



Munich Personal RePEc Archive

**Digital Innovations for Increasing
Financial Inclusion: CBDC,
Cryptocurrency, Embedded finance,
Artificial Intelligence, WaaS, Fintech,
Bigtech, and DeFi**

Ozili, Peterson K

2024

Online at <https://mpra.ub.uni-muenchen.de/121848/>
MPRA Paper No. 121848, posted 31 Aug 2024 13:23 UTC

Digital Innovations for Increasing Financial Inclusion: CBDC, Cryptocurrency, Embedded finance, Artificial Intelligence, WaaS, Fintech, Bigtech, and DeFi

Peterson K. Ozili

Abstract

Digital innovations are emerging to solve known problems using new digital tools or technologies. Digital innovations also have wide application for financial inclusion. Private sector agents are using digital innovations to increase financial inclusion in remarkable ways. This chapter explores the recent digital innovations that are changing the financial inclusion landscape toward digital financial inclusion. The study used the discourse analysis methodology. It was found that digital innovations, such as central bank digital currency (CBDC), cryptocurrency, embedded finance, artificial intelligence, wallet as a service (WaaS), Fintech, Bigtech, and decentralized finance (DeFi), are helping to accelerate digital financial inclusion in many parts of the world. Each of these digital innovations serve a specific purpose, and they contribute to accelerating digital financial inclusion in unique ways, even though they all pose some risks that can be mitigated with careful and purposeful regulation.

Keywords: Digital innovation; Financial inclusion; CBDC; Cryptocurrency; Embedded finance; Artificial intelligence; Wallet as a service; Fintech; Bigtech; DeFi.

May 2024

To cite: Ozili, P.K. (2024). Digital Innovations for Increasing Financial Inclusion: CBDC, Cryptocurrency, Embedded finance, Artificial Intelligence, WaaS, Fintech, Bigtech and DeFi. In *Impact of Artificial Intelligence on Society*, pp.174-184. Chapman and Hall/CRC.

1. Introduction

The rising number of people without bank accounts in the world has led policymakers and practitioners to invent innovative ways to increase financial inclusion for over two billion people who are unbanked, globally. Many of these innovations are digital in nature and are mostly the result of private sector intervention while very few digital innovations are led by the public sector. There is high optimism, even among academics, that digital innovations would accelerate financial inclusion by providing an easy, safe, and efficient way to bring formal financial services to marginalized and underserved populations (Chen et al. 2022; Yang et al. 2022; Lee et al. 2023).

The recent COVID-19 pandemic of 2020–2022 accelerated the use of digital innovation to access basic financial services during the COVID-era lockdown and social distancing restrictions in many countries (Eton et al. 2023; Ravishankar et al. 2023). During this time, although many people transitioned to the digital economy, a large segment of the population were both digitally excluded and financially excluded (Gill et al. 2021; Bastick and Mallet-Garcia 2022). This led to concerns about creating a more equitable and inclusive digital and financial system. As a result, several digital innovations have emerged to assist in creating a more inclusive digital and financial system (Malladi et al. 2021; Frost et al. 2021).

This chapter explores some of these digital innovations. They include central bank digital currency, cryptocurrency, embedded finance, artificial intelligence, wallet-as-a-service, Fintech, Bigtech, and decentralized finance. By definition, a central bank digital currency is the digital alternative to fiat paper money and is issued by a central bank (Infante et al. 2022). Embedded finance is the incorporation of financial products and services into the business platforms of a non-financial services company (Ozili 2022a). Artificial intelligence is the use of computer systems to mimic human intelligence (Haenlei and Kaplan 2019). Wallet-as-a-service refers to access and use of financial services from a customized wallet (Castejon-Molina et al. 2023). Fintech entails access, use, and delivery of financial services using software technology (Puschmann 2017). Bigtech refers to large non-financial corporations that offer financial services on their own platforms (Frost et al. 2019; Liu et al. 2022). Decentralized finance (DeFi) describes access to financial services and products from a decentralized blockchain network and without requiring intermediaries (Harvey et al. 2021; Popescu 2022).

