank and Credit Suisse are also among financial firms who have invested in Blockchain with some of them successfully deploying it [127].

Blockchain technology is very much sharia complaint as it does not violate the basic tenets of sharia [8], [128]. Though, Islamic banks and financial institutions are the late adopters of the Blockchain technology, but they have embraced this technology and benefiting from it. This disruptive technology is slowly gaining momentum among the Islamic finance industry players and some of the examples include in the year 2020 Abu Dhabi Islamic bank became the first Islamic bank to adopt Blockchain technology for its trade finance distribution. In addition to this, Bahrain's Economic Network for Financial Transaction (BENEFIT PAY) uses Blockchain technology for its KYC (Know your customer) utility. Blockchain and Blockchain based Cryptocurrency have disrupted the financial sectors and making inroads into the Islamic finance sector. The next section discusses the Cryptocurrency and its sharia compliance.

4.2 Cryptocurrency

Cryptocurrency is a medium of exchange in digital form which is not backed by national or central banks hence it is completely unregulated [129]. Cryptocurrency uses Blockchain based technology of decentralizing all the transactions taking place in the system. It is a virtual currency that records ownership of crypto tokens or coins in a digital ledger using cryptographic hash function to ensure transactions are secure and verified [130]. Bitcoin was the first decentralized cryptocurrency introduced which is why it is interchangeably used with the term 'cryptocurrency'. It is important to understand that Bitcoin is merely a type of cryptocurrency among 6000 other altcoins which were released gradually [131], [132]. Bitcoin uses proof of work scheme to ensure safety of the system and users from denial of service attacks such as spam mails and heavy traffic resulting in freezing the system [80]. Peercoin, another form of cryptocurrency, was the first to use a combination of proof of work & proof of stake. Proof of stake randomly chooses the developer of the next block based on their wealth whereas proof of work requires the potential block creator to solve some complex equations. Some of the attractive features of cryptocurrency that has garnered lot of attention are [133]–[135].

- The decentralized process that disregards the involvement of intermediaries such as the government or banks and permits P2P trading.
- The transparency involved in every transaction; all the cryptocurrency users have access to all the information about all the transactions that has taken place in the Blockchain database.
- The transaction fee is comparatively lower due to zero interventions and regulations
- Transactions are validated without the need of lengthy paperwork as Blockchain system uses smart contracts generated by the computer to impose a contract.
- All the information is available under a single umbrella facilitating convenience and making it difficult for hackers to get into the system as there are way too many nodes to completely cease its operations.
- Finally, immutability disallows transactions from being altered or cancelled. Once a transaction has occurred in the system, it is unchangeable. Hence, it is trustworthy.

Figure 3: Top 10 Cryptocurrencies by market capitalization Source: Bagshaw, April 22nd, 2020 (Yahoo Finance)

Cryptocurrency has been one of the most controversial financial innovation of the last decade [136], [137], See figure 3. Sharia scholars are divided over the sharia compliance of the Cryptocurrency as there is no unanimous view whether it can be considered as the sharia compliant or not sharia complaint. The scholars such as (Abubakar et al., 2019; Hammad, 2018; Virgana et al., 2019; Saleh et al., 2020) are of the opinion that the Cryptocurrency is sharia compliant and it should not be declared *Haram*. They have their own arguments in the fair of allowing Cryptocurrency as sharia complaint. (Saleh et al., 2020; Sangwan et al., 2019), argue that Cryptocurrency s the innovation and Muslim *Ummah* can benefit from it and those who says that it's not sharia compliant they should provide evidence and not the one who are in favor and supports it. Cryptocurrency is the new and disruptive innovation, and it is going to replace the fiat money in the time to come and it should be declared Halal by the sharia scholars on the *Maqasid –al-sharia* basis. On the other hand, other section of scholars is completely against the sharia compliance of the Cryptocurrency, and they opine that it should be declared Haram on the ground that, it is too much volatile, there is uncertainty and *gharar*, there is no regulating body, the investment in Cryptocurrency are not safe, it can be misused by anti-social elements for terror funding etc. Cryptocurrency is neither a fiat money nor a real money and it is also not backed by the real assets, and absence of intrinsic value and with zero supervision by the regulating agency make it vulnerable to be misused by the anti-social elements [143].

After the extensive review of available literature and analysis of opinions of the scholars, we conclude that trading in Cryptocurrencies such as Bitcoin, Ripple and Ethereum is not *Halal* and it must be declared haram [144]. We strongly believe that trading in these cryptocurrencies is not having value and neither economic growth gives it any value and its return have any origin. It is highly volatile and chances of fluctuation in the prices are very high (*Gharar*), there are great chances that it might be used for the unfair trade practices such as terrorism, gambling, tax evasion and money laundering etc. [145]. Any legitimate Islamic government has still not adopted it by considering it to be to be regarded it as legitimate. Most of the characteristics of Cryptocurrency falls in the haram category asper sharia. However, considering the huge popularity and demand from the Muslim youth and investors there is need to develop and fully sharia compliant Cryptocurrency by removing these obstacles to provide them an alternative investment avenue which is safe, sustainable and follows the ethos and principles of sharia.

4.3 Crowdfunding

Crowdfunding is a means of raising capital for an idea, business, or a cause by bringing together investors who are interested in the project. The investors pitch in capital until the goal is met and the business is operating. Crowdfunding is a method of raising capital for small business or startups by collectively pooling money from interested stakeholders. It is done to support any entrepreneurial project, organization, art with an aim to break the traditional barriers of financing and to endorse social change Past several years, crowdfunding has shown huge improvement as a result of advance in the internet [53], [146]. Due to a rising demand in encouraging start-ups and small business, crowdfunding has gained popularity with investors participating in the business by way of providing capital. Crowdfunding has three major aspects to it, the project proposers who come up with the idea, the investors that are interested in that idea, and the internet that brings them all together. Back in 2015, the crowdfunding industry raised almost 34 billion dollars (P2PMarketData, 2019) Crowdfunding has created an opening for most entrepreneurs to raise a good amount of capital to invest in their dream projects. Crowdfunding provides a platform for anyone with an idea to show it to the investors. One of the types of crowdfunding that's gaining popularity is equity-based crowdfunding as this allows most start-up companies to finance their business without giving up control to the investors. This in turn provides the investors with a stake in the venture. Crowdfunding also allows investors to invest as low as 10 dollars (Smith, 2019) Depending on the percentage of funds raised crowdfunding sites generate revenue.

According to analysts crowdfunding market is expected to grow to USD 300Bn by 2030 (UNDP, 2018) Moreover, more than 6 million crowdfunding campaigns were held in 2019 (Saleh et al., 2020) and the three countries that are dominating the crowdfunding market are China, UK and the USA [148].

Due to crowdfunding, the way the products are brought into the market by entrepreneurs and established companies has been changed. Most companies are turning to crowdfunding in order to enhance research development and innovation. Since 2019, Bahrain is home to a debt-based crowdfunding platform. A great example of finance raised through crowdfunding would be that of Oculus VR, well known for virtual reality. Oculus was funded through Kickstarter which is among the leading crowdfunding platforms. The resultant capital was tenfold higher than the target investment [149].

Islamic finance can highly benefit from this because it satisfies the basic principle of sharia-compliant banking. Crowdfunding doesn't involve interest payments and is done to support small or medium sized business who would otherwise be excluded [150], [151]. The investors of a crowdfunding project are collectively sharing profits and the risk is low because it is diversified among them. Islamic crowdfunding would require investment in halal projects and would be extremely suitable to the millions of Muslims who struggle to raise capital to start a business [150], [152]. Crowdfunding would also satisfy the Islamic rule of being socially responsible by supporting a business and in turn profiting together without the loss of another [153]. The Central Bank of Bahrain has launched traditional and sharia-compliant crowdfunding for small and medium sized enterprises. However, even with government initiatives, crowdfunding hasn't raised a lot of demand. This could be due to inadequate awareness, lack of technical knowledge and slow electronic process [154]. Nevertheless, Islamic crowdfunding is a valuable program for creative entrepreneurs which gives them a way out of the traditional financing methods and consists of less risk. Initiatives must be put in place to encourage sharia-compliant crowdfunding for those who are unaware and might be in need. Government can ease the procedures involved and pace up the process. There must be a push in this direction of financing in the Islamic world to lift small & medium businesses and promote collective well-being. [150], [151], [153], [155].

4.4 P2P lending

Many individuals & households globally do not have a bank account; the number of unbanked individuals is massive. These, mainly being the poor community are in much need of funds in the form of loans and they resort to local lenders who exploit their state and charge unreasonable rates of interest. This is one of the main reasons why the poor community always stays poor, it's an endless loop [156]–[158]. Nonetheless P2P lending is here to break this ugly pattern. P2P lending will not merely promote financial inclusion by offering loans, but investors can also aim for higher returns without the involvement of financial institutions [53], [150].

P2P lending is a platform that provides lenders and buyers with a space meet but of course without the intervention of banks [146]. These firms mostly operate online which allows them to provide their services at lower rates than the incumbents [159]. Breaking it down, investors open an account in a P2P platform and deposit the amount they want to loan out. They can either loan it out altogether or distribute it among various borrowers. On the other hand, the borrower makes a profile for himself, and the firm assesses the creditworthiness of the individual after which, the rate of interest that he is capable of paying is determined. Once the borrower chooses an offer, the deal is finalized and the lending platform take care of the payments and transfers [160]

P2P lending is gaining recognition because of the burden-free process and superior benefits for both the parties. In case of a bank, the investor receives a lesser rate, and the borrower is charged a higher rate. Since these online platforms don't have to pay overheads, they offer their services at much lower rate. Moreover, applying for a loan is painstaking & time-consuming process which is completely erased with P2P lending platforms [161]–[163]. It can be observed from the figure that, China is the biggest market for the P2P lending platforms followed by the USA and United Kingdom.

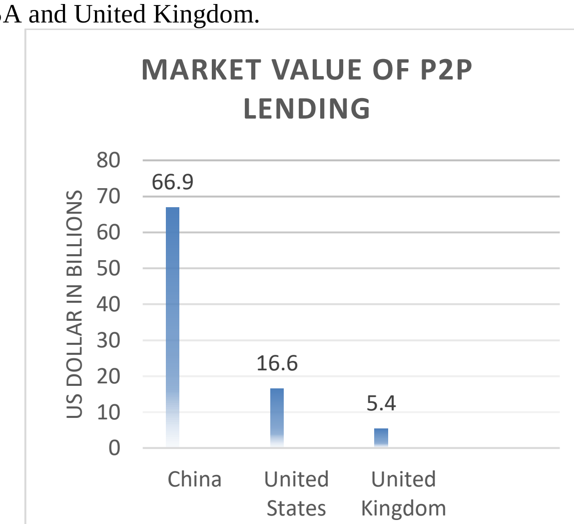

Figure 4: Market value of P2P lending Source: Statista, 2016

As far as Sharia compliance of the P2P lending is concerned, it may or may not be sharia compliant based on the nature of contract. It can be called as sharia complaint if it does not promise fixed profit to the investors [146], [159]. Looking at the nature of transaction in the P2P lending, it looks less closer sharia compliant as compare to the crowdfunding. Sharia principle-based Fintech models for Crowdfunding and Peer to Peer lending platforms can resolve most of the existing problems and challenges of these platforms [151], [152].

4.5 Smart Contracts

Smart contracts are self-enforcing agreements that is stored as a computer code handled on a Blockchain database [164]. These computer codes are a set of conditions which are enforced on the involved parties after digitally signing them using cryptographic keys. The agreement is executed automatically once the stated conditions are fulfilled. The contract is now available on many computers and these computers perform as a witness for the enforced contract [136].

An example of smart contract being used as a Fintech tool could be a farmer produces crops and has insured his crops against bad weather. The routine procedure would require a paper contract to be signed and the farmer can file a suit in case of crop damage due to harsh weather. On the contrary, enforcing a smart contract would automatically result in the negotiation being released to the farmer in case of such an event. It's a major step away from these time-consuming paperwork and unnecessary courtroom drama [165].

The most appealing feature of smart contracts are that they are pre-defined and can function autonomously and independently. Smart contracts like many other Fintech innovations cancel out intermediaries and as a result eliminate the need of paper documents which are a fuss. Smart contracts also ensure immutability hence it cannot be altered in any form (Ali et al., 2020). This ensures security and reliability with either the payment being released immediately in case the conditions are met or a refund for the payer [167], [168]. Hence, both the party's benefit with no chance of being deceived. Therefore, smart contracts ensure certainty and speed by automating the entire process [169].

