

ASSESSING THE ROLE OF THE FINTECH ERA ON THE BANKING STABILITY OF AN EMERGING ECONOMY: INTERACTION ANALYSIS OF THE INDIAN BANKING INDUSTRY

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Abstract

Research background: The rapid expansion in recent fintech innovations has garnered researchers' attention to evaluate its influence on the banking industry.

Purpose: In this quest, the current study conducts an interaction analysis to measure the impact of the fintech era on Indian banking stability.

Research methodology: Similarly to previous studies, we use a regression analysis and a Pearson correlation on the transition period of the fintech era to measure the impact of explanatory variables on the outcome variables of the Indian banking industry. Furthermore, as a robustness test, we have also used the Generalised Method of Moments system approach. This enabled us to make comparisons with similar studies.

Results: Using annual data from 1995 to 2021, the study reveals that, compared to the first fintech era, the second era assisted in reducing NPLs and enhancing financial stability in India. The study concludes

that during the second wave of the fintech revolution, through interaction analysis, explanatory variables positively influence banking stability and NPLs.

Novelty: The current study contributes toward understanding the significance of fintech development from the context of an emerging country. It also helps to interpret the importance of disruptive forces of fintech development in the banking industry.

Keywords: fintech innovations, non-performing loans, banking stability, corruption, interaction analysis, fintech first wave, fintech era

JEL classification: G21, G28

Introduction

Over the last two decades, the working of the banking sector has changed drastically. In the aftermath of the financial crisis of 2007–2008, banks worldwide have implemented several regulatory measures to limit banking sector instability. In addition to the regulatory measures, banks have also introduced various other innovative products to diversify the risk arising from uncertain situations. In continuation with these innovations and preventive methods, the exponential growth in technological advancement (Fintech) has also resulted in the development of innovative products, which helped the financial outreach activities of the banking sector. Several scholars have described the advancement of technological innovation in financial services as the fintech revolution. The word Fintech is derived from the “Financial Services Technology Consortium,” a project introduced by the Citi group to promote technological collaboration. Fintech is the amalgamation of digital technologies with financial services in simple terminology. The advancement of the fintech revolution has changed the traditional role of banking services by introducing new financial services like peer-to-peer lending, crowdfunding, digital lending, online payments, virtual currency, etc. These new e-financial services have increased the role of non-banking financial services as a service provider, resulting in interference with conventional banking Arora *et al.*, (2023)

Several scholars have described the fintech revolution as a double-edged sword. On the one hand, it reduces the banking cost by lowering the requirement of bank branches, whereas on the contrary, it also increases the operation cost required in setting up the infrastructure needed for the development of fintech technologies, especially in emerging countries. Ozili (2022) advocated that fintech lending increases the chances of non-performing loans (NPLs).

In recent years, due to the growth in the fintech revolution, fintech lending has witnessed unprecedented growth. Fintech lending has increased the affordability of easy loans for households and individuals. Magee (2011) advocated that fintech lending increases NPLs because the collateral requirement is low in fintech lending, and the legal support for loan recovery is also weak in fintech lending. However, contrary to the above requirement, Claessens *et al.* (2018) argued that the chances of default in fintech loans are comparatively low compared to the commercial bank because fintech lending provides short-term loans and these loans are more focused on the retail segment rather than the commercial sector. Both the above arguments share an inconclusive view about the impact of the fintech revolution on banking performance. In addition, few studies depict that growing fintech influence and its role in the financial sector make banking more vulnerable to competitive forces. For example, expansion in the fintech revolution lowers banking market share, reduces profit margins, and creates a more stringent regulatory framework for bank functioning. In totality, we can infer that the adverse competitive forces may have some consequences on banking stability among emerging countries in the long run Manohar *et al.* (2020), Varma *et al.* (2022).

Few studies have investigated the role of the fintech revolution on banking performance, like Ozili (2018), Phan *et al.* (2020), Ozili (2022), and Gomber *et al.* (2018). Ozili (2022) and Gongwen (2023) explored the impact of the fintech era on the banking sector NPLs. He concluded that the fintech era negatively influences the banking sector NPLs. Similarly, Thakor (2020) and Zalan and Toufaily (2017) concluded that the fintech revolution negatively influences bank performance by reducing income and market share. In contrast to the above studies, few scholars have highlighted several positive impacts of the fintech revolution. For example, fintech services help promote financial intermediation and financial inclusion, reduce poverty, and help in sustainable development (Ozili, 2018; Wang *et al.*, 2020; Afzal, 2017). However, to the authors' knowledge, no specific study has investigated the fintech era's role in India's banking sector's stability. The current paper tries to bridge this gap and add to the growing literature on the nexus between the fintech era and its impact on banking performance.

In this study, we have investigated the impact of the fintech era on Indian banking stability by segregating the fintech era into two timelines, i.e., the fintech era's first wave and the fintech era's second wave, based on the inferences from the study of Ozili (2022) and Arner *et al.* (2016). In addition, we have also included an interaction analysis to explore how the above relationship changes when these variables interact with the fintech revolution and affect the stability of the Indian banking sector.

We have included India in our empirical analysis since India is one of the fastest emerging economies endowed with a high share of the shadow economy/informal economy and an unbanked population. Also, India has a well-diversified banking structure comprising public, private, and foreign banks, and the Indian banking system is struggling with a high percentage of NPLs, i.e., more than 8 percent. Moreover, India's share of digital transactions is low compared to other emerging countries like China, and the Indian fintech market is growing tremendously. According to a Boston Consulting Group report released in March 2021, the Indian fintech market is valued at US\$31 billion and is expected to grow to US\$84 billion by 2025 (Orsolya Kovács-Ondrejko, S.2021).

In addition, the fintech transaction value size in India is projected to grow to US\$138 billion by 2023 from US\$66 billion in 2019. Considering these opportunities for the Indian fintech markets and banking conditions, we have investigated the above relationship. For the empirical analysis, we have included country-level data of Z-score to measure banking stability, along with other determinants which may influence banking sector stability during the fintech era. Due to the non-availability of fintech data, we have performed the analysis based on the fintech era instead of fintech variables. Furthermore, country-level annual data is included in the current study to avoid the problem of nonrepresentation Jain *et al.* (2023); Kaur *et al.* (2021).

