Determinants of Fintech and Bigtech lending: the role of financial inclusion and financial development

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14 May 2023

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Abstract

Credit markets around the world are undergoing digital transformation which has led to the rise in Fintech and Bigtech lending. Fintech and Bigtech lending is the provision of credit by Fintech and Bigtech providers who have more capital, cutting-edge IT systems, worldwide recognition, greater online presence and are able to handle more big data on computers and mobile phones than traditional banks. Fintech and Bigtech lending is growing in importance, but the determinants of Fintech and Bigtech lending have received little attention in the literature. This study investigates the determinants of Fintech and Bigtech lending. The study focused on the effect of financial inclusion and financial development on Fintech and Bigtech lending. Using data for 18 countries from 2013 to 2019 and employing the difference-GMM and 2SLS regression methods, the findings reveal that financial inclusion and financial development are significant determinants of Fintech and Bigtech lending. Financial development is a positive determinant of Fintech and Bigtech lending while financial inclusion has a significant effect on Fintech and Bigtech lending. Also, Fintech and Bigtech lending lead to greater banking sector stability and also poses the risk of rising nonperforming loans. There is also a significant positive correlation between financial development and Fintech and Bigtech lending. These findings add to the emerging literature on the role of Fintech and Bigtech in financial intermediation. This research is significant because it provides insights into the role of financial inclusion and financial development in digital transformation of credit markets.

May, 2023

1. Introduction

This study investigates the determinants of Fintech and Bigtech lending.

Fintech and Bigtech lending is the provision of credit by Fintech and Bigtech providers. Bigtech often refers to the most dominant and largest information technology companies in a country that offer digital services which often includes digital financial services. Bigtech lending occurs when large technology companies issue loans to their large customer base using their own digital platforms. Fintech or 'financial technology' refers to any technology that delivers financial services through software, such as online banking and mobile payment apps. The goal of Fintech is to change the way consumers and businesses access financial services (Bains et al, 2022). Fintech providers often use their technology to offer the same products (e.g., loans) offered by traditional banks, and they offer these products to bank customers, thereby competing with traditional banks. Fintech lending involves using digital technology tools to issue loans to customers through websites or mobile apps.

Fintech and Bigtech lending is growing rapidly in many countries due to the digital transformation of credit markets. Recently, Fintech and Bigtech lending has been at the forefront of debates among academics, regulators and policymakers. They are confounding traditional models of lending both in developed and developing countries. Fintech and Bigtech lending not only offer credit to customers, they also improve the online customer-lender interaction which leads to a better user experience, faster processing time and lower operational costs (Berg et al, 2022). Both Fintech and Bigtech lenders use their digital technology to improve customer-lender interaction and lenders' screening and monitoring of borrowers (Berg et al, 2022; Cornelli et al, 2020).

Fintech and Bigtech lenders also use technology to improve screening or monitoring of borrowers when borrowers use cashless payments that produce transferable and verifiable information that can be analyzed using machine learning methods (Ghosh et al, 2021). They increase convenience and speed in lending – an attribute that is lacking among many traditional lenders (Berg et al, 2022; Agarwal and Zhang, 2020). Despite these unique advantages, Fintech and Bigtech lending still accounts for a small share of total credit and it accounts for a smaller share of GDP. Existing

studies focus on the rise in Fintech and Bigtech innovations and the potential disruption to financial services (e.g. Stulz, 2019; Cornelli et al, 2020; Valverde and Fernández, 2020). Other studies examine how Fintech and Bigtech innovations would disrupt credit markets (e.g. Stulz, 2019; Valverde and Fernández, 2020). Only few studies have examined the factors that led to the rise in Fintech and Bigtech lending or the determinants of Fintech and Bigtech credit. It is important for financial industry participants, policymakers and researchers to understand what is stimulating the growth in Fintech and Bigtech lending.

Some researchers have argued that the factors leading to the rise in Fintech and Bigtech credit are the less stringent regulation of Fintech and Bigtech companies compared to banks (Stulz, 2019), the large digital savvy customers (Gautam et al, 2022), the burdensome lending requirements by banks (Agarwal and Zhang, 2020), banks' refusal to innovate and the high rate of loan application denials by banks (Barkley and Schweitzer, 2020; Jagtiani et al, 2021). Despite these arguments, little is known about the macro-financial determinants of Fintech and Bigtech lending. Although few studies have examined the determinants of Fintech and Bigtech credit (Arslanian and Fischer, 2019; Menat, 2016), no studies have examined the macro-financial determinants of Fintech and Bigtech lending. This study is different from prior studies that provide case studies about how specific Fintech or Bigtech credit products improve access to finance (Balyuk et al, 2020; Chapple and Jeon, 2021). This study is also different from other studies that focus on the disruption caused by Fintech and Bigtech players (Vives, 2019). The present study aims to fill the gap in the financial innovation literature by presenting an empirical analysis of some macro-financial determinants of Fintech and Bigtech lending.