Smart Contracts and its application Islamic Finance are also interesting. As the basic characteristics of smart contracts i.e., transparency, efficiency and speedy execution of transaction are in consistent with the rules and regulation aid down by the sharia. Fintech in Islamic finance has helped Islamic banks to firmly establish themselves as a strong contender while holding true to sharia principles. Islamic beliefs teach values of fairness and honesty. As per hadith of Ibn Maajah (2443), the prophet (PBUH) said "Give the worker his wages before his sweat dries." This indicates towards impermissibility of withholding payments of workers. Thus, smart contracts can be applied to Islamic finance to completely validate the principles of sharia and correspondingly facilitate immediate payment to the payee [62], [170].

4.6 Regtech

Ever since the 2008 global crisis, financial institutions have been increasingly subjected to stringent compliance and regulatory standards. The number of fines paid by firms for nonconformity has only been rising and costing a huge amount of money. An estimate suggests that banks devote around $270Bn for compliance every year and it is said to increase twofold by 2022 [171]. In such a scenario, where banks and financial institutions are incurring huge expenses for complying with regulations, Regtech comes to the rescue with its efficient and inexpensive services [172], [173].

Regtech is, as the name suggests, Regulatory Technology. Breaking it down, Regtech is a Fintech innovation that combines technology with regulatory & compliance process. It automates regulatory monitoring, reporting & compliance thereby enhancing the process of delivering regulatory requirements for financial institutions [174]–[176]. Regtech is the blend of regulation in combination with the technology, aimed at improving and enhancing the efficiency, transparency and standardization of organization in terms of regulatory compliance [177], [178]. Regtech startups gather information online or from the web and use data analytics tools to determine anomalies and predict shady areas or patterns [179]. There is bulk of data available on the internet, and it isn't practically possible for the financial firms to go through each one of them. A Regtech startup takes it up from here and goes through all the information related to the compliance requirements for the firm. Regtech and financial organizations often use the cloud system to exchange information for higher security and lower costs [180]. A cloud system is a technology where all the information is stored on the internet in contrast to being stored on a computer or a hard disk and as such information is available in real time for those accessing it [181]. Regtech mainly minimizes the task that banks and financial institutions must indulge in for keeping up with the regulatory requirements. Investing in Regtech is highly economical, less labor-intensive and enhances the quality of compliance by using data analytics tools to develop meaningful results from the vast data that is lying around uselessly [182]. There is a vast number of Regtech companies currently operating and specializing in diverse domains of finance. Trunomi, Silverfinch, PassFort are some of the prominent ones [183].

Islamic financial institutions (IFIs) are required to go through the strictest rules and regulation of sharia and complying with these rules and regulations can put these institution in serious danger [184], [185]. In this scenario Regtech comes as a savior to these institutions and IFIs have embraced Regtech for enhancing its transparency, efficiency, consistency and standardization of the regulatory formalities in such a way that promote integration and interpretation of sharia regulatory standards at the lower possible cost. The financial innovations must not come as an excuse for the financial institutions to oversight the sharia regulations, rather it should be the premise on which sharia governance can be enhanced [62]. The synergy between Fintech and Islamic finance is expected to ensure enhancing sharia compliance by the Islamic financial institutions and it is also expected to help the Sharia Supervisory Board (SCB) and Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI) in addressing the sharia non-compliance issues that may arise due to the advancement in technology and financial innovation.

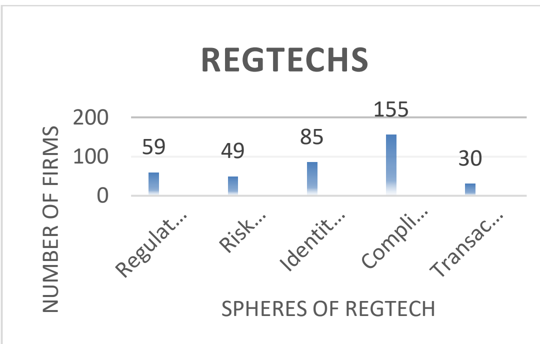

Figure 5: Regtech Source: [186]

4.7 *Smart Banking*

Smart banking is the latest 'Fourth Industrial Revolution'-4IR (Banking 4.0) banking revolution in the Fintech world aimed at providing banking solutions like checking, saving and investing and planning to meet the investors goal [187], [188]. Smart banking shows digital recruitment and a variety of innovative products that are delivered through a mobile application. The first drive to smart banking was to reduce paper within the transactions, to stop the long queue in banks and to make ease of banking to customers. In order to keep the customers occupied, most banks have introduced smart robots to keep them waiting customers entertained [100]. The use of such technologies is mainly focused on retrieving great operational efficiencies. One of the very few examples could be the use of smart banking during this pandemic; people prefer to go contactless and online banking instead of paperwork and physical presence is gaining demand. Within your reach, at the tip of your fingertips, now it's possible to make any transactions, without even standing or waiting in the long queues [189]. Smart banking has paved a long way for customers that find difficulty in going to a bank and conducting in their transactions [190].
The main contact point being smart phones and mobile tablets where the banks interact with their customers is just as important as electronic bill payment and ATM's. Most banks are engaging in social media in order to attract their customers and to interact, provide answer to customer queries and gain important feedback [191]. In 2018 China revealed that almost 168 million people have switched to smart banking rather than stick to cash payments [192]. According to a recent statistic almost 73% customers use an online banking channel every 30 days [193] and physical bank locations are anticipated to decrease by 36% by 2022 [194].

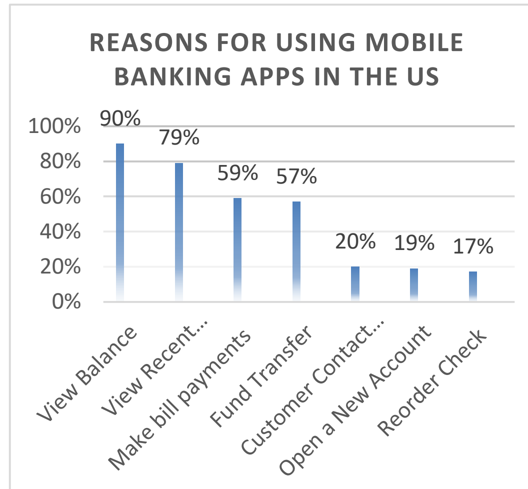

Figure 6: Reasons for Using Mobile Banking Apps in the US Source: [195]

4.8 *Digital Payments*

Digital payments are the simplest yet one of the most popular form of Fintech innovation [196]. Digital payments are transactions that are undertaken without the involvement of cash, aka, non-cash payments. The entire purpose of digital payments it to provide convenient form of lifestyle, banking and financing for consumers [197]. From paying for food, laundry services, transferring money, taxi service, shopping, donations and so on, digital payments are an integral part of our lives. Digital payments are expected to disrupt the banking industry by offering customers with alternatives such as e-wallet and mobile in contrast to cash or cards (Alkhowaiter, 2020; Vijayan et al., 2020).
Digital payments can either be transactions made online for shopping using a range of payment methods such as cards, PayPal, Alipay, BenefitPay, etc. or POS payments using Bwallet and STCpay which provides a contactless payment option to the consumers.
Amidst the coronavirus pandemic, this form of payment is gaining a lot of traction. With people dreading minutest form of contact, digital payments are the go-to option for consumers. According to an analyst, people are increasingly downloading applications on smartphones to make payments digitally and expected an increase in innovations from this sector (Al Nawayseh, 2020a). A study suggests that the pandemic has the capacity to disturb one of the strongest contenders in the financial sector, debit cards and credit cards. The pandemic has

resulted in quicker acceptance and adoption of digital payments with an inclination towards contactless payments [202], [203].

Convenience is not the only upside of digital payments; cost savings, transparency, security, financial inclusion, and inclusive growth are what digital payment brings along. Mexico saved US$ 1.27Bn with a move to digitize delivery of pensions, wages, and social welfare. India saw a 47% decrease in bribery by digitalizing pension payments. Between years 2008 and 2012, 1.9M jobs were created because of digital payments.

Digital payment platforms are sharia compliant as it has nothing which can be described as something against the sharia [62], [204]. In fact, digital payment platforms promote the *maqasid-al-sharia* concept of ease, quality, reliability, efficiency and reduced cost of transactions for the Islamic finance users [24].

4.9 Others

There are people who believe that the financial sector, among other sectors is very slow when it comes to innovation and then there are others that believe that financial sector has seen a vast improvement and innovative. For example, during this COVID-19 pandemic we have witnessed the escalation of pace in which Fintech innovations are improved to make life easier for customers, such as digital banking, mobile transactions, cashless payments, etc. [205]–[207]. It must be noted that Fintech innovations aren't only limited to the ones mentioned above, there are way more out there.

Artificial Intelligence (AI) is another dynamic area of Fintech innovation [34], [208], [209]. Financial institutions are increasingly investing in AI due to the wide range of benefits they offer, ranging from wealth management, underwriting, credit scoring and insurance to customer service.

AI for wealth management can make use of Natural Language Processing (NLP) software for analyzing the reactions of public to news about mergers or other matter that could affect stock rates and predictive analysis can suggest the best stocks for a trader to buy at the perfect time. NLP can also be used in the case of underwriting to determine whether a customer is trustworthy and likely to repay his loan by searching through his web activity or social media posts. This way a bank can avoid taking responsibility for customers who are faulty. Many eligible applicants miss out on borrowing loans due to inadequate credit history but by using AI software for determining credit score, these excluded individuals can benefit [38], [210].

InsureTech has enabled insurance companies to reduce risks and costs to a great extent by providing customized insurances for customers. AI software's, cameras and GPS can be used for tracking which would ease out the process of identifying insurance frauds. Customers also benefit with lower rates due to tailored policies. AI in customer service is one of the most common use of the technology whereby Chatbot are assigned for simple customer queries.

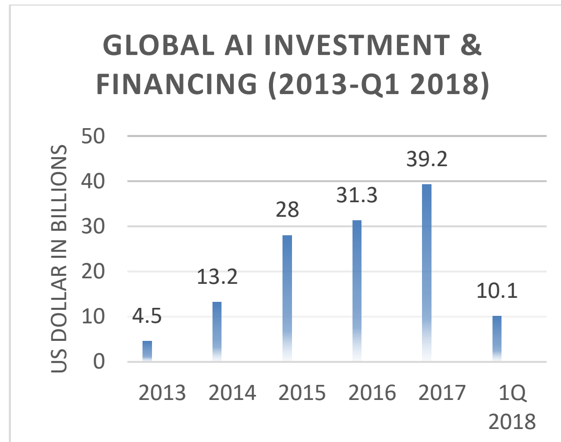

Figure 7: Global AI Investment & Financing (2013-Q1 2018) Source: [54]

5. UNIQUE ISSUES AND FINTECH CHALLENGES

5.1 Fintech challenges

Fintech has completely revolutionized the finance sector and like everything in the world, nothing is too perfect. Fintech is certainly a great package, but it does have complexities that needs to be resolved to ensure greater security, higher profitability and higher adoption rates. Some of the major overall challenges that Fintech firms facing the Fintech firms are highlighted as below;

- **Cybersecurity -** definitely tops the list of challenges to Fintech firms with cyber-attacks happening on an average of every 39 seconds [58]. Since all the operations and transactions are automated and conducted online, there are hackers working around the globe trying to get into the systems to steal sensitive information or digital money. Fintech firms spend a lot of money and efforts on cybersecurity to have a strong defense against traffic and attacks [211]. Some of the notorious identity thefts includes the data breach in Capital One, Equifax, JPMorgan Chase and CheckFree where confidential data of millions were stolen [212]. Some of the worst cyber-attacks have been in the cryptocurrency area where coins worth millions were stolen as shown in the chart below.

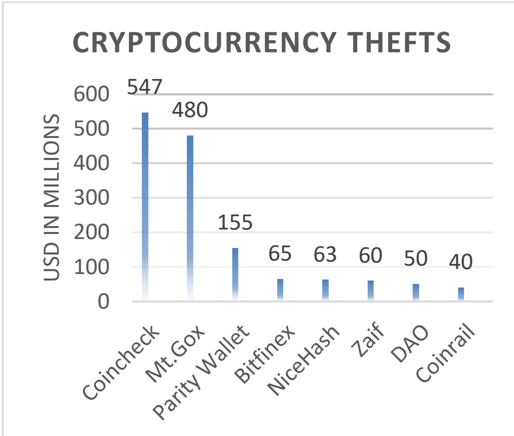

Figure 8: Cryptocurrency thefts Source: [213]

- **Customer Experience** has been an obstacle to the growth of Fintech since a long time. Fintech innovations involve the use of technology obviously which is attractive to millennials and the tech savvy group, but the middle-age groups find it difficult to use such technology. Although, it brings along efficiency and cost reduction, there is less awareness regarding Fintech products. There are individuals who do not completely trust Fintech because of the misconceptions surrounding it and the lack of understanding. Since money is involved, customers are increasingly cautious and prefer to play it safe siding with the traditional players. Additionally, some of the websites are difficult to navigate around and customers sometimes prefer communicating with a human instead of a chatbot which results in disappointing customer experiences (Gomber et al., 2018).
- **Regulatory Compliance** has been something that Fintech was outside the radar of. But the volatile regulatory environment keeps introducing new regulations that the finance industry needs to adhere to. The last few years witnessed the introduction of General Data Protection Regulation (GDPR) which sets out a boundary for gathering personal information of citizens [173] and Revised Payment Services Directive (PSD2) which provides regulations for online payment services such as adhering to strict security measures [214]. Fintech are assigned with the job of showing customers how responsibly their personal data are being used. Although, PSD2 encourages transparency to third party providers, it increases the burden of strict security measures for these services. Anti-Money Laundering and You're your Customer regulations are also crucial to be complied with and can lead to hefty fines in case of violations [215].