The present study contributes to the large body of literature in the following ways. First, as per the authors' knowledge, this is the first study focused on the Indian banking sector and its interaction analysis with the fintech revolution. This study sheds light on how, over the years, fintech expansion has contributed to the stability of the Indian banking sector. Second, this study also incorporates two proxies to measure banking sector stability, i.e. Z-score and non-performing loans, which contributes to the literature void since most previous studies have only used the Z-score to measure banking sector stability. Thirdly, this study also incorporates institutional variables ignored in most of the previous empirical literature. The inclusion of institutional variables will contribute significantly to the literature on fintech expansion and banking sector stability. Finally, the study also employs the system GMM estimation technique, adding to the methodological novelty.

The study proceeds as follows: Section 1 discusses in detail the empirical literature available on the above issue; Section 2 presents the methodology and the empirical framework; Section 3 covers the analysis and discussion of the results; and the last section highlights the concluding remarks and policy recommendations.

1. Literature review

The subsequent sections discuss the literature on the nexus between fintech evolution, financial sector performances, and the determinants of banking sector stability.

1.1. The empirical and theoretical literature on the fintech evolution and financial sector performance

Over the past few years, several scholars have empirically examined the influence of the digital transition of financial services on the financial sector's performance. Ozili (2022) explored the influence of the fintech revolution on the banking sector NPLs of 35 countries. He concluded that the transition in the fintech evolution during the second wave has a negative impact on the banking NPLs. Likewise, during the global financial recession, Pierri and Timmer (2020) investigated the role of IT innovation on banking NPLs. They concluded that banks that use more IT services in banking transactions have fewer NPLs. In context to competition and market share, Hau *et al.* (2019) reveal that fintech credit providers in China enjoy an added competitive advantage compared to traditional commercial banks. Therefore, it negatively influences commercial banks' market share and performance. Ozili (2022) also supported the above findings of Imran and Rehman (2024). In addition, he added that due to the cost-competitive advantage of fintech lenders, traditional commercial banks report their earnings after considering the abnormal fluctuation caused by the competitive advantages of fintech service providers. Likewise, Buchak *et al.* (2017) advocated that rural banks are losing their share of bank loans because of the expansion of peer-to-peer lending. Regional and rural banks are also resorting to riskier lending in response to the rampant competition from P2P lending. Romanova and Kudinska (2017), while analysing the opportunities and threats of fintech services to the banking industry, concluded that because of the evolution of fintech services, the banking industry is facing tough competition from non-banking financial companies. The study further added that as most banking products are information-based, they can be easily availed from fintech service providers. Therefore, it hampers the business prospects of traditional banking. However, they further conclude that the banking sector's timely adaptation of fintech services will also improve its performance in the long run. Supporting the above arguments, Politico (2016) raised concern regarding the regulation and supervision of fintech services and their impact on US banking regulations. He argued that the issues of lending disparity, misuse of banking data, and disclosure issues of small enterprises raise some banking apprehension for the regulators in the long run.

Based on the above studies, we can conclude that the expansion of digital financial services creates excessive pressure on traditional commercial banking. For example, it leads to a partial loss of market share due to new competitors (especially in payments, credit cards, and simple savings); it creates additional margin pressure. Consequently, lower revenues increase operational risk and fraud, erode face-to-face customer-banker relationships, and increase growing bank dependence on financial services technology solutions, hampers banking productivity and performance, especially in the short run. However, several studies have highlighted the positive influence of the fintech era on banking performance and efficiency. For instance, Cortina and Schmukler (2018) advocated that the expansion of fintech services has a low negative consequence on financial services. In addition, they quoted that only 1 percent of consumer banking revenue loss is witnessed in North America due to the expansion of fintech services. Navaretti *et al.* (2017) concluded that traditional banks, prominently large commercial banks, are indifferent to fintech services. These large banks have realised that the fintech era is not temporary. Therefore, they have already started complimenting digital financial services to sustain in the long run, as moving with the fintech revolution will be more beneficial.

Likewise, Weweg *et al.* (2020) suggested that financial service innovation complements the banking industry. Fintech innovation assists banks in providing customer-centric products with fast and cost-effective financial transactions and boosts financial sector outreach activities. The studies conducted by (Haas *et al.*, 2015; Setia *et al.*, 2013) support the above findings and highlight the positive aspects of the fintech era on banking sector performance. Based on the above literature review, we can infer that the issue of the fintech era and its impact on banking sector performance are still debatable. Some scholars argue that the fintech era benefits the banking sector because of its added advantages toward banking sector performance. For instance, Fintech helps lower banking operating costs, increases financial outreach activities, helps convert the unbanked population into the banked population, etc.

Furthermore, another strand of literature depicts that expansion in the fintech era negatively influences banking sector performance. These studies highlight that augments in the fintech era result in lower profit margins for traditional banks, which increases the chances of financial fraud and lowers commercial banks' market share. Against this backdrop, we tried to revisit the nexus of the fintech era and banking sector performance by investigating how the different fintech waves influence banking stability in India. The subsequent section discusses the available literature on the determinants of banking sector stability.

1.2. Literature on the determinants of banking sector stability

Banking sector stability is one of the main objectives of central banks and the regulators to ensure the proper functioning of financial systems. The stability of the banking sector is important because high instability leads to the collapse of banks, which eventually hampers economic development (Vo *et al.*, 2019). Numerous scholars have measured the determinants of banking sector stability by including bank-specific and macroeconomic factors. For instance, Segoviano and Goodhart (2009) highlighted the role of economic growth and unemployment in banking sector stability. Boateng *et al.* (2016) advocated the role of banking lending practices, liquidity, and profitability for a stable banking environment. Fratzscher *et al.* (2016) emphasised the importance of institutional regulation towards maintaining a robust banking environment. In addition to the above studies, several other scholars have also examined the influence of different determinants of banking sector stability. For example, Ijtsma *et al.* (2017) explored the role of banking concentration on banking stability, Liu, Molyneux, and Wilson (2013), and Schaeck and Cihák (2014) investigated the influence of competition on banking stability, and Ozili (2018) measured the role of banking asset quality and the level of financial development on banking stability. We can infer from the above literature that adequate studies have examined the various determinants of banking stability; however, as per the authors's knowledge, no specific study has investigated how these determinants reacted during the different fintech eras with banking sector stability. Based on this literature gap, we have tried to investigate how the determinants influenced banking stability during the first and second waves of the fintech revolution. We have attempted to address the question of whether Fintech's first and second waves have any role in banking sector stability.

