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Does Fintech development have a diverse impact on banking performance and stability? A panel study of Indian banks

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Abstract

This paper investigates the influence of fintech on banking performance and stability using a sample of Indian banks from 2013 to 2022. The investigation was carried out using feasible generalized least squares and Quantile regression while the robustness of the results was demonstrated using GMM. Consistent across all models, the study found that fintech hurts the performance and stability of banks. The ownership structure shows that public and foreign banks had no effect, private banks benefit, and cooperative banks suffer from fintech innovation. With the exception of Private banks, fintech has a detrimental effect on the stability of traditional banks. The research also indicated that fintech developments negatively affect non-performing loans (NPL), suggesting that banks can minimize their NPLs by employing fintech departments. This is the first research that examines the effects of fintech on bank performance, stability, and loan performance in the Indian banking sector. The study offers some suggestions and recommendations to policymakers.

Keywords: Fintech, Stability, Performance, FGLS & Quantile Regression

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There exists no conflict of interest in the present study.

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Informed Consent: This article does not contain any studies performed by the author with human participants, human data**.**

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1. Introduction

Increased technological advancement has enriched the current financial system and spawned the much-discussed field of "Fintech." The Financial Stability Board (FSB) defines Fintech as "technology-enabled innovation in financial services" that has the potential to provide new business models, applications, procedures, or products that have a "substantial influence" on the delivery of financial services. Cryptocurrency, electronic banking, online insurance, crowdfunding, trading platforms, online advising, and many more are just some of the many new services that have emerged as a result of the boom in fintech. Consequently, between 2010 and 2020, the average annual growth rate of investments in fintech businesses was 45%, whereas the growth rate of non-fintech acquisitions was merely 8% (S&P, 2021). The astonishing value of an investment in fintech companies in 2021 is 226.5 US dollars (Statista).

The nexus between fintech evolution and bank performance is elucidated by consumer theory (Aaker and Keller, 1990) and disruptive information theory (1997). Consumer theory states that old services (over-the-counter deposits and withdrawals) presented by traditional banking systems will be replaced by new services (mobile banking) offered by fintech firms to satisfy the same demand. Disruptive innovation theory suggests that new entrants (fintech firms) initially enter the market at the bottom of the pyramid by using innovative technology to offer higher value at lower prices and then persistently progressing upwards until they replace established ventures. However, it is also argued that sometimes the introduction of fintech entities can turn out to be a blessing in disguise for the traditional banking system. They may benefit from technological spillovers, be forced to redesign their way of doing business, innovate new services, provide contactless banking, and be expected to improve their performance to maintain their rein and eventually grow upward. Therefore, the evolution of fintech is expected to promote financial stability. The channels of data technology, cloud technology, and artificial intelligence are the most effective tools to promote financial stability. However, blindly introducing new services to merely deal with competition can have adverse effects and do more harm than good. This could be substantiated by the fact that the recent market crash of 2008 resulted from excessive financial innovation. Therefore, to achieve financial stability and leverage positives from fintech, firms must not use technology recklessly but rather in an efficient and objective-driven manner.

This research is being conducted in India because of the dramatic transformation that technology-driven banking is bringing to the banking and finance sectors in India and other developing countries. India, in contrast to the global average of 64 percent, has an adoption rate of 87 percent, making it the leader in the field (Earnest & Young). In fact, the Indian fintech business has attracted over $8 billion in investment and created more than 15 unicorns only in 2021. By 2030, the Indian financial technology sector is forecast to generate $200 billion in revenue and manage $1 trillion in assets (Earnest & Young). This supports our notion of doing an empirical study of the issue in India and speaks loudly about the potential of the fintech business there.

Our study adds significantly to the existing body of knowledge on fintech and banking efficiency. To the best of our knowledge, this is the first research that examines the effects of fintech on bank performance, stability, and loan performance. Quantile regression and GMM were also used to test the robustness of the results obtained through FGLS. Also, alternative proxies for performance and stability have been employed to validate the consistency of findings. Furthermore, the study investigates the factors that influence our findings and how they change depending on the bank's ownership structure (public, private, foreign, and cooperative) and size (small, medium, and large).

The rest of the paper is organised as follows: Section 2 presents a literature review, and Section 3 provides a detailed description of the variables and methodology adopted. Section 4 presents the empirical results and discussion. Section 5 provides the robustness of our results, and finally, Section 6 provides the conclusion and offers some policy implications.

2 Review Of literature

A plethora of study has been conducted to investigate the factors that influence banking performance. This encompasses a wide range of topics ranging from macroeconomic indicators such as changing global situations, exchange rate dynamics, interest rate deregulation, or investigating how the firm's individual characteristics (debt, profitability, expansion, and so on) affect the bank's performance. However, although the expansion of fintech products has brought about a transformation in our daily lives, there has been surprisingly little empirical study of this phenomenon. According to Mark Carney (2017), the integration of fintech and innovation will most likely make banking accessible to more people. He stresses that with the rise of fintech companies, customers will have more options, small businesses will have better access to credit, the banking system will be more efficient, and transaction costs will go down, thanks to fierce competition among industry players. Li et al. (2017) investigated the impact of rising fintech start-

ups on the performance of retail banks. Using a sample of 47 US banks for the period from 2010 to 2016, the study found a complementarity/positive relationship between fintech and traditional banking. The study substantiates the findings with the explanation that the existence of fintech units may be too small to affect retail banking, and consumers may be initially reluctant to trust the online banking system. In line with this, Lee et al. (2021) examined whether fintech development improves cost efficiency and the technology adopted by Chinese commercial banks. This study covers the sample period of 2003–2017 for 86 Chinese commercial banks. The study observed that Chinese banks not only operate with mediocre technology but are also less cost-efficient. However, through partnerships with fintech companies, commercial banks in China have not only reduced overhead but also modernized their operations with cutting-edge enhanced technology. It has been noted that market-based support systems are crucial to the development of technology and the promotion of cost-effectiveness in the banking sector. In addition, between 2011 and 2018, Tianxiang Sheng (2021) examined the impact of fintech companies on the availability of finance for small and medium-sized businesses. According to the research, small and medium-sized enterprises (SMEs) benefit from the cooperation between banks and fintech. Large banks are in a better position to take advantage of technological advances and adapt to shifting market conditions because of their size and the economies of scale that come with it. In an intriguing study, Chen et al. (2020) analyzed patent application data from 2003–2017 in the US to determine the value of fintech breakthroughs. The research shows that fintech advancements are quite beneficial to business owners. While it is true that disruptive technical innovations can have a negative impact on the industry as a whole, it has also been observed, in line with Sheng (2021), that market leaders who invest heavily in their innovations can mitigate or even eliminate these effects, ultimately increasing their firms' value. Moreover, the consequences of fintech on bank stability have been previously addressed in the literature. The influence of fintech on bank stability was previously investigated by Safiullah (2022). For the time period covering the global financial crisis of 2008 in Malaysia, bank stability was evaluated using the Z-score. According to the findings, fintech has a net positive effect on the financial stability of banks, especially smaller banks and Islamic banks. It has been noted that huge financial institutions are slow to implement changes that will strengthen their businesses. As a result, we can't rule out the possibility of a detrimental effect of fintech on banks. This could be analyzed by Phan et al (2020) who examined the impact of fintech on banking performance for the period of 20 years from 1997-2017. It was discovered that fintech reduces a bank's productivity. The proliferation of fintech firms causes a drop in both return on equity (ROE) and return on assets (ROA), by 7.30 percentage points and 1.73 percentage points, respectively. The dangers of fintech for state-owned banks are greater than for private banks. In the aftermath of

