



Empirical Analysis of the Nexus between Interest Rate Marketization, Interbank Business and Bank Liquidity Risk: a Mediating Model

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Abstract

Interest rate marketization reform plays an important role in the transition from a planned economy to a market economy, and it poses challenges for traditional banking business model. This statistical research aims at analyzing the relationships between interest rate marketization, interbank business, and commercial banks' liquidity risk using a mediating model. Specifically, a series of panel data models were established to show the impact of interest rate marketization on interbank business and liquidity risk respectively using the financial data covering the period 2010-2020 from 22 listed commercial banks in China. The mediating role of interbank business in the influencing path between interest rate marketization and bank liquidity risk was also analyzed. The findings suggest that interbank business and bank liquidity risk are both positively influenced by interest rate marketization, while interbank business partially mediates the path between interest rate marketization and bank liquidity risk via a negative indirect effect.

Keywords: *Mediating Model, Panel Data Analysis, Statistical Regression, Principal Component Analysis, Interest Rate Marketization, Interbank Business, Liquidity Risk.*

1. INTRODUCTION

Interest rates play an important role in regulating the effective allocation of funds. As the reform of interest rate marketization continues to advance in China, the business, operation, and risk management of commercial banks have been greatly affected. Against the background of interest rate deregulation and intensified interbank competition, commercial banks have accelerated their business transformation and innovation, which would eventually affect the level of bank liquidity risk. For example, interest rate marketization has changed the formation mechanism of interest rates [24][27], and this may result in higher volatility of interest rates [8][25], impacting commercial banks' traditional deposit and loan business and raising the level of bank liquidity risk. On the other hand, interest rate marketization may also lead to an increase in the volume of interbank business, which could promote the contagion effect of bank liquidity risk and thus increase the overall systematic financial risk [20]. Therefore, it is of great practical importance to investigate the impact of

interest rate marketization on commercial banks' liquidity risk.

Most existing scholars mainly analyzed the impact of interest rate marketization on commercial banks' liquidity risk through theoretical reasoning, lacking relevant micro empirical tests as support. Meanwhile, the existing literature studies ignore the potential path that interest rate marketization affects liquidity risk through affecting interbank business.

The purpose of this paper is to investigate the influence of interest rate marketization on the volume of interbank business and bank liquidity risk, and to test the mediating role of interbank business in it.

The research work is structured as follows: first, constructing a bank liquidity risk index based on principal component analysis; second, empirically analyzing the influence of interest rate marketization on interbank business and bank liquidity risk using a series of panel data models; third, investigating the nexus between interest rate marketization, interbank business, and bank liquidity risk using the mediating effect model.

2. INFLUENCING MECHANISMS

The theory of financial liberalization [2][16] argues that imperfect financial market institutions, capital market distortions, and excessive government intervention are financial disincentives that can seriously affect economic growth. This theory also believes that financial repression is the cause of frequent financial and economic crises in developing countries [3], so it advocates financial liberalization to achieve financial deepening, and interest rate marketization is the core element of financial liberalization [13][22]. Previous studies [17][30] have also shown that under the traditional separated operation model, China's commercial banks benefited from interest rate regulation, their deposit and loan business accounted for most of the banks' profit sources. However, under interest rate marketization, commercial banks have to increase the level of deposit interest rates to fight for liability [31], which would push up the cost of liabilities, and this leads to the narrowing of credit spreads and the income of credit business is negatively affected [7]. Commercial banks will therefore choose to participate in interbank business vigorously and broaden the sources of non-interest income to cope with the reduction of interest income caused by interest rate marketization. Some researchers [6][12][26] identified that the scale of interbank business increased gradually in the process of interest rate marketization reform in the United States, and a similar trend would be expected in China.