Furthermore, to make the study more comprehensive, we have included NPLs, banking, and Z-score as proxies to measure banking sector stability. We have included the above proxies to measure banking stability because, in most previous studies, only either a Z-score or NPLs are used as a proxy to measure banking stability (Phan *et al.*, 2020; Ghosh, 2015; Dwumfour, 2017; Fernández *et al.*, 2016). Hence, combining both proxies will contribute to the literature and provide more robust estimates.

1.3. Hypothesis

Based on the above comprehensive literature review, the current study attempts to explore the following hypothesis:

H₀: The Fintech Revolution positively impacts the stability of the Indian banking sector.

H₁: The Fintech Revolution negatively impacts the stability of the Indian banking sector.

2. Research methodology

In the current study to investigate the influence of the fintech era on banking sector stability, we have included the following proxies. We have included the percent of non-performing loans to total loans and Z-score as the proxy variables to measure banking sector stability. The Z-Score is calculated as a weighted average of the Z-scores of a country's individual banks (the weights are based on the individual banks' total assets). The Z-score compares a bank's buffers (capitalisation and returns) with the volatility of those returns. It is estimated as $(ROA + (\text{equity/assets}))/\text{Standard Deviation (ROA)}$ (Lepetit, Strobel, 2015). In addition, economic growth rate, corruption, institutional, legal framework, government stability, interest rate, credit-to-GDP ratio, and banking credit-to-deposit ratio are included as explanatory variables. The above explanatory variables are included based on the above comprehensive literature review. Furthermore, to measure the impact of the fintech era, we have segregated the total period of the current study into the first wave and the second wave of the fintech era. The Arner *et al.* (2016) and Ozili (2022) fintech era classification is taken as a benchmark to determine which year belongs to the first fintech wave and the second fintech wave.

The fintech era's first stage is led by the evolution of traditional banks with fintech innovations, whereas the second stage is dominated by new entrants and more specialised and advanced fintech institutions and lenders. Therefore, based on these fintech evolutions and their influence on traditional banking, we have analysed Indian banking stability from 1995 to 2021, including the timeline of the first and second waves of the fintech era. The explanatory and outcome variables data are extracted from the International Financial Statistics database, International Monetary Fund and Bank for International Settlement database (Vide Table 1).

We have used the following equation to measure the influence of various determinants on banking sector instability (i.e. The model framework used to analyse the determinants of banking sector stability).

$$NPL_{i,t} = c + \beta_1 GDP_{i,t} + \beta_2 Cor_{i,t} + \beta_3 Ir_{i,t} + \beta_4 Bc_{i,t} + \beta_5 GS_{i,t} + \beta_6 Int_{i,t} + \beta_7 CGDP_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$ZScore_{i,t} = c + \beta_1 GDP_{i,t} + \beta_2 Cor_{i,t} + \beta_3 Ir_{i,t} + \beta_4 Bc_{i,t} + \beta_5 GS_{i,t} + \beta_6 Int_{i,t} + \beta_7 CGDP_{i,t} + \varepsilon_{i,t} \quad (2)$$

Equations 1 and 2 are further extended to include the interaction analysis. The equation formulated after including the fintech second wave interaction variable is as follows:

$$\begin{aligned}
NPL_{i,t} = & c + \beta_1 GDP_{i,t} + \beta_2 Cor_{i,t} + \beta_3 Ir_{i,t} + \beta_4 Bc_{i,t} + \beta_5 GS_{i,t} + \beta_6 Int_{i,t} + \\
& + \beta_7 CGDP_{i,t} + \beta_8 FIN2_{i,t} + \beta_7 GDP \times FIN2_{i,t} + \beta_8 Cor \times FIN2_{i,t} + \\
& + \beta_9 IR \times FIN2_{i,t} + \beta_{10} Bc \times FIN2_{i,t} + \beta_{11} GS \times FIN2_{i,t} + \\
& + \beta_{12} INT \times FIN2_{i,t} + \beta_{13} CGDP \times FIN2_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{3}$$

$$\begin{aligned}
ZScore_{i,t} = & c + \beta_1 GDP_{i,t} + \beta_2 Cor_{i,t} + \beta_3 Ir_{i,t} + \beta_4 Bc_{i,t} + \beta_5 GS_{i,t} + \\
& + \beta_6 FIN2_{i,t} + \beta_7 GDP \times FIN2_{i,t} + \beta_8 Cor \times FIN2_{i,t} + \\
& + \beta_9 Ir \times FIN2_{i,t} + \beta_{10} Bc \times FIN2_{i,t} + \beta_{11} GS \times FIN2_{i,t} + \\
& + \beta_{12} INT \times FIN2_{i,t} + \beta_{13} CGDP \times FIN2_{i,t} + \beta_{12} INT \times FIN2_{i,t} + \\
& + \beta_{13} CGDP \times FIN2_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{4}$$

Table 1. The phase of the fintech evolution

Fintech Progression				
Evolution	First Wave		Second Wave	
Era	1866–1967	1967–2007	2008–Present	
Geography	Global/Developed countries	Global/Developed countries	Developed countries	Emerging/Developed countries
Key elements	Infrastructure/computerisation	Traditional/internet	Mobile/Start-ups/New entrants	
Shift Origin	Linkages	Digitalisation	2008 Financial Crisis/Smartphone	Last Mover Advantage

Source: Adapted from the study of Arner *et al.* (2016).

