Asian Management and Business Review, Volume 4 Issue 2, 2024: 324-339

Navigating regulatory sandbox initiatives for innovation diffusion in fintech lending: A systematic review

Rahardito Dio Prastowo[1]*, Dana Indra Sensuse[2], Sofian Lusa[3], Prasetyo Adi Wibowo Putro[4]
[1,2,4]Faculty of Computer Science, Universitas Indonesia, Depok, Indonesia
[3]Master's Degree of Tourism Dept, Trisakti Institute of Tourism, Jakarta, Indonesia

Article History
Received : 2024-07-03
Revised : 2024-08-11
Accepted : 2024-08-17
Published : 2024-08-23

Keywords:
FinTech; regulatory sandbox; systematic review; TOE; DOI.

***Corresponding author:**
rahardito.dio@ui.ac.id

DOI:
10.20885/AMBR.vol4.iss2.art10

Abstract

The development of digital technology has succeeded in providing alternative financial services with the FinTech lending industry. This industry allows direct connection between lenders and borrowers through a digital platform. FinTech lending has unique characteristics that provide advantages over traditional financial institution services, such as utilizing soft information for credit risk assessment, providing unsecured loans, and using third-party platforms to secure transactions. Indonesian government continues to update the regulatory framework for the FinTech industry including the implementation of regulatory sandbox. This effort aims to ensure that the development of digital financial innovation is beneficial and safe for society. Various jurisdictions have also implemented similar initiatives to address issues in FinTech lending, allowing companies to test their operations under regulatory supervision. This research conducted a systematic review using the PRISMA 2020 methodology to understand issues related to FinTech lending and the initiatives provided by regulatory sandboxes to address the issues. The study identified 10 issues in the FinTech lending sector using the Technology, Organization, and Environment (TOE) framework and 11 initiatives from implementing regulatory sandboxes using the Diffusion of Innovation (DOI) framework. Finally, this study highlights the potential for further research regarding the issues of algorithmic bias and monopolistic practices, as well as the exploration of how regulatory sandboxes can mitigate these issues.

Introduction

The development of digital technology has produced alternative financial services other than traditional financial institutions; one of the services is in the form of loan opportunities that allow borrowers to deal directly with lenders and apply for loans without temporary collateral, while lenders can evaluate loan applications using the information provided by the borrower (Chen et al., 2020). Financial technology (FinTech) lending, as this service is called, not only increases inclusiveness by providing alternative lending opportunities, but this industry has also utilized automation technology to increase operational efficiency and reduce borrowing costs (Basha et al., 2021; Vijayakumar Bharathi et al., 2023).

The COVID-19 pandemic is one cause of the growth of online solutions to meet business needs, one of which is the FinTech lending industry, which showed an increase in adoption of 64% in 2019 (Cumming et al., 2023). Apart from that, this was also driven by a decline in the loan business from traditional institutions, which was caused by crisis conditions and strict regulations, especially for small business loans (Basha et al., 2021). The characteristics of FinTech lending in the form of unsecured loans and technology to help analyze soft information are considered to increase investment returns and reduce loan costs (Liu et al., 2020). However, these unique characteristics also make it challenging for regulators to provide specific regulations to deal with possible risks (Chen et al., 2021).

E ISSN 2775-202X

The government of the Republic of Indonesia continues to strive to update the regulatory framework to face the challenges of the FinTech industry. The Indonesian Financial Services Authority issued POJK Number 10 of 2022, which states that P2P lending companies must operate as limited liability companies. Previous regulations required a minimum capital of IDR 1 billion at the time of company registration and IDR 2.5 billion at the time of company licensing has been changed to IDR 25 billion at the time of company establishment. This institution also issued SEOJK Number 19 of 2023, which states that loan interest rates in peer-to-peer (P2P) lending are limited to between 0.1% and 0.3% per day.

Currently, many jurisdictions have implemented a 'sandbox' system that allows financial technology companies to test financial technology products, and this testing will be under the supervision of financial authorities (Truby, 2020). However, the implementation and impact of regulatory sandboxes, which are intended to balance innovation and consumer protection, have varied significantly across different countries and contexts (Chemmanur et al., 2020). Several states in the US have also adopted regulatory sandboxes and expanded their functions, such as in legal and insurance services; even Utah uses regulatory sandboxes for general purposes in various fields. The role of regulatory sandboxes outside the FinTech industry has also been expanded in South Korea and the EU by implementing regulatory sandboxes in several sectors (Hemphill, 2023). In addition to providing a supervisory function in product testing, the implementation of regulatory sandboxes can also increase investment activity, as experienced by the UK, where there was a more than 6-fold increase in several companies that were able to graduate from the sandbox program (Tsang & Chen, 2022). The Indonesian Financial Services Authority has also issued POJK Number 3 of 2024 to encourage further the use of regulatory sandboxes in implementing financial technology innovations for better risk management in protecting consumers.

There are several studies related to the implementation of regulatory sandboxes and their relation to the FinTech industry, such as that conducted by Goo and Heo (2020), who successfully proved that the implementation of regulatory sandboxes could increase investment activity in the financial industry, this finding is in line with research conducted by Hellmann et al. (2024) which also successfully proved a positive impact on fundraising both directly for sandbox participants and indirectly for financial companies outside participants (Goo & Heo, 2020; Hellmann et al., 2024). Other studies that discuss the role of regulatory sandboxes in general context of the FinTech industry were conducted by Fáykiss et al. (2018), Ghahroud et al. (2021), and Just et al. (2024). These literatures discuss the implementation of regulatory sandboxes with a best practice approach from various countries selected qualitatively. Based on those studies, this paper will provide a different contribution by conducting a thematic analysis that utilizes a conceptual framework to allow for a comprehensive analysis and avoid missing essential insights (Jaakkola, 2020). This systematic review utilizes the TOE conceptual model to analyze issues related to FinTech lending adoption and uses the DOI conceptual model to identify regulatory sandbox initiatives to address these issues. Thus, this study aims to answer the following research questions:

RQ1: What issues are discussed across various jurisdictions in the FinTech lending sector?

RQ2: How does the regulatory sandbox initiative facilitate the diffusion of innovation in the FinTech lending sector?

Literature Review

Financial Technology (FinTech) integrates financial services with technological innovation to create new products and services, and one kind of industry is the FinTech lending service (Jinasena et al., 2023). FinTech lending or Peer-to-peer (P2P) lending is a financial industry that allows individuals to carry out money lending and borrowing transactions with each other, which is facilitated by a digital platform. This industry enables prospective lenders to bear the financial risk of loan default without any collateral required for prospective borrowers (Bastani et al., 2019). The interest rate in P2P lending is determined based on the risk associated with the borrower. Higher interest rates are assigned to borrowers who are riskier and have a high likelihood of default (Klein et al., 2023). In addition, with its initial target being a market that has yet to be served by conventional financial institutions, this strategy allows the P2P lending platform to reach a broader

market segment (Najaf et al., 2022). The difference between the P2P lending business model and traditional institutional lending is illustrated in Figure 1.