I predict that the progress made towards financial inclusion and financial development would provide an enabling environment for Fintech and Bigtech lending to thrive. It would also provide some incentives for Fintech and Bigtech players to emerge and enter the credit market, extend credit and gain market share towards improving credit supply to the private sector. This is the fundamental argument that explains the empirical relationship between financial inclusion, financial development and Fintech and Bigtech lending. I utilize an international sample of countries and using macro-financial data. The analysis is based on 18 countries from 2013 to 2019 using the GMM and 2SLS regression estimation techniques. The findings show evidence of a

significant positive effect of financial development on Fintech and Bigtech lending. Financial inclusion also has a significant impact on Fintech and Bigtech lending. Also, Fintech and Bigtech lending leads to greater banking sector stability and also poses the risk of rising nonperforming loans.

This study contributes to the literature on financial innovation and development. This is the first study to investigate the impact of financial inclusion and financial development on Fintech and Bigtech lending. It is argued that financial inclusion and financial development are preconditions that could incentivize Fintech and Bigtech lenders to offer credit to individuals and businesses to carry out economic activities. This study also contributes to the financial innovation and development studies that examine the role of financial innovations in credit markets and for financial intermediation (e.g., Achieng et al, 2015; Blake, 1996), but which have not captured the effects of financial inclusion and financial development on Fintech and Bigtech lending.

The next section presents the literature review and hypothesis. Section 3 presents the research methodology. Section 4 reports the empirical results. Section 5 presents the conclusion of the study.

2. Literature review and hypothesis

2.1. Literature review

Some studies have examined the effect of Bigtech on lending. De la Mano and Padilla (2018) explored the implications of the entry of Bigtech platforms into retail banking. They showed that the entry of Bigtech platforms can transform the banking industry in radical ways. First, it would increase competition to the benefit of consumers in the short term. Second, Bigtech companies may monopolize the origination and distribution of loans to consumers and small and medium enterprises (SMEs). Kowalewski and Pisany (2022), in their study, showed that the relationship between Fintech/Bigtech credit providers and banks is competitive especially in developed markets. They also showed that banks' retail lending grows simultaneously with Fintech credit market development in emerging economies, while Bigtech lending is treated as a serious

competition for banks' relationship lending. As a result of this competition, Liu et al (2022) showed that Bigtech loans are smaller and have higher interest rates, and borrowers of Bigtech loans tend to repay their loans before maturity which enables them to borrow more frequently. This suggests that the role of Bigtech in the lending business is to provide short term liquidity to borrowers rather than providing credit for long-term financing needs. But the advantage of Bigtech firms would depend on the extent of competition in the industry. Vives (2019) stated that competition would increase as new Bigtech companies emerge, and regulation would influence the extent to which Bigtech will enter the industry and who the dominant players will be. Although regulation can play an important role in Fintech and Bigtech development, Frost et al (2019) showed that Bigtech firms lend more in countries with less competitive banking sectors and in countries with less stringent bank regulation. The Bigtech companies acquire a vast amount of non-traditional information, they serve unbanked borrowers and they have an advantage in contract enforcement (Frost et al, 2019). Jagtiani and Lemieux (2017) explored the advantages and disadvantages of loans offered by a large Fintech lender and similar loans that originated through traditional banking channels. They found that the Fintech lender's lending activities penetrated areas that lose bank branches. The Fintech lender used alternative information sources to screen borrowers. This approach ensured that some borrowers who would be classified as 'subprime' by traditional bank criteria would be slotted into better loan grades and good credit score, therefore, getting cheaper credit (Jagtiani and Lemieux, 2017).

Other studies examined the role of Fintech and Bigtech for financial inclusion. Makina (2019) showed that mobile money is one of the manifestation of Fintech in Africa and is helping to break the barriers to financial inclusion in Africa. The author showed that mobile money has the potential to alleviate SME funding constraints. Demir et al (2022) showed that financial inclusion is a key channel through which Fintech reduces income inequality and improves welfare and the positive effect is greater in high-income countries. Chinoda and Mashamba (2021) also showed that financial inclusion plays a fundamental role in reducing income inequality in Africa through Fintech penetration. Ozili (2020) pointed out that Fintech helped to expand financial services to customers during the COVID-19 pandemic. Baber (2019) found that countries that use conventional finance have a higher number of Fintech users compared to religious countries.