Where NPL represent non-performing loans to total loans, the Z-score is used to measure banking sector stability, ‘Cor’ is used to describe the corruption index, ‘Lg’ is used to describe the legal and regulatory framework, BC is used to represent bank credit to deposit ratio, GS denotes government stability, ‘Int’ represents interest rate, CGDP denotes credit to GDP ratio, FIN 2 is used to describe the fintech second wave, i represents the country, t describes the time period, ε is used to show the error term, and c is the constant. All the variables are included in their natural log form. Finally, we estimated the linear relationship among the variables using a regression and Pearson correlation.

In addition to the regression and Pearson correlation, we have also employed the GMM estimation system developed by Arellano and Bover (1995) and Blundell and Bond (1998). Traditional regression methods like ordinary least square, fixed, and random effect models sometimes show econometric errors due to their static natures. Thus, the GMM model is used to avoid these biases as it considers instrumental variables. This model combines differences

with the regression in levels and uses the lagged values of the dependent and other explanatory variables as the instruments for the regression in differences and the lagged differences of the explanatory variables as the instruments for the regression in levels. Furthermore, the GMM technique is more appropriate for analysing small sample sizes and unbalanced data. This model is also superior because it avoids the problems of autocorrelation, heteroscedasticity, reverse causality and bias. Moreover, the two necessary robustness tests, i.e., the Sargan–Hansen test and the Arellano-Bond test, also assist in testing for over-identifying restrictions and autocorrelation in the model.

In the current analysis, we have included seven explanatory variables. Economic growth is included because previous literature concludes that expansion in economic activities increases banking profitability and capital buffer, eventually increasing banking stability. Higher economic growth promotes high income and employment opportunities, reducing debt obligations. Hence, we assume a negative relationship between economic growth and banking stability.

The corruption index is included because countries facing higher corruption levels have a higher chance of banking instability. Corruption induces loan default and internal conflicts within the organisation, which may positively impact banking stability (Toader *et al.*, 2018). The institutional regulatory index is also included as an explanatory variable because the quality of the institutional regulation promotes organisational efficiency and productivity. Thus, we can assume a positive association between institutional regulation and banking sector stability. Next, we have also taken the bank credit-to-deposit ratio as an independent variable because previous studies have concluded that expansion in economic development leads to higher credit growth and investment opportunities. Expansion in credit distribution without proper monitoring may impact banking stability. However, tight monitoring may enhance the banking sector's stability by increasing the banking capital buffer and profitability. In addition to the bank credit-to-deposit ratio, we have also included the credit-to-GDP ratio to measure the overall impact of credit expansion on banking sector stability. Most previous studies conclude that credit expansion without proper regulation and supervision is detrimental to banking sector stability. Therefore, we assume a negative association between banking stability and credit to GDP ratio (Fratzscher *et al.*, 2016; Syed *et al.*, 2022). Government stability is also included because previous literature exhibits that a stable government promotes low economic policy uncertainty (Murshed, Saadat, 2018). Low economic policy uncertainty enhances the development and progress of a country and eventually leads to stability in the functioning of various industries. Therefore, we assume a positive relationship between government stability

and banking stability. Interest rate is also added as an explanatory variable because extant literature projects that higher interest rates negatively hampers debt servicing capabilities, creating a downward fall on banking sector stability. We assume a negative relationship between banking sector stability and interest rates (Ghosh, 2022; Syed *et al.*, 2021; Syed, 2024).

Finally, FIN2 is taken as a binary variable that assumes values 1 from 2008–2021 and 0 from 1995–2008. FIN2 is used to depict the influence of the second wave of the fintech era on banking sector stability. Here, we assume that FIN2 positively impacts banking sector stability. Technological innovation and the growth in fintech products with adequate monitoring facilities may reduce banking instability in the long run. Table 2 shows the description of the variables and their expected relationship.

Table 2. Variables and their probable sign with the dependent variable

Abbreviations	Probable Relationship	Variables' names
GDP	+	Countries growth rate
Cor	–	Corruption index
Ir	+	Institutional regulatory index
Bc	+	Bank credit to deposit ratio
Gs	+	Government Stability
CGDP	–	Credit to GDP ratio
Int	–	Interest rate
FIN2	+	Fintech Second Wave

Source: authors' compilation.

3. Results and analysis

3.1. Descriptive statistics

Table 3 shows the descriptive statistics of explanatory and outcome variables during the first and the second wave of the fintech era. The descriptive statistic shows that during the second wave of the fintech revolution, the mean value of GDP (5.67), corruption (2.45), bank credit to deposit ratio (75.76), credit to GDP ratio (101.34) and the Z-Score (17.06) has increased compared to the first wave of the fintech revolution. Whereas the mean score of NPLs (5.68), Institutional regulation (–0.27), Interest rate (3.40) and government stability (7.22) have fallen during the second wave of the fintech era as compared to the first Fintech. It implies that banking stability, credit distribution, economic growth, and corruption have

increased during the second wave, whereas institutional regulation, non-performing loans, and government stability have reduced compared to the first wave of the fintech era. However, the descriptive statistic also shows that the difference in the mean value of government stability and institutional regulation is scanty between the first and second eras of fintech expansion.

Table 3. Descriptive statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev
Fintech First Wave					
GDP	6.24	6.86	8.84	3.80	1.95
Corruption	2.39	2.50	3.00	1.50	0.55
Institutional regulatory	-0.35	-0.35	-0.15	-0.55	0.10
Bank credit to deposit ratio	63.38	61.88	70.52	60.87	3.17
Government Stability	8.36	8.39	10.08	7.54	0.73
Interest rate	5.03	5.61	7.12	4.09	0.72
Credit to GDP ratio	75.72	79.27	87.21	53.12	3.19
NPLs	9.11	9.60	14.7	2.70	4.36
Z-Score	14.92	15.27	17.55	10.58	2.19
Fintech Second Wave					
GDP	5.67	6.93	8.68	-6.60	3.95
Corruption	2.45	2.50	2.50	2.00	0.15
Institutional regulatory	-0.27	-0.27	-0.08	-0.47	0.09
Bank credit to deposit ratio	75.76	75.71	79.10	71.96	1.64
Government Stability	7.22	7.81	8.41	5.33	1.18
Interest rate	3.41	3.41	5.68	1.80	1.09
Credit to GDP ratio	101.34	103.75	111.70	84.40	4.12
NPLs	5.68	5.11	9.98	2.20	2.84
Z-Score	17.06	17.05	19.44	14.98	1.16

Source: authors' compilation.