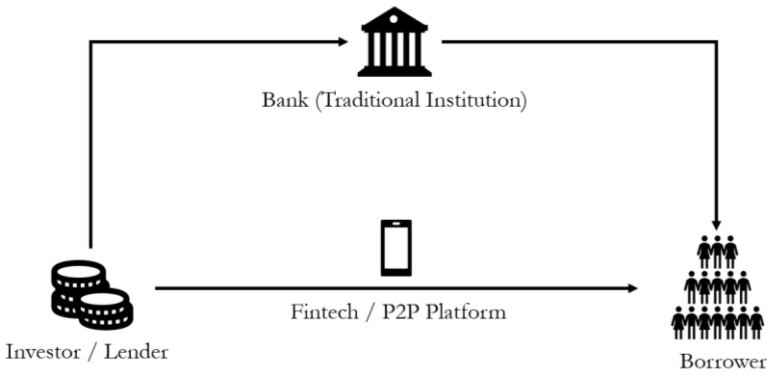

Figure 1. FinTech Lending Business Model

The regulatory sandbox implementation started before the increasing trend of financial technology. Previously, the initiative was implemented in various industries, such as medical and IT environments (Butor-Keler & Polasik, 2020). Nowadays, several countries have explored using a regulatory sandbox to respond to the challenges faced along with technological advances in various business sectors. This initiative allows companies to test new financial technology products and services and provides an opportunity for governments to produce regulations that can accommodate specific business models and technical complexities (Washington et al., 2022). In addition, this initiative will support the development of new financial technology products and help build consumer trust by demonstrating that these products are tested under strict regulatory oversight (Allayarov et al., 2020).

Researchers have used the technological, organizational, and environmental (TOE) framework as a structured approach to assess the critical factors influencing technology adoption and adoption effectiveness (Chang et al., 2024). Although the framework is commonly used in software adoption research, it is also applied in various innovation adoption contexts (Masood & Egger, 2019). Sampat et al. (2024) used the framework to identify challenges related to FinTech adoption. The technological dimension describes how financial technology operates in a highly regulated industry, the organizational dimension relates to the start-up industry as emerging companies, and the environmental dimension highlights the context of developing countries with financial exclusion. The study used the framework to map the challenge into three types: regulatory irresponsibility, technical incompetence, and consumer vulnerability (Sampat et al., 2024).

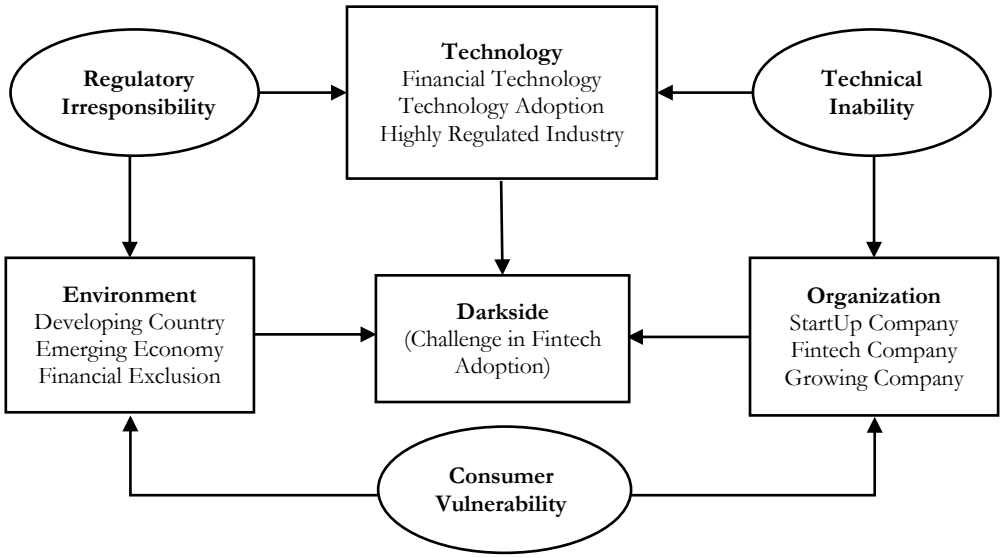

Figure 2. TOE Framework for Challenge in FinTech Adoption (Sampat et al., 2024)

Research on how innovation spreads in a social system is often conducted using the Diffusion of Innovation (DOI) framework, developed by Everett Rogers. The framework explains how new ideas and technologies spread in a population group (Crema et al., 2024). In empirical research, the DOI model is often used to measure the spread of innovation. This spread is generally categorized into five groups: innovators, early adopters, early majority, late majority, and laggards (Iqbal & Zahidie, 2022). In addition, this framework can also be used to study the factors that influence efforts to facilitate the spread of technological innovation. The framework includes relative advantage as the perceived benefits of an innovation, the innovation's fit with current technology or values, complexity in terms of how challenging the innovation is to adopt, testability in terms of how potential users can try the innovation, and observability as how easy it is for users to observe the innovation and the benefits it can provide (Koloseni & Mandari, 2024).

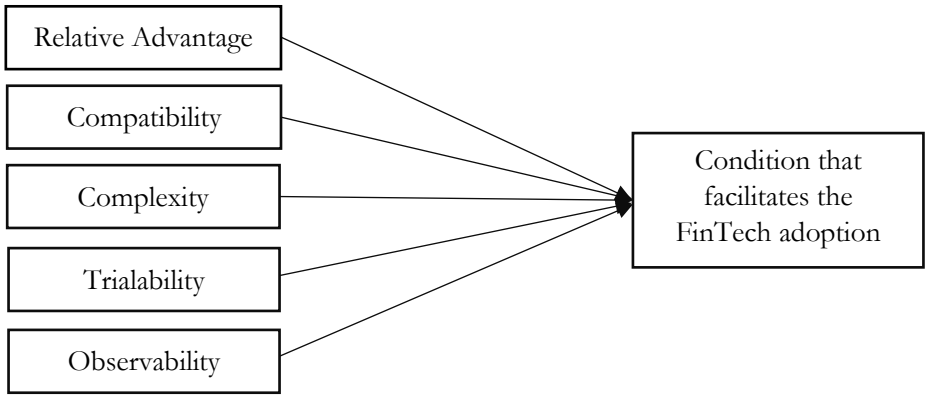

Figure 3. DOI Framework in FinTech Adoption (Koloseni & Mandari, 2024)

Several studies have integrated the TOE and DOI frameworks with various integration models to improve the quality of research. Hiran and Henten (2020) and Alkhalil et al. (2017) used this integration model to analyze the adoption of cloud computing technology. Both literatures use different variations of the TOE and DOI framework integration, where Hiran and Henten (2020) integrated the model to produce four research dimensions, including technology, environment, organization, and socio-culture, to analyze the adoption of cloud computing in higher education environments (Hiran & Henten, 2020), while Alkhalil et al. (2017) used this integration model to produce four research dimensions including technology, environment, organization, and innovation characteristics, to analyze the adoption of cloud computing in various organizations (Alkhalil et al., 2017). Research with a different context was conducted by Basloom et al. (2022), where this integration model was used to analyze the behavior of civil service officials to the innovation in administrative processes by forming five dimensions, including top management, use of IT, political aspect, quality of the member, and budget management (Basloom et al., 2022).

