International Journal of Innovative Research and Scientific Studies, 8(3) 2025, pages: 291-299

IJIRSS
International Journal of Innovative Research & Scientific Studies

ISSN: 2617-6548

URL: www.ijirss.com

Implications of fintech revolution in the efficiency of regional innovation: Insights from Jordan

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Abstract

Due to digital transformation in finance, researchers have paid dramatic attention to evaluating the impact of financial technology on regional innovation efficiency. Hence, since Fintech's ability is found to significantly influence local innovation, the current research was primarily designed to scrutinize the relationship between financial technology (Fintech) and regional innovation efficiency in Jordan. Moreover, by utilizing the dynamic spatial Durbin model, the study provided empirical evidence for the impact of Fintech's spatial spillover in a sample of 12 Jordanian Governorates for the period 2013-2022. Consequently, the findings proved that there is a noteworthy worldwide spatial correlation and time dependence of regional innovation efficiency during the study period. Additionally, Fintech improves regional innovation efficiency, and this effect has a large positive spatial spillover. Therefore, the study recommends that the financial sector in Jordan use innovative strategies and financial technology to boost regional innovation efficiency and technological innovation.

Keywords: Dynamic Durbin model, Fintech revolution, Regional innovation efficiency, Spatial spillover, Technological revolution.

DOI: 10.53894/ijirss.v8i3.6502
Funding: This study received no specific financial support.
History: Received: 06 March 2025 / **Revised:** 07 April 2025 / **Accepted:** 09 April 2025 / **Published:** 25 April 2025

Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Publisher: Innovative Research Publishing

1. Introduction

At this crucial stage, Jordan is concentrating on creating new technologies for international development. Technological innovation is essential for the growth of the local economy. Fintech, a new technological revolution driven by big data, blockchain, cloud computing, artificial intelligence, and mobile Internet, has transformed traditional financial business scenarios, streamlined the financial ecosystem, and expanded the scope and depth of financial services [1].

One of the first markets where innovation is tested and then commercialized for increased productivity and profitability is the financial services industry. For example, Bank of America was the first financial institution to employ computers in the 1950s [2]. The widespread adoption of mobile applications made possible by high-speed internet access, artificial

intelligence, distributed ledger technology (DLT), powerful computing, and other 4IR technologies are facilitating the spread of Fintech throughout markets. "Providing new solutions that strive to boost the efficiency, accessibility, and security of financial services provision" is what Fintech services and business models are all about [3].

Financial services, for the industrial sector, should be given a top priority by local governments, and they should also create a system of financial products that fits the needs of emerging sectors. Effective and affordable financial services assistance is necessary to fulfill funding demands in the R&D stage, scientific transformation and technical consequence, industrialization and deployment of new technologies, and other innovative activities [4]. As Jordan does not yet have a regional innovation policy, it is critical to understand how Fintech affects the country's ability to innovate to create governorate-specific policies. Therefore, the policymakers should investigate the impact of Fintech in the performance of regional innovation. Numerous studies have been carried out to show how Fintech and the efficiency of regional innovation are related. When considering the role of finance in economic growth, Schumpeter highlighted the significance of financial development to technical innovation as early as 1921. Because of this, during the second wave of the global technology revolution, the growth of digital technologies like big data, cloud computing, artificial intelligence, and 5G networks led to the organic combination of the banking industry with IT businesses to build a new financial technology known Fintech and financial model as digital finance [5].

A paradigm shift in the financial sector has resulted from the rise of Fintech, giving rise to new prospects and creative business models. According to Manish and Sergeeva [6], the term “Fintech" describes a variety of technological advancements meant to enhance customer satisfaction and financial operations. Fintech has disrupted established financial services like banking, insurance, and investing by providing fresh and innovative goods and previously unachievable services. Financial institutions may now offer their clients faster, more affordable, and more convenient services, one of its key benefits [7]. Additionally, thanks to Fintech, financial institutions can now provide their clients with more specialized services tailored to their individual needs and behaviors. New players in the industry, including online lenders and Fintech companies, have also been brought about by Fintech [8]. These players have challenged the dominance of major financial institutions and disrupted the conventional financial landscape.