These digital innovations are important, and they can be used to support ongoing efforts to increase financial inclusion. However, there is limited knowledge in the literature on the role

of these digital innovations in accelerating financial inclusion. The academic literature has not produced significant research on how these digital innovations might accelerate financial inclusion. This might be because these innovations are still emerging or due to lack of a research agenda in this area. Therefore, this chapter attempts to address this gap in the literature, by offering some insight into how these digital innovations might increase financial inclusion. The discussion in the chapter takes a generalist approach, meaning that the discussion is not specific to any country, even though the strategies discussed are applicable to most developing countries.

The contribution of this study to the literature are twofold. First, the discussion in this chapter contributes to the literature that examines the role of digital innovations in improving development outcomes. The study shows that digital innovation can lead to positive development outcomes by accelerating financial inclusion for unbanked and underserved people. Second, the study contributes to the financial inclusion literature that examines the strategies or tools that are useful in accelerating financial inclusion.

The rest of the study has three sections. Section 2 presents the literature review. Section 3 identifies some of the digital innovations for increasing financial inclusion, while section 4 presents the conclusion of the study.

2. Literature Review

Existing studies document some benefits of financial inclusion for societal development. Damodaran (2013) showed that financial inclusion benefits society by decreasing the inequality between the rich and the poor and by making it easier for low income and marginalized people to access the same formal financial services that the rich already have access to. Alnabulsi and Salameh (2021) showed that financial inclusion could be used as a strategy to accelerate economic development. They argued that financial inclusion may create opportunities for job creation, greater financial stability and it can make macroeconomic policies more effective, thereby leading to positive economic development. Valencia et al. (2021) investigated whether financial inclusion can complement societal development in terms of achieving the sustainable development goals. They found a causal association between financial inclusion and achieving the sustainable development goals. Similarly, Sarma and Pais (2011) observed that higher financial inclusion is correlated with greater human development because greater access and

use of finance, over time, lead to better income equality in society. Despite the contribution of financial inclusion to societal development, Mader (2018) warned that financial inclusion strategies could lead to the financialization of poverty in society, and it may also lead to over indebtedness and may expose vulnerable poor people to risks.

Recently, researchers have examined the role of digital technology in increasing financial inclusion. In the digital financial inclusion literature, for example, Bachas et al. (2018) emphasized that using digital technology could go a long way in delivering financial services to the people who need it the most. The authors further stressed that digital technology could bypass existing barriers that have hindered poor people from accessing essential financial services such as high transaction cost and the onerous paperwork required to open a basic bank account. It was also argued that innovations such as debit cards will not only reduce transaction cost but will also enable faster and quicker access to a bank account. Ferrata (2019) argued that digital instruments may boost financial inclusion for the poor because the weakest and poorest among us can use digital instruments to access financial services to improve their life conditions and it contributes to attaining the sustainable development goals; therefore, digital tools and digital finance can help in leaving no one behind toward greater financial inclusion. Gallego-Losada et al. (2023), in a survey of prior studies, document that the deployment of information and communication technologies (ICT) to achieve financial inclusion has given rise to digital financial inclusion, and digital financial inclusion has created opportunities to expand financial services to unbanked and underserved people which contribute to poverty reduction and social development. Kulkarni and Ghosh (2021) showed that there is much progress in digital financial inclusion in India, and digital financial inclusion is giving women greater social autonomy and financial independence. Despite this, many women in India still face a significant barrier that prevent them from accessing digital financial services and the barrier is the wide gender gap in digital financial inclusion in India. The authors conclude by suggesting that financial inclusion policies should be gender-sensitive to close the gender gap in digital financial inclusion for women in India. Shen et al. (2020) assessed the medium or channel through which financial inclusion is achieved in China and found that financial literacy and usage of digital financial services are the most potent mediums through which financial inclusion is achieved in China. They recommend that policymakers in China should focus on improving consumer's use of digital financial services and increasing their financial literacy level. Dluhopolskyi et al. (2023) assessed the effect of the COVID-19 pandemic on digital financial inclusion. The pandemic led to lockdown which abruptly reduced physical access to

financial institutions and reduced access and use of basic financial services. They showed that many people turned to digital innovations during the pandemic in order to access existing financial services, and some of the digital innovations that were used to advance financial inclusion during the pandemic emerged before the pandemic, but the pandemic made them more popular such as artificial intelligence, cryptocurrency, central bank digital currency, the Internet of Things (IoT), and blockchain technology. As a result, the demand for these innovations ballooned during the COVID-19 pandemic and they helped to improve access to financial services.