3.2. Correlation Analysis

After analysing the descriptive statistics, we evaluated the variables' correlation relationship. Table 4 presents the results of the correlation analysis. The Pearson correlation coefficient shows that NPLs negatively correlate with the fintech second wave. It implies that NPLs have reduced during the second wave of the fintech revolution. In addition, the results also show that institutional regulation, banking, and government stability are negatively correlated with NPLs. The above findings also collaborate with the results of Ozili (2022).

Conversely, corruption, interest rate, credit-to-GDP ratio and bank credit-to-deposit ratio are positively associated with NPLs. This shows that corruption levels, interest rates, credit-to-GDP ratios, and bank-credit-to-deposit ratios enhance NPLs, whereas tight institutional regulation and stable government help reduce banking sector NPLs. These outcomes are in line with the work of Son *et al.* (2020), Mohamad and Jenkins (2021).

On the other hand, in terms of the Z-score, correlation results show that the second wave of Fintech is positively associated with the Z-Score (proxy of banking stability). It implies that banks are more stable during the second wave of the fintech revolution. Likewise, the result also reveals that corruption, interest rate, credit to GDP ratio and bank credit are negatively associated with banking stability (Z-score). In comparison, institutional regulation and government stability positively correlate with the banking Z-score. It signifies that corruption level, interest rate, and credit to GDP ratio. Also, the bank credit-to-deposit ratio reduces banking stability, whereas institutional regulation quality, government stability, and Fintech development enhance banking sector stability in India. The above results align with the study of Daud *et al.* (2022).

Table 4. Correlation analysis

	NPLs	Z-Score	Cor	Ir	Bc	Gs	GDP	Int	CGDP	FIN2
NPLs	1.000									
Z-Score	-0.015*	1.000								
Cor	0.042**	-0.256*	1.000							
Ir	-0.213*	0.175***	0.142	1.000						
Bc	0.289*	-0.274*	0.478	0.278	1.000					
Gs	-0.271	0.368*	0.105**	0.388*	0.176	1.000				
GDP	-0.003**	0.072*	-0.297*	0.688**	0.531*	0.214***	1.000			
Int	0.076**	-0.176**	0.063	0.031	0.071*	0.040	0.082	1.000		
CGDP	0.140**	-0.498*	0.019*	-0.078	0.142*	0.320*	0.367*	0.250	1.000	
FIN2	-0.142**	0.164*	0.018	0.218	0.267*	0.276*	0.134*	0.119	0.162	1.000

Ref: *, **, *** refer to the level of significance at 10, 5 and 1 percent, respectively.

Source: authors' compilation.

Table 5 reports the findings of the regression analysis. The results show that corruption positively impacts NPLs (0.743) and the banking Z-score (-0.613). It implies that banking stability decreases (increases) with the increase (decreases) in the level of corruption. In addition, based on the coefficient value of explanatory variables, we can infer that NPLs reduce and banking

stability (Z-score) increases with the increase in institutional regulation (−0.013, 0.207), economic growth (−0.197, 0.687), and government stability (−0.419, 0.119). Moreover, in terms of interest and credit growth, the results infer that with an increase in credit growth and interest rate, NPLs increase (0.460, 219), whereas banking stability decreases (−0.219, −0.234). The study of Ofria and Mucciadri (2022) on European countries also strengthens the above empirical outcomes. They concluded that higher corruption, low economic growth, high-interest rates and weak institutional regulation increase non-performing loans in some European economies.

Table 5. Regression analysis

	Dependent Variable NPLs			Dependent Variable Z-Score		
	coefficient (T-stat) (1)	coefficient (T-stat) (2)	coefficient (T-stat) (3)	coefficient (T-stat) (1)	coefficient (T-stat) (2)	coefficient (T-stat) (3)
C	5.089 (3.18)	6.289 (3.12)	6.812 (3.19)	5.017 (2.23)	6.021 (2.18)	7.119 (2.29)
Cor	0.743 (2.08)**	0.318 (1.82)	0.672 (3.39)	−0.613 (2.87)*	0.519 (2.19)	0.598 (2.09)
Ir	−0.013 (2.05)*	0.827 (4.12)	0.287 (3.18)	0.207 (2.19)*	0.318 (2.82)	0.318 (3.29)
Bc	0.382 (2.21)*	0.387 (2.21)	0.419 (0.72)	−0.318 (3.06)	0.198 (1.08)	0.492 (0.67)
Gs	−0.419 (2.18)**	0.237 (1.09)	0.429 (2.56)	0.119 (3.09)*	0.232 (2.19)	0.287 (1.22)
GDP	−0.197 (2.93)*	0.671 (3.19)	0.014 (1.09)	0.687 (2.41)**	0.278 (2.89)	0.278 (2.89)
Int	0.460 (2.90)***	0.279 (1.29)	0.417 (2.67)	−0.319 (3.12)**	0.362 (3.39)	0.219 (2.47)
CGDP	0.219 (2.00)***	0.587 (2.25)	0.019 (2.18)	−0.234 (2.07)**	0.318 (2.19)	0.312 (2.83)
FIN2		−6.219 (−3.05)*	−6.198 (−2.32)**		6.441 (3.03)*	6.782 (2.19)**
FIN2*Cor		−0.009 (−2.12)**	−0.212 (−1.67)**		−0.519 (−2.71)**	0.332 (2.29)**
FIN2*Ir		−0.017 (−2.18)*	−0.117 (−2.09)*		0.073 (3.17)*	0.049 (2.18)*
FIN2*Bc		0.443 (3.87)*	0.072 (2.74)*		0.092 (3.19)*	0.069 (2.79)*
FIN2*Gs		−0.507 (−2.19)**	−0.043 (−3.58)**		0.072 (2.21)**	0.078 (3.41)**
FIN2*GDP		−0.772 (−2.02)*	−0.075 (−2.76)*		0.412 (3.19)*	0.209 (3.41)*
FIN2*Int		0.219 (2.07)**	0.019 (−0.51)**		−0.081 (−3.16)**	−0.070 (−2.42)**
FIN2*CGDP		−0.132 (−2.22)*	−0.071 (−1.19)*		0.219 (2.78)*	0.318 (2.19)*
R ²	66.19	55.32	63.17	62.10	61.19	58.08
Adjusted R ²	61.29	53.17	60.13	57.29	58.02	56.07
F-statistics	9.18	11.21	12.14	11.19	10.76	13.16
Prob(F-stat)	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000

