경영학박사학위논문

Essays on Market Discipline in the Capital Market

금융시장에서의 시장규율에 관한 연구

-2008년 미국 금융위기를 중심으로-

2015년 2월

서울대학교 대학원

경영학과 경영학 전공

김 정 심

Essays on Market Discipline in the Capital Market

지도교수 조 성 욱

이 논문을 경영학 박사학위논문으로 제출함

2014년 11월

서울대학교 대학원

경영학과 경영학 전공

김 정 심

김정심의 박사학위논문을 인준함

2014년 12월

위 원 장 : 김 영 진 (인)

부 위 원 장 : 이 인 호 (인)

위 원 : 윤 석 헌 (인)

위 원 : 김 우 진 (인)

위 원 : 조 성 욱 (인)

Abstract

Essays on Market Discipline in the Capital Market

Jeongsim Kim

Department of Finance

Business School

Seoul National University

This thesis consists of two chapters that examine two important issues in commercial banking: market discipline provided by wholesale financiers, and the effect of wholesale funding on the credit supply. I use a panel dataset for US commercial banks between 2002:Q1 and 2012:Q4 to investigate the impact of the 2008 financial crisis on the disciplining role of wholesale financiers.

The first chapter analyzes whether wholesale financiers punish banks for taking greater risks by demanding higher interest rates or withdrawing their funds. I focus on the interaction effects of bank-specific risk and market (common) risk on the supply of wholesale funding, in addition to the difference between short-term wholesale financiers (interbank lenders and repo lenders) and long-term wholesale financiers (large time depositors) because investors may have different incentives to monitor

banks depending on debt maturity or the strength of government protections. I provide evidence that wholesale financiers behave differently in favorable and unfavorable economic conditions. Both short- and long-term wholesale financiers disciplined risky banks during the pre-crisis period. Specifically, short-term wholesale financiers adjusted both the price and quantity when their borrower banks become riskier, while long-term wholesale financiers disciplined banks only through quantity rationing during stable economic periods. However, neither of them was sensitive to bank risk during the crisis, when the US government implemented extensive rescue programs. This result implies that substantial government support eliminates wholesale financiers' incentives to discipline banks. Furthermore, during the crisis, large time depositors seemed to exploit government safety nets by putting more money into riskier banks that provided higher prices. Interestingly, the lack of market discipline continued in the post-crisis period, although the Dodd–Frank Wall Street Reform and Consumer Protection Act was enacted in 2010. These results are robust even after controlling for the effect of the Troubled Asset Relief Program, for the quantitative easing policy, and for credit demands of bank borrowers.

The second chapter investigates how wholesale funding affects the extent to which banks supply credit to their borrowers depending on macroeconomic conditions. This study has three objectives. First, to determine whether wholesale funding contributed to both the lending boom during the pre-crisis period and the credit contraction during the crisis. Second, to investigate whether riskier banks with more wholesale funds engage in more prudent lending than those with less wholesale funding, based on the

disciplinary role of wholesale financiers. Finally, to determine how these banks change their lending behavior depending on market conditions. To this end, I consider risky lending by defining risky lending as increased credit or its risky loan components (short-term loans, real estate loans, and commercial and industrial loans) with higher interest rates on this credit. I find that banks relying more heavily on wholesale funds provided more credit during the pre-crisis period. This result implies that the increase in credit supply by high wholesale-funded banks led to the lending boom, and thus the increased the financial fragility in the banking system during the boom. High wholesale-funded banks, however, cut their lending more significantly during the crisis, suggesting that they contributed to the severe credit crunch. I also find that riskier banks with high wholesale dependence increased risky lending during the crisis and post-crisis periods, though these banks did not pursue risky lending during boom times.

……

Keywords : Wholesale Funding, Market Discipline, Credit Supply, Bank Risk, Financial Crisis

Student Number: 2008-30839

Contents

List of Figures

List of Tables

Chapter 1

Do Wholesale Financiers Discipline Risky Banks? Evidence from the Financial Crisis of 2008[1]

1.1 Introduction

Literature published before the financial crisis of 2008 argues for the benefit of wholesale funding[2] as a bank's alternative funding source. Wholesale financiers provide market discipline because they are more sensitive to bank risk and more informed on bank projects than retail depositors (Calomiris and Kahn 1991; Calomiris 1999; Flannery 2001)[3]. Unlike insured depositors, uninsured liability holders bear the losses from bank failures. Empirical studies that find interest rates on wholesale funding increase with bank risk support this view (e.g., Hannan and Hanweck 1988). Other studies focusing on both price and quantity analysis also supports this view. That

[1] This chapter is largely based on "Market Discipline by Wholesale Financiers Revisited" by Sung Wook Joh and Jeongsim Kim, Working Paper, 2014.

[2] Wholesale funding in this study refers to the sum of federal funds purchased, securities sold under agreements to repurchase, subordinated notes and debentures, brokered deposits, other borrowed money, deposits in foreign offices, and uninsured long-term deposits.

[3] Market discipline in the banking sector refers to the market-based monitoring mechanism in which bank liability holders punish banks for taking greater risks by imposing higher interest rates or reducing their investments (Flannery 1998; Martinez Peria and Schmukler 2001; Nier and Baumann 2006).

is, riskier banks pay higher interest rates and have wholesale funds withdrawn early (Park and Peristiani 1998; King 2008).

In contrast to the evidence supporting the presence of market discipline before the crisis, experiences in the wholesale funds market during the crisis raise questions about the presence of market discipline (Acharya, Gale, and Yorulmazer 2011; Huang and Ratnovski 2011; Hahm, Shin, and Shin 2013). The sudden dry-up of short-term money market funding during the crisis posed a serious problem to banks relying heavily on these markets. Several healthy banks with a higher non-core funding ratio failed as they had difficulty raising funds from their wholesale financiers, suggesting that wholesale fund markets do not differentiate safe banks from risky ones (Shin 2009). This contradicts the conventional view that wholesale financiers penalize banks for taking higher risks. In fact, using data on subordinated notes and debentures (SNDs) from 2009 through 2011, Balasubramnian and Cyree (2014) report that market discipline, defined as whether the funding advantage of too-big-to-fail (TBTF) banks was reduced, improved only after the Dodd–Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) was enacted in 2010.

This study aims to reconcile these two conflicting views concerning the disciplining role of wholesale financiers using more recent data covering the periods before and after the financial crisis of 2008. I investigate the presence of market discipline considering both a bank's risks and market-wide risks, such as the 2008 crisis. First, I empirically examine whether wholesale financiers discipline banks for taking greater risk by imposing higher interest rates on their investments (the price

dimension) or withdrawing their funds (the quantity dimension). Second, I investigate whether market discipline still exists when banks face market (common) risks by examining whether wholesale financiers punish risky banks more during periods of market stress and how government intervention during the crisis by rescuing risky banks affects market discipline. Third, I investigate whether different types of wholesale financiers have different incentives to monitor banks. For example, I consider whether long-term individual wholesale financiers, such as large time depositors, discipline banks differently from short-term institutional wholesale financiers, such as lenders in the Federal (Fed) funds market in the US. Finally, I examine whether wholesale financiers behave differently depending on bank size, and whether financiers have different incentives to discipline large banks or small banks depending on the change in market-wide risk.

Considering market risk in this study is important because banks are exposed to changes in market environments during periods of market stress. Borrowers' economic activities suffer from negative macro-economic shocks, leading to higher borrower default rates and lower recovery rates. Therefore, wholesale financiers are more likely to bear losses from bank failures during crises. In fact, 465 banks failed between 2008 and 2012, while only 21 banks failed between 2002 and 2007.[4]

Facing a market (common) risk, wholesale financiers' ex-ante incentives to discipline risky banks are ambiguous, depending on whether the government intervenes. Without government intervention to rescue failing banks, weaker banks face more

[4] FDIC failed bank list. https://www.fdic.gov/bank/individual/failed/banklist.html

credit risks and become even more vulnerable during tight economic periods. For example, even insured depositors might leave risky banks during or after a crisis (Martinez Peria and Schmukler 2001), making it difficult for risky banks to secure financing. On the other hand, when the government intervenes to stabilize the economy during a crisis, risky banks might gain stronger (implicit) guarantees, as the government is more likely to bailout distressed banks because it might not be able to determine which banks are riskier. There exists an information asymmetry between banks and the government as to whether a bank fails due to bank-specific problems or common market shocks (Freixas and Jorge 2008; Afonso, Kovner, and Schoar 2011). Therefore, the chance of bailing out bad banks increases when the government tries to bear the systemic risks in the banking sector. In this case, wholesale financiers may take advantage of strengthened government guarantees instead of making efforts to influence banks to avoid excessive risks during a crisis.

Interestingly, researchers analyzing wholesale financiers' behavior have not fully considered that the incentives to discipline banks may vary by type of investor, as most previous studies examine only one type of wholesale funds in a study. For instance, researchers primarily focus on uninsured deposits (Keeley 1990; Goldberg and Hudgins 1996; Park and Peristiani 1998), SNDs (Avery, Belton, and Goldberg 1988; Flannery and Sorescu 1996), or overnight interbank loans (Furfine 2001; King 2008; Afonso, Kovner, and Schoar 2011). Each component of these wholesale funds has different maturities, and there are different types of wholesale financiers, such as banks in the overnight Fed funds market, institutional investors in the repo market, or

individual time depositors.

From the perspective of the types of wholesale funds, market monitoring by wholesale financiers may stem from different incentives based on maturity, the strength of government protection, or the ability to collect and process information. First, the incentives to discipline based on maturity are ambiguous ex ante. On the one hand, because of an extremely short-term maturity, interbank lenders and repo lenders may provide better discipline because their losses from withdrawing funds before maturity are relatively small. For example, sellers in the overnight Fed funds market can stop funding risky banks without losing accrued interests when they perceive risks. In contrast to short-term money market investors, long-term wholesale financiers such as large time depositors might not engage in disciplinary activities because they have to forfeit some of accrued interests if they withdraw before maturity. Therefore, large time depositors must weigh the cost and benefit from early withdrawals. On the other hand, the extremely short-term maturity may create little incentive for short-term wholesale financiers to monitor banks. This may simply be because investors in the overnight Fed funds markets can get their money back the next day (King 2008; Craig and Dinger 2013). However, large time depositors may have more incentive to monitor banks because the longer maturities force more prudence in when and where they make deposits.

Second, the ability to monitor banks may affect market discipline. Short-term wholesale financiers are large institutional investors, that is, banks are the participants in the Fed funds market (Furfine 2001). Repo lenders are largely money market mutual

funds and security lending firms, while repo borrowers are broker-dealers and banks (Gorton and Metrick 2012; Krishnamurthy, Nagel, and Orlov 2014). However, large time depositors are small individual investors, and institutional investors have an advantage in collecting and processing information. Therefore, short-term wholesale financiers may provide better discipline than long-term wholesale financiers.

Finally, the strength of government protection may affect incentives to provide discipline. Historically, the government is concerned about bank runs by depositors (Diamond and Dybvig 1983), and will therefore provide better protection for depositors. In fact, the US government provided strong depositor protection during this recent crisis, such as increasing the deposit insurance coverage from $100,000 to $250,000 and unlimited guarantees for non-interest bearing transaction accounts. Additionally, uninsured large time depositors enjoyed both explicit and implicit government protection during the crisis. Conversely, interbank and repo lenders rely only on implicit government safety nets. Therefore, large time depositors may have less incentive to discipline banks or even exploit strong government guarantees.

Using 183,618 US commercial bank data points from 2002 to 2012, I present evidence that both short- and long-term wholesale financiers discipline banks for their individual risks during stable economic periods. However, I find little evidence for the presence of market discipline during the financial crisis of 2008, suggesting that wholesale financiers take advantage of the higher possibility for bailouts during the crisis. Interestingly, there is no evidence for market discipline during the post-crisis period, which includes the period after the Dodd-Frank Act was passed, implying that

the Dodd-Frank Act is not effective. Both large and small banks show the same results before, during, and after the crisis, except for large time depositors during the pre-crisis period, which neither charge higher interest rates for large, risky banks nor withdraw their funds during stable economic periods. In my analysis, I control for bank characteristics (such as size, profitability, and capital ratio), market structure (such as market concentration), and macro-economic conditions, and the results are robust even after controlling for government interventions to rescue specific banks through the Troubled Asset Relief Program(TARP)[5], for Quantitative Easing (QE), and for liquidity demands from bank loan borrowers. In addition, I use several methods to check for robustness. For bank specific risks, I use non-performing loans (NPL) as a proxy of bank risk, with Z-scores and risk-weighted assets (RWA) as alternative proxies. Local market recessions at the MSA level and the TED spread are used as proxies of market-wide risks, other than the financial crisis of 2008. The results remain unchanged even after considering these additional proxies for a bank's internal risk and market-wide shocks.

The results explain why wholesale financiers failed to discipline risky banks during the 2008 crisis. While the aggregate value of wholesale funds plummeted during

[5] The TARP was established in October 2008 by the US government to strengthen market stability in response to the financial crisis of 2008. Under the program, the Treasury Department was allowed to purchase up to $700 billion of distressed assets or to purchase senior preferred stock and warrants in qualified financial institutions. The TARP was one of the largest government rescue programs in the United States (Black and Hazelwood 2013; Li 2013).

the crisis, investors withdrew funds from safe banks rather than risky ones. Surprisingly, wholesale funding for risky banks rather increased during the crisis, a result discussed further in Section 1.3. Previous studies demonstrate that market discipline tends to be weak during a crisis because uninsured investors expect implicit or explicit protection provided by government safety nets (e.g., Calomiris 1999). Using yields on subordinated debentures from 1983 to 1991, Flannery and Sorescu (1996) find that SND investors are insensitive to banks' risk-taking when government guarantees cover bank debentures. However, the results from this study provide stronger evidence that market discipline broke down during the crisis period; riskier banks attracted more wholesale funds, without experiencing lower interest rates. In particular, riskier banks gained more large time deposits, paying higher interest rates on the deposits during the crisis, suggesting that riskier banks exploited government interventions to stabilize the economy during the severe crisis.

If the lack of market discipline is attributed to monitoring ability, then ineffective market discipline by individual depositors should be observed for both large and small banks compared to institutional investors. Alternatively, the lack of market discipline from depositors should be more prominent in small banks than in large banks because they are generally more opaque than large banks. However, this study's results show that large time depositors do not discipline large banks while they punish small banks during stable economic periods. Therefore, the lack of discipline is not related to ability.

The results from this study instead suggest that the lack of discipline is an outcome of the interaction between maturity and the strength of government protection.

In stable economic periods, maturity seems to be prioritized over the strength of government protection, as this study's results demonstrate that short-term wholesale financiers provide monitoring by adjusting both the price and quantity. However, long-term wholesale financiers only discipline banks through quantity rationing. Furthermore, long-term wholesale financiers do not discipline large banks during stable economic periods, suggesting that the strength of government protection has a small amount of influence during stable economic periods because uninsured time depositors do not monitor large banks, which are more likely to be bailed out. The strength of government protection becomes more important than maturity during the severe crisis period. The extensive government rescue programs during the crisis removed the incentives for bank creditors to monitor their borrowers, since these protections eliminated the probability of bank failure.

Interestingly, the absence of market discipline continued during the post-crisis period, inconsistent with Martinez Peria and Schmukler (2001) and Balasubramnian and Cyree (2014). Using insured and uninsured deposit data in Argentina, Chile, and Mexico between the 1980s and the 1990s, Martinez Peria and Schmukler (2001) conclude that market discipline improved in the after math of crises because depositors become more responsive to bank risk through their experiences of massive bank defaults during the crisis. Balasubramnian and Cyree (2014) show that SND investors better reflect bank default risk after the Dodd-Frank Act. However, the results from this study show that investors still maintain an expectation of government protections after the Dodd-Frank Act, though this act aimed to limit this expectation. This study's

findings imply that in the post-crisis period, the financial crisis of 2008 failed to change wholesale financiers' opinions, and that the Dodd-Frank Act is ineffective.

The rest of the paper proceeds as follows. Section 1.2 reviews related literature. Section 1.3 graphs the time-series trends of the quantity and cost of wholesale funding, both at the aggregate and the bank level. Section 1.4 describes the data and empirical methodology, and Section 1.5 presents the empirical results. Section 1.6 describes the robustness tests for the empirical findings. Finally, Section 1.7 concludes the paper.

1.2 Related Literature

There are two conflicting views on the disciplining role of wholesale financiers. Market discipline refers to the market-based monitoring mechanism in which bank creditors punish banks for excessive risk-taking by imposing higher interest rates or withdrawing their investments. A great deal of literature prior to the 2008 crisis provides evidence that market discipline is in effect, although some earlier empirical studies report insignificant coefficients of bank risk measures on interest rates paid by banks (e.g., Avery, Belton,and Goldberg 1988; Gorton and Santomero 1990). Studies after the crisis, however, raise questions about the presence of market discipline.

Earlier studies focus on the advantages of wholesale funding as an alternative funding source, arguing that wholesale funds complement retail deposits, and uninsured wholesale financiers play an essential role in disciplining banks. Proponents for the presence of market discipline argue that wholesale financiers, as informed but

uninsured investors, influence banks to avoid excessive risks. Calomiris and Kahn (1991) show that uninsured bank creditors have an incentive to invest in information-gathering in order to monitor banks because they face sequential service constraints (first-come, first-served rule for demanded payments). Therefore, better informed wholesale financiers penalize banks by withdrawing their funding when bankers act against the interests of the short-term creditors. Similarly, Diamond and Rajan (2001) argue that wholesale financiers discipline banks by using their early withdrawal abilities, focusing more on the ex-post disciplining role.

Many earlier empirical studies supporting the presence of market monitoring have argued that wholesale financiers charge different prices depending on the borrower's risks. As wholesale financiers are reluctant to lend money, riskier banks face higher funding costs. Examining the relationship between insolvency risk and the cost of uninsured wholesale funding, existing empirical studies have focused on one type of wholesale funds in their studies. Baer and Brewer (1986), Hannan and Hanweck (1988), and Keeley (1990) empirically test the relationship between insolvency risk and interest rates on large certificates of deposit (CDs). Flannery and Sorescu (1996) find a positive relationship between bank risk and SND yield spreads. Furfine (2001) finds that the interest rate paid on federal funds transactions are sensitive to bank risk.

From the perspective of the quantity analysis, correctly pricing bank risk is often difficult in reality. Furthermore, investors cannot observe prices when quantity rationing occurs (King 2008). In this case, quantity rationing itself provides information on market discipline although prices do not reflect the change in bank risk.

Therefore, later studies focused on both the price and quantity dimensions. Park and Peristiani (1998) find that riskier banks pay higher interst rates and attract less uninsured deposits. King (2008) also find that market discipline exists both in the price and quantity dimension in the Fed funds market. Additionally, some studies find evidence for market discipline in the quantity dimension, even when controlling for funding costs (Maechler and McDill 2006).

The financial crisis in 2008 has changed the view on market discipline. Not only the sudden freeze in the wholesale funds market, but also the fact that healthy banks with sound assets could not take out short-term debt during the crisis raised questions about the presence and effectiveness of market discipline (Shin 2009; Acharya, Gale, and Yorulmazer 2011). In addition, Hahm, Shin, and Shin (2013) report that aggressive lending based on the growth of wholesale funding leads to vulnerability to a financial crisis for both emerging and developing economies.

The impact of a financial crisis on market discipline is ambiguous ex ante depending on government intervention. With limited and selective government interventions to bailout failing banks, uninsured financiers bear losses from the banks' bankruptcies. Weaker banks become even more vulnerable and face more credit risks during a market-wide crisis. Using bank-level data on deposits in Argentina, Chile, and Mexico, Martinez Peria and Schmukler (2001) find that uninsured depositors discipline banks by withdrawing deposits and demanding higher risk premiums in the aftermath of banking crises. In particular, depositors become more sensitive to risks after experiencing bank failures and depleted deposit insurance funds during crises. On the

other hand, government bails outs of banks during a crisis can lead to moral hazard behavior among banks. With a strong belief in government intervention to rescue failing banks, uninsured financiers take advantage of implicit government guarantees instead of conducting costly monitoring (Calomiris 1999; Nier and Baumann 2006). Balasubramnian and Cyree (2014) find that market discipline has improved after the enactment of the Dodd-Frank Act through a decrease in TBTF banks' funding advantage on SND yield spreads by using SND transactions between June 2009 and December 2011.

1.3 Background Information on Wholesale Funding and its Relationship with Bank Risk

In this study, wholesale funding consists of 1) purchased federal funds (Fed funds), 2) securities sold under agreements to repurchase (repos), 3) SNDs, 4) brokered deposits, 5) other borrowed money, 6) deposits in foreign offices, and 7) uninsured time deposits of more than $100,000 ($250,000 starting from the first quarter in 2010)[6].

[6] The temporary increase in deposit insurance limits was effective in October 2008, and then permanently rose to $250,000 in July 2010. However, reporting thresholds on time deposits in the Call Reports reflect this change in deposit insurance limits from 2010:Q1. Therefore, the decrease in the total amount of wholesale funds from the decrease in uninsured time deposits occurs in 2010:Q1. The results remain robust even when reflecting the changes in deposit insurance coverage.

The volume of aggregate wholesale funding has greatly fluctuated in the 2000s (Brunnermeier 2009). Figure 1.1 shows that the aggregate wholesale funding for all commercial banks in the US increased until the break of the 2008 financial crisis, although the US entered a recession in 2007. Thereafter, aggregate wholesale funding plummeted from the fourth quarter of 2008, after the Lehman Brothers' bankruptcy. Such trends are robust even after considering the change in the deposit insurance limit from $100,000 to $250,000. These results suggest that wholesale financiers merely responded to the outbreak of the crisis, which was a macro shock affecting all banks, rather than take the preemptive measure of reducing their exposure before the crisis.

Since bank size affects accessibility to the Fed funds and SND markets, figures 1.1.2 and 1.1.3 show the wholesale funding trends by bank size and multi-market operation, respectively. Large or multi-market banks contribute the most to the wholesale funds market trend fluctuations. These trends suggest that large or multi-market banks are more likely to attract uninsured wholesale funding than small or single-market banks.

Wholesale funding also depends on bank risk. Figure 1.2.1 shows wholesale funding trends in banks with high-risk (high NPL ratio), medium-risk (medium NPL ratio), and low-risk (low NPL ratio), divided into these groups based on the annual tercile values of non-performing loans over total loans. High risk banks have higher wholesale funding than low-risk banks during the sample period. Furthermore, aggregate wholesale funding increased for high-risk banks, while funding decreased for medium- and low-risk banks during the crisis. That is, the decline in aggregate

wholesale funds during the crisis mainly results from the decrease in funding for safe (medium- and low-risk) rather than risky banks. This figure suggests that wholesale financiers are not sensitive to individual bank risk.

Figures 1.2.2 and 1.2.3 show the trends of wholesale funding in high-risk, medium-risk, and low-risk banks in groups of large and small banks, respectively. The banks are sorted first by size, then by risks. For each year, they are divided into two groups, large and small, then into three risk groups to reflect the fact that wholesale funding depends on bank size and risk. In both size groups, the amount of wholesale funding varies similar to risk level. In the group of large banks, high-risk banks have more wholesale funding than low-risk banks. Furthermore, the aggregate wholesale funds of large high-risk banks increased over the period of the 2008 financial crisis (See Figure 1.2.2). Small high-risk banks obtained more wholesale funds than low-risk banks during the crisis (See Figure 1.2.3). Note that in both size groups, the significant decline in the wholesale funds market during the crisis mainly came from medium and low-risk banks.

In addition to aggregate wholesale funding itself, I also analyze how the ratio of wholesale funding to total assets (*WF/TA*) varies across bank size and bank risk. Differences in the average *WF/TA* between high-risk and low-risk banks are positive for both large (Figure 1.2.4) and small banks (Figure 1.2.5), suggesting that risky banks rely more on wholesale funding more than safe ones. In the group of large banks, the difference in average *WF/TA* dramatically increases during the recession periods in 2001-2002 following the burst of the dot-com bubble, and in 2008-2009 after the

Lehman Brothers bankruptcy. In small banks, the difference dramatically increased over the 2008-2009 crisis and post-crisis periods. Even after the Dodd-Frank Act was enacted, risky banks relied more on wholesale funding than safe banks. In short, wholesale financiers do not seem to withdraw from risk banks, especially during recessions. In fact, they seem to take more risk by increasing their investment in risky banks when markets are distressed due to liquidity risk.

I investigate whether risky banks pay higher interest rates on wholesale funds than safe banks by comparing the average cost of wholesale funds (*WF_RATE*) for high-risk banks with that of low-risk banks for a given bank size group. *WF_RATE* is measured by the quarterly expenses of wholesale funding as a fraction of the quarterly average amount of wholesale funding. This variable measures average costs of wholesale funding, though it does not measure exact price. Large risky banks pay higher interest rates on wholesale funds than safe banks except for a few quarters (Figure 1.3.1). For small banks, however, risky banks often pay lower interest rates than safe banks (Figure 1.3.2). For large banks, the difference in average funding costs between risky and safe banks is lower than 0.2%. For small banks, it is less than 0.15%. Combining the results in Figures 1.2 and 1.3 suggests that risky banks obtain more financing more from wholesale funds than safe ones. While risky banks often pay higher interest rates than safe banks, the difference is quite small.

1.4 Data and Methodology

1.4.1 Data

I build a quarterly panel data set from the beginning of 2002 through the fourth quarter of 2012 that includes all insured US commercial banks, and collect financial information for commercial banks providing Consolidated Reports of Condition and Income (Call Reports) from the Federal Financial Institutions Examination Council (FFIEC). The Call Reports include quarterly bank financial information and the components of wholesale funds such as the amount of Fed funds, repos, and uninsured deposits. The data excludes banks with zero total assets, zero total loans, and zero total deposits. I also winsorize financial statement variables at the top and bottom 1% of the distribution of each variable. The final sample consists of 183,618 bank-quarter observations for 5,966 US commercial banks.