These are some of the major challenges faced by Fintech, however there are plenty more. Difficulty in attracting investors due to Fintech being viewed as a competition than an opportunity. Fintech organizations find it difficult to build a reputation without collaborating with mainstream banks. This also leads to a struggle in international expansion where large amounts of money are involved. Fintech must find a way to work through all the challenges to reap the most out of the innovation.

Islamic Fintech, like conventional Fintech, started gaining traction after the 2008 global crisis which lead to major distrust in conventional banks [24]. Islamic finance being an ethical model of banking sparked a lot of interest among consumers who were yearning for a reliable institution. Islamic finance is built on the foundation of treating borrowers and lenders fairly without exploiting one's situation. Incorporating Fintech in Islamic finance is what makes up Islamic Fintech. Everything is permissible in Islamic finance and all the innovations are permissible if it doesn't indulge in things that are explicitly prohibited by the Sharia. As per the director of an Islamic consultancy firm in UK, finding adequately skilled and knowledgeable personnel for Islamic Fintech is a big hurdle. In order to develop trained persons for Fintech, proper institutions must be established with well recognized Islamic Fintech courses (Shaikh, 2020). There must be an encouraging push from the academic organizations and the government towards an Islamic Fintech model of banking. Academic scholars must take up more research in this field to theoretically assist in Islamic Fintech innovations. A lack of academic research, lack of trained personnel and lack of support have resulted in a deficiency for skilled job seekers [217].

Regulations is another area which needs to be correctly developed to encourage Islamic Fintech innovations. With almost all transactions being conducted online and massive information stored on the web, customer's interests and confidential data must be protected. Government should come up with flexible regulations that wouldn't hinder of such startups. Regulations should be an ideal balance between protecting the customers and inspiring progress for the startups. Adhering to government backed regulations can also help Islamic Fintech firms to gain customer's faith easily and thereby build a trustworthy reputation. Regulatory authorities, Government and Islamic Fintech must come together to mutually agree on regulations that are in favor of all parties. This is an extremely complex task considering the decentralized nature of Fintech. Adhering to regulations is another time consuming and hectic task but Islamic Fintech firms can utilize RegTech to reduce the burden of compliance on themselves. Although, attracting investors for raising finance is not as much of a challenge as the ones we discussed above, it still cannot be ignored [62]. Financial institutions need to raise sufficient finance in order to stay afloat and since trust in Islamic Fintech as a newcomer is generally low, it is difficult to raise large amount of finance for the startups. Investors find it difficult to estimate and assess if their investments will earn them reasonable profits [218].

Apart from these Islamic Fintech challenges, the operations of such firms are completely disclosed which is the reason for transparency. Firms will have to be very cautious to maintain unambiguity at every level. Additionally, Islamic Fintech needs to catch up on the latest innovations in the financial sector and modify it to their benefit. Cyber Security is another major issue that comes along with technology and Islamic Fintech must also control fraudulent activities [218].

Table 2: How challenges of Islamic Fintech are different?

Conventional Fintech Challenges	Islamic Fintech Challenges
Cyber Security is one of the main issues due to increase in hacking events.	Cyber Security is also prevalent in Islamic Fintech and huge expenses need to be incurred to tighten security measures.
The new regulations that must be complied with require Fintech firms to put in a lot more time and efforts.	Flexible regulations are much needed in the Islamic Fintech area to protect investors and at the same time to let innovations grow.
Customer experience in terms of complex websites, lack of human touch and difficulty in building trust & reputation	Lack of academic research, short term courses and programs result in lack of well-trained human resource.
Difficulty in attracting investors due to being new and the competitive nature of conventional banks	Raising finance is also among the main challenges in Islamic Fintech with investors finding it problematic to understand this model of banking combined with Fintech
International expansion is important in the long term, and it is not easy to do this without support from incumbents.	Islamic Fintech needs to keep up with the innovations in the traditional finance to compete on the same level.

By drawing comparison, we can clearly see that many of the challenges are identical however Islamic Fintech has additional problems to tackle mainly due to lack of research and study in that field.

5.2 *Fintech and Financial inclusion*

Financial exclusion has been a major drawback of the traditional financial institutions. The compliance standards require banks to go through some strict KYC regulations before allowing an individual to open his/her bank account [219]. As a result, a large chunk of the world's population remains unbanked and deprived of the benefits that banking can offer them. As per the report by World Bank, a total of 1.7Bn people remained unbanked as of 2017 [220]. Mainly, this chunk consists of the poorest population who are underprivileged to open accounts, borrow loans and save, while they are the ones who need it the most. Younger generation also make up a fair share of about 30% of unbanked population globally [220]. There were various reasons discovered for being underbanked and among the top were not having enough money, high cost and inadequate documents. This is where Fintech steps in and charms us with its benefits. One of the attractive qualities of Fintech has been financial inclusion as it has the potential to minimize the wealth distribution barriers by providing equal opportunity for all individuals [69]. Mobile phones have fast paced the process of digitalization and automation thereby reducing cost of transaction and attaining higher efficiencies. Fintech thus encourages financial inclusion by lowering costs which one among the main barriers for customers. Digital bank accounts ease the process of opening a bank account and do not require being present at the physical branch which could be problematic for certain working-class groups. Individuals who weren't allowed to open a bank account earlier due to lack of data regarding credit worthiness, can benefit from Fintech whereby other methods are used to assess credit worthiness. The otherwise excluded population can now store their savings and earn returns, helping them progress financially. By providing easy to navigate websites or applications, Fintech can promote participation from underserved segments such as women, poor community, young individuals and first-time users [67], [221], [222].

Fintech not only provides a means to attain financial inclusion for conventional banks but also provides a great opportunity for Islamic finance whose very essence is built upon financial inclusion, collective growth and poverty eradication [221], [223]. Unfortunately, Islamic banks have found it difficult to maintain low transaction costs due to their nature of banking. As per research, the number of families without a bank account are higher in member countries of Organization of Islamic Cooperation (OIC) as compared to Non-OICs [79], [224]. One of the resulting factor responsible for the high level of unbanked households is religious reason with 34% Afghans, 23% Saudis and about 27% of Iraqis and Tunisians mentioning this [79]. In countries with well-developed Islamic banks like UAE & Bahrain, the unbanked segment seems to be low. High transaction cost is another factor central to the exclusion of the poor households and expat workforce as it isn't cost-effective for banks to offer an account providing all benefits to this segment. It is evident in many of the low-income expat workforce receiving their payments in cash. Fintech 's cost effective attribute is the highlight of the innovation. With the help of Fintech, Islamic banks can achieve cost efficiencies and include the underserved section of the society by striking out the 'high transaction cost' barrier [62]. Fintech will provide a way for Islamic banks to become more competitive against their traditional foils by cutting costs. Smart contracts, big data, AI, Blockchain, digitalization and automation can significantly minimize costs in the long run which is the main obstacle holding Islamic banks back. Crowdfunding and P2P lending is also another Fintech service that encourages the excluded community to raise finance for startups and provide loans. Islamic Fintech could be the source to exterminate the bridge between banked and underserved segment of the society and promoting welfare of all individuals..

5.3 *Fintech and Sustainability*

Sustainability, in simple terms, using our resources in a responsible way so that the next generation isn't deprived of them due to our exploitation or over usage (Aliyu et al., 2017; Hussain et al., 2019). Industrial revolution led to the idea of sustainability being raised. With industrial revolution, a lot of chemical factories were developed, population rose, and natural resources were draining due to high level of pollution in the environment. As a result, the world was quaked by the environmental & economic crises that took place during those times such as the Bhopal disaster, Chernobyl disaster, Exxon Valdez oil spill and oil shocks, the American banking crisis, the 1930 financial crisis respectively [13], [227]. These crises led to the need of developing a sustainable framework for all business to adhere by [228]. Since then, sustainable development has been given a high status to achieve long term economic and ecological growth [50], [55], [229].
Green finance means financial investments that are aimed at achieving sustainable development goals by driving funds towards green projects and thereby ensuring higher level of accountability [230]. Green finance supports green technologies, green bonds, water sanitation and low carbon projects [207]. Therefore, green finance facilitates taking responsibility of environmental problems and solving them for a cleaner world (Sun et al., 2020). However, green projects are expensive, time consuming and lack enough data. Therefore, small banks find it increasingly difficult to fund green finance. Banks are threatened with loss of profits and missing out on other opportunities with higher returns, so green holdings are less than 1% by global investors (Sun et al., 2020).
Fintech always comes to the rescue when the issue is high cost and lengthy time. Fintech primarily encourages sustainability by digitalizing operations, by facilitating less wastage in terms of paperwork, paper bills and unnecessary driving to banks for every transaction. In China, Green Finance Information Management System was introduced to tackle the problem of inadequate data by using big data, data analytics, cloud system and AI to derive reliable statistics (Dal Mas et al., 2020). Fintech also enables low transaction cost and high operational efficiency by digitalizing green assets [94]. Transactions are transparent encouraging more participants to invest in environmentally friendly projects. Fintech has a wide range of users and is spread across wide channels which will help attract more customers at a lower cost. Information asymmetry can also be resolved with the help of Blockchain transparency and big data can be used for risk management and detecting environmental violations [234]. Main users of green finance are large scale organizations because of the heavy costs involved. Although, small and medium scale enterprises also have a responsibility towards the environment [235], [236]. Fintech can offer reasonable investment plans for such organizations and push them towards a green change [237]. Another example is crowdfunding where investors can fund a green project or idea. The upside to this way of raising finance would be, if an investor doesn't see this as a good investment, he/she can back off without wasting his time or money. Personalized green investment portfolios can be generated through an AI which would show the investors a clear idea as to where the funds are going, and the results achieved from the investment. Green bonds can be raised through Blockchain technology, in fact China even cleared settlement through automation [238]. Ant Forest is a green Fintech project on Alipay where customers can grow a virtual tree by doing activities or transactions in an environmentally responsible way. These activities earn "green energy" for customers through which they can raise a virtual tree. Once a complete virtual tree is formed with enough green energy, the organization plants a real tree on your behalf. The green energy must be recompensed after a real tree is grown [239]. More than a 100 million trees were planted through this system by the first quarter of 2019. Such schemes encourage consumers to live a low carbon lifestyle [240], [241].

5.4 *5. Conclusion*

In this study we performed the systematic review of the available literature on Fintech innovations, scope, challenges, and implications in Islamic finance industry covering the breadth and depth of Fintech research since its inception, financial crisis period and role if Fintech during and post COVID-19 pandemic. We acknowledge that though the conventional Fintech industry is growing and a mature industry itself. However, the published research in Islamic Fintech is immature and empirical and theoretical evidence continues to grow daily. It is beyond the scope of our study to include every research published on Fintech and Islamic Finance. One of the limitations of our study that some of the potentially relevant studies related to the role of Fintech post COVID-19 are excluded due to the publication process. Thorough this systematic review we conclude that Fintech is here to stay and if Islamic finance industry aims to catchup with the growth in conventional industry, they must be quick to adopt Fintech based innovative financial services.

We are living in a world where contactless payments are key to controlling the spread of the COVID-19 virus and finance world has taking this opportunity to expand its rea of operation and taken their market to the undiscovered territory. In can be concluded that the disruptions caused by the COVID-19 pandemic will foster growth in the Fintech sector as the governmental measures such as; necessity to maintain social distance and avoid physical contact is in favor of Fintech and boosting its growth faster than ever. This development is not going to fall flat after the pandemic because once consumers experience the ease and convenience, they are going to want to stay. The hardest part was getting customers to trust Fintech and give it a genuine chance, the pandemic has made that happen. Ultimately, banks must realize that Fintech is here to stay and they need to step up.