Ref: *, **,*** refer to the level of significance at 10, 5 and 1 percent, respectively.

Source: authors' compilation.

In addition to the above analysis between the determinants of NPLs and the Z-score, we have also included the interaction analysis results. The interaction analysis depicts how

the determinants of NPLs and banking stability react to the expansion of the second wave of the fintech revolution compared to the first wave. The findings report that the second wave of FinTech has assisted in reducing NPLs and increasing banking sector stability (Z-Score). The coefficient values of FIN2 are negative for NPLs and positive for the Z-score. The expansion in fintech services has resulted in the increase of fintech lenders, which have reduced the credit demands of conventional banks and have assisted in reducing NPLs. Another reason is that the increase in fintech services has improved loan monitoring and tracking services, eventually lowering NPLs and improving banking sector stability. The above findings also collaborate with the outcome of the study conducted by Yin *et al.* (2022) on the Chinese banking sector. The authors concluded that expansion in the fintech services during the second wave of the fintech revolution assisted in reducing the non-performing loans of the Chinese banking sector.

In addition, the above interaction results also conclude that the second wave of the fintech era has reduced corruption, improved institutional regulation, and promoted government stability and growth, which cumulatively assisted in reducing NPLs and increasing banking sector stability. The results show that the coefficient value of the explanatory variable (FIN2*Cor, FIN2*Ir, FIN2*Gs, FIN2*GDP, FIN2*CGDP) is negative in the case of NPLs and positive for the Z-score, except for interest rate. The study reveals that the second wave of FinTech cannot mitigate the adverse shocks of interest rate fluctuations. Hence, considering the other explanatory variables, we can conclude that during the second wave of the fintech era, the Indian banking condition has improved, banks are more stable, and the non-performing loans have reduced compared to the first wave of the fintech revolution. This also validates our null hypothesis (H_0) that the fintech era positively influences the stability of the Indian banking sector and rejects the alternative hypothesis (H_1). Our findings align with Ozili's (2022), Pierri, and Timmer's (2020) results.

Furthermore, we have also used GMM as a robustness test to substantiate the regression estimate. The result of the GMM (Table 6) collaborates with the empirical outcomes of the regression model. It concludes that the fintech second wave, when interacting with explanatory variables like corruption, institutional regulation, government spending, economic growth and credit distribution, assists in reducing non-performing loans and improving banking sector stability. Finally, the value of Sargen Hansen and AR(2) also validate the suitability of the GMM model.

Table 6. Robustness Test: GMM

	Dependent Variable NPLs		Dependent Variable Z-Score	
	coefficient (T-stat) (1)	coefficient (T-stat) (2)	coefficient (T-stat) (1)	coefficient (T-stat) (2)
Cor	0.816 (1.04)***	0.270 (2.19)	−0.837 (2.79)**	0.374 (1.09)
Ir	−0.536 (2.04)*	0.917 (3.02)	−0.176 (3.17)**	0.293 (2.71)
Bc	0.208 (1.19)*	0.261 (1.17)	−0.278 (2.86)***	0.207 (2.78)
Gs	−0.379 (3.69)***	0.189 (2.09)	0.116 (4.08)**	0.274 (4.30)
GDP	−0.108 (2.78)***	0.501 (5.17)	0.784 (3.62)**	0.215 (2.04)
Int				
CGDP				
FIN2		−7.105 (−4.04)***		8.642 (4.23)*
FIN2*Cor		−0.008 (−2.02)***		−0.018 (−3.92)**
FIN2*Ir		−0.014 (−1.08)*		0.032 (4.07)*
FIN2*Bc		−0.319 (−3.19)*		0.059 (2.86)***
FIN2*Gs		−0.418 (−4.07)***		0.081 (3.16)**
FIN2*GDP		−0.513 (−3.01)**		0.381 (3.41)**
FIN2*Int		0.110 (2.21)**		−0.207 (−2.18)**
FIN2*CGDP		0.518 (3.18)*		−0.012 (−2.89)*
R ²	64.31	53.76	60.11	59.81
Sargan Hansen test	59.03	51.23	52.17	53.62
AR(2)	9.03	10.09	10.31	11.42

Ref: *, **,*** refer to the level of significance at 10, 5 and 1 percent, respectively.

Source: authors' compilation.

Conclusions

The current study explores the influence of the fintech era on the Indian banking sector's stability and non-performing loans. To measure the impact of the fintech era, we have segregated the data into the first and second eras of the fintech revolution following the work of Arner *et al.* (2016). The findings of our study conclude that Fintech's second era has a significant positive impact on the Indian banking sector's stability and NPLs. During the second wave, the rapid expansion of fintech services has assisted in reducing NPLs and improving banking stability (Z-score). The findings from the interaction analysis conclude that the second era of the fintech revolution has positively impacted the explanatory variables, which has improved the banking sector's stability. Advancements in the fintech revolution have created an advanced monitoring and tracking environment. In addition, it also supplements conventional banking by providing

easy credit through the expansion of fintech lenders. Fintech innovation also creates new opportunities for investment and growth. Thus, these cumulative benefits of the fintech second era have assisted in reducing NPLs and improving the banking sector's stability.