Based on the above inference, interest rate marketization would promote commercial banks to acquire liquidity through more interbank business activities, which would increase the overall volume of interbank business. The following hypothesis is therefore proposed:

H1: *interbank business is positively influenced by interest rate marketization.*

The endogenous financial development theory suggests that financial liberalization promotes the growth of commercial banks' credit supply. There are two possible reasons. First, commercial banks' performance appraisal pressure will prompt them to choose to issue loans with longer maturities, given the increased cost of liabilities. This increases the maturity mismatch of balance sheets [5] and thus would push up the level of liquidity risk. Second, due to a limited number of large high-quality enterprises customers, in a relatively fully competitive environment, banks will make efforts acquiring more small and medium enterprises (SMEs) customers to meet strict credit growth requirements and profitability requirements, and their shifts from low-risk (high-quality large enterprises) to high-risk (SMEs) could increase the overall credit risk of banks' assets and thus enhance the level of liquidity risk [14]. Therefore, based on the above analysis,

interest rate marketization could lead to increased bank competition and higher credit risk, which would ultimately increase the level of bank liquidity risk. The following hypothesis is proposed:

H2: *bank liquidity risk is positively influenced by interest rate marketization.*

3. MODEL AND DATA

3.1. Model Specification

Static panel data models were employed to study the nexus between interest rate marketization, interbank business and bank liquidity risk. Specifically, Model 1 was regressed to reveal the relationship between interest rate marketization (IRM) and bank liquidity risk (LRI); Model 2 was then regressed to show the relationship between interest rate marketization (IRM) and interbank business (IBS); Model 3 was further regressed to investigate the mediating role of interbank business (IBS) between interest rate marketization (IRM) and bank liquidity risk (LRI).

Models 1-3 are specified as follows:

$$LRI_{it} = \beta_0 + \beta_1 IRM_{it} + \beta_j Control_{jit} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

$$IBS_{it} = \gamma_0 + \gamma_1 IRM_{it} + \gamma_j Control_{jit} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

$$LRI_{it} = \alpha_0 + \alpha_1 IRM_{it} + \theta_1 IBS_{it} + \alpha_j Control_{jit} + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

In the above models, the term μ_i represents the unobserved individual effects in panel data models, the term λ_t represents the time effects, and the term $Control_j$ represents the j th control variable.

3.2. Data and Variables

3.2.1. Data

This paper uses the financial data of 22 listed banks from the year 2010 to 2020 and data were collected from Wind database, the official website of China's central bank, annual reports of listed banks, CSMAR database, and iFinD database. The 22 listed China's commercial banks include six state-owned banks, ten joint-stock banks, and six city commercial banks. The period from 2010 to 2020 was selected on the grounds that the period can adequately represent the continuous development of China's financial market, the milestone of interest rate marketization reform is at the midpoint, which is the year 2015.

3.2.2. Variables

The critical explanatory variable in Models 1-3 is interest rate marketization (IRM). The landmark event in the process of China's interest rate marketization reform was on 24th October in 2015, when China's central bank decided to no longer set a floating ceiling on deposit

rates for commercial banks and rural cooperative financial institutions. This marked a brand-new stage of interest rate marketization reform in China. This paper uses a dummy variable approach to set 2015 and prior years as 0 and set post-2015 as 1.

The dependent variable in Model 2 is the volume of interbank business (IBS). The dependent variable in Model 1 and Model 3 is the level of liquidity risk of commercial banks, and the values are reflected by the liquidity risk index (LRI) of commercial banks, which were calculated using a principal component analysis approach. Most previous studies generally used a single indicator, such as the deposit-to-loan ratio or the liquidity ratio, to reflect the magnitude of bank liquidity risk. However, studies [1][19] have shown that bank liquidity risk can actually be affected by several influencing factors simultaneously, so a single indicator may not accurately and truly reflect the level of commercial banks' liquidity risk.

Therefore, this paper selects total asset turnover ratio (AT), deposit to loan ratio (LD), and capital adequacy ratio (CAR) as three basic indicators, and then constructs a liquidity risk index through PCA. The descriptive statistics for the variables AT, LD and CAR are summarized in Table 1.

Table 1: Descriptive statistics for variables used in PCA.