Arner et al (2018) argued that to reap the greatest benefits of Fintech for financial inclusion, a framework that supports infrastructure and an enabling policy and regulatory environment, built on a strong foundation of digital identification and electronic payment systems, is needed to support digital financial transformation. Jonker and Kosse (2022) pointed out that the financial inclusion opportunities created by Bigtech could introduce financial stability risks. They emphasized the importance of proper supervision and regulation in the financial system.

While these studies examined the role of Fintech and Bigtech in financial intermediation, these studies did not examine the macro-financial determinants of Fintech and Bigtech lending. The present study fills this gap in the literature by investigating the effect of financial inclusion and financial development on Fintech and Bigtech credit.

2.2. Hypothesis

The main mechanism through which Fintech and Bigtech lenders affect financial intermediation is through their larger capital, cutting-edge IT systems, worldwide recognition, greater online presence and their ability to handle more big data on computers and mobile phones than traditional banks. This gives Fintech and Bigtech lenders access to extensive information which they are able to use to develop credit products for the users on their digital platforms (Berg et al, 2022; Cornelli et al, 2020). Therefore, Fintech and Bigtech lending is expected to facilitate greater financial intermediation in the financial system because Fintech and Bigtech lenders will use their digital technology and platforms to improve customer-lender interaction, improve lenders' screening and monitoring of borrowers, and deliver financial services to both well-served and underserved customers through software, thereby increasing financial intermediation (Berg et al, 2022; Cornelli et al, 2020). I argue that the current level of financial inclusion and financial development in a country can enhance or inhibit the lending activities of Fintech and Bigtech lenders since Fintech and Bigtech lenders can only lend to people who are digitally and financially included. Therefore, I predict that level of financial inclusion and the level of financial development are potential determinants of the extent of Fintech and Bigtech lending.

Ho. Financial inclusion and financial development are determinants of Fintech and Bigtech lending

3. Research methodology

3.1. Data and sample

Data were collected for 24 countries. The countries were selected based on data availability. Country-level annual data were collected from the Global Financial Development indicators (GFDI) from the World Bank database. See table 1 for variable description. Countries that did not have sufficient data for the '*Fintech and Bigtech credit to GDP ratio*' variable were excluded from the sample. The final sample is an unbalanced panel data of 18 countries during the 2013 to 2019 period. The selection of the 2013 to 2019 period corresponds to the period when significant amount of credit was provided by Fintech and Bigtech companies in most countries. The sample period also avoids the potential effect of the COVID pandemic so that the COVID event won't contaminate the data or the estimation results.

Table 1. Variable description

Variable	Indicator Name	Short definition	Source
ATM	ATMs per 100,000 adults	A measure of financial inclusion. It refers to the number of ATMs per 100,000 adults in a country.	GFDI
BR	Bank branches per 100,000 adults	A measure of financial inclusion. It refers to the number of commercial bank branches per 100,000 adults.	GFDI
ZS	Bank Z-score	A measure of banking sector solvency or banking sector stability. It captures the probability of default of a country's commercial banking system. Z-score compares the buffer of a country's commercial banking system (capitalization and returns) with the volatility of those returns.	GFDI
FT	Credit flows by fintech and bigtech companies to GDP (%)	It refers to new lending provided by fintech and big tech companies over a calendar year, normalized by nominal GDP.	GFDI
DCP	Domestic credit to private sector (% of GDP)	A measure of financial development and a measure of financial depth. The domestic credit to private sector (DCP) refers to financial resources provided to the private sector.	GFDI

Table 2 presents the sample distribution by country and the descriptive statistics. In terms of Fintech and Bigtech lending (FT), countries that had the highest level of Fintech and Bigtech lending in the sample are China and Japan while countries like Nigeria and Mozambique had the lowest Fintech and Bigtech lending during the period examined. In terms of the number of ATMs per 100,000 adults (ATM), Korea, Japan and the United Kingdom had the highest ATMs per 100,000 adults while Uganda and Tanzania had very low ATMs per 100,000 adults during the

period. In terms of the number of commercial bank branches per 100,000 adults (BR), France and Japan had higher commercial bank branches per 100,000 adults compared to Uganda and Tanzania which had the lowest commercial bank branches per 100,000 adults during the period. This indicates that African countries have low levels of financial inclusion (BR and ATM) compared to advanced countries. In terms of ZS, the United States and China had the highest ZS while Indonesia and Mozambique had very low ZS. The United States, Japan and China had the highest domestic credit to the private sector (DCP) which is the measure of financial development during the period.