However, Jordan's financial ecosystem is seeing a major push towards digital transformation as a result of government strategies to realize the Economic Modernization Vision 2033 and Jordan Vision 2025. Over 78 million electronic payment transactions were made throughout the nation in 2022. Furthermore, according to Statista, the percentage of people using online banking is predicted to reach 4.59% in 2023, and the total transaction value is predicted to expand at an annual rate of 14.13% (CAGR 2023–2027), resulting in a projected total value of US$12.25 billion by 2027. Nevertheless, the Fintech environment is still in a critical stage due to ongoing challenges, including cybersecurity, financial and digital exclusion, cross-border payments, and concentration risk. These difficulties have an impact on the industry as well as Jordan's overall economic growth and the outcomes of the digital revolution initiatives by the government [9].

The development and improvement of financial services efficiency and financial resource allocation efficiency have also involved a deep integration of emerging technology and finance. In the meantime, it has an impact on locals' consumption patterns, which will unavoidably have an additional impact on each region's innovation efficiency [10]. Applying Fintech and digital finance will increase the depth and breadth of financial services while filling in the gaps in traditional financial services with its digital elements. Additionally, Fintech led to change the financial services industry through developing accessible financial services for market participants with creative potential who are not served by traditional finance [11]. Furthermore, there has been a strong integration of finances and developing technology to advance and improve the efficiency of financial services and the distribution of financial resources. Beyond that, it has an impact on locals' consumption patterns, which will unavoidably have an additional impact on each region's innovation efficiency [12].

Thus, it is necessary to address a few pressing issues of Fintech and the effectiveness of regional innovation: Does Jordan's Fintech development promote regional innovation efficiency and the underlying mechanisms that make it possible? Since the presence of factor flows links innovation activity across regions, does the influence of Fintech have a spatial spillover? Thus, appropriately assessing how Fintech affects regional innovation efficiency, investigating Fintech development policies, and enhancing regional innovation efficiency is of great theoretical and practical importance.

The following elements are potential research contributions of this paper. Firstly, Fintech and regional innovation efficiency are part of the same research framework, and a systematic analysis is conducted on the role of Fintech’s mechanisms in regional innovation efficiency. Secondly, the influence of Fintech on regional innovation efficiency is examined from a spatial perspective by building a spatial correlation matrix based on two innovation factors. The direct and cumulative effects of Fintech on regional innovation efficiency are then evaluated to deeply explore the spatial heterogeneity between the two, offering a fresh viewpoint for further research on both. This is done because regional innovation efficiency exhibits spatial correlation. Finally, to guide the implementation of targeted and differentiated policies, we examine the heterogeneous impact of Fintech on regional innovation efficiency from the perspective of regional imbalances and structural factors.

The remained of this research is structured as follows. In the second section, the study reviewed literature regarding the role of financial technology in improving financial services and products, as well as in increasing the effectiveness of regional innovation.

Thereafter, the third section discussed the methodology that is used to conduct this research. However, section 4 is concerned with analyzing data and testing hypotheses. Section 5 presented a discussion about the study’s findings. Section 6 provided concluding remarks.

2. Literature Review

Fintech, a new technology, is the driving force behind the financial industry's revolution, affecting all electronic financial services and products [13]. According to Mhlanga [14], Fintech has three advantages over the traditional banking sector, and those are including the payment channels, information matching, and data. Fintech has not altered the fundamental nature of finance. Fintech has improved contemporary financial activities by eliminating financial exclusion, cutting the cost of financial services, and improving information asymmetry through the use of digital payment platforms, mobile phones, and online banking.

According to Brown et al. [15], support for R&D funding is a crucial pathway via which finance contributes to economic growth. On the other hand, opinions among academics on the impact of financial development on the efficiency of innovation remain divided. According to certain academics, financial development has a major impact on the effectiveness of innovation [16]. Research on Fintech's effects primarily concentrates on the company's function in the financial sector [17]. Discovered that, rather than raising the default rate, Fintech increased the processing speed of loan applications by around 20%. Fintech-enabled loan lenders can also better understand the market, lessen financial constraints for businesses, and handle demand shocks. Similar conclusions were reached by Jagtiani and Lemieux [18] and Abbasi and Weigand [19], indicating that Fintech uses big data or machine learning to lower risk and enhance access to financing for certain businesses.