The study will help in better understanding the Fintech in general and the role of Fintech in fostering the growth in Islamic finance industry. It will be helping the regulators, governmental agencies in making favorable regulations to help in enhancing the growth in Islamic Fintech. Future studies can be conducted on Fintech adoption and customers' perception, evaluation of countries growth in Fintech, Fintech, and automation process in Islamic banks etc.

REFERENCES

[1] S. N. M. Daud, A. H. Ahmad, A. Khalid, and W. N. W. Azman-Saini, "FinTech and financial stability: Threat or opportunity?," *Financ. Res. Lett.*, 2022, doi: 10.1016/j.frl.2021.102667.

[2] P. Gomber, R. J. Kauffman, C. Parker, and B. W. Weber, "Institutional Knowledge at Singapore Management University On the Fintech revolution : Interpreting the forces of innovation , disruption and transformation in financial services On the Fintech Revolution : Interpreting the Forces of Innovation , Disrupti," no. 1, 2018.

[3] E. Honisch and M. Ottenbacher, "Crowdfunding in Restaurants: Setting the Stage," *J. Culin. Sci. Technol.*, vol. 15, no. 3, pp. 223–238, 2017, doi: 10.1080/15428052.2016.1225539.

[4] Y. Nichkasova and H. Shmarlouskaya, "Financial technologies as a driving force for business model transformation in the banking sector," *Int. J. Bus. Glob.*, vol. 25, no. 4, pp. 419–447, 2020, doi: 10.1504/IJBG.2020.109120.

[5] M. R. Rabbani, A. Bashar, M. Atif, A. Jreisat, Z. Zulfikar, and Y. Naseem, "Text mining and visual analytics in research: Exploring the innovative tools," in *2021 International Conference on Decision Aid Sciences and Application (DASA)*, 2021, p. (pp. 1087-1091). IEEE.

[6] A. Demir, V. Pesqué-Cela, Y. Altunbas, and V. Murinde, "Fintech, financial inclusion and income inequality: a quantile regression approach," *Eur. J. Financ.*, 2020, doi: 10.1080/1351847X.2020.1772335.

[7] C. W. H. Cheong, "Cryptocurrencies vs global foreign exchange risk," *J. Risk Financ.*, vol. 20, no. 4, pp. 330–351, 2019, doi: 10.1108/JRF-11-2018-0178.

[8] H. Mohamed and H. Ali, *Blockchain, Fintech, and Islamic Finance*. 2018.

[9] M. Jünger and M. Mietzner, "Banking goes digital: The adoption of FinTech services by German households," *Financ. Res. Lett.*, vol. 34, 2020, doi: 10.1016/j.frl.2019.08.008.

[10] T. A. Siddiqui and K. I. Siddiqui, "FinTech in India: An analysis on impact of telecommunication on financial inclusion," *Strateg. Chang.*, vol. 29, no. 3, pp. 321–330, 2020, doi: 10.1002/jsc.2331.

[11] L. F. Passi, "An open banking ecosystem to survive the revised payment services directive: Connecting international banks and fintechs with the CBI globe platform," *J. Payments Strateg. Syst.*, vol. 12, no. 4, pp. 335–345, 2018.

[12] J. Wonglimpiyarat, "Analysis of FinTech in the banking industry," *Int. J. Bus. Innov. Res.*, vol. 19, no. 1, pp. 125–138, 2019, doi: 10.1504/IJBIR.2019.099752.

[13] S. Aliyu, M. K. Hassan, R. Mohd Yusof, and N. Naiimi, "Islamic Banking Sustainability: A Review of Literature and Directions for Future Research," *Emerging Markets Finance and Trade*. 2017, doi: 10.1080/1540496X.2016.1262761.

[14] C. P. S. Nayer, "Can a traditional financial technology co-exist with modern financial technologies? The Indian experience.," *Savings Dev.*, vol. 10, no. 1, pp. 31–58, 1986, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-0022857091&partnerID=40&md5=b6201b31f78c45999593114c51dc5e47.

[15] N. Iman, "The rise and rise of financial technology: The good, the bad, and the verdict," *Cogent Bus. Manag.*, vol. 7, no. 1, 2020, doi: 10.1080/23311975.2020.1725309.

[16] P. Gomber, R. J. Kauffman, C. Parker, and B. W. Weber, "On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services," *J. Manag. Inf. Syst.*, vol. 35, no. 1, pp. 220–265, 2018, doi: 10.1080/07421222.2018.1440766.

[17] Pwc, "FinTech ' s growing influence on Financial Services," 2017.

[18] M. K. Hassan, M. R. Rabbani, and Y. Abdullah, "Socioeconomic Impact of COVID-19 in MENA region and the Role of Islamic Finance," *Int. J. Islam. Econ. Financ.*, vol. 4, no. 1, pp. 51–78, 2021.

[19] R. Hayat *et al.*, "Critical success factors for TQM implementation and their impact on performance of SMEs عوامل النجاح الحرجة لتطبيق إدارة الجودة الشاملة وأثرها على أداء الشركات الصغيرة والمتوسطة," *J. Public Econ.*, 2008, doi: 10.1108/17410400910938832.

[20] M. R. Rabbani, H. Bawazir, S. Khan, S. Karim, and D. Chebab, "Smart contract-based Islamic Fintech model for Mudaraba financing," *Int. J. Bus. Innov. Res.*, vol. In press, 2022.

[21] M. R. Rabbani, U. Kayani, H. Bawazir, and I. T. Hawldar, "A Commentary On Emerging Market Banking Sector Spill Over Covid Vs GFC Pattern Analysis," *Heliyon*, vol. In press, 2022.

[22] S. A. Shaikh, "Using Fintech in scaling up Islamic microfinance," *J. Islam. Account. Bus. Res.*, 2020, doi: 10.1108/JIABR-10-2019-0198.

[23] M. Raza Rabbani, M. Asad Mohd. Ali, H. U. Rahiman, M. Atif, Z. Zulfikar, and Y. Naseem, "The Response of Islamic Financial Service to the COVID-19 Pandemic: The Open Social Innovation of the Financial System," *J. Open Innov. Technol. Mark. Complex.*, vol. 7, no. 1, 2021, doi: 10.3390/joitmc7010085.

[24] M. K. Hassan, M. R. Rabbani, and M. A. Ali, "Challenges for the Islamic Finance and banking in post COVID era and the role of Fintech.," *J. Econ. Coop. Dev.*, vol. 43, no. 3, 2020.

[25] Irum Saba, Rehana Kouser, and Imran Sharif Chaudhry, "Fintech and Islamic Finance-challenges and Opportunities," *Rev. Econ. Dev. Stud.*, vol. 5, no. 4, pp. 581–590, 2019, doi: 10.26710/reads.v5i4.887.

[26] B. Saiti, M. H. Musito, and E. Yucel, "Islamic Crowdfunding: Fundamentals, Developments and Challenges," *Islam. Q.*, 2018.

[27] A. Bashar, M. R. Rabbani, S. Khan, and M. A. M. Ali, "Data driven finance: A bibliometric review and scientific mapping," in *021 International Conference on Data Analytics for Business and Industry (ICDABI)*, 2021, pp. 161–166.

[28] M. R. Lee, D. C. Yen, and G. F. Hurlburt, "Financial Technologies and Applications," *IT Prof.*, vol. 20, no. 2, pp. 27–33, 2018, doi: 10.1109/MITP.2018.021921648.

[29] G. Walker, "Financial technology law - A new beginning and a new future," *Int. Lawyer*, vol. 50, no. 1, pp. 137–215, 2017, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032010410&partnerID=40&md5=565002e4221f98bfcec60318ceb13ca1.

[30] E. Abad-Segura, M.-D. González-Zamar, E. López-Meneses, and E. Vázquez-Cano, "Financial Technology: Review of trends, approaches and management," *Mathematics*, vol. 8, no. 6, 2020, doi: 10.3390/math8060951.

[31] I. Anagnostopoulos, "Fintech and regtech: Impact on regulators and banks," *J. Econ. Bus.*, vol. 100, pp. 7–25, 2018, doi: 10.1016/j.jeconbus.2018.07.003.

[32] Y. Li, R. Spigt, and L. Swinkels, "The impact of FinTech start-ups on incumbent retail banks' share prices," *Financ. Innov.*, vol. 3, no. 1, 2017, doi: 10.1186/s40854-017-0076-7.

[33] O. Acar and Y. E. Çitak, "Fintech Integration Process Suggestion for Banks," in *3rd World Conference on Technology, Innovation and Entrepreneurship, WOCTINE 2019*, 2019, vol. 158, pp. 971–978, doi: 10.1016/j.procs.2019.09.138.

[34] M. R. Rabbani, S. Khan, M. K. Hassan, and M. Ali, "7 Artificial intelligence and Natural language processing (NLP) based FinTech model

of Zakat for poverty alleviation and sustainable development for Muslims in India.," in *ICOVID-19 and Islamic Social Finance: 104.*, 2021.

[35] M. R. Rabbani, S. Khan, and E. I. Thalassinos, "FinTech, blockchain and Islamic finance: An extensive literature review," *Int. J. Econ. Bus. Adm.*, vol. 8, no. 2, pp. 65–86, 2020, doi: 10.35808/ijeba/444.

[36] G. Dorfleitner and L. Hornuf, *FinTech and data privacy in Germany: An empirical analysis with policy recommendations*. Center of Finance, University of Regensburg, Regensburg, Germany: Springer International Publishing, 2019.

[37] G. Dorfleitner, L. Hornuf, M. Schmitt, and M. Weber, *FinTech in Germany*. University of Regensburg, Regensburg, Germany: Springer International Publishing, 2017.

[38] V. Sangwan, Harshita, P. Prakash, and S. Singh, "Financial technology: a review of extant literature," *Stud. Econ. Financ.*, vol. 37, no. 1, pp. 71–88, 2019, doi: 10.1108/SEF-07-2019-0270.

[39] G. Kou, "Introduction to the special issue on FinTech," *Financ. Innov.*, vol. 5, no. 1, 2019, doi: 10.1186/s40854-019-0161-1.

[40] Y. Kim, J. Choi, Y.-J. Park, and J. Yeon, "The adoption of mobile payment services for 'fintech,'" *Int. J. Appl. Eng. Res.*, vol. 11, no. 2, pp. 1058–1061, 2016, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84959530641&partnerID=40&md5=01ffedcecd6b6f0ccc874643fa172510.

[41] M. Md Husin, R. Haron, and S. Aziz, "Adoption of financial technology in islamic crowd-funding: Predicting small and medium-sized enterprises' intention to use the investment account platform," in *Impact of Financial Technology (FinTech) on Islamic Finance and Financial Stability*, Azman Hashim International Business School (AHIBS), Universiti Teknologi Malaysia, Malaysia: IGI Global, 2019, pp. 12–35.

[42] E. Macchiavello, *Microfinance and financial inclusion: The challenge of regulating alternative forms of finance*. 2017.

[43] R. V Lavrov, "Innovative financial technologies in banking: Essence, problems and opportunities for development," *Actual Probl. Econ.*, vol. 126, no. 12, pp. 221–229, 2011, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84930491486&partnerID=40&md5=68cf9ec05a0b9d0ec3a346eb74ed1216.

[44] S. Khan, M. R. Rabbani, M. Kamal, and A. Bashar, "Stock Price Forecasting Using Deep Learning Model," in *2021 International Conference on Decision Aid Sciences and Application (DASA)*, 2021, p. (pp. 215-219). IEEE.

[45] M. R. Rabbani *et al.*, "Exploring the role of islamic fintech in combating the aftershocks of covid-19: The open social innovation of the islamic financial system," *J. Open Innov. Technol. Mark. Complex.*, vol. 7, no. 2, 2021, doi: 10.3390/joitmc7020136.

[46] W. J. Hippler III, S. Hossain, and M. K. Hassan, "Financial crisis spillover from Wall Street to Main Street: further evidence," *Empir. Econ.*, vol. 56, no. 6, pp. 1893–1938, 2019, doi: 10.1007/s00181-018-1513-9.

[47] A. Ashraf, W. Lane, and M. K. Hassan, "Monetary policy responses to the 2008 financial crisis: Quantitative easing evidence in the United Kingdom," *J. Econ. Coop. Dev.*, 2018, doi: 10.2139/ssrn.2944499.

[48] A. Ashraf, M. K. Hassan, and W. J. Hippler, "Monetary shocks, policy tools and financial firm stock returns: Evidence from the 2008 us quantitative easing," *Singapore Econ. Rev.*, 2017, doi: 10.1142/S0217590817400021.

[49] D. Pattnaik, M. K. Hassan, S. Kumar, and J. Paul, "Trade credit research before and after the global financial crisis of 2008 – A bibliometric overview," *Research in International Business and Finance*. 2020, doi: 10.1016/j.ribaf.2020.101287.