Table 2. Descriptive statistics for the variables (mean values)					
	ATM	BR	ZS	FT	DCP
Argentina	51.38	13.37	8.15	0.022	14.71
Brazil	111.11	20.02	15.71	0.021	63.08
China	76.84	8.54	21.85	2.373	151.63
France	103.74	36.65	25.19	0.021	99.42
Ghana	9.93	7.09	13.82	0.329	13.91
India	19.42	13.70	20.82	0.011	50.64
Indonesia	51.63	16.98	4.37	0.097	38.04
Japan	127.20	33.99	17.29	0.311	167.29
Kenya	9.17	5.24	21.17	0.721	35.48
Korea	274.43	16.28	11.33	0.252	136.62
Mexico	54.66	14.16	21.02	0.010	32.93
Mozambique	10.13	4.18	5.28	0.003	27.14
Nigeria	15.95	4.99	14.05	0.002	12.39
south Africa	-	15.95	13.51	0.003	47.88
Tanzania	5.92	2.53	14.18	0.419	13.21
Uganda	4.41	2.82	13.46	0.221	13.39
United Kingdom	124.63	25.13	15.36	0.231	135.74
United States	-	31.92	34.23	0.187	184.49
Aggregate statistics					
Mean	68.91	15.28	15.41	7.83	70.57
Median	52	14.03	14.98	0.03	39.40
Minimum	4.044	2.52	0.001	0.0001	10.24
Maximum	288.58	38.63	35.09	0.145	190.75
Standard deviation	70.19	10.52	8.16	31.16	59.77
Observation	106	114	126	126	119

3.2. Empirical models

To estimate the determinants of Fintech and Bigtech lending, the baseline model employed is a modified form of the models used in Ozili (2022) and Yang and Wang (2022). The equation, Eq. (1), estimates the determinants of Fintech and Bigtech lending.

$$FTi,t = \beta 1 LagFTi,t + \beta 2 ATMi,t + \beta 3 BRi,t + \beta 4 ZSi,t + \beta 5 DCPi,t + \varepsilon i,t \ldots\ldots\ldots\ldots.Eq1$$

Where i,t represent country and year. FT represents the Fintech and Bigtech lending variable. 'ATM' represents the number of ATMs per 100,000 adults which is a measure of financial inclusion. 'BR' represents the number of commercial bank branches per 100,000 adults which is a measure of financial inclusion. DCP is the measure of financial development. It measures financial depth. ZS is the measure of banking system solvency or banking system stability. εit is the error term.

Regarding the estimation method, the Arellano Bond (1991) first-difference GMM estimation method was used. The Arellano Bond (1991) first-difference GMM estimation method addresses the potential endogeneity between Fintech and Bigtech credit, financial development and financial inclusion. It also controls for the unobserved effects by transforming the variables into first difference to eliminate unobserved heterogeneity and omitted variable bias. The study also used the two-stage least squares (2SLS) regression method for robustness purposes.

Next, I discuss the variable justification. FT is the dependent variable. It measures the share of Fintech and Bigtech credit relative to GDP. The ATM and BR variables are the financial inclusion variables. These two variables have been widely used by previous studies to measure the level of financial inclusion (see, for example, Siddik et al (2020), Ozili (2021), Mehrotra and Yetman (2015), etc). I argue that ATM supply and bank branch expansion can complement Fintech and Bigtech lending activities. This is because Fintech-enabled ATMs and bank branch agent networks can be used to offer credit to customers and borrowers through Fintech and Bigtech platforms, thereby increasing the share of Fintech and Bigtech credit relative to GDP. Hence, a positive relationship between financial inclusion (BR and ATM) and FT is predicted. The DCP variable controls for the level of financial development. It captures the depth of the financial system through the increase in domestic credit to the private sector. This variable has been used to

measure financial development in previous studies (e.g. Wolde-Rufael, 2009; Ozili and Ndah, 2021). I argue that a large private credit market could lead to more credit supply by Fintech and Bigtech players because Fintech and Bigtech companies would be motivated to exploit the opportunities in a large private credit market, and offer credit services to customers through their Fintech and Bigtech platforms to generate profit and to gain market share, thereby increasing the share of Fintech and Bigtech credit to GDP. Hence, a positive relationship between DCP and FT is predicted. The ZS variable captures banking sector solvency. Previous studies have used this variable to capture the solvency and stability of the banking system (see, for example, Ozili (2018a), Kasman and Kasman (2015), etc). I argue that banks in a solvent or stable banking system would seek to retain their dominance and market share in the credit market, thereby crowding out lending by Fintech and Bigtech companies. Hence, a negative relationship between ZS and FT is predicted.