the global financial crisis of 2008, Buchak et al. (2018) analyzed how did bank lending unfold over the last decade. The study witnessed a drastic change in the residential mortgage market post-crisis. Fintech lenders saw a rise in market share of 300% (from earlier 3% in 2007 to 12% in 2015). This is essential because of regulatory differences and technological advantages. The paper argues that post-crisis banks have been subject to strict regulatory mechanisms and have reduced mortgage lending. Also, the mechanism followed by fintech lenders in determining the interest rates to be charged is based on information obtained through online lending. The paper suggested that the regulatory framework accounts for 60% while technological enhancement contributes a 30% rise to the shadow banking growth. These findings substantiate the proposition of consumer theory (Aaker and Keller, 1990) & Disruptive information theory (1997) argues that new services driven by technological enhancement and innovation are likely to replace the existing system. Therefore, the empirical literature is scant and inconclusive on the extent of the impact of fintech on banking performance and stability. In the backdrop of this study has been undertaken to investigate how the performance and stability of banks have unfolded with the rise in fintech entities.

3 Data and Methodology:

We retrieved our data primarily from three key sources, notably the Reserve Bank of India, for fintech development in India, which is proxied by four alternative measures: total mobile payments in value and volume, mobile wallet payments, and mobile banking transactions. Next, we used the Center for Monitoring the Indian Economy (CMIE) for bank-level data such as ROA, ROE, bank size, credit risk, funding risk, etc. Additionally, we used information from world development indicators (WDI) for economic level control variables like GDP and inflation. This study is based on a 10-year sample period ranging from 2013–2022, for a sample of 53 Indian banks. To account for the differential impact of fintech across different banking sectors and sizes, we classified our data into public, private, and foreign banks as well as small, medium, and large banks. The availability of data influences the sample size and choice. Our sample period has been limited to 10 years because the last decade in India signified a digital revolution and numerous advances, such as KYC, and UPI payments, and the fact that demonetization in 2016 further increased the potential for digital payments. Table 1 displays the variables and their measurement proxies**.**

3.1 Dependent variable.

For this research, we used alternative models with ROA, ROE, and ROC as dependent variables to analyze how the fintech development has affected banking performance. The second phase of the study assessed how fintech affects bank stability using z-score and NPL-ratio as dependent

variables. Many previous studies, including A Demir et al. (2022), & Phan Dinh et al (2019), have employed the Z-score to evaluate bank stability. The bankruptcy risk of a bank can be quantified using the Z-score, which is determined by dividing the sum of the return on assets and the capital asset ratio by the standard deviation of the return on assets. A lower z-score indicates greater financial instability. Alternatively, we have used the ratio of non-performing loans to total loans as a surrogate for bank stability; a higher ratio indicates a higher chance of insolvency and, thus, greater instability.

Table 1. Description of variables.

S. No	Variable	Measurement proxy	Source
1.	ROA	(Total Return / total assets) *100	CMIE's Prowess IQ
2.	ROE	(Total return/ total equity) * 100	CMIE's Prowess IQ
3.	ROC	(Total return/ total capital) * 100	CMIE's Prowess IQ
4.	Fintech- value	ln (Total mobile payments in value)	RBI website
5.	Fintech- Volume	Ln (Total mobile payments in volume)	RBI website
6.	Mobile-Wallet	Ln (Total mobile Wallet's payments)	RBI website
7.	Mobile-Banking	Ln (Total mobile banking payments)	RBI website
8.	Bank Size	Ln (total assets)	CMIE's Prowess IQ
9.	Credit-risk	(Net loans/ total Assets) *100	CMIE's Prowess IQ
10.	Deposit-risk	(Total deposits/ total loans) *100	CMIE's Prowess IQ
11.	Funding-risk	$\frac{\text{Deposits/total assets} + \text{CAR}}{\delta(\text{Deposits/total assets})}$	Author's calculation
13.	Z-score	$\frac{ROA + CAR}{\delta(ROA)}$	Author's calculation
14.	NPL-ratio	$\frac{\text{Non} - \text{performing loans}}{total\ loans}$	Author's calculation
15.	GDP	GDP at constant prices (2012)	World development indicator
16.	Inflation	CPI at constant prices (2012)	World development indicator

Source: Authors' compilation

.3.2 Independent variable.

The development of fintech is our primary area of interest. Financial technology, or fintech, is what allows for the easy and convenient digital implementation of conventional financial services like

money transfers and mobile phone-based payments. Since fintech evolution is associated with inflicting the competition on traditional banking by offering the innovative digital financial services and therefore it becomes imperative to examine fintech's impact on traditional banking. Four alternative proxies of fintech were considered, including total mobile payments in value and volume, mobile wallet transactions, and mobile banking. Each of the four proxies was used in its own set of models to establish validity and consistency of results.

