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Bank funding structure and lending under liquidity shocks: Evidence from Korea ☆

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ABSTRACT

This paper examines the relation between bank funding structure and lending to firms during periods of liquidity shocks. We analyze this relation by using quarterly loan panel data of all commercial banks in Korea, as well as their borrowing firms. We find that when liquidity shocks are severe, banks generally reduce their lending, but banks with a high core funding ratio tend rather to increase their lending to firms during periods of market-wide liquidity shocks, thereby offsetting the reduction in lending due to liquidity shocks. This tendency is stronger in banks that maintain relationship banking with these firms. However, these findings are valid only for large banks. Our findings could provide some important policy implications for financial supervisory authorities seeking some regulatory policies on liquidity such as those of Basel III.

1. Introduction

The bank regulatory environment has significantly changed since the recent global financial crisis. Before the global financial crisis, regulatory authorities had tried to ease regulations based on the belief that efficient capital allocation could be achieved through financial innovation. Since the global financial crisis, however, both economists and regulatory authorities have come to agree that certain elements of regulatory easing instead bolstered the vulnerability of the financial system. The Basel Committee on Banking Supervision (BCBS)

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and the financial regulatory authorities of major countries view banks' tendency to rely excessively on wholesale funding as a major source of the aggravated financial market turmoil.[3] Based on this view, they are expected to adopt liquidity regulation in addition to capital regulation as a global-level regulatory scheme.

The wholesale funding of banks is generally not covered by deposit insurance; hence uninsured creditors respond sensitively to market-wide liquidity shocks. Therefore, banks with high wholesale funding will be severely affected in their lending when market-wide liquidity shocks are high. In contrast, banks' core funding, which has sufficiently stable sources of funding, is relatively less sensitive to financial market-wide liquidity shocks. The BCBS has strengthened its liquidity framework by developing a minimum standard for funding which is designed to achieve the following objective. That is to reduce funding risk over a longer time horizon by requiring banks to fund their activities with sufficiently stable sources of funding in order to mitigate the risk of future funding stress. As such *stable funding* sources, the BCBS suggests retail (demand and term) deposits, capital, and liabilities with effective maturity of one year or more.[4] As core funding, therefore, we include retail (demand and term) deposits covered by deposit insurance (or core deposits), core capital (Tier 1 capital),[5] and debt and bank debentures with long-term maturities. Since most retail deposits are covered by deposit insurance, retail depositors respond much less sensitively to market-wide liquidity shocks. Further, banks are flush with funds from deposit inflows because investors tend to seek a safe haven for their money in financial market turmoil. As a result, banks with high core funding can even increase lending to firms when liquidity shocks are severe.

Banks may well behave differently in lending to firms according to their funding structure, particularly during a liquidity shock crisis. This paper examines the relation between banks' funding structure and their lending to firms in Korea during liquidity shock crises. The extent to which bank lending is related to funding structure is affected by the banks' characteristics (such as capital structure, profitability, and the amount of non-performing loans), as well as the characteristics of borrowing firms (such as leverage ratio, profitability, and firm value). To analyze this relation, therefore, we use panel data of both banks and firms from June 2007 to September 2011. Most previous studies use the panel data of banks only. To our knowledge, our study is the first to analyze the effect of bank funding structure on their lending to firms during liquidity shock periods after controlling for factors that may affect the demand and supply of corporate lending by using the panel data of both banks and firms.

The findings of this study are as follows. First, when liquidity shocks are intense (i.e., bank credit spreads widen), banks generally reduce their lending, but banks with a core funding ratio higher than a certain level tend to increase their lending to firms, thereby offsetting the reduction in lending due to liquidity shocks. These results indicate that banks with a stable funding structure increase their lending during a liquidity shock crisis and play an important role in absorbing market-wide liquidity shocks in the financial markets. Second, the tendency of banks with a higher core funding ratio to increase lending is stronger in main banks that maintain a strong relationship with their lending firms.[6] In other words, even though main banks have a core funding ratio lower than a certain level, during a liquidity shock crisis, they tend to increase their lending to firms that maintain relationship banking with them. Both banks and firms receive benefits from relationship banking.

The results in this study provide some important policy implications for financial supervisory authorities seeking some regulatory policies on liquidity such as those of Basel III.[7] Our results provide justification for the adoption of such regulatory policies that encourage banks to change their funding structure by reducing

[3] Wholesale funding is a method of funding that banks use in addition to core retail funding (based on deposits) to finance their long-term assets from other financial institutions and in financial markets. Wholesale funds are usually raised on a short-term rollover basis. According to Huang and Ratnovski (2011), there is a risk that at the refinancing stage wholesale financiers will suddenly withdraw their funds upon a hint of negative news. This could trigger disorderly liquidations. When wholesale withdrawals follow a market-wide signal, correlated bank failures exacerbate systemic risk.

[4] See Table 1 on page 5 of the BCBS document entitled "Basel III: The Net Stable Funding Ratio (2014)," which is available on the BIS website (www.bis.org).

[5] Tier 1 capital is composed of *core capital*, which consists primarily of common stock and disclosed reserves (or retained earnings).

[6] When a firm borrows from multiple banks, the bank that maintains the largest amount of loan with the firm is defined as its main bank. There are no multiple main banks in our sample. There is no case that a firm has no main bank.

[7] Refer to Basel Committee on Banking Supervision (2014).

wholesale funding and securing stable core funding. Banks with this changed funding structure would eventually increase their lending to firms especially during the periods of severe liquidity shocks.[8] This study should help an understanding of the mechanism of bank intermediation in loans and the prediction of the effect of the introduction of liquidity regulations on banks' practices in lending to firms.

This paper is organized as follows: Section 2 establishes hypotheses on the relation between bank funding structure and lending to firms. Section 3 describes the data and presents summary statistics for the characteristic variables of banks and firms. Section 4 presents the empirical results and Section 5 concludes.

2. Bank funding structure and lending to firms: hypothesis

In this section, we review the relevant literature on bank funding structure and corporate lending decisions and establish hypotheses.

2.1. Bank funding structure and lending

Various recent theoretical and empirical studies have enhanced the understanding of commercial bank practices in undertaking two activities with different characteristics: deposit taking and lending. Kashyap et al. (2002) argue that banks may enjoy synergies in offering both deposit taking and lending. The reason is that since bank lending is often conducted via loan commitments and transaction deposits represent very similar products, both are two different manifestations of the same function: the provision of liquidity on demand. In a simple model, the authors develop a theoretical and empirical case for one particular such synergy, which is the sharing of the burden of holding liquid assets on the balance sheet unless deposit withdrawals and loan commitment takedowns are perfectly correlated. For example, banks can reduce liquidity risk (i.e., maintain a stable amount of liquid assets on their balance sheet) by increasing (decreasing) loan commitments when liquidity increases (decreases) due to a rise (fall) in transaction deposits.

Gatev and Strahan (2006) complement the argument of Kashyap et al. (2002) by showing that banks are well suited to provide liquidity insurance to firms (borrowers). During periods of market-wide liquidity shocks, commercial paper (CP) spreads widen and, thus, borrowing in the markets becomes expensive and investing in marketable securities such as CP is not attractive compared to its risk. In this case, banks are flush with funds from deposit inflows because investors tend to seek a safe haven for their money, a flight-to-quality phenomenon. These deposit inflows allow banks to meet loan demand from borrowers without operating with a large amount of liquid assets. Gatev et al. (2006) demonstrate that banks with a high level of transaction deposits as a source of core funding do not face high liquidity risk from unused loan commitments, while banks without such high level of transaction deposits do. During periods of market-wide liquidity shocks, nervous investors move funds out of the securities markets and into banks, since the government provides deposit insurance for their deposits and emergency relief funds to banks when necessary. Therefore, this deposit-lending hedge becomes especially powerful during periods of tight liquidity.

Ivashina and Scharfstein (2010) report that during the 2007–2009 global financial crisis, in the United States banks with a higher ratio of deposits to assets significantly increased lending to firms, although new lending for real investment such as working capital and capital expenditure declined rapidly. Cornett et al. (2011) show that U.S. banks that rely more heavily on core deposits (e.g., insured demand and term deposits) and equity capital financing, which are stable sources of funding, continued to lend to firms during the financial crisis of 2007–2009. Using Canadian banks and firms, Allen and Paligorova (2011) show that banks that rely most on wholesale funding reduce lending the most during the 2007–2009 global financial crisis.

[8] On December 16, 2009, the Financial Supervisory Commission in Korea announced the introduction of regulatory measures on the loan-to-deposit ratio, and these regulatory measures have been in force since the end of June 2012 for large banks in Korea (including branches of foreign banks). The objectives of the adoption of these regulatory measures are (i) to curb banks' extension of excessive or imprudent loans and (ii) to encourage banks to change their funding structure by reducing wholesale funding and securing stable core funding. Our results therefore support the adoption of such regulatory measures by the authority with respect to at least its second objective. When the adoption of the regulatory measures was announced, the average loan-to-deposit ratio of all commercial banks in Korea was about 135%, which was higher than other major countries The Financial Supervisory Commission in Korea then adopted a target loan-to-deposit ratio of 100%.

The above studies show that banks funded more heavily from core funding provide more lending to firms during periods of market-wide liquidity shocks. We expect that the relation between core funding and lending to firms observed in the North American banks also holds in Korean banks during the global financial crisis. Accordingly, we establish the following hypothesis.

Hypothesis 1. When wholesale funding conditions in the market become worse due to financial market liquidity shocks, banks generally reduce their lending to firms; however, banks with a high core funding ratio increase their lending to firms.

The phenomenon of deposit inflows during a period of liquidity shocks or a flight to quality tends to be more common for larger banks. Since smaller banks have more restricted access to interbank markets and capital markets, particularly during periods of liquidity shocks, core deposits are a more valuable and important source of funding for smaller banks. However, these core deposits would be first used to hoard liquidity for precautionary reasons. For example, Diamond and Rajan (2011) and Gale and Yorulmazer (2013) show theoretically that banks hoard liquidity to protect themselves against future liquidity shocks, to take advantage of potential sales, and to hedge risk from the insolvency of their counterparties in interbank markets.[9] Acharya and Skeie (2011) show that hoarding of liquidity was greater for banks that had suffered greater equity losses in the financial crisis. Therefore, smaller banks would have less leeway for lending to firms than larger banks do. We therefore set up the following hypothesis.