3.3. Pearson correlation

A Pearson correlation test was conducted to determine the correlation among the variables. The Pearson correlation result in table 3 shows evidence of a positive correlation between the ATM variable and the FT variable while the BR variable is negatively correlated with the FT variable. This suggests that greater ATM supply is correlated with higher lending by Fintech and Bigtech companies while greater bank branch expansion is correlated with fewer lending by Fintech and Bigtech companies. But the correlations are not statistically significant. The ZS variable is significant and positively correlated with the FT variable. Similarly, the DCP variable is significant and positively correlated with FT. The two results suggest that banking sector solvency and the size of domestic private credit are positively correlated with Fintech and Bigtech lending. Overall, the correlation coefficients of the ATM, BR, ZS and DCP with FT variables are sufficiently low and below 0.4, therefore, multicollinearity is not a problem in the empirical analysis.

Table 3. Pearson correlation for the variables

Variable	FT	ATM	BR	ZS	DCP
FT	**1.000**				

ATM	**0.078**	1.000			
	(0.43)	-----			
BR	**-0.128**	0.547****	1.000		
	(0.21)	(0.00)	-----		
ZS	**0.269****	0.026	0.298***	1.000	
	(0.01)	(0.79)	(0.00)	-----	
DCP	**0.398***	0.737***	0.615***	0.321***	1.000
	(0.00)	(0.00)	(0.00)	(0.00)	-----

p-values are in parenthesis. **, *** represent statistical significance at the 5% and 1% levels.

4. Empirical results

4.1. Determinants of Fintech and Bigtech lending

The result is reported in column 1 of table 4. The financial inclusion variable 'ATM' is significant and positively related to FT in the GMM estimation in column 1. This result indicates that greater financial inclusion via ATM supply has a significant effect on Fintech and Bigtech lending. This result implies that greater ATM supply complements Fintech and Bigtech lending activities. This result is intuitive because it suggests that Fintech-enabled ATMs can be used to offer credit to customers and borrowers, thereby increasing the share of Fintech and Bigtech credit relative to GDP. This result is in line with studies that show that ATM supply enhances third-party lending (see. Ozili, 2018b; Makina, 2019).

In terms of economic significance, the ATM coefficient is not economically significant because a 1% increase in the ATM variable leads to a small increase in FT, precisely, a 0.5% increase in Fintech and Bigtech lending.

In column 1, the financial inclusion variable 'BR' is not significant in the GMM estimation in column 1. This result indicates that greater bank branch presence does not have a significant effect on Fintech and Bigtech lending.

The financial development variable 'DCP' is significant and positively related to FT in the GMM estimation in columns 1 and 4. This result indicates that greater financial development has a significant effect on Fintech and Bigtech lending. This result implies that higher levels of private sector credit led to more lending by Fintech and Bigtech companies. This result is intuitive because Fintech and Bigtech lenders would be motivated to exploit the opportunities in a large private credit market, and offer credit services to customers through their Fintech and Bigtech platforms to generate profit and to gain market share, thereby increasing the share of Fintech and Bigtech credit relative to GDP. In terms of economic significance, the DCP coefficient is not economically significant because a 1% increase in the DCP variable leads to a small increase in FT, precisely, a 0.6% increase in Fintech and Bigtech lending. This result is in line with studies that show a positive association between Fintech growth and financial sector development (see, for example, Berg et al (2022), Ozili (2018b), Agarwal and Zhang (2020), etc).

The ZS variable is significant and negatively related to FT in the GMM estimation in columns 1, 2, 3 and 4. This result indicates that greater banking solvency leads to fewer Fintech and Bigtech lending. This result implies that Fintech and Bigtech issue fewer credit when the banking sector is stable and solvent. This is intuitive because banks will seek to retain their dominance and market share in the credit market, thereby crowding out lending by Fintech and Bigtech companies. In terms of economic significance, the ZS coefficient is economically significant because a 1% increase in the ZS variable leads to a 19.9% decrease in Fintech and Bigtech lending.