Fintech and competitiveness and performance have been the subject of numerous studies, Bömer [20] and Momaya et al. [21]. According to Bömer [20]. Fintech can be divided into four categories, including Fintech 1.0, 2.0, 3.0, and 4.0. These classifications are linked with attaining competitiveness. For instance, Kenyan commercial banks' ability to compete is found to be significantly affected by mobile banking, e-banking, agency banking, and process automation [22]. Adoption of Fintech involves utilizing the ease of communication, the ease and security of financial transactions, the widespread use of the internet, and the automated processing of data and financial industry activities [23]. Furthermore, there is a risk associated with financial services operations implementing new Fintech, specifically about financial losses brought on by various elements of the business environment. Every nation has to cope with local laws about the adoption of Fintech and laws governing the financial industry. By examining the effects of financial technology on a selection of significant Chinese cities, Yao et al. [24] affirmed that financial technology will tangentially foster regional technical innovation. Financing institutions may misallocate resources, resulting in inefficient technological innovation. The financial mismatch and funding limits resulting from the financial development are seen as key barriers to investing in basic and high-technology R&D, as proven by Liu et al. [25]. These barriers will hinder innovation efficiency and ultimately harm local total factor productivity. Furthermore, in an attempt to highlight the significance of financial development in technological innovation, Li et al. [26] stated that financial development can lower innovation costs by stimulating innovation, eliminating moral hazards and adverse selection issues in the innovation process, reviewing and monitoring innovation projects, and providing financial support for innovation and efficiently allocating scarce resources.

Zhai et al. [27] contend that as demand for digital services grows, financial institutions will be "pushed" to offer sophisticated digital banking services, creating a supportive financial environment that fosters local innovation. According to previous literature, Fintech and digital finance will cause changes in the financial cycle that will benefit innovation as well. Fintech integration will boost local businesses' innovative practices and increase the prosperity of regional trade [28]. Regional governments can now more accurately assess an enterprise's capacity for innovation thanks to Fintech. Fintech promotes policy efficiency by evaluating an enterprise's ability to innovate and operate using big data technologies [29]. According to several academics, the primary driver of creative enterprises is competition. Long-term regional government policy assistance also causes some businesses to become less innovative and more dependent on policy operations. Fintech provides governments with the capacity to monitor corporate innovation over time in response to this circumstance. Data mining technology allows the government to avoid the issue of over-support efficiently. Moreover, the rise of Fintech has elevated Internet finance to a prominent position. The conventional financial model's information asymmetry has lessened. This has reduced SMEs' environmental strain when securing funding [5]. Through cloud platforms, internet finance has expanded corporate funding sources, increasing the effectiveness of regional innovation [30]. Fintech, however, also makes it possible to more accurately identify creative businesses for focused investment.

3. Methodology

3.1. Research Hypotheses

The external and internal factors that impact regional innovation activity are optimized by Fintech. Regional innovation is more effective when Fintech is used. Fintech may help businesses with their funding issues and encourage their R&D and innovation. Fintech integrates financial resources efficiently over the internet, Ren et al. [31] creating a P2P-like platform for trading investments, offering multi-channel financing possibilities for creative initiatives, and satisfying the funding requirements of research and development as well as innovation. Fintech employs big data technology to manage risk, save time, and lower labor costs in the financing process by screening and disclosing reliable information, enhancing information transparency, and effectively minimizing information asymmetry [27]. Financial technology application creates a multidimensional system for evaluating an enterprise's creditworthiness, allowing investors to quickly and effectively determine the enterprise's creditworthiness. This reduces the approval process, increases financing efficiency, and makes it easier to invest in and develop R&D and innovation on time [32]. Fintech has made financial services more widely available and easily accessible. It has also successfully made up for the traditional financial market's underrepresentation of users by actively utilizing the long-tail effect to involve marginalized groups in the innovation and investment sectors. This expands the amount of funding available for R&D innovation and encourages private companies, SMEs and banking sectors, thus

forcing them to improve resource allocation efficiency. In turn, this creates an ecologically sound financial climate that supports efficient regional innovation. Thus, the following hypothesis is formulated in this study.

