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Internet finance development and banking market discipline: Evidence from China

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ABSTRACT

Depositor discipline is the only viable and universal source of banking market discipline in China. This paper investigates whether the depositor discipline of banking works in the context of an emerging economy under financial repression and implicit government guarantee, such as the Chinese economy; how banking market discipline is affected by Internet finance development; and whether the impact of Internet finance development on market discipline changes across heterogeneous banks. The results suggest that, in general, measures of bank risk are negatively associated with the growth of deposit volumes. Internet finance development alters the sensitivity of deposit growth ratios to some bank risk measures. For non-state-owned banks, fewer measures of bank risk are significantly negatively associated with the growth of deposit volumes, and the attenuation impact of Internet finance development on market discipline for bank capitalization instead relatively increases. For large banks, market discipline works significantly, except in the case of the bank capitalization variable; moreover, these significant market disciplines are strengthened with the development of Internet finance.

1. Introduction

The idea of employing market discipline as an adjunct to supervision in the regulation of commercial banks dates back to the mid-1970s. A number of studies have investigated the role of market discipline in controlling bank risks (Bliss, 2015), and market discipline is one of the three pillars in the capital adequacy framework of the Basel Accord II. The Basel Accord III also highlights the importance of market discipline. Since the financial crisis of 2008, banking market discipline has become a central issue in financial system reform. Empirical examinations of banking market discipline have been important contributions in the academic and regulatory banking literatures (Cubillas et al., 2012; Hasan et al., 2013; Balasubramnian and Cyree, 2014). In comparison, empirical evidence on the market discipline in China's banking sector remains very scarce.

China's economy has achieved remarkable developments over the last two decades. Nevertheless, reforms in the financial sector have lagged behind those in other economic sectors. Financial repression remains one of the essential characteristics of China's financial system; the pace of interest rate liberalization is considerably slow (Allen et al., 2013).

China has a bank-based financial system. Despite the reforms, the opening up of its financial system, and the significant achievements since joining the WTO, China's banking sector is still dominated by large state-owned banks, i.e., the "Big Four" banks of ICBC, CBC, BOC, and ABC[1]. The dominance of the large state-owned banks implies low competition within the banking sector. In addition, China's banking sector is under strict government intervention, with regulations on banking market access and the range of products. Meanwhile, the Chinese government is in a position to provide commercial banks with an implicit safety net[2]. The described context creates a unique opportunity to study the effectiveness of banking market discipline exercised by customer depositors in an emerging market country, such as China.

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[1] They are the Industrial & Commercial Bank of China, Construction Bank of China, Bank of China, and Agricultural Bank of China, respectively.

[2] To date, there has only been one bank failure case in China, i.e., the bankruptcy of the Hainan Development Bank, announced by the People's Bank of China in 1998, which makes the implicit safety net look like partly believable for Chinese depositors. More details about the implicit safety net are provided in Allen et al. (2007, 2013).

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Furthermore, the explosive penetration of the Internet and mobile Internet has laid a sound foundation for Internet finance in China, which has been rapidly expanding[3]. Many people in China access the Internet not only on their computers but also on their mobile phones. Additionally, China's eCommerce industry is not strictly an urban phenomenon. It has taken off as a way for rural residents to access coveted products in China's vast and underdeveloped interior (Swanson, 2014). Internet finance, which integrates Internet technologies and financial activities, plays an important role in four major areas: payment and settlement, resource allocation, risk management and networking channels. It can effectively reduce the transaction costs and the degree of information asymmetry in financial activities. Internet finance has contributed to market-driven financial liberalization while financial control and regulation in China have not kept up with Internet finance's rapid growth (Lei, 2014).

From commercial banks' standpoint, the development of Internet finance could lead to fluctuations in bank deposits because depositors' behavior would be affected by the change in status of transaction costs and agency problems on the basis of Internet finance development. We deepen this study by examining how banking market discipline is affected by Internet finance development. We also investigate whether the impact of Internet finance development on market discipline changes across heterogeneous banks. Following Demirgüç-Kunt and Huizinga (2004), Hasan et al. (2013), and Berger and Turk-Ariss (2013), we focus on market discipline exercised through deposit volume and therefore restrict the term "market discipline" to mean depositor discipline, i.e., the sensitivity of deposit growth rates to bank risk measures. This definition can be justified because competition in China's banking system expresses itself as a contention for deposit quantity due to the tight control of the deposit rate by the government. In addition, quantity effects may be less ambiguous when research questions on banking market discipline are investigated (Bliss, 2015).

Our main empirical results suggest that, in general, measures of bank risk are negatively associated with the growth of deposit volumes, even in the case of implicit government deposit guarantee. Internet finance development has significant impacts on banking market discipline by altering the sensitivity of the deposit growth rate to some bank risk measures. For non-state-owned banks, fewer measures of bank risk are significantly negatively associated with the growth of deposit volumes; the attenuation impact of Internet finance development on market discipline for bank capitalization instead relatively increases. Finally, for large banks, market discipline works significantly, except in the case of the bank capitalization variable; moreover, these significant market disciplines are strengthened with the development of Internet finance.

This study complements the existing empirical research on banking market discipline in four ways. First, this study increases our understanding of banking market discipline in an emerging economy by investigating the market discipline in China's banking sector, which is dominated by large state-owned banks that operate under strict government regulations and are guaranteed by an implicit government safety net. Second, the article constructs a novel index of China's Internet finance development using the word frequency statistics of "text mining", which is the premise of the following empirical test. Third, it provides empirical evidence, in the context of transitional economies, on the impacts of Internet finance development on banking market discipline. Fourth, we also investigate whether the impact of Internet finance development on market discipline changes across heterogeneous banks, such as non-state-owned banks and large banks. Although the evidence presented in this study is derived from the Chinese experience, the main findings are also relevant to other developing countries with similar banking competitive structures, especially when their banking sectors are undergoing marketization transition.

The remainder of the paper is organized as follows. Section 2 reviews the literature and presents our hypotheses. Section 3 describes the data, variables, and methodology. Section 4 discusses the empirical results and provides some robustness test results. Section 5 concludes this study.

2. Literature review and hypotheses development

The vast majority of studies on depositor market discipline address this topic in the context of developed countries. Most investigate changes in deposit quantity and yields. Bliss (2015) indicates that quantity effects may be less ambiguous; yield results are difficult to interpret. Park and Peristiani (1998), Jagtiani and Lemieux (2000), Goldberg and Hudgins (2002), and Shimizu (2009) demonstrate that banks in danger of bankruptcy do not attract uninsured deposits and that weak banks actively substitute insured deposits for lost uninsured liabilities. Berger and Turk-Ariss (2013) investigate depositor discipline in the US, EU and Switzerland before and after the financial crisis and find significant evidence of depositor discipline in the relationship between deposit growth rates and bank capital ratios in large US banks. Non-US banks show weak depositor discipline, which is consistent with the more widespread expectations of government intervention in distressed banks.

Furthermore, studies that employ data from emerging markets are more relevant to this investigation. Calomiris and Powell (2001) confirm that depositors have monitored the risk-taking activities of private banks in Argentina during the last years of the 20th century. Hosono (2005) demonstrates that a solid capital base and high profitability have insignificant impacts on the growth of bank deposit volumes. Hadad et al. (2011) find that higher deposit rates have been associated with higher default and liquidity risk in Indonesia. Hasan et al. (2013) find that the financial crisis did not change the sensitivity of deposit growth rates to bank risk measures using the data from transition countries. In addition, depositors react rationally to sources of information other than financial statements. In comparison, empirical evidence on the market discipline of China's banking sector remains very scarce. Zhang and She (2008) document that the implicit deposit insurance in the four original state banks undermines banking market discipline and creates a moral hazard.

Chinese bank supervisory authorities should reform polices to enhance market discipline. China's banking sector is dominated by large state-owned banks that operate under strict government regulations and are guaranteed by an implicit government safety net. The current literature does not answer the basic question of whether depositor market discipline in banking works in the context of an emerging economy under financial repression and implicit government guarantee, such as China. Moreover, in China, Internet finance has contributed to market-driven financial liberalization because financial control and regulation in China have not kept up with Internet finance's rapid growth. The existing studies also do not answer the question of whether banking market discipline is affected by the development of Internet finance or whether banking market discipline and the relationship between Internet finance development and depositor market discipline change across heterogeneous banks.

In this paper, we focus on market discipline exercised through deposit volume, and restrict the term "market discipline" to refer to depositor discipline, i.e., the sensitivity of deposit growth rates to

[3] China stands out for its Internet and mobile Internet development among emerging market economies with penetration ratios of 45.8% and 37.1%, respectively, in 2013 (Lei, 2014).

bank risk measures[4]. If banks take excessive risks, then customers will discipline them by moving their deposits out of these banks (Demirgüç-Kunt and Huizinga, 2004; Hasan et al., 2013; Berger and Turk-Ariss, 2013). Stephanou (2010) develops the main building blocks of a banking market discipline framework based on existing literature. The framework comprises four building blocks, including information and disclosure (public availability of adequate, timely, consistent, and reliable information on the bank's risk exposures), market participants (market participants with the incentives to monitor the bank and the ability to process accurately the disclosed information), discipline mechanisms (the various instruments that market participants can use to exercise discipline), and internal governance (the organizational and compensation structures inside a bank that determine the insiders' incentives to control the risks and change their behavior in response to market signals).

