Received: 26 November 2022 | Accepted: 30 November 2022
DOI: 10.52898/ijif.2022.10

ORIGINAL ARTICLE

NONLINEAR EFFECT OF LOAN TO DEPOSIT RATIO ON BANK PERFORMANCE: A COMPARISON WITH PAKISTAN AND CHINA

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Abstract
The main objective of this study is to empirically study the influence of loan-to-deposit ratio (LTDR) on bank performance measured by return on assets (ROA) over the period 2010–2019. Based on the data of 24 listed Chinese banks and 15 listed Pakistani banks, this study uses the dynamic panel data regression technique (i.e. fixed effects GMM) to examine this relationship. We identify a non-linear U-shaped relationship between LTDR and ROA for listed Pakistani banks. However, our results for listed Chinese banks indicate a non-linear inverted U-shaped relationship between LTDR and ROA. Our empirical findings suggest that policymakers should pay more attention to LTDR, which has the potential to improve banks' profitability.

Keywords
Listed commercial Banks; Loan to deposit ratio; Profitability, fixed effects GMM

JEL Classification
C23, G21.

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1. INTRODUCTION

The main function of banks in any economy is financial intermediation. Banks are exposed to many risks due to their financial intermediation functions in the financial markets. Since the 2007 global financial crisis, bank management, financial markets, and regulatory and supervisory authorities have paid close attention to the problem of bank liquidity.

The loan-to-deposit ratio is one of the most important liquidity indicators in the banking industry and is a vital tool that indicates whether domestic savings are sufficient to finance the loan demand in domestic markets. Moreover, a higher loan-to-deposit ratio may cause banks to borrow from foreign financial markets, while a low ratio could lead to disruption of production and investment activities in the domestic markets due to inefficient use of funding resources.

Normally, core liabilities such as time deposits and demand deposits are generally used to support bank loans provided to clients. Core liabilities are recognized as reliable and comparatively stable funding sources in the banking sector (Akdoğan et al., 2021). However, if the increase in loan demand due to the expansion of the economy is higher than the growth in deposits, then banks may resort to non-core liabilities such as short-term foreign debt or interbank borrowing to finance their loans (Kazaz, 2020). Therefore, the increase in non-core liabilities may not only enhance the vulnerability against liquidity shocks but also trigger systemic risks due to the contagion effect. Consequently, it is critical for the stability of the financial system to regularly monitor and control for the association between illiquid assets (i.e. loans) and core liabilities (i.e. deposits), especially in emerging economies.

The aim of this paper is to empirically investigate the association between the loan-to-deposit ratio and bank performance in two Asian emerging economies (i.e., Pakistan and China) in the period of 2010-2019.

The present study aims to contribute to the existing literature in various ways. First, it is the first study that analyzes and compares the influence of the loan-to-deposit ratio on the performance of listed commercial banks operating in Pakistan and China.

Second, this study explores the existence of an optimal level of liquidity for commercial banks by analyzing the non-linear effect of the loan-to-deposit ratio, which is not considered in most bank performance studies.

Third, we use a fixed effects GMM estimator that allows us to control for unobserved bank-specific effects as well as for endogeneity. This estimator has been used in a few banking studies (e.g., Aydemir & Ovenc, 2016; Aydemir & Guloglu, 2017; Aydemir et al., 2018).

Finally, this study guides the management of commercial banks to improve their financial performance through efficient liquidity management and provides important insights for policymakers to take necessary measures to maintain stability in the banking system.

The rest of the study is structured as follows. Section 2 presents a literature review of related studies. Section 3 describes the data, model specification and estimation methodology. Section 4 presents and discusses the findings. Section 5 summarizes the results and draws conclusions.

2. RELATED LITERATURE

In the previous literature, there are many empirical studies investigating the association between the loan-to-deposit ratio (LTDR) and performance. A brief summary of some of these studies is presented in Table 1.