Variable	Mean	Std	Min	Max
AT	0.0288	0.0043	0.0182	0.0410
LD	73.8685	14.3394	26.3235	115.9852
CAR	12.7318	1.6628	8.3300	17.5200

Prior to the PCA analysis, the KMO test and the Bartlett's sphericity test need to be performed on the selected data to ensure that the selected data meet the prerequisite requirements for factor analysis. The SPSS 26 software was used to perform the tests. The KMO value is 0.501, and the data also passed the Bartlett's spherical test, indicating that the selected data are suitable for dimensionality reduction using factor analysis. The VARIMAX rotation was used and two components were extracted, explaining 76.85% of the total variance. The final results of the liquidity risk index were shown in Figure 1.

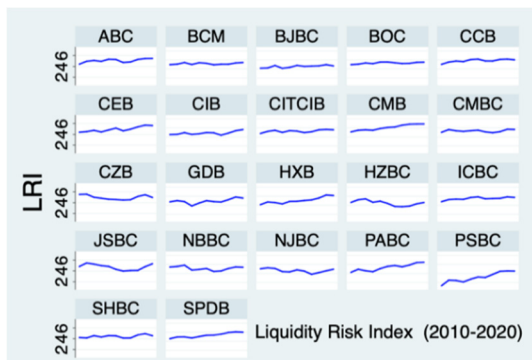


Figure 1: The liquidity risk index (LRI) of banks.

In this paper, the nonperforming loan ratio (NPL) and gross domestic product growth rate (GDP) are chosen as control variables in the empirical models, this is consistent with existing similar empirical studies [21][23]. It should be noted that the number of control variables is not necessarily the more the better, nor is the less the better. On the one hand, too many control variables may cause serious multicollinearity issues, and if control variables do not satisfy the underlying strict exogenous assumption, endogenous control variables may instead cause biased coefficient estimates [15]. On the other hand, fewer control variables may lead to omitted variable bias [9], which may also lead to biased coefficient estimates. Therefore, the choice of control variables needs to be decided on a case-by-case basis, and it is recommended to maintain consistency with existing studies in the literature.

3.3. Descriptive statistics

The results of descriptive statistics for variables (IBS, LRI, NPL and GDP) are summarized in Table 2. It can be seen that the variables do not show extreme values and are well distributed overall.

It should be noted that IBS is the logarithmic value of the volume of a bank's interbank business. Prior to regression analysis, Models 1-3 are required to be evaluated to determine whether there is any severe multicollinearity issue.

Table 2: Descriptive statistics for variables in Models 1-3.

Variable	Mean	Std	Min	Max
LBS	8.5893	1.0943	5.7511	10.4698
LRI	5.0002	0.7402	1.2600	6.8600
NPL	1.1840	0.4182	0.1600	2.3900
GDP	7.1845	2.0267	2.2000	10.6359

Multicollinearity would cause an increase in the standard errors, which in turn causes a loss of significance of the estimated coefficients and makes the parameter estimates lose their explanatory economic significance [18]. In this paper, VIF tests were employed to check the presence of any severe multicollinearity. The VIF values of each variable are less than 5, and there is no high correlation between the variables, easing the concern of severe multicollinearity.

4. EMPIRICAL RESULTS

4.1. Impact of IRM on IBS

To study the impact of interest rate marketization on interbank business, we use the OLS estimation, the RE estimation and the FE estimation to estimate Model 1. Table 3 shows the regression results: first, individual effects are not controlled in the OLS estimation and the

IRM coefficient is -0.2660, which is not significant at the 10% level; second, in the cases of the RE estimation and the FE estimation, the individual effects and the time effects are both controlled, and the estimated coefficients of the explanatory variable IRM are significantly positive, which are 0.4982 and 0.5141, respectively. It can be inferred that interest rate marketization has a positive influence on commercial banks' interbank business, a result that is consistent with the proposed research hypothesis.

Table 3: Regression results showing the relationship between IRM and IBS (OLS, RE and FE).