Hypothesis 2. Even with a high core funding ratio, small banks do not increase lending to firms during a period of liquidity shocks.

2.2. Bank funding structure and lending from main banks to their client firms

Prior studies provide evidence showing that when borrowing firms maintain a durable lending relationship with their banks, both firms and banks benefit. For example, Berlin and Mester (1999) argue that access to core deposits insulates banks' cost of funding from exogenous liquidity shocks and, in turn, borrowers are insulated by their banks against exogenous credit shocks. The authors find that banks more heavily funded with core deposits provide borrowers with smoother loan rates in response to exogenous changes in aggregate credit risk. Many researchers also show that a strong bank–firm relationship significantly reduces firms' cash holdings (Amihud et al., 2010) and improves borrowers' corporate governance and enhances firms' value, as measured by Tobin's Q, by inducing better monitoring (Dass and Massa, 2011). Bharath et al. (2007) show that the establishment of a strong relationship between lenders and borrowers enables the lenders to produce and process information more efficiently and a relationship lender's informational advantage over a non-relationship lender generates higher profitability in selling information-sensitive products to borrowers.

Studies also show that maintaining a main bank relationship affects the amount of bank credit to firms. For example, by using a large sample of Italian firms, De Mitri et al. (2010) show that bank credit available to firms maintaining a main bank (i.e., a strong bank–firm relation) was actually increased after Lehman's collapse, while the opposite happened to firms maintaining a multiple-bank relation (i.e., a weak bank–firm relation). Using Canadian bank data, Allen and Paligorova (2011) show that the more banks rely on wholesale funding, the more likely they are to reduce syndicated lending to firms during a financial crisis. However, the amount of lending is not affected for firms with a strong bank–firm relationship.

From the above discussion of the previous literature, it would appear that a strong long-term relationship between firms and banks is beneficial to both sides. When banks have difficulties in raising funds in the markets because of market-wide liquidity shocks, banks generally reduce their lending to firms as a whole due to a lack of loanable funds. In such situations, however, banks would reduce their lending less to firms with which they have a strong relationship than to firms with which they do not. This relationship lending practice would be more sustainable and stronger for banks with high core funding than for banks with low core funding, since banks with high core funding have more stable sources of funds. We therefore set up the following hypothesis.

[9] Berrospide (2013) provides empirical evidence that banks tend to hoard liquidity, regardless of their size.

Hypothesis 3. When wholesale funding conditions worsen due to financial market liquidity shocks, banks with high core funding reduce their lending less to firms with which they have a strong relationship than to firms with which they do not.

3. Data and summary statistics

3.1. Data

We limit our analysis to bank loans to manufacturing firms by commercial banks. It is necessary, therefore, to briefly explain the institutional background for commercial banks in Korea. Financial institutions in Korea are divided into six categories: banks, non-bank depository institutions, financial investment business entities, insurance companies, other financial institutions, and financial auxiliary institutions. Among these, banks and non-bank depository institutions take deposits and lend.[10] Banks are divided into commercial banks and specialized banks. Commercial banks consist of nationwide (7) and local banks (6) and branches of foreign banks (39: Numbers in parentheses indicate the number of institutions, as of December 2011). Specialized banks (5) are financial institutions established under a special act rather than the Banking Act, and their main business is to provide commercial banking services.[11] Among these banks, we include bank loans from seven nationwide and six local commercial banks and one specialized bank only in our sample.[12] The reason we include loans from this specialized bank (named as Industrial Bank of Korea) in the sample is that this bank is permitted to conduct deposit operations at the same level as commercial banks and to lend out the majority of its deposits either to firms only or to both individuals and firms, although it is established as a specialized bank.

We use quarterly panel data of bank loans during the period from June 2007 (2007:Q2) to September 2011 (2011:Q3) by all commercial banks to manufacturing firms listed on the Korea Exchange (KRX), which includes the Korea Stock Exchange and Korean Securities Dealers Automated Quotations (KOSDAQ).[13] The sources of data in this study are the Bank of Korea for bank (lender) characteristics and bond yield data, FnGuide for firm (borrower) characteristics, NICE Dun and Bradstreet (NICE D&B) for loan characteristics, and the Korea Deposit Insurance Corporation (KDIC) for the outstanding balance of insured deposits in each bank.

Table 1 presents the total loan amounts outstanding (in millions of KRW), the number of firm-banks, and the number of manufacturing firms (borrowers) with positive bank loans outstanding at the end of each quarter over the sample period. At the end of September 2011 (2011:Q3), the amount of outstanding bank loans in Korea was 87.1 trillion KRW, with 4573 outstanding bank loans to 1255 manufacturing firms.[14] We also report the loan amount from the main-bank relationship among the total loan amount in this table.

Table 2 presents the composition of core funding of all commercial banks in Korea over the sample period. On average, core deposits make up 65% of the total core funding, core capital makes up 25%, and debts and bank debentures make up the remaining ten percent. The portion of core deposits shows an increasing trend from 63% in the beginning of the sample period (June 2007) to 72% in the end of the sample period (September 2011), while the portion of core capital trends downward from 27% to 18% over the sample period. The portion of debts and bank debentures remains unchanged. Table 2 also presents the composition of

[10] Non-bank depository institutions are established for more limited purposes and fall under distinct regulations concerning their raising and management of funds. That is, the scope of their business activities is narrower than that of banks, payment and settlement services are either non-existent or provided in a limited manner. Non-bank depository institutions comprise mutual savings banks (98), credit cooperatives including credit unions (957), community credit cooperatives (1448) and mutual banking entities (1389), merchant banks (1) and the postal savings (1). Numbers in parentheses indicate the number of institutions, as of December 2011.

[11] Specialized banks include the Korea Development Bank, the Export–Import Bank of Korea, the Industrial Bank of Korea, the National Agricultural Cooperative Federation ("NongHyup"), and the National Federation of Fisheries Cooperatives ("SuHyup"). They are not public companies and are owned by the Korean government and government agencies.

[12] Seven nationwide commercial banks are KB Kookmin Bank, Shinhan Bank, Woori Bank, Hana Bank, Korea Exchange Bank, Standard Chartered Bank Korea, and Citibank Korea. Six local banks operating mainly within certain regions are Busan Bank, Daegu Bank, Kwangju Bank, Kyongnam Bank, Jeonbuk Bank, and Jeju Bank.

[13] KOSDAQ is an electronic stock market in Korea that was established in 1996. Being initially set up by the Korea Financial Investment Association as a stock market independent from the Korean Stock Exchange, it is benchmarked its American counterpart, the NASDAQ.

[14] We exclude loans that are less than 0.1% of a firm's total asset, since this small amount of loan is maintained usually for operation of the firm and this operational purpose is hardly affected by the market liquidity situation and the CFA of the banks.

Table 1
Loans to manufacturing firms by all commercial banks in Korea. This table presents summary statistics of the loans by Korean commercial banks to manufacturing firms (borrowers) listed on the KRX (Korea Stock Exchange and KOSDAQ). Firms with a ratio of loans to assets (LTA) less than 0.1% are excluded. The source of data is NICE D&B. The sample includes eight large commercial banks and six small local banks. The eight large banks are KB Kookmin Bank, Shinhan Bank, Woori Bank, Hana Bank, Korea Exchange Bank, Standard Chartered Bank Korea, Industrial Bank of Korea (IBK), and Citibank Korea. The six small local banks are Busan Bank, Daegu Bank, Kwangju Bank, Kyongnam Bank, Jeonbuk Bank, and Jeju Bank. When a firm borrows from multiple banks, the bank that maintains the largest amount of loan with the firm is defined as its main bank. Numbers in parentheses indicate the proportion (in %) of the total loans from the main banks among the total loans from all commercial banks.

Year/quarter	Aggregate loans outstanding from all commercial banks to manufacturing firms (trillion KRW)	Aggregate loans outstanding from the main banks to manufacturing firms (trillion KRW)	Number of firm-bank observations	Number of firms with positive bank loans outstanding
2007.6	53.1	14.0 (26.4)	4095	1141
2007.9	52.8	13.4 (25.4)	4203	1153
2007.12	54.2	13.5 (24.9)	4359	1163
2008.3	69.2	16.0 (23.1)	4172	1204
2008.6	66.3	16.0 (24.1)	4360	1217
2008.9	66.2	16.2 (24.5)	4530	1226
2008.12	66.2	16.5 (24.9)	4587	1224
2009.3	86.6	17.3 (20.0)	4029	1105
2009.6	85.7	18.0 (21.0)	4410	1179
2009.9	90.0	18.3 (20.3)	4755	1239
2009.12	90.8	18.8 (20.7)	4945	1267
2010.3	76.7	17.7 (23.1)	4447	1240
2010.6	80.0	19.7 (24.6)	4367	1241
2010.9	79.3	19.4 (24.5)	4400	1240
2010.12	78.7	19.1 (24.3)	4452	1252
2011.3	83.3	20.1 (24.1)	4522	1254
2011.6	81.0	18.9 (23.3)	4496	1245
2011.9	87.1	19.8 (22.7)	4573	1255

core funding of large and small commercial banks. We define the eight nationwide banks (seven nationwide commercial banks and one specialized bank) operating across the country as "large" banks and six local banks operating mainly within certain regions as "small" banks. The composition of the core funding of large banks is similar to that for all banks as a whole. Small banks have a slightly larger portion of core deposits in core funding than do large banks.