Table 1

Literature review

References	Banking sector	Data period	Methodology used	Empirical findings
Pasiouras and Kosmidou (2007)	15 EU countries	1995–2001	Fixed effects (FE) estimator	There is a negative relationship between LTDR and profitability in the sample of domestic banks, but a positive and significant relationship is observed between LTD ratio and profitability for foreign banks in sample.
Flamini et al. (2009)	Sub-Saharan Africa countries	1998–2006	Generalized Method of Moments (GMM)	The positive and significant coefficient of LTDR is reported.
Sohail et al. (2013)	Pakistan	2004-2010	Ordinary least square (OLS) estimator	LTDR has a significant and positive influence on the profitability.
Samad (2015)	Bangladesh	2009-2010	OLS estimator	The effect of LTDR on profitability is positive and significant.
Shiri et al. (2015)	Zimbabwe	2005-2012	Regression analysis	LTDR has not significant impact on the profitability.
Boadi et al. (2016)	Ghana	2005-2013	FE estimator	There exists a significant and negative linkage between LTDR and profitability.
Islam and Nishiyama (2016)	Bangladesh, India, Nepal and Pakistan	1997–2012	FE estimator	LTDR significantly increases profitability of banks.
Işık et al. (2017)	Turkiye	2006-2014	FE estimator	LTDR has a significant and negative impact on bank profitability.
Bapat (2018)	India	2006–2013	GMM estimator	There exists no relation between LTDR and profitability.
Aydemir et al. (2018)	Turkiye	2002-2015	FE and GMM estimators	There is an inverted U-shaped association between the LTDR and profitability variables.
Yüksel et al. (2018)	Post-Soviet countries	1996-2016	GMM estimator	LTDR does not affect bank profitability.
Do et al. (2020)	Vietnam	2008-2017	FGLS estimator	LTDR has a significant and positive impact on bank profitability.
Hosen (2020)	Bangladesh	2014-2018	OLS estimator	LTDR is found to be insignificantly related to the profitability.
Rahman et al. (2020)	Pakistan	2003–2017	GMM estimator	LTDR adversely affects the profitability of Pakistani banks.
Vera-Gilces et al. (2020)	Ecuador	2002−2017	GMM estimator	LTDR does not have a significant impact on banks' profits.
Ariyibi et al.(2020)	Nigera	2004-2018	Random effects (RE) estimator	The impact of LTDR on profitability is positive and significant.
Siniţîn and Socol (2020)	13 European Union countries	2000-2017	OLS estimator	There is an inverse relation between the two variables.
Al-Mosharrafa and Islam (2021)	Bangladesh	2007-2017	Driscoll and Kraay FE estimator	The effect of LTDR on different profitability measures such as ROA, ROE and NIM is different.
Doan and Bui (2021)	Vietnam	2013-2018	GMM estimator	Profitability is positively and significantly affected by the LTDR.
Ayalew (2021)	Ethiopia	2013-2019	FE estimator	An increase in LTDR is significantly related to higher level of profitability.

Kumar and Bird (2022)	China and India	2004-2019	GMM estimator	profitability indicator is negatively affected by the LTDR of Indian banks, however, it is positively affected by the LTDR of the Chinese banking sector.
Kumar et al. (2022)	Japan	2004-2018	GMM estimator	Profitability is not influenced by the LTDR.
Gurung and Gurung (2022)	Nepal	2009-2020	FE estimator	There is no relationship between the two variable.
Sidhu et al. (2022)	India	2010-2019	GMM estimator	LTDR has an inverted U-shaped relationship with the profitability.
Gazi et al. (2022)	Bangladesh	2010-2021	FE estimator	LTDR does not affect profitability significantly.
Merry et al. (2022)	Indonesia	2019-2021	OLS estimator	LTDR has no significant effect on profitability indicators.
Meng and Ugut (2022)	Indonesia and China	2015-2019	FE estimator	LTDR has a positive influence on the profitability of Indonesian banks but a negative effect on the profitability of banks in China.
Adelopo et al. (2022)	28 European Union countries	2010-2018	OLS, FE and RE estimators	LTDR has a negative influence on EU banks' profitability.