Research Methods

Various literature review methodologies, such as systematic, semi-systematic, and integrative, can be used in scientific writing. In addition, there are some approaches for extracting the information, including qualitative, quantitative, or mixed, depending on the specific research question (Snyder, 2019). The authors employed a systematic literature review (SLR) methodology in this study, as the method has a structured and transparent sample selection process to produce a comprehensive review (Hiebl, 2023). The study also integrated TOE and DOI frameworks into the SLR method, which is used as a guideline to ensure a more comprehensive understanding of the literature analysis process.

The authors used Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), a set of evidence-based guidelines, to improve the identification, screening, and reporting process (Hiebl, 2023). The initial stage of the PRISMA protocol involves identifying records, which is crucial in systematic reviews. This study utilized electronic searches in databases like Scopus, ScienceDirect, and ProQuest, which are known for their comprehensive coverage of relevant scientific fields.

The set of keywords was developed to construct an effective search strategy for precise literature retrieval. The primary variable of keywords was represented as 'REGULATORY SANDBOX'. The second segment focused more on the context and was defined as ('FINANCIAL TECHNOLOGY' OR 'FINTECH' OR 'PEER-TO-PEER' OR 'P2P') AND 'LENDING'. The ultimate search query was a combination of both segments: 'REGULATORY SANDBOX' AND (('FINANCIAL TECHNOLOGY' OR 'FINTECH' OR 'PEER-TO-PEER' OR 'P2P') AND 'LENDING'). Next, the search criteria encompassed inclusion (IN) and exclusion (EX) parameters, which ensure the expected outcomes of the systematic review process, as detailed in Table 1.

Table 1. Search Criteria

Type	Criteria	Code
Inclusion	Articles published from 2019 to 2024	IN1
	Articles are written in English	IN2
	Articles published in international journals	IN3
	Articles related to fintech and/or regulatory sandbox	IN4
Exclusion	Articles in formats other than journal	EX1
	Full-text access is not available	EX2
	Duplicate studies	EX3

Table 2. Quality Assessment Questions

Criteria	Code
Q1	Does the article describe the research objectives clearly?
Q2	Does the article specifically discuss issues in a particular country?
Q3	Is the article published in Q1, Q2, Q3, and Q4 Scopus-indexed journals?

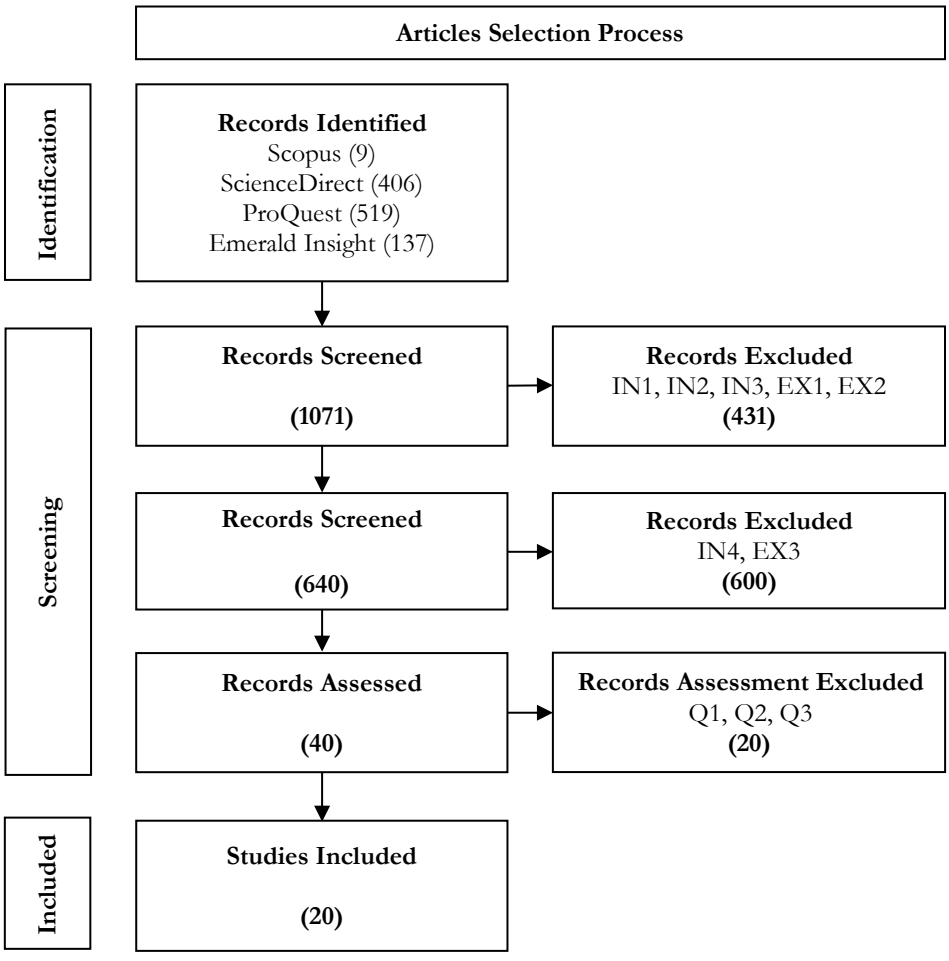

Figure 4. Article Selection Process

The article selection process began by identifying records from various databases. This process resulted in 1071 records: 9 from Scopus, 406 from ScienceDirect, 519 from ProQuest, and 137 from Emerald Insight. All literature was evaluated during the first screening phase, excluding 431 records due to pre-defined inclusion (IN1, IN2, IN3) and exclusion (EX1, EX2), leaving 640 records. These 640 records were further reviewed in the second screening phase, excluding 600 records for additional inclusion (IN4) and exclusion (EX3). After completing the screening phase, the authors used quality assessment criteria to evaluate the remaining 40 articles. Table 2 contains three questions used for qualitative assessment. The assessment focused on the appropriateness of the research objectives and conclusions and the quality of the journal index in which the article was published. After the screening and quality assessment process, 20 publications were identified that met the criteria as listed in Table 3.