In an emerging and transitional economy, such as the Chinese economy, the implicit government deposit guarantee is not fully credible to depositors because of the more dynamic inconsistency of government commitment arising from the restricted government support capacity and the government's opportunism (Roland, 2000). The implicit guarantee commitment is incomplete, thereby implying the likelihood of this commitment being violated and renegotiated when economic and political conditions change dramatically in the process of marketization. Depositors, as market participants, remain the incentives to discipline banks and are sensitive to some bank risk indicators[5]. The building block of banking market discipline, i.e., market participants, still plays the role in monitoring banks' ascending risk-taking[6]. Thus, we begin with a traditional test based on market discipline theory for the existence of depositor discipline by proposing hypothesis H1:

H1. Measures of bank risk are negatively associated with the growth of deposit volumes, even in the case of an implicit government deposit guarantee.

Internet finance, which integrates Internet technologies and financial activities, plays an important role in four major areas: payment and settlement, resource allocation, risk management, and networking channels. Internet finance is an important factor with implications mainly for the functions of information and disclosure, market participants, and discipline mechanisms.

First, the availability of timely and adequate information to the public on a bank's risk exposures is improved. Depositors can obtain knowledge of the risk-taking of banks in a more convenient and faster manner, resulting in increased concern over the poor performance of a risk measure that could have easily been neglected in the past. Depositors also tend to be less sensitive to bank risk indicators that perform quite well. Second, the development of Internet finance networking channels has resulted in the enhancement of depositors' ability to acquire more accurate disclosed information. Thus, other things being equal, the information asymmetry between banks and depositors can be reduced, the associated agency problem alleviated, and a risk measure with poor performance is treated more cautiously. Finally, in the exercise of banking market discipline, depositors can withdraw their funds and search for safer investment opportunities using various Internet finance instruments at lower transaction costs. This line of reasoning yields hypothesis H2:

H2. Internet finance development has significant impacts on banking market discipline by altering the sensitivity of the deposit growth rate to some bank risk measures[7].

Furthermore, non-state-owned banks are generally recognized as more absent from the government's guarantee. Therefore, the potential cost of bank failure increases because of the increased probability of being in financial trouble, which will affect the market discipline building blocks of market participants and internal governance. Bank depositors whose ex ante incentives to discipline banks are strengthened must exhibit more discretion in forming deposit decisions and assessing risks more accurately by seeking relevant information despite the high transaction costs before their bank savings. Bank depositors may believe that non-state-owned banks are likely to place more weight on credit risk management because bank insiders also have increased incentive to control risk-taking[8]. As a result, depositors may not be very sensitive to changes in the bank credit risk of non-state-owned banks compared with the empirical results obtained from our entire sample.

Moreover, the development of Internet finance augments the channels of non-state-owned banks to increase internal and external capital because these banks can circumvent the strict regulations on a bank's sphere of business[9], thereby creating more revenue opportunities and external capital funding. Internet finance development affects the discipline building block of risk governance. More specifically, the ability of bank insiders to control capitalization risk and adjust capital structure in response to market fluctuations is improved and consequently, depositors' concerns over the bank capitalization risk of non-state-owned banks are alleviated[10]. Therefore, the attenuation effect of Internet finance development on market discipline for bank capitalization is expected to increase relatively for non-state-owned banks. This reasoning leads us to hypothesis H3:

[4] In this paper, we employ several accounting ratios to measure bank risks. These ratios include the ratio of loan loss reserves to gross loans, which is a proxy for credit risk; the ratio of liquid assets to total assets, which reflects liquidity risk. The ratio of equity capital to total assets and the ratio of total loans to total assets are also included as indicators of bank risk. The former measures bank capitalization, the latter evaluates the share of risky assets.

[5] On average, the temporary bank payment difficulty (small liquidity risk) is the least of Chinese depositors' worries because of the government policy of "stability as a principle of overriding importance" and the government's relatively ample financial resources, which can provide banks with temporary relief from a small-scale liquidity crisis.

[6] After all, there was one bank failure case in China, i.e., the bankruptcy of the Hainan Development Bank, announced by the People's Bank of China in 1998. Besides, there is no official document that publicly promises to provide depositors with full deposit insurance. In view of the fact that deposits dominate in the Chinese residents' financial assets, it is predictable that depositors, as market participants, remain the incentives to discipline banks and are sensitive to some bank risk indicators.

[7] More specifically, as reported in Section 4.2, the positive relationship between bank capitalization (*EASSET*) and the deposit growth weakens with Internet finance development. The negative relationship between the share of risky assets (*LASSET*) and deposit growth further strengthens when the degree of Internet finance development increases. Chinese depositors are less sensitive to the change in *EASSET* maybe because, with the development of Internet finance, they learn it more cheaply and find that *EASSET* performs better than expected, which results from the influence of the Basel Accord and China's "Banking Sector Restructuring Plan", which was implemented by the State Council of China with the aim of strengthening banks' capital. However, depositors find that the share of risky assets, *LASSET*, is in a high level. Thus, they withdraw their funds and search for other investment opportunities through Internet finance channels at a lower transaction cost. The development of Internet finance has asymmetric impacts on market discipline for different bank risk measures.

[8] Non-state-owned banks are often seen as being guaranteed by the government's implicit commitment more weekly than state-owned banks because the majority shareholders of state-owned banks are exactly the governments. Thus, the moral hazard problem of non-state-owned banks, which leads to non-performing loans, is relatively not very serious compared to that of state-owned banks.

[9] The motivation for state-owned banks to raise internal and external capital by Internet finance channels is relatively weak because they have more government capital support than non-state-owned banks can obtain.

[10] In view of the government's limited financial resources, the government's implicit guarantee of capital banking for non-state-owned banks is often seen to be less strong than that of state-owned banks in China.

H3. For non-state-owned banks, fewer measures of bank risk are significantly negatively associated with the growth of deposit volumes. In addition, the attenuation impact of Internet finance development on market discipline for bank capitalization instead relatively increases.

Depositors of large commercial banks in China have confidence in the capital adequacy of these banks because of their historical experiences in the restructuring of China's banking sector[11]. Therefore, as market participants, depositors have fewer incentives to monitor bank capital risk and are insensitive to the large bank capitalization variable.

In addition, Internet finance has contributed to the function strengthening of information and disclosure as one of the market discipline building blocks. Unsophisticated depositors can obtain true information on the risk exposures of large banks in a timelier manner because of the availability of Internet finance, which enables searching for and analyzing relevant information at lower costs. The development of Internet finance has also lead to increased expectations on the part of depositors for possible government reform plans to reduce the market power of large banks and attain a gradual decrease in the guarantee of credit risks, liquidity risks, and risky assets of large banks[12]. Consequently, the incentive of depositors to discipline the banks, which is a market discipline building block of market participants, is strengthened and the significantly negative relationship between bank risk measures and deposit growth rates is strengthened as the degree of Internet finance development increases. We express this hypothesis in H4:

H4. For large banks, market discipline works significantly, except in the case of the bank capitalization variable. Moreover, these significant market disciplines are strengthened with the development of Internet finance.

3. Data, variables, and methodology

3.1. Sample and data sources

China entered the WTO at the end of 2001. From 2002 onwards, this event has considerably influenced China's banking industry, and China's large commercial bank reform began in 2003. In addition, the Baidu search engine is employed to construct Internet finance indexes through the word frequency statistics of "text mining". Baidu is the world's largest Chinese search platform, and it can access the news history of over 500 main news websites since 2003. Therefore, our study spans the 2003–2014 period.

We collect the data for the estimation from a number of sources. All bank-specific financial information is drawn from the BankScope database, the Financial Yearbook of China, and the statements of sample banks in their annual financial reports. Based on these data, we construct a panel for 56 banks. These banks account for over 90% of the total assets of all Chinese commercial banks. Macroeconomic data such as the GDP growth rate, inflation rate, the broad measure of monetary supply, and the dollar–yuan exchange rate derive from the CEIC database. Moreover, the data on market capitalization are obtained from the CSMAR database.

3.2. Variables

3.2.1. Dependent variable

Following Hasan et al. (2013) and Bertay et al. (2013), we specify the real growth rate of customer deposits (*DEPOSITGR*) as the main dependent variable in our empirical models[13]. The explicit deposit insurance system was not implemented in China during our sample period; thus, insured and uninsured deposits do not need to be differentiated in this study.

In the current literature, the liability interest rate and cost of debt issued by banks other than the real growth rate of customer deposits are also specified as dependent variables (Bertay et al., 2013; Beyhaghi et al., 2014). However, the pace of interest rate liberalization is considerably slow in China. Almost all Chinese commercial banks pay interest to depositors according to the maximum statutory interest rate promulgated by the People's Bank of China. The average liability interest paid by banks varies with changes in the statutory interest rate and their deposit structure, which is not necessarily associated with the funding costs that reflect bank risks. In addition, the overwhelming majority of Chinese commercial banks could not issue debt in China's financial markets in our sample period. Therefore, only the real growth rate of customer deposits can be specified as a dependent variable when we investigate market discipline in China's banking sector[14].

3.2.2. Bank risk

In this study, we focus on market discipline exercised through deposit volume, i.e., the sensitivity of deposit growth rates to bank risk measures. For measures of bank risk, as in Demirgüç-Kunt and Huizinga (2004) and Hadad et al. (2011), we employ several accounting ratios. These ratios include the ratio of loan loss reserves to gross loans (*LLRGL*), which is a proxy for credit risk, and the ratio of liquid assets to total assets (*LIQATA*), which reflects liquidity risk.

Moreover, according to Hasan et al. (2013), the ratio of equity capital to total assets (*EASSET*) and the ratio of total loans to total assets (*LASSET*) are also included as indicators of bank risk. The former measures bank capitalization, the latter evaluates the share of risky assets[15]. If depositors observe bank risk and banking market discipline is effective, then high *LLRGL* and *LASSET* should decrease deposit growth rates. By contrast, the rises of *LIQATA* and *EASSET* should positively affect the dependent variable.