3. Some Recent Development

This section highlights some recent innovative developments that are being used to increase financial inclusion. They are mostly central bank digital currency (CBDC), cryptocurrency, embedded finance, artificial intelligence (AI), wallet-as-a-service (WaaS), Fintech, Bigtech, and decentralized finance (DeFi). Some of these digital innovations require internet connectivity to function while others can operate offline as shown in Table 1.

Table 1 Digital innovations with online and offline capabilities

Digital innovations	Can operate with internet connectivity	Can operate offline	Remarks
CBDC	✓	✓	CBDC can operate both online and offline
Cryptocurrency	✓		All cryptocurrency users need internet to operate. They need internet to connect with other cryptocurrency users
Embedded finance	✓		Users need internet connection
Artificial intelligence	✓	✓	AI can operate both online and offline because AI systems can

			interact with the trained data without needing to connect to other AI systems
Wallet as a service	✓		All WaaS platforms need internet to operate
Fintech	✓		All Fintech platforms need internet to operate
Bigtech	✓		All Bigtech platforms need internet to operate
Decentralized finance	✓		Most blockchain networks and decentralized apps (dApps) rely on the internet to work

3.1. Role of Wallet-as-a-Service

Wallet-as-a-service (WaaS) has the potential to increase access to digital financial services and is, therefore, beneficial for digital financial inclusion. WaaS refers to any API-based service or solution that enable unbanked and underserved users to open, manage, and secure a digital account in a wallet. Users of WaaS can use the funds in their wallet to trade and to make an investment digitally to generate income and improve their well-being. WaaS is remarkable because it allows unbanked and underserved adults to seamlessly open a digital account in a wallet, manage their account without needing technical or sophisticated knowledge of blockchain technology, and it enables them to access their wallet from any device at any time and from any location, thereby closing the physical barriers to financial services.

Many providers of digital financial services in the private sector are turning to wallet-as-a-service to increase financial inclusion. Deploying WaaS allows providers of digital financial services to incorporate ready-made solutions into a wallet and deliver the wallet to unbanked and underserved adults to meet their unique needs. WaaS offers many advantages for financial inclusion. It presents a reliable solution-in-hand to meet the financial inclusion needs of unbanked and underserved adults as well as for SMEs. It has features that enable the storing of digital money or digital assets. It facilitates seamless cross-border digital payments and transactions at exceptionally low cost. Users can easily obtain the wallet that offer the specific

financial services they need, thereby enabling them to access other digital financial services easily.

Despite the potential of WaaS to increase financial inclusion, there are challenges that could hinder the widespread adoption of wallet-as-a-service. One, the presence of a weak or poor digital (blockchain) infrastructure is a challenge. Many countries have a weak or poor digital (blockchain) infrastructure that hinders the widespread use of WaaS. Blockchain infrastructure may be slow and may not offer fast payment to users. Therefore, a weak digital (blockchain) infrastructure may not be able to deploy WaaS effectively. This problem is further compounded by slow internet connectivity. Two, digital literacy and poor knowledge of WaaS is also a challenge. Knowledge of WaaS is still limited among the population. Three, the regulation of WaaS is slow and emerging. This may slowdown the widespread adoption of WaaS. Four, the risk of security breaches is high such as unauthorized access to user wallet that leads to loss of funds in a digital account held in the wallet. This is a significant challenge because users' monies are only as secure as the wallet themselves.