3.3 Control variables:

First, we employed bank size as a control variable; this variable was proxied using the natural log of total assets, which is in line with previous research. Since larger banks have a larger client base, more available resources, and a higher level of technical expertise, we predict that there is a positive relationship between bank size and both performance and stability. We utilize credit risk as a second firm-specific control variable to characterize the loan-to-asset ratio (Adusei, 2015). Increases in the loan-to-asset ratio show that banks have extended credit beyond the value of their assets, which may pose a credit risk because bad loans are more likely if the loan portfolio is not effectively managed. On the flip side, if the risk and return hypothesis holds, banks that make more loans could see a rise in both profits and stability if those loans are properly managed. In light of this, we did not anticipate any sign prediction for credit risk. The deposit risk characterized as the ratio of deposits to loans serves as our third control variable. When the ratio rises above one, it means that the bank is carrying an excessive amount of customer deposits that it must pay interest on but is failing to convert these deposits into loans (assets). As a result, we anticipate that deposit risk will have a detrimental impact on bank performance and stability. Our next control variable is funding risk measured as a z-score of deposits and assets (Adusei 2015). It simply indicates the number of standard deviations of a bank's deposit funding has to drop before the bank resorts to non-deposit funding or insolvency. Non-deposit funding sources are considered to be more volatile and thus pose a significant challenge for banks to manage their stability. Therefore, we expect a positive relationship between funding risk with bank stability. We chose the Gross Domestic Product (GDP), which measures the rate of economic growth in the country, and inflation, which measures the rate of macroeconomic instability in the country, as the two primary variables for controlling the economic level information.

3.4 Econometric model:

We conduct a multi-stage empirical estimation utilizing multiple proxies for dependent and independent variables to examine the effect of fintech innovation on banking performance and

stability. We begin by performing a regression analysis on how fintech and other control variables affect banking outcomes. As a result, our model looks like this.

$$Per_{i,t} = \alpha_0 + \beta_1 Fintech_{i,t} + \beta_2 Size_{i,t} + \beta_3 stability_{i,t} + \beta_4 C.risk_{i,t} + \beta_5 D.risk_{i,t} + \beta_6 F.risk_{i,t} + \beta_7 GDP_t + \beta_8 inflation_{i,t} + \varepsilon_{i,t} \quad (1)$$

Whereas, (Per) represents the banking performance to be measured on three different proxies (ROA, ROE, ROC) by using three separate models. Fintech is the focus variable and is proxied by four different variables in four alternative models. Size represents the bank's asset base, stability is measured using Z-score, (C-risk) denotes credit risk of a particular bank at time t, similarly (D-risk) is deposit risk and (F-risk) is funding risk, GDP is gross domestic product at constant prices and inflation is based on consumer price index. The subscript (I) denotes number of cross-sections (1-53) and (t) represents time dimension (2013-2022).

Since small and large banks take diverse methods to embracing change and competition, there is a wide range of management and ownership structures within the banking industry. However the effects of fintech may differ depending on the type of bank and whether or not it is a large or small institution, to account for the same we thus included four banking sector dummy variables namely public, private, foreign and cooperative banks. Also, three bank type dummies are employed to depict if there is difference in impact across small, medium and large banks. Therefore, our refined model looks like this.

$$Per_{i,t} = \alpha_0 + \beta_1 Fintech_{i,t} + \beta_2 Size_{i,t} + \beta_3 stability_{i,t} + \beta_4 C.risk_{i,t} + \beta_5 D.risk_{i,t} + \beta_6 F.risk_{i,t} + \beta_7 GDP_t + \beta_8 inflation_{i,t} + \beta_{9-12} sector_{i,t} + \beta_{13-15} type_{i,t} + \varepsilon_{i,t} \quad (2)$$

Whereas β_{9-12}, represents the four sector dummies and will take the value of 1 if a particular bank is identified in a particular sector identification of RBI, otherwise 0. β_{13-15} denotes three dummies for small, medium and large banks.

Given the multicollinearity and heterostadasticity problem in our data we moved from fixed/random model to feasible generalized least square (FGLS) which is very reluctant for these problems (Sana and Joo 2021). Also, we used the white standard errors to control for heterostadasticity and to ensure the robustness of standard errors.

We then looked at how fintech might affect banking stability, which can be quantified with the help of two proxies: the z-score and the non-performing loan ratio. Once again, we followed standard practice by creating distinct models for each of the available alternate proxies for fintech. Finally,

the empirical model looks like this since we utilized same-sector and size dummies to extrapolate the effect across banking sectors and bank types:

$$stability_{i,t} = \alpha_0 + \beta_1 Fintech_{i,t} + \beta_2 Size_{i,t} + \beta_3 ROA + \beta_4 C.risk_{i,t} + \beta_5 D.risk_{i,t} + \beta_6 F.risk_{i,t} + \beta_7 GDP_t + \beta_8 inflation_{i,t} + \beta_{9-12} sector_{i,t} + \beta_{13-15} type_{i,t} + \varepsilon_{i,t} \quad (3)$$

Finally, we employ quantile regression to examine if there are significant differences in FinTech's impact on financial stability across sectors at varying phases of stability distribution. Given the heterogenous distribution of our data OLS estimates may give overestimation or underestimation of results because it summarizes the relationship based on conditional mean however Quantile regression summarizes the relation based on different quantiles which is the very robust method with non-normal distribution like in our case. This will allow us to see if the effects of fintech are uniform across the banking industry or if there are some subsets that feel its effects more strongly than others. It is possible that banks with low stability and high stability may react differently to the fintech developments, which can be more accurately assessed through quantile regression, due to the fact that multiple quantiles can be conditioned and more precise interpretations can be drawn based on the distribution of banking stability. Furthermore, as it does not take into consideration the heterogeneity in distribution of data, such as excessive skewness, outliers, etc., linear regression conditioned on mean may produce overestimation or underestimate. As a result, we implement the quantile regression approach proposed by (Koenker and Bassett 1978). For quantile regression analysis in panels, we propose the following equation:

$$Q_{y_{i,t}}(\pi|x_{i,t}) = x'_{i,t}\,\beta(\pi) + \alpha_i + \varepsilon_{i,t}$$

where $Q_{y_{i,t}}(\pi|x_{i,t})$ represents the π-th quantile of the response variable; $x'_{i,t}$ is the vector of the explanatory and control variables; α_i captures for the individual effect; $\beta(\pi)$ represents the regression parameter of the π-th quantile, and can be calculated as.

$$\text{Min } (\alpha, \beta) \sum_{k=1}^{k} \sum_{t=1}^{t} \sum_{n=1}^{n} (y_{it} - \alpha_i - x'_{it}\beta_\pi) W_{kt}$$

Where k denotes the number of quintiles, t denotes the number of years and n denote the number of banks. x'_{it} is the vector off explanatory and control variables. W_{kt} is the weight assigned to kth quantile at time t which acts as a control for the proportion of different levels of quantiles or in other words it gives the asymmetric penalties for underestimation and overestimation.