4.2. Interaction analysis

In this section, I examine the effect of the combined financial inclusion variables on Fintech and Bigtech lending. I combine the two financial inclusion variables to determine their joint effect on Fintech and Bigtech lending. The result is reported in columns 2 and 4 of table 4. The financial inclusion joint variable 'ATM*BR' is significant and positively related to FT in the GMM estimation in columns 2 and 4. This result indicates that greater financial inclusion has a significant effect on

Fintech and Bigtech lending. This result implies that greater ATM and bank branch presence do not reduce Fintech and Bigtech lending activities rather they complement Fintech and Bigtech lending by increasing it. This result is in line with studies that show that Fintech activities can complement the activities of banks rather than compete with banks (see Cole et al, 2019; Cornelli et al, 2020). In terms of economic significance, the ATM*BR coefficient is not economically significant because a 1% increase in ATM*BR leads to a small increase in FT, precisely, a 0.4% increase in Fintech and Bigtech lending.

Next, I examine the joint effect of financial inclusion and financial development on Fintech and Bigtech lending. The explanatory variable of interest in this analysis is the 'ATM*BR*DCP' variable. The result is reported in columns 3 and 4 of table 4. The 'ATM*BR*DCP' variable is significant and positively related to FT in the GMM estimation in columns 3 and 4. This result indicates that high levels of financial inclusion and financial development have a joint positive and significant effect on Fintech and Bigtech lending. This result implies that greater financial inclusion and financial development complements Fintech and Bigtech lending. This result is in line with studies which argue that financial inclusion and financial development enhances the credit activities of Fintech and Bigtech companies (see Stulz, 2019; Beck, 2020).

	1	2	3	4
Table 4. Determinants of Fintech and Bigtech Lending (Difference-GMM estimation)				
	Dependent variable: FT	Dependent variable: FT	Dependent variable: FT	Dependent variable: FT
	Coefficient (t-value)	Coefficient (t-value)	Coefficient (t-value)	Coefficient (t-value)
FT(lag)	0.840***	1.028***	0.822***	1.029
	(3.22)	(2.99)	(4.55)	(1.05)
ATM	0.005***	-0.092***	-0.011***	-0.091***
	(3.96)	(2.87)	(4.45)	(4.31)
BR	0.026	-0.377***	-0.153***	-0.412***
	(1.56)	(3.10)	(3.45)	(3.32)
ATM*BR		0.004***		0.005***
		(2.97)		(5.67)
ATM*BR*DCP			0.0001***	0.0001**
			(2.76)	(6.43)
ZS	-0.199***	-0.179***	-0.165***	-0.176***
	(3.48)	(4.33)	(2.88)	(4.11)
DCP	0.006***	0.044***	-0.014***	0.048***
	(4.56)	(3.56)	(2.78)	(3.11)
J-statistic	9.638	8.868	8.68	10.28
Pvalue (J-statistic)	0.563	0.449	0.46	0.211
AR(1)	0.19	0.45	0.34	0.25
AR(2)	0.11	0.13	0.09	0.12
*, **, *** represent statistical significance at the 10%, 5% and 1% levels				

4.3. Further analysis

4.3.1. Effect of Fintech and Bigtech lending on the financial system

In this section, I examine the impact of Fintech and Bigtech lending on the broader financial system. To do this, I introduce some financial sector profitability indicators and risk indicators into the model as the dependent variable. I use these indicators as measures of financial system performance. The profitability indicators used in the model are the return on asset (ROA) variable and the net interest margin (NIM) variable. The risk indicators used in the model are the nonperforming loans ratio (NPL) variable which measures credit risk in the banking sector, and the z-score (ZS) which measures banking sector solvency or stability.

The explanatory variable of interest in this analysis is the 'FT' variable. The result is reported in table 5. The FT variable is strongly significant and positively related to the NPL and ZS dependent variables in columns 3 and 4 of table 5. **In terms of economic significance, the FT coefficient is economically significant because a 1% increase in the FT variable leads to a 135% decrease in bank solvency and nonperforming loans, as shown in columns 3 and 4.** This result indicates that greater Fintech and Bigtech lending lead to greater banking stability and higher nonperforming loans. The result implies that although Fintech and Bigtech lending improves banking sector solvency or stability as shown in column 3 of table 5, it also poses the risk of rising nonperforming loans as shown in column 4 of table 5. This result is interesting because it suggests that although Fintech and Bigtech lending can facilitate efficient financial intermediation, there is a need to pay attention to risks that could arise from Fintech and Bigtech lending particularly the risk of high nonperforming loans.

Meanwhile, the FT variable is not significantly related to banking sector profitability variables (i.e. ROA and NIM) in columns 3 and 4 of table 5, implying that Fintech and Bigtech lending does not significantly increase financial sector profitability.