It is worth noting that, in the context of developing economies, non-financial depositors are typically unsophisticated investors and react sensitively to concise risk indicators rather than a sophisticated measure, such as the Z-score (Zhang and She, 2008; Hasan et al., 2013; Karas et al., 2013).

3.2.3. Internet finance development variable

The construction of the Internet finance index is the premise of the following empirical tests. However, the quantitative measurement of Internet finance is seldom discussed in the previous literature. In this study, we use the word frequency statistics of "text mining" to build Internet finance indexes. "Text mining", which is based on intelligent algorithms, extracts effective information processing methods from unstructured texts. The specific implementation steps of the Internet finance index are described in Appendix A.

[11] According to Allen et al. (2007), the Chinese central government has replenished large banks' capital using fiscal funds and foreign exchange reserves on many occasions to keep their capital adequacy ratios standard in many past banking restructuring movements.

[12] The concern over these risks is inferior to that over the bank capital risk by the government in consideration of historical experiences of China's banking reform (Allen et al., 2007, 2013).

[13] The variable of deposits from banks is not appropriate to be specified as a dependent variable because this study mainly focuses on the sensitivity of non-financial depositors' reaction to bank risk-taking following the previous literature (Berger and Turk-Ariss, 2013; Hasan et al., 2013).

[14] Bliss (2015) also argues that quantity effects may be less ambiguous when research questions on banking market discipline are investigated.

[15] The interested readers can refer to above literatures for detailed discussion about the extent to which *LLGRL*, *EASSET* and the others can be considered measures of risk.

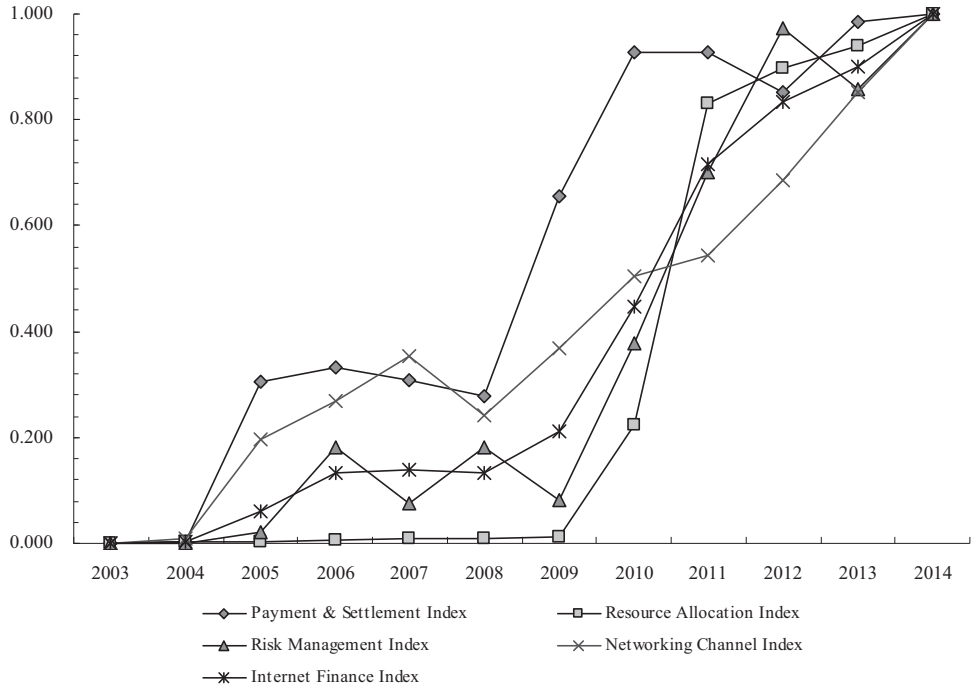

Fig. 1. Changes in the Internet finance development indexes of China.

As a result, Fig. 1 shows the change in the calculated Internet finance development indexes over the years. The figure shows that the indexes of China's Internet finance development in general have an upward trend, fluctuating during the sample period (see Appendix B for Internet finance development indexes over the years calculated in this paper).

3.2.4. Control variables

Following Zhang and She (2008), Hasan et al. (2013), Bertay et al. (2013), and Karas et al. (2013), we include bank-level, industry-level, and macroeconomic variables as our control variables.

The bank-level characteristics include the following: the contemporaneous interest cost (*INTERESTC*), which is the ratio of total interest costs to liabilities and is affected by bank moral hazard; the cost to income ratio (*CIR*), which reflects the quality of management; the bank size (*BSCALE*), which is the logarithm of total assets and represents the bank's operational scale; the bank business structure and product mixes (*NFCSHARE*), which is the share of net commission and fee income in the bank's operating income; the bank funding strategy (*FSTRATEGY*), which is the ratio of customer deposits to total funding, excluding derivatives; the ownership dummy variable (*OWNERSHIP*), which takes the value of 1 if the bank is state-owned; and the dummy variable (*LDUMMY*), which takes the value of 1 if the bank is listed[16].

Following previous studies, at the financial structure and macroeconomic level, we also control for the ratio of market capitalization to GDP (*MCGDP*), which reflects the competitive effect of capital market development, the GDP growth rate (*GDPGR*), the inflation rate (*INFLATION*), and the growth rate of the broad measure of monetary supply (*M2GROWTH*). *GDPGR*, *INFLATION*, and *M2GROWTH* are used to control for the volatile economic conditions during our sample period. In addition, year dummy variables are included in the empirical equations to control for changes in the strength of government regulation, the bank production technique, and the influence of the global financial environment.

Table 1 reports the descriptive statistics for the dependent variable and the selected explanatory variables. Bank-level data are sufficiently representative of the entire population. The difference between extreme values reflects the comparison results across various banks in different years. The difference between extreme values in individual years is not as large as it appears.

All variables have been Winsorized at the 5th and 95th percentile to remove outliers of the main variables from our data set. Furthermore, we test the multicollinearity of the main explanatory variables; the mean Variance Inflation Factor (VIF) and condition number of this procedure all suggest that high multicollinearity has not been found.

Table 1
Descriptive statistics for the dependent variable and the selected explanatory variables.

Note: All level variables are in millions of CNY; and the ratio variables are expressed as a percentage

Variable	Mean	Std. Dev.	Minimum	Maximum
DEPOSITGR	22.778	12.118	6.787	53.652
LLRGL	2.362	0.825	1.070	4.132
LIQATA	23.123	8.206	10.776	41.043
EASSET	5.671	1.799	2.207	9.295
LASSET	49.342	9.382	29.396	63.205
INTERFINANCE	0.325	0.324	0.000	0.899
INTERESTC	2.004	0.700	1.030	3.469
CIR	39.476	10.691	25.821	68.648
BSCALE	12.274	1.948	9.608	15.992
NFCSHARE	7.281	5.337	1.288	19.601
FSTRATEGY	83.295	9.735	63.420	97.855
MCGDP	55.054	28.905	23.550	130.735
GDPGR	10.105	1.812	7.650	14.160
INFLATION	2.631	2.083	−0.800	5.900
M2GROWTH	17.372	3.725	13.600	27.680

[16] Overhead, defined as non-interest bank expenses divided by assets, mainly has an impact on the interest rate according to the previous literature (Demirgüç-Kunt and Huizinga, 2004; Cubillas et al., 2012). Therefore, we did not include it as a control variable in the following empirical equations.

3.3. Methodology

Based on the discussions of the dependent and explanatory variables, we employ dynamic panel models that are similar to those employed by Maechler and McDill (2006), Oliveira et al. (2011), and Hasan et al. (2013) to test our hypotheses. The benchmark dynamic panel model is as follows:

$$\begin{aligned} DEPOSITGR_{i,t} &= \beta_0 + \beta_1 DEPOSITGR_{i,t-1} + \beta_2 LLRGL_{i,t-1} + \beta_3 LIQATA_{i,t-1} + \beta_4 EASSET_{i.t-1} + \beta_5 LASSET_{i,t-1} \\ &+ \beta_6 LINTERFINANCE_t + \beta_7 LLRGL_{i,t-1} \times LINTERFINANCE_t + \beta_8 LIQATA_{i,t-1} \times LINTERFINANCE_t \\ &+ \beta_9 EASSET_{i.t-1} \times LINTERFINANCE_t + \beta_{10} LASSET_{i,t-1} \times LINTERFINANCE_t + \beta_{11} INTERESTC_{i,t} + \\ &\beta_{12} CIR_{i,t} + \beta_{13} BSCALE_{i,t} + \beta_{14} NFCSHARE_{i,t} + \beta_{15} FSTRATEGY_{i,t} + \beta_{16} OWNERSHIP_{i,t} + \beta_{17} LDUMMY_{i,t} \\ &+ \beta_{18} MCGDP_t + \beta_{19} GDPGR_t + \beta_{20} INFLATION_t + \beta_{21} M2GROWTH_t + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where i, t refer to the bank and year, respectively. ε_{it} is the error term with a mean of zero. First-order lagged bank risk variables $LLRGL_{i,t-1}$, $LIQATA_{i,t-1}$, $EASSET_{i,t-1}$, and $LASSET_{i,t-1}$ are introduce into the empirical models because we make the reasonable assumption that the changes in bank risk-taking in a given year are perceived by depositors and influence their reactions with a lag in the following year[17]. Index variables, such as *INTERFINANCE*, are included in the logarithmic form as $LINTERFINANCE_t$; all ratio variables are expressed as a percentage[18].

We then split the data into two subsamples based on the category of bank-specific characteristics, i.e., bank ownership and bank size, to investigate whether the impact of Internet finance development on market discipline changes for non-state-owned banks and large banks. China's non-state-owned commercial banks are routinely supposed to be less strongly guaranteed than the state-owned banks by the implicit government safety net; and the "too-big-to-fail" hypothesis suggests that depositors will be compensated by the government in the event of difficulties (Bliss, 2015).