Hypothesis 1: Fintech positively impacts regional innovation efficiency.

Regional innovation activities are ultimately impacted by the financial operations of nearby regions because, according to spatial spillovers, economic activities in each region are not entirely independent but rather are connected in some way [33]. This indicates that one major aspect influencing the effectiveness of regional innovation is the spatial spillover effect of fintech.

Due to its broad geographic penetration and ability to offer financial services across borders, fintech can enhance the financial resources allocated to innovation-related activities in certain regions, thereby generating efficiency in regional innovation. Fintech's contribution to R&D innovation in nearby locations has a demonstrative effect on the surrounding community. Information is shared more frequently between areas, strengthening information interaction between them and diluting interregional barriers. This increases the amount and quality of spatial spillover knowledge. Thus, the following hypothesis is proposed in this research paper.

Hypothesis 2: Fintech improves regional innovation efficiency through positive spatial spillover.

3.2. Sample and Data Collection

This work applied panel data from 12 governorates in Jordan from 2013 to 2022. Data were collected from the Global Innovation Index and the Ministry of Industry and Trade. Other data were obtained from the official website of the Department of Statistics Jordan and the Amman Stock Exchange. Some listed firms were selected to investigate the impact of Fintech. Firms whose revenue was greater than 25 million were selected for the analysis.

3.3. Research Instrument

This study used the DEA method for investigating innovation efficiency. Idea generation, input, and output are just a few of the many processes that make up the complex and dynamic process of innovation. Therefore, the impact of several input-output variables should be combined when calculating innovation efficiency. The DEA method is currently the most widely used technique in academia for assessing innovation efficiency. DEA offers numerous benefits when calculating regional innovation efficiency. DEA is a non-parametric estimation technique, to start. It avoids the problems of the subjective weighting method by creating an ideal model based on the input-output variables and performance optimization analysis of regional innovation.

3.4. Research Variables

3.4.1. Regional Innovation Efficiency

The input-output-based stochastic frontier approach (SFA) is used in this study to calculate the efficiency of regional innovation. Generally speaking, both labor and capital are inputs into regional innovation activity. The full-time equivalent of R&D personnel was selected as the labor input indicator because it can more closely reflect the real level of labor input when compared to the number of R&D personnel. Although internal R&D expenditure is typically used to measure capital input, we decided to utilize the stock of R&D expenditure as the capital input indicator for regional innovation activities since it may have an impact on future R&D output, See Figure 1. The number of granted patent applications is utilized as the innovation output indicator for regional innovation activity.

3.4.2. Fintech

According to studies, the use of FinTech can increase financial inclusion by giving underprivileged groups access to financial services. Because people can save, invest, and engage in the market, this can ultimately result in better financial performance and regional innovation efficiency. Structured indicator systems are built using the transaction and operational data of fintech companies. This approach was utilized by Feng et al. [34] to create the inclusive finance index. According to Huang and Huang [5] digital technologies like big data, cloud computing, and artificial intelligence are the components of Fintech.

3.4.3. Control Variables

Government intervention, degree of openness, industrial structure, and human capital were chosen as the control variables Su et al. [4] see Figure 1. The measure of openness, industrial structure, and human capital is the natural logarithm of the average number of years that the population aged six and above has completed schooling. Government intervention is indicated as the ratio of local government expenditure to GDP. The measure of openness is the ratio of total imports and exports to GDP after exchange rate treatment.