3.2. Summary statistics of bank and firm characteristics

Table 3 presents the summary statistics of the characteristics of loans, firms (borrowers), and banks (lenders). All variables are of quarterly frequency. Panel A shows the characteristic variables of the loans: loan amount (in billion KRW), the ratio of loans to a bank's total assets (in percent), and the number of banks lending to a firm. Panel B shows the characteristic variables of the firms: firms' assets (FASS) (in billion KRW), *Tobin's Q* (the ratio of the market value of the sum of equity and debt to assets), FLEV (firm leverage ratio defined as the ratio of debt to equity), and PROFIT (the ratio of earnings before interests, taxes, depreciation, and amortization (EBITDA) to assets).[15] Firms with negative equity capital are excluded.[16] To control for extreme values, we hereafter exclude firms whose variable values are less than the 1st percentile and greater than the 99th percentile.

We select bank characteristic variables that can affect a bank's decision to lend to firms. Panel C of Table 3 presents the summary of these bank variables for all commercial banks, large and small: bank's assets (BASS)

[15] We also consider the ratio of book-to-market values of common equity as a firm characteristic variable. However, we do not include this variable because it has a high correlation with Tobin's Q, 0.71. Earnings before interest, taxes, depreciation and amortization (EBITDA) are computed on a yearly basis based on the past four quarters.

[16] Firms in workout processes (bank or court conciliation) tend to have negative equity capital. To enable these firms to survive, the creditors often provide specially-arranged bank loans or sometimes agree to convert loans into equity. The loan amount of those firms may thus distort the results. We therefore exclude firms with negative equity capital.

[17] Otherwise mentioned as in market values, the components used in the definition of variables representing firm and bank characteristics are obtained from their financial statements (i.e., in book values).

Table 2
Composition of core funding. This table presents the composition of core funding of commercial banks in Korea in terms of the amount of Korean won (in trillion KRW) and as a percentage (in parentheses). Core funding is defined as the sum of core deposits, core capital, and debt and debentures with a maturity of longer than one year. Large commercial banks are eight nationwide banks operating across the country, and small commercial banks are six local banks operating mainly within certain regions. The eight large banks are KB Kookmin Bank, Shinhan Bank, Woori Bank, Hana Bank, Korea Exchange Bank, Standard Chartered Bank Korea, Industrial Bank of Korea (IBK), and Citibank Korea. The six small local banks are Busan Bank, Daegu Bank, Kwangju Bank, Kyongnam Bank, Jeonbuk Bank, and Jeju Bank. Numbers in parentheses indicate the composition of the core funding in percentage.

Year/quarter	Core funding				Non-core funding
	Core deposit	Core capital	Debt & bank debentures	Total	
Panel A: All commercial banks					
2007. 6	404.4 (63.2)	169.9 (26.5)	66.0 (10.3)	640.2 (100.0)	408.3
2007. 9	394.2 (61.0)	184.1 (28.5)	68.0 (10.5)	646.2 (100.0)	438.2
2007.12	403.9 (60.9)	192.7 (29.0)	66.8 (10.1)	663.3 (100.0)	421.8
2008. 3	401.8 (60.5)	192.2 (28.9)	70.4 (10.6)	664.4 (100.0)	515.3
2008. 6	401.0 (59.3)	202.5 (29.9)	73.2 (10.8)	676.7 (100.0)	537.7
2008. 9	408.9 (58.6)	215.4 (30.9)	73.9 (10.6)	698.1 (100.0)	604.0
2008.12	446.6 (59.7)	222.8 (29.8)	78.6 (10.5)	747.9 (100.0)	571.9
2009. 3	464.0 (61.0)	213.1 (28.0)	83.2 (10.9)	760.3 (100.0)	597.4
2009. 6	484.6 (62.1)	208.7 (26.8)	86.8 (11.1)	780.2 (100.0)	555.0
2009. 9	492.7 (63.3)	196.5 (25.2)	89.2 (11.5)	778.3 (100.0)	555.5
2009.12	508.5 (64.5)	191.0 (24.2)	88.7 (11.3)	788.2 (100.0)	488.9
2010. 3	535.1 (65.6)	188.7 (23.1)	91.9 (11.3)	815.7 (100.0)	502.2
2010. 6	578.1 (66.9)	193.7 (22.4)	92.7 (10.7)	864.6 (100.0)	481.2
2010. 9	584.3 (67.9)	181.5 (21.1)	95.1 (11.0)	860.9 (100.0)	490.1
2010.12	717.3 (73.2)	169.7 (17.3)	92.7 (9.5)	979.6 (100.0)	328.0
2011. 3	643.7 (72.0)	161.0 (18.0)	89.5 (10.0)	894.2 (100.0)	474.2
2011. 6	654.6 (72.3)	159.1 (17.6)	92.2 (10.2)	905.8 (100.0)	453.3
2011. 9	663.3 (71.8)	166.1 (18.0)	94.7 (10.2)	924.0 (100.0)	489.9
Ave	510.4 (64.6)	189.3 (24.7)	83.0 (10.6)	782.7 (100.0)	495.2
Panel B: Large commercial banks					
2007. 6	367.1 (62.4)	159.9 (27.2)	61.4 (10.4)	588.4 (100.0)	371.4
2007. 9	358.0 (60.2)	173.4 (29.2)	63.1 (10.6)	594.5 (100.0)	399.3
2007.12	366.9 (60.2)	180.7 (29.6)	62.1 (10.2)	609.7 (100.0)	382.2
2008. 3	366.6 (59.9)	180.2 (29.4)	65.4 (10.7)	612.2 (100.0)	472.1
2008. 6	365.3 (58.6)	190.2 (30.5)	67.8 (10.9)	623.3 (100.0)	490.4
2008. 9	372.6 (57.9)	203.1 (31.5)	68.3 (10.6)	644.0 (100.0)	557.5
2008.12	407.3 (58.9)	211.3 (30.6)	72.7 (10.5)	691.2 (100.0)	528.1
2009. 3	423.7 (60.6)	199.7 (28.5)	76.2 (10.9)	699.6 (100.0)	555.8
2009. 6	442.5 (61.6)	196.3 (27.3)	79.6 (11.1)	718.4 (100.0)	513.1
2009. 9	450.6 (62.9)	183.7 (25.7)	81.7 (11.4)	716.1 (100.0)	510.8
2009.12	465.4 (64.2)	178.6 (24.6)	81.3 (11.2)	725.3 (100.0)	447.0
2010. 3	490.5 (65.3)	176.7 (23.5)	84.1 (11.2)	751.2 (100.0)	457.5
2010. 6	530.7 (66.6)	181.7 (22.8)	84.8 (10.6)	797.2 (100.0)	435.7
2010. 9	535.1 (67.5)	170.3 (21.5)	86.9 (11.0)	792.3 (100.0)	444.5
2010.12	654.5 (73.0)	158.1 (17.6)	84.5 (9.4)	897.1 (100.0)	295.4
2011. 3	584.9 (71.7)	149.2 (18.3)	81.3 (10.0)	815.4 (100.0)	435.0
2011. 6	592.6 (71.9)	147.5 (17.9)	83.7 (10.2)	823.8 (100.0)	414.4
2011. 9	599.0 (71.4)	154.3 (18.4)	85.8 (10.2)	839.1 (100.0)	449.9
Ave	465.2 (64.2)	177.5 (25.2)	76.1 (10.6)	718.8 (100.0)	453.3
Panel C: Small commercial banks					
2007. 6	37.3 (71.9)	9.9 (19.2)	4.6 (8.9)	51.8 (100.0)	36.9
2007. 9	36.2 (70.1)	10.6 (20.5)	4.8 (9.4)	51.7 (100.0)	38.8
2007.12	36.9 (68.8)	12.0 (22.3)	4.8 (8.9)	53.6 (100.0)	39.6
2008. 3	35.2 (67.4)	12.0 (22.9)	5.0 (9.6)	52.3 (100.0)	43.3
2008. 6	35.7 (66.9)	12.3 (23.0)	5.4 (10.1)	53.3 (100.0)	47.3
2008. 9	36.3 (67.0)	12.3 (22.7)	5.6 (10.3)	54.1 (100.0)	46.5
2008.12	39.4 (69.3)	11.5 (20.2)	5.9 (10.4)	56.8 (100.0)	43.9
2009. 3	40.3 (66.5)	13.4 (22.1)	6.9 (11.4)	60.7 (100.0)	41.6
2009. 6	42.2 (68.2)	12.5 (20.1)	7.2 (11.6)	61.8 (100.0)	42.0
2009. 9	42.0 (67.5)	12.8 (20.5)	7.4 (12.0)	62.3 (100.0)	44.7

Table 2 (*continued*)

Year/quarter	Core funding				Non-core funding
	Core deposit	Core capital	Debt & bank debentures	Total	
Panel C: Small commercial banks					
2009.12	43.1 (68.5)	12.4 (19.7)	7.5 (11.9)	62.9 (100.0)	42.0
2010. 3	44.6 (69.3)	12.0 (18.6)	7.8 (12.1)	64.5 (100.0)	44.6
2010. 6	47.5 (70.4)	12.0 (17.8)	8.0 (11.8)	67.4 (100.0)	45.5
2010. 9	49.2 (71.8)	11.2 (16.3)	8.2 (12.0)	68.6 (100.0)	45.6
2010.12	62.8 (76.1)	11.6 (14.0)	8.2 (9.9)	82.5 (100.0)	32.6
2011. 3	58.8 (74.6)	11.8 (15.0)	8.2 (10.4)	78.8 (100.0)	39.2
2011. 6	62.0 (75.6)	11.6 (14.1)	8.5 (10.3)	82.1 (100.0)	38.9
2011. 9	64.3 (75.7)	11.8 (13.9)	8.9 (10.5)	85.0 (100.0)	39.9
Ave	45.2 (70.3)	11.9 (19.1)	6.8 (10.6)	63.9 (100.0)	41.8

Table 3

Summary statistics of loans, borrowing firms, and banks. This table presents summary statistics of loans, firms (borrowers), and banks (lenders). Large commercial banks are eight nationwide banks operating across the country, and small commercial banks are six local banks operating mainly within certain regions. The eight large banks are KB Kookmin Bank, Shinhan Bank, Woori Bank, Hana Bank, Korea Exchange Bank, Standard Chartered Bank Korea, Industrial Bank of Korea (IBK), and Citibank Korea. The six small local banks are Busan Bank, Daegu Bank, Kwangju Bank, Kyongnam Bank, Jeonbuk Bank, and Jeju Bank. *Tobin's Q* is defined as the ratio of market value of equity and debt to assets. *FLEV* is the firm's leverage ratio defined as the ratio of debt to equity. PROFIT is the ratio of EBITDA to assets. EBIDTA is computed on a yearly basis based on the past four quarters. *CFA* is the ratio of core funding to assets. *CFL* is the ratio of core funding to loans. Core funding is defined as insured deposits, core capital, and debts and bank debentures with a maturity more than one year. *TIER1* is the ratio of tier 1 capital to assets. *NPL* is the ratio of non-performing loans to assets. ROA is the ratio of the previous four quarters' net profit to assets. All data are of quarterly frequency. The sample period is from June 2007 to September 2011. The sources of data are FnGuide for firm data, the Bank of Korea for bank data, and NICE D&B for loan data.