3. RESEARCH DESIGN

3.1. Sample

In this paper, we aim to identify the impact of LTDR on bank profitability by employing 15 listed Pakistani banks and 24 listed Chinese banks. The data covers the years 2010 through 2019, depending on the availability of the data. Banks with missing data are excluded from our sample. The bank-specific variables are taken from the BankScope database, and the data on economic growth and inflation are taken from the World Development Indicators (WDIs) of the World Bank. We also winsorized all data at the 1st and 99th percentiles to mitigate the effect of outliers. Table 2 below presents the variables and their definitions.

Table 2
Definition of variables, notation, expected effect, and source

Variables	Notation	Explanation	Expected Sign	Source
Dependent Variables				
Return on Assets	ROA	Net income/total assets		BankScope
Independent Variable				
Loans to Deposit Ratio	LTDR	Total loans/total deposits	+/-	BankScope
Bank-Specific Control Variables				
Cost to Income Ratio	COST	Operating cost/total income	-	BankScope
Non-performing Loan	NPL	Non-performing loans/total loans	-	BankScope
Bank Capital	BC	Equity/total assets	+/-	BankScope
Bank Size	BS	Logarithm of total assets	+/-	BankScope
Macroeconomic Control Variables				
Gross Domestic Product	GDP	Yearly GDP growth rate	+	WDIs
Inflation Rate	INF	Yearly percentage change in CPI	+	WDIs

3.2. Model specification

The aim of our analysis is to estimate the impact of LTDR on the financial performance of listed commercial banks in Pakistan and China. Thus, we use the following dynamic panel data model with fixed effects to investigate how the impact of LTDR on bank profitability differs between Pakistan and China:

$$(\mathrm{FP})_{\mathrm{it}} = \alpha + \varsigma(\mathrm{FP})_{\mathrm{it}-1} + \gamma(\mathrm{LTDR})_{\mathrm{it}} + \delta(\mathrm{LTDR})_{it}^{2} + \sum_{j=1}^{4}(\mathrm{BSCV})_{\mathrm{it}}\,\beta_{\mathrm{j}+} + \sum_{j=1}^{2}(\mathrm{MECV})_{\mathrm{t}}\,\lambda_{\mathrm{j}} + \varepsilon_{\mathrm{it}} \quad (1)$$

In the above specification, subscripts i and t represent individual bank and year, respectively; α is a constant term; $\mathrm{FP}_{\mathrm{it}}$ is the dependent variable, and measured by the ratio of net income to total assets (ROA); $FP_{\mathrm{it}-1}$ is the lagged value of ROA; LTD_{it} is the independent variables and measured by the ratio of loans to deposit; LTD_{it}^{2} is square of LTD_{it}; $\mathrm{BSCV}_{\mathrm{it}}$ is a vector of bank-specific control variables consisting of the variables, such as cost to income ratio, non-performing loans, bank capital and bank size; the vector $MECV_{\mathrm{t}}$ represents macroeconomic control variables such as GDP growth and Inflation rate; The coefficients $\alpha, \varsigma, \gamma, \delta, \beta_{\mathrm{j}}$, and λ_{t} are the parameters to be estimated; and the combined error term $\varepsilon_{\mathrm{it}}$ consists of a time-invariant bank-level fixed effects ω_{i} and an idiosyncratic component u_{it}.

3.3. Estimation methodology

The persistence of bank profitability is well documented in prior banking literature (Trujillo-Ponce, 2013; Isik, 2017; Yüksel et al., 2018; Song et al., 2019; Horobet et al., 2021). We assess the relationship between LTDR and profitability using a fixed-effects GMM estimation approach to account for profit persistence and endogeneity that might develop owing to unobservable heterogeneity, as well as possible reverse causality from profitability to bank-specific variables.

The Davidson-MacKinnon test (1993) is applied to check the endogeneity of the independent and control variables used in the regression model. The Davidson-MacKinnon test results reported in Table 3 demonstrate that the null of exogeneity is rejected only for bank capital and non-performing loans variables, indicating that both variables are endogenous.

In our study, we employ the lagged values of endogenous variables and the current values of the exogenous variables as instruments for the endogenous variables. Kleibergen and Paap rank LM test (2006), Cragg-Donald F test (1993) and Hansen test (1982) are performed to check whether our instrument variables were valid, respectively. According to the test statistics reported at the bottom of Table 6, the instrumental variables used in the estimations seem to be valid.