I identify bank holding companies using information from Federal Deposit Insurance Corporation (FDIC). Information on aggregate deposits in the Metropolitan Statistical Area (MSA) markets is collected from the Summary of Deposits (SOD) database of the FDIC. Income growth and the real GDP of MSA information are collected from the Bureau of Economic Analysis (BEA). Information about the business cycle and the TED spread are obtained from National Bureau of Economic Research (NBER) and Federal Reserve Economic Data (FRED), respectively. Data on

the effective Fed funds rate and monetary aggregates (M2) are retrieved from the Federal Reserve Board (FRB). Information about the Troubled Asset Relief Program (TARP) is obtained from the US Treasury Department.

1.4.2 Econometric Methods

The following two fixed effects models are used to test for the presence of market discipline:

$$Spreads\ on\ funds_{it} = \alpha_0 + \alpha_1 Bank\ Risk_{it-1} + \alpha_2 Crisis_t + \alpha_3 Bank\ Risk_{it-1} * Crisis_t + \alpha_4 Other\ controls_{it-1} + \mu_{1i} + \tau_{1t} + \varepsilon_{it} \quad (1)$$

$$\Delta Wholesale\ funds_{it} = \beta_0 + \beta_1 Bank\ Risk_{it-1} + \beta_2 Crisis_t + \beta_3 Bank\ Risk_{it-1} * Crisis_t + \beta_4 Other\ controls_{it-1} + \mu_{2i} + \tau_{2t} + \eta_{it} \quad (2)$$

Where μ_1 and μ_2 are bank-fixed effects to control for time-invariant unobserved heterogeneity at the bank level (i), and τ_1 and τ_2 are time-fixed effects to account for changes in the economic environment across quarters (t). ε_{it} and η_{it} are error terms. Explanatory variables related to bank financial data take values lagged by one quarter to avoid the potential endogeneity problem. All panel regressions are estimated with robust standard errors clustered at the bank level to account for within-bank serial correlation. I estimate each of these equations separately for large (with total assets

greater than $1 billion) and small (with total assets less than $1 billion) banks since accessibility to wholesale funding varies by bank size, which is elaborated in detail below. Table 1.1 provides detailed definitions of the variables used in the estimation. All variables, except for macroeconomic variables, are winsorized at the 1st and 99th percentiles.

$Spreads\ on\ funds_{it}$ and $\Delta Wholesale\ funds_{it}$ represents the quantity and the cost of wholesale funding, respectively. Therefore, Equation (1) tests whether wholesale financiers discipline banks' risk-taking by demanding higher interest rates, and Equation (2) tests whether wholesale financiers adjust their investment holdings when the bank takes on more risk. I focus on three components of wholesale funds depending on different maturities: *Fed funds* (extremely short-term), *large time deposits*, and *wholesale funds* (total wholesale funding).[7] *Fed funds* is defined as the sum of federal funds and repos[8]. Since both types of funding have very short-term marities (Furfine 2001; Gorton and Metrik 2012), the interest rate on *Fed funds* can be taken as the cost of very short-term wholesale liabilities (Craig and Dinger 2013). *Large time deposits* are uninsured time deposits over $100,000 until 2009:Q4 and over $250,000 from 2010:Q1.

[7] I do not analyze how wholesale financiers discipline banks that issue SNDs. About 8,893 bank-quarter observations are available among 183,618 total observations. The dataset includes fewer than 500 unique banks that have issued SNDs. Furthermore, among banks with any SNDs, the portion of their funding based on SNDs is less than 3 percent of total assets.

[8] Expenses for Fed funds and repos are reported as the sum of the two accounts in income statements although the amounts of Fed funds and repos are reported separately in balance sheets. Therefore, I employ a variable *Fed funds* by combining Fed funds and repos together.

Maturity based wholesale funding addresses differences in practical accessibility to wholesale funds markets. Whereas a large portion of wholesale funding for small banks comes from uninsured time deposits, large banks have more access to the wholesale funds market by various means, such as issuing debentures and taking foreign deposits. Most banks have a type of wholesale funding (for example, uninsured time deposits), but not all. About 60 percent of the wholesale funding for small banks is uninsured time deposits. Furthermore, banks purchasing federal funds or issuing SNDs are often large banks. In contrast, small and risky banks often fail to obtain Fed funds or repos. The methodology section below describes how I address the sample selection problem depending on different wholesale funding products.

As explained in Table 1.1, the price of wholesale funding ($Spreads\ on\ funds_{it}$) is measured as the spread, expressed in annual terms, between the implicit interest rates on *Fed funds* (*large time deposits* and *wholesale funds*) and the effective Fed funds rate (one-year treasury constant maturity rate), since large time depositors and wholesale funding sources other than *Fed funds* tend to have long maturities of around one year. The implicit interest rates are calculated as the quarterly average expenses of *Fed funds* divided by the quarterly average amounts of *Fed funds*. The expenses for *wholesale funds* include interests on uninsured time deposits, SNDs, deposits in foreign offices, and Fed funds and repo expenses[9].

[9] Income statements do not provide information about the expenses for brokered deposits and other borrowed money. These are therefore excluded from interest rate calculations for wholesale funds.

I measure the quantity of wholesale funding ($\Delta Wholesale\ funds_{it}$) as the change in wholesale funds during the quarter normalized by the total assets at the beginning of the period ($Total\ assets_{it-1}$). Specifically, *Changes in Fed funds* (*large time deposits* and *wholesale funds*) is the quarterly change in the amounts of *Fed funds* (*large time deposits* and *wholesale funds*) during the quarter as a fraction of the start of quarter total assets.

The variable of interest is bank risk. $Bank\ Risk_{it-1}$ refers to bank-specific risk. I employ NPL, the ratio of non-performing loans to total loans, as a proxy for bank risk. A bank classifies loans as non-performing when they are 90-days or more past due or nonaccrual in the Call Reports. I also employ additional proxies for bank risk taking. The first is the ratio of risk-weighted assets to total assets. NPL ratios based on a bank's lending outcomes are an ex-post indicator for bank risk taking. Based on Basel rules, banks are required to calculate their own risk weighted assets to determine a bank's real world exposure to potential losses. All assets and off-balance sheet activities are assigned different relative risk weights according to their perceived credit risks (Avery and Berger 1991; Berger and Udell 1994). For example, commercial loans are perceived to be riskier than Treasury securities according to the risk-based capital standard. RWA is an ex-ante measure reflecting bank asset risk based on the allocation of assets. The second risk measure is the Z-score, which indicates a bank's overall risk by measuring the distance to default, and is calculated as the sum of the return on assets (ROA) and the equity ratio divided by the standard deviation of ROA. The means and standard deviations of the Z-score components are estimated over rolling

windows of 12 quarters. A higher value indicates a lower risk of default.

Market-wide liquidity shocks are measured through an indicator variable for the 2008 financial crisis. I divide the 2008 crisis period into two sub-periods using the failure of Lehman Brothers as the watershed. The Lehman failure has different implications in terms of government intervention. The pre-Lehman crisis periods (*CrisisI*) covers the third quarter of 2007 to the second quarter of 2008 (2007:Q3-2008:Q2), and the post-Lehman crisis period (*CrisisII*) starts from the third quarter of 2008 to the second quarter of 2009 (2008:Q3-2009:Q2). In addition to the crisis period, I employ two additional variables as proxies for market-wide liquidity shocks. The first is a dummy variable for recessions at the MSA level (*Recession_MSA).* I set the indicator equal to one when a bank operates in an MSA that experiences a decline in real GDP for two consecutive quarters. In the case of a multi-market bank, the value is one when the bank experiences a decline in at least 25% or more of the MSAs in which it operates. The second market risk variable is the TED spread (*TED spread*), which is the spread between the three-month London Interbank Offered Rate (LIBOR) based on US dollars and the three-month T-bill rate. The TED spread is a measure of credit risk in the economy because LIBOR is risky while T-bills are risk-free. An increase in the TED spread means lenders believe that the risk of default on interbank loans is increasing. In general, the TED spread widens during a crisis (Brunnermeier2009; Cornett, McNutt, Strahan, and Tehranian 2011).

The effect of bank risk on the quantity or the cost of *Fed funds* depends on a bank's ability to attract *Fed funds*. A bank's financial soundness affects its probability

of participating in the overnight Fed funds and repo markets. A specific distribution of the unobservable characteristics jointly affects participation and the supply of wholesale funding. Large or multi-market banks are more likely to obtain non-core funds (Park and Pennacchi 2009). In general, large banks are purchasers while small banks are suppliers in the overnight Fed funds market (Ho and Saunders 1985). To address this sample selection problem, I apply Heckman's (1979) two-stage model when analyzing the Fed funds and repo markets. Specifically, I first estimate the probability that a bank attracts funds in each quarter using a probit model for all banks in the sample. In the second stage, I conduct ordinary least squares (OLS) for banks with a positive volume of *Fed funds* using Heckman's (1979) lambda (*Lambda*) estimated from the first-stage probit model.

Since sophisticated investors make lending decisions based on bank-specific factors as well as market and macroeconomic factors, I also include bank-specific, market, and macroeconomic variables as other control variables ($Other\ controls_{it-1}$). Bank-specific control variables include bank size (*Log total assets*), capital ratio (*Capital ratios*), and profitability (*Return on assets*) to control for the effect of bank characteristics on the quantity or cost of wholesale funding. *Log total assets* are measured as the natural log of total assets in million dollars. As mentioned above, large or multi-market banks have an advantage in wholesale funding compared to small or single-market banks (Park and Pennacchi 2009).[10] *Return on assets* represents return on

[10] Due to a high correlation (=0.4943) between bank size (*Log total assets*) and multi-market operation, I exclude multi-market operation in the regressions to avoid the multicollinearity problem.

assets (ROA). *Capital ratios* are measured as the ratio of bank equity to total assets. Well-capitalized banks are more likely to obtain wholesale funding because they are more stable, especially in periods of market stress, thanks to their capital buffers (Jokipii and Milne 2008; Acharya and Mora 2014). *Bank holding company* indicates a quarterly dummy variable that takes a value of one for a member of a bank holding company. During the 2008 crisis, the US government intervened and bailed out banks by providing TARP funds. *TARP amounts* indicate a bank's amount of received TARP funds, which is scaled by total assets.

Market level variables include deposit-market concentration (*Weighted HHI*) and income growth rate (*Weighted income growth*). *Weighted HHI* (Herfindahl–Hirschman Index) is calculated using branch-level deposit data from the FDIC's SOD database. When a bank operates in multiple-MSA markets, I weight MSA level variables (HHI and income growth rate) by the proportion of the bank's deposits in each MSA. Additionally, macroeconomic conditions include the level of money supply (*M2/GDP*), calculated as M2 divided by GDP to account for the effect of a quantitative easing policy.

Table 1.2 shows summary statistics for the variables employed in the estimations. Variables except for *M2/GDP* and *TED spread* are winsorized at the 1st and 99th percentiles to reduce the impact of outliers. Not surprisingly, interest rates on time deposits are higher than those on Fed funds due to longer maturities; the mean of the implicit interest rates on *Fed funds* is 0.0232 while that on *large time deposits* is 0.03. The average changes in *Fed funds* are lower relative to *large time deposits* and

wholesale funds; the mean percentage change for *Fed funds* is 0.16; for *large time deposits* is 0.18; and for *wholesale funds* is 0.46.

1.5 Empirical Results

1.5.1 The Effect of Bank Risk on the Price and Quantity of Wholesale Funds: Basic Results

Table 1.3 shows how wholesale financiers, including (short-term) sellers of Fed funds and (long-term) large time depositors, change their behavior of disciplining banks depending on macroeconomic conditions. To investigate, I employ interaction terms between bank risk (*NPL*) and market risk (*Crisis*): *NPL*CrisisI*, *NPL*CrisisII*, and *NPL*Postcrisis*. *CrisisI*, *CrisisII*, and *Postcrisis* are defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4, respectively. As this study examines the presence of market discipline both in the price and quantity dimensions, the dependent variables are the implicit cost (*Spreads on Fed funds*) and the change in *Fed funds* during the quarter (*Changes in Fed funds*) in Panel A, the imputed cost (*Spreads on large time deposits*) and the change in large time deposits (*Changes in large time deposits*) in Panel B, and the imputed cost (*Spreads on wholesale funds*) and the change in total wholesale funding (*Changes in wholesale funds*) in Panel C. Models (1) and (2) for Fed funds and repos are estimated using

Heckman's (1979) two-stage procedure to control for the sample selection problem arising from access to short-term money markets. *Lambda* indicates the inverse Mills ratio from the first-stage probit model. R^2 of the probit regression represents Pseudo-R^2. Models (3)-(6) show the coefficients in the fixed effects regressions.

The first column of Panel A in Table 1.3 shows the regression estimates of the probit model for whether banks attract Fed funds or repos. A bank is more likely to obtain Fed funds or repos if it is larger and has fewer troubled assets. Bank holding company status also played a significant role in participation in Fed funds or repo markets. A member of a bank holding company has a higher chance of securing Fed funds or repos. Models (1) and (2) report the second stage estimates of the Heckman procedure for the cost and quantity of funding, respectively. The coefficient of *NPL* in Model (1) is positive and significant at the 5% level, implying that lenders in the overnight Fed funds market require a risk premium when the bank takes greater risks. Furthermore, the coefficient of *NPL* in Model (2) is negative and significant at the 1% level, suggesting that interbank lenders withdraw their money when the bank increases its risk-taking. Putting these results for *NPL* into Models (1) and (2) together indicates that interbank lenders disciplined banks during the pre-crisis period by adjusting both price and quantity, a result consistent with Furfine (2001) and King (2008). However, the results of the interaction term between *NPL* and the macroeconomic crisis do not provide evidence for market discipline. The coefficients of *NPL*CrisisI* in Models (1) and (2) are 0.0141 and -0.0118, respectively, and insignificant. *NPL*CrisisII* also has insignificant coefficients in both the price and quantity equations. These results suggest

that risky banks do not pay higher interest rates when they borrowed from short-term wholesale financiers, and did not experience withdrawal of funds during the 2008 crisis. Furthermore, *NPL*Postcrisis* in Models (1) and (2) also has insignificant coefficients, implying that there is no evidence of market discipline, even during the post-crisis period. These results are inconsistent with the disciplinary argument in which banks are less likely to be rescued in case of failure because governments have committed to rescuing too-big-to-fail banks since the Dodd-Frank Act was enacted. The absence of market discipline during the post-crisis period raises questions about the effectiveness of the Dodd-Frank Act, a result inconsistent with Balasubramnian and Cyree (2014) who argue that market discipline improved after the Dodd-Frank Act.

In Panel B for large time deposits, *NPL* has an insignificant coefficient in the price equation but a significantly negative coefficient in the quantity equation, indicating that large time depositors discipline banks by rationing investments, although they do not adjust the price based on bank risk during stable economic periods. That is, risky banks experienced the withdrawal of funds but not higher funding costs for uninsured time deposits. *NPL*CrisisI* has significantly negative coefficients in both the price and quantity equations. That is, risky banks paid lower interest rates and attracted fewer large time deposits during the pre-Lehman crisis period. One possible explanation for this result is regulatory discipline. Risky banks may decrease deposits by reducing their risky assets in response to regulatory pressure wherein risky banks were required to increase their risk-based capital ratio during a crisis. In this case, banks may lower deposit rates to reduce deposits due to the decrease in assets. Regulatory discipline is

different from market discipline because risky banks pay lower interest rates on financing instead of a higher one (Martinez Peria and Schmukler 2001). On the other hand, *NPL*CrisisII* has significantly positive coefficients in both the price and quantity equations. Risky banks paid higher interest rates on large time deposits and increased the amount of deposits during the post-Lehman crisis period (*CrisisII*), suggesting that risky banks may attempt to increase time deposits by increasing interest rates. That is, risky banks obtained more uninsured time deposits than safe banks after the Lehman Brothers failure. Therefore, large time depositors did not punish banks for increased risks during the post-Lehman crisis period. Rather, they deposited more money into risky banks that provided higher interest rates during one of the most severe crises in US history. This result implies that large time depositors may exploit the increased possibility of government aid during a crisis. Interestingly, I find no evidence for the presence of market discipline, even in the post-crisis period when the Dodd-Frank Act was enacted, as with the results of Panel A.

Panel C shows regression estimates for total wholesale funding. As described in Table 1.1, total wholesale funding includes Fed funds, repos, and other long-term wholesale funds. The results in Panel C are very similar to those in Panel B. That is, I find evidence for market discipline in the form of quantity rationing during stable periods. However, I find evidence for regulatory discipline during the *CrisisI* period. In addition, I find little evidence for market discipline during *CrisisII* and *Postcrisis*.

In short, market discipline occurs during stable economic periods. However, market discipline methods differ between short-term and long-term investors. Investors

in the very short-term money markets actively reflect bank risk in their pricing decisions. Large time depositors penalize banks for increasing risks by withdrawing funds, though they do not adjust prices in response to bank risk. As discussed previously, this may be attributed to the difference in maturities. Long-term investors may incur larger losses from forfeiting accrued interest while short-term investors may not have this kind of risk. Therefore, investors in the Fed funds or repo market have more incentive to discipline banks. The most interesting finding in this study is the absence of market discipline during the 2008 crisis. My results are similar to those of Flannery and Sorescu (1996), though this study's results provide stronger evidence for the absence of market discipline during tight economic periods when government intervention is expected. I consider both the price and quantity dimensions for market discipline, while Flannery and Sorescu (1996) do not examine responses along the quantity dimensions on banks' increased risk. Furthermore, I find an increase in the probability of wholesale funding for risky banks during the crisis. When wholesale financiers anticipate an increase in government aid and the possibility of bailouts, they have little incentive to discipline banks (Calomiris 1999; Nier and Baumann 2006). In addition, I find evidence for the ineffectiveness of the Dodd-Frank Act because there is no evidence of market discipline from all wholesale financiers during the post-crisis period. Furthermore, I control for the effect of QE using the level of money supply (*M2/GDP*) in all regressions, and the results remain robust after controlling for the effect of QE.

1.5.2 Controlling for Bank Borrowers' Credit Demands and Government Intervention

Some may argue that high NPL banks may attract more funding by providing higher interest rates because these banks rely on wholesale funds to satisfy borrowers' increased loan demands during a crisis. In this case, this study's main results may be driven by bank borrower demands, not by the lack of market discipline. In Table 1.4, I address the situation wherein risky banks in need of funding during the crisis attract wholesale funds by increasing their interest rates. Since borrowers used their lines of credit to meet liquidity demands during the crisis (Ivashina and Scharfstein 2010), I employ the changes in the sum of loans and undrawn credit lines scaled by the sum of deposits and equity (*ΔCredits*) as a proxy of borrowers' credit demands.

In addition, I examine whether the banks that received TARP funds attracted more wholesale funding, to ensure that the main findings for the increase in wholesale funding are driven by the banks instead of the lack of market discipline. The US government assisted some banks through the TARP during the crisis. The TARP was introduced in October 2008 when the US government tried to increase government support for the banking system immediately after the Lehman failure, and aimed to strengthen the financial system's stability by helping sound banks in financial distresses (Black and Hazelwood 2013; Li 2013; Acharya and Mora2014).

My results are robust after controlling for the both the effects of borrowers' credit

demands and TARP banks. The overall results in Table 1.4 are similar to those in Table 1.3. In stable economic periods, short-term wholesale financiers discipline banks by demanding higher interest rates and by withdrawing funds, while long-term wholesale financiers discipline banks only by decreasing their investment amounts. During the 2008 crisis, however, short-term wholesale financiers did not reflect bank risk in their pricing and quantity decisions. Long-term wholesale financiers (large time depositors) were also insensitive to bank risks during the crisis. There was regulatory discipline during the pre-Lehman crisis period (*CrisisI*). During the post-Lehman crisis period (*CrisisII*), long-term wholesale financiers required higher interests rates for riskier banks, but they also increased their investments in weaker banks. This result implies that large time depositors exploit government safety nets by investing in riskier banks that provided higher interest rates. Furthermore, all types of wholesale financiers failed to discipline banks for increased risk during the crisis. This result may indicate moral hazard from wholesale financiers with little incentive to provide discipline because of extensive government guarantees during the crisis. In particular, large time depositors received both explicit and implicit government support during the crisis. Aside from bank bailouts (implicit government safety nets), deposits were protected during the crisis by the increase in deposit insurance coverage and unlimited guarantees for non-interest bearing transaction accounts (explicit government safety nets). Therefore, depositors may have more incentive to exploit these safety nets by increasing risky investments because depositors are more likely to be protected than other types of uninsured creditors. This result is consistent with Nier and Baumann (2006)'s argument

that the extent of government guarantees affects the effectiveness of market discipline. Furthermore, I also find no evidence of market discipline during the post-crisis period, confirming my earlier findings.

1.5.3 Results for Subsamples based on Bank Size

Table 1.5 reports regression estimates testing whether the effect of bank risk on the price and quantity of wholesale funding varies by bank size. Investors may have different incentives to monitor a bank depending on its size because large banks are more likely to be bailed out when the economy tightens. Therefore, uninsured investors have less incentive to monitor a large bank compared to a small bank. Furthermore, these incentives may be different depending on macroeconomic conditions. During times of tight liquidity, uninsured investors may have less incentive to monitor large banks than small banks either because of governments' too-big-to-fail policy and/or weaker banks become riskier during a crisis. Small banks are generally weaker than large banks. Investors should monitor riskier banks to protect their investments. Even during stable economic periods, large banks are also more viable and profitable than small banks. Therefore, uninsured investors may have little incentive to monitor large banks, regardless of macroeconomic market conditions. Panels A and B present estimates for large and small banks, respectively. Large banks are defined as banks with greater than $1 billion in total assets, and small banks with less than $1 billion in total assets.

Panel A1 of Table 1.5 shows that Fed funds or repo market investors discipline banks by demanding higher interest rates. The coefficient *NPL* on *Spreads on Fed funds* is positive (0.0325) and significant at the 5 % level, while that of *NPL* on *Changes in Fed funds* is statistically insignificant. The coefficients for both price and quantity of *NPL*CrisisI* and *NPL*CrisisII* are insignificant, implying that market discipline was lacking during the 2008 crisis. Also, consistent with my earlier findings, this evidence for the absence of market discipline continues during the post-crisis period, suggesting the ineffectiveness of the Dodd-Frank Act.

Panel A2 shows that large time depositors do not punish large riskier banks since both price and quantity do not reflect the change in bank risk because the coefficients of both *Spreads on large time deposits* and *Changes in large time deposits* are insignificant. Large time depositors may have a stronger expectation of government protection through implicit or explicit government safety nets when their borrowers fail. Historically, governments have tried to protect deposits to prevent bank runs (Bernanke 1983; Diamond and Dybvig 1983). Therefore, uninsured time depositors may have less incentive to monitor banks than other types of uninsured liability holders. Alternatively, they may not have enough information because monitoring is costly. In general, time depositors are small, individual investors, while short-term money market participants are institutional investors. Repo lenders are largely money market mutual funds and security lending firms, while repo borrowers are broker-dealers and banks (Krishnamurthy, Nagel, and Orlov 2014). However, my results show that this lack of discipline from large time depositors is due to the greater possibility for government

support, and not the lack of information since large time depositors discipline small banks during stable economic periods (see Panel B of Table 1.5). If information matters, uninsured time depositors would do better to monitor large banks that have more public information. This implies that uninsured time depositors have less incentive to discipline large banks than small banks because of the low risk of failure.

Panel B of Table 1.5 for small banks shows very similar results to the main findings in Tables 1.3 and 1.4. That is, all wholesale financiers, including short- and long-term wholesale financiers, played a disciplinary role for small banks by discouraging greater risks in the pre-crisis period. However, they did not penalize small banks during the crisis and post-crisis periods. Uninsured time depositors increased their deposits in small risky banks that provided higher interest rates during the *CrisisII* period. Combining the results of Panels A and B, high expectations of bank bailouts during the crisis affects both large and small banks. Furthermore, this expectation continued during the post-crisis period, inconsistent with Martinez Peria and Schmukler (2001), who report that the incentive to monitor banks increases after a banking crisis because a crisis increases depositors' awareness of the risk from a possible depletion of deposit insurance funds. My contrasting findings seem to be related to the the credibility of explicit and implicit government guarantees. Martinez Peria and Schmukler (2001) investigate the cases of Argentinian, Chilean, and Mexican banking crises, while the current study examines the US. Wholesale financiers who invest in US commercial banks seem not to worry about the depletion of deposit insurance funds and rely on strong guarantees for the US banking system.

1.6 Robustness Tests

This section presents the results of a number of robustness tests to check the validity of the results. First, I re-estimate the models, controlling for the impact of government intervention and bank borrower demands by using two additional proxies for market risks: MSA-level macro liquidity risk (*Recssion_MSA*) and credit risk in the general economy (*TED spread*). Second, I consider two additional proxies for bank risks: *RWA* and *Z-score*. Finally, I exclude funding from the Federal Home Loan Bank (FHLB) and funding from the TARP funds received in the form of SNDs.