	Min	1%	Average	Median	SD	99%	Max
Panel A: Loan characteristics							
Loan (billion KRW)	0.01	0.08	16.90	4.92	52.30	216.14	2067.49
Loan to assets (%)	0.10	0.12	4.93	2.89	6.22	28.93	195.23
Number of banks lending to a firm	1.00	1.00	3.65	3.00	2.08	9.00	13.00
Panel B: Firm characteristics							
Assets (billion KRW)	12.53	16.68	436.52	101.21	1194.74	7211.14	11,797.03
Tobin's Q	0.24	0.46	1.23	1.01	0.97	4.47	38.39
FLEV	1.00	1.05	2.20	1.72	10.69	7.85	1616.40
PROFIT	−2.87	−0.27	0.04	0.04	0.11	0.27	1.17
Panel C: Bank characteristics							
All commercial banks							
CFA	0.32	0.39	0.59	0.59	0.10	0.87	0.88
CFL	0.46	0.56	0.87	0.86	0.20	1.62	1.69
Assets (trillion KRW)	2.69	2.77	91.3	61.0	82.1	266.3	267.1
TIER1 (%)	6.51	6.83	9.55	9.32	1.83	16.63	17.28
NPL (%)	0.36	0.47	1.27	1.23	0.58	3.40	3.96
ROA (%)	−0.11	−0.03	0.64	0.63	0.26	1.19	1.56
Large commercial banks							
CFA	0.32	0.33	0.59	0.60	0.11	0.87	0.88
CFL	0.47	0.53	0.89	0.87	0.24	1.67	1.69
Assets (trillion KRW)	47.0	50.8	146.5	145.5	67.7	266.4	267.2
TIER1 (%)	17.66	17.74	18.68	18.80	0.52	19.40	19.40
NPL (%)	0.50	0.51	1.30	1.28	0.57	3.40	3.96
ROA (%)	−0.11	−0.09	0.60	0.59	0.29	1.29	1.56
Small commercial banks							
CFA	0.45	0.45	0.60	0.59	0.08	0.84	0.85
CFL	0.63	0.67	0.87	0.85	0.11	1.18	1.21
Assets (trillion KRW)	2.69	2.74	17.6	17.9	10.2	35.1	36.1
TIER1 (%)	14.81	14.82	16.42	16.70	0.84	17.37	17.40
NPL (%)	0.36	0.38	1.24	1.11	0.60	3.17	3.45
ROA (%)	0.19	0.26	0.69	0.69	0.19	1.03	1.07

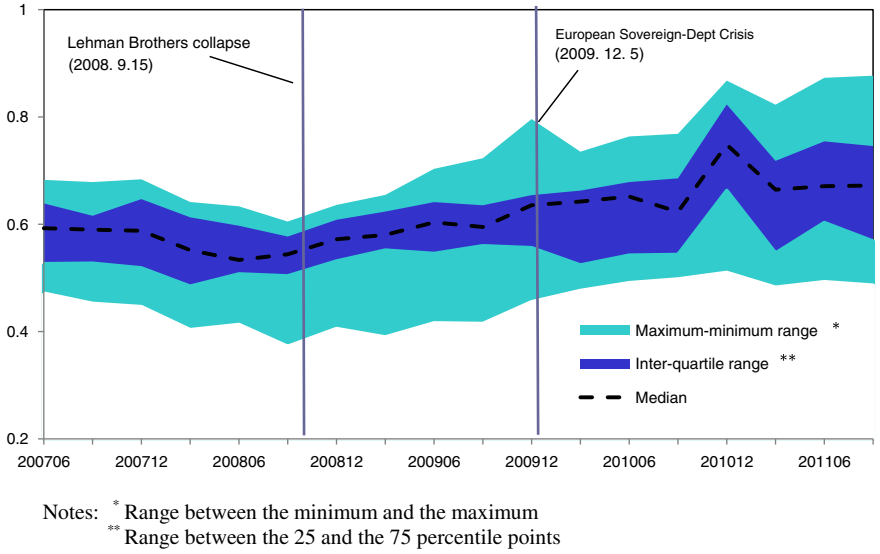

Fig. 1. Core funding to asset ratios of Korean commercial banks. This graph shows the ratio of core funding to assets (CFA) of Korean commercial banks. Core funding is defined as the sum of core deposits (insured by the Korea Deposit Insurance Corporation), core capital, and debt and bank debentures with a maturity more than one year. The source of data is the Bank of Korea. Notes: * Range between the minimum and the maximum. ** Range between the 25 and the 75 percentile points.

(in trillion KRW), *CFA* (the ratio of core funding to assets), *CFL* (the ratio of core funding to loans), *TIER1* (the ratio of tier 1 capital to assets, measuring a bank's capital adequacy ratio), *NPL* (the ratio of non-performing loans to assets), and ROA (the ratio of the previous four quarters' net profits to assets).[17]

Core funding is defined as core deposits (demand and term deposits insured by the KDIC), core capital (Tier I capital), and debts and bank debentures with a more than one year maturity.[18] Thus, core funding indicates a bank's stable funding sources. Since CFA is a key explanatory variable for the amount of loans, we rewrite it as

$$\text{Core funding to assets (CFA)} = \frac{\begin{array}{c}\text{Core deposit} + \text{Core capital}\\ +\text{Debt with a maturity longer than one year}\end{array}}{\text{Total assets}}. \quad (1)$$

CFA ranges from 0.32 to 0.88 with an average of 0.59, and CFL ranges from 0.46 to 1.69 with an average of 0.87 for all commercial banks. The ranges of CFA and CFL are similar for large and small commercial banks. Fig. 1 illustrates the pattern of the core funding ratio, CFA, over the sample period. The core funding ratio in Korea tends to decrease or stabilize during non-crisis periods and to increase during crisis periods. Specifically, the CFA tends to increase after two financial crises of Lehman Brothers' collapse and the European sovereign debt crisis. During non-crisis periods, however, it tends to stabilize or even decrease.

Fig. 2 illustrates the movement of the yield spread between one-year bank debentures and one-year Treasury bonds over the sample period. This figure shows that yield spread spikes around the global financial crisis and stabilizes afterward. When the yield spread is high, it is difficult for banks to raise funds by issuing bank debentures. Since the yield spread reflects credit risk premia and moves quite sensitively with the liquidity status of financial markets, we use this spread as a proxy for market-wide liquidity shocks.[19]

[18] Since January 1, 2001, the KDIC has insured up to KRW 50 million per depositor including principal and designated interest in case an insured financial institution becomes insolvent due to an insurance contingency (e.g. business suspension, license revocation).

[19] A bank's short-term funding condition in financial markets is generally measured by the spread between three-month LIBOR and the three-month government debenture (Dagher and Kazimov, 2012). In Korea, however, interbank funding markets are not as active as in developed countries and the spreads observed in these markets are not robust. We therefore use the yield spread between a one-year financial debenture and a one-year government bond to represent the credit status in the market.

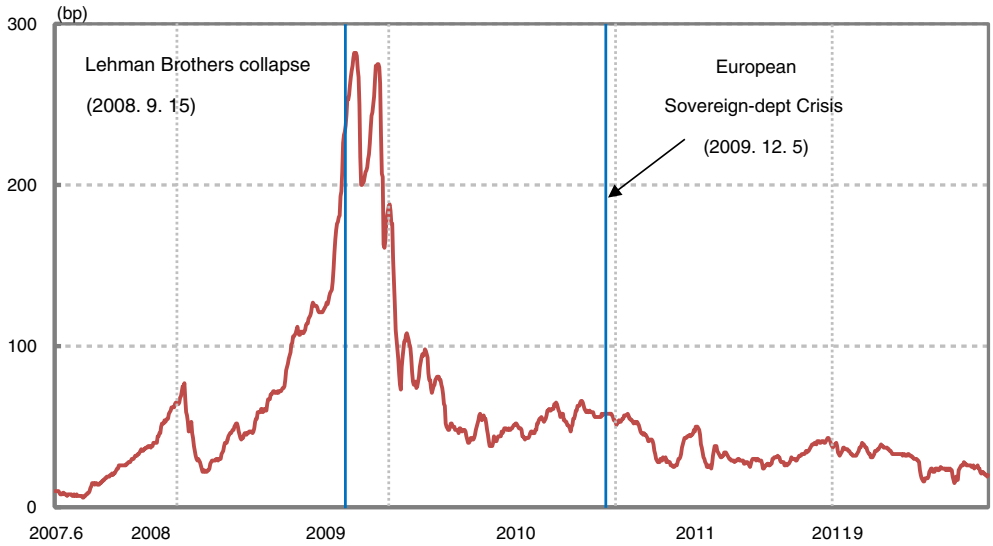

Fig. 2. Liquidity shocks proxied by yield spread. This graph shows the yield spread between one-year bank debentures and one-year Treasury bonds. We use this spread as a proxy for a market-wide liquidity shock. The source of data is the Bank of Korea.