[50] S. Karim, M. R. Rabbani, and M. A. Khan, "Determining the key factors of corporate leverage in Malaysian service sector firms using dynamic modeling," *J. Econ. Coop. Dev.*, vol. 42, no. 3, 2021.

[51] A. Mehrotra, "Financial Inclusion Through FinTech - A Case of Lost Focus," in *2019 International Conference on Automation, Computational and Technology Management, ICACTM 2019*, 2019, pp. 103–107, doi: 10.1109/ICACTM.2019.8776857.

[52] D. K. C. Lee, "FinTech and alternative investment," *J. Altern. Investments*, vol. 20, no. 3, pp. 6–15, 2018, doi: 10.3905/jai.2018.20.3.006.

[53] Darmansyah, B. A. Fianto, A. Hendratmi, and P.

F. Aziz, "Factors determining behavioral intentions to use Islamic financial technology: Three competing models," *J. Islam. Mark.*, 2020, doi: 10.1108/JIMA-12-2019-0252.

[54] DinarStandard, "State of the Global Islamic Economy Report 2020/21," 2020. [Online]. Available: https://haladinar.io/hdn/doc/report2018.pdf.

[55] S. Karim, M. R. Rabbani, and H. Bawazir, "Applications of Blockchain Technology in the Finance and Banking Industry Beyond Digital Currencies," in *Blockchain Technology and Computational Excellence for Society 5.0*, IGI Global, 2022, pp. 216–238.

[56] A. Jreisat, M. R. Rabbani, Z. M. Hatamleh, and H. Grewal, "COVID-19: A Closer Look at the MENA Banking Sector," 2021.

[57] A. Jreisat, M. R. Rabbani, A. Bashar, M. A. M. Ali, and A. AlAbbas, "Is Fintech Valuation an Art of Science? Exploring the Innovative Methods for the Valuation of Fintech Startups," in *2021 International Conference on Decision Aid Sciences and Application (DASA)*, 2021, p. (pp. 922-925). IEEE.

[58] H. Henderson, "Fintech: Good and Bad News for Sustainable Finance," *Pesqui. Debate. Rev. do Programa Estud. Pós-Graduados em Econ. Política. ISSN 1806-9029*, vol. 28, no. 1(51), pp. 6–15, 2017.

[59] S. Saksonova and I. Kuzmina-Merlino, "Fintech as financial innovation - The possibilities and problems of implementation," *Eur. Res. Stud. J.*, vol. 20, no. 3, pp. 961–973, 2017, doi: 10.35808/ersj/757.

[60] I. Goldstein, W. Jiang, and G. A. Karolyi, "To FinTech and beyond," *Rev. Financ. Stud.*, vol. 32, no. 5, pp. 1647–1661, 2019, doi: 10.1093/rfs/hhz025.

[61] DinarStandard, "Islamic Fintech Report 2018: Current Landscape & Path Forward," 2021. [Online]. Available: https://www.dinarstandard.com/wp-content/uploads/2018/12/Islamic-Fintech-Report-2018.pdf.

[62] N. Alam, L. Gupta, and A. Zameni, *Fintech and Islamic finance: Digitalization, development and disruption*. Henley Business School, University of Reading Malaysia, Iskandar Puteri, Johor, Malaysia: Springer International Publishing, 2019.

[63] H. Sun, M. R. Rabbani, M. S. Sial, S. Yu, J. A. Filipe, and J. Cherian, "Identifying Big Data's Opportunities, Challenges, and Implications in Finance," *Mathematics*, vol. 8, no. 10, 2020, doi: https://doi.org/10.3390/math8101738.

[64] G. Bacso, M. Dietz, and M. Radnai, "Banking: Decoding financial-technology innovation," *McKinsey Q.*, no. 2, pp. 26–27, 2015, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84933565154&partnerID=40&md5=a9a86919cade23553963cf3ed6a4ffca.

[65] M. A. Chen, Q. Wu, and B. Yang, "How Valuable Is FinTech Innovation?," *Rev. Financ. Stud.*, vol. 32, no. 5, pp. 2062–2106, 2019, doi: 10.1093/rfs/hhy130.

[66] M. Kasthuri, "Transforming fintech architecture via blockchain as a service," *Cut. Bus. Technol. J.*, vol. 31, no. 11–12, pp. 23–28, 2018, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064386027&partnerID=40&md5=606b73db1c8e4cdfa73dc7c02efaf3e2.

[67] D. W. Arner, R. P. Buckley, D. A. Zetzsche, and R. Veidt, "Sustainability, FinTech and Financial Inclusion," *Eur. Bus. Organ. Law Rev.*, vol. 21, no. 1, pp. 7–35, 2020, doi: 10.1007/s40804-020-00183-y.

[68] B. Li, S. D. Hanna, and K. T. Kim, "Who Uses Mobile Payments: Fintech Potential in Users and Non-Users," *J. Financ. Couns. Plan.*, vol. 31, no. 1, pp. 83–100, 2020, doi: 10.1891/JFCP-18-00083.

[69] D. Makina, "The Potential of FinTech in Enabling Financial Inclusion," in *Extending Financial Inclusion in Africa*, Department of Finance, Risk Management and Banking, University of South Africa, Pretoria, South Africa: Elsevier, 2019, pp. 299–318.

[70] A. K. Kyari, "Managing fintech's destruction through innovative banking: An empirical investigation," *Int. J. Innov. Creat. Chang.*, vol. 13, no. 1, pp. 253–274, 2020, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85085205260&partnerID=40&md5=17957d368342d07e7a9208d53ccb128e.

[71] M. Kabir Hassan, B. Sanchez, and M. Faisal Safa, "Impact of financial liberalization and foreign

bank entry on Islamic banking performance," *Int. J. Islam. Middle East. Financ. Manag.*, 2013, doi: 10.1108/17538391311310716.

[72] M. Cheng and Y. Qu, "Does bank FinTech reduce credit risk? Evidence from China," *Pacific Basin Financ. J.*, vol. 63, 2020, doi: 10.1016/j.pacfin.2020.101398.

[73] S. Singh, M. M. Sahni, and R. K. Kovid, "What drives FinTech adoption? A multi-method evaluation using an adapted technology acceptance model," *Manag. Decis.*, 2020, doi: 10.1108/MD-09-2019-1318.

[74] Fenergo, "AML, KYC & Sanctions Fines for Global Financial Institutions Top $36 Billion Since Financial Crisis," *Fenergo Press Releases*, 2020. .

[75] T. Larsen *et al.*, "Gx-Deloitte-Tmt-2018-Predictions-Full-Report," *J. Business-to-bus. Mark.*, 2015.

[76] PWC, "Customers in the spotlight - How FinTech is reshaping banking," 2016.

[77] S. Blakstad and R. Allen, *FinTech revolution: Universal inclusion in the new financial ecosystem*. Hiveonline Copenhagen, Denmark: Springer International Publishing, 2018.

[78] L. Chen, "From Fintech to Finlife: the case of Fintech Development in China," *China Econ. J.*, vol. 9, no. 3, pp. 225–239, 2016, doi: 10.1080/17538963.2016.1215057.

[79] D. H. B. Phan, P. K. Narayan, R. E. Rahman, and A. R. Hutabarat, "Do financial technology firms influence bank performance?," *Pacific Basin Financ. J.*, vol. 62, 2020, doi: 10.1016/j.pacfin.2019.101210.

[80] S. Park and H. W. Park, "Diffusion of cryptocurrencies: web traffic and social network attributes as indicators of cryptocurrency performance," *Qual. Quant.*, vol. 54, no. 1, pp. 297–314, 2020, doi: 10.1007/s11135-019-00840-6.

[81] A. Amendola and L. Sensini, "Comparing the performances of garch-type models in capturing cryptocurrencies volatility," *WSEAS Trans. Bus. Econ.*, vol. 17, pp. 646–656, 2020, doi: 10.37394/23207.2020.17.62.

[82] K. Jerzy, *Banking: Services, opportunities and risks*. Nova Science Publishers, Inc., 2017.

[83] I. Romanova and M. Kudinska, "Banking and fintech: A challenge or opportunity?," *Contemporary Studies in Economic and Financial Analysis*, vol. 98. Emerald Group Publishing Ltd., Faculty of Economics and Management, University of Latvia, Latvia, pp. 21–35, 2016, doi: 10.1108/S1569-375920160000098002.

[84] M. Wibowo and V. Aumeboonsuke, "Bank financial capability on MSME lending amid economic change and the growth of Fintech companies in Indonesia," *Thail. World Econ.*, vol. 38, no. 2, pp. 63–87, 2020, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85093892679&partnerID=40&md5=08e26ded5cf2137950ec09d465ea4627.

[85] Wharton School, "How Fintech Is Revolutionizing Financial Services," *PwC - Glob. Fintech Rep.*, 2016.

[86] M. Alam, M. R. Rabbani, M. R. Tausif, and J. Abey, "Banks' Performance and Economic Growth in India: A Panel Cointegration Analysis," *Economies*, vol. 9, no. 1, p. 38, 2021.

[87] M. Atif, M. K. Hassan, M. R. Rabbani, and S. Khan, "Islamic FinTech: The digital transformation bringing sustainability to Islamic finance," in *In COVID-19 and Islamic Social Finance . Routledge.*, 2021, pp. 94–106.

[88] J. Abey, M. R. Rabbani, R. Velmurugan, M. A. M. Ali, and A. Bashar, "Financial decision making and Foreign Direct Investment in the era of COVID-19 and beyond: Evidence from India," in *2021 International Conference on Decision Aid Sciences and Application (DASA)*, 2021, p. (pp. 38-44). IEEE.

[89] D. Chebab, A. Moulay, and M. Rabbani, "Taking the Debate on E-Learning Pedagogical Strategies Beyond Students and Technology Spheres: An Insight into the Instructor's Core Mission," *J. Teach. Teach. Educ.*, vol. 9, no. 02, 2021.

[90] A. Bashar and M. R. Rabbani, "Exploring the Role of Web Personalization in Consumer Green Purchasing Behavior: A Conceptual Framework," in *2021 Third International Sustainability and Resilience Conference: Climate Change*, 2021, pp. 23–28.

[91] M. R. Rabbani, A. Sarea, S. Khan, and Y. Abdullah, "Ethical Concerns in Artificial Intelligence (AI): The Role of RegTech and Islamic Finance," in *The International Conference On Global Economic Revolutions*, 2021, pp. 381–390.

[92] T. Zhang and Y. Zhuang, "Research on the impact of Fintech event on Chinese commercial banks' stock price," *Int. J. Wirel. Mob. Comput.*, vol. 18, no. 3, pp. 289–294, 2020, doi: 10.1504/IJWMC.2020.106781.

[93] P. Schulte and G. Liu, "Fintech is merging with iot and AI to challenge banks: How entrenched interests can prepare," *J. Altern. Investments*, vol. 20, no. 3, pp. 41–57, 2018, doi: 10.3905/jai.2018.20.3.041.

[94] D. L. K. Chuen, *Inclusive fintech: Blockchain, cryptocurrency and Ico*. Singapore University Of Social Sciences, Singapore: World Scientific Publishing Co., 2018.

[95] A. Ranade, "Role of 'Fintech' in Financial inclusion and new business models," *Econ. Polit. Wkly.*, vol. 52, no. 12, pp. 125–128, 2017, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85016258361&partnerID=40&md5=96a60587203cf6661420bb90cb809d02.

[96] H.-S. Ryu and K. S. Ko, "Sustainable development of Fintech: Focused on uncertainty and perceived quality issues," *Sustain.*, vol. 12, no. 18, 2020, doi: 10.3390/su12187669.

[97] Statista, "Global social media ranking 2018," *Statista.Com*. 2017.

[98] T. Zalan and E. Toufaily, "The promise of fintech in emerging markets: Not as disruptive," *Contemp. Econ.*, vol. 11, no. 4, pp. 415–430, 2017, doi: 10.5709/ce.1897-9254.253.

[99] N. T. Kim Lien, T. T. Doan, and T. N. Bui, "Fintech and banking: Evidence from Vietnam," *J. Asian Financ. Econ. Bus.*, vol. 7, no. 9, pp. 419–426, 2020, doi: 10.13106/JAFEB.2020.VOL7.NO9.419.

[100] A. V Thakor, "Fintech and banking: What do we know?," *J. Financ. Intermediation*, vol. 41, 2020, doi: 10.1016/j.jfi.2019.100833.

[101] M. Atif *et al.*, "Oil price changes and stock returns: Fresh evidence from oil exporting and oil importing countries," *Cogent Econ. Financ.*, vol. 10, no. 1, p. 2018163, 2022.