1.6.1 Macroeconomic Risk: MSA Level Market Risk and the TED Spread

As many banks operate in certain MSAs, local market conditions can affect banks' profits and credit risks, since local market conditions affect borrowers more than national economic conditions. As a proxy for a market recession, I use a quarterly dummy variable for two consecutive quarters of decline in real GDP at the MSA level (*Recession_MSA*). For a multi-market bank, the value of *Recession_MSA* is one if a bank experiences a recession in at least 25 percent or more of the MSAs in which it operates. I control for both local market recessions and the national crisis of 2008 because local market recessions do not necessarily coincide with national recessions. Each MSA has its own economic situations and development. The local economy is

broadly related to the national economy, though it is possible that the relationship between the two is low. In fact, the correlation between MSA-level recessions and the crisis is low: the correlation between *Recession_MSA* and *CrisisI* is 0.1419, and the correlation between *Recession_MSA* and *CrisisII* is 0.2969.

Table 1.6 presents the robustness tests for the effect of bank risk on the price and quantity of wholesale funding, using recession periods at the MSA level as an alternative proxy for market-wide liquidity risk. My results are robust even in the case of local recessions. In Panel A, the coefficients of *NPL* on *Spreads on Fed funds* (price) and *Changes in Fed funds* (quantity) are 0.0255 and -0.0226, respectively, which are statistically significant at the 1% level. This result shows that interbank and repo lenders discipline banks during stable economic conditions after controlling for local market recessions and the national crisis. The coefficients of both the price and quantity of *NPL*Recession_MSA* are insignificant, implying that the price and quantity of short-term wholesale funding did not reflect the change in bank risk during local market recession periods. This result confirms that the findings for the national economy also hold local market cases. Therefore, during both local market recessions and national recessions, short-term wholesale financiers do not discipline risky banks, while they provide discipline during stable economic periods.

Panel B also provides results consistent with my earlier findings. Large time depositors are sensitive to bank risk during stable economic periods. They discipline banks by withdrawing funds, though they do not require higher interest rates. However, the coefficients of *NPL*Recession_MSA* on *Spreads on large time deposits* and

Changes in large time deposits are positive and significant at the 1% level. As with the results in Tables 1.3 and 1.4, this result suggests that large time depositors seem to invest in risky banks providing higher interest rates during local market recessions.

Panel C also confirms my earlier results in terms of local market recessions. Wholesale financiers discipline banks by reducing investments in riskier banks during stable economic periods after controlling for local market recessions and the 2008 financial crisis. The coefficient of *Changes in wholesale funds* is negative and significant, while that of *Spread on wholesale funds* is positive but insignificant. However, during local market recessions, wholesale financiers do not discipline banks. The coefficients of *NPL*Recession_MSA* for both the price and quantity equations are insignificant, suggesting that wholesale financiers neither demand higher interest rates nor adjust their investments in response to the increased bank risk during local market recessions at the MSA level.

In addition, in Table 1.7, I re-estimate my models using the TED spread as a proxy for market-wide liquidity shocks. Cornett, McNutt, Strahan, and Tehranian (2011) report that the TED spread, which indicates the counterparty risk between banks, closely mirrored the severity of the 2008 crisis. My data also show that the correlation between *TED spread* and *CrisisI* is 0.5369, and the correlation between *TED spread* and *CrisisII* is 0.6115. Therefore, I do not include crisis dummies to avoid the multicollinearity problem in the estimations in Table 1.7. These results are also consistent with my earlier findings. During periods of high credit risks between banks (high *TED spread*), neither short-term wholesale financiers nor long-term wholesale

financiers punished banks for increased risks. All coefficients of *NPL*TED spread* in Panels A and B are insignificant. Both coefficients of *NPL*TED spread* for the price and quantity equations in Panel C are negative and significant.

1.6.2 Bank-Specific Risk: Risk Weighted Assets (RWA) and the Z-score

Table 1.8 shows the results of the robustness tests for the effect of bank risk on the price and quantity of wholesale funding using risk weighted assets as an alternative proxy for bank risk. RWA is an ex-ante risk measure, while NPL is an ex-post risk measure. Wholesale financiers' decisions based on a forward-looking risk measure may differ from those based on the (ex-post) outcome of bank risk. However, my results for the crisis and post-crisis periods are robust after employing the ex-ante risk measure. During the crisis and post-crisis periods, all wholesale financiers, including interbank lenders, repo lenders, and large time depositors, did not discipline banks. Only *RWA*CrisisI* in Panel B shows the presence of market discipline during the pre-Lehman crisis period. This may be attributed to a low expectation of government intervention during the pre-Lehman crisis period (*CrisisI*), though the US government provided extensive government support immediately after the Lehman Brothers failure (*CrisisII*). From the ex-ante bank risk perspective, long-term wholesale financiers may have worried about bank failures during the pre-Lehman crisis period. Their concerns about bank safety definitely changed after substantial government rescue programs were implemented during the post-Lehman crisis period. Furthermore, both short-term

and long-term wholesale financiers had little incentive for monitoring and discipline after the crisis, implying that strong government protection during the crisis may make wholesale financiers insensitive to banks' risk despite the enactment of the Dodd-Frank Act.

Table 1.9 presents robustness tests for the effect of bank risk on the price and quantity of wholesale funding using the Z-score as an alternative proxy for bank risk. A higher Z-score value indicates a lower risk of failure. Note that the Z-score is negatively associated with bank risk. Therefore, I expect the opposite signs on the estimated coefficients. The results are similar to my earlier results, in that there was a lack of market discipline during the crisis and post-crisis periods for all types of wholesale financiers.

1.6.3 Excluding Funding from Government Agencies

My finding of the lack of market discipline contradicts the previous literature supporting the disciplinary role of wholesale financiers. Market discipline is effective when investors are concerned about losses in the event of a bank failure. Government interventions to prevent bank runs, however, eliminate the possibility of a decrease in investors' wealth. In this case, wholesale financiers have little incentive to discipline banks. In this section, I examine whether the absence of market discipline can be attributed partly to government support provided through funding from government agencies during the 2008 crisis.

Some banks received TARP funds in the form of subordinated debentures, which represents part of the wholesale funding measure in this study. Therefore I exclude the support in the form of SNDs in the amount of total wholesale funds (*wholesale funds*) to account for the effect of government intervention. Additionally, borrowings from the Federal Home Loan Bank (FHLB), which lends funds to their member banks on favorable terms, must be considered.

Table 1.10 shows robustness tests for the effect of bank risk on wholesale funding considering government intervention in the form of TARP funds and FHLB loans. The dependent variable, *Changes in wholesale funds*, is the quarterly growth of wholesale funds. *Wholesale funds* are measured by excluding the amount of SNDs among the types of TARP funds and the amount of FHLB loans. The regression results for *Spreads on wholesale funds* is shown in column (5) in Table 1.4 because interest rates on wholesale funds excluding the TARP funds or FHLB loans are not reported in income statements. Since the proportions of funding from FHLB and TARP funds (SNDs) are very small, the results for price would not change, though their impact on the price variable is considered. My findings remain robust after accounting for these government funding sources. Consistent with my earlier findings, there is evidence for the presence of market discipline by wholesale financiers during stable economic periods. However, market discipline disappeared during the crisis and post-crisis period.

1.7 Conclusion

Many previous studies argue for the benefit of using wholesale funds as an alternative source of funding. While deposits are very stable, wholesale funding seeks profitable investments and encourages banks to prudently invest in projects. Numerous studies show that market discipline exists by examining different countries during various time periods. The financial crisis of 2008, however, raises questions about whether these sophisticated investors really discipline banks by conducting costly monitoring.

In my analyses, I find no evidence that wholesale financiers demanded higher prices from risky banks and withdrew funds during the crisis; wholesale financiers invested even more money into risky banks while they withdrew funds from safe banks. In addition, in the post-crisis period, I find no evidence of market discipline. This finding for the post-crisis period suggests that neither the Dodd-Frank Act improved market discipline (Balasubramnian and Cyree 2014), nor that the crisis contributed to increased awareness for the risk of bearing losses related to concerns about the depletion of deposit insurance funds (Martinez Peria and Schmukler 2001). Considering the fact that wholesale financiers did not withdraw their funds from risky banks during the financial crisis, it seems that wholesale financiers do not worry about the depletion of the US deposit insurance funds. Right after the Lehman Brothers bankruptcy, the US government worked to reassure nervous investors through extensive government interventions such as the increase in deposit insurance coverage, bank bailouts, quantitative easing (QE), and providing TARP funds. These emergency

actions to stabilize the economy during the severe financial crisis may encourage an expectation among sophisticated investors of implicit/explicit government safety nets, thereby removing their incentives to discipline banks.

References

Acharya, V. V., Gale, D., & Yorulmazer, T. (2011). Rollover risk and market freezes. *The Journal of Finance, 66*(4), 1177-1209.

Acharya, V. V., & Mora, N. (2014). A crisis of banks as liquidity providers. *The Journal of Finance*.

Afonso, G., Kovner, A., & Schoar, A. (2011). Stressed, Not Frozen: The Federal Funds Market in the Financial Crisis. *The Journal of Finance, 66*(4), 1109-1139.

Avery, R. B., Belton, T. M., & Goldberg, M. A. (1988). Market discipline in regulating bank risk: New evidence from the capital markets. *Journal of Money, Credit and Banking*, 597-610.

Avery, R. B., & Berger, A. N. (1991). Risk-based capital and deposit insurance reform. *Journal of Banking & Finance, 15*(4), 847-874.

Baer, H., & Brewer, E. (1986). Uninsured deposits as a source of market discipline: Some new evidence. *Economic Perspectives*(Sep), 23-31.

Balasubramnian, B., & Cyree, K. B. (2014). Has market discipline on banks improved after the Dodd-Frank Act? *Journal of Banking & Finance*.

Berger, A. N., & Udell, G. F. (1994). Did risk-based capital allocate bank credit and cause a credit crunch in the United States? *Journal of Money, Credit and Banking*, 585-628.

Bernanke, B. S. (1983). Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression. *The American Economic Review, 73*(3), 257-276.

Black, L. K., & Hazelwood, L. N. (2013). The effect of TARP on bank risk-taking. *Journal of Financial Stability, 9*(4), 790-803.

Brunnermeier, M. K. (2009). Deciphering the Liquidity and Credit Crunch 2007-2008. *Journal of Economic Perspectives, 23*(1), 77-100.

Calomiris, C. W. (1999). Building an incentive-compatible safety net. *Journal of Banking & Finance, 23*(10), 1499-1519.

Calomiris, C. W., & Kahn, C. M. (1991). The role of demandable debt in structuring optimal banking arrangements. *The American Economic Review*, 497-513.

Cornett, M. M., McNutt, J. J., Strahan, P. E., & Tehranian, H. (2011). Liquidity risk management and credit supply in the financial crisis. *Journal of Financial Economics, 101*(2), 297-312.

Craig, B. R., & Dinger, V. (2013). Deposit market competition, wholesale funding, and bank risk. *Journal of Banking & Finance, 37*(9), 3605-3622.

Diamond, D. W., & Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *The journal of political economy*, 401-419.

Diamond, D. W., & Rajan, R. G. (2001). Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking. *Journal of Political Economy, 109*(2), 287.

Flannery, M. J. (1998). Using market information in prudential bank supervision: A review of the US empirical evidence. *Journal of Money, Credit and Banking*, 273-305.

Flannery, M. J. (2001). The faces of “market discipline”. *Journal of Financial Services*

Research, 20(2-3), 107-119.

Flannery, M. J., & Sorescu, S. M. (1996). Evidence of bank market discipline in subordinated debenture yields: 1983–1991. *The Journal of Finance, 51*(4), 1347-1377.

Freixas, X., & Jorge, J. (2008). The Role of Interbank Markets in Monetary Policy: A Model with Rationing. *Journal of Money, Credit and Banking, 40*(6), 1151-1176. doi: 10.1111/j.1538-4616.2008.00152.x

Furfine, C. H. (2001). Banks as Monitors of Other Banks: Evidence from the Overnight Federal Funds Market. *The Journal of Business, 74*(1), 33-57.

Goldberg, L. G., & Hudgins, S. C. (1996). Response of uninsured depositors to impending S&L failures: Evidence of depositor discipline. *The Quarterly Review of Economics and Finance, 36*(3), 311-325.

Goldberg, L. G., & Hudgins, S. C. (2002). Depositor discipline and changing strategies for regulating thrift institutions. *Journal of Financial Economics, 63*(2), 263-274.

Gorton, G., & Metrick, A. (2012). Securitized banking and the run on repo. *Journal of Financial Economics, 104*(3), 425-451.

Gorton, G., & Santomero, A. M. (1990). Market discipline and bank subordinated debt: Note. *Journal of Money, Credit and Banking*, 119-128.

Hahm, J. h., Shin, H. S., & Shin, K. (2013). Noncore bank liabilities and financial vulnerability. *Journal of Money, Credit and Banking, 45*(s1), 3-36.

Hannan, T. H., & Hanweck, G. A. (1988). Bank Insolvency Risk and the Market for

Large Certificates of Deposit. *Journal of Money, Credit and Banking*, *20*(2), 203-211.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica: Journal of the econometric society*, 153-161.

Ho, T. S., & Saunders, A. (1985). A micro model of the federal funds market. *The Journal of Finance, 40*(3), 977-988.

Huang, R., & Ratnovski, L. (2011). The dark side of bank wholesale funding. *Journal of Financial Intermediation, 20*(2), 248-263.

Ivashina, V., & Scharfstein, D. (2010). Bank lending during the financial crisis of 2008. *Journal of Financial economics, 97*(3), 319-338.

Jokipii, T., & Milne, A. (2008). The cyclical behaviour of European bank capital buffers. *Journal of banking & finance, 32*(8), 1440-1451.

Keeley, M. C. (1990). Deposit insurance, risk, and market power in banking. *The American Economic Review*, 1183-1200.

King, T. B. (2008). Discipline and liquidity in the interbank market. *Journal of Money, Credit and Banking, 40*(2-3), 295-317.

Krishnamurthy, A., Nagel, S., & Orlov, D. (2014). Sizing up repo. *The Journal of Finance*.

Li, L. (2013). TARP funds distribution and bank loan supply. *Journal of Banking & Finance, 37*(12), 4777-4792.

Maechler, A. M., & McDill, K. M. (2006). Dynamic depositor discipline in US banks. *Journal of Banking & Finance, 30*(7), 1871-1898.

Martinez Peria, M. S., & Schmukler, S. L. (2001). Do depositors punish banks for bad behavior? Market discipline, deposit insurance, and banking crises. *The Journal of Finance, 56*(3), 1029-1051.

Nier, E., & Baumann, U. (2006). Market discipline, disclosure and moral hazard in banking. *Journal of Financial Intermediation, 15*(3), 332-361.

Park, K., & Pennacchi, G. (2009). Harming depositors and helping borrowers: The disparate impact of bank consolidation. *Review of Financial Studies, 22*(1), 1-40.

Park, S., & Peristiani, S. (1998). Market discipline by thrift depositors. *Journal of Money, Credit and Banking*, 347-364.

Shin, H. S. (2009). Reflections on Northern Rock: the bank run that heralded the global financial crisis. *The Journal of Economic Perspectives*, 101-120.

Figure 1.1 Trends in the Total Amount of Wholesale Funds

These figures present trends in the total amount of wholesale funds by bank size and multi-market operation over the period between 2002:Q1 and 2012:Q4. Aggregate wholesale funds ($100,000) indicate the amount of wholesale funds without applying the increase in FDIC deposit insurance coverage from $100,000 to $250,000. Aggregate wholesale funds ($250,000) are the amount of wholesale funding reflecting the increase in the deposit insurance coverage. Aggregate wholesale funds based on deposit insurance coverage of $100,000 are applied to Figures 1.1.2 and 1.1.3 to avoid a drop in wholesale funds resulting from the impact of the regulatory change. Large banks are defined as banks with greater than $1 billion in total assets, and small banks with less. Multi-market banks are defined as banks that operate in multiple Metropolitan Statistical Areas (MSAs), and single-market banks otherwise. The data are obtained from Call Reports.

Figure 1.1.1 Total amount of wholesale funds

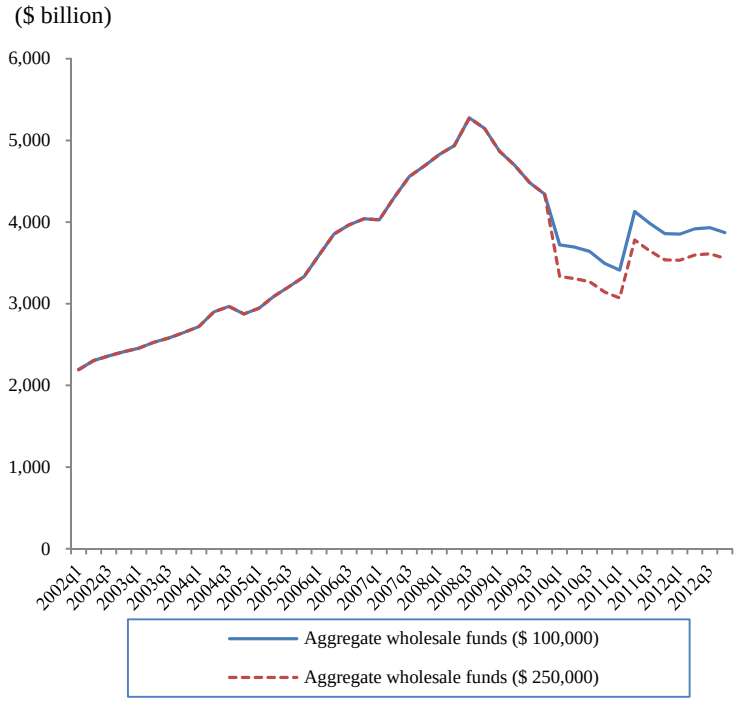


Figure 1.1.2 Total amount of wholesale funds by bank size

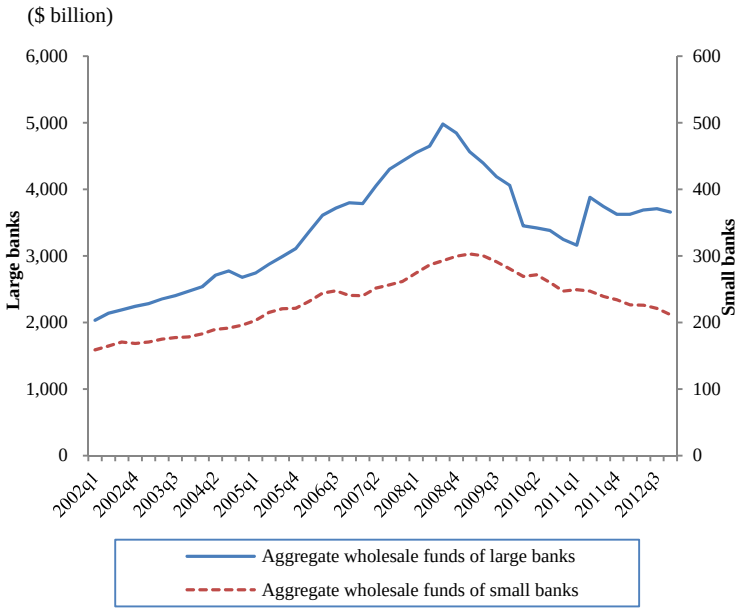


Figure 1.1.3 Total amount of wholesale funds by multimarket operation

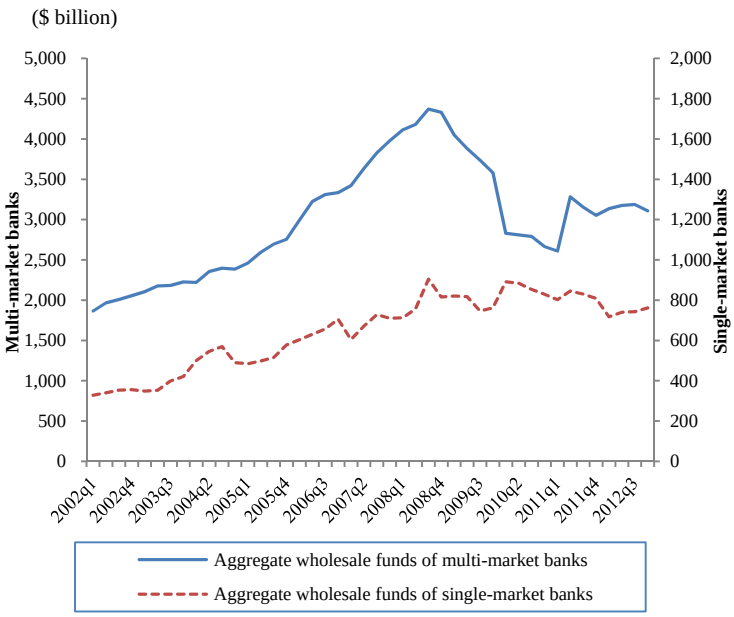


Figure 1.2 Bank Risk and the Quantity of Wholesale Funding

Figure1.2.1 shows time-trends in the aggregate quantity of wholesale funding by bank risk depending on the level of NPL: high, medium, and low risk. Figure 1.2.2 shows aggregate wholesale funding by bank risk in large banks with total assets of $1 billion and Figure 1.2.3 shows the trend by bank risk in small banks. Figures 1.2.4 and 1.2.5 show the difference in the portion of wholesale funding over total assets between high-risk banks and low-risk banks in the group of large banks and in the group of small banks, respectively. In all figures, wholesale funds include time deposits above $100,000. The data are obtained from Call Reports.

1) Quantity of wholesale funds: Aggregate level

Figure 1.2.1 Total amount of wholesale funds by bank risk

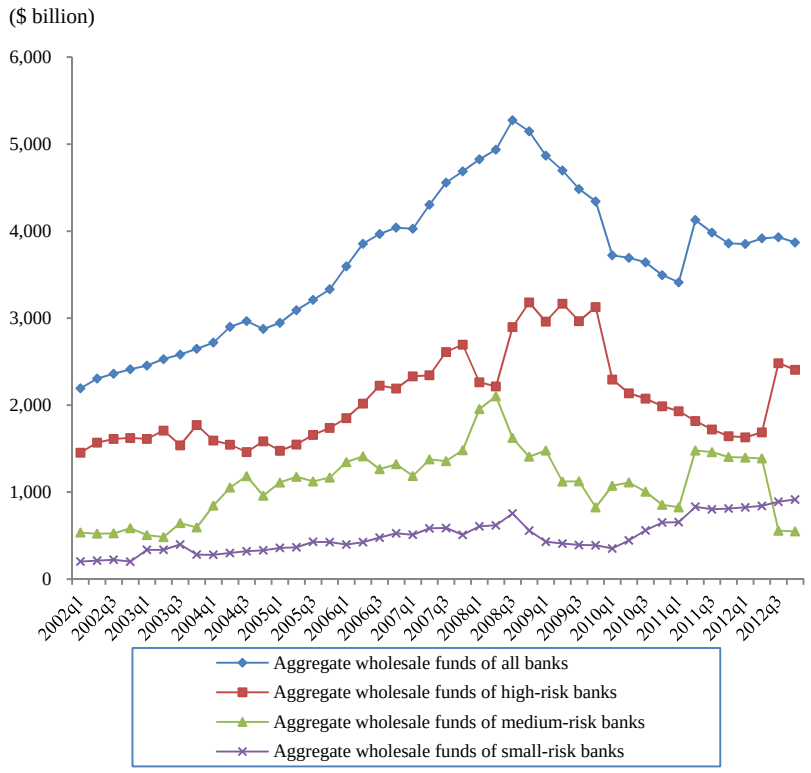


Figure 1.2.2 Aggregate wholesale funding by the risk level among large banks

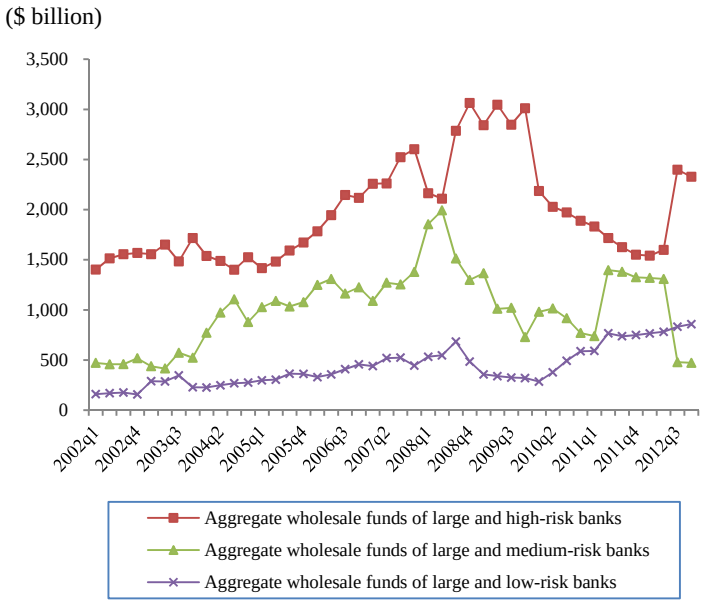
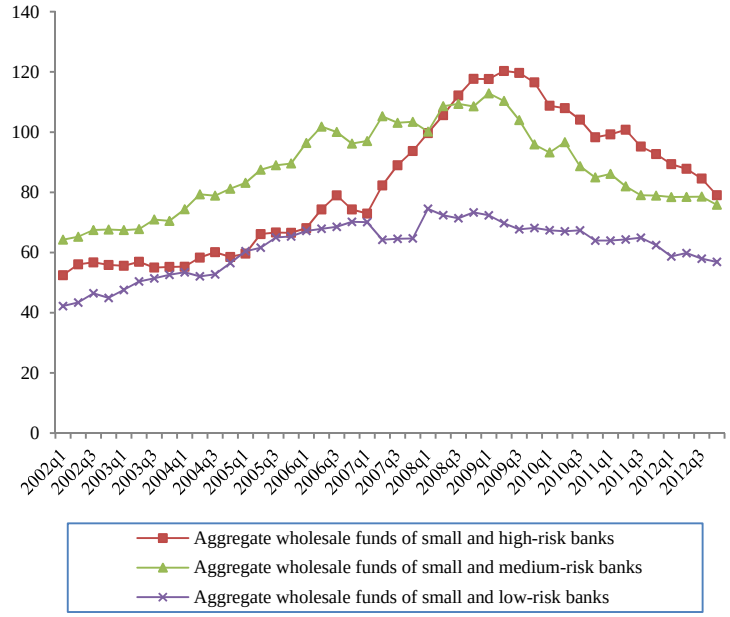