The findings of the current study offer the following policy recommendations. First, we can infer that fintech expansion is a progressive measure for developing countries, as it helps to improve banking stability. Therefore, policymakers in developing countries must ensure the expansion of fintech services. Adequate measures are also required to avoid the apprehension of fintech lenders and innovations from the perceptions of borrowers and the public. Second, we recommend that banks should use more Fintech credit monitoring services to control and monitor NPLs. Third, as private sector loans are riskier, banking officials should also take the initiative to include fintech lenders in providing loans to private-sector borrowers. Fourth, bank officials should also consider the disruption of fintech lenders and their impact on conventional banks toward stress testing. Finally, policymakers should also inculcate fintech innovations toward evaluating the creditworthiness of borrowers.

The strength of the present study is that this is the first study in the Indian banking sector that conducts an interaction analysis between the fintech era and the determinants of banking sector stability and NPLs. Unfortunately, due to the lack of data availability for all the explanatory and outcome variables, the present study's contribution could not be extended beyond 2021, and the study is focused only on the Indian banking sector. However, these limitations also serve as a potential direction for future researchers who can expand the study by increasing the sample size or including new and emerging blocs in the empirical analysis.

Future direction and limitation of the study

This study aims to analyse the impact of the fintech revolution on the stability of the Indian banking sector. However, it is important to note that the impact may not be linear and could have nonlinear effects. This limitation should be considered for future research.

References

- Arner, D.W., Barberis, J., Buckey, R.P. (2016). FinTech, RegTech, and the reconceptualisation of financial regulation. *Nw. J. Int'l L. & Bus.*, 37, 371.
- Arora, M., Gupta, J., Mittal, A. (2023). Adoption of food delivery apps during a crisis: exploring an extended technology adoption model. *Global Knowledge, Memory and Communication*.
- Barba Navaretti, G., Calzolari, G., Pozzoli, A. (2017). Getting Rid of NPLs in Europe. *European Economy*, 1, 11–30.
- Boateng, H., Adam, D.R., Okoe, A.F., Anning-Dorson, T. (2016). Assessing the determinants of Internet banking adoption intentions: A social cognitive theory perspective. *Computers in Human Behavior*, 65, 468–478. DOI: 10.1016/j.chb.2016.09.017.
- 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. DOI: 10.1016/j.jfineco.2018.03.011
- Claessens, S., Frost, J., Turner, G., Zhu, F. (2018). Fintech credit markets around the world: size, drivers and policy issues. *BIS Quarterly Review September*, 29–40.
- Cortina Lorente, J.J., Schmukler, S.L. (2018). The Fintech Revolution: A Threat to Global Banking? *World Bank Research and Policy Briefs* (125038).
- Daud, S.N.M., Khalid, A., Azman-Saini, W.N.W. (2022). FinTech and financial stability: Threat or opportunity? *Finance Research Letters*, 47, 102667. DOI: 10.1016/j.frl.2021.102667.
- Dwumfour, R.A. (2017). Explaining banking stability in Sub-Saharan Africa. *Research in International Business and Finance*, 41, 260–279. DOI: 10.1016/j.ribaf.2017.04.027.
- Fernández, A.I., González, F., Suárez, N. (2016). Banking stability, competition, and economic volatility. *Journal of Financial Stability*, 22, 101–120. DOI: 10.1016/j.jfs.2016.01.005.
- Fratzscher, M., König, P.J., Lambert, C. (2016). Credit provision and banking stability after the Great Financial Crisis: The role of bank regulation and the quality of governance. *Journal of international money and finance*, 66, 113–135. DOI: 10.1016/j.jimonfin.2016.02.015.
- Ghosh, A. (2015). Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states. *Journal of financial stability*, 20, 93–104. DOI: 10.1016/j.jfs.2015.08.004.
- Ghosh, S. (2022). Financial inclusion and banking stability: Does interest rate repression matter? *Finance Research Letters*, 50, 103205.
- Gomber, P., Kauffman, R.J., Parker, C., Weber, B.W. (2018). On the fintech revolution: Interpreting the forces of innovation, disruption, and transformation in finan-

- cial services. *Journal of Management Information Systems*, 35(1), 220–265. DOI: 10.1080/07421222.2018.1440766.
- Haas, P., Blohm, I., Peters, C., Leimeister, J.M. (2015, December). Modularisation of crowd-funding services: Designing disruptive innovations in the banking industry. *Association for Information Systems*. Retrieved from <https://www.alexandria.unisg.ch/publications/244075>.
- Hau, H., Huang, Y., Shan, H., Sheng, Z. (2019, May). How FinTech enters China's credit market. *AEA Papers and Proceedings*, 109, 60–64. DOI: 10.1257/pandp.20191012.
- Ijtsma, P., Spierdijk, L., Shaffer, S. (2017). The concentration–stability controversy in banking: New evidence from the EU-25. *Journal of Financial Stability*, 33, 273–284. DOI: 10.1016/j.jfs.2017.06.003.
- Imran, M., Rehman, Z.U. (2024). Interplay of Government Support and Foreign Investment in Enhancing R&D in China's Strategic Sectors. *J. Organ. Technol. Entrep.*, 2(1), 1–13. DOI: 10.56578/jote020101.
- Jain, R., Kumar, S., Sood, K., Grima, S., Rupeika-Apoga, R. (2023). A Systematic Literature Review of the Risk Landscape in Fintech. *Risks*, 11(2), 36.
- Kaur, B., Kiran, S., Grima, S., Rupeika-Apoga, R. (2021). Digital banking in Northern India: The risks on customer satisfaction. *Risks*, 9(11), 209.
- Lepetit, L., F. Strobel. (2015). Bank insolvency risk and Z-score measures: A refinement. *Finance Research Letters* 13, 214–224.
- Liu, H., Molyneux, P., Wilson, J.O. (2013). Competition and stability in European banking: a regional analysis. *The Manchester School*, 81(2), 176–201. DOI: 10.1111/j.1467-9957.2011.02285.x.
- Magee, J. (2011). Peer-to-peer lending in the United States: surviving after Dodd-Frank. *North Carolina Banking Institute Journal*, 15, 139–174.
- Manohar, S., Mittal, A., Marwah, S. (2020). Service innovation, corporate reputation and word-of-mouth in the banking sector: A test on multigroup-moderated mediation effect. *Benchmarking: An International Journal*, 27(1), 406–429.
- Mohamad, A., Jenkins, H. (2021). Corruption and banks' non-performing loans: empirical evidence from MENA countries. *Macroeconomics and Finance in Emerging Market Economies*, 14(3), 308–321. DOI: 10.1080/17520843.2020.1842478.
- Murshed, M., Saadat, S.Y. (2018). An Empirical Investigation of Non-performing Loans and Governance: A South Asian Perspective. *World Review of Business Research*, 8(1), 188–206.
- Ofria, F., Mucciardi, M. (2022). Government failures and non-performing loans in European countries: a spatial approach. *Journal of Economic Studies*, 49(5), 876–887. DOI: 10.1108/JES-01-2021-0010.