3.5 Robustness Analysis:

It is very possible that our estimation suffers from potential endogeneity due to the reverse causality between the mobile payments and bank performance and stability because it is not only newly introduced fintech firms who enjoy the digital spaces, traditional banks also accepted the competition and came with fintech products like digital lending, digital payments as a result bank level fintech products may improve their performance and thus there is chance of endogeneity through reverse causality. To account for the same, we run two-step GMM (Generalized method of moments) to ensure the robustness of results.

3.6 Summary Statistics

We begin by presenting a brief snapshot of the variables under study. Table 2 below depicts the characteristics of our data. The Z-score, which measures the stability of the bank, varies significantly across banks, from -6.76 to 10.23. Among the bank performance measures, return on equity exhibits a significantly higher level of variation. The risk measured by the standard deviation is also higher. Keeping the risk-return principle in mind, the return on equity has offered a higher average return of 4.48% compared to the return on an asset of 0.60%. Furthermore, among the control variables, GDP has by and large remained within a close range, and funding risk has indicated the maximum variation.

Table 2 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Return On Asset	530	.603	1.276	-6.85	10.22
Return On Equity	530	4.485	14.5	-76.14	24.85
Z-Score	530	.667	1.289	-6.765	10.231
Fintech Value	530	13.769	.749	12.399	14.761
Fintech Volume	530	8.485	1.568	5.994	10.896
Mobile Wallet	530	7.992	1.837	4.424	9.817
Mobile banking	530	10.964	2.492	6.213	14.037
Credit Risk	530	.558	.128	.049	.934
Default Risk	530	7.217	6.831	.001	13.931
Funding Risk	530	17.695	21.423	.023	26.732
GDP	530	18.534	.156	18.264	18.729
Inflation	530	5.826	2.171	3.4	10.28

Source: Authors' compilation

3.7 Correlation Matrix

Table 3, which presents the results of the correlation matrix, shows that both the dimensions of fintech (value as well as volume) hurt select indicators of banking performance like return on equity, assets, and capital employed. Among the control variables, credit risk, GDP, funding risk, and size have a significantly positive relationship with indicators of banking performance, while default risk and inflation have a negative relationship. Our correlation matrix also serves as an indicator for multicollinearity, in which none of the variables displays a correlation of more than 80% with another variable, therefore providing a preliminary idea of no multicollinearity.

Table 3. Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	12
(1) ROA	1.000											
(2) ROE	0.851	1.000										
(3) z-score	0.866	0.842	1.000									
(4) FT-value	-0.292	-0.315	-0.292	1.000								
(5) FT-vol	-0.210	-0.206	-0.209	0.853	1.000							
(6) M-wallet	-0.260	-0.280	-0.260	0.856	0.847	1.000						
(7) M-bank	-0.229	-0.240	-0.229	0.802	0.874	0.884	1.000					
(8) C-risk	0.069	0.108	0.025	-0.109	-0.166	-0.134	-0.147	1.000				
(9) D-risk	-0.002	-0.014	0.025	-0.049	-0.025	-0.045	-0.042	-0.208	1.000			
(10) F-risk	0.016	0.033	-0.031	-0.005	-0.006	-0.005	-0.005	0.159	-0.082	1.000		
(11) GDP	0.252	0.262	-0.252	0.848	0.774	0.789	0.783	-0.147	-0.036	-0.006	1.000	
(12) inflation	-0.256	-0.309	0.257	-0.764	-0.627	-0.732	-0.765	0.038	0.068	0.001	-0.763	1.00

Source: Authors' compilation

4. Results and Discussion

This section is dedicated to examining the impact of fintech on bank performance. Subsequently, we also examine the impact of the volume dimension of fintech on a bank's performance. Table 4 depicts the negative impact of fintech across all three indicators of banks' performance. The results are consistent across both fintech value and volume. Fintech value negatively affects ROA (-0.0052), ROE (-0.4149), and ROC (-1.211), while fintech volume also hurts ROA (-0.0044), ROE (-0.5248), and ROC (-1.016). The dimensions of fintech state that with every new transaction, there is a reduction in banks' performance across all parameters. The coefficients of banks' performance indicate that return on capital employed is the worst hit across both indicators of fintech among all indicators of banks' performance. These findings are consistent with consumer theory (1990), which argues that old bank services are bound to be replaced by new offerings and Disruptive Information Theory (1997) states that innovation-driven services find a substantial place in the

market over time. Further, in the case of return on assets Except for inflation and funding risk, all the control variables significantly affect the performance of banks. However, when tested for the other two measures, they also have a significant impact. In fact, the result for funding risk falls in line with a positive relationship. Further on expected lines Size, stability, credit risk, and GDP positively impact banking performance, while default risk negatively.

Table 4 Impact of fintech on bank performance.

Variables	**Return on Assets (ROA)**		**Return on Equity (ROE)**		**Return on capital (ROC)**	
Fintech-Val	-0.0052**	-1.941	-0.4149	-1.334	-1.211***	-3.451
Fintech-Vol	-0.0044***	-2.588	-0.5284*	-1.745	-1.016***	-3.360
M-wallet	0.0082***	4.223	0.0632*	0.277	0.205*	0.447
M-banking	0.0035***	3.027	0.2332**	1.891	0.449***	3.017
Size	0.010***	34.124	0.3264**	2.398	0.171**	2.441
Stability	0.994***	144.05	9.4624***	19.64	4.288***	29.05
Credit-risk	0.229***	47.271	16.181***	9.382	6.096***	7.449
Default-risk	-2.810***	-4.513	0.0002	0.492	-0.0001**	-2.179
Funding-risk	-1.352	-0.599	0.0125***	6.141	0.0107**	2.278
GDP	0.020**	2.300	3.1189***	3.150	7.5221***	5.040
Inflation	0.0003	0.594	0.3215***	5.464	0.180***	2.845
Constant	-0.6240***	-4.592	-59.796***	-3.455	-125.07***	-5.204
R-square	**0.9999**		**0.874**		**0.832**	
Adj R-sq	**0.9998**		**0.842**		**0.815**	
F-stat	**296716**		**354.14**		**292.61**	
Obs.	**530**		**530**		**530**	

*Note: *, **, *** denotes the significance level at 10%, 5% and 1% respectively.*

Moreover, we test if banking ownership determines the impact of fintech on banking performance. Therefore, sample firms are distributed across public, private, foreign, and cooperative banks. The study observed no impact of fintech (both value and volume-wise) on the public sector's and foreign banks' performance, as can be seen from Table 5. This could be possible because fintech units may be still in their infancy stage and small enough to affect the performance of public and foreign units, especially given the economies of scale and resources that the public sector owns. Also, it could be because fintech firms target small and risky customers, who are usually left uncovered by the former two entities (Demos, 2016; Hayashi, 2016). However, it was observed that fintech is significant and positively complements the performance of private banks. This is primarily because private banks may be quick enough to react to newly introduced technology or receive positive technological spillovers from new entrants.