4. Empirical analyses

4.1. The estimation model

To examine whether banks with high core funding increase their lending to firms during periods of market-wide liquidity shocks (Hypothesis 1), we estimate the following dynamic model from panel data.

Model 1:

$$\begin{aligned}\ln \mathrm{Loan}_{i,k,t} = {} & \alpha_{i,k} + \lambda_t + \delta\, \mathrm{LiquidityShock}_t + \mu\, \mathrm{CFA}_{i,t} + \gamma\left(\mathrm{LiquidityShock}_t \times \mathrm{CFA}_{i,t}\right) \\ & + \theta Z_{i,t} + \beta X_{k,t-1} + \sum_{j=1}^{m} \phi_j \ln \mathrm{Loan}_{i,k,t-j} + \epsilon_{i,k,t},\end{aligned} \tag{2}$$

where $\ln \mathrm{Loan}_{i,k,t}$ is the natural logarithm of the loan amount of firm k with bank i at quarter t; $\mathrm{LiquidityShock}_t$ is the liquidity shock at quarter t, which is proxied by the yield spread between one-year bank debentures and one-year Treasury bonds; and $\mathrm{CFA}_{i,t}$ is the ratio of core funding to assets of bank i at quarter t. As control variables, Model 1 includes $Z_{i,t}$ (a set of bank characteristic variables of bank i at quarter t) and $X_{k,t-1}$ (a set of firm characteristic variables of firm k at quarter $t-1$). The term $Z_{i,t}$ contains ln BASS, TIER1, NPL, and ROA, and $X_{k,t-1}$ contains ln FASS, *Tobin's Q*, FLEV, and PROFIT. To control for serial correlation of the dependent variable, we set $m = 4$ in Eq. (2). The reason we use one-quarter-lagged firm characteristic variables is that banks' lending decisions are based on firm characteristic information of the previous quarter. In the above model, we use a quarterly dummy to control for changes in macroeconomic conditions. The term λ_t captures such time (intertemporal) fixed effects, and $\alpha_{i,k}$ is another fixed term that captures firm-bank (cross-sectional) fixed effects.

In Model 1, the key coefficient of interest is γ, which measures the extent to which banks that rely on core funding increase their lending to firms during periods of severe liquidity shocks relative to periods of mild liquidity shocks. If liquidity shocks are intense (i.e., as liquidity in wholesale funding markets dries up), banks that rely more heavily on core funding are expected to have the capacity to provide loans and further increase their lending to firms. Therefore, we expect γ to be positive.

Table 4
Relationship between loans and bank's core funding for all commercial banks. The dependent variable is the natural logarithm of loans to firms ($\ln \text{Loan}_{i,k,t}$). "Liquidity shock" is the spread in yield between financial debentures and government bonds. *CFA* is the ratio of core funding to assets. Core funding is defined as insured deposits, core capital, and debts and bank debentures with a maturity more than one year. ln BASS is the natural logarithm of a bank's assets. *TIER1* is the ratio of tier 1 capital to assets. *NPL* is the ratio of non-performing loans to assets. ROA is the ratio of the previous four quarters' net profit to assets. ln FASS is the natural logarithm of a firm's assets. *Tobin's Q* is defined as the ratio of market value of equity and debt to assets. *FLEV* is a firm's leverage ratio defined as the ratio of debt to equity. PROFIT is the ratio of EBITDA to assets. EBIDTA is computed on a yearly basis based on the past four quarters. The bank and firm characteristics are used as control variables. Quarterly dummy is included in all regression equations. The sample period is from June 2007 to September 2011. Numbers in parentheses indicate *t*-statistics, and *, **, and *** refer to 10%, 5%, and 1% statistical significance, respectively.

Explanatory and control variables	Model 1(a)	Model 1(b)	Model 1(c)	Model 1(d)
LiquidityShock_t	−0.0134 (−0.93)		−0.0102 (−0.63)	−0.0862** (−2.24)
CFA_t		0.0554 (0.43)	0.0554 (0.43)	0.0048 (0.04)
$\text{LiquidityShock}_t \times \text{CFA}_t$				0.1331** (2.22)
Bank characteristics:				
$\ln \text{BASS}_t$	−0.0951 (−0.75)	−0.0711 (−0.50)	−0.0711 (−0.50)	−0.0731 (−0.52)
TIER 1_t	−0.5326 (−0.70)	−0.5670 (−0.74)	−0.5670 (−0.74)	−0.8161 (−1.05)
NPL_t	−3.5548** (−2.53)	−3.5230** (−2.52)	−3.5230** (−2.52)	−3.2969** (−2.35)
ROA_t	−1.5255 (−0.58)	−1.5633 (−0.59)	−1.5633 (−0.59)	−1.1999 (−0.45)
Firm characteristics:				
$\ln \text{FASS}_{t-1}$	0.0549 (1.20)	0.0549 (1.198)	0.0549 (1.20)	0.0553 (1.21)
Tobin's Q_{t-1}	−0.0084 (−0.52)	−0.0084 (−0.52)	−0.0084 (−0.52)	−0.0085 (−0.52)
FLEV_{t-1}	−0.0212** (−2.29)	−0.0212** (−2.29)	−0.0212** (−2.29)	−0.0211** (−2.28)
PROFIT_{t-1}	−0.0179 (−0.13)	−0.0183 (−0.13)	−0.0183 (−0.13)	−0.0183 (−0.13)
Serial correlation of the dep. variable:				
$\ln \text{LOAN}_{t-1}$	0.5299*** (19.06)	0.5297*** (19.05)	0.5297*** (19.05)	0.5293*** (19.04)
$\ln \text{LOAN}_{t-2}$	0.0264*** (3.84)	0.0264*** (3.84)	0.0264*** (3.84)	0.0264*** (3.85)
$\ln \text{LOAN}_{t-3}$	0.0086 (1.23)	0.0086 (1.24)	0.0086 (1.24)	0.0087 (1.25)
$\ln \text{LOAN}_{t-4}$	−0.1285*** (−11.46)	−0.1286*** (−11.49)	−0.1286*** (−11.49)	−0.1288*** (−11.50)
Quarterly dummy included?	Yes	Yes	Yes	Yes
AR(1) test p-value	0.000	0.000	0.000	0.000
AR(2) test p-value	0.524	0.525	0.525	0.537
Hansen J test p-value	0.117	0.117	0.117	0.118
Number of instruments	37	38	38	39
Observations	38,539	38,539	38,539	38,539
Number of firm-banks	5086	5086	5086	5086

To further examine whether main banks with high core funding increase lending to their client firms when wholesale funding conditions worsen due to financial market liquidity shocks (Hypothesis 2), we also estimate the following dynamic model from panel data.
Model 2:

$$\begin{aligned}\ln \text{Loan}_{i,k,t} = {} & \alpha_{i,k} + \lambda_t + \delta\, \text{LiquidityShock}_t + \mu\, \text{CFA}_{i,t} + \gamma \left(\text{LiquidityShock}_t \times \text{CFA}_{i,t}\right) \\ & + \eta\, \text{MB}_{i,k,t} + \varphi\left(\text{CFA}_{i,t} \times \text{MB}_{i,k,t}\right) + \omega \left(\text{LiquidityShock}_t \times \text{MB}_{i,k,t}\right) \\ & + \psi\left(\text{LiquidityShock}_t \times \text{CFA}_{i,t} \times \text{MB}_{i,k,t}\right) \\ & + \theta\, Z_{i,t} + \beta X_{k,t-1} + \sum_{j=1}^{m} \phi_j \ln \text{Loan}_{i,k,t-j} + \epsilon_{i,k,t},\end{aligned} \tag{3}$$

where $\text{MB}_{i,k,t}$ is a main bank dummy variable that equals one if a loan to firm *k* is from its main bank at quarter *t* and zero otherwise.

Table 5
Relationship between loans and bank's core funding of large and small commercial banks. The dependent variable is the natural logarithm of loans to firms ($\ln \text{Loan}_{i,k,t}$). Large commercial banks are eight nationwide banks operating across the country, and small commercial banks are six local banks operating mainly within certain regions. "Liquidity shock" is the spread in yield between financial debentures and government bonds. *CFA* is the ratio of core funding to assets. Core funding is defined as insured deposits, core capital, and debts and bank debentures with a maturity more than one year. ln BASS is the natural logarithm of a bank's assets. *TIER1* is the ratio of tier 1 capital to assets. *NPL* is the ratio of non-performing loans to assets. ROA is the ratio of the previous four quarters' net profit to assets. ln FASS is the natural logarithm of a firm's assets. *Tobin's Q* is defined as the ratio of market value of equity and debt to assets. *FLEV* is a firm's leverage ratio defined as the ratio of debt to equity. PROFIT is the ratio of EBITDA to assets. EBIDTA is computed on a yearly basis based on the past four quarters. The bank and firm characteristics are used as control variables. Quarterly dummy is included in all regression equations. The sample period is from June 2007 to September 2011. Numbers in parentheses indicate *t*-statistics, and *, **, and *** refer to 10%, 5%, and 1% statistical significance, respectively.