Figure 1.2.3 Aggregate wholesale funding by the risk level amongsmall banks



2) Quantity of wholesale funds: Bank level (Ratio of wholesale funds to total assets: *WF/TA*)

Figure 1.2.4 Difference in the average *WF/TA* between high-risk banks and low-risk banks among large banks

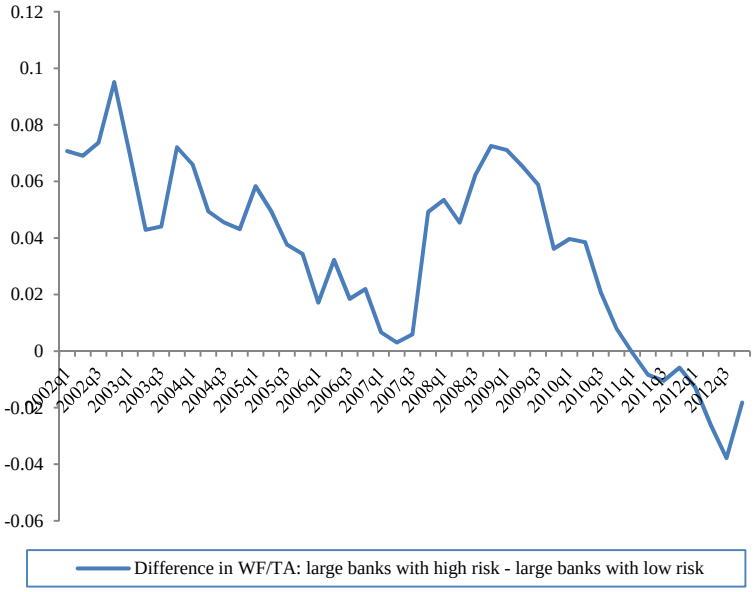


Figure 1.2.5 Difference in the average *WF/TA* between high-risk banks and low-risk banks among small banks

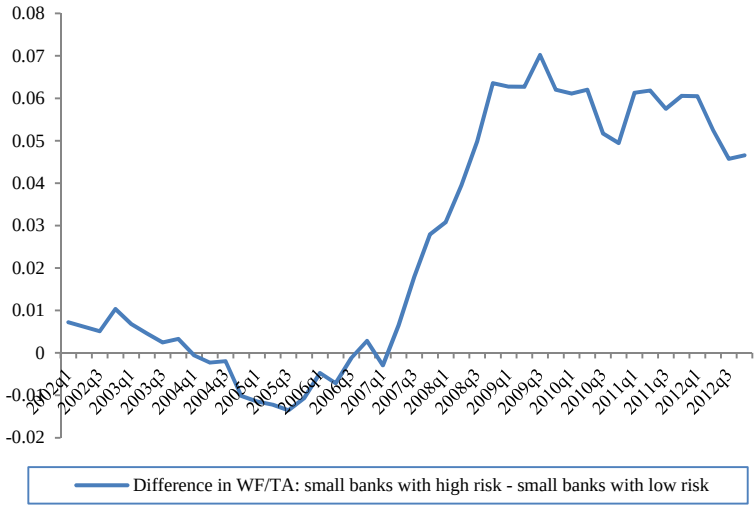


Figure 1.3 Bank Risk and the Cost of Wholesale Funding

These figures show the net level of the average cost of wholesale funds (*WF_RATE*), calculated as the wholesale funding expense divided by the amount of wholesale funding, between high-risk and low-risk banks among large (Figure 1.3.1) and small banks (Figure 1.3.2). The data are obtained from Call Reports.

Figure 1.3.1 Difference in the average *WF_RATE* between high-risk banks and low-risk banks among large banks

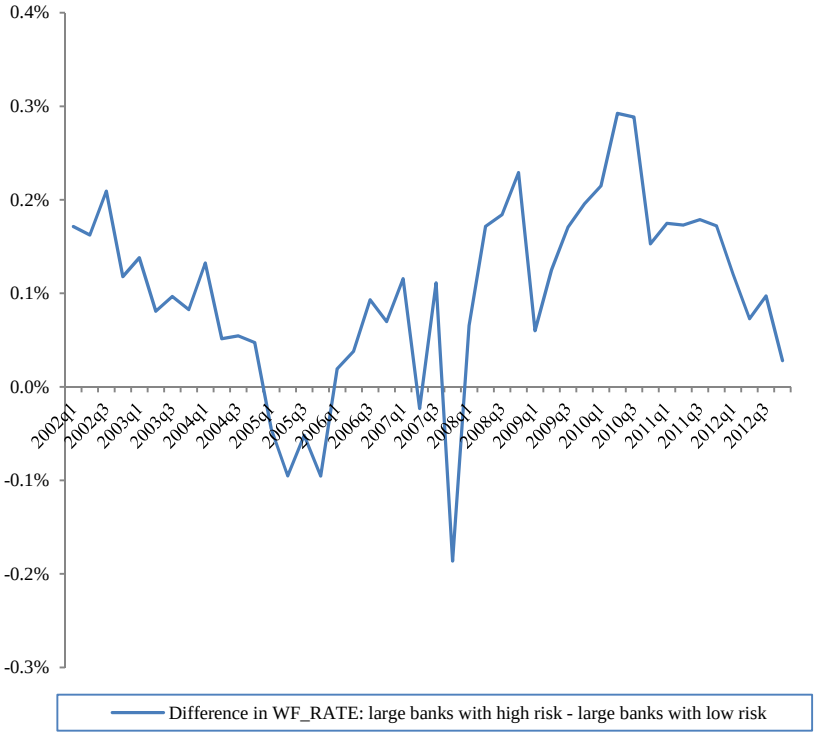


Figure 1.3.2 Difference in the average *WF_RATE* between high-risk banks and low-risk banks among small banks

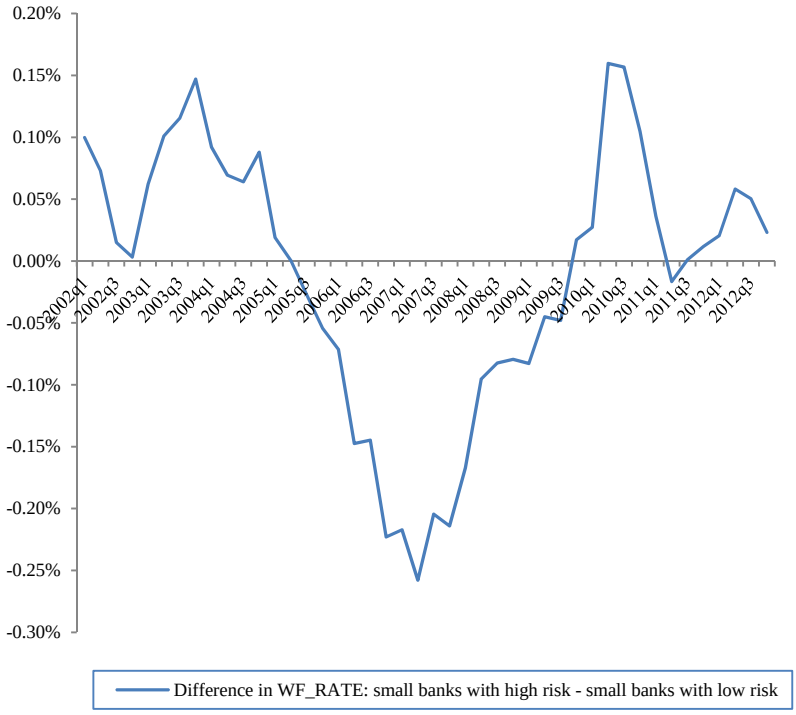


Table 1.1 Variable Definitions and Data Sources
This table presents the definitions of variables and data sources.

Variable	Definition	Source
Dependent variables		
Price variables		
Spreads on fed funds	Spreads between the implicit interest rates on *fed funds* and the effective federal funds rate, expressed in annual terms. *fed funds* is defined as the sum of federal funds purchased andsecurities sold under agreements to repurchase. The imputed rates are calculated as the quarterly average expenses of *fed funds* divided by the quarterly average amounts of *fed funds.*	Call Reports. Author's calculations
Spreads on large time deposits	Spreads between the implicit interest rates on large time deposits and the one-year treasury constant maturity rate, expressed in annual terms. Large time deposits are uninsured deposits over $100,000 until 2009:Q4 and $250,000 from 2010:Q1). The implicit rates are calculated as the quarterly average expenses of large time deposits divided by the quarterly average amounts of large time deposits.	Call Reports. Author's calculations

Spreads on wholesale funds	Spreads between the implicit interest rates on total wholesale funds and the one-year treasury constant maturity rate, expressed in annual terms. The imputed rates are calculated as the quarterly average expenses of total wholesale funds divided by the quarterly average amounts of total wholesale funds. Total wholesale funds are defined as the sum of 1) federal funds purchased, 2) securities sold under agreements to repurchase 3) subordinated notes and debentures, 4) brokered deposits, 5) other borrowed money, 6) the estimated amount of deposits obtained through the use of deposit listing services that are not brokered deposits 7) deposits in foreign offices, and 8) uninsured large time deposits.	Call Reports. Author's calculations
Quantity variables		
Changes in fed funds	Quarterly change in the amounts of *fed funds* during the quarter as a fraction of beginning of quarter total assets: $(fed\ funds_t – fed\ funds_{t-1})/total\ assets_{t-1}$.The amount of *fed funds* is quarterly averages.	Call Reports. Author's calculations
Changes in large time deposits	Quarterly change in the amounts of large time deposits during the quarter divided by beginning of quarter total assets: $(large\ time\ deposits_t – large\ time\ deposits_{t-1})/total\ assets_{t-1}$	Call Reports. Author's calculations
Changes in wholesale funds	Quarterly change in the amounts of total wholesale funds during the quarter as a fraction of beginning of quarter total assets: $(wholesale\ funds_t – wholesale\ funds_{t-1})/total\ assets_{t-1}$	Call Reports. Author's calculations

Explanatory variables

NPL	Non-performing loans divided by total loans; non-performing loans are defined as the sum of loans past due 90days or more and nonaccrual loans. A higher ratio indicates a riskier loan portfolio.	Call Reports. Author's calculations
RWA	Risk-weighted assets as a fraction of total assets. A higher value indicates a riskier loan portfolio.	Call Reports. Author's calculations
Z-score	A bank's distance to default, calculated as the sum of the return on assets and the equity ratio divided by the standard deviation of the return on assets. A higher value indicates lower risk of default.	Call Reports. Author's calculations
Log total assets	Natural log of total assets (in million dollars)	Call Reports
Return on assets	Return on assets	Call Reports
Capital ratios	Bank equity capital divided by total assets	Call Reports
Bank holding company	Dummy that equals 1 if the bank belongs to a bank holding company	FDIC
TARP amounts	The amounts of received TARP funds as a fraction of total assets	Treasury Department
ΔCredits	Quarterly change in the amount of credits. Credits are defined as the sum of loans and loan commitments divided by equity and core deposits	Call Reports Author's calculations
Weighted HHI	Bank-level Herfindahl–Hirschman Index, weighted by the proportion of the bank's deposits in each MSA where the bank operates.	FDIC SOD Author's calculations

Weighted income growth	Bank-level income growth rate, weighted by the proportion of the bank's deposits in each MSA where the bank operates.	BEA Author's calculations
Recession_MSA	Quarterly dummy variable for the recession periods at the MSA level; the value is 1 when a bank operates in the MSA which experiences the decline in real GDP for two consecutive quarters. In the case of a multimarket bank, the value is 1 when the bank experiences the decline in at least 25% or more of the MSAs where the bank operates.	BEA Author's calculations
CrisisI	Dummy for the pre-Lehman crisis periods: 2007Q3- 2008Q2	NBER Author
CrisisII	Dummy for the post-Lehman crisis periods: 2008Q3- 2009Q2	NBER Author
Postcrisis	Dummy for the post-crisis periods: 2009Q3-2012Q4	NBER Author
TED spread	TED spread, calculated as the spread between the three-month LIBOR and the three-month Treasury bill rate	FRED
M2/GDP	Money supply, measured as M2 divided by GDP	FRB

Table 1.2 Summary Statistics

This table provides discriptive statistics forthe variables used in the estimations. *Spreads on fed funds* indicates the difference between the implicit interest rate on *fed funds* and the effective federal funds rate. *fed funds* is defined as the sum of federal funds purchased (fed funds) andsecurities sold under agreements to repurchase (repos). *Spreads on large time deposits* (*wholesale funds*) are defined as the difference between the implicit interest rates on *large time deposits* (*wholesale funds*) and the one-year treasury constant maturity rate. The implicit interest rate is calculated as the quarterly average interest expenses on wholesale funds divided by the quarterly average amounts of the components of wholesale funds, based on Call Report data. Quantity variables are changes in fed funds and repos, large time deposits, and total wholesale funds, scaled by the start of quarter total assets, respectively. *Changes in fed funds* are calculated based on quarterly average amounts. Table 1.1 provides detailed information about the variables. Variables except for *M2/GDP* and *TED spread* are winsorized at the 1st and 99th percentiles.

Variables	Observations	Mean	Std. Dev.	Min	Max
Dependent variables					
Price variables					
Spreads on fed funds	75,848	0.0030	0.0175	-0.0284	0.1657
Spreads on large time deposits	180,843	0.0105	0.0120	-0.0177	0.0399
Spreads on wholesale funds	183,618	0.0029	0.0138	-0.0333	0.0304
Quantity variables					
Changes in fed funds	75,848	0.0016	0.0137	-0.0456	0.0528
Changes in large time deposits	180,843	0.0018	0.0271	-0.1302	0.0945
Changes in wholesale funds	183,618	0.0046	0.0435	-0.1556	0.1732
Explanatory variables					
Bank risk variables					
NPL	183,618	0.0171	0.0236	0	0.1237
RWA	183,618	0.7113	0.1291	0.3449	0.9894
Z-score	117,001	32.0728	16.7470	5.5678	97.9014
Other control variables					
Log total assets	183,618	5.3210	1.3106	2.6983	10.0472
Return on assets	183,618	0.0044	0.0077	-0.0309	0.0234
Capital ratios	183,618	0.1048	0.0367	0.0540	0.3127
Bank holding company	183,618	0.8308	0.3749	0	1
TARP amounts	183,618	0.0016	0.0078	0	0.0625
ΔCredits	176,950	-0.0086	0.1080	-0.5493	0.3813
Weighted HHI	183,618	0.6973	0.0647	0.2848	0.8399
Weighted income growth	183,618	0.0408	0.0323	-0.0583	0.1184
M2/GDP	183,618	0.5366	0.0409	0.4934	0.6212
TED spread	183,618	0.4898	0.4631	0.1470	2.4472

Table 1.3 Effect of Bank Risk on the Price and Quantity of Wholesale Funds

This table shows the effect of bank risk on the price and quantity of wholesale funding, using the Heckman's (1979) two-stage estimation [Models (1) and (2)] and the fixed effects model [Models (3)-(6)] for a panel dataset for US commercial banks from 2002:Q1 to 2012:Q4. Panels A, B, and C present regression estimates for fed funds and repos (*fed funds*), large time deposits (*large time deposits*), and total wholesale funds (*wholesale funds*), respectively. *Crisis I*, *Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Detailed information on the variables is provided in Table 1.1. The probit regression estimates the probability that a bank attracts fed funds or repos. *Lambda* indicates the inverse Mills ratio in the Heckman procedure. R^2 of the probit regression represents Pseudo-R^2. Robust standard errors of Models (3)-(6) are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Federal funds and repos			Panel B: Large time deposits		Panel C: Total wholesale funds	
	Probit (Participation)	*Spreads on fed funds*	*Changes in fed funds*	*Spreads on large time deposits*	*Changes in large time deposits*	*Spreads on wholesale funds*	*Changes in Wholesale funds*
	First stage	(1) Second stage	(2) Second stage	(3) FE	(4) FE	(5) FE	(6) FE
NPL	-4.9398***	0.0212**	-0.0234***	-0.0024	-0.1325***	-0.0013	-0.2225***
	(-28.98)	(2.48)	(-3.32)	(-0.57)	(-11.99)	(-0.25)	(-12.52)
CrisisI		0.0082***	0.0013	0.0154***	-0.0029***	0.0146***	0.0062***
		(5.82)	(1.12)	(101.41)	(-4.83)	(88.43)	(5.70)
*NPL*CrisisI*		0.0141	-0.0118	-0.0131**	-0.0279*	-0.0175**	-0.1081***
		(0.95)	(-0.96)	(-2.42)	(-1.69)	(-2.32)	(-3.99)
CrisisII		0.0140***	0.0008	0.0303***	0.0062***	0.0299***	0.0140***
		(2.61)	(0.17)	(130.55)	(6.40)	(124.79)	(6.56)
*NPL*CrisisII*		-0.0143	-0.0026	0.0156***	0.0504***	0.0075	0.0206
		(-1.17)	(-0.26)	(3.17)	(3.40)	(1.22)	(0.91)
Postcrisis		0.0079	0.0018	0.0253***	0.0010	0.0349***	-0.0037
		(1.03)	(0.28)	(38.86)	(0.34)	(56.71)	(-0.51)
*NPL*Postcrisis*		-0.0123	-0.0016	-0.0059	0.0740***	0.0086	0.0572***
		(-1.30)	(-0.20)	(-1.30)	(6.62)	(1.45)	(3.10)
Log total assets	0.5183***	0.0011***	0.0005***	0.0008***	-0.0097***	-0.0010***	-0.0163***
	(168.74)	(7.33)	(4.53)	(5.54)	(-19.45)	(-5.12)	(-17.73)
Return on assets	-5.2216***	-0.0506***	-0.0180*	-0.0264***	0.0514***	-0.0198***	0.0528**
	(-10.05)	(-4.45)	(-1.96)	(-6.52)	(3.60)	(-3.52)	(1.97)
Capital ratios	-2.0143***	-0.0080***	0.0054***	0.0012	0.0971***	0.0095***	0.2025***
	(-20.42)	(-3.52)	(2.94)	(0.76)	(21.05)	(4.48)	(23.82)
Weighted HHI		-0.0060***	-0.0000	0.0019	-0.0025	-0.0062***	-0.0014
		(-6.24)	(-0.02)	(1.10)	(-0.65)	(-2.69)	(-0.22)
Weighted income growth		0.0002	0.0119***	0.0037***	0.0023	0.0145***	-0.0103*
		(0.06)	(4.58)	(3.18)	(0.69)	(9.56)	(-1.84)
M2/GDP		0.0063	-0.0300	-0.1069***	-0.0435*	-0.0941***	0.0224
		(0.10)	(-0.54)	(-20.54)	(-1.79)	(-20.51)	(0.36)
Bank holding company	0.3061***						
	(32.57)						
Lambda		0.0080***	0.0034***				
		(15.08)	(7.96)				
Constant		-0.0146	0.0102	0.0450***	0.0726***	0.0406***	0.0648**
		(-0.44)	(0.37)	(15.39)	(5.72)	(14.10)	(2.06)
Bank fixed effects	No	No	No	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	No	No	No	Yes	Yes	Yes	Yes
R-squared	0.1853			0.7600	0.3562	0.7607	0.2220
Wald exogeneity test (p-value)		0.0000	0.0000				
Observations	183,618	183,618	183,618	180,843	180,843	183,618	183,618
Censored observations		107,789	107,789				
Uncensored observations		75,829	75,829				

Table 1.4 Effect of Bank Risk on Wholesale Funding: Bank Borrowers' Credit Demands and the Impact of TARP

This table shows robustness tests for the effect of bank risk on the price and quantity of wholesale funds, controlling for bank borrowers' demands for loans (*ΔCredits*) and the impact of the TARP (*TARP amounts*). Models (1) and (2) report the second stage estimates of the Heckman's (1979) two-stage model and Models (3)-(6) report results of the fixed effect model. *Crisis I*, *Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Detailed information on the variables is provided in Table 1.1. *Lambda* indicates the inverse Mills ratio in the Heckman procedure. R^2 of the probit regression represents Pseudo-R^2. Robust standard errors of Models (3)-(6) are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Federal funds and repos		Panel B: Large time deposits		Panel C: Total wholesale funds	
	Spreads on fed funds	*Changes in fed funds*	*Spreads on large time deposits*	*Changes in large time deposits*	*Spreads on wholesale funds*	*Changes in wholesale funds*
	(1) Heckman	(2) Heckman	(3) FE	(4) FE	(5) FE	(6) FE
NPL	0.0260***	-0.0237***	-0.0029	-0.1207***	-0.0032	-0.2136***
	(3.00)	(-3.28)	(-0.69)	(-11.31)	(-0.60)	(-12.31)
CrisisI	0.0095***	0.0016	0.0151***	0.0036***	0.0141***	0.0137***
	(6.79)	(1.36)	(121.02)	(5.35)	(91.76)	(12.52)
*NPL*CrisisI*	-0.0010	-0.0094	-0.0144***	-0.0313*	-0.0166**	-0.0967***
	(-0.07)	(-0.76)	(-2.73)	(-1.92)	(-2.19)	(-3.64)
CrisisII	0.0163***	0.0015	0.0300***	0.0134***	0.0294***	0.0226***
	(3.08)	(0.34)	(149.45)	(13.69)	(128.03)	(11.32)
*NPL*CrisisII*	-0.0234*	0.0020	0.0144***	0.0467***	0.0093	0.0213
	(-1.91)	(0.20)	(2.96)	(3.22)	(1.49)	(0.97)
Postcrisis	0.0107	0.0027	0.0243***	0.0119***	0.0341***	0.0086
	(1.41)	(0.43)	(41.86)	(4.10)	(55.76)	(1.20)
*NPL*Postcrisis*	-0.0150	0.0009	-0.0057	0.0700***	0.0101*	0.0577***
	(-1.56)	(0.11)	(-1.29)	(6.46)	(1.67)	(3.20)
Log total assets	0.0010***	0.0006***	0.0009***	-0.0091***	-0.0011***	-0.0156***
	(6.97)	(4.79)	(5.80)	(-18.37)	(-5.41)	(-16.76)
Return on assets	-0.0344***	-0.0027	-0.0306***	0.0941***	-0.0164***	0.0814***
	(-2.91)	(-0.28)	(-7.15)	(6.42)	(-2.75)	(2.97)
Capital ratios	-0.0107***	0.0029	-0.0021	0.0869***	0.0090***	0.1949***
	(-4.57)	(1.53)	(-1.34)	(18.32)	(3.91)	(21.51)
Weighted HHI	-0.0056***	0.0002	0.0014	-0.0019	-0.0061***	-0.0026
	(-5.81)	(0.21)	(0.81)	(-0.53)	(-2.59)	(-0.40)
Weighted income growth	0.0003	0.0123***	0.0030***	0.0027	0.0147***	-0.0083
	(0.09)	(4.70)	(2.58)	(0.83)	(9.35)	(-1.49)
M2/GDP	-0.0107	-0.0373	-0.0996***	-0.0820***	-0.0918***	-0.0156
	(-0.16)	(-0.68)	(-20.93)	(-3.35)	(-19.78)	(-0.25)
TARP amounts	0.0249***	-0.0001	-0.0268***	-0.0256**	0.0013	-0.0968***
	(3.51)	(-0.02)	(-5.61)	(-2.39)	(0.17)	(-4.52)
ΔCredits	0.0018***	0.0021***	-0.0003*	0.0123***	-0.0025***	0.0175***
	(3.24)	(4.58)	(-1.85)	(12.60)	(-13.54)	(9.77)
Lambda	0.0077***	0.0035***				
	(14.65)	(8.03)				
Constant	-0.0067	0.0134	0.0419***	0.0824***	0.0405***	0.0738**
	(-0.20)	(0.49)	(15.36)	(6.45)	(13.83)	(2.33)
Bank fixed effects	No	No	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	No	No	Yes	Yes	Yes	Yes
R-squared			0.7861	0.3608	0.7661	0.2232
Wald exogeneity test (p-value)	0.0000	0.0000				
Observations	176,950	176,950	174,232	174,232	176,950	176,950

Table 1.5 Effect of Bank Risk on Wholesale Funding: Large vs. Small banks

This table presents whether the effect of bank risk on the price and quantity of wholesale funding varies across bank size. Large banks are defined as banks with greater than $1 billion in total assets, and small banks otherwise. *Crisis I*, *Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Detailed information on the variables is provided in Table 1.1. Robust standard errors are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Large banks