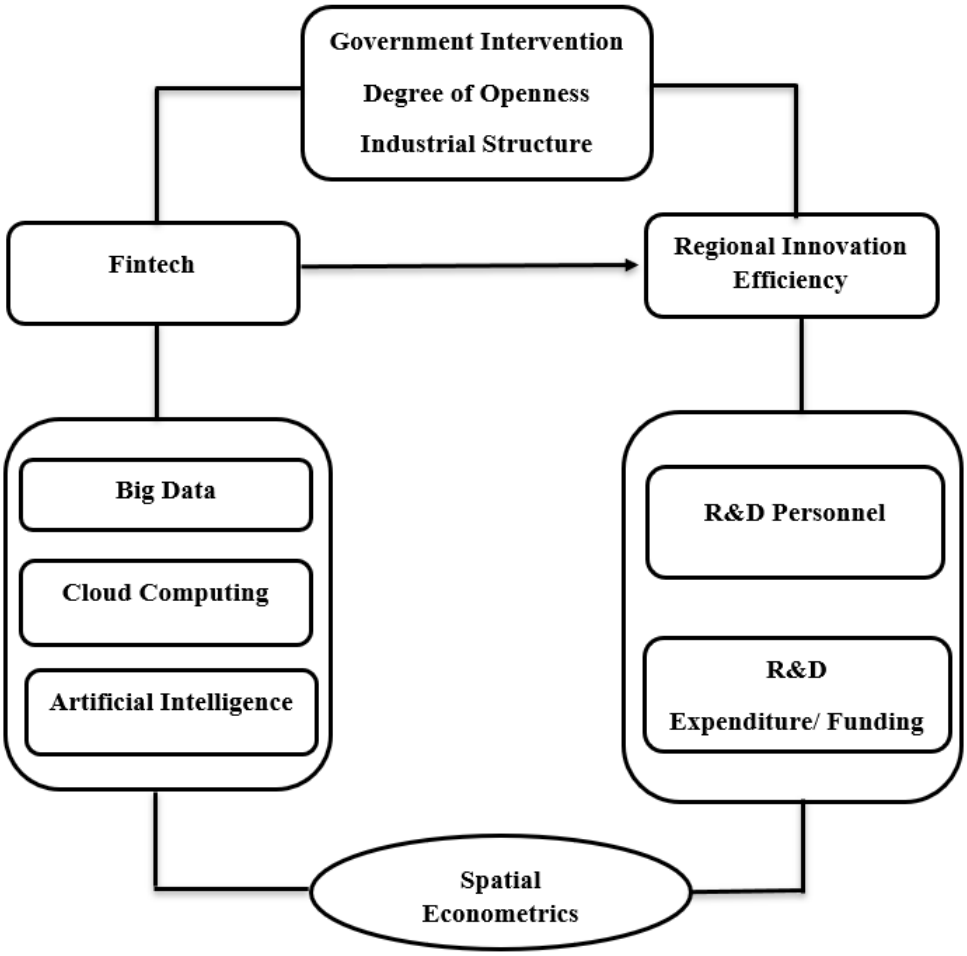

Figure 1.
Conceptual Framework.

3.5. Setting of Correlation and Econometric Model

3.5.1. Spatial Correlation Test

A spatial correlation test must be performed before the spatial econometric regression. The worldwide Moran's I index, computed as follows, is employed in this study for the spatial correlation test:

$$\boldsymbol{Moran's\ I} = \frac{\boldsymbol{n}\sum_{i=1}^{n}\sum_{j=1}^{n}\boldsymbol{W_{ij}}(\boldsymbol{X_i}-\bar{\boldsymbol{x}})(\boldsymbol{X_i}-\bar{\boldsymbol{x}})}{\sum_{i=1}^{n}\sum_{j=1}^{n}\boldsymbol{W_{ij}}\sum_{i=1}^{n}(\boldsymbol{X_i}-\bar{\boldsymbol{x}})^{2}} \qquad (\mathbf{1})$$

Where, the w_{ij} represents the spatial weight matrix where regions or governorates are represented by the symbols i and j, the regional innovation efficiency by x. The average value for regional innovation efficiency is indicated by $\bar{x}$.

3.5.2. Spatial Econometric Model

In spatial econometric models, the spatial autoregressive model (SAR) investigates the spatial effects produced by the explanatory factors, which are represented as spatial lag terms. Meanwhile, the spatial error model explores the spatial effects of additional random shocks, which are represented as spatial error terms. Both of these spatial impacts might exist, and focusing only on one could lead to inaccurate estimations. This study integrates a spatial error model and a spatial lag model. The Spatial Durbin model is required to incorporate the spatial interaction effects into the linear model.