	Large commercial banks				Small commercial banks			
Explanatory and control variables	Model 1(a)	Model 1(b)	Model 1(c)	Model 1(d)	Model 1(a)	Model 1(b)	Model 1(c)	Model 1(d)
Panel A: Model estimation results								
LiquidityShock_t	−0.0109 (−0.74)		−0.0086 (−0.51)	−0.0860** (−2.21)	−0.1325 (−1.63)		−0.0998 (−1.14)	0.0318 (0.08)
CFA_t		0.0417 (0.31)	0.0417 (0.31)	−0.0096 (−0.07)		0.3555 (1.04)	0.3555 (1.04)	0.4567 (1.21)
$\text{LiquidityShock}_t \times \text{CFA}_t$				0.1360** (2.25)				−0.2236 (−0.35)
Bank characteristics:								
$\ln \text{BASS}_t$	−0.1053 (−0.74)	−0.0867 (−0.54)	−0.0867 (−0.54)	−0.0916 (−0.57)	−0.3708 (−0.83)	−0.2421 (−0.58)	−0.2421 (−0.58)	−0.2652 (−0.66)
TIER 1_t	−0.3340 (−0.43)	−0.3564 (−0.46)	−0.3564 (−0.46)	−0.6135 (−0.77)	−3.8409 (−0.90)	−4.0331 (−0.96)	−4.0331 (−0.96)	−3.6104 (−0.89)
NPL_t	−3.8572** (−2.46)	−3.8265** (−2.46)	−3.8265** (−2.46)	−3.5603** (−2.28)	−2.7756 (−0.82)	−2.4466 (−0.72)	−2.4466 (−0.72)	−2.5480 (−0.76)
ROA_t	−1.8379 (−0.67)	−1.8654 (−0.68)	−1.8654 (−0.68)	−1.4825 (−0.54)	−3.4564 (−0.22)	−4.8846 (−0.30)	−4.8846 (−0.30)	−5.8610 (−0.37)
Firm characteristics:								
$\ln \text{FASS}_{t-1}$	0.0681 (1.45)	0.0682 (1.45)	0.0682 (1.45)	0.0685 (1.45)	−0.2586* (−1.83)	−0.2601* (−1.83)	−0.2601* (−1.83)	−0.2620* (−1.84)
$\text{Tobin's } Q_{t-1}$	−0.0063 (−0.38)	−0.0063 (−0.38)	−0.0063 (−0.38)	−0.0064 (−0.38)	−0.0733 (−1.14)	−0.0726 (−1.13)	−0.0726 (−1.13)	−0.0736 (−1.14)
FLEV_{t-1}	−0.0240** (−2.45)	−0.0241** (−2.45)	−0.0241** (−2.45)	−0.0240** (−2.45)	0.0170 (0.66)	0.0166 (0.65)	0.0166 (0.65)	0.0164 (0.63)
PROFIT_{t-1}	−0.0614 (−0.44)	−0.0618 (−0.44)	−0.0618 (−0.44)	−0.0618 (−0.44)	1.0035** (2.18)	1.0138** (2.21)	1.0138** (2.21)	1.0150** (2.20)

Serial correlation of the dep. variable:								
ln $LOAN_{t-1}$	0.5254*** (18.81)	0.5253*** (18.80)	0.5253*** (18.80)	0.5251*** (18.80)	0.7183*** (3.36)	0.7149*** (3.35)	0.7149*** (3.35)	0.7247*** (3.42)
ln $LOAN_{t-2}$	0.0283*** (4.02)	0.0283*** (4.02)	0.0283*** (4.02)	0.0284*** (4.03)	−0.0249 (−0.97)	−0.0257 (−1.01)	−0.0257 (−1.01)	−0.0251 (−0.99)
ln $LOAN_{t-3}$	0.0086 (1.20)	0.0087 (1.21)	0.0087 (1.21)	0.0087 (1.21)	0.0175 (0.67)	0.0175 (0.67)	0.0175 (0.67)	0.0182 (0.68)
ln $LOAN_{t-4}$	−0.1312*** (−11.49)	−0.1313*** (−11.51)	−0.1313*** (−11.51)	−0.1315*** (−11.52)	−0.0643 (−1.15)	−0.0655 (−1.19)	−0.0655 (−1.19)	−0.0650 (−1.18)
Quarterly dummy included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(1) test p-value	0.000	0.000	0.000	0.000	0.003	0.003	0.003	0.002
AR(2) test p-value	0.585	0.586	0.586	0.600	0.710	0.713	0.713	0.721
Hansen J test p-value	0.192	0.191	0.191	0.192	0.869	0.874	0.874	0.875
Number of instruments	37	38	38	39	37	38	38	39
Observations	36,271	36,271	36,271	36,271	2268	2268	2268	2268
Number of firm-banks	4738	4738	4738	4738	348	348	348	348

Panel B: *t*-test statistics for the difference in the coefficients of the target variables between large and small banks

Target explanatory variables	Model 1(a)	Model 1(b)	Model 1(c)	Model 1(d)
$LiquidityShock_t$	(−0.47)		(−0.36)	(−1.21)
CFA_t		(−1.35)	(−1.29)	(−1.73)
$LiquidityShock_t \times CFA_t$				(1.18)

In Model 2, the key coefficient of interest is ψ, which measures the extent to which banks that rely on core funding increase their lending more to firms that have a strong relationship with them relative to firms that do not during periods of severe liquidity shocks. Therefore, we also expect ψ to be positive.

The reason we use the dynamic panel model is to consider that banks make dynamic adjustments in their lending to firms through using a wide range of lending instruments with different maturities. To estimate the above dynamic panel models, we employ the generalized method of moments (GMM) of Arellano and Bond (1991) to address the serial correlation problem caused by lagged dependent variables that are included as explanatory variables in the dynamic panel model.[20] We compute all *t*-statistics of the coefficient estimates based on heteroskedasticity-consistent standard errors.

4.2. Main results

4.2.1. Bank funding structure and lending

Table 4 presents the estimation results of Model 1 in Eq. (2) by using all commercial banks. The coefficient estimate on the core funding ratio, CFA, in the full model is positive but statistically insignificant; $\hat{\mu} = 0.0048$ with a *t*-statistic of 0.04 (in Model 1(d) in Table 4), which indicates that banks with a high core funding ratio generally do not increase their lending to firms. The coefficient on the liquidity shock variable is significantly negative ($\hat{\delta} = -0.0862$, with a *t*-statistic of -2.24), which means that banks reduce lending when liquidity shocks are severe. More specifically, an increase of one unit of liquidity shock (i.e., one percentage point of the yield spread between financial debentures and government bonds) leads to an 8.62 percentage point reduction in bank lending (in natural logarithm) to firms. However, the coefficient estimate on the interaction term, LiquidityShock × CFA, is positive and statistically significant at the 5% level; it is $\hat{\gamma} = 0.1331$, with a *t*-statistic of 2.22. These results indicate that when liquidity shocks are severe, banks generally reduce their lending; but banks with a high core funding ratio actually increase their lending to firms and thereby offset the loan reduction due to liquidity shocks. More specifically, banks with a core funding ratio greater than 64.76% appear to increase their lending to firms, even when market-wide liquidity worsens.[21] In other words, for those banks with a core funding ratio greater than 64.76%, lending increases to offset the reduction of lending due to liquidity shocks. These results support Hypothesis 1. One noteworthy thing for the control variables is that banks with high NPL values decrease their lending to firms and highly leveraged firms receive a smaller amount of loans from banks.

To evaluate whether our model is correctly specified, we use two criteria: The first is the test for the first- and second-order serial correlations of the residuals in the differenced equations and the second is the Hansen *J*-test. If the model is correctly specified, the variables in the instrument set should be uncorrelated with the second-order serial correlation of error terms in the relevant equations.[22] The Hansen J-test tests over-identification under the null hypothesis of instrument validity.[23] Table 4 shows that the p-value of the AR(1) test statistic is lower than 0.01, and the *p*-value of the AR(2) test statistic is higher than 0.10, indicating the good fitness of the model. The *p*-value of the Hansen J-test statistic is higher than 0.10 and does not reject the overidentifying restriction for the GMM.

To examine whether the previously observed pattern of banks with a high core funding ratio increasing lending to firms when liquidity shocks are severe is different across bank size (i.e., to test Hypothesis 2), we re-estimate Model 1 of Eq. (2) by using large and small commercial banks, respectively, and present the estimation results in Table 5. The results for large commercial banks are similar to those observed in Table 4 for all commercial banks, which support both Hypotheses 1 and 2. However, the results for small commercial banks are quite different. The coefficient estimate on the interaction term, LiquidityShock × CFA, in the full model (in Model 1(d) in Table 5) for small commercial banks is statistically insignificant; it is $\hat{\gamma} = -0.2236$ (*t*-statistic of -0.35). This finding indicates that small commercial banks, even those with a high core funding

[20] We use the Xtabond2 package of Stata 12.0 to perform the dynamic panel's GMM estimation.

[21] The effect of a liquidity shock on lending can be expressed as $\partial(\ln \text{loan})/\partial(\text{LiquidityShock}) = -0.0862 + 0.1331 \times \text{CFA}$. To have a positive effect of liquidity shock on lending, *CFA* needs to exceed 0.6476.

[22] Arellano and Bond's (1991) GMM estimation method uses the first-order difference of the characteristic variables of firms and banks to eliminate the unobserved characteristics of firms and banks. Thus, the fixed term $\alpha_{i,k}$ can be eliminated in the estimation. Under the null of no serial correlation of the differenced residuals, the p-value for AR(1) in the first-order difference should be different from zero and that for AR(2) in the second-order difference should be zero.

[23] The Hansen J-test is performed based on the assumption that error terms are heteroskedastic.

Table 6
Relationship between loans and core funding to assets in main banks of all commercial banks. The dependent variable is the natural logarithm of loans to firms ($\ln Loan_{i,k,t}$). "Liquidity shock" is the spread in yield between financial debentures and government bonds. *CFA* is the ratio of core funding to assets. Core funding is defined as insured deposits, core capital, and debts and bank debentures with a maturity more than one year. MB_t is a dummy variable which is one if the loan to the firm is from its main bank and zero otherwise. ln BASS is the natural logarithm of a bank's assets. *TIER1* is the ratio of tier 1 capital to assets. *NPL* is the ratio of non-performing loans to assets. ROA is the ratio of the previous four quarters' net profit to assets. ln FASS is the natural logarithm of a firm's assets. *Tobin's Q* is defined as the ratio of market value of equity and debt to assets. *FLEV* is a firm's leverage ratio defined as the ratio of debt to equity. PROFIT is the ratio of EBITDA to assets. EBIDTA is computed on a yearly basis based on the past four quarters. The bank and firm characteristics are used as control variables. Quarterly dummy is included in all regression equations. All data are of quarterly frequency. The sample period is from June 2007 to September 2011. Numbers in parentheses indicate *t*-statistics, and *, **, and *** refer to 10%, 5%, and 1% statistical significance, respectively.