Variable	Dependent variable: LBS		
	OLS	RE	FE
IRM	-0.2660 (0.5747)	0.4982*** (0.1701)	0.5141*** (0.1671)
NPL	1.4861*** (0.2055)	0.1096 (0.0883)	0.0810 (0.0872)
GDP	-0.0563 (0.0770)	-0.0501** (0.0223)	-0.0500** (0.0219)
Bank effect		Control	Control
Time effect	Control	Control	Control
Cons.	7.2057*** (0.8610)	8.3323*** (0.3160)	8.3557*** (0.2501)
N	242	242	242
R ²	0.250	0.592	0.592

To verify the robustness of the above result, we performed the FE estimation with the selection of the clustered robust standard error using a stepwise regression approach. The detailed regression results are summarized in Table 4, in which: column (1) shows the FE estimation result without control variables, the coefficient of IRM is 0.9773 and significant at the 1% level; column (2) shows the FE estimation result with the control variable NPL, the coefficient of IRM is 0.9335 and significant at the 1% level; column (3) shows the FE regression result with the inclusion of the control variable GDP on top of (2), the coefficient of IRM is 0.5141 and significant at the 5% level. It can be seen that the coefficient of IRM is still significantly positive with the use of clustered-robust standard errors, further indicating the reliability of the finding that interest rate marketization has a positive contribution to the volume of interbank business.

Table 4: Regression results showing the relationship between IRM and IBS (FE with clustered robust SEs).

Variable	Dependent variable: LBS		
	(1)	(2)	(3)
IRM	0.9773*** (0.0862)	0.9335*** (0.1317)	0.5141** (0.2022)
NPL		0.0810 (0.1629)	0.0810 (0.1629)
GDP			-0.0500*** (0.0122)

Bank effect	Control	Control	Control
Time effect	Control	Control	Control
Cons.	7.8947*** (0.0823)	7.8244*** (0.1473)	8.3557*** (0.1602)
N	242	242	242
R ²	0.590	0.592	0.592

4.2. Impact of IRM on LRI

Table 5 reports the regression results of Model 2: first, in the OLS estimation case, the coefficient of the explanatory variable IRM is 0.431, but it is not significant at the 10% level; second, the coefficients of IRM are 0.6869 (significant at the 1% level) and 0.7214 (significant at the 1% level) in the cases of the RE estimation and the FE estimation respectively, indicating that interest rate marketization raises the level of liquidity risk of commercial banks, and this empirical result remains consistent with the hypothesis presented in section 2. The above finding is generally consistent with existing literature [28][29] relevant to the impact of interest rate marketization on bank liquidity risk.

Table 5: Regression results showing the relationship between IRM and LRI (OLS, RE and FE).

Variable	Dependent variable: LRI		
	OLS	RE	FE
IRM	0.4314 (0.3762)	0.6869*** (0.2409)	0.7214*** (0.2401)
NPL	0.9405*** (0.1345)	0.4803*** (0.1219)	0.4182*** (0.1253)
GDP	0.0016 (0.0504)	0.0037 (0.0316)	0.0040 (0.0314)
Bank effect		Control	Control
Time effect	Control	Control	Control
Cons.	3.7451*** (0.5636)	4.1219*** (0.3754)	4.1726*** (0.3594)
N	242	242	242
R ²	0.298	0.394	0.394

To further verify the reliability of the finding that interest rate marketization has a positive impact on commercial banks' liquidity risk, this paper again selects clustered robust standard errors and stepwise regressions. The regression results are summarized in Table 6, and individual and time effects are both controlled: column (1) reports the FE estimation result without control variables, and the coefficient of IRM is 0.9041 (significant at the 1% level); column (2) reports the FE estimation result with the inclusion of the control variable NPL, and the coefficient of IRM is 0.6880 (significant at the 1% level); column (3) reports the FE estimation result with the inclusion of the control variables NPL and GDP, the estimated coefficient is still 0.7214 and significant at the 5% level (higher standard errors). As can be seen, the finding that interest rate marketization positively affects bank liquidity risk is robust and reliable.

Table 6: Regression results showing the relationship between IRM and LRI (FE with clustered robust SEs).