Table 5 Impact of fintech on Bank performance Across Sectors

Sector	**Public sector**		**Private sector**		**Foreign banks**		**Cooperative banks**	
Variables	**ROA**	**ROC**	**ROA**	**ROC**	**ROA**	**ROC**	**ROA**	**ROC**
Fintech-value	0.0009 (0.716)	0.373 (0.423)	0.001** (2.334)	0.969** (2.219)	0.015 (1.278)	-0.641 (-1.482)	-0.003 (-1.484)	-1.73** (-2.063)
Fintech-Volume	-0.002 (-1.329)	0.775 (1.181)	0.014*** (3.610)	0.547* (1.732)	-0.005 (-0.685)	0.439 (1.286)	0.0034* (-1.958)	1.296* (-1.833)
M-wallet	0.003** (2.183)	0.365 (0.559)	0.0013** (2.027)	0.488* (1.171)	0.013 (1.446)	1.16*** (3.564)	0.0008 (0.523)	-0.657 (-0.763)
M-bank	0.0004 (0.734)	0.675*** (2.842)	0.0006** (2.5409)	0.019* (1.400)	-0.001 (-0.413)	0.280 (1.564)	0.0018** (3.863)	0.268 (0.932)
Size	0.004*** (4.302)	0.279** (0.032)	0.003*** (21.978)	0.527*** (4.529)	0.063*** (10.41)	0.91*** (13.05)	0.006*** (4.060)	0.88*** (4.327)
Stability	0.999*** (1008)	19.74*** (43.347)	0.999*** (3271.1)	4.365*** (28.105)	0.974*** (124.80)	2.411*** (30.250)	1.004*** (738.38)	1.02*** (7.183)
C-risk	0.082*** (4.883)	1.085 (0.267)	0.021** (4.798)	11.31*** (2.654)	0.655*** (6.166)	3.359** (2.384)	0.048*** (3.112)	0.483 (0.474)
D-risk	-0.002** (4.883)	-0.41*** (-3.606)	-0.01*** (-16.731)	-0.05*** (-4.180)	1.846*** (3.243)	0.002*** (-4.726)	-6.782** (-2.294)	0.047** (3.077)
F-risk	9.793*** (10.10)	0.010*** (2.777)	5.193*** (3.2105)	0.014** (4.812)	0.003** (1.993)	0.014** (2.221)	1.361 (0.250)	0.068** (3.979)
GDP	0.02*** (5.123)	1.783** 0.513	0.0034* (1.667)	2.725 (1.289)	0.168*** (4.217)	4.074** (2.346)	0.047*** (4.744)	1.137 (0.248)
Inflation	-0.001** (-2.236)	-0.009 (-0.073)	-0.005** (-4.833)	0.150*** (3.040)	0.014*** (4.774)	-0.040 (-0.508)	0.0003 (1.117)	-0.006 (-0.101)
Constant	0.379*** (3.730)	-27.33** (-0.499)	-0.083** (-2.793)	-35.816 (-1.070)	-4.64*** (-6.236)	-78.5*** (-2.84)	-0.98*** (-6.05)	-4.583 (-0.062)
r-sq	0.999	0.998	0.9999	0.853	0.998	0.962	0.9999	0.263
Adj. r-sq	0.999	0.991	0.9998	0.827	0.994	0.919	0.9994	0.241
f-stat	333672	1977.4	98597	108.08	2775.6	170.35	21052	5.34
Obs	120	120	180	180	120	120	110	110

*Note: *, **, *** denotes the significance level at 10%, 5% and 1% respectively. t-values are placed in parenthesis.*

Moreover, in many cases, fintech ventures find themselves as part of existing private banks' business setups via outsourcing, partnerships, acquisitions, etc. For private players, fintech ventures are a valuable addition to their business. Therefore, a collaboration between the two only complements their performances. Further, cooperative banks seem to have been negatively

impacted by fintech. This can be explained by the fact that cooperative banks aren't rich enough to invest in their innovation setup and avail the benefits of the fintech revolution. Moreover, in consonance with the aforementioned findings, all the control variables have almost similar results across all the sectors of banks.

Next, we investigate whether fintech impacts the financial stability of banks. It is evident from Table 6 that fintech negatively impacts the financial stability of banks across both dimensions of fintech value and volume (-0.002 and -0.0019). The risk that fintech imposes on the stability of banks could be either through micro- or macro-financial channels (FSB, 2017). Micro-financial risk arises from a single firm or sector that is exposed to shocks, while macro-financial risk refers to innovations that have the potential to generate excess volatility and contagion (FSB, 2017). Also, the study attempts to analyze if fintech influences banks' loan performance, and the results from Table 6 state that fintech value negatively affects non-performing loans, which indicate that non-performing loans of banks get reduced with the help of fintech units (yin at all 2022). Our findings show that a 1% increase in fintech value reduces non-performing loans by 1%, whereas when we use alternative proxies for fintech advancement, the power of the coefficient decreases. For example, when we use mobile wallet payments and mobile banking as proxies for fintech advancement, the power of the coefficient decreases. We observe that a 1.5% increase in fintech reduces non-performing loans by only 1.2% and 0.43%, respectively. FinTech assists by performing online document verification, checking the credentials of businesses, and determining candidates' repayment capacity. Moreover, fintech enhances government regulation and institutional mechanisms, thereby reducing corruption and improving the performance of non-performing loans. However, when the fintech volume is tested, it doesn't significantly impact banks' loan performance. Moreover, when comparing banks of varying sizes, we find that only the large banks can benefit from fintech in order to lower their NPL ratio. whereas the smaller and medium-sized banks have a positive impact of fintech on their NPL ratio, which may be attributable to the fierce competition sourced from fintech firms to lend money in the form of unsecured loans without optimizing on the quality of their borrowers. The findings are consistent on z-score across bank sizes, with a negative relationship between fintech and z-score for small and medium sized banks, indicating that fintech development is inviting instability for small and medium sized banks.

Table 6. Impact of Fintech on Bank Stability and Loan Performance.