- Orsolya Kovács-Ondrejko, S., Baier, J., Antebi, P., Kavanagh, K., López Gobernado, A. (2021). Decoding Global Ways of Working March 2021. *Boston Consulting Group March 2021*. Retrieved from <https://web-assets.bcg.com/74/33/14077446434fa8685891ba0e2e69/bcg-decoding-global-ways-of-working-mar-2021.pdf>.
- Ozili, P.K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul Review*, 18(4), 329–340. DOI: 10.1016/j.bir.2017.12.003.
- Ozili, P.K. (2022). Bank non-performing loans in the fintech era. *International Journal of Financial Innovation in Banking*, 3(2), 95–112. DOI: 10.1504/IJFIB.2022.124197.
- Ozili, P.K., Lay, S.H., Syed, A.A. (2023). Impact of financial inclusion on economic growth in secular and religious countries. *Journal of Financial Regulation and Compliance*.
- 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, 101–210. DOI: 10.1016/j.pacfin.2019.101210.
- Pierri, N., Timmer, Y. (2020). Tech in fin before Fintech: blessing or curse for financial stability? IMF Working Papers. Working Paper No. 20/14. Washington DC.
- Románova, I., Kudinska, M. (2016). Banking and Fintech: A challenge or opportunity? In *Contemporary issues in finance: Current challenges from across Europe*, 98, 21–35. DOI: 10.1108/S1569-375920160000098002.
- Schaeck, K., Cihák, M. (2014). Competition, efficiency, and stability in banking. *Financial management*, 43(1), 215–241. DOI: 10.1111/fima.12010.
- Segoviano, M.A., Goodhart, M.C. (2009). Banking Stability Measures (No. 2009/004). *International Monetary Fund*.
- Setia, P., Setia, P., Venkatesh, V., Joglekar, S. (2013). Leveraging digital technologies: How information quality leads to localised capabilities and customer service performance. *MIS Quarterly*, 565–590.
- Son, T.H., Liem, N.T., Khuong, N.V. (2020). Corruption, non-performing loans, and economic growth: International evidence. *Cogent Business & Management*, 7(1), 1735691. DOI: 10.1080/23311975.2020.1735691.
- Syed, A.A. (2024). Economic policy uncertainty and Indian banking stability: the mediating role of regulation and supervision. *Journal of Financial Regulation and Compliance*, 32(1), 47–60.
- Syed, A.A., Ahmed, F., Kamal, M.A., Trinidad Segovia, J.E. (2021). Assessing the role of digital finance on shadow economy and financial instability: An empirical analysis of selected South Asian countries. *Mathematics*, 9(23), 3018.
- Thakor, A.V. (2020). Fintech and banking: What do we know? *Journal of Financial Intermediation*, 41, 1–13. DOI: 10.1016/j.jfi.2019.100833.

- Toader, T., Onofrei, M., Popescu, A.I., Andrieş, A.M. (2018). Corruption and banking stability: Evidence from emerging economies. *Emerging Markets Finance and Trade*, 54(3), 591–617. DOI: 10.1080/1540496X.2017.1411257.
- Varma, P., Nijjer, S., Sood, K., Grima, S., Rupeika-Apoga, R. (2022). Thematic Analysis of Financial Technology (Fintech) Influence on the Banking Industry. *Risks*, 10(10), 186.
- VO, A.T., Van, L.T.H., VO, D.H., McAleer, M. (2019). Financial inclusion and macroeconomic stability in emerging and frontier markets. *Annals of Financial Economics*, 14(02), 1950008. DOI: 10.1142/S2010495219500088.
- Wang, R., Liu, J., Luo, H. (2021). Fintech development and bank risk-taking in China. *The European Journal of Finance*, 27(4–5), 397–418. DOI: 10.1080/1351847X.2020.1805782.
- Wewege, L., Lee, J., Thomsett, M.C. (2020). Disruptions and Digital Banking Trends. *Journal of Applied Finance and Banking*, 10(6), 15–56.
- Xu, G.W., Ali, D.A., Bhaumik, A., Yang, M.S., Wang, N. (2023). The Influence of Digital Transformation in Enterprises on the Dynamics of Supply Chain Concentration: An Empirical Analysis of Chinese A-Share Listed Companies. *J. Organ. Technol. Entrep.*, 1(2), 88–97. DOI: 10.56578/jote010202.
- Yin, F., Jiao, X., Zhou, J., Yin, X., Ibeke, E., Iwendi, M.G.P., Biamba, C. (2022). Fintech application on banking stability using Big Data of an emerging economy. *J Cloud Comp* 11(43). DOI: 10.1186/s13677-022-00320-7.
- Zalan, T., Toufaily, E. (2017). The promise of Fintech in emerging markets: Not as disruptive. *Contemporary Economics*, 11(4), 415–431.

Citation

- Syed, A.A., Grima, S., Sood, K. (2024). Assessing the Role of the Fintech Era on the Banking Stability of an Emerging Economy: Interaction Analysis of the Indian Banking Industry. *Folia Oeconomica Stetinensia*, 24(1), 182–202. DOI: 10.2478/fofi-2024-0011.