Explanatory and control variables	Model 2(a)	Model 2(b)	Model 2(c)	Model 2(d)	Model 2(e)
$LiquidityShock_t$	−0.0862**	−0.1002***	−0.1057***	−0.1057***	−0.0793*
	(−2.24)	(−2.68)	(−2.81)	(−2.81)	(−1.93)
CFA_t	0.0048 (0.04)	0.0302 (0.24)	0.0296 (0.24)	0.0450 (0.35)	0.0693 (0.53)
$LiquidityShock_t \times CFA_t$	0.1331** (2.22)	0.1448** (2.47)	0.1439** (2.45)	0.1441** (2.45)	0.0973 (1.49)
MB_t		0.5553*** (24.75)	0.5354*** (22.61)	0.6010*** (8.12)	0.6925*** (7.57)
$CFA_t \times MB_t$				−0.1045	−0.2575*
				(−0.94)	(−1.81)
$LiquidityShock_t \times MB_t$			0.0327** (2.51)	0.0319** (2.48)	−0.1223
					(−1.57)
$LiquidityShock_t \times CFA_t \times MB_t$					0.2703** (2.02)
Bank characteristics:					
$\ln BASS_t$	−0.0731	−0.0654	−0.0633	−0.0605	−0.0684
	(−0.52)	(−0.49)	(−0.47)	(−0.45)	(−0.51)
$TIER\ 1_t$	−0.8161	−0.8154	−0.7740	−0.7765	−0.7669
	(−1.05)	(−1.10)	(−1.05)	(−1.05)	(−1.04)
NPL_t	−3.2969**	−3.2597**	−3.2074**	−3.2056**	−3.1651**
	(−2.35)	(−2.43)	(−2.39)	(−2.39)	(−2.36)
ROA_t	−1.1999	−0.5556	−0.5788	−0.5433	−0.5993
	(−0.45)	(−0.22)	(−0.23)	(−0.21)	(−0.24)
Firm characteristics:					
$\ln FASS_{t-1}$	0.0553 (1.21)	0.0762* (1.74)	0.0760* (1.74)	0.0761* (1.74)	0.0762* (1.74)
$Tobin's\ Q_{t-1}$	−0.0085	−0.0060	−0.0059	−0.0058	−0.0060
	(−0.52)	(−0.39)	(−0.39)	(−0.38)	(−0.40)
$FLEV_{t-1}$	−0.0211**	−0.0188**	−0.0185**	−0.0185**	−0.0185**
	(−2.28)	(−2.10)	(−2.07)	(−2.07)	(−2.08)
$PROFIT_{t-1}$	−0.0183	−0.0448	−0.0421	−0.0424	−0.0411
	(−0.13)	(−0.34)	(−0.32)	(−0.32)	(−0.31)
Serial correlation of the dep. variable:					
$\ln LOAN_{t-1}$	0.5293*** (19.04)	0.4792*** (17.61)	0.4792*** (17.61)	0.4784*** (17.59)	0.4781*** (17.56)
$\ln LOAN_{t-2}$	0.0264*** (3.85)	0.0230*** (3.48)	0.0227*** (3.44)	0.0226*** (3.42)	0.0228*** (3.45)
$\ln LOAN_{t-3}$	0.0087 (1.25)	0.0078 (1.18)	0.0074 (1.11)	0.0075 (1.12)	0.0074 (1.11)
$\ln LOAN_{t-4}$	−0.1288***	−0.1229***	−0.1224***	−0.1223***	−0.1224***
	(−11.50)	(−11.34)	(−11.31)	(−11.31)	(−11.32)
Quarterly dummy included?	Yes	Yes	Yes	Yes	Yes
AR(1) test p-value	0.000	0.000	0.000	0.000	0.000
AR(2) test p-value	0.537	0.827	0.784	0.825	0.786
Hansen J test p-value	0.118	0.308	0.315	0.314	0.313
Number of Instruments	39	40	41	42	43
Observations	38,539	38,539	38,539	38,539	38,539
Number of firm-banks	5086	5086	5086	5086	5086

ratio, do not increase lending to firms during a period of liquidity shocks. Table 5 also shows that the coefficient estimate on the variable, LiquidityShock, is statistically insignificant for small banks which is in contrast with its significance for large banks. These results indicate that no significant change in the loan supply of

Table 7
Relationship between loans and core funding to assets in main banks of large and small commercial banks. The dependent variable is the natural logarithm of loans to firms ($\ln Loan_{i,k,t}$). Large commercial banks are eight nationwide banks operating across the country, and small commercial banks are six local banks operating mainly within certain regions. "Liquidity shock" is the spread in yield between financial debentures and government bonds. *CFA* is the ratio of core funding to assets. Core funding is defined as insured deposits, core capital, and debts and bank debentures with a maturity more than one year. MB_t is a dummy variable which is one if the loan to the firm is from its main bank and zero otherwise. ln BASS is the natural logarithm of a bank's assets. *TIER1* is the ratio of tier 1 capital to assets. *NPL* is the ratio of non-performing loans to assets. ROA is the ratio of the previous four quarters' net profit to assets. ln FASS is the natural logarithm of a firm's assets. *Tobin's Q* is defined as the ratio of market value of equity and debt to assets. *FLEV* is a firm's leverage ratio defined as the ratio of debt to equity. PROFIT is the ratio of EBITDA to assets. EBIDTA is computed on a yearly basis based on the past four quarters. The bank and firm characteristics are used as control variables. Quarterly dummy is included in all regression equations. All data are of quarterly frequency. The sample period is from June 2007 to September 2011. Numbers in parentheses indicate *t*-statistics, and *, **, and *** refer to 10%, 5%, and 1% statistical significance, respectively.

Explanatory and control variables	Large commercial banks					Small commercial banks				
	Model 2(a)	Model 2(b)	Model 2(c)	Model 2(d)	Model 2(e)	Model 2(a)	Model 2(b)	Model 2(c)	Model 2(d)	Model 2(e)
Panel A: Model estimation results										
$LiquidityShock_t$	−0.0860**	−0.0995***	−0.1050***	−0.1049***	−0.0790*	0.0318	−0.0217	−0.0078	−0.0128	0.0096
	(−2.21)	(−2.62)	(−2.75)	(−2.75)	(−1.90)	(0.08)	(−0.06)	(−0.02)	(−0.04)	(0.03)
CFA_t	−0.0096	0.0199	0.0194	0.0315	0.0550	0.4567	0.4089	0.4295	0.5489	0.5727
	(−0.07)	(0.15)	(0.15)	(0.23)	(0.40)	(1.21)	(1.10)	(1.16)	(1.45)	(1.47)
$LiquidityShock_t \times CFA_t$	0.1360**	0.1460**	0.1452**	0.1454**	0.0994	−0.2236	−0.1511	−0.1859	−0.1769	−0.2170
	(2.25)	(2.47)	(2.45)	(2.45)	(1.51)	(−0.35)	(−0.25)	(−0.31)	(−0.29)	(−0.34)
MB_t		0.5580***	0.5387***	0.5917***	0.6816***		0.4974***	0.4688***	0.8716***	0.9633**
		(24.23)	(22.18)	(7.79)	(7.28)		(5.24)	(4.54)	(3.44)	(2.57)
$CFA_t \times MB_t$				−0.0846	−0.2351				−0.6200*	−0.7707
				(−0.74)	(−1.61)				(−1.80)	(−1.35)
$LiquidityShock_t \times MB_t$			0.0316**	0.0310**	−0.1205			0.0513	0.0474	−0.1075
			(2.35)	(2.33)	(−1.53)			(1.03)	(0.96)	(−0.31)
$LiquidityShock_t \times CFA_t \times MB_t$					0.2657*					0.2684
					(1.95)					(0.43)
Bank characteristics:										
ln $BASS_t$	−0.0916	−0.0715	−0.0691	−0.0668	−0.0763	−0.2652	−0.3379	−0.3306	−0.3283	−0.3287
	(−0.57)	(−0.47)	(−0.46)	(−0.44)	(−0.50)	(−0.66)	(−0.87)	(−0.85)	(−0.86)	(−0.86)
TIER 1_t	−0.6135	−0.6669	−0.6227	−0.6254	−0.6147	−3.6104	−3.5048	−3.3800	−3.4699	−3.5296
	(−0.77)	(−0.88)	(−0.83)	(−0.83)	(−0.81)	(−0.89)	(−0.89)	(−0.85)	(−0.88)	(−0.89)
NPL_t	−3.5603**	−3.7950**	−3.7378**	−3.7364**	−3.6904**	−2.5480	−1.5149	−1.5208	−1.4776	−1.4647
	(−2.28)	(−2.55)	(−2.51)	(−2.51)	(−2.48)	(−0.76)	(−0.47)	(−0.47)	(−0.46)	(−0.46)
ROA_t	−1.4825	−0.8270	−0.8602	−0.8260	−0.8839	−5.8610	−6.1735	−6.2752	−7.6077	−7.5918
	(−0.54)	(−0.31)	(−0.32)	(−0.31)	(−0.33)	(−0.37)	(−0.40)	(−0.40)	(−0.49)	(−0.49)