We estimate the model parameters using the Generalized Method of Moments (GMM-SYS) procedure proposed by Blundell and Bond (1998). The GMM-SYS estimator enables us to remove the strict exogeneity assumption for regressors and eliminate the unobserved bank-specific effects. In addition, the estimation of the dynamic panel model can be applied to control for path dependence in the series of the dependent variable. Although we include the lagged values of bank risk variables in the empirical model to partially reduce the potential for reverse causation, the endogeneity problem caused by the reciprocal effect that lies between the dependent and explanatory variables may still exist. Nevertheless, the dynamic panel estimator can control for this potential endogeneity by employing suitably lagged values of the explanatory variables as instrumental variables in the equations in the first differences and the first differences of these regressors in the equations in the levels. Furthermore, before using the GMM-SYS estimator, the ordinary least squares (OLS) regressions with a clustered sandwich estimator of variance, which controls for the cluster effect of time, are employed as the preliminary results[19].

In our specification, the coefficients of bank risk variables measure the importance of banking market discipline. To assess whether deposit volume sensitivity changes with the development of Internet finance in China, we investigate interactions between bank risk variables and the logarithm of the Internet finance development index. We further examine whether the impact of Internet finance development on market discipline changes across heterogeneous banks by running regressions based on non-state-owned and large bank subsample. Table C1 in Appendix C summarizes the expected signs of the coefficients of bank risk variables and their interactions with the *LINTERFINANCE*, in light of our hypotheses.

4. Empirical results

4.1. Correlation structure

Table 2 reports the Pearson pairwise correlation coefficients between the dependent variable and main explanatory variables in this study during the sample period. We find that the bank risk variables are correlated with the dependent variable in the expected direction. Almost all correlations among the bank risk variables are not statistically significant. The correlations between the logarithm of Internet finance development and each bank risk variable are not strong, although they are slightly significant. We test the multicollinearity of the main explanatory variables; the mean VIF and condition number of this procedure all suggest that high multicollinearity has not been found[20].

4.2. Regression results

Before using the GMM-SYS estimator, the ordinary least squares (OLS) regressions with a clustered sandwich estimator of variance, which controls for the cluster effect of time, are employed as the preliminary results. The clustered sandwich estimator of variance specifies that standard errors allow for intra-cluster correlation, relaxing the usual requirement that observations be independent. The observations now are not necessarily independent within clusters, which is appropriate for our regression models to control for the time effects[21]. Table 3 reports the empirical results.

[17] We followed Holod and Peek (2007), Oliveira et al. (2011), Bhaumik et al. (2011), and Hasan et al. (2013) to specify our empirical equation. The variables that reflect the operating and institutional environment of the banks, such as ownership, being listed, business model, management quality, funding strategy, Internet finance development, and other macroeconomic variables in our paper, affect the dependent variable in the same year, while bank risk variables affect the deposit growth rate with a one-year lag. This specification seems reasonable because the perception of bank risk-taking by depositors takes time, but the degree of Internet finance development, as a changing environmental variable, affects the behavior of depositors quickly. In addition, when we used the logarithm of a first-order lagged index of Internet finance development, $LINTERFINANCE_{t-1}$, instead of $LINTERFINANCE_t$, and the cross-product term between it and the lagged bank risk variables, the main conclusions in this study still hold.

[18] This specification makes the explanations for the estimates of variable coefficients easier and economically meaningful.

[19] The clustered sandwich estimator of variance specifies that standard errors allow for intra-cluster correlation, relaxing the usual requirement that observations must be independent. The observations now are not necessarily independent within clusters, which is appropriate for our regression models to control for the time effects. In addition, bank-specific dummy variables are not included in the OLS regressions to keep the parsimony of empirical models because the inclusion of redundant dummy variables leads to the inaccuracy of statistical inferences. $DEPOSITGR_{i,t-1}$ is also not included when we run the OLS regressions to avoid the problem of dynamic bias.

[20] The correlation analysis can only provide some constructive clues to our following regression analysis because of the omission of key control variables and the ambiguous causality of the correlation coefficients.

[21] Bank-specific dummy variables are not included in OLS regressions to keep the parsimony of empirical models because the inclusion of redundant dummy variables

Table 2
Correlation coefficients between the selected variables.

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

Variable	A	B	C	D	E	F	G
A. *DEPOSITGR*	1	0.383***	−0.268***	0.024	0.076	−0.021	0.095*
B. $DEPOSITGR_{(t-1)}$		1	−0.345***	0.142**	−0.075	−0.086	0.097*
C. *LLRGL*			1	0.026	0.037	0.074	0.129**
D. *LIQATA*				1	−0.003	−0.471***	0.330***
E. *EASSET*					1	0.010	0.410***
F. *LASSET*						1	−0.307***
G. *LINTERFINANCE*							1

Table 3
OLS regression results of Internet finance development and market discipline.

*, **, *** Denote statistical significance at the 10%, 5%, and 1% levels, respectively. Corresponding robust standard errors that allow for intragroup correlation are in parentheses

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LLRGL	−3.755*** (0.819)		−3.228*** (0.787)	−3.194*** (0.817)	−3.230*** (0.788)	−2.977*** (0.715)	−2.972*** (0.723)
LIQATA	0.172 (0.105)		0.063 (0.145)	0.066 (0.143)			0.095 (0.106)
EASSET		0.646 (0.626)	0.119 (0.497)	0.179 (0.511)	0.139 (0.541)	0.613 (0.685)	0.657 (0.671)
LASSET		−0.299*** (0.075)	−0.213** (0.092)	−0.219** (0.093)	−0.239*** (0.074)	−0.281*** (0.066)	−0.244*** (0.074)
LINTERFINANCE	5.720* (2.746)	9.761*** (3.011)	10.543** (3.849)	10.223** (3.973)	10.588*** (2.928)	10.214*** (2.813)	8.298** (3.031)
LLRGL × *LINTERFINANCE*	−0.393 (0.382)		−0.352 (0.382)	−0.316 (0.392)	−0.376 (0.438)	−0.142 (0.526)	−0.154 (0.453)
LIQATA × *LINTERFINANCE*	0.106* (0.054)		0.004 (0.055)	0.005 (0.054)			0.040 (0.046)
EASSET × *LINTERFINANCE*		−0.733** (0.275)	−1.067** (0.352)	−1.018** (0.347)	−1.030** (0.353)	−0.658** (0.290)	−0.638* (0.301)
LASSET × *LINTERFINANCE*		−0.126** (0.043)	−0.109* (0.054)	−0.111* (0.053)	−0.110** (0.044)	−0.137** (0.055)	−0.118** (0.050)
INTERESTC	−2.281 (1.435)	−1.647 (1.539)	−3.212* (1.521)	−3.129* (1.525)	−3.150* (1.590)	−2.034 (1.496)	−2.073 (1.482)
CIR	0.085 (0.128)	0.209 (0.142)	0.193 (0.140)	0.191 (0.138)	0.197 (0.128)	0.161 (0.124)	0.161 (0.136)
BSCALE	−2.025** (0.854)	−1.748* (0.807)	−1.775* (0.891)	−1.731* (0.913)	−1.770* (0.959)	−1.610* (0.791)	−1.695* (0.858)
NFCSHARE	0.519** (0.215)	0.502** (0.205)	0.509** (0.221)	0.509** (0.221)	0.507** (0.220)	0.493* (0.219)	0.495* (0.220)
FSTRATEGY	0.150 (0.132)	0.132 (0.131)	0.198 (0.130)	0.200 (0.131)	0.194 (0.135)	0.165 (0.136)	0.168 (0.133)
OWNERSHIP	−6.274*** (1.699)	−9.795*** (2.001)	−8.634*** (2.077)	−8.614*** (2.078)	−8.890*** (1.889)	−8.491*** (2.011)	−8.329*** (2.112)
LDUMMY	1.803 (2.039)	2.767 (1.673)	2.516 (1.816)	2.371 (1.744)	2.555 (1.843)	1.754 (1.883)	1.762 (1.734)
MCGDP	0.002 (0.013)	−0.046** (0.017)		0.015 (0.041)	0.014 (0.042)	−0.023 (0.014)	−0.022 (0.014)
GDPGR	0.150 (0.221)	0.595* (0.317)				0.247 (0.288)	0.270 (0.283)
INFLATION	−0.269 (0.416)	−0.142 (0.322)				−0.217 (0.299)	−0.294 (0.360)
M2GROWTH	0.727** (0.228)	0.689*** (0.194)				0.686*** (0.197)	0.665** (0.238)
R-squared	0.272	0.290	0.274	0.275	0.274	0.320	0.320

The estimated coefficients of *LLRGL* and *LASSET* are statistically negative in all estimations. The coefficients estimated for *LIQATA* and *EASSET* are positive, although they are insignificant. In specifications (5) and (6), *LIQATA* is excluded from the estimations because it is statistically insignificant in all specifications in Table 3. Overall, the results suggest the presence of banking market discipline in China's banking sector during the study period. Our hypothesis H1 is supported. In general, the measures of bank risk are negatively related to the growth rate of deposits[22]. Depositors discipline commercial banks in an emerging economy whose banking sector is dominated by large state-owned banks under strict government regulations and are guaranteed by an implicit government safety net, which implies that the implicit government safety net is not fully credible. In addition, depositors are more concerned with the changes in bank credit risks and risky assets rather than the changes in liquidity risks and bank capitalization.

The development of Internet finance, *LINTERFINANCE*, has a significantly positive impact on the deposit growth rates in all specifications. Moreover, the estimated coefficients of interaction terms, i.e., *EASSET* × *LINTERFINANCE* and *LASSET* × *LINTERFINANCE*, are all significantly negatively associated with the dependent variable. This outcome supports H2 and suggests that Internet finance development alters the sensitivity of deposit growth ratios to bank risk measures, i.e., *EASSET* and *LASSET* in specifications (2)–(7). The depositor discipline of *EASSET* further weakens with the development of Internet finance. By contrast, the depositor discipline of *LASSET* strengthens when the degree of Internet finance development improves.