Table 5. Effects of Fintech and Bigtech Lending on the financial system
(Difference-GMM estimation)

	1	2	3	4
	Dependent variable: ROA	Dependent variable: NIM	Dependent variable: NPL	Dependent variable: ZS
	Coefficient (t-value)	Coefficient (t-value)	Coefficient (t-value)	Coefficient (t-value)
ROA(lag)	-0.0903*** (-2.72)			
NIM(lag)		-0.383*** (-5.03)		
NPL(lag)			0.297*** (3.39)	
ZS(lag)				0.217*** (18.49)
FT	**-0.064** **(-0.75)**	**-0.821** **(-0.57)**	**1.353*** ** **(5.03)**	**1.357*** ** **(3.15)**
ATM	-0.063** (-2.36)	0.061 (0.76)	0.723*** (3.62)	0.083* (1.74)
BR	-0.747*** (-6.24)	-0.394 (-0.65)	0.905 (1.22)	0.594*** (8.31)
DCP	-0.036 (-1.26)	-0.084 (-0.96)	0.345*** (3.31)	0.125** (2.54)
J-statistic	5.085	9.593	10.06	10.92
Pvalue (J-statistic)	0.89	0.48	0.35	0.36
AR(1)	0.12	0.07	0.12	0.22
AR(2)	0.03	0.01	0.04	0.02

*, **, *** represent statistical significance at the 10%, 5% and 1% levels

4.3.2. Robustness check using alternative estimation

In this section, I re-estimate the initial results using the two-stage least squares (2SLS) regression estimation to verify whether the results remain robust to alternative estimation. The 2SLS result is reported in table 6. The result shows that the DCP variable is significant and positively related to FT in the 2SLS estimation in columns 1 to 4 of table 6. This result is consistent and robust with the earlier result reported in columns 1 to 4 of table 3 that shows a significant positive

relationship with the FT variable. This indicates that the level of financial development (DCP) is a significant positive determinant of the Fintech and Bigtech lending.

The financial inclusion joint variable 'ATM*BR' is significant and negatively related to FT in the 2SLS estimation in column 2 of table 6. This result is inconsistent with the earlier result reported in columns 2 and 4 of table 3 that shows a significant positive relationship with the FT variable. The 'ATM*BR' coefficient remains significant in the two estimations but the coefficient signs are different.

Similarly, the 'ATM*BR*DCP' variable is significant and negatively related to FT in the 2SLS estimation in columns 3 and 4 of table 6. This result is inconsistent with the earlier result reported in columns 3 and 4 of table 3 that shows a significant positive relationship with the FT variable. The 'ATM*BR*DCP' coefficient remains significant in the two estimations but the coefficient signs are different. Therefore, I can conclude that the level of financial development and the level of financial inclusion are significant determinants of Fintech and Bigtech lending.

Table 6. Determinants of Fintech and Bigtech lending
(Two-stage least squares regression estimation)

	1	2	3	4
	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)
ATM	-0.003** (-2.38)	0.001 (0.44)	-0.001 (-0.79)	-0.002 (-0.91)
BR	-0.046*** (-5.94)	-0.019 (-1.46)	-0.032*** (-3.68)	-0.039** (-2.45)
ATM*BR		**-0.0004** (-2.47)**		**0.0002 (0.57)**
ATM*BR*DCP			**-0.0001*** (-3.23)**	**-0.0001** (-2.10)**
ZS	0.019*** (2.78)	0.005 (0.62)	0.003 (0.31)	0.004 (0.44)
DCP	**0.014*** (7.14)**	**0.015*** (7.67)**	**0.018*** (8.05)**	**0.018*** (7.15)**
R^2	46.09	49.41	51.55	10.28
Pvalue (J-statistic)	0.011	0.059	0.406	0.211

In table 7, I also re-estimate the results for the effects of Fintech and Bigtech lending on the financial system using the two-stage least squares regression estimation method to verify whether the results remain robust to alternative estimations. The 2SLS result is reported in table 7. The result shows that the FT variable remains significant and positively related to the NPL variable in the 2SLS estimation in column 3 of table 7. This result is consistent and robust with the earlier result reported in column 3 of table 5 that show a significant positive relationship between the FT and NPL variables. Therefore, the result is robust, and indicates that greater Fintech and Bigtech lending lead to higher nonperforming loans and greater banking stability. The result implies that Fintech and Bigtech lending poses the risk of rising nonperforming loans as shown in column 4 of tables 5 and 7.