Firm characteristics:										
ln $FASS_{t-1}$	0.0685	0.0892**	0.0890**	0.0890**	0.0890**	−0.2620*	−0.2321*	−0.2302*	−0.2294*	−0.2272
	(1.45)	(1.99)	(1.98)	(1.98)	(1.98)	(−1.84)	(−1.68)	(−1.66)	(−1.66)	(−1.64)
Tobin ' s Q_{t-1}	−0.0064	−0.0029	−0.0028	−0.0028	−0.0030	−0.0736	−0.0891	−0.0896	−0.0888	−0.0886
	(−0.38)	(−0.19)	(−0.18)	(−0.18)	(−0.19)	(−1.14)	(−1.38)	(−1.39)	(−1.39)	(−1.39)
$FLEV_{t-1}$	−0.0240**	−0.0210**	−0.0207**	−0.0207**	−0.0208**	0.0164	0.0130	0.0133	0.0136	0.0135
	(−2.45)	(−2.22)	(−2.19)	(−2.20)	(−2.20)	(0.63)	(0.51)	(0.52)	(0.54)	(0.53)
$PROFIT_{t-1}$	−0.0618	−0.0865	−0.0843	−0.0846	−0.0833	1.0150**	0.9660**	0.9897**	0.9975** (2.32)	0.9983**
	(−0.44)	(−0.64)	(−0.62)	(−0.62)	(−0.61)	(2.20)	(2.24)	(2.30)		(2.33)
Serial correlation of the dep. variable:										
ln $LOAN_{t-1}$	0.5251***	0.4738***	0.4738***	0.4732***	0.4729***	0.7247***	0.6842***	0.6879***	0.6787***	0.6768***
	(18.80)	(17.35)	(17.34)	(17.33)	(17.31)	(3.42)	(3.20)	(3.23)	(3.18)	(3.16)
ln $LOAN_{t-2}$	0.0284***	0.0247***	0.0244***	0.0243***	0.0245***	−0.0251	−0.0264	−0.0264	−0.0265	−0.0264
	(4.03)	(3.65)	(3.60)	(3.59)	(3.62)	(−0.99)	(−1.11)	(−1.11)	(−1.12)	(−1.11)
ln $LOAN_{t-3}$	0.0087	0.0078	0.0074	0.0074	0.0074	0.0182	0.0190	0.0188	0.0183	0.0183
	(1.21)	(1.14)	(1.07)	(1.08)	(1.08)	(0.68)	(0.76)	(0.75)	(0.74)	(0.74)
ln $LOAN_{t-4}$	−0.1315***	−0.1250***	−0.1245***	−0.1244***	−0.1246***	−0.0650	−0.0707	−0.0698	−0.0689	−0.0690
	(−11.52)	(−11.32)	(−11.30)	(−11.30)	(−11.31)	(−1.18)	(−1.30)	(−1.28)	(−1.27)	(−1.27)
Quarterly dummy included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR(1) test p-value	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.004	0.005	0.005
AR(2) test p-value	0.600	0.829	0.787	0.821	0.782	0.721	0.845	0.835	0.861	0.860
Hansen J test p-value	0.192	0.408	0.416	0.415	0.414	0.875	0.881	0.88	0.898	0.901
Number of Instruments	39	40	41	42	43	39	40	41	42	43
Observations	36,271	36,271	36,271	36,271	36,271	2268	2268	2268	2268	2268
Number of firm-banks	4738	4738	4738	4738	4738	348	348	348	348	348

Panel B: *t*-test statistics for the difference in the coefficients of the target variables between large and small banks

Target explanatory variables	Model 2(a)	Model 2(b)	Model 2(c)	Model 2(d)	Model 2(e)
$LiquidityShock_t$	(−1.21)	(−0.89)	(−0.92)	(−0.97)	(−0.89)
CFA_t	(−1.73)	(−1.38)	(−1.41)	(−1.81)	(−1.71)
$LiquidityShock_t \times CFA_t$	(1.18)	(0.89)	(0.93)	(0.98)	(0.89)
MB_t		(0.75)	(0.75)	(−1.04)	(−0.87)
$CFA_t \times MB_t$				(1.54)	(1.11)
$LiquidityShock_t \times MB_t$			(−0.27)	(−0.22)	(0.21)
$LiquidityShock_t \times CFA_t \times MB_t$					(−0.23)

small banks after liquidity shocks is observed irrespective of their level of CFA, which suggests that small banks do not suffer from liquidity shocks.

4.2.2. Bank funding structure and lending from main banks to their client firms

This section examines the effect of bank funding structure on lending to firms that maintain a strong relationship with their main banks during periods of market-wide liquidity shocks when wholesale funding conditions worsen. Table 6 presents the estimation results of Model 2 in Eq. (3). In the full model of Model 2(e) in Table 6, the coefficient estimate on LiquidityShock, is negative and statistically significant ($\hat{\delta} = -0.0793$, with a t-statistic of -1.93), and the coefficient estimate on the interaction term, LiquidityShock × CFA, is positive but statistically insignificant ($\hat{\gamma} = 0.0973$, with a t-statistic of 1.49) at the traditional significance level.[24] However, the coefficient estimate on the triple interaction term of our main interest, LiquidityShock × CFA × MB, is positive and statistically significant; it is $\hat{\psi} = 0.2703$, with a t-statistic of 2.02. Together with the significant effect of ψ, these results indicate that when liquidity shocks are severe, banks generally reduce their lending; however, main banks with a high core funding ratio actually provide more loans to firms than do the non-main banks despite severe liquidity shocks.

The full model of Model 2(e) in Table 6 also shows that the coefficient estimate on the main bank dummy variable, MB, is positive and strongly significant; it is $\hat{\eta} = 0.6925$, with a t-statistic of 7.57. The coefficient estimate on the interaction term, CFA × MB, is negative and marginally significant; it is $\hat{\varphi} = -0.2575$, with a t-statistic of -1.81. These results indicate that the main banks provide more loans in general than do the non-main banks, but this effect becomes smaller as the main banks have a higher CFA.[25]

The above results for the coefficient estimate $\left(\hat{\psi}\right)$ on the triple interaction term, LiquidityShock × CFA × MB, imply that main banks with a core funding ratio higher than a certain level provide more loans to firms by 27.03 percentage points $\left(=\hat{\psi}\right)$ than do the non-main banks. More specifically, the main banks with a core funding ratio greater than 54.84% appear to rather increase their lending to firms, even when liquidity becomes worse.[26] In other words, for those banks with a core funding ratio greater than 54.84%, lending increases to offset the reduction of lending due to liquidity shocks. Where the bank is the main bank to a firm, its core funding ratio needs to exceed only 54.84% for it to increase lending to firms and to offset the reduction of lending due to liquidity shocks. This core funding ratio is lower by 9.92 percentage points than in the case of all banks (whether main banks or not). Note that such core funding ratio of all banks is at least 64.76%. Overall, the above results support Hypothesis 3.

To examine whether the previously observed lending behavior of the main banks with a high core funding ratio to their client firms is different across bank size, we re-estimate Model 2 of Eq. (3) by using large and small commercial banks, respectively. Table 7 presents the estimation results. For large banks, the coefficient estimate $\left(\hat{\psi}\right)$ on the triple interaction term of main interest, LiquidityShock × CFA × MB, is also positive and statistically significant; $\hat{\psi} = 0.2657$ with a t-statistic of 1.95. For small commercial banks, however, the coefficient estimate $\left(\hat{\psi}\right)$ is statistically insignificant; $\hat{\psi} = 0.2684$ with a t-statistic of 0.43. These results indicate that large-sized main banks with a high core funding ratio further increase their lending to their client firms despite severe liquidity shocks, while small-sized main banks with a high core funding ratio do not

[24] In the reduced models of Model 2 in which the interaction term, LiquidityShock × CFA × MB, is not included (i.e., Models 2(a) through 2(d) in Table 6), the coefficient estimates ($\hat{\gamma}$) on the interaction term, LiquidityShock × CFA, are all positively statistically significant at the 1% level.

[25] A possible reason for this is that the main banks with a high CFA are large banks that finance more funds from the market, and borrowers from such main banks do not depend on bank loans. To confirm this reasoning, we divide all main banks into two groups at every quarter based on the median value of CFA. The main bank group with a high CFA is larger in bank asset size than the group with a low CFA (176 billion KRW vs. 131 billion KRW). The borrowers from the main bank group with a high CFA are larger in asset size than those from the main bank group with a low CFA (283 billion KRW vs. 204 billion KRW). However, the former borrowers have a lower ratio of bank loans to their total liabilities than do the latter borrowers (0.3015 vs. 0.3217). These differences are all statistically significant at the 1% level.

[26] When the main bank is considered in the model, the effect of a liquidity shock on lending can be expressed as $\partial(\ln \text{ loan})/\partial(\text{LiquidityShock}) = -0.0793 + 0.0973 \times \text{CFA} - 0.1223 \times \text{MB} + 0.2703 \times \text{CFA} \times \text{MB}$. If the bank is a main bank, $\partial(\ln \text{ loan})/\partial(\text{LiquidityShock}) = -0.2016 + 0.3676 \times \text{CFA}$. Thus, to have a positive effect of liquidity shock on lending, CFA needs to exceed 0.5484.

increase lending even to their client firms. It could be argued, therefore, that the findings in Table 6 are observed for large banks only and that neither LiquidityShock nor CFA matters for small banks.

5. Conclusions

This paper examines the relation between bank funding structure and lending to firms in Korea when market-wide liquidity shocks are severe. We analyze this relation by using quarterly panel data of all commercial banks as well as their borrowing firms. To the best of our knowledge, our study is the first to analyze the effect of bank funding structure on lending to firms during periods of liquidity shocks after controlling for factors that may affect the demand and supply of corporate lending by using the panel data of both banks and firms.

The findings of this study are as follows. First, when liquidity shocks are severe, banks generally reduce their lending, but banks with a core funding ratio higher than a certain level tend to increase their lending to firms during periods of market-wide liquidity shocks, thereby offsetting the reduction in lending due to liquidity shocks. Second, the tendency toward an increase in lending by banks with a higher core funding ratio is stronger in main banks that maintain relationship banking with their client firms. In other words, even though main banks have a core funding ratio below a certain level, they tend to increase lending to their client firms during periods of liquidity shocks. However, these findings are valid only for large-sized main banks, not for small-sized main banks in Korea.

Our results provide justification for the adoption of regulatory policies on liquidity such as those of Basel III. In other words, financial supervisory authorities should have regulatory measures on liquidity in force that encourage banks to change their funding structure by reducing wholesale funding, which is vulnerable to market conditions, and securing stable core funding, and to eventually increase their lending to firms especially during the periods of severe liquidity shocks. This study should help an understanding of the mechanism of bank intermediation in loans and the prediction of the effect of the introduction of liquidity regulations on banks' practices in lending to firms.

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