We then perform diagnostic tests for autocorrelation (Wooldridge, 2010) and heteroskedasticity (Greene, 2008) in the fixed effects panel data models and detect that statistics for both tests are significant. In this study, test statistics that are robust to autocorrelation and heteroskedasticity are employed while reporting the empirical results.

Table 3

Davidson-McKinnon test for exogeneity

	Panel A – Pakistan		Panel B – China	
Variables	**Test Statistic**	**Prob.**	**Test Statistic**	**Prob.**
LTDR	1.190	.2754	1.759	.1847
COST	2.117	.1457	1.908	.1672
NPL	7.651	.0057	4.869	.0273
BC	7.120	.0076	5.823	.0158
BS	0.540	.4623	0.223	.6364

4. RESULTS

4.1. Descriptive statistics

Table 4 reports the comparison of the descriptive statistics between Pakistan and China. We have also applied the t-test to see whether there are significant differences between commercial banks operating in Pakistan and China in terms of the means of all variables employed in the study. Statistics for the t-test are reported in the last column of Table 4.

The average value for ROA of Pakistan and Chinese banks are %1.061 and %1.056, respectively. However, according to the t-test results, there is no significant difference between the banks of both countries in terms of the average of this variable. The mean LTDR of Pakistan and Chinese banks are %60.924 and %69.552, respectively. This indicates that Chinese banks have higher LTDR than Pakistani banks. The t-test statistics reported in the last column of Table 3 suggest that there exist significant differences in other variables, except ROA, between banks in Pakistan and China.

Table 4

Descriptive statistics of commercial banks in Pakistan and China

	Panel A – Pakistan					Panel B – China					Diff. t-Stat.
	N	**Min**	**Mean**	**SD**	**Max**	**N**	**Min**	**Mean**	**SD**	**Max**	
ROA	150	-1.452	1.061	.78	3.118	240	.636	1.056	.186	1.468	-0.099
LTDR	150	33.618	60.924	14.583	103.993	150	26.426	69.552	12.586	110.97	-13.54*
COST	150	30.798	61.283	21.025	144.883	240	22.76	36.193	6.422	51.679	-17.26*
NPL	150	1.457	10.067	5.181	30.943	240	.139	1.174	.45	2.351	-26.45*
BC	150	3.689	9.153	4.153	25.327	240	4.259	6.581	1.008	8.777	-9.18*
BS	150	5.853	8.237	.972	9.915	240	9.425	12.627	1.446	15.203	32.75*
GDP	150	.989	3.957	1.613	5.836	240	5.951	7.678	1.338	10.636	24.65*
INF	150	2.529	7.546	3.47	12.939	240	1.437	2.59	1.125	5.554	-20.48*

Note: * $p < 0.01$, ** $p < 0.05$, *** $p < 0.10$.

4.2. Investigation of Multicollinearity

The Spearman correlation test and variance inflation factors are used to determine if there is a multicollinearity issue among the independent and control variables utilized in the investigation (VIFs). The results are presented in Table 5.

All correlations among the variable pairs in both bank samples are less than .80. It is also determined that all coefficients of VIFs computed for the variables in both samples take values between 1.26 and 4.44. Thus, they are less than 5. Both correlation values and VIF values suggest the absence of multi-collinearity among variables included in the regression models.

Table 5
Spearman correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A – Pakistan							
(1) LTDR	1.000						
(2) COST	0.560*	1.000					
(3) NPL	0.175	0.014	1.000				
(4) BC	-0.041	-0.424*	0.333*	1.000			
(5) BS	-0.331*	-0.514*	-0.149	-0.042	1.000		
(6) GDP	-0.173	0.058	-0.255*	-0.099	0.168	1.000	
(7) INF	0.302*	0.018	0.235*	0.072	-0.194	-0.742*	1.000
VIFs	1.26	1.53	1.82	1.92	2.64	4.04	4.44
Panel B – China							
(1) LTDR	1.000						
(2) COST	-0.169*	1.000					
(3) NPL	-0.121*	-0.376*	1.000				
(4) BC	-0.398*	-0.452*	0.443*	1.000			
(5) BS	0.311*	-0.175*	0.403*	0.373*	1.000		
(6) GDP	-0.248*	0.681*	-0.624*	-0.569*	-0.257*	1.000	
(7) INF	-0.116	0.292*	-0.411*	-0.193*	-0.148*	0.430*	1.000
VIFs	1.28	1.37	1.46	1.86	1.97	2.63	2.78