Table 3. Selected Articles

Code	Author-Year	Journal Name	Publisher	Indexation
a1	(Huang & Wang, 2023)	European Business Organization Law Review	Springer	Scopus Q1
a2	(Sarabdeen, 2023)	International Journal of Law and Management	Emerald Group	Scopus Q2
a3	(Aloulou et al., 2024)	Journal of Financial Reporting and Accounting	Emerald Group	Scopus Q2
a4	(McCarthy, 2023)	Journal of Financial Regulation and Compliance	Emerald Group	Scopus Q3
a5	(Mohd Haridan et al., 2023)	Journal of Islamic Accounting and Business Research	Emerald Group	Scopus Q2
a6	(Arslan et al., 2022)	Journal of Small Business and Enterprise Development	Emerald Group	Scopus Q1
a7	(Bayram et al., 2022)	Sustainability	MDPI	Scopus Q1
a8	(Rupeika-Apoga & Wendt, 2022)	Risks	MDPI	Scopus Q2
a9	(Hesekova Bojmirova, 2022)	Juridical Tribune	Bucharest Univ.	Scopus Q2
a10	(Gerlach et al., 2019)	Credit and Capital Markets	Duncker und Humblot	Scopus Q3
a11	(Bejar et al., 2022)	Latin American Journal of Central Banking	Elsevier B.V.	Scopus Q3
a12	(Suryono et al., 2021)	Heliyon	Elsevier B.V.	Scopus Q1
a13	(Lee & Seo, 2022)	Technological Forecasting & Social Change	Elsevier B.V.	Scopus Q1
a14	(Kaur et al., 2024)	Global Finance Journal	Elsevier B.V.	Scopus Q1
a15	(Saklain, 2024)	International Review of Financial Analysis	Elsevier B.V.	Scopus Q1
a16	(Sunio et al., 2023)	Global Transitions	KeAi Comm. Co	Scopus Q1
a17	(Peón et al., 2024)	Research in International Business and Finance	Elsevier B.V.	Scopus Q1
a18	(Nguyen & Dang, 2022)	Research in Globalization	Elsevier B.V.	Scopus Q1
a19	(Molla & Biru, 2023)	Technological Forecasting & Social Change	Elsevier B.V.	Scopus Q1
a20	(Kemal Tosun et al., 2023)	Journal of International Financial Markets, Institutions & Money	Elsevier B.V.	Scopus Q1

Results and Discussion

The authors began discussing this research by examining research trends before delving into the main research questions. Table 4 compiles the distribution of regions and publication years of the observed literature. This process aimed to understand whether there are certain trends related to the discussion of implementing regulatory sandboxes in facilitating FinTech lending.

Table 4. Countries of Observation

Code	Country	Region	Year
a1	China	Asia	2023
a2	Arabia	Asia	2023
a3	United Arab Emirates	Asia	2023
a4	United Kingdom	Europe	2022
a5	Malaysia	Asia	2023
a6	Sub-Saharan Africa	Africa	2021
a7	Turkey	Europe	2022
a8	Latvia	Europe	2022
a9	Slovakia	Europe	2022
a10	Germany	Europe	2019
a11	America Latin	America	2022
a12	Indonesia	Asia	2021
a13	Korea	Asia	2022
a14	India	Asia	2024
a15	Australia	Oceania	2024
a16	Philippine	Asia	2023
a17	Spain	Europe	2024
a18	Vietnam	Asia	2022
a19	Africa	Africa	2023
a20	United States	America	2023

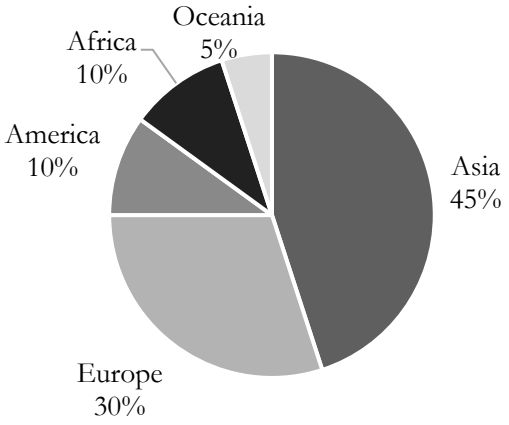

Figure 5. Distribution of Observation Regions

Figure 5 provides information on the regional distribution of observations. Asia has the highest count with nine articles, followed by Europe with six articles. America and Africa have two articles, and Oceania has the fewest with one article.

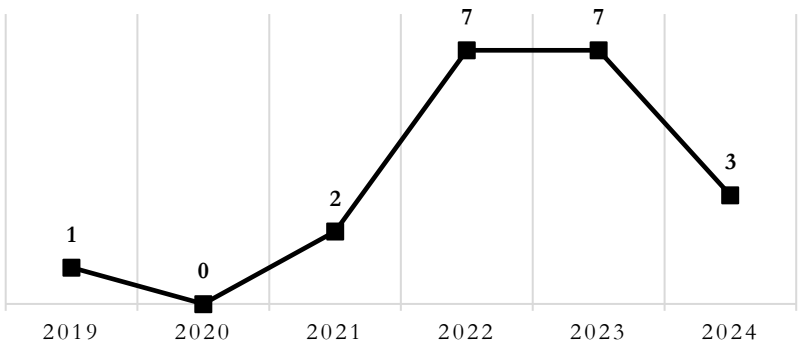

Figure 6. Publication Trends Over the Years

In time dimension, the publication year of these articles was classified to identify trends over time. Figure 6 displays the number of articles published yearly from 2020 to 2024. The fluctuation in the number of articles published each year peaks in 2022, followed by a decline in the following years. Figure 7 further illustrates the relationship between regions and the publication year of the analyzed articles. In particular, there is a substantial increase in publications from 2021 to 2022, with Europe leading during this period. The trend remains consistent in 2023, with Asia emerging as the leading region. For 2024, there is still a possibility of growth in the number of publications because this study was conducted before mid-2024.

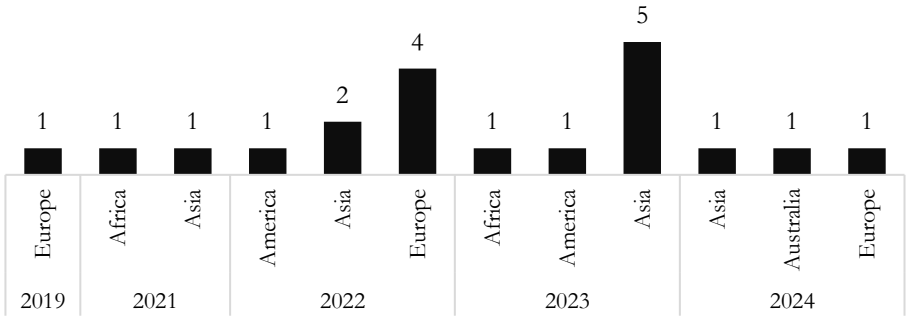

Figure 7. Distribution of Publication

The authors used the conceptual model of the TOE model adoption created by Sampat et al. (2024) to answer the first research question. This conceptual model mapped the dimensions of issues in FinTech lending adoption into three categories: *technical inability*, *consumer vulnerability*, and *regulatory irresponsibility* (Sampat et al., 2024). Qualitative methods were employed in analyzing the issues discussed in the articles, and these issues were quantified based on predetermined dimensions, as shown in Table 5.