	A1: Federal funds and repos		A2: Large time deposits		A3: Total wholesale funds	
	Spreads on fed funds	*Changes in fed funds*	*Spreads on large time deposits*	*Changes in large time deposits*	*Spreads on wholesale funds*	*Changes in wholesale funds*
	(1) Heckman	(2) Heckman	(3) FE	(4) FE	(5) FE	(6) FE
NPL	0.0325**	-0.0300	0.0436	-0.0440	-0.0115	-0.2381***
	(2.02)	(-1.37)	(1.48)	(-1.05)	(-0.51)	(-2.88)
CrisisI	0.0080***	0.0016	0.0122***	0.0004	0.0031***	0.0105***
	(4.64)	(0.67)	(21.85)	(0.22)	(5.76)	(3.18)
*NPL*CrisisI*	0.0136	-0.0051	-0.0182	0.0056	0.0040	-0.1180
	(0.49)	(-0.13)	(-0.56)	(0.09)	(0.12)	(-0.70)
CrisisII	0.0145**	0.0093	0.0156***	0.0124***	0.0228***	0.0201***
	(2.30)	(1.07)	(22.62)	(5.31)	(35.37)	(3.84)
*NPL*CrisisII*	0.0117	0.0035	-0.0051	-0.0598	0.0434*	0.0360
	(0.55)	(0.12)	(-0.16)	(-1.06)	(1.77)	(0.37)
Postcrisis	0.0123	0.0132	0.0111***	0.0126	0.0293***	0.0152
	(1.36)	(1.07)	(6.26)	(1.62)	(16.23)	(0.72)
*NPL*Postcrisis*	-0.0102	0.0216	-0.0390	-0.0289	0.0223	0.0058
	(-0.60)	(0.93)	(-1.29)	(-0.65)	(0.90)	(0.07)
Log total assets	0.0005***	-0.0002	-0.0001	-0.0114***	-0.0006	-0.0275***
	(3.76)	(-1.15)	(-0.21)	(-7.60)	(-0.90)	(-10.40)
Return on assets	-0.0890***	0.1050***	-0.0081	0.1817***	-0.0164	0.2674***
	(-5.63)	(4.89)	(-0.55)	(4.61)	(-0.86)	(3.40)
Capital ratios	-0.0210***	-0.0003	-0.0166***	0.0047	-0.0080	0.1136***
	(-6.72)	(-0.07)	(-2.98)	(0.40)	(-1.08)	(3.35)
Weighted HHI	-0.0047***	0.0003	0.0012	0.0036	-0.0155**	0.0028
	(-4.59)	(0.22)	(0.20)	(0.39)	(-2.31)	(0.12)
Weighted income growth	-0.0077	0.0066	0.0031	-0.0000	0.0163***	0.0113
	(-1.58)	(0.98)	(0.64)	(-0.00)	(2.69)	(0.55)
M2/GDP	0.0025	-0.1300	-0.1081***	-0.0976	-0.0765***	-0.1290
	(0.03)	(-1.21)	(-7.00)	(-1.34)	(-5.41)	(-0.66)
TARP amounts	-0.0012	-0.0053	-0.0304**	-0.0103	-0.0316	-0.0841*
	(-0.15)	(-0.49)	(-2.52)	(-0.53)	(-1.41)	(-1.73)
ΔCredits	-0.0002	0.0018**	0.0003	0.0021	-0.0011**	0.0058
	(-0.35)	(1.97)	(0.60)	(1.03)	(-2.29)	(1.34)
Lambda	0.0029**	0.0018				
	(2.42)	(1.13)				
Constant	-0.0069	0.0669	0.0670***	0.1397***	0.0419***	0.2815***
	(-0.18)	(1.24)	(7.06)	(3.63)	(4.54)	(2.74)
Bank fixed effects	No	No	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	No	No	Yes	Yes	Yes	Yes
R-squared			0.7312	0.3401	0.7208	0.1797
Wald exogeneity test (p-value)	0.0000	0.0000				
Observations	18,588	18,588	18,243	18,243	18,588	18,588

Panel B: Small banks

	B1: Federal funds and repos		B2: Large time deposits		B3: Total wholesale funds	
	Spreads on fed funds	*Changes in fed funds*	*Spreads on large time deposits*	*Changes in large time deposits*	*Spreads on wholesale funds*	*Changes in wholesale funds*
	(1) Heckman	(2) Heckman	(3) FE	(4) FE	(5) FE	(6) FE
NPL	0.0464***	-0.0209***	-0.0034	-0.1217***	-0.0010	-0.2085***
	(4.53)	(-2.70)	(-0.82)	(-10.97)	(-0.19)	(-11.44)
CrisisI	0.0093***	0.0012	-0.0010***	0.0023***	-0.0041***	0.0076***
	(5.25)	(0.89)	(-5.05)	(3.83)	(-16.60)	(7.35)
*NPL*CrisisI*	-0.0000	-0.0068	-0.0165***	-0.0382**	-0.0174**	-0.0925***
	(-0.00)	(-0.53)	(-3.09)	(-2.26)	(-2.26)	(-3.40)
CrisisII	0.0183***	-0.0012	0.0139***	0.0122***	0.0116***	0.0172***
	(2.69)	(-0.23)	(61.73)	(13.90)	(45.88)	(9.45)
*NPL*CrisisII*	-0.0265*	0.0039	0.0128***	0.0522***	0.0061	0.0246
	(-1.85)	(0.36)	(2.62)	(3.46)	(0.96)	(1.07)
Postcrisis	0.0131	-0.0009	0.0081***	0.0119***	0.0162***	0.0050
	(1.34)	(-0.12)	(13.68)	(4.09)	(26.19)	(0.69)
*NPL*Postcrisis*	-0.0130	-0.0018	-0.0058	0.0707***	0.0075	0.0574***
	(-1.16)	(-0.22)	(-1.31)	(6.26)	(1.22)	(3.01)
Log total assets	-0.0024***	0.0001	0.0011***	-0.0100***	-0.0014***	-0.0170***
	(-5.74)	(0.17)	(6.22)	(-18.94)	(-5.91)	(-17.16)
Return on assets	-0.0020	-0.0362***	-0.0329***	0.0956***	-0.0141**	0.0681**
	(-0.14)	(-3.35)	(-7.42)	(6.04)	(-2.26)	(2.32)
Capital ratios	0.0025	0.0054**	0.0003	0.0925***	0.0091***	0.2058***
	(0.83)	(2.35)	(0.19)	(17.99)	(3.75)	(21.57)
Weighted HHI	-0.0051***	0.0002	0.0014	-0.0025	-0.0054**	-0.0044
	(-3.88)	(0.19)	(0.81)	(-0.63)	(-2.12)	(-0.66)
Weighted income growth	0.0023	0.0136***	0.0029**	0.0025	0.0135***	-0.0100*
	(0.62)	(4.79)	(2.42)	(0.72)	(8.41)	(-1.74)
M2/GDP	-0.0160	-0.0023	-0.0982***	-0.0930***	-0.0949***	-0.0292
	(-0.19)	(-0.04)	(-19.54)	(-3.61)	(-19.16)	(-0.45)
TARP amounts	0.0187*	0.0049	-0.0219***	-0.0421***	0.0112	-0.0961***
	(1.95)	(0.68)	(-4.04)	(-3.27)	(1.29)	(-4.08)
ΔCredits	0.0025***	0.0023***	-0.0004***	0.0138***	-0.0029***	0.0190***
	(3.52)	(4.25)	(-2.75)	(12.79)	(-14.41)	(9.83)
Lambda	0.0001	0.0024***				
	(0.11)	(3.01)				
Constant	0.0192	-0.0006	0.0562***	0.0911***	0.0610***	0.0880***
	(0.45)	(-0.02)	(19.52)	(6.71)	(19.45)	(2.65)
Bank fixed effects	No	No	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	No	No	Yes	Yes	Yes	Yes
R-squared			0.7920	0.3658	0.7729	0.2333
Wald exogeneity test (p-value)	0.0000	0.0000				
Observations	158,362	158,362	155,989	155,989	158,362	158,362

Table 1.6 Robustness Tests: Market Risk - Recessions at the MSA Level

This table presents robustness tests for the effect of bank risk on the price and quantity of wholesale funding using recession periods at the MSA level as an alternative proxy for market-wide liquidity risk. *Recession_MSA* is a quarterly dummy variable for the recession period at the MSA level; the value is 1 when a bank operates in the MSA which experiences the decline in real GDP for two consecutive quarters. *Crisis I*, *Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Models (1) and (2) report the second stage estimates of the Heckman procedure. Detailed information on variables is provided in Table 1.1. Robust standard errors are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Federal funds and repos		Panel B: Large time deposits		Panel C: Total wholesale funds	
	Spreads on fed funds	*Changes in fed funds*	*Spreads on large time deposits*	*Changes in large time deposits*	*Spreads on wholesale funds*	*Changes in Wholesale funds*
	(1) Heckman	(2) Heckman	(3) FE	(4) FE	(5) FE	(6) FE
NPL	0.0255***	-0.0226***	-0.0036	-0.1223***	-0.0036	-0.2124***
	(2.92)	(-3.12)	(-0.87)	(-11.40)	(-0.68)	(-12.17)
Recession_MSA	-0.0000	-0.0000	-0.0003***	-0.0003	-0.0007***	-0.0001
	(-0.11)	(-0.05)	(-3.11)	(-1.33)	(-5.01)	(-0.20)
*NPL*Recession_MSA*	0.0051	-0.0093	0.0078***	0.0154*	0.0058	-0.0100
	(0.66)	(-1.47)	(2.98)	(1.89)	(1.61)	(-0.73)
CrisisI	0.0095***	0.0016	0.0151***	0.0037***	0.0141***	0.0136***
	(6.79)	(1.35)	(121.22)	(5.43)	(91.23)	(12.44)
*NPL*CrisisI*	-0.0029	-0.0059	-0.0168***	-0.0363**	-0.0179**	-0.0930***
	(-0.19)	(-0.47)	(-3.16)	(-2.22)	(-2.34)	(-3.47)
CrisisII	0.0163***	0.0014	0.0301***	0.0136***	0.0295***	0.0225***
	(3.09)	(0.31)	(149.04)	(13.79)	(126.44)	(11.29)
*NPL*CrisisII*	-0.0262**	0.0073	0.0107**	0.0391***	0.0071	0.0265
	(-2.03)	(0.68)	(2.17)	(2.64)	(1.10)	(1.16)
Postcrisis	0.0108	0.0025	0.0244***	0.0120***	0.0340***	0.0084
	(1.42)	(0.40)	(42.01)	(4.16)	(55.26)	(1.17)
*NPL*Postcrisis*	-0.0154	0.0017	-0.0065	0.0687***	0.0094	0.0585***
	(-1.60)	(0.21)	(-1.46)	(6.35)	(1.56)	(3.25)
Log total assets	0.0010***	0.0006***	0.0009***	-0.0091***	-0.0011***	-0.0156***
	(6.97)	(4.81)	(5.74)	(-18.41)	(-5.30)	(-16.70)
Return on assets	-0.0339***	-0.0039	-0.0304***	0.0950***	-0.0170***	0.0803***
	(-2.86)	(-0.40)	(-7.09)	(6.48)	(-2.85)	(2.92)
Capital ratios	-0.0107***	0.0029	-0.0020	0.0868***	0.0091***	0.1950***
	(-4.58)	(1.54)	(-1.33)	(18.31)	(3.97)	(21.53)
Weighted HHI	-0.0056***	0.0002	0.0014	-0.0019	-0.0060**	-0.0025
	(-5.80)	(0.26)	(0.83)	(-0.52)	(-2.56)	(-0.40)
Weighted income growth	0.0005	0.0117***	0.0025**	0.0026	0.0128***	-0.0092
	(0.15)	(4.32)	(2.13)	(0.78)	(8.14)	(-1.63)
M2/GDP	-0.0112	-0.0363	-0.1001***	-0.0830***	-0.0919***	-0.0148
	(-0.17)	(-0.66)	(-21.05)	(-3.40)	(-19.75)	(-0.24)
TARP amounts	0.0248***	0.0002	-0.0266***	-0.0257**	0.0020	-0.0964***
	(3.50)	(0.03)	(-5.58)	(-2.39)	(0.25)	(-4.50)
ΔCredits	0.0018***	0.0021***	-0.0003*	0.0123***	-0.0025***	0.0175***
	(3.24)	(4.58)	(-1.84)	(12.60)	(-13.56)	(9.76)
Lambda	0.0077***	0.0034***				
	(14.66)	(8.00)				
Constant	-0.0065	0.0130	0.0422***	0.0831***	0.0406***	0.0733**
	(-0.20)	(0.47)	(15.50)	(6.50)	(13.84)	(2.32)
Bank fixed effects	No	No	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	No	No	Yes	Yes	Yes	Yes
R-squared			0.7861	0.3608	0.7663	0.2232
Wald exogeneity test (p-value)	0.0000	0.0000				
Observations	176,950	176,950	174,232	174,232	176,950	176,950

Table 1.7 Robustness Tests: Market Risk -TED Spread

This table presents robustness tests for the effect of bank risk on the price and quantity of wholesale funding using the TED spread as an alternative proxy for market-wide liquidity risk. TED spread is the spread between 3-Month LIBOR based on US dollars and 3-Month Treasury bill. Models (1) and (2) report the second stage estimates of the Heckman procedure. Detailed information on variables is provided in Table 1.1. Robust standard errors are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Federal funds and repos		Panel B: Large time deposits		Panel C: Total wholesale funds	
	Spreads on fed funds	*Changes in fed funds*	*Spreads on large time deposits*	*Changes in large time deposits*	*Spreads on wholesale funds*	*Changes in Wholesale funds*
	(1) Heckman	(2) Heckman	(3) FE	(4) FE	(5) FE	(6) FE
NPL	0.0171***	-0.0225***	-0.0043**	-0.0652***	0.0079***	-0.1620***
	(3.30)	(-5.28)	(-2.17)	(-11.83)	(2.75)	(-16.20)
TED spread	0.0098	0.0145	-0.0452***	0.0030	0.0034	-0.0991***
	(0.23)	(0.41)	(-80.37)	(0.19)	(1.58)	(-2.68)
*NPL*TED spread*	-0.0069	-0.0022	0.0028	-0.0123	-0.0092***	-0.0357***
	(-1.06)	(-0.39)	(1.34)	(-1.61)	(-3.03)	(-2.71)
Log total assets	0.0010***	0.0006***	-0.0001	-0.0093***	-0.0012***	-0.0158***
	(7.00)	(4.79)	(-0.46)	(-18.91)	(-5.59)	(-17.17)
Return on assets	-0.0313***	-0.0033	-0.0018	0.0822***	-0.0185***	0.0696**
	(-2.67)	(-0.35)	(-0.44)	(5.55)	(-3.13)	(2.52)
Capital ratios	-0.0105***	0.0029	-0.0061***	0.0852***	0.0088***	0.1936***
	(-4.50)	(1.53)	(-3.87)	(17.98)	(3.84)	(21.42)
Weighted HHI	-0.0056***	0.0002	-0.0010	-0.0017	-0.0060**	-0.0023
	(-5.78)	(0.21)	(-0.57)	(-0.47)	(-2.58)	(-0.36)
Weighted income growth	0.0001	0.0123***	-0.0233***	0.0035	0.0145***	-0.0079
	(0.03)	(4.69)	(-19.89)	(1.05)	(9.23)	(-1.42)
M2/GDP	0.1365	0.1847	0.0265***	-0.0421	-0.0433	-1.5563***
	(0.21)	(0.34)	(18.91)	(-0.17)	(-1.32)	(-2.74)
TARP amounts	0.0244***	0.0000	-0.0245***	-0.0243**	0.0012	-0.0958***
	(3.44)	(0.00)	(-5.12)	(-2.26)	(0.15)	(-4.46)
ΔCredits	0.0018***	0.0021***	-0.0011***	0.0124***	-0.0025***	0.0176***
	(3.22)	(4.58)	(-6.60)	(12.63)	(-13.45)	(9.81)
Lambda	0.0078***	0.0034***				
	(14.73)	(8.03)				
Constant	-0.0900	-0.1251	0.0112***	0.0709	0.0439**	1.0642***
	(-0.22)	(-0.36)	(8.36)	(0.45)	(2.10)	(2.94)
Bank fixed effects	No	No	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	No	No	Yes	Yes	Yes	Yes
R-squared			0.7539	0.3603	0.7660	0.2229
Wald exogeneity test (p-value)	0.0000	0.0000				
Observations	176,950	176,950	174,232	174,232	176,950	176,950

Table 1.8 Robustness Tests: Bank Risk - RWA

This table shows robustness tests for the effect of bank risk on the price and quantity of wholesale funding using risk weighted assets (RWA) as an alternative proxy for bank risk. A higher value indicates higher risk of failure. Models (1) and (2) report the second stage estimates of the Heckman procedure. *Crisis I, Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Detailed information on variables is provided in Table 1.1. Robust standard errors are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗ represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Federal funds and repos		Panel B: Large time deposits		Panel C: Total wholesale funds	
	Spreads on fed funds	*Changes in fed funds*	*Spreads on large time deposits*	*Changes in large time deposits*	*Spreads on wholesale funds*	*Changes in Wholesale funds*
	(1) Heckman	(2) Heckman	(3) FE	(4) FE	(5) FE	(6) FE
RWA	0.0025***	-0.0003	0.0039***	0.0286***	-0.0014*	0.0598***
	(3.60)	(-0.61)	(6.45)	(18.72)	(-1.69)	(20.57)
CrisisI	0.0109***	-0.0015	0.0138***	0.0119***	0.0201***	0.0026
	(5.73)	(-0.95)	(31.40)	(8.16)	(32.92)	(1.07)
*RWA*CrisisI*	-0.0019	0.0037***	0.0015**	-0.0122***	-0.0083***	0.0120***
	(-1.11)	(2.63)	(2.57)	(-6.76)	(-10.28)	(3.84)
CrisisII	0.0217***	0.0086*	0.0291***	0.0085***	0.0330***	0.0117***
	(3.98)	(1.90)	(53.58)	(4.82)	(50.27)	(3.68)
*RWA*CrisisII*	-0.0081***	-0.0097***	0.0013*	0.0057***	-0.0043***	0.0116***
	(-4.36)	(-6.30)	(1.92)	(2.73)	(-5.11)	(3.30)
Postcrisis	0.0133*	0.0026	0.0268***	0.0271***	0.0291***	0.0365***
	(1.74)	(0.41)	(37.25)	(9.03)	(34.65)	(5.00)
*RWA*Postcrisis*	-0.0044***	-0.0002	-0.0042***	-0.0203***	0.0088***	-0.0394***
	(-3.38)	(-0.19)	(-6.26)	(-14.32)	(9.05)	(-15.86)
NPL	0.0138***	-0.0232***	-0.0036**	-0.0606***	0.0005	-0.1559***
	(3.47)	(-7.13)	(-2.20)	(-13.66)	(0.21)	(-19.13)
Log total assets	0.0010***	0.0006***	0.0010***	-0.0089***	-0.0012***	-0.0153***
	(6.93)	(4.65)	(6.30)	(-18.60)	(-5.77)	(-16.88)
Return on assets	-0.0357***	-0.0072	-0.0345***	0.0607***	-0.0155***	0.0160
	(-3.03)	(-0.75)	(-8.11)	(4.10)	(-2.62)	(0.58)
Capital ratios	-0.0104***	0.0032*	-0.0019	0.0864***	0.0092***	0.1945***
	(-4.44)	(1.66)	(-1.22)	(18.56)	(4.03)	(22.11)
Weighted HHI	-0.0057***	0.0002	0.0014	-0.0015	-0.0058**	-0.0021
	(-5.84)	(0.24)	(0.81)	(-0.42)	(-2.52)	(-0.33)
Weighted income growth	-0.0003	0.0116***	0.0033***	0.0070**	0.0133***	0.0019
	(-0.10)	(4.43)	(2.80)	(2.14)	(8.50)	(0.34)
M2/GDP	-0.0075	-0.0351	-0.0964***	-0.0759***	-0.0984***	0.0037
	(-0.11)	(-0.64)	(-20.21)	(-3.10)	(-21.09)	(0.06)
TARP amounts	0.0277***	0.0025	-0.0229***	-0.0061	-0.0084	-0.0480**
	(3.87)	(0.41)	(-4.84)	(-0.56)	(-1.04)	(-2.24)
ΔCredits	0.0018***	0.0022***	-0.0006***	0.0104***	-0.0022***	0.0130***
	(3.25)	(4.80)	(-3.74)	(10.64)	(-11.43)	(7.26)
Lambda	0.0078***	0.0034***				
	(14.66)	(7.81)				
Constant	-0.0101	0.0128	0.0370***	0.0569***	0.0451***	0.0179
	(-0.30)	(0.46)	(13.28)	(4.42)	(14.88)	(0.56)
Bank fixed effects	No	No	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	No	No	Yes	Yes	Yes	Yes
R-squared			0.7866	0.3639	0.7686	0.2298
Wald exogeneity test (p-value)	0.0000	0.0000				
Observations	176,950	176,950	174,232	174,232	176,950	176,950

Table 1.9 Robustness Tests: Bank Risk -Z-score

This table presents robustness tests for the effect of bank risk on the price and quantity of wholesale funding using the Z-score as an alternative proxy for bank risk. The Z-score is measured as the sum of the return on assets and the equity capital ratio divided by the standard deviation of the return on assets. A higher value indicates lower risk of default. Models (1) and (2) report the second stage estimates of the Heckman procedure. *Crisis I*, *Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Detailed information on variables is provided in Table 1.1. Robust standard errors are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗ represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Federal funds and repos		Panel B: Large time deposits		Panel C: Total wholesale funds	
	Spreads on fed funds	*Changes in fed funds*	*Spreads on large time deposits*	*Changes in large time deposits*	*Spreads on wholesale funds*	*Changes in Wholesale funds*
	(1) Heckman	(2) Heckman	(3) FE	(4) FE	(5) FE	(6) FE
Z-score	0.0001	0.0001	-0.0012**	-0.0014	-0.0005	-0.0049**
	(0.11)	(0.09)	(-2.26)	(-1.14)	(-0.67)	(-2.49)
CrisisI	0.0020***	-0.0002	-0.0009***	-0.0003	-0.0059***	0.0063***
	(2.63)	(-0.33)	(-3.81)	(-0.39)	(-18.35)	(4.62)
*Z-score*CrisisI*	0.0033**	-0.0016	0.0002	-0.0007	0.0005	0.0005
	(2.06)	(-1.14)	(0.29)	(-0.38)	(0.60)	(0.18)
CrisisII	0.0114***	-0.0024***	0.0199***	0.0039***	0.0184***	0.0002
	(11.44)	(-2.81)	(64.17)	(4.30)	(48.43)	(0.10)
*Z-score*CrisisII*	0.0038**	0.0027**	0.0005	-0.0009	0.0000	0.0045
	(2.40)	(2.01)	(0.83)	(-0.50)	(0.05)	(1.50)
Postcrisis	0.0093***	-0.0016**	0.0110***	0.0009	0.0179***	0.0020
	(10.75)	(-2.19)	(39.83)	(1.35)	(48.66)	(1.50)
*Z-score*Postcrisis*	0.0015	-0.0002	0.0020***	0.0015	-0.0019**	0.0079***
	(1.43)	(-0.17)	(3.21)	(1.26)	(-2.14)	(3.91)
Log total assets	0.0012***	0.0002	0.0007***	-0.0102***	-0.0013***	-0.0183***
	(7.85)	(1.41)	(3.50)	(-16.01)	(-4.57)	(-15.32)
Return on assets	-0.0058	0.0347***	-0.0231***	0.1193***	-0.0012	0.0886***
	(-0.42)	(2.97)	(-4.66)	(7.04)	(-0.17)	(2.80)
Capital ratios	-0.0177***	0.0036	-0.0059***	0.0649***	0.0063*	0.1760***
	(-6.04)	(1.47)	(-2.63)	(10.52)	(1.83)	(14.44)
Weighted HHI	-0.0041***	0.0005	-0.0012	0.0082*	-0.0071***	0.0102
	(-3.75)	(0.55)	(-0.61)	(1.89)	(-2.61)	(1.41)
Weighted income growth	0.0008	0.0132***	0.0005	0.0019	0.0121***	-0.0123**
	(0.25)	(4.64)	(0.45)	(0.56)	(7.73)	(-2.17)
M2/GDP	-0.0525***	-0.0014	-0.1215***	-0.0059	-0.1164***	-0.0187**
	(-6.51)	(-0.20)	(-71.25)	(-1.37)	(-60.96)	(-1.96)
NPL	0.0321***	-0.0083**	-0.0081***	-0.0612***	0.0013	-0.1624***
	(7.93)	(-2.36)	(-4.27)	(-12.01)	(0.47)	(-18.61)
TARP amounts	0.0271***	-0.0060	-0.0288***	-0.0129	0.0021	-0.1002***
	(3.83)	(-0.98)	(-5.32)	(-1.11)	(0.22)	(-4.23)
ΔCredits	0.0018***	0.0009	-0.0005***	0.0105***	-0.0030***	0.0127***
	(2.79)	(1.53)	(-3.04)	(9.13)	(-13.54)	(6.21)
Lambda	0.0070***	0.0018***				
	(13.22)	(3.99)				
Constant	0.0197***	-0.0011	0.0724***	0.0488***	0.0752***	0.0897***
	(4.44)	(-0.28)	(40.69)	(10.72)	(31.55)	(10.52)
Bank fixed effects	No	No	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	No	No	Yes	Yes	Yes	Yes
R-squared			0.8144	0.3993	0.7921	0.2447
Wald exogeneity test (p-value)	0.0000	0.0000				
Observations	117,001	117,001	115,025	115,025	117,001	117,001

Table 1.10 Robustness Tests: Government Intervention

This table shows robustness tests for the effect of bank risk on wholesale funding considering government intervention in the form of TARP funds and FHLB loans. The dependent variable, *Changes in wholesale funds*, is the quarterly growth of wholesale funds. Wholesale funds are measured by excluding the amount of subordinated debentures among types of TARP supports or the amount of loans from FHLB. The regression result of *Spreads on wholesale funds* is from column (5) in Table 1.4 because interest rates on wholesale funds excluding the amount of TARP funds in the form of subordinated debentures or FHLB loans are not reported in income statements. *Crisis I*, *Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Detailed information on variables is provided in Table 1.1. Robust standard errors are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Spreads on wholesale funds	*Changes in Wholesale funds*
	(1) FE	(2) FE
NPL	-0.0032	-0.9319***
	(-0.60)	(-11.06)
CrisisI	0.0141***	0.0139***
	(91.76)	(2.58)
*NPL*CrisisI*	-0.0166**	-0.1570
	(-2.19)	(-1.34)
CrisisII	0.0294***	0.0562***
	(128.03)	(3.69)
*NPL*CrisisII*	0.0093	0.2122**
	(1.49)	(2.14)
Postcrisis	0.0341***	-0.0627
	(55.76)	(-1.01)
*NPL*Postcrisis*	0.0101*	0.2775***
	(1.67)	(3.07)
Log total assets	-0.0011***	-0.0639***
	(-5.41)	(-15.59)
Return on assets	-0.0164***	-0.3395**
	(-2.75)	(-2.40)
Capital ratios	0.0090***	0.9712***
	(3.91)	(20.72)
Weighted HHI	-0.0061***	-0.0320
	(-2.59)	(-0.98)
Weighted income growth	0.0147***	-0.0226
	(9.35)	(-0.80)
M2/GDP	-0.0918***	0.5638
	(-19.78)	(1.05)
TARP amounts	0.0013	-0.3909***
	(0.17)	(-4.20)
ΔCredits	-0.0025***	0.0454***
	(-13.54)	(7.22)
Constant	0.0405***	0.0202
	(13.83)	(0.07)
Bank fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Clustering	Yes	Yes
R-squared	0.7661	0.1612
Observations	176,950	176,950

Chapter 2

Bank Funding Structure, Market Discipline, and Credit Supply

2.1 Introduction

The financial crisis of 2008 shed new light on the volatile nature of wholesale funds as a funding source. During the crisis, wholesale financiers withdrew their money en masse, leading to a severe credit contraction[1]. Prior to the crisis, wholesale financiers dramatically increased their investments in banks, which allowed banks to increase the supply of credit, resulting in accumulated vulnerabilities in the financial system (Demirgüç-Kunt and Huizinga 2010; Hahm, Shin, and Shin 2013). Figure 2.1 supports this fact: banks' balance sheets in terms of total assets expanded greatly until the Lehman Brothers failure in 2008:Q3. Similarly, bank loans significantly increased during the pre-crisis period, but decreased during the crisis period. These trends in assets and loans may be attributed to wholesale funds rather than core deposits because wholesale funds show similar rends to those of assets and loans. Core deposits were

[1] In contrast, demand deposits flowed into banks to seek a safe haven during the same time period, mainly attributable to government safety nets for deposits in the form of deposit insurance (Kashyap, Rajan, and Stein 2002; Gatev and Strahan 2006; Gatev, Schuermann, and Strahan 2009; Cornett, McNutt, Strahan, and Tehranian 2011; Acharya and Mora 2014).

stable until 2008:Q3, and increased significantly after the crisis, consistent with the findings of previous studies (Ivashina and Scharfstein 2010; Acharya and Mora 2014).