Note: * $p < 0.01$, ** $p < 0.05$, *** $p < 0.10$.

4.3. Regression results

Table 6 reports dynamic panel regression results for Pakistani banks (Panel A) and Chinese banks (Panel B). First, we carried out the analysis without including a squared term of LTDR. The empirical results are reported in the first and third columns of Table 6. The effect of LTDR on ROA is negative but insignificant for banks in Pakistan. In Pakistan, however, this impact is both positive and considerable.

As seen in the second and last columns, a squared term of LTDR variable is added to the model to investigate the nature of nonlinearity in the LTDR-ROA relationship. When the quadratic model results reported in the second column of Table 6 for Pakistani banks are analyzed, the coefficient estimates for LTDR and its square are negative and positive, respectively. This means that the ROA decreases up to a certain point as the LTDR increases. This threshold value can be computed by optimizing the ROA as a function of the LTDR. The computing of the critical value in the regression in column 4 of Table 6 is done by calculating the first derivative of this regression in terms of the LTDR variable and then making it equal to zero. When we solve for LTDR representing the point at which the ROA is minimized, we get the value of 63.44%. This result suggests that when LTDR=63.44%, the ROA of Pakistani banks is minimized. This value is higher than the mean LTDR (60.92%) shown in Table 4, implying that most Pakistani banks are operating below the optimal ratio.

However, it can be observed from the last column of Table 6 that the coefficient value of LTDR is positive, and the coefficient value of $LTDR^2$ is negative for Chinese banks. It indicates a non-linear inverted U-shape relationship between LTDR and ROA. Empirical results for Chinese banks show that ROA increases up to a certain level as LTR increases. The threshold value calculated for Chinese banks is 64.44%, which is lower than the average LTDR (69.55%) reported in Table 4. This result implies that banks in China are operating above the optimal level. These results are consistent with those of Aydemir et al. (2018), Sidhu et al. (2022), who find that the LTR-profitability relationship is non-linear inverted U-shaped.

As for the bank-specific variables, the estimated coefficients of the cost-to-income ratio (COST) are negative and significant for all specifications, indicating that an increase in operating expenses

reduces the ROA of banks operating in Pakistan and China.

Non-performing loans (NPL) are negatively and significantly associated with ROA in all specifications, showing that high credit risk is associated with low profitability in both countries.

It appears that no significant relationship exists between bank capital (BC) and ROA of banks operating in Pakistan and China for the investigated timeframe and chosen bank sample.

Our results regarding the effect of bank size (BS) on profitability are negative for both countries. However, this effect is significant only for Chinese banks. Negative and significant coefficient estimates for the BS variable reveal that Chinese banks do not benefit from economies of scale.

The statistically significant coefficient estimates for the lagged dependent variable (ROA) in all model specifications justify the use of a dynamic model, suggesting that the previous year's profitability has a positive impact on the current year's profitability.

In terms of macroeconomic variables, we find a significant and positive association between GDP growth and ROA only for Pakistani banks. This finding can be explained by the fact that economic booms are generally associated with greater demand for loans. Table 6 also suggests that there is a positive and significant relation between Inflation and ROA only for Pakistan, which means that bank management anticipates inflation expectations and adjusts interest rates to achieve higher profitability.