Regarding the coefficient estimates of other control variables, they are generally consistent with Zhang and She (2008) and Hasan et al. (2013). Nevertheless, the significantly negative signs of the coefficients estimated for *BSCALE* and *OWNERSHIP* in all specifications suggest that large banks and state-owned commercial banks report lower deposit growth rates. The deposit growth is faster for small and non-state-owned banks in China. On the other hand, the significantly positive impacts of *NFCSHARE* on the dependent variable in all specifications in Table 3 imply the more expansionary deposit growth strategies followed by banks with more nontraditional banking activities. Finally, the macroeconomic control variables influence deposit growth in the expected directions. *M2GROWTH* is positively associated with the dependent variable significantly in all specifications.

To further control for path dependence in the series of the dependent variable, remove the strict exogeneity assumption for regressors, and eliminate the unobserved bank-specific effects, we estimate Eq. (1) employing the GMM-SYS estimator and base our statistical inferences regarding the significance of the estimates on the one-step estimator because the asymptotic standard errors for

leads to the inaccuracy of statistical inferences. $DEPOSITGR_{i,t-1}$ is also not included when we run the OLS regressions to avoid the problem of dynamic bias.

[22] Recall that higher *LLRGL* and *LASSET* (lower *LIQATA* and *EASSET*) indicate more risk-taking on the part of banks.

Table 4
Dynamic panel regression results of Internet finance development and market discipline.

*, **, *** Denote statistical significance at the 10%, 5%, and 1% levels, respectively. Corresponding robust standard errors are in parentheses

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$DEPOSITGR_{(t-1)}$	0.112** (0.044)	0.136*** (0.042)	0.107** (0.043)	0.113*** (0.044)	0.105** (0.044)	0.105** (0.044)	0.113*** (0.044)
LLRGL	−2.415* (1.269)		−2.647** (1.122)	−1.990* (1.188)	−2.006* (1.201)	−2.006* (1.200)	−1.990* (1.188)
LIQATA	0.017 (0.113)		−0.166 (0.103)	−0.067 (0.125)			−0.067 (0.124)
EASSET		1.837*** (0.582)	0.456 (0.440)	1.132** (0.569)	1.304** (0.588)	1.304** (0.588)	1.132** (0.570)
LASSET		−0.252** (0.100)	−0.252** (0.103)	−0.255** (0.109)	−0.237** (0.102)	−0.237** (0.102)	−0.256** (0.109)
LINTERFINANCE	6.720* (3.746)	6.013* (3.280)	12.978*** (4.127)	8.394* (4.475)	7.653** (3.457)	8.423** (3.361)	9.037** (4.348)
LLRGL × *LINTERFINANCE*	−0.171 (0.551)		−0.583 (0.531)	−0.333 (0.579)	−0.297 (0.569)	−0.296 (0.569)	−0.333 (0.579)
LIQATA × *LINTERFINANCE*	0.075 (0.061)		−0.061 (0.063)	−0.013 (0.069)			−0.014 (0.069)
EASSET × *LINTERFINANCE*		−0.553* (0.320)	−1.291*** (0.239)	−0.835** (0.338)	−0.779** (0.335)	−0.779** (0.335)	−0.835** (0.339)
LASSET × *LINTERFINANCE*		−0.082* (0.046)	−0.114* (0.062)	−0.103* (0.061)	−0.100* (0.056)	−0.100* (0.056)	−0.103* (0.061)
INTERESTC	−0.949 (1.236)	−1.198 (1.184)	−3.654*** (0.901)	−1.401 (1.106)	−2.004* (1.132)	−2.003* (1.131)	−1.401 (1.106)
CIR	−0.028 (0.090)	0.251 (0.088)	0.255*** (0.083)	0.156* (0.085)	0.178* (0.092)	0.178* (0.092)	0.156* (0.085)
BSCALE	−0.421 (0.789)	−1.166* (0.701)	−1.298* (0.700)	−0.850 (0.732)	−1.173 (0.761)	−1.173 (0.761)	−0.850 (0.731)
NFCSHARE	0.574*** (0.213)	0.995*** (0.226)	0.716*** (0.191)	0.688*** (0.199)	0.813*** (0.207)	0.813*** (0.207)	0.688*** (0.199)
FSTRATEGY	0.201** (0.081)	0.193** (0.080)	0.173** (0.077)	0.179** (0.077)	0.201** (0.079)	0.201** (0.079)	0.179** (0.077)
OWNERSHIP	−8.059*** (2.009)	−9.673*** (1.935)	−8.153*** (1.736)	−8.189*** (1.774)	−9.051*** (1.827)	−9.051*** (1.826)	−8.189*** (1.774)
LDUMMY	0.537 (2.518)	0.938 (2.599)	1.756 (2.299)	1.284 (2.354)	2.151 (2.509)	2.151 (2.509)	1.284 (2.354)
MCGDP	−0.025 (0.030)	−0.060* (0.032)		0.001 (0.026)	0.004 (0.026)	−0.042 (0.031)	−0.034 (0.031)
GDPGR	0.074 (0.430)	0.913* (0.484)				0.474 (0.502)	0.329 (0.512)
INFLATION	−0.412 (0.399)	−0.523 (0.395)				−0.655 (0.414)	−0.706* (0.421)
M2GROWTH	0.702*** (0.192)	0.432** (0.208)				0.375* (0.223)	0.390* (0.235)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald χ^2	192.050***	246.680***	197.050***	243.950***	251.920***	251.920***	243.950***

the two-step estimator can be a poor guide for hypothesis testing (Blundell and Bond, 1998). Table 4 reports the dynamic panel regression results of Internet finance development and market discipline. Our regressions can pass, at the 5% significance level, the Arellano-Bond test for zero autocorrelation in the first-differenced errors and the Sargan test of overidentifying restrictions[23]. The results of the Fisher-type unit-root tests for our dependent variable and main explanatory variables indicate that the hypotheses of panels containing unit roots are not supported.

After controlling for path dependence in the series of the dependent variable, removing the strict exogeneity assumption for regressors, eliminating the unobserved bank-specific effects, and including the year dummy variables, we find that the our models possess good econometric properties and fit the data well in contrast with the model fitness of previous OLS regressions. The results are consistent with the presence of market discipline, except in the case of *LIQATA*, during the sample period. *LLRGL* and *LASSET* have negative estimated coefficients, and *EASSET* has a positive coefficient, all of them being statistically significant in almost all specifications in Table 4, which is consistent with predictions based on market discipline theory. H1 is confirmed again. In general, measures of bank risk are negatively associated with the growth of deposit volumes, even in the case of an implicit government deposit guarantee. More specifically, depositors are sensitive to bank risk measures, i.e., *LLRGL*, *EASSET*, and *LASSET*. For depositors, the implicit government safety net for bank risks is not fully credible, although depositors are not sensitive to the changes in bank liquidity risk[24].

All other things being equal, *LINTERFINANCE* has a significantly positive effect on the deposit growth rates in all specifications. Moreover, the coefficient estimates of the interaction terms, i.e., *EASSET* × *LINTERFINANCE* and *LASSET* × *LINTERFINANCE*, are all significantly negatively associated with the deposit growth rates. H2 is confirmed again. Internet finance development alters the sensitivity of deposit growth ratios to bank risk measures, i.e., *EASSET* and *LASSET*. More specifically, the positive relationship between *EASSET* and the deposit growth weakens with Internet finance development. The negative relationship between *LASSET* and deposit growth further strengthens when the degree of Internet finance development increases. However, *LINTERFINANCE* has no impacts on the significantly negative relationship between *LLRGL* and the dependent variable.

Chinese depositors are less sensitive to the change in *EASSET* perhaps because, with the development of Internet finance, they learn it more easily and find that *EASSET* perform quite well, which results from the influence of the Basel Accord and China's "Banking Sector Restructuring Plan", which was implemented by the State Council of China with the aim of strengthening banks' capital. However, depositors find that the share of risky assets, *LASSET*, is in a high level. Thus, they withdraw their funds and search for other investment opportunities through Internet finance channels at a lower transaction cost. It is shown that the development of Internet finance has asymmetric impacts on market discipline for different bank risk measures.

In Table 4, the significance of the coefficient estimates of the control variable *BSCALE* is very weak. By contrast, the signs of the coefficients estimated for *OWNERSHIP* in all specifications are still significantly negative. The significantly positive impacts of *NFCSHARE* and *FSTRATEGY* on the dependent variable in all specifications imply the more expansionary deposit growth strategies followed by banks with the more nontraditional banking activities in their asset business and by banks that rely more on deposit taking in their liability business. Finally, among all macroeconomic control variables, only *M2GROWTH* is significantly positively associated with the dependent variable in all specifications.

To assess the impact of Internet finance development on banking market discipline, we need to investigate the significant coefficients

[23] Following Hadad et al. (2011), Cubillas et al. (2012), and Hasan et al. (2013), and addressing the endogeneity problem with further caution, we treat all main explanatory variables as endogenous except for the year dummy variables. In addition, our main hypotheses still cannot be rejected when partial bank-specific regressors are treated as predetermined.

[24] On average, Chinese depositors are insensitive to the bank liquidity risk maybe because they are not concerned with temporary bank payment difficulties under the government policy of "stability as a principle of overriding importance". They pay closer attention to the bank's essential solvency and asset quality, which cannot be fully guaranteed by the government.

Table 5
Percentages change in bank deposit growth as a result of an increase in the bank risk measures.