Additionally, the lagged period of the explanatory variables is integrated into the model to develop a dynamic spatial Durbin model to better assess the impact of Fintech on regional innovation efficiency, taking into account the possibility that the previous period may have an effect. The particular model was put together in this way:

$$\boldsymbol{ref_{it}} = \boldsymbol{\rho}\sum_{j=1}^{n}\boldsymbol{w_{ij}ref_{it}} + \boldsymbol{\alpha_1 ref_{it-1}} + \boldsymbol{\alpha_2 fti_{it}} + \boldsymbol{\alpha_3}\sum_{j=1}^{n}\boldsymbol{w_{ij}fti_{it}} + \boldsymbol{\alpha_4 z_{it}} + \boldsymbol{\alpha_5}\sum_{j=1}^{n}\boldsymbol{w_{ij}z_{it}} + \boldsymbol{\mu_i} + \boldsymbol{\theta_t} + \boldsymbol{\varepsilon_{it}} (\mathbf{2})$$

The regions and times are indicated by i and t, accordingly; The regional innovation efficiency is denoted by ref_{it}, and the delayed one-period term of regional innovation efficiency is represented by ref_{it-1}. fti$_{it}$stands for fintech; The control variable is z_{it}, while the parameters to be estimated are represented by α. The coefficient of the spatially delayed term of regional innovation efficiency is denoted by ρ, while the spatial weight matrix is represented by w_{ij}. The random disturbance term is denoted by ε_{it}, while the individual and time-fixed effects are represented by μ_i and θ_t, respectively [35].

4. Results and Analysis

For geographical correlation testing, Stata 15 software was used to introduce the R&D funding matrix and R&D staff matrix. Table 1 displays Moran's Index for fintech and regional innovation efficiency in Jordan from 2013 to 2022. The results demonstrate that Moran's I index is significant for both spatial weight matrices. It shows that spatial econometric models are applicable. Conversely, it exhibits significantly positive spatial correlations and spatial clustering phenomena with fintech and regional innovation efficiency in Jordan.

Table 1.
Moran's Index.

Year	R&D funding matrix		R&D Personnel matrix	
	Innovation Efficiency	Fintech	Innovation Efficiency	Fintech
2013	0.372***	0.628***	0.499***	0.492***
2014	0.362***	0.631***	0.492***	0.481***
2015	0.363***	0.630***	0.490***	0.493***
2016	0.372***	0.599***	0.491***	0.467***
2017	0.371***	0.589***	0.485***	0.482***
2018	0.369***	0.624***	0.482***	0.502***
2019	0.372***	0.621***	0.476***	0.438***
2020	0.370***	0.632***	0.470***	0.462***
2021	0.365***	0.611***	0.476***	0.461***
2022	0.369***	0.587***	0.471***	0.455***

Note: ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

Separate regressions were conducted for the random effects model, the individual fixed effects model, and the two-way fixed-effects model under the non-spatial panel. In this paper, the dynamic spatial Durbin model that accounts for two-way fixed effects was first used. Additionally, LR and Wald tests were run on the model to see if it might degenerate into a spatial lag model or a spatial error model [36]. The outcomes demonstrate that the dynamic spatial Durbin model is more suitable for this investigation, as indicated by the Wald and LR tests. First, as shown in Table 2, there is a considerable spatial dependence between the regional innovation efficiency of each region and the spatial autocorrelation coefficient ρ, which is significantly positive for both innovation factors in the spatial correlation matrix. The local area benefits from the neighborhood's increased regional innovation efficiency. It's crucial to remember that this innovation neighborhood is a spatially connected area created by the mobility of R&D professionals and financing. Regional innovation efficiency exhibits both a "snowball" impact and substantial path dependence in the time dimension, as evidenced by the significantly positive calculated coefficients of regional innovation efficiency lagged by one period. Even after accounting for the geographic interaction effect, the estimated Fintech coefficients were still considerably positive when compared to the non-spatial term; however, the coefficients were significantly smaller, suggesting that the non-spatial model may overlook the spatial factor and produce biased estimates.