Table 5. Issues of FinTech Lending Adoption

Dimensions	Issue Codes	Issues	Article Codes	Total
Technical Inability	i1a	Cybersecurity Risk	a1, a2, a3, a4, a5, a8, a11	7
	i1b	Technological Infrastructure	a1, a5, a6, a12, a13, a16, a19	7
	i1c	Reputation Risk	a2, a4, a5, a7, a9	5
	i1d	Algorithmic Bias	a1, a2, a4	3
Consumer Vulnerability	i2a	Financial Systemic Risk	a1, a10, a15 a18, a20	5
	i2b	Data Privacy Risk	a1, a2, a5, a11, a12, a13	6
	i2c	Credit Risk	a1, a7, a12, a14, 18	5
Regulatory Irresponsibility	i3a	Compliance Challenges	a1, a2, a4, a8, a10, a19	6
	i3b	Regulatory Requirement	a1, a2, a4, a8, a9, a10	6
	i3c	Monopolistic Practices	a1, a17	2

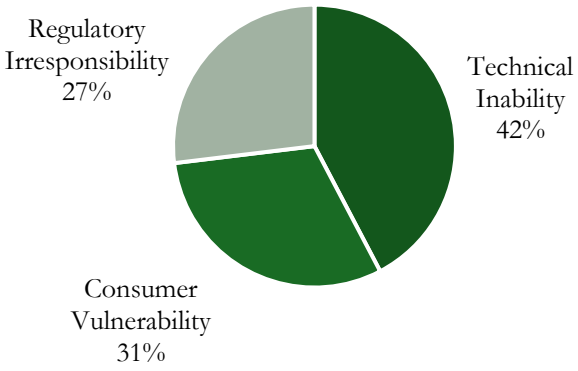

Figure 8. Distribution of Issues Dimension

As shown in Figure 8, this study found that *technical inability* context is a significant issue in adopting FinTech lending, as mentioned in 42% of the articles. The *cybersecurity risk* is usually about accessing sensitive information, especially user accounts (Aloulou et al., 2024), and it becomes more critical when the system relies on cloud computing and outsourcing services (Rupeika-Apoga & Wendt, 2022). Cybersecurity incidents can easily weaken stakeholder trust, undermine regulator credibility (Mohd Haridan et al., 2023), and impact the financial system (Huang & Wang, 2023). Large FinTech firm also have to invest heavily in robust database and sopistichated *technological infrastructure* (Huang & Wang, 2023; Suryono et al., 2021). This infrastructure supports advanced capabilities such as big data analysis, enabling rapid recording and sharing of large amounts of data among participants despite concerns about potential security breaches (Mohd Haridan et al., 2023). Additionally, integrating blockchain, artificial intelligence, and cloud computing lowers operational costs and drives innovation in this sector (Arslan et al., 2022; Sunio et al., 2023). However, challenges persist, including inadequate infrastructure (Suryono et al., 2021), a poor business environment, and insufficient human resource development, all of which can hinder the adoption of technology (Arslan et al., 2022; Sunio et al., 2023). Additionally, incorrect assumptions from regulators, such as those regarding the technical incompetence of the regulated entity, can impact *reputation risk* (Hesekova Bojmirova, 2022). Another challenge in technical inability is *algorithmic bias*, often related to the quality in the modeling process (Sarabdeen, 2023). When algorithms use biased data, they can make decisions that unfairly disadvantage certain borrower groups. Moreover, the algorithms' design can also introduce bias (Huang & Wang, 2023) and create an impression of a lack of transparency (McCarthy, 2023).

The second issue concerns about *consumer vulnerability*, accounting for 31% of the articles. The *financial systemic risk* in the FinTech industry refers to the operational dependency between institutions, which carries the risk that an operational failure could have systemic impacts (Gerlach et al., 2019; Huang & Wang, 2023; Molla & Biru, 2023) Although a study states that FinTech companies do not have a major impact on systemic risk, they are vulnerable to systemic shocks (Saklain, 2024), thus requiring an appropriate response when facing such conditions (Kemal Tosun et al., 2023). Another significant challenge is *data privacy risks* related to consumer data, financial information, and transactions (Bejar et al., 2022; Suryono et al., 2021), which are vulnerable to unauthorized access and illegal activities (Huang & Wang, 2023). These risks include data manipulation, privacy violations, and a lack of accountability and transparency in handling user data (Lee & Seo, 2022; Sarabdeen, 2023). FinTech companies must also consider that the *credit risk* management capabilities of some existing financial institutions are relatively poor (Bayram et al., 2022; Huang & Wang, 2023). Although FinTech lending is typically associated with leveraging technology to address these issues (Kaur et al., 2024), there is a need to educate lenders about credit risk, particularly in P2P lending (Suryono et al., 2021).

Third, *regulatory irresponsibility* in the FinTech lending sector, highlighted in 27% of articles, underscores the critical issue of inadequate regulatory oversight (Hesekova Bojmirova, 2022; Huang & Wang, 2023). FinTech lending adoption presents unique *compliance challenges*, particularly in meeting regulatory requirements that differ significantly from those governing traditional financial institutions (Rupeika-Apoga & Wendt, 2022), often leading to market entry barriers (Gerlach et al., 2019). These challenges include accurately recording transaction data involving multiple parties, simplifying reporting processes for compliance and operational efficiency, and managing risks associated with automated decision-making technologies (McCarthy, 2023; Sarabdeen, 2023). *Regulatory requirements* cover a broad range of rules, regulations, and standards set by authorities that FinTech companies must comply with (Huang & Wang, 2023; Sarabdeen, 2023). These requirements address various aspects of legal compliance related to finances, organizational structure, and personnel, all crucial for ensuring adherence to applicable regulations (Gerlach et al., 2019; Rupeika-Apoga & Wendt, 2022). Issues concerning regulatory requirements arise particularly during shifts in financial activities undertaken by market players (Molla & Biru, 2023). Another critical regulatory concern relates to the *monopolistic practices* of FinTech lending companies, which have the potential to harm financial institutions, hinder competition, and increase costs for consumers (Huang & Wang, 2023; Peón et al., 2024).

To answer the second research question, the authors employed the DOI model as utilized by Koloseni and Mandari (2024). This conceptual model was used to assess the conditions facilitating FinTech adoption, encompassing dimensions such as *relative advantage*, *complexity*, *compatibility*, *trialability*, and *observability* (Koloseni & Mandari, 2024). As mentioned in the articles, the initiative of regulatory sandboxes was identified using qualitative methods. These initiatives are mapped against the key issues of FinTech lending adoption as identified in the previous analysis, as shown in Table 6.

Table 6. Regulatory Sandbox Initiative

Dimensions	Sandbox Initiatives	Article Codes	Issues
Relative Advantage	a. Fostering Market Entry and Scalability	a1, a9, a14	i2a, i3c
	b. Enhancing Competition	a1, a17	i2a, i3c
	c. Fostering a Culture of Innovation	a1, a3, a6, a8, a9	i1a, i1b, i2b, i2c
Complexity	a. Regulatory Guidance	a1, a2, a4, a8, a9, a10, a12	i2a, i3a, i3b
	b. Streamlining the complex process	a1, a2, a4, a8, a10	i2a, i3a, i3b
Compatibility	a. Cross-Border Collaboration	a1, a2, a5, a7, a8, a9, a11, a13	i1c, i3a, i3b
	b. Technological Infrastructure Guidance	a1, a2, a4, a5, a12	i1a, i1b, i1d, i2b, i2c
Trialability	a. Safe Testing Environment	a1, a2, a7, a8, a9, a19	i1a, i1b, i1d, i2b, i2c
	b. Evaluation Feedback	a2, a10	i1b, i1c
Observability	a. Knowledge Sharing	a2, a13	i1b, i3a, i3b
	b. Impact Measurement	a4, a9, a15	i2a, i3a, i3b

Through the analysis of selected articles, the author identified eleven regulatory sandbox initiatives and categorized them using the DOI framework. The first initiative, highlighting the *relative advantage*, promotes financial innovation and enhances market competition (Hesekova Bojmirova, 2022; Huang & Wang, 2023) . It also increases FinTech adoption in underserved rural areas (Kaur et al., 2024; Peón et al., 2024). Countries implementing sandbox regulatory policies benefit by positioning themselves as supportive environments for technological progress in the financial services market (Aloulou et al., 2024; Mohd Haridan et al., 2023). These policies also provide standards for risk mitigation (Hesekova Bojmirova, 2022; Rupeika-Apoga & Wendt, 2022), and prevent large companies from unfairly using their technological advantages to harm competitors or control the market (Huang & Wang, 2023; Peón et al., 2024).