Wholesale funds have conflicting effects on banks' financial stability depending on market conditions (Diamond and Rajan 2009; Shin 2009; Huang and Ratnovski 2011; He and Xiong 2012)[2]. In good times, short-term wholesale debt is less expensive than long-term debt, and makes up for the shortage of retail deposits so banks need not give up profitable investments while disciplining banks against excessive risks. In bad times, however, these wholesale financiers, rather than demand depositors, run regardless of a bank's financial health[3]. Furthermore, they seem not to discipline banks for increased risks by demanding higher interest rates or withdrawing funds during the 2008 financial crisis (Joh and Kim 2014). Recently, a great deal of literature has examined the relationship between the type of funding sources and credit supply, especially concerning the credit crunch during the 2008 crisis (e.g., Allen and Paligorova 2011). However, there is no explicit research on the effect of wholesale funding on the credit supply considering the change in wholesale financiers' disciplining role in the aftermath of the crisis. This study aims to fill this gap in the growing literature on the relationship between bank funding structure and credit supply by constructing a panel dataset for US commercial banks between 2002 and 2012 to examine the impact of the 2008 financial

[2] There is extensive literature discussing disciplinary measures taken by depositors or short-term creditors. See Gilbert (1990) or Flannery (1998) for good reviews.

[3] Traditionally, bank runs were triggered by demand depositors (Bryant 1980; Diamond and Dybvig 1983). However, traditional bank runs have become less likely since the introduction of deposit insurance (Demirgüç-Kunt and Kane 2002; Shin 2009).

crisis.

The main purpose of this study is to investigate whether wholesale financiers discipline banks against excessive risk-taking-in terms of risky lending depending on market conditions: before, during, and after the financial crisis[4]. To this end, my empirical analyses begin by examining the relationship between wholesale funds and credit supply. To my knowledge, there is no direct research examining whether wholesale funds are positively associated with bank lending during both good times (pre-crisis period) and bad times (crisis and post-crisis period), although there is evidence that banks with more core deposits or equity capital cut their lending less during the 2008 crisis (Ivashina and Scharfstein 2010; Cornett, McNutt, Strahan, and Tehranian 2011). Hahm, Shin, and Shin (2013) show thata high reliance on wholesale funding serves as an indicator of vulnerability to a financial crisis using a panel dataset of around 20-70 developing countries from 2000 to 2010.

I find that banks which rely more on wholesale funding granted more credit, short-term loans, real estate loans, and commercial and industrial (C&I) loans during the pre-crisis period. This suggests that accumulating vulnerability in the banking system stems from the increase in the supply of credit by banks relying on high wholesale funding during the pre-crisis period. During the crisis, however, banks with more wholesale

[4] Regarding market discipline by wholesale financiers, the previous literature argues that wholesale financiers play an essential role in monitoring and disciplining banks for excessive risk-taking behavior (Calomiris and Kahn 1991; Diamond and Rajan 2001; Ellis and Flannery 1992; Flannery 2001; Hannan and Hanweck 1988). However, recent studies report that market discipline by wholesale financiers was limited during the financial crisis of 2008 (Afonso, Kovner, and Schoar 2011; Huang and Ratnovski 2011; Joh and Kim 2014).

funds reduced their supply of loans, loan commitments, short-term loans, real estate loans, and C&I loans to a greater extent than those with less wholesale funds. This resulting credit contraction by banks with high levels of wholesale funding is prominent during the post-Lehman crisis period, and continues during the post-crisis period for all types of loans and commitments.

After providing evidence that banks with high levels of wholesale funding reduced their supply of credit during the crisis and post-crisis period, I examine how risky banks with high wholesale funding dependence adjusted their credit supply in response to the increased market-wide liquidity risk during the crisis. I consider credit supply in the form of on-balance sheet total loans, off-balance sheet undrawn loan commitments[5], and credits (sum of loans and loan commitments) to control for the effects of the drawdown of preexisting commitments, since loan commitments become loans after the takedown. I also consider risky lending in order to examine how banks adjust risky lending depending on macroeconomic conditions. If market discipline exists, risky banks with more wholesale funds decrease risky lending than those with fewer wholesale funds.

Risky lending can be defined along the following four dimensions: quantity, price, risk components, and maturity. First, for the quantity and price dimensions, if a bank increases loans with higher interest rates, it can be assumed that these are riskier, since risky borrowers are more willing to pay higher interest rates (Stiglitz and Weiss 1981; Pagaon and Jappelli 1993; Berger and Udell 1995). Second, loan components, such as

[5] In this paper, I use loan commitments and lines of credit interchangeably.

real estate and C&I loans can be considered a factor to determine whether the loan is riskier. Riskier loans have greater exposure to real estate. Santos (2010) and Acharya and Mora (2014) argue that real estate loans were a primary cause of banks' insolvency during the 2008 crisis. Blaško and Sinkey (2006) provide evidence that banks with high real restate exposure are more likely to fail using US commercial bank data between 1989 and1996. In addition, some argue that C&I loans are riskier than other loans. Samolyk (1994) shows that C&I loans are positively related to non-performing loans and net charge-offs. Demsetz and Strahan (1997) report that banks with more C&I loans have higher firm-specific risk. Finally, regarding risky lending from the maturity perspective, short-term loans are more likely to be riskier than long-term loans since banks grant loans with short-term maturity for riskier borrowers.

In terms of market discipline, I find conflicting results about the disciplining role of wholesale financiers in terms of preventing banks from granting more risky loans depending on market conditions. Market discipline occurs during stable economic periods, though there is little evidence of market discipline during the crisis period after the Lehman Brothers bankruptcy. This lack of market discipline continues, and even sometimes intensifies, during the post-crisis period. Specifically, risky banks with more wholesale funds decreased the supply of credit and risky loans, with lower spreads on total loans, real estate loans, and C&I loans during the boom period. However, risky banks with more wholesale funds increased the supply of credit and risky loans with higher spreads on total loans, real estate loans, and C&I loans during the post-Lehman period when the government intervened with protections such as quantitative easing (QE)

or the Troubled Asset Relief Program (TARP). This result implies that a lack of market discipline is possible even during a severe crisis if extensive government rescue programs are implemented to stabilize the economy. Interestingly, this continued during the post-crisis period when the Dodd–Frank Wall Street Reform and Consumer Protection Act (Dodd- Frank Act) was enacted in 2010.

The remainder of this paper proceeds as follows. Section 2.2 briefly shows the relationship between wholesale funding and bank lending through a graphical analysis. Section 2.3 describes the data and econometric methods. Section 2.4 presents the empirical evidence. Section 2.5 checks the robustness of the results. Finally, Section 2.6 concludes the paper.

2.2 Descriptive Analysis of the Relationship between Bank Funding Structure and Credit Supply

This section offers a brief analysis of how wholesale funding affects the extent that banks provide credit to borrowers using a graphical analysis. Bank funding structures have changed significantly over the past decades. Figure 2.2 shows the trends of bank funding structures at US commercial banks between 2002 and 2012. Core deposits include transaction accounts, savings deposits, and fully insured time deposits of less than $100,000 (less than $250,000 after 2008). Wholesale funds include federal funds purchased, securities sold under agreements to repurchase, subordinated notes and

debentures, other borrowed money, brokered deposits, and uninsured large time deposits. Equity is bank equity capital. The funding structure data are quarterly averages. Until 2008, the ratio of wholesale funding to total assets grew quickly while the core funding ratio decreased. However, the trend reversed after the 2008 financial crisis. In other words, the wholesale funding ratio decreased after the crisis while the core funding ratio dramatically increased. The equity capital ratio has remained around 10% over the sample period, although it increased slightly after the crisis.

Figure 2.3 shows the relationship between wholesale funding and loan supply at the aggregate level for US commercial banks between 2002 and 2012. Banks are divided into three categories: banks with high, medium, and low wholesale funding ratios (WF). The wholesale funding ratio is defined as the ratio of wholesale funding to total assets. Figure 2.3.1 shows the trends of the aggregate loan supply by the level of wholesale funding ratio. High wholesale-funded banks significantly decreased the loan supply during the crisis period, while banks with medium or low wholesale funding ratios increased lending during the same time period. This result suggests that the decrease in lending by high wholesale-funded banks was the main cause of credit contraction in the economy during the crisis. In Figures 2.3.2 and 2.3.3, banks are divided by size to examine which types of banks mainly contributed to the credit contraction. Banks are classified based on total assets: large (greater than $1 billion in assets) and small banks (less than or equal to $1 billion in assets). Figures 2.3.2 and 2.3.3 show the aggregate loan supply depending on the level of the wholesale funding ratio for large and small banks, respectively. The axis on the left-hand side of Figure 2.3.3 shows the aggregate

loans of small banks, while the axis on the right-hand side of the graph shows the aggregate loans of small banks with high/medium/low wholesale funding ratios. Figures 2.3.1 and 2.3.2 show that the changes in the total amount of loans stem mostly from large banks because they move together closely. This result also implies that large banks are more likely to attract funding from the capital market, such as the fed funds or debenture markets than small banks (Park andPennacchi 2009; Afonso, Kovner, and Schoar 2011). Figure 2.3.2 shows consistent results regarding the decrease in the loan supply from high wholesale-funded banks. Large high wholesale-funded banks reduced lending during the crisis period, while large, medium wholesale-funded banks provided more credit during the same time period. Figure 2.3.3 for small banks shows similar results: small high wholesale-funded banks most dramatically cut their lending during the 2008 crisis.

Figure 2.4 shows the relation between wholesale funding and credit supply at the bank level. Three types of credit supply are defined in this figure: loans, loan commitments, and credits (loans plus loan commitments). Figures 2.4.1 and 2.4.2 show the difference in the ratio of loans to total assets (*Loans*) between high wholesale-funded banks and low wholesale-funded banks (Large banks with high WF – Large banks with low WF) for large (Figure 2.4.1) and small banks (Figure 2.4.2), respectively. Figures 2.4.3 and 2.4.4 show the difference in the ratio of loan commitments to total assets plus loan commitments (*Loan commitments*) between high wholesale-funded banks and low wholesale-funded banks for large and small banks, respectively. Figures 2.4.5 and 2.4.6 show the difference in the ratio of loans plus loan commitments to total assets plus loan

commitments (*Credits*) between high wholesale-funded banks and low wholesale-funded banks for large and small banks, respectively. All figures show that banks with high wholesale funding dependence decreased the average credit supply during the financial crisis, which is prominent for loan commitments and total credits.

2.3 Data and Econometric Methods

2.3.1 Data

The quarterly data from the financial statements of insured US commercial banks are obtained from the Federal Financial Institutions Examination Council (FFIEC) Consolidated Reports of Condition and Income (Call Reports) during the period 2002:Q1-2012:Q4. The Call Reports include detailed information for both on- and off-balance sheet assets, loans, deposits, wholesale funds, equity, and loan commitments. Data on market concentrations for the Metropolitan Statistical Area (MSA) where a bank operates are collected from the FDIC's Summary of Deposits (SOD) database. Data on income growth and real GDP at the MSA level are obtained from the Bureau of Economic Analysis (BEA). Information about monetary aggregates (M2) is collected from the Federal Reserve Board (FRB).The house price index is obtained from the Federal Housing Finance Agency (FHFA). Banks with zero total assets, zero total loans, and zero total deposits were removed, as it is difficult for these banks to realistically

operate. Financial statement variables are winsorized at the 1st and 99th percentiles to eliminate the impact of outliers in the estimations. The final sample consists of 155,980 bank-quarter observations for 5,068 U.S. commercial banks during the period from 2002:Q1 to 2012:Q4.

2.3.2 Methodology and Variables

To investigate whether wholesale funding impacts the supply of credit that contributed to the lending boom in the pre-crisis period, and the credit crunch during the 2008 crisis, I employ the following fixed effects model:

$$\Delta\, Credits_{it} = \alpha_0 + \alpha_1 Wholeslae\ Funding_{it-1} + \alpha_2 Crisis_t + \alpha_3 Wholesale\ Funding_{it-1} * Crisis_t + \alpha_4 Other\ Contols_{it-1} + \mu_{1i} + \tau_{1t} + \varepsilon_{it} \quad (1)$$

Where $\Delta\, Credits_{it}$ is the change in credits during the quarter divided by the start of quarter total assets. $\Delta\, Credits_{it}$ includes loans ($\Delta\, Loans_{it}$), loan commitments ($\Delta\, Commitments_{it}$), and loan components (short-term loans, real estate loans, and C&I loans). Specifically, $\Delta\, Loans_{it}$ (including short-term loans, real estate loans, and C&I loans) indicates the change in loans as a fraction of the start of quarter total assets for bank i in quarter t. $\Delta\, Commitments_{it}$and $\Delta\, Credits_{it}$ refer to the change in loan

commitments and total credits as a fraction of the start of quarter total assets plus loan commitments for bank i in quarter t, respectively.

$Wholeslae\ Funding_{it-1}$ is the main variable of interest. I focus on two components of wholesale funding depending on maturity: *WF* (total wholesale funds) and *SWF* (short-term wholesale funds). As mentioned above, *WF* consists of fed funds, repos, subordinated debentures, brokered deposits, other borrowed money, deposits in foreign offices, and large time deposits (over $100,000 until 2009:Q4 and $250,000 from 2010:Q1)[6]. *SWF* refers to short-term wholesale funds with a remaining maturity of one year or less as a fraction of total assets. By definition, *SWF* includes fed funds and repos.

I include the interactions between wholesale funding (*WF* or *SWF*) and Crisis (*CrisisI* and *CrisisII*) to examine the effect of wholesale funding on the credit supply during the crisis. Macroeconomic risk is measured through an indicator variable ($Crisis_t$) for the 2008 financial crisis. Following Acharya and Mora (2014) and Joh and Kim (2014), I divide the crisis period into two sub-sample periods taking the Lehman Brothers bankruptcy as the watershed. The Lehman failure has different implications from the perspective of government support. Extensive government emergency actions to stabilize the economy immediately after the Lehman failure could lead to the problem of moral hazard for both wholesale financiers and banks (Calomiris 1999; Flannery and

[6] Deposit insurance limits were raised to $250,000 in October 2008. However, reporting thresholds on time deposits in Call Reports reflect this change in deposit insurance coverage from 2010Q1.

Sorescu 1996). These types of strong government guarantees may diminish investors' incentives to monitor banks. The pre-Lehman crisis periods (*CrisisI*) covers the third quarter of 2007 to the second quarter of 2008 (2007:Q3-2008:Q2), and the post-Lehman crisis period (*CrisisII*) starts from the third quarter of 2008 to the second quarter of 2009 (2008:3Q-2009:2Q).

Information on other control variables ($Other\ Contols_{it-1}$) is described in detail below. Explanatory variables related to a bank's financial data take values lagged by one quarter to avoid the potential endogeneity problem. $\mu_1$is bank fixed effects to control for time-invariant unobserved heterogeneity at the bank level (i), and $\tau_1$is time-fixed effects to account for changes in the economic environment across quarters (t). ε_{it} is the error term. All panel regressions are estimated with robust standard errors clustered at the bank level to account for within-bank serial correlation.

In addition, I employ the following two fixed effect models to examine how risky banks with more wholesale funding adjust risky lending depending on macroeconomic conditions. Specifically, I include the interaction term *WF(SWF)*NPL*Crisis*: wholesale funding, bank risk, and market conditions, respectively. Risky lending is defined as an increase in credit with higher rates. Equations (2) and (3) are models for quantity and price, respectively.

$$\Delta\, Credits_{it} = \beta_0 + \beta_1 Wholeslae\ Funding_{it-1} + \beta_2 Bank\ Risk_{it-1} + \beta_3 Crisis_t +$$
$$\beta_4 Wholesale\ Funding_{it-1} * Bank\ Risk_{it-1} +$$
$$\beta_5 Wholesale\ Funding_{it-1} * Crisis_t +$$
$$\beta_6 Wholesale\ Funding_{it-1} * Bank\ Risk_{it-1} * Crisis_t +$$
$$\beta_7\ Other\ Controls_{it-1} + \mu_{2i} + \tau_{2t} + \omega_{it} \quad (2)$$

$$Loan\ Spreads_{it} = \gamma_0 + \gamma_1 Wholeslae\ Funding_{it-1} + \gamma_2 Bank\ Risk_{it-1} +$$
$$\gamma_3 Crisis_t + \gamma_4 Wholesale\ Funding_{it-1} * Bank\ Risk_{it-1} +$$
$$\gamma_5 Wholesale\ Funding_{it-1} * Crisis_t +$$
$$\gamma_6 Wholesale\ Funding_{it-1} * Bank\ Risk_{it-1} * Crisis_t +$$
$$\gamma_7\ Other\ Controls_{it-1} + \mu_{3i} + \tau_{3t} + \eta_{it} \quad (3)$$

Where μ_2 and μ_3 are bank-fixed effects, and τ_2 and τ_3 are time-fixed effects that are common to all banks during the quarter. ω_{it} and η_{it} are error terms. Like Equation (1), explanatory variables related to a bank's financial data take values lagged by one quarter. All panel regressions are estimated with robust standard errors clustered at the bank level. Variables in the estimations as defined in detail in Table 2.1. Variables except for *M2/GDP* are winsorized at the top and bottom 1% of the distribution.

$Loan\ Spreads_{it}$ include spreads on total loans, C&I loans, and real estate loans[7].

[7] I calculate spreads on total loans, C&I loans, and real estate loans for the price Equation (2) based on data availability, although I calculate the changes in loans, loan commitments, short-term loans, real estate loans, and C&I loans for the quantity Equations (1) and (3). The income

The spread on total loans (C&I loans) are the difference between the implicit interest rates on total loans (C&I loans) and the three-year treasury constant maturity rate[8], expressed in annual terms. The implicit interest rates on total loans (C&I loans) are calculated as the quarterly average interest incomes of total loans divided by the quarterly average amounts of total loans. *Spreads on real estate loans* indicates the spread between the implicit interest rates on real estate loans and the ten-year treasury constant maturity rate, also expressed in annual terms. The imputed interest rates on real estate loans are calculated as the quarterly average interest incomes of real estate loans divided by the quarterly average amounts of real estate loans.

$Bank\ Risk_{it-1}$ refers to a bank-specific risk. Since sophisticated wholesale investors make a lending decision based on bank-specific and macroeconomic factors, I include bank-specific risk variables ($Bank\ Risk_{it-1}$) and the macroeconomic crisis ($Crisis_t$) in my models. I employ non-performing loans (NPL) and the Z-score as proxies for bank risk. *NPL* indicates the ratio of non-performing loans to total loans. Non-performing loans are those that a bank classifies as 90-days or more past due or nonaccrual in the Call Reports. The Z-score indicates a bank's distance to default, calculated as the sum of the return on assets and the equity capital ratio divided by the

---

statements of the Call Report do not provide the price information on loan commitments and short-term loans.

[8] I also employ the one-year treasury constant maturity rate or the five-year treasury constant maturity rate to calculate the spreads on total loans or C&I loans. My results are the same regardless of the treasury rates used.

standard deviation of the return on assets. A higher value indicates a lower risk of default.

$Other\ Controls_{it-1}$ refer to explanatory variables affecting the supply of bank credit, including bank-specific control variables and general macroeconomic condition variables. Bank-level control variables include bank size (*Ln(total assets)*), capital ratio (*Capital ratios*), and profitability (*Return on assets*). *Ln(total assets)* is measured as the natural logarithm of total assets in millions of dollars. *Capital ratios* is calculated as the ratio of bank equity to total assets. Market- or macroeconomic condition variables include the level of money supply (*M2/GDP*), each MSA's deposit market concentration (Herfindahl–Hirschman Index, HHI), each MSA's income growth, and each MSA's house price index (HPI). *M2/GDP* is calculated as M2 divided by GDP to account for the effect of the quantitative easing policy. HHI is constructed using branch-level deposit data from the FDIC's SOD database. When a bank operates in multiple-MSA markets, I weight the MSA-level variables using the proportion of a bank's deposits in each MSA. Therefore, HHI, income growth, and HPI are weighted variables at the MSA level.

Table 2.2 shows the summary statistics for the variables employed in the estimations, though level variables of the quantity variables and interest rates on loans are not reported because I use change variables of the quantity variables and spreads on loans in the estimations. For more information about my data, I provide summary statistics for the level variables and interest rates. For quantity variables, the ratio of loans to total assets is 0.6625, the ratio of loan commitments to total assets plus loan commitments is

0.1006, the ratio of short-term loans to total loans is 0.3049, the ratio of real estate loans to total loans is 0.7077, and the ratio of C&I loans to total loans is 0.1551. For price variables, interest on total loans is 6.92%, interest on real estate loans is 6.80%, and interest on C&I loans is 7.12%.

2.4 Empirical Results

2.4.1 Relationship between Credit Supply and Wholesale Funding

Table 2.3 reports how high wholesale-funded banks adjust their credit depending on macroeconomic conditions. The dependent variables in columns (1), (2), and (3) are the quarterly growth of loans, loan commitments, and total credits, respectively. Panel A shows the result for total wholesale funding and Panel B shows the result for short-term wholesale funding. In columns (1) and (3) of Panel A, the coefficients of *WF* are positive and significant at the 1% level, suggesting that banks with more wholesale funds provided more loans and loan commitments to borrowers prior to the 2008 crisis. This increase in credit could have led to the lending boom in the pre-crisis period. However, most coefficients of *WF*CrisisI* and *WF*CrisisII* are negative and significant at the 1% level. Banks with more wholesale funds provided fewer loans and loan commitments during the crisis period, implying that high wholesale-funded banks contributed to the credit crunch during the crisis. Ivashina and Scharfstein (2010) and

Cornett, McNutt, Strahan, and Tehranian (2011) provide evidence that banks with more stable funding (deposits or equity) cut their lending less during the crisis. The credit contraction by high wholesale-funded banks continued during the post-crisis period. Panel B for short-term wholesale funding shows the same results. Banks with high short-term wholesale dependence provided more credits during the good period. However, they reduced lending more during the crisis and post-crisis periods.

Table 2.4 reports the effect of wholesale funding on the quarterly growth of short-term loans, real estate loans, and C&I loans. The dependent variables in columns (1), (2), and (3) are the growth of short-term loans, real estate loans, and C&I loans, respectively. In all columns, *WF*(*SWF*) are positively associated with *ΔShort-term loans*, *ΔReal estate loans*, and *ΔC&I loans*. Banks with more wholesale funding increased their short-term, real estate, and C&I loans during the pre-crisis period. Also, all coefficients of *WF*(*SWF*) are statistically significant at the 1% level. During the crisis period, however, those high wholesale-funded banks reduced short-term, real estate, and C&I loans more. This credit contraction is more severe during the post-Lehman crisis period (*CrisisII*) than the pre-Lehman crisis period (*CrisisI*). High wholesale-funded banks decreased during only short-term loans during *CrisisI*. The coefficient of *WF*CrisisI* for short-term loans is significantly negative (-0.0096) and that of *SWF*CrisisI* is also significantly negative (-0.0070). However, the coefficients of *WF*CrisisI* for real estate and C&I loans are insignificant. On the other hand, during *CrisisII*, the coefficients of *WF*CrisisII* and S*WF*CrisisII* for all types of loans are negative and significant at the 1%

level. The decrease in the supply of short-term, real estate, and C&I loans continued during the post-crisis period. In other words, high wholesale-funded banks did not increase any of these types of loans, even after the crisis.