Also, the FT variable is significant and positively related with the ZS variable in the 2SLS estimation in column 4 of table 7. This result is consistent and robust with the earlier result reported in column 3 of table 5 that show that a significant positive relationship between the FT and ZS variables. Therefore, the result is robust, and implies that greater Fintech and Bigtech lending lead to greater banking stability. Therefore, I conclude that although Fintech and Bigtech lending can facilitate efficient financial intermediation and improve the financial system. However, there is a need to pay attention to risks that could arise from Fintech and Bigtech lending particularly the risk of high nonperforming loans.

Table 7. Alternative estimation for the effects of Fintech and Bigtech Lending on the financial system (Two-stage least squares regression estimation)

	1	2	3	4
	Dependent variable: ROA	Dependent variable: NIM	Dependent variable: NPL	Dependent variable: ZS
	Coefficient (t-value)	Coefficient (t-value)	Coefficient (t-value)	Coefficient (t-value)
FT	**0.693****	**1.801***	**1.803***	**3.966*****
	(2.51)	**(1.97)**	**(1.93)**	**(2.78)**
ATM	0.0006	0.003	-0.014	-0.034*
	(0.15)	(0.22)	(-1.11)	(-1.75)
BR	0.078***	0.255***	0.284***	0.696***
	(3.67)	(3.62)	(3.96)	(6.31)
DCP	-0.009	-0.030	-0.020	0.046
	(-1.49)	(-1.38)	(-0.89)	(1.34)
R^2	50.89	43.34	61.43	65.45
Adjusted R^2	46.31	39.12	45.34	59.12
Instrument rank			5	5

The 2SLS instruments are the explanatory variables. . *, **, *** represent statistical significance at the 10%, 5% and 1% levels

5. Conclusion

This study examined the determinants of Fintech and Bigtech lending. It focused on the effect of financial inclusion and financial development on Fintech and Bigtech lending.

The findings revealed that financial inclusion and financial development are significant determinants of Fintech and Bigtech lending. Financial development has a significant and positive impact on Fintech and Bigtech lending. Financial inclusion also has a significant impact on Fintech and Bigtech lending. There is a significant positive correlation between financial development and Fintech and Bigtech lending. Also, Fintech and Bigtech lending leads to greater banking sector stability and also poses the risk of rising nonperforming loans. These findings add to the existing literature on the role of Fintech and Bigtech in financial intermediation.

The findings of the study offer several policy implications. First, policymakers should introduce policies to develop the financial sector as this is essential to increase Fintech and Bigtech lending and aggregate lending in the economy. Second, policymakers should introduce market-enabling policies to increase the level of financial inclusion so that Bigtech and Fintech companies will be motivated to serve the underserved members of society. Three, regulators need to develop strategies to mitigate potential credit risk, operational risk and other risks that may arise from the lending activities of Fintech and Bigtech companies to ensure that their lending activities do not transmit systemic risk to the financial system. The results of this study emphasize that financial inclusion and financial development are fundamental to the growth in Fintech and Bigtech lending. Therefore, policymakers should constantly review existing financial inclusion and financial development frameworks and ensure that these frameworks promote Fintech and Bigtech lending activities and mitigate risks. Also, the findings that growth in Fintech and Bigtech lending can lead to rising nonperforming loans emphasizes the need for policymakers to increase macro prudential safeguards in the financial system to ensure that the lending activities of Fintech and Bigtech lending do not lead to credit risk in the form of rising nonperforming loans that could threaten the stability of the financial system.

This study has some limitations. First, the lack of sufficient data hindered the scope of the econometric analysis. Second, data for the micro indicators of Fintech and Bigtech lending are not available, hence, only a macro indicator of Fintech and Bigtech lending was used in the study. Third, the study does not address some risks associated with Fintech and Bigtech lending, such as cybersecurity risks, operational risks, or risks related to concentration in the financial system. Four, the study only examines the determinants of Fintech and Bigtech lending at a macro level, and does not provide extensive insights into the mechanisms that lead to these determinants.

Future research in this area can explore the following areas. Future studies can investigate the impact of Fintech and Bigtech lending on economic growth. Research in this area is non-existent. Future studies can also develop alternative theoretical frameworks that explain the role of Fintech and Bigtech in financial intermediation. Finally, there is need for more empirical research on how Fintech and Bigtech lending affects credit supply to all the relevant sectors of the economy. Fintech and Bigtech lending may be significant in some sectors of the economy and

less significant in other sectors. As Fintech and Bigtech lenders continue to disrupt credit markets around the world, future research should also focus on how Fintech and Bigtech lending can expand access to formal credit in developing countries

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