3.2. Role of Embedded Finance

Many small businesses are financially excluded. They obtain funding from informal sources. They rely mostly on family, friends, and own funds to raise capital and debt to fund their business. Embedded finance provides an opportunity to change this trend. Embedded finance enables individuals and small business owners to participate in the formal financial system and obtain the funds they need to start and manage their business. Embedded finance entails integrating basic financial services into the product offerings of non-financial firms using APIs (Ozili 2022a). Embedded finance can increase financial inclusion for individuals, small businesses, and MSMEs by giving them the financial tools they need to access funds cheaply, manage their business, and to withstand economic shocks. Many large businesses already offer embedded financial services such as Amazon, Google, Facebook, and Uber. For example, Uber (a non-financial company) integrated a payment and lending service on its app to allow customers make payment without using their own bank app, and the app allows Uber drivers to borrow money (or obtain a loan) from Uber. In the same way, individuals and small businesses can embed basic financial services into their business. This will enable them to provide a convenient and seamless payment experience for their customers at check-out and will also enable them to access cheap and quick funding to start and manage their business. Furthermore, banks and fintech players can reach underserved people and communities by

embedding financial services into their mobile devices and in the e-commerce platforms they patronize. This way, banks and fintech players will be able to serve a larger audience and provide financial services to many unbanked adults.

3.3. Role of Artificial Intelligence and Robotics

Over the years, banks have been accused of favoring middle-income and high-income customers and abandoning poor and low-income customers in the provision of affordable credit and other financial services. In fact, traditional risk management models and bank regulation encourage banks to avoid doing significant business with poor and low-income customers because of their high-risk profiles, thereby creating inequality in the formal financial system. This inequality is pervasive in the financial services industry because banks do not want to lend to low-end risky customers, and it leads to unequal access to credit and other banking services.

AI and robotics may offer a solution. AI and robotics can help to democratize access to financial services for both unbanked adults, high-end, and low-end customers. AI and robotics can be used to increase financial inclusion for the unbanked by overcoming the challenges of documentation-based tiered know-your-customer (KYC) identification (Kshetri 2021). It allows unbanked adults to use face recognition to meet KYC identification requirements. This will expand access to financial services for unbanked adults in neglected communities. After meeting KYC requirements using face recognition, AI and robotics can also be used to generate alternative non-financial data which can be used to generate credit scores for unbanked adults to enable them access formal credit easily and cheaply (Ozili 2021). Predictive robotics and AI through machine learning can also be used to study customers transaction patterns and generate credit scores based on the observed patterns. Lenders can use the generated credit scores to widen access to formal credit for underserved customers and for unbanked adults in neglected communities (Kshetri 2021). Banks can also use AI and robotics to (i) reduce systemic inequality in the provision of formal financial services to high-end and low-end customers, (ii) change how consumers access their formal accounts and using a more equitable approach, (iii) manage risks, (iv) meet customer needs, and (v) offer affordable credit to unbanked and underserved customers outside of their customer base (Ozili 2021; Kshetri 2021). Despite the potential for AI and robotics to expand financial inclusion, AI and robotics should be deployed carefully to avoid known risks, such as data privacy issues, the replication of societal biases in machine learning models, and over-indebtedness through easy access to digital loans (Kshetri 2021; Ozili 2021; Yasir et al. 2022).

3.4. Role of Central Bank Digital Currency

In many countries, central banks are responsible for accelerating financial inclusion and they are constantly in search for effective ways to accelerate financial inclusion. Many central banks are considering using a retail central bank digital currency (CBDC) to increase financial inclusion for unbanked adults. A central bank digital currency is a digital currency or digital money that is issued by a central bank and delivered through an account-based wallet or a token (Auer and Böhme 2020; Ozili 2023d). CBDC may increase financial inclusion in several ways. CBDC can bring many unbanked adults into the formal financial system by first creating digital identities for unbanked adults (Ozili 2023a). CBDC can also increase financial inclusion through ownership of a digital wallet. Individuals without a bank account can own a CBDC digital wallet. They can open a CBDC account to store money digitally, build a credit score, and access other financial instruments or financial services available on the CBDC platform (Allen et al. 2022; Ozili 2023b). Owning a CBDC account does not require burdensome documentation, which makes it easier to enroll compared to the burdensome documentation required by traditional banks (Ozili 2023a). Also, the deployment of offline CBDC will increase financial inclusion for unbanked adults who lack access to internet connectivity either due to lack of internet infrastructure or due to the high cost of internet broadband (Ozili 2023a). To succeed, central banks must determine the best use case of CBDC for financial inclusion and they should ensure that the CBDC is designed with features that increase financial inclusion for unbanked adults.