Table 2.
Baseline estimation results.

Variable	Non-Spatial Panel RE	Non-Spatial Panel FE	Non-Spatial Panel FE	R&D Funding Matrix SDM	R&D personnel matrix SDM
	1	2	3	4	5
L. ref				1.061***	1.007***
				(111.72)	(103.21)
Fti	0.061***	0.051***	0.012***	0.013***	0.017***
	(1078)	(12.01)	(3.06)	(5.11)	(6.52)
Gov	-0.029	0.041	0.072**	0.021***	0.023***
	(-0.040)	(0.42)	(2.11)	(4.21)	(4.12)
Open	-0.106***	-0.123***	-0.004	0.002	0.003**
	(-5.15)	(-5.23)	(-0.40)	(1.01)	(1.23)
Inst	-0.723***	-0.719***	-0.001	0.010**	0.012***
	(-12.42)	(-13.66)	(-0.01)	(2.11)	(2.32)
Hum	0.491***	0.432***	0.080**	0.003	0.008*
	(5.68)	(6.59)	(2.10)	(0.79)	(1.62)
W*fti				0.187***	0.183***
				(6.66)	(6.55)
W*gov				0.812***	0.935***
				(13.23)	(14.65)
W*open				0.091***	0.093***
				(9.01)	(10.12)

W*inst				1.172*** (15.27)	1.251*** (17.23)
W*hum				0.321*** (3.87)	0.472*** (5.02)
ρ				8.13	0.171*** (6.22)
LRSAR				83.23***	9.94* 100.61***
LRSEM				372.29***	422.21***
WaldSAR				341.28***	410.78***
WaldSEM					
City effect	NO	YES	YES	YES	YES
Year effect	NO	NO	NO	YES	YES
R2	0.901	0.921	0.972	0.961	0.961
N	300	300	300	269	269

Note: z-values in brackets; ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

For both of the spatial weight matrices, the above-estimated findings are shown in Table 3 along with the direct, indirect, and total effects. Firstly, Fintech significantly improved smaller county innovation efficiency for both spatial weighting matrices in terms of direct effects, proving that Fintech significantly boosts regional innovation efficiency as well as supporting our hypothesis 1. In Jordan, fintech not only increases capital allocation efficiency and encourages R&D and innovation-focused business enthusiasm, but it also fills in the gaps left by the traditional financial system for the innovation market, particularly by providing a solid foundation for the innovation endeavors of the small, medium, and micro firm [37]. In addition, the tightening of fintech laws by the government and business community in recent years has given a solid assurance of the sector's effectiveness in fostering regional innovation. Regarding secondary effects, all of the fintech's spatial spillover effects on regional innovation efficiency are favorably significant, suggesting that the growth of fintech in surrounding areas also contributes to local regional innovation efficiency. These empirical findings also strongly support Hypothesis 2. The comparison also shows that, in terms of both R&D investment and R&D manpower, the spatial spillover effect of fintech on regional innovation efficiency is larger than the direct benefit.

Additionally, when the spatial spillover effect of fintech is considered, the overall effect of fintech is significantly positive, suggesting that fintech has a considerable positive impact on regional innovation efficiency. The effectiveness of government intervention in regional innovation was found to have a strong positive impact on control variables. This suggests that government support is necessary for carrying out innovation activities and that the government can actively mitigate market imperfections, minimize innovation risks, and enhance innovation potential. The efficiency of regional innovation is positively impacted by openness, which reflects the adoption of cutting-edge technology and the capacity for autonomous invention in international economic endeavors. The process of adjusting the industrial structure reflects the growing need for technical innovation, which is reflected in the promotion of regional innovation efficiency by industrial structure [38]. The accumulation of human capital raises the degree of knowledge and successfully encourages the improvement of regional innovation efficiency. The indirect effects of human capital were all statistically positive; the direct effects were positively significant for the R&D people matrix, and positively significant but not significant for the R&D financing matrix [34].

Table 3.
Decomposition effects.