Variable	Z-Score				Non-performing ratio			
Fintech-value	-0.002* (0.895)				-0.015** (-2.4299)			
Fintech-volume		-0.0019* (-0.991)				0.0046 (0.9028)		
M-wallet			-0.0073** (-4.618)				-0.012** (-2.2479)	
M-Banking				-0.0028** (-2.3704)				-0.0043** (-1.969)
ROA	1.004*** (1671)	1.004*** (1711)	1.004*** (2198)	1.004*** (1755.3)	-0.0301** (-13.293)	-0.030*** (-13.089)	-0.004*** (-12.264)	-0.004*** (-12.159)
Size	0.011*** (42.86)	0.011*** (43.936)	0.0112*** (49.732)	0.0111*** (43.734)	0.0047*** (5.229)	0.0047*** (5.238)	0.0043*** (5.7101)	0.0044*** (5.7691)
C-risk	0.232*** (48.53)	0.231*** (-47.11)	0.232*** (42.77)	0.233*** (53.457)	0.0015 (0.2291)	0.0009 (0.1395)	0.0319*** (7.9749)	0.0316*** (8.4947)
D-risk	2.762*** (4.623)	2.764*** (4.6195)	2.758*** (4.629)	2.757*** (4.627)	4.0186*** (16.261)	4.0276*** (16.264)	4.0076*** (15.208)	3.9824*** (15.200)
F-risk	-1.353* (-0.683)	-1.346* (-0.709)	-1.30 (0.646)	-8.275 (-8.27)	-0.001*** (-4.937)	-0.001*** (-4.9049)	-3.9845* (-1.8735)	-4.25** (-1.9504)
GDP	-0.019* (-0.019)	0.0121* (0.5387)	0.062*** (3.670)	0.0332* (1.5436)	0.0593*** (5.2135)	-0.0315 (-0.4686)	-0.0843 (-1.4588)	-0.0319 (-0.798)
Inflation	-0.0007 (-1.584)	-0.0006 (-1.560)	-0.002*** (-5.153)	-0.001*** (-2.7817)	-0.0011 (-1.244)	-0.0009 (-0.6908)	0.0023** (2.2891)	0.0006 (1.0859)
Constant	0.658*** (4.042)	0.114 (0.284)	-0.767** (-2.553)	-0.258 (-0.667)	-0.939*** (-5.414)	0.559 (0.4626)	1.440 (1.4131)	0.5277 (0.7374)
Adj- R-sq	0.9998	0.9998	0.99982	0.99981	0.619509	0.61654	0.55572	0.5577
F-stat	358967	361023	370567	362319	108.66	107.32	83.714	84.403
Obs	530	530	530	530	530	530	530	530

*Note: *, **, *** denotes the significance level at 10%, 5% and 1% respectively.*

Further, we investigate the role of the ownership structure of a bank in determining its stability. From Table 7, it can be seen that, except for private banks, the financial stability of all types of banks is exposed to potential threats from fintech. Fintech seems to complement the stability of private banks. This could be because private banks are willing to take risks and make decisions that are proactive in nature to deal with any untoward incident that may adversely affect the stability of banks in the future. Following that, in Table 8, we look at how a bank's financial stability varies by

size. It was observed that the stability of small and medium-sized banks gets significantly impacted by the fintech units, while the large banks benefit. This is because large banks are rich in resources and can quickly react to the market with appropriate actions to turn any threat into an opportunity. increase in stability for large sized banks for every 1% increase in fintech value and volume, respectively.

Table 7 Impact of Fintech on Bank Stability Across Sectors

Variables	Public-sector	Private-sector	Foreign-banks	co-op-banks
Fintech-value	-0.001* (-0.804)	0.0014** (2.1823)	-0.025** (-2.307)	-0.002 (1.167)
Fintech-volume	-0.002* (1.382)	0.001*** (3.490)	-0.012* (1.853)	-0.003* (-1.740)
M-wallet	-0.003* (-2.176)	-0.182 (-1.414)	-0.015 (-1.240)	-0.001 (-0.851)
M-banking	-0.0004* (-0.651)	0.096* (1.757)	0.003 (0.078)	-0.001*** (-2.712)
ROA	1.004*** (1005.8)	1.005*** (3352)	1.014*** (161.8)	0.994*** (606.50)
Size	-0.004*** (-4.265)	-0.003*** (-21.88)	-0.058*** (-10.14)	0.005*** (3.775)
C-risk	-0.081*** (-4.840)	0.021*** (4.913)	-0.663*** (-6.208)	-0.046*** (-3.061)
D-risk	0.002*** (8.390)	0.002*** (16.912)	-1.653*** (-3.024)	6.274** (2.150)
F-risk	-9.786*** (-10.23)	-5.127*** (-3.239)	0.0003** (2.286)	4.991* (0.090)
GDP	0.028*** (5.350)	-0.003 (-1.567)	-0.161*** (-3.668)	-0.046*** (-4.267)
Inflation	0.0012** (2.265)	0.005*** (4.878)	-0.014*** (-5.641)	-0.0003 (-0.908)
Constant	-0.390*** (-3.949)	0.080*** (2.719)	4.608*** (5.603)	0.958*** (5.559)
Adj. R-sq	0.9999	0.9999	0.9943	0.9993
F-stat	3328	10093	2625	22152
Observations	120	180	120	110

*Note: *, **, *** denotes the significance level at 10%, 5% and 1% respectively*

Table 8 Impact of Fintech on Bank Stability and Loan Performance Across Bank Size

Variables	z-score		NPL-ratio	
Small Banks				
Fintech-value	-0.07*	(-1.497)	0.03***	(4.276)
Fintech- Volume	-0.03*	(-1.047)	0.02***	(5.862)
M-Wallet	-0.06*	(-1.427)	0.016***	(3.600)
M-banking	-0.004**	(-0.287)	0.012***	(3.714)
Adj. R-square	0.908		0.761	
Observations	220		220	
Medium Banks				
Fintech- value	-0.001**	(-1.151)	0.033***	(8.716)
Fintech- Volume	-0.008***	(-4.145)	0.023***	(18.940)
M-wallet	-0.002*	(-0.510)	0.015***	(10.820)
M-Banking	-0.005***	(-3.54)	0.012***	(3.142)
Adj. R-square	0.898		0.548	
Observations	150		150	
Large Banks				
Fintech- value	1.454*	(0.109)	-0.057***	(-3.318)
Fintech- Volume	0.712**	(1.413)	-0.051*	(-3.961)
M-wallet	-0.05	(-0.412)	-0.061***	(-4.040)
M-Banking	0.003*	(0.351)	-0.029**	(-1.951)
Adj. R-square	0.919		0.764	
Observations	160		160	