3.5. Role of Bigtech

Bigtech emerged from the need of non-financial firms to offer financial services. Bigtech refers to large non-financial companies that operate platforms that are used by a very large number of people and businesses over the internet (Stulz 2019; Frost et al. 2019; Beck et al. 2022; Ozili 2023c). Bigtech can be found mainly in e-commerce (i.e., Amazon and eBay), social media (i.e., Twitter, Facebook, and YouTube), internet search (Google and Yahoo), mobile phone hardware and software (i.e., Apple, IOS, and Android), ride hailing (i.e., Uber and Lyft), and in telecommunications (Frost et al. 2019). Bigtech increases financial inclusion by allowing firms to access the financial services and products offered on their platforms (Ozili 2023c). Bigtech uses Big Data and machine learning to generate credit scores for clients that want to access the loans offered on the platforms of Bigtech firms. (Stulz 2019). As a result, they provide convenience and eliminate the need for their clients to visit a physical bank (Frost et

al. 2019). Bigtech also offer working capital in the form of loans to SMEs to meet their liquidity needs and to help them withstand unexpected financial shock, thereby increasing access to finance for SMEs which is beneficial for financial inclusion (Beck et al. 2022; Ozili 2023c). However, the use of Bigtech to advance financial inclusion is challenging because they pose significant financial stability risks, unfair competitive advantage, and data governance risks. In other words, Bigtech firms may become too big to fail which would be detrimental for users on their platforms if they fail. Bigtech firms also have competitive advantages over smaller firms, and they may kick out small players in that space. There are also data governance issues, such as when collected personal data are not protected or when collected personal data are used to manipulate consumer preferences.

3.6. Role of Fintech

Fintech is also another exciting innovation that has huge potential to accelerate financial inclusion. Fintech, also known as financial technology, entails the use of mobile phones, software, and agent networks to enhance access to formal financial services (Sahay et al. 2020). Many fintech providers offer mobile phone-enabled financial services to ensure equal access and use of financial services for the unbanked and underserved segment of the population (Ozili 2018; Makina 2019). Fintech providers have made it easier to onboard more customers and obtain digital loans simply by uploading minimal documentation or credentials into online digital platforms (Morgan 2022). Fintech is also advancing financial inclusion by reducing operating costs, lowering transaction costs, increasing efficiency in the delivery of financial services, reaching people in remote and rural areas, and serving unbanked adults that are abandoned by traditional banks (Philippon 2019; Ozili 2018). Despite the potential for Fintech to increase financial inclusion, Fintech poses some risks such as cybersecurity risks, weak regulation, over-lending, data privacy, fraud, financial illiteracy, over-indebtedness, and lack of consumer trust (Philippon 2019; Hollanders 2020; Ozili 2023b).

3.7. Role of Cryptocurrencies

Cryptocurrencies are digital currencies that serve multiple purposes. Cryptocurrencies are stored and transferred digitally and do not require physical banking infrastructure which makes them useful in expanding financial services in locations and communities where traditional banking services are unavailable or inaccessible (Ozili 2023b). People without internet connection can access cryptocurrencies, thereby removing geographical barriers (Kim et al.

2022). Also, there is no requirement to own a cryptocurrency account and it can be accessed through mobile phones, thereby making it a useful tool for expanding access to financial services for unbanked and underserved adults who cannot be served by traditional banks (Chung et al. 2023). There is also the view that unbanked adults can use cryptocurrency to make an investment, build wealth, and earn income which would enable them to rise above poverty and live a better life (Ozili 2023b). However, the problems with using cryptocurrency to increase financial inclusion are that cryptocurrencies are not primarily designed for the purpose of serving unbanked adults (Carmona 2022). This is because cryptocurrencies are often expensive, volatile, complex, and unsafe which is contrary to what banked adults really need – they need a safe, stable, reliable, and an inexpensive way to access financial services (Kim et al. 2022).