2.4.2 Controlling for the Impact of the TARP

Table 2.5 tests whether the findings in Tables 2.3 and 2.4 are robust after controlling for the impact of government intervention during the crisis period. In this table, I include the variable *TARP amounts,* which indicates the ratio of the amount of received TARP funds to total assets. Recall that I already control for the impact of QE by using *M2/GDP* in my earlier findings. Although this variable applies only to TARP-funded banks, if TARP significantly contributes to the supply of loans, my results become insignificant due to the inclusion of TARP variable. Panel A reports regression estimates for total wholesale funding (WF), and Panel B reports those for short-term wholesale funding (SWF). In columns (1)-(6), the dependent variables are *ΔLoans*, *ΔLoan commitments*, *ΔCredits*, *ΔShort-term loans*, *ΔReal estate loans*, and *ΔC&I loans*, respectively. My results are robust after controlling for the impact of the TARP. *WF* (*SWF*) is positively related to the growth of loans, credits, short-term, real estate, and C&I loans. In all columns, *WF (SWF)*CrisisII* and *WF (SWF)*Postcrisis* have negative and significant coefficients at the 1% level. Taken together, high (short-term) wholesale-funded banks provided more loans during the pre-crisis period, but decreased their

lending during the crisis and post-crisis periods after controlling for the effect for TARP-funded banks.

2.4.3 Relationship between Credit Supply, Wholesale Funding, and Bank Risk

Table 2.6 shows regression estimates for how risky banks with more wholesale funds adjust their supply of credit depending on macroeconomic conditions. To this end, I include the interaction terms between wholesale funding, bank risk, and market risk: *WF (SWF)*NPL*CrisisI*, *WF (SWF)*NPL*CrisisII*, and *WF (SWF)*NPL*Postcrisis*. Earlier results reported in Tables 2.3 and 2.4 show that a bank with more wholesale funds increased its lending before the crisis while decreasing lending during and after the crisis. If I consider bank risk as an additional explanatory variable of interest, I can test the assumption that risky banks rely more on wholesale funds change their lending decisions during good or bad times. If weak banks with high wholesale dependence increase their loans, especially the risky loan components (short-term, real estate, and C&I loans), it can be assumed that they take more risks. In this case, it is difficult to say that wholesale financiers effectively monitor banks. Furthermore, Joh and Kim (2014) show that wholesale financiers discipline banks for increasing risk only during stable economic periods, and provide evidence that wholesale financiers did not punish risky banks during the 2008 crisis and post-crisis period.

The results reported in Table 2.6 are consistent with Joh and Kim (2014)'s results. That is, (short-term) wholesale financiers discipline banks against increased risky

lending during boom times. However, they do not discipline banks to be prudent in their lending decisions during the crisis and post-crisis periods. Furthermore, this lack of market discipline is more severe during the post-Lehman crisis period when the government implements rescue programs than for the pre-Lehman crisis period. Uninsured market investors may have little incentive to discipline banks because they do not have to bear the losses from bank failures. Interestingly, the increase in risky lending of weak banks with high wholesale funding ratio continued and sometime even intensified during the post-crisis period when the Dodd-Frank Act was introduced, suggesting that the Dodd-Frank Act's aim to reduce expectations of a too-big-to-fail policy and bank bailouts was not met. If the Dodd-Frank Act was effective, wholesale financiers should monitor banks and discourage greater risk because they must bear the losses in case of bank failures.

Specifically, in Panel A, *WF* is positively associated with the changes in loans, loan commitments, total credits, short-term, real estate, and C&I loans in columns (1)-(6). However, the coefficients of *WF*NPL* in columns (1)-(6) have negative values, implying that riskier banks with more wholesale funds decrease total credit and risky loans during boom times while high wholesale-funded banks increase total credit and risky loans during good times. For the crisis period, the coefficients of *WF*CrisisI* and *NPL*CrisisI* have negative values. However, the coefficients of *WF*NPL*CrisisI* are positive in all columns and statistically significant for the changes in loans (column (1)), total credit (column (3)), and real estate loans (column (5)), implying a small measure of evidence for market discipline. The evidence of the lack of market discipline intensified

during *CrisisII* and *Postcrisis*. All coefficients of *WF*NPL*CrisisII* and *WF*NPL*Postcrisis* are positive, while the coefficients of *NPL*CrisisII* or *NPL*Postcrisis* have negative values.

In Panel B, regression estimates for short-term wholesale funding provide similar, though stronger, results than for total wholesale funding in Panel A. All coefficients of *SWF*NPL* in columns (1)-(6) have negative and statistically significant values. In the crisis period (2007:Q3-2008:Q2) prior to the Lehman failure, there was uncertainty about the probability of government intervention (Acharya and Mora 2014) because extensive explicit and implicit government guarantees did not exist until after the Lehman Brothers bankruptcy. My results support this argument because all coefficients of *SWF*NPL*CrisisII* are positive and significant (except for the growth of short-term loans), while all coefficients for *SWF*NPL*CrisisI* are insignificant. The statistical significance of the positive coefficients of *SWF*NPL*Postcrisis* are even stronger during the post-crisis period, implying that the expectation of bank bailouts and government guarantees during the severe recession intensified in the aftermath of the 2008 crisis. This result is inconsistent with Martinez Peria and Schmukler (2001), who argue that a banking crisis plays a role in improving market discipline as a warning of bank insolvency using bank data for Argentina, Chile, and Mexico during the 1980s and 1990s.

Table 2.7 confirms the findings reported in Table 2.6 (quantity) in the price context. Recall that risky lending is defined as an increase in credit (or risky loan components) with higher interest rates. In this table, I attempt to confirm the earlier results for the

quantity equation (Equation (2)), using the price equation (Equation (3)). Panel A presents estimates for total wholesale funding, and Panel B reports those for short-term wholesale funding. The dependent variables in columns (1)-(3) are the spreads on total loans (*Spreads on total loans*), real estate loans (*Spreads on real estate*), and C&I loans (*Spreads on C&I loans*), respectively. Although I use the interest rates on total loans, real estate loans, and C&I loans instead of the spreads, the results are the same whether interest rates or spreads are used. Spreads on total loans and C&I loans (real estate loans) are defined as the difference between the implicit loan rates and the three-year (ten-year) treasury constant maturity rate.

The results in the price equation also confirm the earlier results for the quantity equation. That is, risky banks with high wholesale funding dependence lower their interest rates on total loans, real estate loans, and C&I loans during boom times. In Panel A, *WF*NPL* is negatively associated with *Spreads on total loans, real estate loans,* and *C&I loans*. Combining this result with *WF*NPL* in Panel A of Table 2.6, risky banks with more wholesale funds increased risky loans less and provided lower interest rates on their credit during good times, suggesting that risky banks relying more on wholesale funding invested more prudently than risky banks with less wholesale funding during the pre-crisis period because of the disciplinary role of wholesale financiers, implying that weak banks with more wholesale funds pursue prudent lending during boom periods. During the crisis, the coefficients of *WF*NPL*CrisisII* for *Spreads on total loans* and *Spreads on C&I loans* were significantly positive, while all coefficients of *WF*NPL*CrisisI* are insignificant. Combining this result with *WF*NPL*CrisisI* and

*WF*NPL*CrisisII* in Panel A of Table 2.6 indicates that risky banks with more wholesale funds engaged in risky lending (more credit, short-term loans, real estate loans, and C&I loans with higher prices) during the post-Lehman crisis period. This result questions the effectiveness of market discipline during the post-Lehman crisis period when strong government guarantees protected uninsured bank creditors. Consistent with the earlier results, this lack of market discipline continued during the post-crisis period, also questioning the effectiveness of the Dodd-Frank Act. Panel B for short-term wholesale funds shows the same results as Panel A. The coefficients of *SWF* in columns (1)-(3) are positive and statistically significant. All coefficients of *SWF*NPL*CrisisI* are insignificant, while all coefficients of *SWF*NPL*CrisisII* are significantly positive. Furthermore, *SWF*NPL*Postcrisis* in all columns have positive and significant coefficients.

In short, combining the results of Table 2.6 with those of Table 2.7, I find that risky banks with more wholesale funding lent prudently during the lending boom period, providing evidence of market discipline. However, risky banks with more wholesale funds increased risky lending during the crisis period, implying little evidence for the disciplinary role of wholesale financiers during the 2008 crisis when strong government protections took effect. Even after the crisis, market discipline does not improve, despite the Dodd-Frank Act. This result also seems to stem from strong government guarantees for banks, which eliminate the incentives for uninsured wholesale financiers to monitor banks.

2.5 Robustness Checks

Tables 2.8 and 2.9 provide the results of robustness tests for the presence of market discipline in terms of preventing risky bank lending by employing the Z-score as a proxy of bank risk. Tables 2.8 and 2.9 report the results for quantity and price on the relationship between wholesale funding, bank risk, and macroeconomic conditions, respectively. Note that the Z-score is negatively associated with bank risk. Therefore, I expect the opposite signs on the estimated coefficients. The results are qualitatively similar to the earlier findings, although the statistical significance is weaker.

In Panel A of Table 2.8, *WF*Z-score* of *ΔCommitments* and *ΔCredits* are positive and significant, providing evidence of market discipline for preventing banks from pursuing risky lending during boom times. On the other hand, all coefficients of *WF*Z-score*CrisisI* are insignificant. *WF*Z-score*CrisisII* of *ΔCommitments*, *ΔCredits*, and *ΔC&I loans* has significantly negative coefficients. Additionally, the coefficient of *WF*Z-score*Postcrisis* of *ΔCommitments* is negative and statistically significant at the 5% level. Panel B for short-term wholesale funding also shows qualitatively similar results. There is evidence of market discipline during stable economic periods, while there is little evidence of market discipline during the crisis and post-crisis periods.

Table 2.9 for the price equation complements the results of Table 2.8 for the quantity equation. The coefficients of *WF*Z-score* of the spreads on total loans and real estate loans in Panel A are positive and significant at the 5% level. Combining this result with

the *WF*Z-score* result in Table 2.8 suggests that risky banks with more wholesale funds lower their interest rates and reduce credit during boom times. All coefficients of *WF*Z-score*CrisisI* are insignificant, suggesting that risky banks relying more on wholesale funding did not increase risky investments in terms of both quantity (Table 2.8) and price (Table 2.9) during the pre-Lehman crisis period. The coefficients of *WF*Z-score*CrisisII* of the spreads on total loans and C&I loans are negative and statistically significant. In addition, all coefficients of *WF*Z-score*Postcrisis* have statistically negative coefficients for the post-crisis period. Combining this with the results for the quantity dimension (*WF*Z-score*CrisisII* and *WF*Z-score*Postcrisis* of Table 2.8), risky banks increased risky lending (a higher quantity with a higher price) during the crisis and post-crisis period. In short, my findings support the presence of market discipline, in the form of decreased risky lending during boom times, and provide little evidence of market discipline during the crisis and post-crisis periods, which are robust after employing the Z-score as an additional proxy for bank risk.

2.6 Conclusion

Using a panel dataset for US commercial banks between 2002:Q1 and 2012:Q4, I find that banks which rely more on wholesale funding granted more credit during the pre-crisis period, implying an accumulation of financial vulnerability in the banking system. However, high wholesale-funded banks reduced their credit to a greater extent than low

wholesale-funded banks during the financial crisis of 2008, especially after the Lehman Brothers bankruptcy. The credit contraction continued even after the crisis. From the loan component perspective, high wholesale-funded banks increased short-term, real estate, and C&I loans during the pre-crisis period, though they decreased these in the crisis and the post-crisis periods.

I also find that riskier banks with more wholesale funds do not pursue risky lending during boom times, suggesting the presence of market discipline. Specifically, riskier banks with high wholesale funding dependence decrease the supply of loans, loan commitments, short-term loans, real estate loans, and C&I loans. In addition, they lowered the interest rates charged on total loans, real estate loans, and C&I loans during the credit boom period, while they increased risky lending during the crisis. That is, they increased the supply of loans, loan commitments, short-term loans, real estate loans, and C&I loans, charging higher interest rates. This result implies a lack of market discipline in periods of market stress when governments implement extensive support programs to stabilize the economy. Furthermore, the increase in risky lending continued during the post-crisis period, suggesting the ineffectiveness of the Dodd-Frank Act that aimed to remove the expectation of implicit government protection.

References

Acharya, V. V., & Mora, N. (2014). A crisis of banks as liquidity providers. *The Journal of Finance*.

Afonso, G., Kovner, A., & Schoar, A. (2011). Stressed, not frozen: The federal funds market in the financial crisis. *The Journal of Finance, 66*(4), 1109-1139.

Allen, J., & Paligorova, T. (2011). Bank loans for private and public firms in a credit crunch.

Berger, A. N., & Udell, G. F. (1995). Relationship lending and lines of credit in small firm finance. *Journal of business*, 351-381.

Blaško, M., & Sinkey Jr, J. F. (2006). Bank asset structure, real-estate lending, and risk-taking. *The Quarterly Review of Economics and Finance, 46*(1), 53-81.

Bryant, J. (1980). A model of reserves, bank runs, and deposit insurance? *Journal of Banking & Finance, 4*(4), 335-344.

Calomiris, C. W. (1999). Building an incentive-compatible safety net. *Journal of Banking & Finance, 23*(10), 1499-1519.

Calomiris, C. W., & Kahn, C. M. (1991). The role of demandable debt in structuring optimal banking arrangements. *The American Economic Review*, 497-513.

Cornett, M. M., McNutt, J. J., Strahan, P. E., & Tehranian, H. (2011). Liquidity risk management and credit supply in the financial crisis. *Journal of Financial Economics, 101*(2), 297-312.

Demirgüç-Kunt, A., & Huizinga, H. (2010). Bank activity and funding strategies: The impact on risk and returns. *Journal of Financial Economics, 98*(3), 626-650.

Demirgüç-Kunt, A., & Kane, E. J. (2002). Deposit Insurance around the Globe: Where Does It Work? *The Journal of Economic Perspectives, 16*(2), 175-195.

Demsetz, R. S., & Strahan, P. E. (1997). Diversification, size, and risk at bank holding companies. *Journal of Money, Credit, and Banking*, 300-313.

Diamond, D. W., & Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *The journal of political economy*, 401-419.

Diamond, D. W., & Rajan, R. G. (2001). Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking. *Journal of Political Economy, 109*(2), 287.

Diamond, D. W., & Rajan, R. G. (2009). The Credit Crisis: Conjectures about Causes and Remedies. *American Economic Review, 99*(2), 606-610.

Ellis, D. M., & Flannery, M. J. (1992). Does the debt market assess large banks, risk?: Time series evidence from money center CDs. *Journal of Monetary Economics, 30*(3), 481-502.

Flannery, M. J. (1998). Using market information in prudential bank supervision: A review of the US empirical evidence. *Journal of Money, Credit and Banking*, 273-305.

Flannery, M. J. (2001). The faces of “market discipline”. *Journal of Financial Services Research, 20*(2-3), 107-119.

Flannery, M. J., & Sorescu, S. M. (1996). Evidence of bank market discipline in

subordinated debenture yields: 1983–1991. *The Journal of Finance, 51*(4), 1347-1377.

Gatev, E., Schuermann, T., & Strahan, P. E. (2009). Managing bank liquidity risk: How deposit-loan synergies vary with market conditions. *Review of Financial Studies, 22*(3), 995-1020.

Gatev, E., & Strahan, P. E. (2006). Banks' Advantage in Hedging Liquidity Risk: Theory and Evidence from the Commercial Paper Market. *The Journal of Finance, 61*(2), 867-892.

Gilbert, R. A. (1990). Market discipline of bank risk: Theory and evidence. *Federal Reserve Bank of St. Louis Review, 72*(January/February 1990).

Hahm, J. h., Shin, H. S., & Shin, K. (2013). Noncore bank liabilities and financial vulnerability. *Journal of Money, Credit and Banking, 45*(s1), 3-36.

Hannan, T. H., & Hanweck, G. A. (1988). Bank Insolvency Risk and the Market for Large Certificates of Deposit. *Journal of Money, Credit and Banking, 20*(2), 203-211. doi: 10.2307/1992111

He, Z., & Xiong, W. (2012). Dynamic debt runs. *Review of Financial Studies*, hhs004

Huang, R., & Ratnovski, L. (2011). The dark side of bank wholesale funding. *Journal of Financial Intermediation, 20*(2), 248-263.

Ivashina, V., & Scharfstein, D. (2010). Bank lending during the financial crisis of 2008. *Journal of Financial economics, 97*(3), 319-338.

Joh, S. W., & Kim, J. (2014). Do wholesale financiers discipline risky banks? Evidence from the financial crisis of 2008. Working paper.

Kashyap, A. K., Rajan, R., & Stein, J. C. (2002). Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-Taking. *The Journal of Finance, 57*(1), 33-73.

Martinez Peria, M. S., & Schmukler, S. L. (2001). Do depositors punish banks for bad behavior? Market discipline, deposit insurance, and banking crises. *The Journal of Finance, 56*(3), 1029-1051.

Pagaon, M., & Jappelli, T. (1993). Information sharing in credit markets. *The Journal of Finance, 48*(5), 1693-1718.

Park, K., & Pennacchi, G. (2009). Harming depositors and helping borrowers: The disparate impact of bank consolidation. *Review of Financial Studies, 22*(1), 1-40.

Samolyk, K. A. (1994). US banking sector trends: assessing disparities in industry performance. *Economic Review, Federal Reserve Bank of Cleveland, Q (II)*, 2-17.

Santos, J. A. (2010). Bank corporate loan pricing following the subprime crisis. *Review of Financial Studies*, hhq115.

Shin, H. S. (2009). Reflections on Northern Rock: the bank run that heralded the global financial crisis. *The Journal of Economic Perspectives*, 101-120.

Stiglitz, J. E., & Weiss, A. (1981). Credit rationing in markets with imperfect information. *The American economic review*, 393-410.

Figure 2.1 Trends in Total Assets, Total Loans, Core Deposits, Wholesale Funds, and Equity
This figure shows the trends of the quarterly dollar amount of total assets, total loans, core deposits, wholesale funds, and equity at US commercial banks from 2002:Q1 through 2012:Q4. Core deposits include transaction accounts, savings deposits, and fully insured time deposits of less than $100,000 (less than $250,000 from 2008:Q4). Wholesale funds include federal funds purchased, securities sold under agreements to repurchase, subordinated notes and debentures, other borrowed money, brokered deposits, and uninsured large time deposits. The axis on the left-hand side of the graph shows the trend of total assets. The axis on the right-hand side of the graph shows the trends of total loans, core deposits, wholesale funds, and equity. The data are obtained from Call Reports.

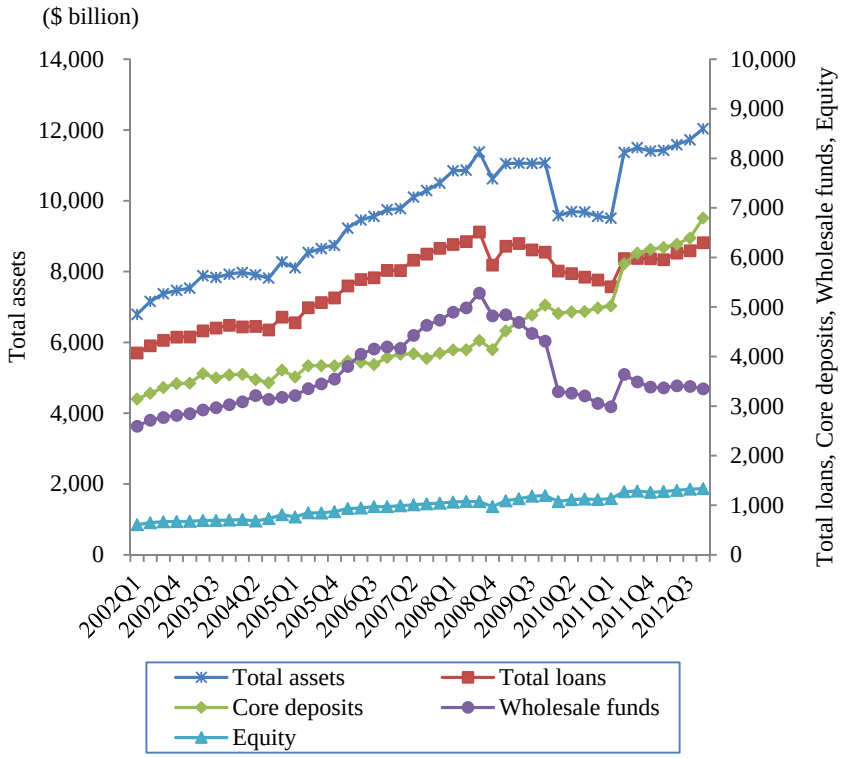


Figure 2.2 Trends in Bank Funding Structure
This figure shows the trend of bank funding structure at US commercial banks during the period 2002-2012. Core deposits include transaction accounts, savings deposits, and fully insured time deposits of less than $100,000 (less than $250,000 from 2008:Q4). Wholesale funds include federal funds purchased, securities sold under agreements to repurchase, subordinated notes and debentures, other borrowed money, brokered deposits, and uninsured large time deposits. Equity is bank equity capital. The funding structure data are quarterly averages. The data are obtained from Call Reports.

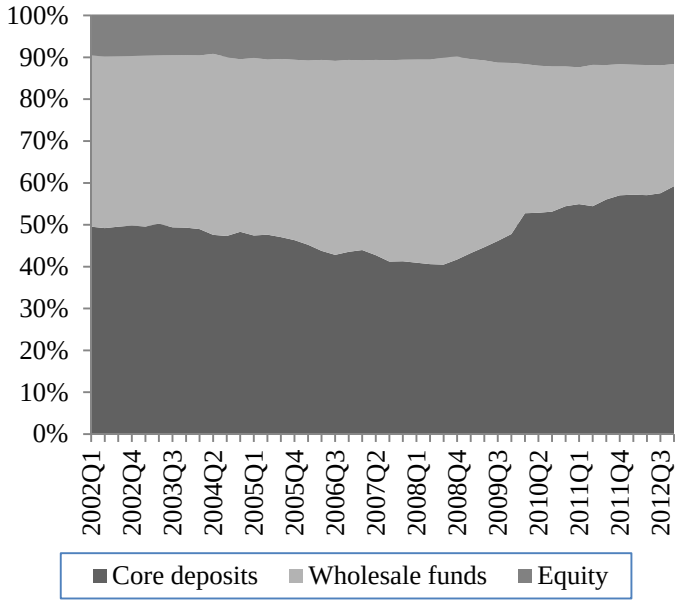


Figure 2.3 Bank Wholesale Funding and Loan Supply: Aggregate Level

Figure 2.3 shows the relation between wholesale funding and loan supply at the aggregate level for US commercial banks between 2002 and 2012. The data are obtained from Call Reports. Figure 2.3.1 shows the trends of the aggregate loan supply across the level of the wholesale funding ratio (*WF*). Banks are divided into three categories: banks with high, medium, and low wholesale funding ratio (*WF*), which is the ratio of wholesale funding to total assets. Wholesale funds include federal funds purchased, securities sold under agreements to repurchase, subordinated notes and debentures, other borrowed money, brokered deposits, and uninsured large time deposits. Figures 2.3.2 and 2.3.3 show the aggregate loan supply across the wholesale funding ratio in large banks and in small banks, respectively. The axis on the left-hand side of Figure 2.3.3 shows aggregate loans of small banks while the axis on the right-hand side of the graph shows aggregate loans of small banks with high/medium/low wholesale funding ratios. Banks are classified as large and small banks based on total assets: large banks (greater than $1 billion in assets) and small banks (less than or equal to $ 1 billion in assets).