*Note: *, ** , *** denotes significance at 10%, 5% and 1% respectively. t-values are placed in parenthesis.*

Further, the paper also uses the quantile regression approach to check how the coefficient of interest(fintech) varies across various quantiles of the model. The results of quantile regression are depicted below in Table 9. The sample firms are distributed across public, private, and foreign banks. Consistent with previous results, the impact of fintech on the stability of public and foreign sector banks is significantly negative. From Table 9, it is clearly depicted that results for private banks are positive from the lower end at 0.10 quantiles to the higher end at 0.90 quantiles. The coefficients of quantile are significantly higher at the lower and upper ends of 0.10 and 0.90, respectively, which indicates that the impact is more prevalent at the tail ends of the quantiles distributed. Further, the reason why fintech positively impacts bank stability follows the same explanation as has been provided above using FGLS. Our coefficient of interest in fintech (value and volume) varies across quantiles, which shows the dynamics of the problem at hand. This has been confirmed by the significance of the Wald test for banks across all sectors. The Wald test indicates that the slope coefficient for fintech (value and volume) varies across various quantiles of the model.

Table 9. Impact of fintech on bank stability(z-score) using quantile regression.

Variables	(0.10)	(0.20)	(0.30)	(0.40)	(0.50)	(0.60)	(0.70)	(0.80)	(0.90)
Public Sector Banks.									
Fintech-value	-2.493**	-1.182**	-1.079**	-1.459***	-1.338***	-1.379***	-1.152***	-0.698***	-0.718***
	(-2.310)	(-2.077)	(-2.383)	(-3.686)	(-3.802)	(-3.955)	(-2.652)	(-1.984)	(-2.748)
Fintech-volume									
	-2.276***	-1.058***	-0.998***	-1.280***	-1.115***	-0.996***	-1.011**	-0.596**	-0.418**
	(-2.668)	(-1.849)	-(2.773)	(-4.183)	(-1.115)	(-3.735)	(-3.862)	(-2.160)	(-1.905)
Constant	44.849**	14.823**	14.900**	22.013***	19.053***	16.881***	17.371**	10.379*	8.088*
	(2.410)	(1.216)	(1.964)	(3.358)	(3.409)	(3.082)	(3.335)	(1.943)	(1.795)
Pseudo R-squared			0.657						
Adjusted R-squared			0.624						
Quasi-LR statistic			96.4						
Wald test			67.21**						
Observations			120						
Private sector Banks									
Fintech-Value	0.206	0.016	0.047	0.097*	0.141**	0.134**	0.214***	0.235***	0.253***
	(1.127)	(0.259)	(0.745)	(1.573)	(2.191)	(2.016)	(3.051)	(3.719)	(4.635)
Fintech- vol.	0.094	0.007	0.027	0.058**	0.062**	0.067**	0.097***	0.125***	0.140***
	(1.626)	(0.277)	(0.941)	(2.058)	(2.241)	(2.273)	(3.220)	(4.348)	(5.514)
Constant	-4.289	-1.375**	-1.471**	-1.433***	-1.455***	-1.621***	-1.339***	-1.110***	-1.448***
	(-1.163)	(-2.016)	(-2.227)	(-2.717)	(-3.205)	(-3.889)	(-3.778)	(-3.158)	(-3.530)
Pseudo R-squared				0.518					
Adjusted R-squared				0.515					
Quasi-LR statistic				198.20					
Wald test				77.810***					
Observations				180					
Foreign Banks									
Fintech-Value	-0.513	-0.444	-0.354***	-0.278***	-0.301***	-0.247***	-0.262***	-0.216**	-0.208**
	(-1.141)	(-1.175)	(-4.034)	(-3.624)	(-3.728)	(-2.994)	(-2.793)	(-2.388)	(-2.154)
Fintech-Vol	-0.296***	-0.220*	-0.180***	-0.151***	-0.150***	-0.146***	-0.135***	-0.121**	-0.062
	(-4.024)	(-1.242)	(-4.289)	(-4.430)	(-4.386)	(-3.984)	(-3.349)	(-2.300)	(-0.999)
Constant	4.627*	3.486*	2.998**	2.682***	2.917***	3.204***	4.287***	5.027***	4.755***
	(1.676)	(1.563)	(3.010)	(3.506)	(3.987)	(4.346)	(5.167)	(5.924)	(5.081)
Pseudo R-squared				0.550					
Adjusted R-squared				0.521					
Quasi-LR statistic				167.38					
Wald test				73.059**					
Observations				120					

*Note: *, **, *** denotes the significance level at 10%, 5% and 1% respectively*

5. Robustness Analysis:

The Study tests the robustness of results using significant methodological tool of Generalized Methods of Moments (GMM). The results in Table-10 for GMM state that the impact of fintech on bank stability is negative for both fintech value & volume. This is consistent with results obtained from FGLS however the coefficient of impact shown by GMM is significantly higher at -1.228(value) & -1.124 (volume) compared to the FGLS at -0.0024 (value) & -0.0019 (volume). This is because, unlike FGLS which is a static model, GMM is a dynamic model which incorporates more information by using lag terms and is considered a robust model. Also, importantly all the control variables have shown consistent results in line with our previous findings. While size, credit risk, funding risk, GDP are positively associated with stability of a banks default risk & inflation have a negative impact. Again, the coefficients of interest are comparatively higher given the dynamics of GMM.