[102] M. K. Hassan, M. Rabbani, and C. Daouia, "Integrating Islamic finance and Halal industry: Current landscape and future forward," *Int. J. Islam. Mark. Brand.*, vol. 6, no. 1, pp. 60–78, 2021.

[103] M. R. Rabbani, "The competitive structure and strategic positioning of commercial banks in Saudi Arabia," *Int. J. Emerg. Technol.*, vol. 11, no. 3, pp. 43–46, 2020.

[104] S. P. Shaikh, M. K. Hassan, M. Atif, and M. R. Rabbani, "Do Implied Volatilities of Stock and Commodities Markets Affect Bond, Conventional and Shariah Indices Differently? Evidence by OVX, GVZ and VIX," *Eurasian Econ. Rev.*, vol. Forthcoming, 2022.

[105] D. Xiang, Y. Zhang, and A. C. Worthington, "Determinants of the Use of Fintech Finance among Chinese Small and Medium-Sized Enterprises," 2018, doi: 10.1109/TEMS-ISIE.2018.8478470.

[106] K. Petrasic, B. Saul, H. Lee, M. Bornfreund, and M. Bonici, "Fintech companies and bank charters: Options and considerations for 2018," *Bank. Law J.*, vol. 135, no. 4, pp. 227–243, 2018, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85047176730&partnerID=40&md5=85e226e995bd857f2e3e42426afd91b9.

[107] F. Flögel and M. Beckamp, "Will FinTech make regional banks superfluous for small firm finance? Observations from soft information-based lending in Germany," *Econ. Notes*, vol. 49, no. 2, 2020, doi: 10.1111/ecno.12159.

[108] O. Unsal and B. Rayfield, "Trends in financial innovation: Evidence from fintech firms," *International Finance Review*, vol. 20. Emerald Group Publishing Ltd., pp. 15–25, 2019, doi: 10.1108/S1569-376720190000020004.

[109] S. Agarwal and J. Zhang, "FinTech, Lending and Payment Innovation: A Review," *Asia-Pacific J. Financ. Stud.*, vol. 49, no. 3, pp. 353–367, 2020, doi: 10.1111/ajfs.12294.

[110] R. Alt, R. Beck, and M. T. Smits, "FinTech and the transformation of the financial industry," *Electron. Mark.*, vol. 28, no. 3, pp. 235–243, 2018, doi: 10.1007/s12525-018-0310-9.

[111] A. Ashta and G. Biot-Paquerot, "FinTech evolution: Strategic value management issues in a fast changing industry," *Strateg. Chang.*, vol. 27, no. 4, pp. 301–311, 2018, doi: 10.1002/jsc.2203.

[112] U. F. Abd-allah, "Innovation and Creativity in Islam," *Nawawi Found. Pap.*, 2006.

[113] H. Baber, "Impact of FinTech on customer retention in Islamic banks of Malaysia," *Int. J.*

Bus. Syst. Res., vol. 14, no. 2, pp. 217–227, 2020, doi: 10.1504/IJBSR.2020.106279.

[114] E. A. Firmansyah and M. Anwar, "Islamic Financial Technology (Fintech): Its Challenges and Prospect," vol. 216, no. Assdg 2018, pp. 52–58, 2019, doi: 10.2991/assdg-18.2019.5.

[115] M. R. Rabbani, Y. Abdulla, A. Basahr, S. Khan, and M. A. Moh'd Ali, "Embracing of Fintech in Islamic Finance in the post COVID era," 2020, doi: 10.1109/DASA51403.2020.9317196.

[116] M. R. Rabbani, "COVID-19 and its impact on supply chain financing and the role of Islamic Fintech: Evidence from GCC countries," *Int. J. Agil. Syst. Manag*, 2021.

[117] Y. Abdulla and M. R. Rabbani, "COVID-19 and GCC Islamic market Indices," in *2021 International Conference on Sustainable Islamic Business and Finance*, 2021, pp. 56–60.

[118] S. Habeeb, M. R. Rabbani, N. Ahmad, M. A. Moh'd Ali, and A. Bashar, "Post COVID-19 challenges for the sustainable entrepreneusrhip," in *2021 International Conference on Sustainable Islamic Business and Finance*, 2021, pp. 154–158.

[119] L. Zhang, Y. Xie, Y. Zheng, W. Xue, X. Zheng, and X. Xu, "The challenges and countermeasures of blockchain in finance and economics," *Syst. Res. Behav. Sci.*, vol. 37, no. 4, pp. 691–698, 2020, doi: 10.1002/sres.2710.

[120] L. Zhang, Y. Xie, Y. Zheng, W. Xue, X. Zheng, and X. Xu, "The challenges and countermeasures of blockchain in finance and economics," *Syst. Res. Behav. Sci.*, vol. 37, no. 4, pp. 691–698, 2020, doi: 10.1002/sres.2710.

[121] C. Harwick and J. Caton, "What's holding back blockchain finance? On the possibility of decentralized autonomous finance," *Q. Rev. Econ. Financ.*, 2020, doi: 10.1016/j.qref.2020.09.006.

[122] A. V Bogucharskov, I. E. Pokamestov, K. R. Adamova, and Z. N. Tropina, "Adoption of blockchain technology in trade finance process," *J. Rev. Glob. Econ.*, vol. 7, no. Special Issue, pp. 510–515, 2018, doi: 10.6000/1929-7092.2018.07.47.

[123] M. Li, S. Shao, Q. Ye, G. Xu, and G. Q. Huang, "Blockchain-enabled logistics finance execution platform for capital-constrained E-commerce retail," *Robot. Comput. Integr. Manuf.*, vol. 65, 2020, doi: 10.1016/j.rcim.2020.101962.

[124] M. Du, Q. Chen, J. Xiao, H. Yang, and X. Ma, "Supply Chain Finance Innovation Using Blockchain," *IEEE Trans. Eng. Manag.*, vol. 67, no. 4, pp. 1045–1058, 2020, doi: 10.1109/TEM.2020.2971858.

[125] J. Liu, X. Li, and S. Wang, "What have we learnt from 10 years of fintech research? a scientometric analysis," *Technol. Forecast. Soc. Change*, vol. 155, 2020, doi: 10.1016/j.techfore.2020.120022.

[126] Ernst & Young, "Global FinTech Adoption Index 2019," *Ernst & Young*, 2019.

[127] S. Guhan *et al.*, "Secure provenance using an authenticated data structure approach," *Comput. Secur.*, 2018, doi: 10.1109/BigDataCongress.2017.85.

[128] M. Abubakar, M. K. Hassan, and M. A. Haruna, "Cryptocurrency tide and islamic finance development: Any issue?," in *International Finance Review*, 2019.

[129] S. A. Yussof and A. Al-Harthy, "Cryptocurrency as an Alternative Currency in Malaysia : Issues and Challenges," *Islam Civilisational Renew.*, vol. 9, no. 1, pp. 48–65, 2018, doi: 10.12816/0049515.

[130] H. Wang, D. He, K.-K. R. Choo, and X. Chen, "Blockchain-based multi-party proof of assets with privacy preservation," *Inf. Sci. (Ny).*, vol. 547, pp. 609–621, 2021, doi: 10.1016/j.ins.2020.08.050.

[131] A. Kliber, P. Marszałek, I. Musiałkowska, and K. Świerczyńska, "Bitcoin: Safe haven, hedge or diversifier? Perception of bitcoin in the context of a country's economic situation — A stochastic volatility approach," *Phys. A Stat. Mech. its Appl.*, vol. 524, pp. 246–257, 2019, doi: 10.1016/j.physa.2019.04.145.

[132] L. Kristoufek, "Bitcoin and its mining on the equilibrium path," *Energy Econ.*, vol. 85, 2020, doi: 10.1016/j.eneco.2019.104588.

[133] X. Bultel, J. Dreier, J.-G. Dumas, and P. Lafourcade, "A faster cryptographer's Conspiracy Santa," *Theor. Comput. Sci.*, vol. 839, pp. 122–134, 2020, doi: 10.1016/j.tcs.2020.05.034.

[134] D. Macrinici, C. Cartofeanu, and S. Gao, "Smart contract applications within blockchain technology: A systematic mapping study," *Telemat. Informatics*, vol. 35, no. 8, pp. 2337–2354, 2018, doi: 10.1016/j.tele.2018.10.004.

[135] J. Surowiecki, "Bitcoin would be a calamity, not an economy," *Technol. Rev.*, vol. 121, no. 3, pp. 28–31, 2018, [Online]. Available:

https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046249264&partnerID=40&md5=26ac9541a2c3b28c6838a71784022cf3.

[136] K. Gagneja, A. Goode, D. Rentos, and K. Rezk, "Traceability of cryptocurrency transactions using blockchain analytics," *Int. J. Comput. Digit. Syst.*, vol. 9, no. 2, pp. 159–165, 2020, doi: 10.12785/IJCDS/090202.

[137] U. Iqbal and A. H. Mir, "Efficient and dynamic access control mechanism for secure data acquisition in IoT environment," *Int. J. Comput. Digit. Syst.*, vol. 10, no. 1, pp. 9–28, 2021, doi: 10.12785/ijcds/100102.

[138] F. Hammad, "Is bitcoin mining halal? Investigating the sharia compliance of bitcoin mining," 2018, doi: 10.1109/3ICT.2018.8855738.

[139] R. A. E. Virgana, M. H. M. Saudi, and O. Sinaga, "Conceptual research: Sharia-based cryptocurrency," *J. Adv. Res. Dyn. Control Syst.*, vol. 11, no. 3 Special Issue, pp. 138–143, 2019, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85069701139&partnerID=40&md5=1c96c715afbcb1ad7913c87a48b57b59.

[140] A.-H. A. I. Saleh, A. A. Ibrahim, M. F. Noordin, and H. Mohd Mohadis, "Islamic approach toward purification of transaction with cryptocurrency," *J. Theor. Appl. Inf. Technol.*, vol. 98, no. 6, pp. 1050–1067, 2020, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85083805038&partnerID=40&md5=44ad6f96d03e03867010064a3a7e89df.

[141] M. Abdul, M. Chowdhury, D. Bin, and A. Razak, "Dynamism and mechanism of digital currency (cryptocurrency) towards Islamic finance," *Eur. J. Islam. Financ.*, vol. 0, no. 14, pp. 1–9, 2019, doi: 10.13135/2421-2172/3736.

[142] A. J. Saleh, F. A. F. Alazzam, K. K. A. R. Aldrou, and Z. Zavalna, "LEGAL ASPECTS OF THE MANAGEMENT OF CRYPTOCURRENCY ASSETS IN THE NATIONAL SECURITY SYSTEM," *J. Secur. Sustain. Issues*, vol. 10, no. 1, pp. 235–247, 2020, doi: 10.9770/jssi.2020.10.1(17).

[143] M. R. Rabbani, A. Alshaikh, A. Jreisat, A. Bashar, and M. A. Moh'd Ali, "Whether Cryptocurrency is a threat or a revolution? An analysis from ESG perspective," in *2021 International Conference on Sustainable Islamic Business and Finance*, 2021, pp. 103–108.

[144] S. Khan and M. R. Rabbani, "In Depth Analysis of Blockchain, Cryptocurrency and Sharia Compliance," *Int. J. Bus. Innov. Res.*, vol. 1, no. 1, p. 1, 2020, doi: 10.1504/ijbir.2020.10033066.

[145] F. Muedini and D. Ph, "The Compatibility of Cryptocurrencies and Islamic Finance," *Eur. J. Islam. Financ.*, vol. 0, no. 10, pp. 1–11, 2018, doi: 10.13135/2421-2172/2569.

[146] S. Abdullah and U. A. Oseni, "Towards a sharī'ah compliant equity-based crowdfunding for the halal industry in Malaysia," *Int. J. Bus. Soc.*, vol. 18, no. S1, pp. 223–240, 2017, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032496111&partnerID=40&md5=6be491893722ce73c9fed2aa1b0a7dd4.

[147] S. N. Saleh, C. U. Lehmann, and R. J. Medford, "Early crowdfunding response to the COVID-19 pandemic," *medRxiv*. 2020, doi: 10.1101/2020.10.12.20211532.

[148] IFSB, "Stability report 2020," 2020.

[149] Y. Zhao, P. Harris, and W. Lam, "Crowdfunding industry—History, development, policies, and potential issues," *J. Public Aff.*, vol. 19, no. 1, 2019, doi: 10.1002/pa.1921.

[150] A. Hendratmi, M. N. H. Ryandono, and P. S. Sukmaningrum, "Developing Islamic crowdfunding website platform for startup companies in Indonesia," *J. Islam. Mark.*, 2019, doi: 10.1108/JIMA-02-2019-0022.