3.8. Role of DeFi

Decentralized finance (DeFi) allows people to access financial services and products over a decentralized blockchain network and without requiring intermediaries (Popescu 2022). DeFi aims to democratize access to financial services using peer-to-peer relationships that do not require financial intermediaries. DeFi may increase financial inclusion by (i) giving banked adults control of their money and data which ensures greater privacy and security, (ii) empowering unbanked adults with digital wallets which they can use to access savings, insurance, and other banking products through their smartphones over the internet (Ozili 2022b), (iii) lowering access barriers and expanding access to DeFi platforms using smartphones and other digital devices, (iv) enabling users to borrow funds or lend their assets on a peer-to-peer basis and without undertaking the traditional loan screening checks, (v) ensuring seamless low-cost cross-border transactions, and (vi) enabling developers to build customized financial services that meet the specific needs of unbanked adults (Popescu 2022). Although DeFi can increase financial inclusion, the risks posed by DeFi include the vulnerability of smart contracts, regulatory uncertainty, and interoperability issues, among others (Popescu 2022; Ozili 2022b).

4. Conclusion

The purpose of the chapter was to highlight the recent digital innovations that are changing the financial inclusion landscape. These developments are simply the emerging digital innovations that are helping to accelerate financial inclusion in many parts of the world. Some of the recent developments that were identified in this study include central bank digital currency, cryptocurrency, embedded finance, artificial intelligence, wallet-as-a-service, Fintech, Bigtech, and decentralized finance. It was shown that each of these digital innovations serve a specific purpose, and they contribute to accelerating financial inclusion in unique ways, even though they all pose some risks that can be mitigated with careful and purposeful regulation. These digital innovations will undoubtedly play an important role in advancing financial inclusion in the future. Therefore, the private sector should be encouraged to develop more low-risk digital financial innovations that can accelerate financial inclusion. Policymakers should support the private sector by developing appropriate regulatory frameworks that can accommodate emerging digital financial innovations that have the potential to expand access to financial services. However, such regulation should mitigate risks without stifling innovation. Other developments that could be explored in a future research study include non-fungible tokens, Internet-of-Things (IoT), and the metaverse.

References

Allen, Franklin, Xian Gu, and Julapa Jagtiani. "Fintech, cryptocurrencies, and CBDC: Financial structural transformation in China." *Journal of International Money and Finance* 124 (2022): 102625.

Alnabulsi, Zaynab Hassan, and Rafat Salameh Salameh. "Financial inclusion strategy and its impact on economic development." *International Journal of Economics and Finance Studies* 13, no. 2 (2021): 226–252.

Auer, Raphael, and Rainer Böhme. "The technology of retail central bank digital currency." *BIS Quarterly Review*, March (2020).

Bachas, Pierre, Paul Gertler, Sean Higgins, and Enrique Seira. "Digital financial services go a long way: Transaction costs and financial inclusion." In *AEA Papers and Proceedings*, vol. 108,

pp. 444–448. 2014 Broadway, Suite 305, Nashville, TN 37203: American Economic Association, 2018.

Bastick, Zach, and Marie Mallet-Garcia. “Double lockdown: The effects of digital exclusion on undocumented immigrants during the COVID-19 pandemic.” *New Media & Society* 24, no. 2 (2022): 365–383.

Beck, Thorsten, Leonardo Gambacorta, Yiping Huang, Zhenhua Li, and Han Qiu. “Big techs, QR code payments and financial inclusion.” (2022).

Carmona, Tonantzin. “Debunking the narratives about cryptocurrency and financial inclusion.” (2022).

Castejon-Molina, Diego, Dimitrios Vasilopoulos, and Pedro Moreno-Sanchez. “CBDC-cash: How to fund and defund CBDC wallets.” *Cryptology ePrint Archive* (2023).

Chen, Yang, Shengping Yang, and Quan Li. “How does the development of digital financial inclusion affect the total factor productivity of listed companies? Evidence from China.” *Finance Research Letters* 47 (2022): 102956.