The regulatory sandbox was also created to develop licensing solutions for the *complex* rules governing FinTech companies, particularly those arising from various partnerships involving multiple institutions (Huang & Wang, 2023). This approach allows for bottom-up standardization, although top-down standardization remains necessary for formalised guidance (McCarthy, 2023; Suryono et al., 2021). Additionally, all participants must comply with existing key consumer protection regulations (Gerlach et al., 2019). Regulatory sandboxes facilitate the review of existing regulations (Hesekova Bojmirova, 2022; Rupeika-Apoga & Wendt, 2022), streamlining the complex process for multiple regulators and ensuring compliance requirements are met without compromising the efficacy of reporting (Sarabdeen, 2023).

In terms of *compatibility*, companies often rely on third-party service providers to connect with large financial institutions, making their failure a potential source of systemic financial risk. Therefore, regulations are necessary to monitor and control default and systemic risks (Rupeika-Apoga & Wendt, 2022). Inadequate credit risk analysis poses significant risks (Bayram et al., 2022). While technology can address these issues, it introduces challenges related to the inherent lack of transparency in automated or algorithmic processes (Huang & Wang, 2023; McCarthy, 2023). This creates a pressing need for regulatory mechanisms to mitigate algorithm bias and protect customers from potential losses (Sarabdeen, 2023). Regulatory sandbox used to provide clear guidance on

FinTech infrastructure and operational practices (Suryono et al., 2021). Therefore, implementing regulatory sandboxes requires an understanding of digital infrastructure (Mohd Haridan et al., 2023). Additionally, sandbox regulations may include requirements for regular reviews of implemented systems, specifically to assess their vulnerability to cyber threat (McCarthy, 2023).

The *trialability* of regulatory sandboxes refers to the innovative testing environment provided by a country's regulatory agency for new business models not covered by existing regulations (Huang & Wang, 2023; Molla & Biru, 2023). It allows for the use of real market data and feedback from participating consumers in a controlled environment to evaluate products (Gerlach et al., 2019; Sarabdeen, 2023). Under the sandbox regulatory framework, unauthorized companies using innovative technology are permitted to test new products and services through customized processes and subsequently gain authorization (Huang & Wang, 2023).

Regulatory sandboxes encourage *observability* through active dialogue between regulators and the entities under their supervision. This interaction allows regulated companies to better understand the regulatory framework, while regulators gain insight into the challenges faced by emerging technology businesses (Lee & Seo, 2022). Regulatory sandboxes offer a realistic assessment of the actual impact of financial innovations and address information asymmetries through interactions between regulators and entities (Hesekova Bojmirova, 2022). They have the potential to transform industrial operational monitoring mechanisms within the regulatory sandbox (Sarabdeen, 2023). An empirical study shows that firms under regulatory supervision are generally less vulnerable to systemic shocks (Saklain, 2024).

To maximize the benefits of regulatory sandboxes, it is recommended to leverage their relative advantage to foster a competitive and inclusive financial ecosystem. This approach ensures that innovative solutions reach underserved rural areas and give small market players a fair chance to compete. Streamlining the compliance process within these sandboxes, such as bottom-up initiatives, will enable regulators to navigate regulatory requirements efficiently, fostering innovation while maintaining robust consumer protection. Additionally, addressing compatibility through regulatory sandboxes is crucial to ensure that FinTech innovations remain strong and secure, thereby reducing potential financial system vulnerabilities. Encouraging the trialability aspect of regulatory sandboxes will allow FinTech companies to experiment and refine their innovations in a controlled environment, minimizing the risk of market entry and promoting creative solutions. Finally, enhancing observability within regulatory sandboxes will encourage transparency and trust between regulators and FinTech companies, leading to better regulatory practices and more resilient financial innovations.

Implication and Conclusion

This study aimed to improve understanding of regulatory sandbox initiatives in addressing challenges in the growth of the FinTech Lending industry. The analysis used the TOE framework to identify issues related to FinTech lending adoption, followed by analysing regulatory sandbox initiatives with the DOI framework to address those issues. The study begins by observing the trend of publications discussing related topics, and based on selected documents, it shows a significant increase in 2022. Europe dominated the publication in 2022, and the number remained relatively stable the following year but was dominated by Asia. This study has revealed that the regulatory sandbox initiative, in the context of FinTech lending adoption, encourages a competitive and inclusive financial ecosystem by making compliance easier while still paying attention to security and risk management. In addition, this initiative also encourages innovation through controlled experiments and promotes transparency and trust between regulators and FinTech companies.

Technical inability was the most commonly discussed issue, reflecting the increasing trend in the FinTech industry driven by technological innovation. Notable findings on algorithmic bias issues reveal a limited number of articles, with only three articles explicitly discussing these concerns. Algorithmic bias refers to unfair outcomes resulting from biased data and inadequate algorithm design. Regulators may propose standards for evaluating AI algorithms and the data used to ensure criteria such as security, transparency, and fairness (Huang & Wang, 2023; McCarthy,

2023). Another perspective emphasizes the importance of avoiding complete reliance on algorithmic decisions without human intervention to understand the underlying reasons behind decision-making (Sarabdeen, 2023).

In addition, significant insight was gained regarding irresponsible regulations, highlighting issues related to monopolistic practice discussed in only two articles. Monopoly practice within the FinTech market refer to the substantial resources invested by BigTech firms, which give them a competitive advantage in forming business partnerships with financial institutions and accessing comprehensive networks, leading to rapid growth. This condition creates barriers to entry into the sector and opportunities to control prices (Huang & Wang, 2023). Regulatory responses, such as anti-monopolistic regulations, aim to prevent these practices and ensure fair competition and consumer protection. Regulatory sandboxes are an example of a policy initiative that promotes equal competition for FinTech companies. By providing a supportive regulatory environment, sandboxes enable these firms to compete effectively with established players, including FinTech ventures owned by traditional banks. This support is crucial for driving innovation and enhancing competitiveness within the FinTech sector (Peón et al., 2024).

For further research, the limitations of research produced in several regions such as America, Africa, and Oceania are interesting to study further regarding whether the lack of literature indicates low development of FinTech adoption in the region. In terms of thematic studies, more discussion is needed regarding algorithmic bias and monopolistic practices. Further research can focus on algorithmic regulatory standards to reduce bias and how monopolistic practices and market concentration affect user acceptance and applicable interest rates. Furthermore, it can be linked to ethical implications, especially regarding data privacy, transparency, and accountability. In addition, the literature selection method used in this study also has limitations that can be gaps for further research. Although guided by the highly structured PRISMA 2020 methodology, this literature review still allows for high-quality literature that was not selected, mainly due to the limitations of the database used.