[151] B. Saiti, M. Afghan, and N. H. Noordin, "Financing agricultural activities in Afghanistan: a proposed salam-based crowdfunding structure," *ISRA Int. J. Islam. Financ.*, vol. 10, no. 1, pp. 52–61, 2018, doi: 10.1108/IJIF-09-2017-0029.

[152] N. S. Grove, "Weapons of mass participation: Social media, violence entrepreneurs, and the politics of crowdfunding for war," *Eur. J. Int. Relations*, vol. 25, no. 1, pp. 86–107, 2019, doi: 10.1177/1354066117744867.

[153] M. P. Rahman, M. A. Mohd Thas Thaker, and J. Duasa, "Developing a Sharīʿah-compliant equity-based crowdfunding framework for entrepreneurship development in Malaysia," *ISRA Int. J. Islam. Financ.*, vol. 12, no. 2, pp. 239–252, 2020, doi: 10.1108/IJIF-07-2018-0085.

[154] B. Saiti, M. H. Musito, and E. Yucel, "Islamic Crowdfunding: Fundamentals, Developments and Challenges," *Islam. Q.*, vol. 62, no. 3, pp. 469–485, 2018, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062840918&partnerID=40&md5=c90f190a304de6e7479ea5f3171b4af7.

[155] A. H. M. Iman and M. T. S. H. Mohammad, "Waqf as a framework for entrepreneurship," *Humanomics*, vol. 33, no. 4, pp. 419–440, 2017, doi: 10.1108/H-01-2017-0015.

[156] H. Baber, "FinTech, Crowdfunding and Customer Retention in Islamic Banks," *Vision*, vol. 24, no. 3, pp. 260–268, 2020, doi: 10.1177/0972262919869765.

[157] S. A. Asongu and J. C. Nwachukwu, "Recent finance advances in information technology for inclusive development: a systematic review," *NETNOMICS Econ. Res. Electron. Netw.*, vol. 19, no. 1–2, pp. 65–93, 2018, doi: 10.1007/s11066-018-9127-0.

[158] E. Macchiavello, *Microfinance and financial inclusion: The challenge of regulating alternative forms of finance*. University of Genoa, Italy: Taylor and Francis, 2017.

[159] M. Tajudin, R. Omar, A. Smedlund, and R. P. Aziz, "Financing with heart and intelligence: augmenting intimacy and sustainability through islamic fintech," *Int. J. Adv. Sci. Technol.*, vol. 29, no. 9 Special Issue, pp. 1638–1664, 2020, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85084368157&partnerID=40&md5=c195213f22e8b1fa570194ac7037a627.

[160] R. M. Stevenson, D. F. Kuratko, and J. Eutsler, "Unleashing main street entrepreneurship: Crowdfunding, venture capital, and the democratization of new venture investments," *Small Bus. Econ.*, vol. 52, no. 2, pp. 375–393, 2019, doi: 10.1007/s11187-018-0097-2.

[161] M. Barbi and M. Bigelli, "Crowdfunding practices in and outside the US," *Res. Int. Bus. Financ.*, vol. 42, pp. 208–223, 2017, doi: 10.1016/j.ribaf.2017.05.013.

[162] H.-C. Hsieh, Y.-C. Hsieh, and T. H. C. Vu, "How social movements influence crowdfunding success," *Pacific Basin Financ. J.*, vol. 53, pp. 308–320, 2019, doi: 10.1016/j.pacfin.2018.11.008.

[163] A. Agrawal, C. Catalini, A. Goldfarb, and H. Luo, "Slack time and innovation," *Organ. Sci.*, vol. 29, no. 6, pp. 1056–1073, 2019, doi: 10.1287/orsc.2018.1215.

[164] R. A. Al Hilali and H. Shaker, "Blockchain technology's status of implementation in Oman: Empirical study," *Int. J. Comput. Digit. Syst.*, vol. 10, no. 1, 2021, doi: 10.12785/IJCDS/100167.

[165] K. Christidis and M. Devetsikiotis, "Blockchains and Smart Contracts for the Internet of Things," *IEEE Access*. 2016, doi: 10.1109/ACCESS.2016.2566339.

[166] M. M. Ali, A. Bashar, M. R. Rabbani, and Y. Abdullah, "Transforming Business Decision Making with Internet of Things (IoT) and Machine Learning (ML)," 2020.

[167] K. Chatterjee, A. K. Goharshady, and E. K. Goharshady, "The treewidth of smart contracts," in *Proceedings of the ACM Symposium on Applied Computing*, 2019, vol. Part F1477, pp. 400–408, doi: 10.1145/3297280.3297322.

[168] A. Savelyev, "Contract law 2.0: 'Smart' contracts as the beginning of the end of classic contract law," *Inf. Commun. Technol. Law*, vol. 26, no. 2, pp. 116–134, 2017, doi: 10.1080/13600834.2017.1301036.

[169] Z. Zheng *et al.*, "An overview on smart contracts: Challenges, advances and platforms," *Futur. Gener. Comput. Syst.*, vol. 105, pp. 475–491, 2020, doi: 10.1016/j.future.2019.12.019.

[170] S. R. Mat Rahim, Z. Z. Mohamad, J. Abu Bakar, F. H. Mohsin, and N. Md Isa, "Artificial Intelligence, Smart Contract and Islamic Finance," *Asian Soc. Sci.*, 2018, doi: 10.5539/ass.v14n2p145.

[171] V. Waye, "Regtech: A new frontier in legal scholarship," *Adelaide Law Rev.*, vol. 40, no. 1, pp. 363–386, 2020, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85083977765&partnerID=40&md5=f7e6096747f7fe41aeaba1a78bc444f4.

[172] N. Pantielieieva, M. Khutorna, O. Lytvynenko, and L. Potapenko, "FinTech, RegTech and Traditional Financial Intermediation: Trends and Threats for Financial Stability," *Lecture Notes on Data Engineering and Communications Technologies*, vol. 42. Springer, Cherkasy Institute, Banking University, Cherkasy, Ukraine, pp. 1–21, 2020, doi: 10.1007/978-3-030-35649-

1_1.

[173] D. W. Arner, J. Barberis, and R. P. Buckley, “FinTech, regTech, and the reconceptualization of financial regulation,” *Northwest. J. Int. Law Bus.*, vol. 37, no. 3, pp. 373–415, 2017, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029366261&partnerID=40&md5=8d52c44c1d5a6142c39beb3f914927c5.

[174] M. Becker, K. Merz, and R. Buchkremer, “RegTech—the application of modern information technology in regulatory affairs: areas of interest in research and practice,” *Intell. Syst. Accounting, Financ. Manag.*, 2020, doi: 10.1002/isaf.1479.

[175] R. Huber, “Can RegTech free the finance industry from the regulatory crisis? ,” *Jusletter IT*, no. May, 2017.

[176] P. Kavassalis, H. Stieber, W. Breymann, K. Saxton, and F. J. Gross, “An innovative RegTech approach to financial risk monitoring and supervisory reporting,” *J. Risk Financ.*, vol. 19, no. 1, pp. 39–55, 2018, doi: 10.1108/JRF-07-2017-0111.

[177] D. W. Arner, J. Barberis, and R. P. Buckley, “RegTech: Building a Better Financial System,” in *Handbook of Blockchain, Digital Finance, and Inclusion, Volume 1: Cryptocurrency, FinTech, InsurTech, and Regulation*, University of Hong Kong, Hong Kong: Elsevier Inc., 2017, pp. 359–373.

[178] M. Turki, A. Hamdan, J. A. Ajmi, and A. Razzaque, “Regulatory technology (regtech) and money laundering prevention: exploratory study from bahrain,” *5th International Conference on Advanced Machine Learning Technologies and Applications, AMLTA 2020*, vol. 1141. Springer, Ahlia University, Manama, Bahrain, pp. 349–359, 2021, doi: 10.1007/978-981-15-3383-9_32.

[179] T. Butler and R. Brooks, “On the role of ontology-based regtech for managing risk and compliance reporting in the age of regulation,” *J. Risk Manag. Financ. Institutions*, vol. 11, no. 1, pp. 19–33, 2018, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85059226180&partnerID=40&md5=2f13500efe6c2054c690f274eb7f3d91.

[180] F. Teichmann and M.-C. Falker, “Money laundering through cryptocurrencies,” *13th International Scientific and Practical Conference on Artificial Intelligence: Anthropogenic nature Vs. Social Origin, ISC Conference - Volgograd 2020*, vol. 1100 AISC. Springer, Teichmann International (Schweiz) AG, Dufourstr. 124, St. Gallen, 9000, Switzerland, pp. 500–511, 2020, doi: 10.1007/978-3-030-39319-9_57.

[181] T. Butler and L. O’Brien, “Understanding RegTech for Digital Regulatory Compliance,” in *Disrupting Finance*, 2019.

[182] H. Вълканов, “RegTech и SupTech - високотехнологичните иновации в сферата на финансовото регулиране,” *RegTech SupTech - High-tech Innov. F. Financ. Regul.*, 2018.

[183] J. Frankenfield, “Artificial Intelligence (AI) Definition,” *Investopedia*, 2020.

[184] M. Mansoor, N. Ellahi, A. Hassan, Q. A. Malik, A. Waheed, and N. Ullah, “Corporate Governance, Shariah Governance, and Credit Rating: A Cross-Country Analysis from Asian Islamic Banks,” *J. Open Innov. Technol. Mark. Complex.*, vol. 6, no. 4, p. 170, 2020, doi: 10.3390/joitmc6040170.

[185] M. J. Murphy and J. M. Smolarski, “Religion and CSR: An Islamic ‘Political’ Model of Corporate Governance,” *Bus. Soc.*, vol. 59, no. 5, pp. 823–854, 2020, doi: 10.1177/0007650317749222.

[186] R. P. Buckley, D. W. Arner, D. A. Zetzsche, and R. H. Weber, “The road to RegTech: the (astonishing) example of the European Union,” *J. Bank. Regul.*, vol. 21, no. 1, pp. 26–36, 2020, doi: 10.1057/s41261-019-00104-1.

[187] L. Ivascu, “Measuring the implications of sustainable manufacturing in the context of industry 4.0,” *Processes*, vol. 8, no. 5, 2020, doi: 10.3390/PR8050585.

[188] B. King, “BANK 4.0: Banking Everywhere, Never at a Bank,” *Bank 4.0*, 2018.

[189] I. Ul Haq and T. M. Awan, “Impact of e-banking service quality on e-loyalty in pandemic times through interplay of e-satisfaction,” *Vilakshan - XIMB J. Manag.*, 2020, doi: 10.1108/xjm-07-2020-0039.

[190] G. W. Peters and E. Panayi, *Banking Beyond Banks and Money*. 2016.

[191] B. Rezayat, “The Effectiveness Assessment of Electronic Banking Training Courses (A Case Study of Maskan Bank Employees in Tehran Province),” *J. Hum. Resour. Manag. Labor Stud.*,

2017, doi: 10.15640/jhrmls.v5n2a4.

[192] T. Milenkovic-Kerkovic and M. Jemovic, "The specific legal nature of the transaction in Islamic banking law," *Eur. Res. Stud. J.*, vol. 16, no. 1, pp. 29–40, 2013, doi: 10.35808/ersj/379.

[193] R. Srinivasan, M. Karanam, R. Shenbagavalli, S. Kumar, and M. V Anuradha, "Reimagining financial services: The FinTech disruption of financial services in India," *J. Adv. Res. Dyn. Control Syst.*, vol. 11, no. 8 Special Issue, pp. 975–983, 2019, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85073478651&partnerID=40&md5=71aee83303a5f950bed782fde3b25bbd.

[194] J. Pilcher, "Online/mobile banking adoption trends & demographic profiles," *Thefinancialbrand.com*, 2013. .

[195] G. Golubic, "Do digital technologies have the power to disrupt commercial banking?," *InterEULawEast*, vol. 6, no. 1, pp. 83–110, 2019, doi: 10.22598/iele.2019.6.1.6.

[196] W. A. Alkhowaiter, "Digital payment and banking adoption research in Gulf countries: A systematic literature review," *Int. J. Inf. Manage.*, vol. 53, 2020, doi: 10.1016/j.ijinfomgt.2020.102102.

[197] M. Aljawder and A. Abdulrazzaq, "The effect of awareness, trust, and privacy and security on students' adoption of contactless payments: An empirical study," *Int. J. Comput. Digit. Syst.*, vol. 8, no. 6, pp. 669–676, 2019, doi: 10.12785/ijcds/080614.

[198] A. Vijayan, A. M. Ashique, M. K. Karunattu, A. John, and M. J. Pillai, "Digital Payments: Blockchain based Security Concerns and Future," in *Proceedings - International Conference on Smart Electronics and Communication, ICOSEC 2020*, 2020, pp. 429–435, doi: 10.1109/ICOSEC49089.2020.9215431.