Variable	Dependent variable: LRI		
	(1)	(2)	(3)
IRM	0.9041*** (0.1884)	0.6880*** (0.1991)	0.7214** (0.2587)
NPL		0.4182' (0.2043)	0.4182' (0.2043)
GDP			0.0040 (0.0160)
Bank effect	Control	Control	Control
Time effect	Control	Control	Control
Cons.	4.5773*** (0.1210)	4.2148*** (0.2136)	4.1726*** (0.2044)
N	242	242	242
R ²	0.362	0.394	0.394

4.3. Mediation Analysis

One of the channels through which interest rate marketization affects bank liquidity risk may be through influencing interbank business. Under such a mechanism hypothesis, interbank business acts as a mediating variable. Therefore, this paper further employs a mediation analysis based on Model 3 to test the above hypothesis.

Table 7 reports the regression results of Model 3: in the OLS estimation case, the coefficients of the explanatory variables are insignificant; in the RE estimation and FE estimation cases, the coefficients of the explanatory variable IRM are 0.7550 and 0.9551, respectively, and the coefficients of the mediating variable IBS are -0.1536 and -0.4546, respectively, and both are significant at the 5% level; in the case of the FE estimation with clustered robust standard errors, and the explanatory variable IRM has a coefficient of 0.9551 and significant at the 5% level, the coefficient of the mediating variable IBS is still -0.4546 and significant at the 5% level. Considering the need for subsequent comparative analysis of the coefficients of Models 1-3, we kept the consistency of the regression estimation methods, so the coefficient estimation results in the case of the FE estimation are only referred to.

Table 7: Regression results showing the relationships among IRM, IBS and LRI (OLS, RE and FE).

Variable	Dependent variable: LRI		
	OLS	RE	FE
IRM	0.4706 (0.3675)	0.7550*** (0.2404)	0.9551*** (0.2334)
IBS	0.1473*** (0.0421)	-0.1536** (0.0738)	-0.4546*** (0.0945)
NPL	0.7216*** (0.1455)	0.5124*** (0.1221)	0.4550*** (0.1194)
GDP	0.0099	-0.0041	-0.0187

	(0.0493)	(0.0315)	(0.0302)
Bank effect		Control	Control
Time effect	Control	Control	Control
Cons.	2.6836*** (0.6285)	5.3894*** (0.7122)	7.9711*** (0.8606)
N	242	242	242
R ²	0.333	0.427	0.455

According to the guidelines regarding mediation analysis recommended by [4], based on the estimated coefficients in Models 1-3, the equation $0.7214=0.9551+0.5141 \times (-0.4546)$ is obtained in the present study, indicating the presence of the mediation effect. Furthermore, this empirical result shows that interbank business enhancement would mitigate bank liquidity risk, in other words, interbank business has a dampening effect on bank liquidity risk. This finding is similar to the results reported in several existing literature studies [10][11].

Overall, Models 1-3 are used to examine the nexus between interest rate marketization, interbank business, and bank liquidity risk. The effect of the causal variable (interest rate marketization) on the outcome variable (bank liquidity risk) through the mediating variable (interbank business) has been well tested (assuming interest rate marketization is exogenous).

5. CONCLUSIONS

In this paper, we have examined the nexus between interest rate marketization, interbank business and bank liquidity risk by panel data models with the financial data in the period 2010-2020 from 22 listed commercial banks in China. We find that interest rate marketization increases the volume of interbank business activities and enhances the level of bank liquidity risk, and interbank business mediates the relationship between interest rate marketization and bank liquidity risk with a negative indirect effect. The present work promotes our understanding of the role of interest rate marketization in shaping banks.

The present work has some limitations. First, interest rate marketization may have different degrees of impact on different types of banks, and the size of a bank may also moderate the influence, future research work may be carried out to study the heterogeneity issue. Second, there is a controversy in the literature about the use of the mediation effect model for mechanism analysis, the endogeneity of the causal variable must be carefully controlled, at the same time, the mediating variable may also be endogenous, the treatment of multiple endogenous variables is therefore subject to future appropriate research design. Third, the current study mainly focuses on empirical analysis. Future research could consider a detailed case study for a particular bank. This might help accumulate more thoughts on the

influence of interest rate marketization on interbank business and risk management of commercial banks.

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