Acknowledgment

The completion of this research would not have been possible without the valuable financial support from the Ministry of Communication and Informatics (KOMINFO) through the "KOMINFO Master Degree Scholarship" program. The authors are grateful to the institution for the funding, which was critical to the success of this project.

References

Alkhalil, A., Sahandi, R., & John, D. (2017). An exploration of the determinants for decision to migrate existing resources to cloud computing using an integrated TOE-DOI model. *Journal of Cloud Computing*, *6*(2), 1-20. https://doi.org/10.1186/s13677-016-0072-x

Allayarov, Sh., Mirzamakhmudov, M., & Mirzamakhmudova, M. (2020). Analysis of regulatory sandbox in the Netherlands that promote development of innovative fintech start-ups. *International Finance and Accounting*, 2020(3), 1-13. https://uzjournals.edu.uz/interfinance/vol2020/iss3/34

Aloulou, M., Grati, R., Al-Qudah, A. A., & Al-Okaily, M. (2024). Does fintech adoption increase the diffusion rate of digital financial inclusion? A study of the banking industry sector. *Journal of Financial Reporting and Accounting*, *22*(2), 289–307. https://doi.org/10.1108/JFRA-05-2023-0224

Arslan, A., Buchanan, B. G., Kamara, S., & Al Nabulsi, N. (2022). Fintech, base of the pyramid entrepreneurs and social value creation. *Journal of Small Business and Enterprise Development*, *29*(3), 335–353. https://doi.org/10.1108/JSBED-10-2020-0370

Basha, S. A., Elgammal, M. M., & Abuzayed, B. M. (2021). Online peer-to-peer lending: A review of the literature. *Electronic Commerce Research and Applications*, *48,* 101069. https://doi.org/10.1016/j.elerap.2021.101069

Basloom, R. S., Sani Mohamad, M. H., & Auzair, S. M. (2022). Applicability of public sector reform initiatives of the Yemeni government from the integrated TOE-DOI framework. *International Journal of Innovation Studies*, *6*(4), 286–302. https://doi.org/10.1016/j.ijis.2022.08.005

Bastani, K., Asgari, E., & Namavari, H. (2019). Wide and deep learning for peer-to-peer lending. *Expert Systems with Applications*, *134*, 209–224. https://doi.org/10.1016/j.eswa.2019.05.042

Bayram, O., Talay, I., & Feridun, M. (2022). Can fintech promote sustainable finance? Policy lessons from the case of Turkey. *Sustainability (Switzerland)*, *14*(19), 12414. https://doi.org/10.3390/su141912414

Bejar, P., Ishi, K., Komatsuzaki, T., Shibata, I., Sin, J., & Tambunlertchai, S. (2022). Can fintech foster competition in the banking system in Latin America and the Caribbean? *Latin American Journal of Central Banking*, *3*(2), 100061. https://doi.org/10.1016/j.latcb.2022.100061

Butor-Keler, A., & Polasik, M. (2020). The role of regulatory sandboxes in the development of innovations on the financial services market: The case of the United Kingdom. *Ekonomia i Prawo*, *19*(4), 621. https://doi.org/10.12775/eip.2020.041

Chang, H. H., Lu, M. T., Huang, L. H., Ling, H. F., & Yen, Y. C. (2024). Assessing the diffusion of fintech innovation in financial industry: Using the rough MCDM model. *Technological and Economic Development of Economy*, *30*(1), 261–286. https://doi.org/10.3846/tede.2024.20260

Chemmanur, T. J., Imerman, M. B., Rajaiya, H., & Yu, Q. (2020). Recent developments in the fintech industry. *Journal of Financial Management, Markets and Institutions*, *8*(01), 20400022. https://doi.org/10.1142/S2282717X20400022

Chen, D., Deakin, S., Johnston, A., & Wang, B. (2021). Too much technology and too little regulation? The spectacular demise of P2P lending in China. *Accounting, Economics and Law: A Convivium*, 1-48 https://doi.org/10.1515/ael-2021-0056

Chen, X., Huang, B., & Ye, D. (2020). Gender gap in peer-to-peer lending: Evidence from China. *Journal of Banking and Finance*, *112,* 105633. https://doi.org/10.1016/j.jbankfin.2019.105633

Crema, E. R., Bloxam, A., Stevens, C. J., & Vander Linden, M. (2024). Modelling diffusion of innovation curves using radiocarbon data. *Journal of Archaeological Science*, *165,* 105962. https://doi.org/10.1016/j.jas.2024.105962

Cumming, D., Johan, S., & Reardon, R. (2023). Global fintech trends and their impact on international business: A review. *Multinational Business Review, 31*(3), 413–436. https://doi.org/10.1108/MBR-05-2023-0077

Fáykiss, P., Papp, D., Sajtos, P., & Tőrös, Á. (2018). Regulatory tools to encourage fintech innovations: The innovation hub and regulatory sandbox in international practice. *Financial and Economic Review*, *2017*(2), 43–67. https://doi.org/10.25201/fer.17.2.4367

Gerlach, J. M., Rugilo, D., & Sc, M. (2019). The predicament of fintechs in the environment of traditional banking sector regulation – An analysis of regulatory sandboxes as a possible solution. *Credit and Capital Markets*, *52*(3), 323–373. https://doi.org/10.1108/MBR-05-2023-0077

Ghahroud, M. L., Ebrahimiyan, N., Bastani, S., Abadi, A., Jafari, F., & Tajdini, S. (2021). The sandbox approach. *Journal of FinTech and Artificial Intelligence, 1*(1), 3-3. https://doi.org/10.47277/JFAI/1(1)022

Goo, J. J., & Heo, J. Y. (2020). The impact of the regulatory sandbox on the fintech industry, with a discussion on the relation between regulatory sandboxes and open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(2), 43. https://doi.org/10.3390/JOITMC6020043

Hellmann, T., Montag, A., & Vulkan, N. (2024). The impact of the regulatory sandbox on the fintech industry. *SSRN 4187295*, 1-52. https://dx.doi.org/10.2139/ssrn.4187295

Hemphill, T. A. (2023). Technology entrepreneurship and innovation hubs: Perspectives on the universal regulatory sandbox. *Science and Public Policy*, *50*(2), 350–353. https://doi.org/10.1093/scipol/scac072

Hesekova Bojmirova, S. (2022). Fintech and regulatory sandbox – New challenges for the financial market: The case of the Slovak Republic. *Juridical Tribune*, *12*(3), 399–411. https://doi.org/10.24818/TBJ/2022/12/3.06

Hiebl, M. R. W. (2023). Sample selection in systematic literature reviews of management research. *Organizational Research Methods, 26*(2), 229–261. https://doi.org/10.1177/1094428120986851

Hiran, K. K., & Henten, A. (2020). An integrated TOE–DOI framework for cloud computing adoption in the higher education sector: Case study of Sub-Saharan Africa, Ethiopia. *International Journal of System Assurance Engineering and Management*, *11*(2), 441–449. https://doi.org/10.1007/s13198-019-00872-z