Chung, Sunghun, Keongtae Kim, Chul Ho Lee, and Wonseok Oh. “Interdependence between online peer-to-peer lending and cryptocurrency markets and its effects on financial inclusion.” *Production and Operations Management* (2023).

Damodaran, Akhil. “Financial inclusion: Issues and challenges.” *AKGEC International Journal of Technology* 4, no. 2 (2013): 54–59.

Dluhopolskyi, Oleksandr, Olena Pakhnenko, Serhiy Lyeonov, Andrii Semenog, Nadiia Artyukhova, Marta Cholewa-Wiktor, and Winczysław Jastrzębski. “Digital financial inclusion: COVID-19 impacts and opportunities.” *Sustainability* 15, no. 3 (2023): 2383.

Eton, Marus, Fabian Mwosi, and Mary Ejang. “The effect of COVID-19 on financial inclusion in the Kigezi and Lango subregions in Uganda.” *Journal of the International Council for Small Business* 4, no. 2 (2023): 89–102.

Ferrata, Luigi. “Digital financial inclusion—an engine for “leaving no one behind”.” *Public Sector Economics* 43, no. 4 (2019): 445–458.

Frost, Jon, Leonardo Gambacorta, Yi Huang, Hyun Song Shin, and Pablo Zbinden. "BigTech and the changing structure of financial intermediation." *Economic Policy* 34, no. 100 (2019): 761–799.

Frost, J., Gambacorta, L., & Shin, H. S. (2021). From financial innovation to inclusion. *Finance & Development*, 14-17.

Gallego-Losada, María-Jesús, Antonio Montero-Navarro, Elisa García-Abajo, and Rocío Gallego-Losada. "Digital financial inclusion. Visualizing the academic literature." *Research in International Business and Finance* 64 (2023): 101862.

Gill, Whitney, Hara Sukhvinder, and Whitney Linda. "A matter of life and death: How the Covid-19 pandemic threw the spotlight on digital financial exclusion in the UK." In *Information security technologies for controlling pandemics*, pp. 65–108. Cham: Springer International Publishing, 2021.

Haenlein, Michael, and Andreas Kaplan. "A brief history of artificial intelligence: On the past, present, and future of artificial intelligence." *California Management Review* 61, no. 4 (2019): 5–14.

Harvey, Campbell R., Ashwin Ramachandran, and Joey Santoro. *DeFi and the Future of Finance*. John Wiley & Sons, 2021.

Hollanders, Marc. "FinTech and financial inclusion: Opportunities and challenges." *Journal of payments strategy & systems* 14, no. 4 (2020): 315–325.

Infante, Sebastian, Kyungmin Kim, André F. Silva, and Robert J. Tetlow. "The macroeconomic implications of CBDC: A review of the literature." (2022).

Kim, Daehan, Maggie Chen, and Doojin Ryu. "Search-Theoretic approach to cryptocurrency adoption and financial inclusion." Available at SSRN 4116714 (2022).

Kshetri, Nir. "The role of artificial intelligence in promoting financial inclusion in developing countries." *Journal of Global Information Technology Management* 24, no. 1 (2021): 1–6.

Kulkarni, Lalitagauri, and Anandita Ghosh. "Gender disparity in the digitalization of financial services: challenges and promises for women's financial inclusion in India." *Gender, Technology and Development* 25, no. 2 (2021): 233–250.

Lee, Chien-Chiang, Runchi Lou, and Fuhao Wang. “Digital financial inclusion and poverty alleviation: Evidence from the sustainable development of China.” *Economic Analysis and Policy* 77 (2023): 418–434.

Liu, Lei, Guangli Lu, and Wei Xiong. *The big tech lending model*. No. w30160. National Bureau of Economic Research, 2022.

Mader, Philip. “Contesting financial inclusion.” *Development and Change* 49, no. 2 (2018): 461–483.

Makina, Daniel. “The potential of FinTech in enabling financial inclusion.” In *Extending financial inclusion in Africa*, pp. 299–318. Academic Press, 2019.

Malladi, Chandra Mohan, Rupesh K. Soni, and Sanjay Srinivasan. “Digital financial inclusion: Next frontiers—Challenges and opportunities.” *CSI Transactions on ICT* 9, no. 2 (2021): 127–134.