Note: Percentage changes in bank deposit growth are computed from $\beta_4 + \beta_9 \times LINTERFINANCE_t$ and $\beta_5 + \beta_{10} \times LINTERFINANCE_t$, respectively, as specified in Eq. (1)

	Changes in bank deposit growth (%)						
Bank risk: *EASSET*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Low *LINTERFINANCE*	–	2.950	3.054	2.813	2.872	2.872	2.813
High *LINTERFINANCE*	–	2.022	0.889	1.412	1.565	1.565	1.412
Average Difference		−0.928	−2.165	−1.401	−1.307	−1.307	−1.401
	Changes in bank deposit growth (%)						
Bank risk: *LASSET*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Low *LINTERFINANCE*	–	−0.087	−0.022	−0.048	−0.036	−0.036	−0.049
High *LINTERFINANCE*	–	−0.224	−0.214	−0.220	−0.203	−0.203	−0.221
Average Difference		−0.137	−0.192	−0.172	−0.167	−0.167	−0.172

of *LINTERFINANCE* and the significant interaction terms between *LINTERFINANCE* and the bank risk measures. For the lower or higher degree of Internet finance development[25], we can calculate the change in deposit growth rates as a result of a 1% increase in the bank risk variables, based on the more precise empirical results in Table 4, which is reported in Table 5.

These results are consistent with H2. They show that an increase in *EASSET* has a positive impact on bank deposit growth and that market discipline diminishes as the degree of Internet finance development increases. As a result of a 1% increase in *EASSET*, bank deposit growth rises by 2.950%, 3.054%, 2.813%, 2.872%, 2.872%, and 2.813% in specifications (2), (3), (4), (5), (6), and (7), respectively, in a lower degree of Internet finance development. However, in a higher degree of Internet finance development, deposit growth rises by 2.022%, 0.889%, 1.412%, 1.565%, 1.565%, and 1.412% in specifications (2), (3), (4), (5), (6), and (7), respectively. The average increase in bank deposit growth narrows by 0.928%, 2.165%, 1.401%, 1.307%, 1.307%, and 1.401% in specifications (2), (3), (4), (5), (6), and (7), respectively, from the low to the high degree of China's Internet finance development, responding to a 1% rise in *EASSET*.

However, we find that an increase in *LASSET* has a negative impact on bank deposit growth and that market discipline intensifies as the degree of Internet finance development increases. As a result of a 1% increase in *LASSET*, bank deposit growth falls by 0.087%, 0.022%, 0.048%, 0.036%, 0.036%, and 0.049% in specifications (2), (3), (4), (5), (6), and (7), respectively, in a lower degree of Internet finance development. However, in a higher degree of Internet finance development, deposit growth falls by 0.224%, 0.214%, 0.220%, 0.203%, 0.203%, and 0.221% in specifications (2), (3), (4), (5), (6), and (7), respectively. The average decrease in bank deposit growth broadens by 0.137%, 0.192%, 0.172%, 0.167%, 0.167%, and 0.172% in specifications (2), (3), (4), (5), (6), and (7), respectively, from the low to the high degree of China's Internet finance development, responding to a 1% rise in *LASSET*.

4.3. Regression results for heterogeneous bank types

We then split the data into two subsamples based on the category of bank-specific characteristics, i.e., bank ownership and bank size, to investigate whether the impact of Internet finance development on market discipline changes for non-state-owned banks and large banks[26]. Banks of a size above the median are included in the subsample of large banks. China's non-state-owned commercial banks are routinely supposed to be less strongly guaranteed than the state-owned banks by the implicit government safety net; and the "too-big-to-fail" hypothesis suggests that depositors will be compensated by the government in the event of difficulties (Bliss, 2015). The non-state-owned banks and large banks subsample regression results based on GMM-SYS estimators are presented in Table 6[27]. Our regressions can pass, at the 5% significance level, the Arellano-Bond test for zero autocorrelation in the first-differenced errors and the Sargan test of overidentifying restrictions.

The results in Table 6 statistically show the coefficients for the variables of bank risk-taking and the interaction variables between the bank risk measures and Internet finance development for groups of non-state-owned and large banks, respectively.

Again, we find that our models possess good econometric properties and fit the data well. For the group of non-state-owned banks, *EASSET* has a significantly positive coefficient, and *LASSET* has a significantly negative estimated coefficient in all specifications, which is consistent with expectations based on market discipline theory. Nevertheless, the negative effects of *LLRGL* on deposit growth are not significant in specifications (3), (4), (5), (6), and (7). The coefficient estimates of the interaction terms, i.e., *EASSET* × *LINTERFINANCE*, are significantly negatively associated with deposit growth, which implies that the positive relationship between *EASSET* and deposit growth weakens with the development of Internet finance. In addition, the impact of Internet finance development on the negative relationship between *LASSET* and deposit growth is no longer significant compared with the regression results in Table 4. These results are consistent with H3. For non-state-owned banks, fewer measures of bank risk are significantly negatively associated with the growth of deposit volumes because banks' stronger ability and desire to manage risks lead to the relative insensitivity of depositors to some risk indicators; and depositors make their deposit decisions more discreetly ex ante. In addition, the attenuation impact of Internet finance development on market discipline for bank capitalization instead relatively increases.

Furthermore, for the group of large banks, the direction of the significant impacts of *LLRGL* and *LASSET* on the dependent variable does not change compared to the results in Table 4. Moreover, *LIQATA* has a very significantly positive effect on deposit growth rate; however, *EASSET* has no significant impact on bank deposit growth for large banks. In addition, the coefficient estimates of the interaction terms, i.e., *LLRGL* × *LINTERFINANCE* and *LASSET* × *LINTERFINANCE*, are all significantly negatively associated with the deposit growth rates. Internet finance development alters the sensitivity of deposit growth ratios to bank risk measures, i.e., *LLRGL* and *LASSET*. The negative relationship between *LLRGL* and deposit growth, in addition to the negative relationship

[25] Lower/higher degree of Internet finance development is represented by the 25th/75th percentile of *LINTERFINANCE*, respectively.

[26] The detailed descriptive statistics for the dependent variable and the selected explanatory variables in following subsample regressions are not reported here; they are available upon request.

[27] To save space, the estimated coefficients on the control variables are not reported in this table.

Table 6
Dynamic panel estimation results of our specification for heterogeneous bank types.

*, **, *** Denote statistical significance at the 10%, 5%, and 1% levels, respectively. Corresponding robust standard errors are in parentheses. To save space, the estimated coefficients on the control variables are not reported in this table

	Non-state-owned banks						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LLRGL	−2.830** (1.423)		−1.841 (1.354)	−1.862 (1.353)	−2.009 (1.364)	−2.009 (1.364)	−1.862 (1.354)
LIQATA	0.071 (0.120)		−0.047 (0.136)	−0.043 (0.136)			−0.043 (0.136)
EASSET		1.649*** (0.617)	1.030* (0.620)	1.033* (0.621)	1.092* (0.638)	1.092* (0.638)	1.033* (0.622)
LASSET		−0.286*** (0.109)	−0.263** (0.120)	−0.269** (0.120)	−0.238** (0.111)	−0.238** (0.111)	−0.269** (0.120)
LINTERFINANCE	−0.748 (1.724)	7.308** (3.510)	9.767* (5.008)	9.933** (5.058)	8.657** (3.753)	9.056** (3.613)	10.311** (4.877)
LLRGL × *LINTERFINANCE*	−0.297 (0.611)		−0.410 (0.676)	−0.381 (0.676)	−0.425 (0.657)	−0.425 (0.657)	−0.381 (0.676)
LIQATA × *LINTERFINANCE*	0.063 (0.066)		−0.029 (0.078)	−0.033 (0.078)			−0.032 (0.077)
EASSET × *LINTERFINANCE*		−0.718** (0.350)	−1.016*** (0.386)	−0.981** (0.385)	−0.949** (0.384)	−0.949** (0.384)	−0.980** (0.385)
LASSET × *LINTERFINANCE*		−0.093* (0.056)	−0.106 (0.071)	−0.111 (0.071)	−0.096 (0.062)	−0.096 (0.061)	−0.111 (0.071)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald χ^2	127.820***	182.840***	174.380***	174.130***	177.750***	177.750***	174.130***
	Large banks						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LLRGL	−3.376*** (1.126)		−2.730** (1.174)	−2.730** (1.174)	−3.084*** (1.186)	−3.084*** (1.186)	−2.730** (1.174)
LIQATA	0.463*** (0.101)		0.349*** (0.119)	0.349*** (0.119)			0.349*** (0.119)
EASSET		0.240 (0.649)	0.350 (0.688)	0.350 (0.688)	−0.116 (0.666)	−0.116 (0.666)	0.350 (0.688)
LASSET		−0.462*** (0.112)	−0.276** (0.113)	−0.276** (0.113)	−0.429*** (0.112)	−0.429*** (0.112)	−0.276** (0.113)
LINTERFINANCE	9.062* (4.799)	9.050*** (2.734)	6.549** (3.217)	6.483** (3.205)	11.157*** (2.870)	11.926*** (2.976)	7.265** (3.294)
LLRGL × *LINTERFINANCE*	−1.106** (0.471)		−1.099** (0.501)	−1.099** (0.502)	−1.152** (0.492)	−1.152** (0.492)	−1.099** (0.502)
LIQATA × *LINTERFINANCE*	0.314*** (0.088)		0.212** (0.097)	0.212** (0.097)			0.212** (0.097)
EASSET × *LINTERFINANCE*		−0.363 (0.328)	−0.323 (0.346)	−0.323 (0.346)	−0.592* (0.338)	−0.592* (0.338)	−0.323 (0.346)
LASSET × *LINTERFINANCE*		−0.310*** (0.085)	−0.252*** (0.087)	−0.252*** (0.087)	−0.335*** (0.086)	−0.335*** (0.086)	−0.252*** (0.087)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald χ^2	219.980***	201.230***	216.900***	216.900***	206.160***	206.160***	216.900***

Table 7
Percentages change in bank deposit growth as a result of an increase in the bank risk measures for heterogeneous bank types.