Table 6

Regression results

	Panel A – Pakistan		**Panel B – China**	
Variables	Linear model	Quadratic model	Linear model	Quadratic model
LTDR	-0.0046	-0.0373**	0.0074***	0.0241***
	(0.0053)	(0.018)	(0.0022)	(0.0084)
$LTDR^2$		0.0294*		-0.0187**
		(0.0177)		(0.0095)
COST	-0.0225***	-0.0231***	-0.0054**	-0.00640**
	(0.0022)	(0.0019)	(0.0025)	(0.0025)
NPL	-0.0180*	-0.0188**	-0.199***	-0.205***
	(0.009)	(0.007)	(0.0373)	(0.0381)
BC	0.0300*	0.0274	-0.00895	-0.00569
	(0.0154)	(0.0188)	(0.0228)	(0.0236)
BS	-0.0541	-0.0225	-0.196***	-0.210***
	(0.194)	(0.213)	(0.0566)	(0.0579)
ROA (lagged)	0.7529**	0.8077**	0.491***	0.500***
	(0.3205)	(0.3364)	(0.0864)	(0.0866)
GDP	0.559*	0.729	-0.0137	-0.0179
	(0.287)	(0.398)	(0.0299)	(0.0294)
INF	0.145**	0.185**	-0.0245	-0.0239
	(0.0471)	(0.0717)	(0.0214)	(0.0205)
F	106.43***	339.53***	87.20***	81.45***
F_μ	7.46***	6.96***	2.54***	2.52 ***
F_{AC}	6.153**	6.255**	28.363***	30.035***
LM_{het}	968.97***	382.41***	388.83***	357.21***
IV test-I	19.861***	19.422***	31.226***	30.439***
IV test-II	18.467***	18.338***	11.336***	11.820***
IV test-III	3.585*	3.491*	1.836	3.554

Notes: Robust standard errors are in parentheses. ***, **and * indicate that the statistics are significant at the 1%, 5% and 10% level, respectively. F statistic tests for overall significance of regression model. F_μ statistic tests for absence of individual effects. F_{AC} and LM_{het} statistics test for absence of serial correlation and homoscedasticity. IV test-I shows the Kleibergen-Paap rk LM statistic for underidentification test. IV test-II demonstrates the Cragg-Donald Wald F statistic for weak identification test, and IV test-III indicates Hansen J-statistic for overidentification test.

5. CONCLUSION

In both bank-based and market-based financial systems, the loan-to-deposit ratio is an important indicator of bank liquidity management and is closely related to banks' risk-taking and profitability. Thus, this study explores how the loan-to-deposit ratio (LTDR) influences bank performance (ROA), focusing on commercial banks listed in Pakistan and China. This study covers the period from 2010 to 2019. In our study, we employ the fixed effects GMM estimator to estimate the linkage between LTR and the profitability of banks.

Our empirical results of the quadratic model for Pakistani listed banks suggest that there exists a nonlinear U-shaped association between LTDR and ROA. This means that as the LTDR increases, ROA tends to decrease first and then increase. However, our empirical findings for Chinese listed banks indicate that there is an inverted U-shaped relation between LTDR and ROA. This finding shows that, to a certain point, an increase in the loan-to-deposit ratio positively affects profitability, but after this point, an increase in the loan-to-deposit ratio causes a decrease in profitability.

The results of this study present clear practical and theoretical implications for the banking sector. Regarding the theoretical implications, this study reveals how important efficient liquidity management is for the profitability of banks. It argues that efficient liquidity management can be used as a strategic tool to improve the profitability of banks. The loan-to-deposit ratio is a critical indicator for the banking sector, and it can reveal whether the savings in the country are sufficient in financing the loans. Regarding practical implications, our results can potentially guide bank management, regulatory and supervisory authorities, and policy-makers in achieving and sustaining financial stability in the banking industry. They should also consider that the effect of the loan-to-deposit ratio on bank performance is not the same across banking sectors.

Declaration of Research and Publication Ethics

This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researchers' Contribution Rate Statement

The authors declare that they have contributed equally to the article.

Declaration of Researcher's Conflict of Interest

There are no potential conflicts of interest in this study

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How to cite this article: Işık, Ö. (2022). Nonlinear effect of loan to deposit ratio on bank performance: A comparison with Pakistan and China. *International Journal of Insurance and Finance, 2*(2), 61-71. https://doi.org/10.52898/ijif.2022.10