Morgan, Peter J. “Fintech and financial inclusion in Southeast Asia and India.” *Asian Economic Policy Review* 17, no. 2 (2022): 183–208.

Ozili, Peterson K. “Impact of digital finance on financial inclusion and stability.” *Borsa Istanbul Review* 18, no. 4 (2018): 329–340.

Ozili, Peterson K. “Big data and artificial intelligence for financial inclusion: Benefits and issues.” *Artificial intelligence fintech, and financial inclusion* (2021).

Ozili, Peterson K. “Embedded finance: assessing the benefits, use case, challenges and interest over time.” *Journal of Internet and Digital Economics* 2, no. 2 (2022a): 108–123.

Ozili, Peterson K. “Decentralized finance research and developments around the world.” *Journal of Banking and Financial Technology* 6, no. 2 (2022b): 117–133.

Ozili, Peterson K. “eNaira central bank digital currency (CBDC) for financial inclusion in Nigeria.” In *Digital economy, energy and sustainability: Opportunities and challenges*, pp. 41–54. Cham: Springer International Publishing, 2023a.

Ozili, Peterson K. “CBDC, Fintech and cryptocurrency for financial inclusion and financial stability.” *Digital Policy, Regulation and Governance* 25, no. 1 (2023b): 40–57.

Ozili, Peterson K. “Determinants of FinTech and BigTech lending: the role of financial inclusion and financial development.” *Journal of Economic Analysis* 2, no. 3 (2023c): 66–79.

Ozili, Peterson K. “Central bank digital currency research around the World: a review of literature.” *Journal of Money Laundering Control* 26, no. 2 (2023d): 215–226.

Philippon, T. (2019). On fintech and financial inclusion. National Bureau of Economic Research.No. 26330.

Popescu, Andrei Dragos. “Understanding FinTech and Decentralized Finance (DeFi) for financial inclusion.” In *FinTech development for financial inclusiveness*, pp. 1–13. IGI Global, 2022.

Puschmann, T. (2017). Fintech. *Business & Information Systems Engineering*, 59, 69–76.

Ravishankar, Pavan, Sudarsan Padmanabhan, and Balaraman Ravindran. “Financial exclusion of internal migrant workers of India during COVID-19: can digital financial inclusion be facilitated by AI?” *Journal of Information Technology Case and Application Research* (2023): 1–30.

Sahay, Ms Ratna, Mr Ulric Eriksson von Allmen, Ms Amina Lahreche, Purva Khera, Ms Sumiko Ogawa, Majid Bazarbash, and Ms Kimberly Beaton. *The promise of fintech: Financial inclusion in the post COVID-19 era*. International Monetary Fund, 2020.

Sarma, Mandira, and Jesim Pais. “Financial inclusion and development.” *Journal of International Development* 23, no. 5 (2011): 613–628.

Shen, Yan, C. James Hueng, and Wenxiu Hu. “Using digital technology to improve financial inclusion in China.” *Applied Economics Letters* 27, no. 1 (2020): 30–34.

Stulz, René M. “Fintech, bigtech, and the future of banks.” *Journal of Applied Corporate Finance* 31, no. 4 (2019): 86–97.

Valencia, Daniel Cardona, Carola Calabuig, Eliana Villa, and Fray Betancur. “Financial inclusion as a complementary strategy to address the SDGs for society.” In *Sustainable development goals for society vol. 1: Selected topics of global relevance*, pp. 79–89. Cham: Springer International Publishing, 2021.

Yang, Xiaolan, Yidong Huang, and Mei Gao. “Can digital financial inclusion promote female entrepreneurship? Evidence and mechanisms.” *The North American Journal of Economics and Finance* 63 (2022): 101800.

Yasir, Anam, Alia Ahmad, Sagheer Abbas, Mohammad Inairat, Amer Hani Al-Kassem, and Atta Rasool. “How Artificial Intelligence Is Promoting Financial Inclusion? A Study on Barriers of Financial Inclusion.” In 2022 International Conference on Business Analytics for Technology and Security (ICBATS), pp. 1–6. IEEE, 2022.