Variable	**R&D funding matrix**			**R&D Personnel matrix**		
	Direct effect	**Indirect effect**	**Total effect**	**Direct effect**	**Indirect effect**	**Total effect**
fti	0.0186*** (6.29)	0.3032*** (6.12)	0.3241*** (6.18)	0.0214*** (7.12)	0.2410*** (6.21)	0.2612*** (6.89)
gov	0.0421*** (6.36)	1.4022*** (8.23)	1.4268*** (8.23)	0.0452*** (6.42)	1.3895*** (10.82)	1.2311*** (10.52)
open	0.0041*** (3.72)	0.1425*** (6.21)	0.1428*** (6.78)	0.0053*** (2.32)	0.1298*** (6.23)	0.1262*** (5.89)
inst	0.0402*** (3.82)	1.8512*** (0.5512)	1.9215*** (7.23)	0.0352*** (3.28)	1.6325*** (8.22)	1.6233*** (8.23)
hum	0.0136*** (2.01)	0.5522*** (4.91)	0.5981*** (4.96)	0.0178*** (2.36)	0.6512*** (6.23)	0.6231*** (6.87)

Note: z-values in brackets; ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

5. Conclusion and Recommendation

The influence of fintech on regional innovation efficiency and its spatial spillover effects are tested in this paper using panel data from 12 governorates in Jordan between 2013 and 2022. Regional innovation efficiency is quantified using the SFA, and a dynamic spatial Durbin model is employed based on the construction of an R&D funding matrix and an R&D personnel matrix. Regional innovation efficiency was found to have path dependence in both its temporal and spatial distribution, while fintech and regional innovation efficiency were found to have a positive spatial association. Fintech has a notable role in enhancing the efficiency of regional innovation, with beneficial geographical spillover effects. According to the results of the decomposition effect, fintech in neighboring areas is more beneficial for boosting local and regional innovation efficiency. Jordan's regional innovation efficiency has a forward-trending, progressively rising tendency. The new growth breakthrough point in the regional innovation development of Jordan is the efficiency of technological improvement. In most governorates, the primary barrier impacting regional innovation efficiency is the effectiveness of the economy of scale. It is becoming increasingly clear how important each region's independent innovation potential is to the transformation of the development model and optimization of innovation efficiency. There are various advantages to the study's findings. Initially, the research offers empirical evidence regarding the impact of fintech on the efficacy of regional innovation. Secondly, the research expands the theoretical framework concerning the study's subject. According to the findings, the study suggests that the financial sector in Jordan should focus more on financial technology and provide training programs for employees and stakeholders in financial technology application areas.

5.1. Practical Implications

The policymakers must understand that foreign investment should be introduced when there is a scale impact issue in regional innovation efficiency and the degree of regional innovation is relatively low. Create a demonstrative effect and enhance the local innovation climate. Encourage aggressive local businesses to purchase cutting-edge technologies already in use. Additionally, local autonomous innovation companies should be encouraged until the regional economy of scale achieves its peak. Encourage collaboration among businesses, academic institutions, and research centers to maximize the level of financial technology in the area. Encourage the upgrading of the local real estate and financial industries through digital innovation to achieve sustainable growth capabilities. For businesses, copying and understanding the technology of more developed businesses is not a sustainable approach. As soon as they achieve a certain level of strength and a stable working environment, they ought to turn their attention to self-innovation. Collaborate with nearby academic and research establishments, and leverage the area's financial technology, capacity to attract talent, and other favorable conditions to enhance your development and create new growth opportunities.

5.2. Limitations and Suggestion for Future Research

There were several limitations to this paper that might be viewed as opportunities for future research or even managerial implications. This study addresses the insufficiency of literature in the same field since there haven't been many studies that offer empirical solutions to evaluate stakeholders' opinions. The study's findings can be applied to the formation of systems for observing, regulating, and diagnosing public policies and practices. Consequently, the components investigated in the study can be utilized by future researchers, and the proposed framework can be employed in empirical studies to measure the effects of fintech adoption on regional innovation efficiency. The researcher also suggests that future researchers build a model to measure fintech's influence and how it affects regional innovation efficacy using the research questions employed in this study. Further research may be carried out using empirical and confirmatory studies to investigate novel factors or validate those that already exist.

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