Compared to the results in Table 5, the positive relationship between *EASSET* and deposit growth weakens with the development of Internet finance; and this works particularly for non-state-owned commercial banks relative to the empirical results from our entire sample. The positive relationship between *EASSET* and deposit growth weakens by 1.204%, 1.704%, 1.646%, 1.592%, 1.592%, and 1.644%, respectively, in specifications (2)–(7). However, for non-state-owned banks, the market discipline for *LASSET* is not significantly affected by the change in *LINTERFINANCE*. Again, these empirical results support our H3

	Changes in bank deposit growth (%) for non-state-owned banks						
Bank risk: *EASSET*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average Difference = (high *LINTERFINANCE*—low *LINTERFINANCE*)	–	−1.204	−1.704	−1.646	−1.592	−1.592	−1.644
	Changes in bank deposit growth (%) for large banks						
Bank risk: *LLRGL*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average Difference = (high *LINTERFINANCE*—low *LINTERFINANCE*)	−1.855	–	−1.843	−1.843	−1.932	−1.932	−1.843
Bank risk: *LIQATA*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average Difference = (high *LINTERFINANCE*—low *LINTERFINANCE*)	0.527	–	0.355	0.355	–	–	0.355
Bank risk: *LASSET*	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average Difference = (high *LINTERFINANCE*—low *LINTERFINANCE*)	–	−0.520	−0.422	−0.422	−0.561	−0.561	−0.422

between *LASSET* and deposit growth, further strengthens when the degree of Internet finance development increases. The estimated coefficients of *EASSET* × *LINTERFINANCE* are not significant in nearly all specifications. However, the significantly positive coefficients of *LIQATA* × *LINTERFINANCE* indicate that the positive relationship between *LIQATA* and deposit growth strengthens with the development of Internet finance. Our hypothesis H4 is confirmed.

We then calculate the average difference of the change in deposit growth rates as a result of a 1% increase in the bank risk variables for heterogeneous bank types from low *LINTERFINANCE* to high *LINTERFINANCE*, based on the empirical results in Table 6, as reported in Table 7. Similarly, we only focus on the risk measures whose coefficients are significant not only when they are included in the regression models alone but also when they enter the regression equations in the form of interaction terms.

In addition, for large bank group, *LINTERFINANCE* has significant impacts on banking market discipline for risk measures, i.e., *LLRGL*, *LIQATA*, and *LASSE*. The negative relationship between *LLRGL* and deposit growth strengthens by 1.855%, 1.843%, 1.843%, 1.932%, 1.932%, and 1.843% in specifications (1), (3), (4), (5), (6), and (7), respectively, from the low degree to the high degree of the Internet finance development. The positive relationship between *LIQATA* and deposit growth strengthens by 0.527%, 0.355%, 0.355%, and 0.355% in specifications (1), (3), (4), and (7), respectively, with the increase in the degree of Internet finance development. Finally, the negative relationship between *LASSE* and deposit growth strengthens by 0.520%, 0.422%, 0.422%, 0.561%, 0.561%, and 0.422% in specifications (2)–(7), respectively. The significantly negative relationship between bank risk measures and deposit growth rates is strengthened with the increase in the degree of Internet finance development. Again, these results are consistent with our hypothesis H4[28].

[28] In consideration of the large sample mean of bank deposits (1126 billion CNY for full sample and 6569 billion CNY for state-owned banks), a change around 1% in bank deposit growth is also economically significant and sufficient to drive banks to alter its risk taking behavior.

4.4. Robustness tests

We conduct a further analysis to check the robustness of our results in this paper[29]. First, we transform all variables in Eq. (1) using the natural logarithmic transformation to handle the potential data skewness. The main results in this study still hold. Second, we add the Herfindahl–Hirschman Index in bank assets and the annual average USD/CNY exchange rate as new control variables to control for the influence of banking market structure and exchange fluctuations, respectively[30], on the dependent variables in this study. The basic results do not change. Third, our basic results do not change essentially when one of the indexes, namely "payment and settlement index", "resource allocation index", "risk management index", and "networking channel index", replaces *INTERFINANCE* as the Internet finance development variable. Fourth, we find that our results still hold when we run our basic regressions employing fixed effects regression with the implementations of the Driscoll and Kraay (1998) standard errors[31].

5. Conclusions

Banking market discipline plays an important role in promoting financial stability. In China, depositor discipline is the only viable and universal source of banking market discipline because of the financial repression policy and strict banking regulations by the government. In this study, we investigate whether the depositor discipline of banking works in the context of an emerging economy under financial repression and implicit government guarantee, such as the Chinese economy, and how banking market discipline is affected by Internet finance development. We also investigate whether the impact of Internet finance development on market discipline changes across heterogeneous banks.

We conclude that the implicit government safety net for bank risks is not fully credible to depositors. In general, measures of bank risk are negatively associated with the growth of deposit volumes, even in the case of an implicit government deposit guarantee. The development of Internet finance has asymmetric impacts on market discipline for different bank risk measures. Internet finance development alters the sensitivity of deposit growth ratios to some bank risk measures; more specifically, the positive relationship between the bank capitalization variable and deposit growth weakens with the development of Internet finance. The negative relationship between the bank's risky assets and deposit growth further strengthens when the degree of Internet finance development increases.

Furthermore, for non-state-owned banks, fewer measures of bank risk are significantly negatively associated with the growth of deposit volumes because banks' stronger ability and desire to manage risks lead to the relative insensitivity of depositors to some risk indicators and depositors will make their deposit decisions more discreetly ex ante. In addition, the attenuation impact of Internet finance development on market discipline for bank capitalization instead relatively increases. Finally, for large banks, market discipline works significantly, except in the case of the bank capitalization variable. Moreover, these significant market disciplines are strengthened with the development of Internet finance.

Our results have some policy implications, at least in an emerging market context. Regulators and depositor discipline should closely complement each other. Bank regulators should monitor the development of Internet finance when it causes a weakening in depositor discipline. Regulators should also take advantage of Internet finance development to strengthen banking market discipline. More specifically, capital adequacy regulation must be strengthened because, on average, the positive relationship between the bank capitalization variable and deposit growth weakens with the development of Internet finance, especially for non-state-owned banks and large banks. In summary, it is better for bank regulators to take advantage of Internet finance development to strengthen banking market discipline; in the meanwhile, they should continue to monitor traditional bank risk indicators to which the sensitivity of depositors decreases. Finally, a noteworthy development in the banking industry in China was the introduction of a formal deposit insurance system in May 1, 2015. The function of banking market discipline and the effects of Internet finance development on the depositor discipline are open questions that need to be investigated further in future studies.

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Appendix A.

First, initial lexicons are constructed from the financial function perspective. From the perspective of functionalism, modern finance is endowed with the following functions: payment and settlement, resource allocation, risk diversification, and information transmission (Merton and Bodie, 1995; Allen and Gale, 2000). Internet finance, which integrates Internet technologies and financial activities, plays an important role in four major areas: payment and settlement, resource allocation, risk management and networking channels. Therefore, in this study, the following four lexicons are established, which are presented in Table A1.

Second, the word frequency of keywords is calculated using the Baidu search engine[32]. First, we utilize the Baidu database to search for the number an initial keyword in the news articles that were released every month from 2003 to 2014. Then, the total number of released news articles in a month is counted, and the word frequency of this keyword in the month is calculated[33]. Eventually, we take the average monthly word frequency of the keyword to obtain the annual word frequency, which is used as the foundation to build the Internet finance development index. News release data are highly associated with social and economic phenomena (Askitas and Zimmermann, 2009). The amount of news articles released on Internet finance is not only positively correlated with the activities of Internet finance enterprises but also positively associated

[29] To save space, the detailed results of the robustness tests are not reported here; they are available upon request.

[30] The Herfindahl–Hirschman Index and annual average USD/CNY exchange rate are not included in our empirical models simultaneously because it is found that they are highly collinear during our sample period.

[31] Driscoll–Kraay standard errors are robust to very general forms of cross-sectional and temporal dependence.

[32] Baidu is currently the world's largest Chinese search platform, and it can access the news history (since 2003) of over 500 news websites.

[33] Given that the Baidu database does not disclose the total number of monthly news articles, the number of news articles including the top ten commonly used Chinese idioms is taken as the proxy variable of the total number of monthly news articles. Information on the top ten commonly used Chinese idioms comes from the "Language Situation Report in China" issued by the Ministry of Education of the People's Republic of China.

Table A1
Initial lexicons for the Internet finance development index.

Dimensions	Detailed description		
Payment & settlement	Third party payment	Online payment	Mobile payment
Resource allocation	Online financing	Online investment	Online loan
Risk management	Internet financial management	Internet insurance	Online finance
Networking channel	Electronic banking	Online banking	Internet banking

Table A2
Test results and variance contribution of factor analysis of the Internet finance development index.

*** Denote statistical significance at the 1% levels. C.F. represents common factor; A.V.C. represents accumulated variance contribution

	Internet finance development	Payment and settlement	Resource allocation	Risk management	Networking channel
KMO	0.763	0.774	0.839	0.752	0.811
Bartlett test	212.920***	19.450***	26.810***	17.570***	16.820***
No. of C.F.	1	1	1	1	1
A.V.C.	85.420%	85.270%	87.980%	90.130%	93.470%

Table A3
Factor loading matrix of the Internet finance development index.