Table 10. Impact of Fintech on Bank Stability Using GMM

Variables	Z-score	Z-score
z-score (-1)	0.307***	0.321***
	(28.759)	(26.224)
Fintech-value	-1.228***	----------
	(-14.676)	
Fintech-Volume		-1.124***
	----------	(15.624)
Size	0.132*	0.330***
	(1.938)	(3.906)
C-Risk	7.341***	7.170***
	(14.640)	(13.074)
D-Risk	-0.0004*	-0.0004***
	(-6.37)	(-6.935)
F-Risk	0.208***	0.249***
	(5.894)	(6.580)
GDP	4.817***	12.245***
	(11.321)	(3.849)
Inflation	-0.026**	-0.136***
	(-2.039)	(-7.204)
J-statistic	33.11660	29.271
Prob(J-statistic)	0.111783	0.209

*Note: *, **, *** denotes the significance level at 10%, 5% and 1% respectively. t-values are in parenthesis.*

6 Conclusion

This paper aims to investigate how fintech has impacted the banking performance and stability in India over a sample period of the last 10 years, ranging from 2013 to 2022 for 53 Indian banks. The study found that fintech (Value and Volume) has a negative impact on the performance of banks and on usage of mobile wallet transactions and mobile banking as the proxies we find the positive influence on banking performance. However, when tested to see how this varies across banking sectors, it was found that public and foreign banks have no impact, while private banks benefit and cooperative banks get negatively affected by fintech evolution. Fintech has a negative impact on bank stability, which is consistent with the results of banking performance. Except for private banks, all the banks have a negative impact on stability. Importantly heterogeneity of impact was observed such that public sector banks and foreign banks have negative impact of fintech on stability with severity of effect at lower quantiles while private banks having the positive impact on stability with greater impact at higher quantiles. Therefore, be it banking performance or stability, private banks take the best possible advantage of fintech to add value to their own entities. The study also analyses how the loan performance of banks is affected by fintech. It was found that non-performing loans at banks get reduced with the help of fintech units. Further, when analyzed across the size of banks, we find fintech inviting the instability only in small and medium sized banks and therefore, only large-sized firms can take advantage of fintech to increase their stability and decrease non-performing loans.

Policy recommendations.

1. Based on the findings of the study, banks must use the arrival of fintech as an opportunity to benefit from the technology introduced by the fintech and must collaborate and cooperate with the fintech startups to leverage their respective strengths.
2. Traditional banks must invest in digital technologies and improve performance to deliver the best possible value to their customers with utmost security and privacy in order to facilitate wider adoption of digital finance.
3. Given the recent rise of bad-debt in public sector banks, the study recommends that policymakers of public sector entities, which are rich in resources and have economies of scale, therefore must proactively use fintech in addressing the issue of mounting bad loans.
4. Cooperation should be encouraged between public and private banks to facilitate adoption and integration of fintech solutions.

References

Aaker, D. A., & Keller, K. L. (1990). Consumer evaluations of brand extensions. *Journal of marketing*, *54*(1), 27-41

Adusei, M. (2015). The impact of bank size and funding risk on bank stability. *Cogent Economics & Finance*, *3*(1), 1111489.

Allen, F., & Gale, D. (1994). *Financial innovation and risk sharing*. MIT press.

Altunbas, Y., Evans, L., & Molyneux, P. (2001). Bank ownership and efficiency. *Journal of money, credit and banking*, 926-954.

Arner DW, Barberis J, Buckey RP (2016) FinTech, RegTech, and the reconceptualization of financial regulation. Nw J Int'l L & Bus 37:371

Berger, A. N. (2003). The economic effects of technological progress: Evidence from the banking industry. *Journal of Money, credit and Banking*, 141-176.

Board, F. S. (2017). Committee on the Global Financial System (2017): FinTech credit: Market structure, business models and financial stability implications.

Buchak, G., Matvos, G., Piskorski, T., & Seru, A. (2018). Fintech, regulatory arbitrage, and the rise of shadow banks. *Journal of financial economics*, *130*(3), 453-483.

Christensen, C., (1997) The innovator's dilemma: when new technologies cause great firms to fail, Harvard Business Review Press, Boston.

Carney, M. (2017, January). The promise of FinTech–something new under the sun. In *Speech at Deutsche Bundesbank G20 Conference, by Bank of England Governor Mark Carney, January 25th*.

Chen, M. A., Wu, Q., & Yang, B. (2019). How valuable is FinTech innovation? *The Review of Financial Studies*, *32*(5), 2062-2106.

Demos, T. (2016, April 20). Loans for Weddings: Fintech Learns to Focus. The Wall Street Journal.

Demir, A., Pesqué-Cela, V., Altunbas, Y., & Murinde, V. (2022). Fintech, financial inclusion, and income inequality: a quantile regression approach. *The European Journal of Finance*, *28*(1), 86-107.

Fang, Y., Hasan, I., & Marton, K. (2014). Institutional development and bank stability: Evidence from transition countries. Journal of Banking & Finance, 39, 160–176

Financial Stability Board (2019). FinTech and market structure in financial services: Market developments and potential financial stability implications.

Hayashi Y (2016, April 7) Consumer Watchdog Chief Sees Role for Fintech in Payday Lending. The Wallstreet Journal

Joo, B. A., & Shawl, S. (2021). Examining the FDI–growth nexus in BRICS: panel data evidence. *The Indian Economic Journal*, *69*(4), 673-687.

Koenker, R., & Bassett Jr, G. (1978). Regression quantiles. *Econometrica: journal of the Econometric Society*, 33-50.

Li, Y., Spigt, R., & Swinkels, L. (2017). The impact of FinTech start-ups on incumbent retail banks' share prices. *Financial Innovation*, *3*(1), 1-16.

Lee, C. C., Li, X., Yu, C. H., & Zhao, J. (2021). Does fintech innovation improve bank efficiency? Evidence from China's banking industry. *International Review of Economics & Finance*, *74*, 468-483

Li, J., Li, J., Zhu, X., Yao, Y., & Casu, B. (2020). Risk spillovers between FinTech and traditional financial institutions: Evidence from the US. International Review of Financial Analysis, 71, 101544

Romānova I, Kudinska M (2016) Banking and Fintech: a challenge or opportunity? In Contemporary issues in fnance: Current challenges from across Europe. Emerald Group Publishing Limited

Phan, D. H. B., Narayan, P. K., Rahman, R. E., & Hutabarat, A. R. (2020). Do financial technology firms influence bank performance? *Pacific-Basin finance journal*, *62*, 101210

Shaban, M., James, G., (2018) The effects of ownership change on bank performance and risk exposure: Evidence from Indonesia, Journal of Banking & Finance, 88, 483 -497

Sheng, T. (2021). The effect of fintech on banks' credit provision to SMEs: Evidence from China. *Finance Research Letters*, *39*, 101558.

Safiullah, M., & Paramati, S. R. (2022). The impact of FinTech firms on bank financial stability. *Electronic Commerce Research*, 1-23.

Thakor AV (2019) Fintech and banking: What do we know? J Financial Intermediation 41:1–13

Yin, F., Jiao, X., Zhou, J., Yin, X., Ibeke, E., Iwendi, M. G., & Biamba, C. (2022). Fintech application on banking stability using Big Data of an emerging economy. *Journal of Cloud Computing*, *11*(1), 1-9.