Huang, R. H., & Wang, C. M. (2023). Fintech-bank partnership in China's credit market: Models, risks and regulatory responses. *European Business Organization Law Review*, *24*(4), 721–755. https://doi.org/10.1007/s40804-023-00269-3

Iqbal, M., & Zahidie, A. (2022). Diffusion of innovations: A guiding framework for public health. *Scandinavian Journal of Public Health*, *50*(5), 533–537. https://doi.org/10.1177/14034948211014104

Jaakkola, E. (2020). Designing conceptual articles: Four approaches. *AMS Review*, *10*(1–2), 18–26. https://doi.org/10.1007/s13162-020-00161-0

Jinasena, D. N., Spanaki, K., Papadopoulos, T., & Balta, M. E. (2023). Success and failure retrospectives of fintech projects: A case study approach. *Information Systems Frontiers, 25,* 259-274. https://doi.org/10.1007/s10796-020-10079-4

Just, S. N., Sivertsen, M. F., & Lewin, S. (2024). Open for business: The discursive diffusion of regulatory sandboxes for fintech innovation. *Journal of Cultural Economy*, *17*(3), 360–378. https://doi.org/10.1080/17530350.2023.2282131

Kaur, M., Ahmad, W., Hari, K. S., & Kattumuri, R. (2024). Fintech entrepreneurial ecosystem in India: Role of incubators and accelerators. *Global Finance Journal*, *60,* 100933. https://doi.org/10.1016/j.gfj.2024.100933

Kemal Tosun, O., Eshraghi, A., & Muradoglu, G. (2023). Learning financial survival from disasters. *Journal of International Financial Markets, Institutions and Money*, *85,* 101778. https://doi.org/10.1016/j.intfin.2023.101778

Nguyen, Q. K., & Dang, V. C. (2022). The effect of fintech development on financial stability in an emerging market: The role of market discipline. *Research in Globalization*, *5,* 100105. https://doi.org/10.1016/j.resglo.2022.100105

Klein, G., Shtudiner, Z., & Zwilling, M. (2023). Why do peer-to-peer (P2P) lending platforms fail? The gap between P2P lenders' preferences and the platforms' intentions. *Electronic Commerce Research*, *23*(2), 709–738. https://doi.org/10.1007/s10660-021-09489-6

Koloseni, D., & Mandari, H. (2024). Expediting financial inclusion in Tanzania using fintech: The perspective of diffusion of innovation theory. *Technological Sustainability*, *3*(2), 171–194. https://doi.org/10.1108/TECHS-11-2023-0048

Lee, S., & Seo, Y. (2022). Exploring how interest groups affect regulation and innovation based on the two-level games: The case of regulatory sandboxes in Korea. *Technological Forecasting and Social Change*, *183,* 121880. https://doi.org/10.1016/j.techfore.2022.121880

Liu, Z., Shang, J., Wu, S. yi, & Chen, P. yu. (2020). Social collateral, soft information and online peer-to-peer lending: A theoretical model. *European Journal of Operational Research*, *281*(2), 428–438. https://doi.org/10.1016/j.ejor.2019.08.038

Masood, T., & Egger, J. (2019). Augmented reality in support of Industry 4.0—Implementation challenges and success factors. *Robotics and Computer-Integrated Manufacturing*, *58*, 181–195. https://doi.org/10.1016/j.rcim.2019.02.003

McCarthy, J. (2023). The regulation of regtech and suptech in finance: Ensuring consistency in principle and in practice. *Journal of Financial Regulation and Compliance*, *31*(2), 186–199. https://doi.org/10.1108/JFRC-01-2022-0004

Mohd Haridan, N., Sheikh Hassan, A. F., Mohammed Shah, S., & Mustafa, H. (2023). Financial innovation in Islamic banks: Evidence on the interaction between Shariah board and fintech. *Journal of Islamic Accounting and Business Research*, *14*(6), 911–930. https://doi.org/10.1108/JIABR-11-2022-0305

Molla, A., & Biru, A. (2023). The evolution of the Fintech entrepreneurial ecosystem in Africa: An exploratory study and model for future development. *Technological Forecasting and Social Change*, *186,* 122123. https://doi.org/10.1016/j.techfore.2022.122123

Najaf, K., Subramaniam, R. K., & Atayah, O. F. (2022). Understanding the implications of fintech peer-to-peer (P2P) lending during the COVID-19 pandemic. *Journal of Sustainable Finance and Investment*, *12*(1), 87–102. https://doi.org/10.1080/20430795.2021.1917225

Peón, D., Antelo, M., & Sun, Y. (2024). Market competition and strategic interaction in the Spanish fintech industry. *Research in International Business and Finance*, *70,* 102365. https://doi.org/10.1016/j.ribaf.2024.102365

Rupeika-Apoga, R., & Wendt, S. (2022). Fintech development and regulatory scrutiny: a contradiction? The case of Latvia. *Risks*, *10*(9), 167. https://doi.org/10.3390/risks10090167

Saklain, M. S. (2024). Fintech, systemic risk and bank market power – Australian perspective. *International Review of Financial Analysis*, *95,* 103351. https://doi.org/10.1016/j.irfa.2024.103351

Sampat, B., Mogaji, E., & Nguyen, N. P. (2024). The dark side of fintech in financial services: A qualitative enquiry into fintech developers' perspective. *International Journal of Bank Marketing*, *42*(1), 38–65. https://doi.org/10.1108/IJBM-07-2022-0328

Sarabdeen, J. (2023). Laws on regulatory technology (RegTech) in Saudi Arabia: Are they adequate? *International Journal of Law and Management*, *65*(6), 523–537. https://doi.org/10.1108/IJLMA-03-2023-0042

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Sunio, V., Mendejar, J., Nery, J. R., & Carlos, J. P. (2023). Generalization of digital innovation for financial inclusion by means of market creation through regulation and governance. *Global Transitions*, *5*, 29–39. https://doi.org/10.1016/j.glt.2023.04.001

Suryono, R. R., Budi, I., & Purwandari, B. (2021). Detection of fintech P2P lending issues in Indonesia. *Heliyon*, *7*(4), e06782. https://doi.org/10.1016/j.heliyon.2021.e06782

Truby, J. (2020). Fintech and the city: Sandbox 2.0 policy and regulatory reform proposals. *International Review of Law, Computers and Technology*, *34*(3), 277–309. https://doi.org/10.1080/13600869.2018.1546542

Tsang, C. Y., & Chen, P. K. (2022). Understanding policy diffusion mechanism of financial regulatory innovation: The experience of Taiwan. *Asia Pacific Law Review*, *30*(1), 21–43. https://doi.org/10.1080/10192557.2022.2045705

Vijayakumar Bharathi, S., Perdana, A., & Kulkarni, M. S. (2023). Exploring the synergy between financial technologies and financial inclusion: What we know and where we should be heading? *Pacific Asia Journal of the Association for Information Systems*, *15*(1), 87–126. https://doi.org/10.17705/1pais.15104

Washington, P. B., Rehman, S. U., & Lee, E. (2022). Nexus between regulatory sandbox and performance of digital banks—A study on UK digital banks. *Journal of Risk and Financial Management*, *15*(12), 610. https://doi.org/10.3390/jrfm15120610