	Internet finance development	Payment and settlement	Resource allocation	Risk management	Networking channel
Third party payment	0.959	0.901			
Online payment	0.832	0.474			
Mobile payment	0.710	0.878			
Online financing	0.892		0.975		
Online investment	0.952		0.935		
Online loan	0.920		0.963		
Internet financial management	0.930			0.892	
Internet insurance	0.921			0.947	
Online finance	0.825			0.885	
Electronic banking	0.856				0.977
Online banking	0.874				0.954
Internet banking	0.976				0.954

with netizens' attention to Internet finance. Financial activities and the attention of netizens reflect the development status of Internet finance from the supply and demand sides of Internet financial services, respectively. Thus, our approach to constructing the Internet finance indexes in this study has an appropriate theoretical basis in the field of "text mining".

Third, the factor analysis method is employed to construct the Internet finance development index (*INTERFINANCE*). We conduct a comprehensive factor analysis based on all of the keywords and calculate the "Internet finance development index", which is then used as a benchmark of the quantitative analysis. First, we run KMO tests and Bartlett tests of sphericity on the variables. Table A2 shows that all KMO test results are greater than 0.6 and the approximate chi-square values of Bartlett test of sphericity are also very significant; thus, these keywords are appropriate for factor analysis.

Then, we extract common factors following the principle that the eigenvalue should be greater than one according to the principal component analysis (PCA) approach. The results show that the variance contribution rate of the extracted common factors exceeds 85%, indicating that the extracted factors can reflect the information contained in the keywords. Finally, after conducting varimax orthogonal rotation on the factor loading matrix that is shown in Table A3, the factor scores of the extracted factors are calculated and reported in Table A4.

To ensure that the data are positive, we apply max-min processing to normalize the data to a range between 0 and 1, obtaining the final indexes. Furthermore, using a process similar to the process described above, according to the keywords of the various dimensions, we conduct hierarchical factor analysis and calculate the "payment and settlement index", "resource allocation index", "risk management index", and "networking channel index".

Table A4
Factor scores matrix of the Internet finance development index.

	Internet finance development	Payment and settlement	Resource allocation	Risk management	Networking channel
Third party payment	0.119	0.499			
Online payment	0.099	0.262			
Mobile payment	0.008	0.486			
Online financing	0.111		0.354		
Online investment	0.118		0.340		
Online loan	0.114		0.350		
Internet financial management	0.116			0.360	
Internet insurance	0.114			0.382	
Online finance	0.102			0.358	
Electronic banking	0.106				0.517
Online banking	0.108				0.512
Internet banking	0.121				0.512

Appendix B.

Table B1
Internet finance development indexes over the years calculated in this paper.

	Internet finance development	Payment and settlement	Resource allocation	Risk management	Networking channel
2003	0.000	0.000	0.000	0.000	0.000
2004	0.003	0.002	0.003	0.001	0.008
2005	0.062	0.305	0.002	0.020	0.196
2006	0.134	0.332	0.007	0.182	0.268
2007	0.138	0.308	0.010	0.075	0.354
2008	0.134	0.279	0.009	0.180	0.241
2009	0.212	0.657	0.013	0.081	0.368
2010	0.446	0.928	0.225	0.379	0.505
2011	0.715	0.929	0.830	0.701	0.544
2012	0.833	0.853	0.896	0.974	0.686
2013	0.899	0.986	0.941	0.857	0.850
2014	1.000	1.000	1.000	1.000	1.000

Appendix C.

Table C1
Expected signs of the coefficients in light of our hypotheses.

Variable	Expected signs		
	Full sample	Non-state-owned banks	Large banks
LLRGL	–		–
LIQATA			+
EASSET	+	+	
LASSET	–	–	–
LLRGL × *LINTERFINANCE*			–
LIQATA × *LINTERFINANCE*			+
EASSET × *LINTERFINANCE*	–	–	
LASSET × *LINTERFINANCE*	–		–

References

Allen, F., Gale, D., 2000. Comparing Financial Systems. MIT Press, Cambridge, MA.

Allen, F., Qian, J., Qian, M., 2007. China's financial system: past, present, and future. In: Rawski, T., Brandt, L. (Eds.), China's Great Economic Transformation. Cambridge University Press, Cambridge, pp. 506–568.

Allen, F., Qian, J., Zhang, C., Zhao, M., 2013. China's financial system: opportunities and challenges. In: Fan, P.H.J., Morck, R. (Eds.), Capitalizing China. University of Chicago Press, Chicago, IL, pp. 63–143.

Askitas, N., Zimmermann, K.F., 2009. Google econometrics and unemployment forecasting. Appl. Econ. Q. 55, 107–120.

Balasubramnian, B., Cyree, K.B., 2014. Has market discipline on banks improved after the Dodd–Frank Act? J. Bank. Finance 41, 155–166.

Berger, A.N., Turk-Ariss, R., 2013. Do depositors discipline banks and did government actions during the recent crisis reduce this discipline? An international perspective. In: University of South Carolina Working Paper.

Bertay, A.C., Demirgüç-Kunt, A., Huizinga, H., 2013. Do we need big banks? Evidence on performance, strategy and market discipline. J. Finan. Intermediation 22, 532–558.

Beyhaghi, M., D'Souza, C., Roberts, G.S., 2014. Funding advantage and market discipline in the Canadian banking sector. J. Bank. Finance 48, 396–410.

Bhaumik, S.K., Dang, V., Kutan, A.M., 2011. Implications of bank ownership for the credit channel of monetary policy transmission: evidence from India. J. Bank. Finance 35, 2418–2428.

Bliss, R., 2015. Market discipline in financial markets: theory, evidence, and obstacles. In: Berger, A.N., Molyneux, P., Wilson, J.O.S. (Eds.), The Oxford Handbook of Banking. , second ed. Oxford University Press Inc., New York, NY, pp. 568–588.

Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. J. Econometrics 87, 115–143.

Calomiris, C.W., Powell, A., 2001. Can emerging market bank regulators establish credible discipline? The case of Argentina, 1992–1999. In: Mishkin, F.S. (Ed.), Prudential Supervision: What Works and What Doesn't. The University of Chicago Press, Chicago, IL, pp. 147–196.

Cubillas, E., Fonseca, A.R., González, F., 2012. Banking crises and market discipline: international evidence. J. Bank. Finance 36, 2285–2298.

Demirgüç-Kunt, A., Huizinga, H., 2004. Market discipline and deposit insurance. J. Monet. Econ. 51, 375–399.

Driscoll, C., Kraay, A., 1998. Consistent covariance matrix estimation with spatially dependent panel data. Rev. Econ. Stat. 80, 549–560.

Goldberg, L.G., Hudgins, S.C., 2002. Depositor discipline and changing strategies for regulating thrift institutions. J. Finan. Econ. 63, 263–274.

Hadad, M.D., Agusman, A., Monroe, G.S., Gasbarro, D., Zumwalt, J.K., 2011. Market discipline, financial crisis and regulatory changes: evidence from Indonesian banks. J. Bank. Finance 35, 1552–1562.

Hasan, I., Jackowicz, K., Kowalewski, O., Kozłowski, Ł., 2013. Market discipline during crisis: evidence from bank depositors in transition countries. J. Bank. Finance 37, 5436–5451.

Holod, D., Peek, J., 2007. Asymmetric information and liquidity constraints: a new test. J. Bank. Finance 31, 2425–2451.

Hosono, K., 2005. Market discipline to banks in Indonesia, the Republic of Korea, Malaysia and Thailand. In: Asian Development Bank Institute Conference, Corporate Governance of Banks in Asia, January, January 20–21.

Jagtiani, J., Lemieux, C., 2000. Stumbling Blocks to Increasing Market Discipline in the Banking Sector: A Note on Bond Pricing and Funding Strategy Prior to Failure. Federal Reserve Bank of Chicago, Chicago, IL.

Karas, A., Pyle, W., Schoors, K., 2013. Deposit insurance, banking crises, and market discipline: evidence from a natural experiment on deposit flows and rates. J. Money Credit Bank. 45, 179–200.

Lei, Y., 2014. Policy discussion of internet finance in China. In: BOFIT Policy Brief. Institute for Economies in Transition, Bank of Finland.

Maechler, A.M., McDill, K.M., 2006. Dynamic depositor discipline in US banks. J. Bank. Finance 30, 1871–1898.

Merton, R.C., Bodie, Z., 1995. A conceptual framework for analyzing the financial environment. In: Crane, D.B., Froot, K.A., Mason, S.P., Perold, A., Merton, R.C., Bodie, Z., Sirri, E.R., Tufano, P. (Eds.), The Global Financial System: A Functional Perspective. Harvard Business School Press, Boston, MA, pp. 3–31.

Oliveira, R.F., Schiozer, R.F., Barros, L.A.B., 2011. Financial crisis and cross-border too big to fail perception. In: Midwest Finance Association 2012 Annual Meetings Paper, http://www.dx.doi.org/10.213 9/ssrn.1787661.

Park, S., Peristiani, S., 1998. Market discipline by thrift depositirs. J. Money Credit Bank. 30, 347–364.

Roland, G., 2000. Transition and Economics: Politics, Markets, and Firms. MIT Press, Cambridge, MA.

Shimizu, K., 2009. Is the information produced in the stock market useful for depositors? Finance Res. Lett. 6, 34–39.

Stephanou, C., 2010. Rethinking market discipline in banking: lessons from the financial crisis. In: Policy Research Working Paper WPS5227. The World Bank, Washington, DC.

Swanson, A., 2014. Internet finance in China: will it disrupt traditional banking? China Bus. Rev., ⟨http://www.chinabusinessreview.com/internet-finance-in-china-will-it-disrupt-traditional-banking/⟩.

Zhang, Q., She, G., 2008. Is there any effect of market discipline on China's bank supervision? J. Econ. Policy Reform 11, 29–35.