[199] M. Anshari, M. N. Almunawar, M. Masri, and M. Hamdan, "Digital marketplace and FinTech to support agriculture sustainability," in *5th International Conference on Power and Energy Systems Engineering, CPESE 2018*, 2019, vol. 156, pp. 234–238, doi: 10.1016/j.egypro.2018.11.134.

[200] M. K. Al Nawayseh, "Fintech in COVID-19 and beyond: What factors are affecting customers' choice of fintech applications?," *J. Open Innov. Technol. Mark. Complex.*, 2020, doi: 10.3390/joitmc6040153.

[201] A. Sambetbayeva *et al.*, "Development and prospects of the fintech industry in the context of COVID-19," 2020, doi: 10.1145/3410352.3410738.

[202] M. K. Al Nawayseh, "Fintech in COVID-19 and beyond: What factors are affecting customers' choice of fintech applications?," *J. Open Innov. Technol. Mark. Complex.*, vol. 6, no. 4, pp. 1–15, 2020, doi: 10.3390/joitmc6040153.

[203] Islamic Development Bank Group, "the Covid-19 Crisis and Islamic Finance," 2020. [Online]. Available: https://irti.org/product/the-covid-19-crisis-and-islamic-finance/.

[204] F. Amilahaq, P. Wijayanti, N. E. Mohd Nasir, and S. Ahmad, "Digital platform of zakat management organization for young adults in indonesia," vol. 1194 AISC. Springer, Department of Accounting, Faculty of Economics, Universitas Islam Sultan Agung, Jalan Raya Kaligawe KM 4, Semarang, Indonesia, pp. 454–462, 2021, doi: 10.1007/978-3-030-50454-0_46.

[205] M. Dharani, M. K. Hassan, M. R. Rabbani, and T. Huq, "Does the Covid-19 pandemic affect faith-based investments? Evidence from global sectoral indices," *Res. Int. Bus. Financ.*, vol. 59, p. 101537, 2022.

[206] N. Pankaje, H. U. Rahiman, M. R. Rabbani, A. Kulal, A. Toushif, and S. Irfana, "COVID-19 and its impact on educational environment in India," *Environ. Sci. Pollut. Res.*, vol. In Press, 2022.

[207] M. A. Naeem, M. R. Rabbani, S. Karim, and M. Billah, "Religion vs Ethics: Hedge and haven properties of Sukuk and green bonds for stock markets pre- and during COVID-19," *Int. J. Islam. Middle East. Financ. Manag.*, vol. ahead-of-p, no. ahead-of-print, p. https://doi.org/10.1108/IMEFM-06-2021-0252, 2021.

[208] A. Sarea, M. R. Rabbani, M. S. Alam, and M. Atif, "8 Artificial intelligence (AI) applications in Islamic finance and banking sector," in *Artificial Intelligence and Islamic Finance: Practical Applications for Financial Risk Management*, Routledge, 2021, pp. 108–121.

[209] S. Khan, M. K. Hassan, and M. R. Rabbani, "An Artificial Intelligence-based Islamic FinTech model on Qardh-Al-Hasan for COVID 19 affected SMEs," in *ISLAMIC PERSPECTIVE FOR SUSTAINABLE FINANCIAL SYSTEM*, 2021.

[210] K. Siau *et al.*, "Fintech empowerment: Data science, AI, and machine learning," *Cut. Bus. Technol. J.*, vol. 31, no. 11–12, pp. 12–18, 2018, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85064398408&partnerID=40&md5=2dd1b4030cb4d2a14bb6eaad556194df.

[211] M. A. M. Abu Daqar, S. Arqawi, and S. A. Karsh, "Fintech in the eyes of Millennials and Generation Z (the financial behavior and Fintech perception)," *Banks Bank Syst.*, vol. 15, no. 3, pp. 20–28, 2020, doi: 10.21511/bbs.15(3).2020.03.

[212] P. J. Phillips and B. McDermid, "FinTech, terrorism-related fund transfers and behavioural finance," *Dyn. Asymmetric Confl. Pathways Towar. Terror. Genocide*, vol. 14, no. 3, pp. 226–246, 2021, doi: 10.1080/17467586.2020.1821074.

[213] L. P. Bakumenko and E. A. Minina, "International Index of Digital Economy and Society (I-DESI): Trends in the Development of Digital Technologies," *Stat. Econ.*, 2020, doi: 10.21686/2500-3925-2020-2-40-54.

[214] L. Ribisel, "FinTech regulation: How do regulators react to technology in financial services? A comparative study," *Jusletter IT*, no. May, 2018.

[215] L. Haffke, M. Fromberger, and P. Zimmermann, "Cryptocurrencies and anti-money laundering: the shortcomings of the fifth AML Directive (EU) and how to address them," *J. Bank. Regul.*, vol. 21, no. 2, pp. 125–138, 2020, doi: 10.1057/s41261-019-00101-4.

[216] S. A. Shaikh, "Using Fintech in scaling up Islamic microfinance," *J. Islam. Account. Bus. Res.*, 2020, doi: 10.1108/JIABR-10-2019-0198.

[217] C. F. Breidbach, B. W. Keating, and C. Lim, "Fintech: research directions to explore the digital transformation of financial service systems," *J. Serv. Theory Pract.*, vol. 30, no. 1, pp. 79–102, 2020, doi: 10.1108/JSTP-08-2018-0185.

[218] M. K. Hassan and M. R. Rabbani, "Islamic Fintech, Blockchain & Crowdfunding: current landscape & path forward," 2021.

[219] B. D. Saraswati, G. Maski, D. Kaluge, and R. K. Sakti, "The effect of financial inclusion and financial technology on effectiveness of the Indonesian monetary policy," *Bus. Theory Pract.*, vol. 21, no. 1, pp. 230–243, 2020, doi: 10.3846/BTP.2020.10396.

[220] A. Demirguc-Kunt, L. Klapper, D. Singer, S. Ansar, and J. Hess, *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*. 2018.

[221] H. Baber, "Financial inclusion and FinTech: A comparative study of countries following Islamic finance and conventional finance," *Qual. Res. Financ. Mark.*, 2019, doi: 10.1108/QRFM-12-2018-0131.

[222] S. Sinha, K. Raj Pandey, and N. Madan, "Fintech and the demand side challenge in financial inclusion," *Enterp. Dev. Microfinance*, vol. 29, no. 1, pp. 94–98, 2018, doi: 10.3362/1755-1986.17-00016.

[223] M. Gün, "The path to fintech development research on islamic finance in Turkey," in *Impact of Financial Technology (FinTech) on Islamic Finance and Financial Stability*, Recep Tayyip Erdogan University, Turkey: IGI Global, 2019, pp. 65–96.

[224] S. W. Narayan, "Does fintech matter for Indonesia's economic growth?," *Bul. Ekon. Monet. dan Perbank.*, vol. 22, no. 4, pp. 437–456, 2020, doi: 10.21098/bemp.v22i4.1237.

[225] H. I. Hussain, J. Grabara, M. S. A. Razimi, and S. P. Sharif, "Sustainability of leverage levels in response to shocks in equity prices: Islamic finance as a socially responsible investment," *Sustain.*, vol. 11, no. 12, 2019, doi: 10.3390/su10023260.

[226] S. Aliyu, R. M. Yusof, and N. Naiimi, "The role of moral transaction mode for sustainability of banking business: A proposed conceptual model for Islamic microfinance banks in Nigeria," *Int. J. Soc. Econ.*, vol. 44, no. 12, pp. 2238–2256, 2017, doi: 10.1108/IJSE-07-2016-0205.

[227] A. Jan, M. Marimuthu, and M. P. B. M. @ Mat Isa, "The nexus of sustainability practices and financial performance: From the perspective of Islamic banking," *J. Clean. Prod.*, vol. 228, pp. 703–717, 2019, doi: 10.1016/j.jclepro.2019.04.208.

[228] youmatter, "Globalization: definition, benefits, effects, examples – What is globalization?," *What is Glob. All Defin. Glob.*, 2020.

[229] S. Karim, M. A. Naeem, A. A. Meero, and M. R. Rabbani, "Examining the role of gender diversity on ownership structure-sustainable performance nexus: fresh evidence from emerging markets," *Environ. Sci. Pollut. Res.*, pp. 1–16, 2021.

[230] United Nations Environment Programme, "Renewables 2020 Global Status Report," 2020.

[231] H. Sun *et al.*, "CSR, Co-Creation and Green Consumer Loyalty: Are Green Banking Initiatives Important? A Moderated Mediation Approach from an Emerging Economy," *Sustain.*, vol. 12, no. 24, p. 10688, 2020.

[232] A. Ignatyuk, O. Liubkina, T. Murovana, and A. Magomedova, "FinTech as an innovation challenge: From big data to sustainable development," in *2020 International Conference on Sustainable Futures: Environmental, Technological, Social and Economic Matters, ICSF 2020*, 2020, vol. 166, doi: 10.1051/e3sconf/202016613027.

[233] F. Dal Mas, G. Dicuonzo, M. Massaro, and V. Dell'Atti, "Smart contracts to enable sustainable business models. A case study," *Manag. Decis.*, 2020, doi: 10.1108/MD-09-2019-1266.

[234] K. Alrajhi and M. A. ELAffendi, "Automatic Arabic part-of-speech tagging: Deep learning neural LSTM versus Word2Vec," *Int. J. Comput. Digit. Syst.*, vol. 8, no. 3, pp. 308–315, 2019, doi: 10.12785/ijcds/080310.

[235] "Green Finance and Islamic Finance," *Int. J. Soc. Sci. Educ. Stud.*, 2017, doi: 10.23918/ijsses.v4i3p115.

[236] C. Kemfert, D. Schäfer, and W. Semmler, "Great Green Transition and Finance," *Intereconomics*, vol. 55, no. 3, pp. 181–186, 2020, doi: 10.1007/s10272-020-0896-y.

[237] R. Wilson, "Islamic finance and ethical investment," *Int. J. Soc. Econ.*, 1997, doi: 10.1108/03068299710193624.

[238] M. Kumar, N. Nikhil, and R. Singh, "Decentralising finance using decentralised blockchain oracles," 2020, doi: 10.1109/INCET49848.2020.9154123.

[239] H. Sun Yin and R. Vatrapu, "A first estimation of the proportion of cybercriminal entities in the bitcoin ecosystem using supervised machine learning," in *Proceedings - 2017 IEEE International Conference on Big Data, Big Data 2017*, 2017, vol. 2018-Janua, pp. 3690–3699, doi: 10.1109/BigData.2017.8258365.

[240] J. Hall, S. Matos, and V. Bachor, "From green technology development to green innovation: inducing regulatory adoption of pathogen detection technology for sustainable forestry," *Small Bus. Econ.*, vol. 52, no. 4, pp. 877–889, 2019, doi: 10.1007/s11187-017-9940-0.

[241] S. A. A. Bukhari, F. Hashim, A. B. Amran, and K. Hyder, "Green Banking and Islam: two sides of the same coin," *J. Islam. Mark.*, vol. 11, no. 4, pp. 977–1000, 2019, doi: 10.1108/JIMA-09-2018-0154.

Dr. Mustafa Raza Rabbani
Assistant Professor
Department of Economics & Finance
College of Business Administration, University of Bahrain.
mrabbani@uob.edu.bh

Dr. Mustafa Raza Rabbani holds a Ph.D. in Banking and Financial Services from the prestigious Jamia Millia Islamia, University, New Delhi, India. His research areas are Financial Technology (Fintech) and its potential application in Islamic finance and banking industry, Integrating Halal economy with the Islamic finance and exploring the possibilities of sharia compliant cryptocurrency. Dr. Rabbani is a passionate researcher and in the last 2 years he has published more than 30 peer-reviewed research papers in the international journal of repute published by Emerald, Elsevier, Springer, Inderscience, and indexed in Scopus, Web of Science (WoS) and ABDC listed etc. According to various databases, Dr. Rabbani is the highest cited researcher in Islamic Fintech and has also authored most number of research articles on Islamic Fintech. He is serving as an Assistant Professor at the Department of Economics and Finance, University of Bahrain. Prior to this he has been associated with Kingdom University, Bahrain, Jamia Millia Islamia, New Delhi, Saudi Electronic University and IMS Unison University as an assistant professor, lecturer, course coordinator and program coordinator. His work has been published in a variety of international journals including Energy Economics, Research in International Business and Finance (RIBAF), Journal of Islamic and Middle eastern Finance and Management, Economic Research, Journal of Islamic Accounting and Business Research, Heliyon Business and Economics, Environmental Science and Pollution Research etc.