Figure 2.3.1 Total amount of loans by wholesale funds

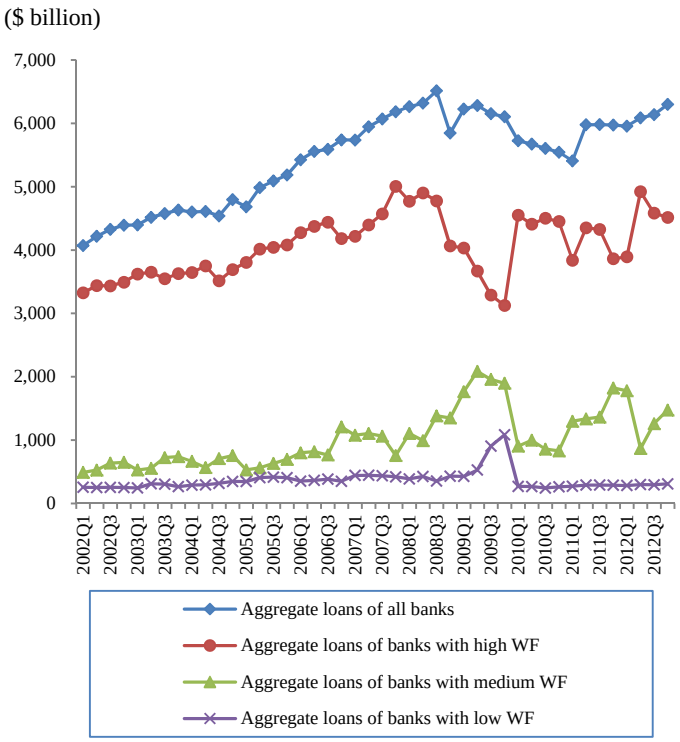


Figure 2.3.2 Total amount of loans by wholesale funds among large banks

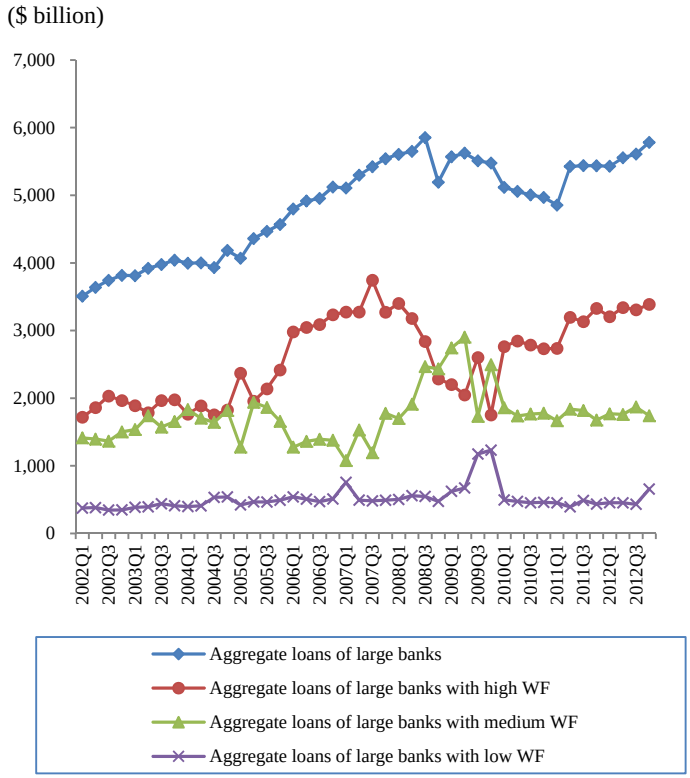


Figure 2.3.3 Total amount of loans by wholesale funds among small banks

($ billion)

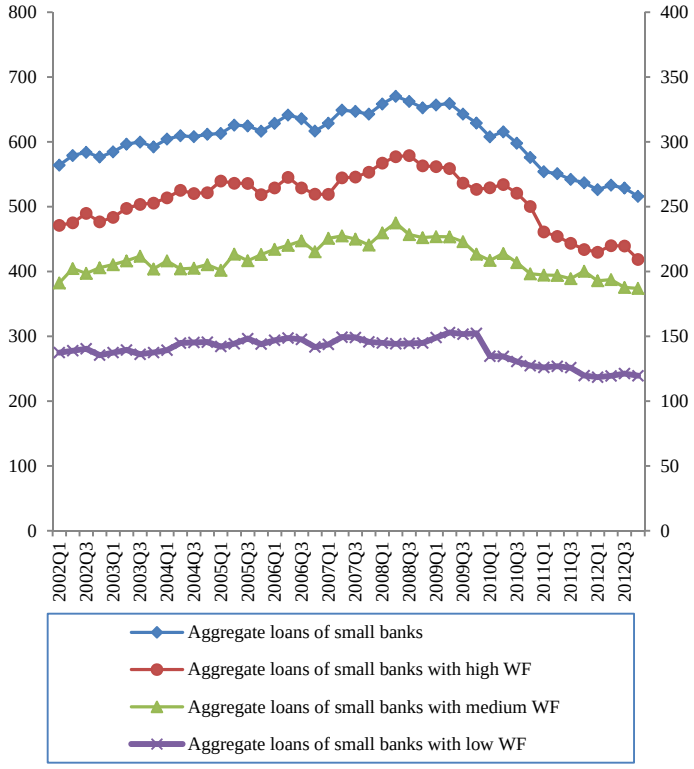


Figure 2.4 Bank Wholesale Funding and Credit Supply: Bank Level

Figure 2.4 shows the relation between wholesale funding and credit supply at the bank level depending on bank size (large or small banks). Three types of credit supply are defined in this figure: loans, loan commitments, and credits (loans plus loan commitments). Figures 2.4.1 and 2.4.2 show the difference in the ratio of loans to total assets (*Loans*) between high wholesale funding banks (high *WF*) and low wholesale funding banks (low *WF*) in the group of large banks and in the group of small banks, respectively. Figures 2.4.3 and 2.4.4 show the difference in the ratio of loan commitments to total assets plus loan commitments (*Loan commitments*) between high wholesale funding banks and low wholesale funding banks in the group of large banks and in the group of small banks, respectively. Figures 2.4.5 and 2.4.6 show the difference in the ratio of credits (loans plus loan commitments) to total assets plus loan commitments (*Credits*) between high wholesale funding banks and low wholesale funding banks in the group of large banks and in the group of small banks, respectively.

Figure 2.4.1 Difference in average *Loans* between large banks with high *WF* and those with low *WF*

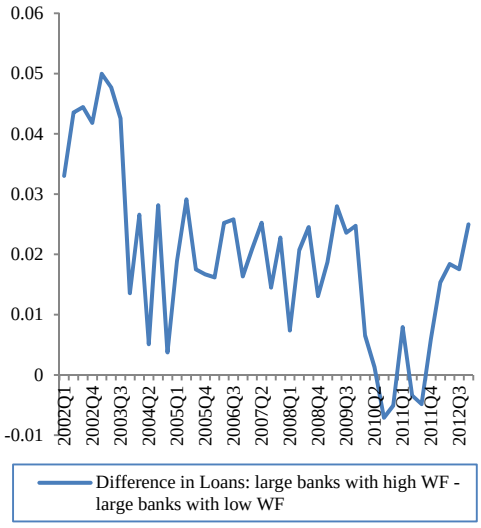


Figure 2.4.2 Difference in average *Loans* between small banks with high *WF* and those with low *WF*

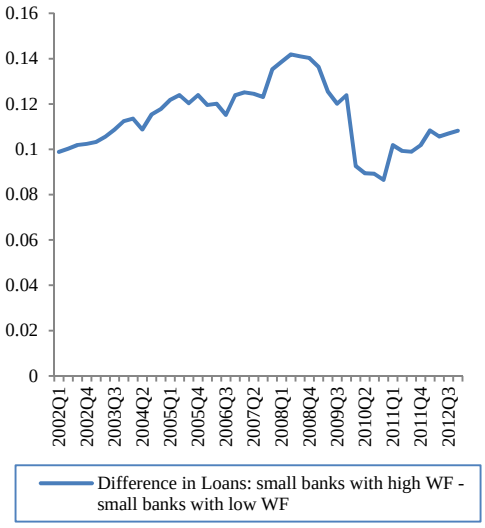


Figure 2.4.3 Difference in average *Loan commitments* between large banks with high *WF* and those with low *WF*

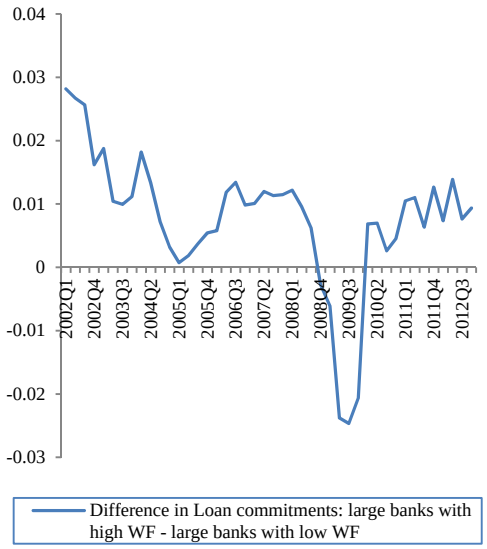


Figure 2.4.4 Difference in average *Loan commitments* between small banks with high *WF* and those with low *WF*

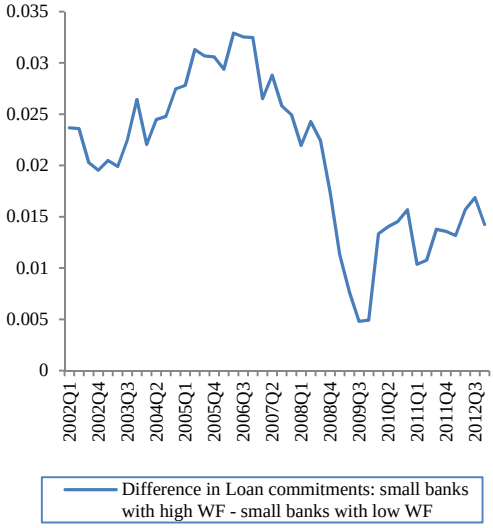


Figure 2.4.5 Difference in average *Credits* between large banks with high *WF* and those with low *WF*

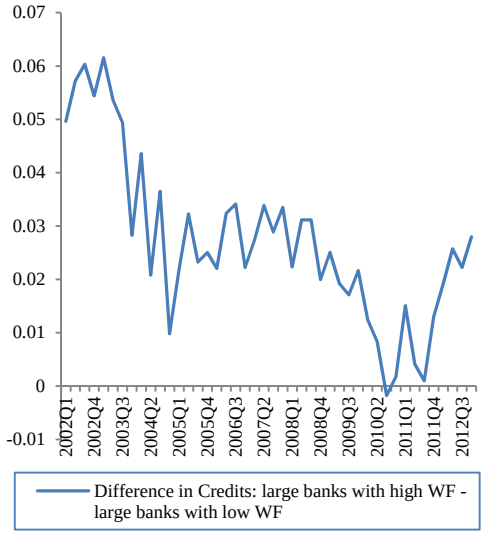


Figure 2.4.6 Difference in *Credits* between small banks with high *WF* and those with low *WF*

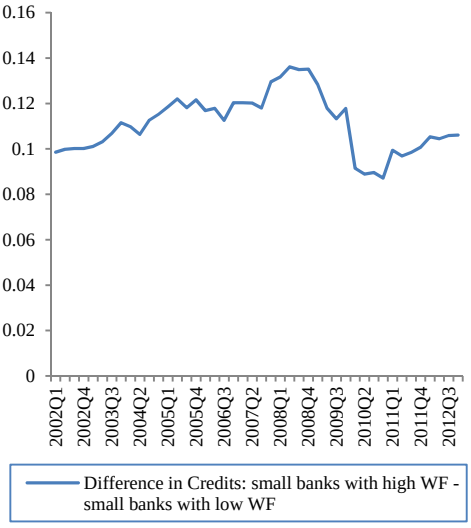


Table 2.1 Variable Definitions and Data Sources
The table presents the variable definitions and data sources.

Variable	Definition	Source
Dependent variables		
Quantity variables		
ΔLoans	Changes in total loans during the quarter divided by beginning of quarter total assets. (*Total loans$_t$ – Total loans$_{t-1}$)/Total assets$_{t-1}$*	Call Reports. Author's calculations
ΔLoan commitments	Changes in undrawn loan commitments during the quarter divided by beginning of quarter total assets. (*Loan commitments$_t$–Loan commitments$_{t-1}$)/Total assets$_{t-1}$*	Call Reports. Author's calculations
ΔCredits	Changes in loans and unused loan commitments during the quarter as a fraction of beginning of quarter total assets plus undrawn credit lines. (*Credits$_t$–Credits$_{t-1}$)/Total assets$_{t-1}$*	Call Reports. Author's calculations
ΔShort-term loans	Changes in short-term loans during the quarter divided by beginning of quarter total assets. (*Short-term loans$_t$–Short-term loans$_{t-1}$)/Total assets$_{t-1}$*	Call Reports. Author's calculations
ΔReal estate loans	Changes in real estate loans during the quarter divided by beginning of quarter total assets. (*Real estate loans$_t$– Real estate loans$_{t-1}$)/Total assets$_{t-1}$*	Call Reports. Author's calculations
ΔC&I loans	Changes in commercial and industrial (C&I) loans during the quarter divided by beginning of quarter total assets. (*C&I loans$_t$–C&I loans$_{t-1}$)/Total assets$_{t-1}$*	Call Reports. Author's calculations

Price variables		
Spreads on total loans	Spreads between the implicit interest rates on total loans and the three-year treasury constant maturity rate, and expressed in annual terms. The implicit rates are calculated as the quarterly average interest incomes of total loans divided by the quarterly average amounts of total loans	Call Reports. Author's calculations
Spreads on C&I loans	Spreads between the implicit interest rates on C&I loans and the three-year treasury constant maturity rate, expressed in annual terms. The imputed rates are calculated as the quarterly average interest incomes of C&I loans divided by the quarterly average amounts of C&I loans.	Call Reports. Author's calculations
Spreads on real estate loans	Spreads between the implicit interest rates on real estate loans and the ten-year treasury constant maturity rate, expressed in annual terms. The imputed rates are calculated as the quarterly average interest incomes of real estate loans divided by the quarterly average amounts of real estate loans.	Call Reports. Author's calculations
Explanatory variables		
Wholesale funds (WF)	Total amount of wholesale funding divided by total assets; wholesale funding is the sum of 1) federal funds purchased, 2) securities sold under agreements to repurchase 3) subordinated notes and debentures, 4) brokered deposits, 5) other borrowed money, 6) the estimated amount of deposits obtained through the use of deposit listing services that are not brokered deposits 7) deposits in foreign offices, and 8) uninsured time deposits (over $100,000 until 2009:Q4 and $250,000 from 2010:Q1)	Call Reports. Author's calculations

Short-term wholesale funds (SWF)	Short-term wholesale funds with a remaining maturity of one year or less(including fed funds and repos) divided by total assets	Call Reports. Author's calculations
NPL	Non-performing loans divided by total loans; non-performing loans are defined as the sum of loans past due 90days or more and nonaccrual loans. A higher ratio indicates a riskier loan portfolio.	Call Reports. Author's calculations
Z-score	A bank's distance to default, calculated as the sum of the return on assets and the equity capital ratio divided by the standard deviation of the return on assets. A higher value indicates lower risk of default.	Call Reports. Author's calculations
Return on assets	Return on assets (ROA)	Call Reports
Ln(total assets)	Natural logarithm of total assets in $ million	Call Reports
Capital ratios	Equity capital divided by total assets	Call Reports
Deposit-weighted HHI	Bank-level Herfindahl–Hirschman Index, weighted by the proportion of the bank's deposits in each MSA where the bank operates.	FDIC SOD Author's calculations
Deposit-weighted Income growth	Bank-level income growth rate, weighted by the proportion of the bank's deposits in each MSA where the bank operates.	BEA Author's calculations
Deposit-weighted HPI	Quarterly house price index at the MSA level, weighted by the proportion of the bank's deposits in each MSA where the bank operates.	FHFA Author's calculations
M2/GDP	Money supply, calculated as M2 as a fraction of GDP	FRB

Table 2.2 Summary Statistics

This table shows summary statistics for variables employed estimations. Quantity variables are scaled by beginning of period total assets (*ΔLoans*) or beginning of period total assets plus unused loan commitments (*ΔLoan commitments* and *ΔCredits*). *Credits* are defined as the sum of loans and undrawn loan commitments. Detailed information on the variables is provided in Table 2.1. Spreads on total loans are defined as the implicit interest rates on total loans and the three-year treasury constant maturity rate. Spreads on C&I loans are defined as the implicit interest rates on C&I loans and the three-year treasury constant maturity rate. Spreads on real estate loans are defined as the implicit interest rates on real estate loans and the ten-year treasury constant maturity rate. Variables except for *M2/GDP* are winsorized at the top and bottom 1% of the distribution.

Variables	Observations	Mean	SD	Min	Max
Dependent variables					
Quantity variables					
ΔLoans	155,980	0.0136	0.0390	-0.0738	0.1979
ΔLoan commitments	155,980	0.0025	0.0194	-0.0545	0.0832
ΔCredits	155,980	0.0141	0.0426	-0.0822	0.2140
ΔShort-term loans	155,980	0.0040	0.0311	-0.1003	0.1349
ΔC&I loans	155,980	0.0020	0.0130	-0.0398	0.0588
ΔReal estate loans	155,980	0.0114	0.0318	-0.0568	0.1624
Price viariables					
Spreads on total loans	155,980	0.0444	0.0124	-0.0064	0.1094
Spreads on C&I loans	155,980	0.0465	0.0202	-0.0346	0.1617
Spreads on real estate loans	155,980	0.0302	0.0106	-0.0087	0.0932
Explanatory variables					
Wholesale funds (WF)	155,980	0.2174	0.1411	0.0079	0.7355
Short-term wholesale funds (SWF)	155,980	0.1532	0.1058	0.0034	0.5676
Ln(total assets)	155,980	5.2899	1.3167	2.6983	10.047
NPL	155,980	0.0168	0.0228	0	0.1237
Extremely high NPL	155,980	0.1497	0.3541	0	1
High NPL	155,980	0.1043	0.3057	0	1
Z-score	103,502	32.112	16.967	5.2882	100.32
Return on assets	155,980	0.0046	0.0075	-0.0309	0.0234
Capital ratios	155,980	0.1041	0.0343	0.0540	0.3127
TARP amounts	155,980	0.0015	0.0074	0	0.0625
Deposit-weighted HHI	155,980	0.7020	0.0628	0.2848	0.8399
Deposit-weighted income growth	155,980	0.0416	0.0319	-0.0583	0.1184
Deposit-weighted HPI	155,980	4.9024	0.8116	0.3950	5.6110
M2/GDP	155,980	0.5397	0.0430	0.4934	0.6340

Table 2.3 Relationship between Credit Supply and Wholesale Funding

This table shows the effect of wholesale funds on the loan, commitment (line of credit), and credit supply growth using the fixed effects model. The quarterly growth in loan supply is scaled by beginning of period total assets. The quarterly growth in loan commitment and credit (loan plus undrawn loan commitments) supply are scaled by beginning of period total assets plus unused loan commitments. *Crisis I*, *Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Detailed information on the variables is provided in Table 2.1. Robust standard errors are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗ represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Total wholesale funding (WF)			Panel B: Short-term wholesale funding (SWF)		
	ΔLoans	*ΔCommitments*	*ΔCredits*	*ΔLoans*	*ΔCommitments*	*ΔCredits*
	(1)	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
WF (SWF)	0.0160***	-0.0007	0.0158***	0.0189***	0.0011	0.0220***
	(5.29)	(-0.55)	(3.97)	(5.01)	(0.71)	(4.53)
CrisisI	0.0410***	0.0012	0.0434***	0.0401***	0.0015	0.0430***
	(19.18)	(0.79)	(15.22)	(18.69)	(1.00)	(15.07)
*WF (SWF)*CrisisI*	-0.0012	-0.0098***	-0.0121***	0.0054	-0.0152***	-0.0121*
	(-0.34)	(-5.24)	(-2.61)	(1.15)	(-6.01)	(-1.95)
CrisisII	0.6054***	0.0060	0.6202***	0.6081***	0.0063	0.6239***
	(20.30)	(0.26)	(15.44)	(20.39)	(0.27)	(15.52)
*WF (SWF)*CrisisII*	-0.0169***	-0.0197***	-0.0396***	-0.0180***	-0.0269***	-0.0492***
	(-4.76)	(-10.53)	(-8.25)	(-3.66)	(-10.61)	(-7.59)
Postcrisis	2.9055***	0.0406	2.9839***	2.9207***	0.0437	3.0052***
	(20.07)	(0.37)	(15.33)	(20.17)	(0.39)	(15.42)
*WF (SWF)*Postcrisis*	-0.0340***	-0.0062***	-0.0433***	-0.0359***	-0.0079***	-0.0468***
	(-8.76)	(-4.30)	(-9.24)	(-7.47)	(-3.88)	(-7.65)
Ln(total assets)	-0.0256***	-0.0076***	-0.0347***	-0.0259***	-0.0077***	-0.0352***
	(-17.70)	(-17.80)	(-18.81)	(-17.91)	(-18.28)	(-19.16)
Capital ratios	0.2611***	0.0434***	0.3235***	0.2606***	0.0451***	0.3252***
	(20.91)	(9.32)	(20.24)	(20.82)	(9.71)	(20.41)
NPL	-0.4725***	-0.0617***	-0.5360***	-0.4773***	-0.0629***	-0.5424***
	(-44.36)	(-16.30)	(-40.92)	(-44.86)	(-16.78)	(-41.48)
Return on assets	-0.1360***	0.0485***	-0.1054***	-0.1337***	0.0488***	-0.1024**
	(-4.17)	(3.50)	(-2.64)	(-4.09)	(3.52)	(-2.56)
Deposit-weighted HHI	0.0018	0.0141***	0.0226*	0.0017	0.0138***	0.0222*
	(0.17)	(3.30)	(1.72)	(0.16)	(3.24)	(1.69)
Deposit-weighted income growth	0.0521***	0.0314***	0.0838***	0.0522***	0.0316***	0.0843***
	(8.04)	(10.90)	(10.11)	(8.08)	(11.02)	(10.18)
Deposit-weighted HPI	0.0007	-0.0013**	-0.0008	0.0007	-0.0013**	-0.0008
	(0.59)	(-2.33)	(-0.51)	(0.64)	(-2.29)	(-0.46)
M2/GDP	-26.0653***	-0.3277	-26.7274***	-26.2141***	-0.3556	-26.9305***
	(-20.00)	(-0.33)	(-15.25)	(-20.11)	(-0.36)	(-15.35)
Constant	13.2743***	0.1989	13.6445***	13.3510***	0.2131	13.7490***
	(20.16)	(0.39)	(15.42)	(20.28)	(0.42)	(15.52)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.2116	0.0437	0.1924	0.2110	0.0438	0.1918
Observations	155,980	155,980	155,980	155,980	155,980	155,980

Table 2.4 Relationship between Credit Supply and Wholesale Funding: Loan Components

This table shows the effect of wholesale funding on the short-term loan, real estate loan, and C&I loan supply growth using the fixed effects model. The quarterly growth in short-term loans, real estate loans, and corporate loans is scaled by beginning of period total assets. *Crisis I*, *Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Detailed information on the variables is provided in Table 2.1. Robust standard errors are clustered by bank to control for heteroskedasticity and within-bank serial correlation. T-statistics are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Total wholesale funding (WF)			Panel B: Short-term wholesale funding (SWF)		
	ΔShort-term loans	*ΔReal estate loans*	*ΔC&I loans*	*ΔShort-term loans*	*ΔReal estate loans*	*ΔC&I loans*
	(1)	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
WF (SWF)	0.0098***	0.0138***	0.0037***	0.0095***	0.0161***	0.0047***
	(5.20)	(5.69)	(4.21)	(4.02)	(5.23)	(4.46)
CrisisI	0.0325***	0.0205***	0.0068***	0.0315***	0.0197***	0.0067***
	(16.35)	(10.90)	(7.63)	(15.92)	(10.43)	(7.60)
*WF (SWF)*CrisisI*	-0.0096***	-0.0028	0.0002	-0.0070**	0.0025	0.0005
	(-3.88)	(-0.95)	(0.16)	(-2.13)	(0.62)	(0.35)
CrisisII	0.4557***	0.2844***	0.0882***	0.4562***	0.2870***	0.0885***
	(15.18)	(10.74)	(6.56)	(15.20)	(10.84)	(6.58)
*WF (SWF)*CrisisII*	-0.0133***	-0.0142***	-0.0028***	-0.0174***	-0.0132***	-0.0046***
	(-5.42)	(-4.78)	(-2.74)	(-5.17)	(-3.25)	(-3.48)
Postcrisis	2.2132***	1.3507***	0.4224***	2.2147***	1.3666***	0.4233***
	(15.17)	(10.52)	(6.48)	(15.18)	(10.64)	(6.48)
*WF (SWF)*Postcrisis*	-0.0224***	-0.0268***	-0.0061***	-0.0251***	-0.0265***	-0.0081***
	(-10.07)	(-8.99)	(-5.24)	(-8.81)	(-6.98)	(-5.65)
Ln(total assets)	-0.0103***	-0.0189***	-0.0046***	-0.0104***	-0.0192***	-0.0046***
	(-15.10)	(-16.46)	(-12.49)	(-15.24)	(-16.70)	(-12.29)
Capital ratios	0.0930***	0.1809***	0.0529***	0.0924***	0.1804***	0.0526***
	(12.93)	(18.08)	(15.25)	(12.88)	(18.02)	(15.13)
NPL	-0.2053***	-0.3846***	-0.0626***	-0.2089***	-0.3886***	-0.0631***
	(-28.25)	(-44.83)	(-20.08)	(-28.72)	(-45.27)	(-20.37)
Return on assets	0.0557***	-0.0832***	-0.0107	0.0553**	-0.0803***	-0.0112
	(2.58)	(-3.22)	(-1.05)	(2.55)	(-3.10)	(-1.09)
Deposit-weighted HHI	0.0081	0.0039	-0.0026	0.0079	0.0038	-0.0026
	(1.27)	(0.46)	(-0.85)	(1.23)	(0.45)	(-0.86)
Deposit-weighted income growth	0.0284***	0.0483***	0.0026	0.0278***	0.0487***	0.0024
	(6.28)	(8.86)	(1.30)	(6.16)	(8.94)	(1.20)
Deposit-weighted HPI	-0.0010	0.0021**	-0.0002	-0.0009	0.0021**	-0.0002
	(-1.37)	(2.24)	(-0.72)	(-1.27)	(2.28)	(-0.70)
M2/GDP	-19.8510***	-12.0923***	-3.7937***	-19.8734***	-12.2447***	-3.8029***
	(-15.11)	(-10.47)	(-6.46)	(-15.13)	(-10.60)	(-6.47)
Constant	10.0647***	6.1828***	1.9388***	10.0767***	6.2614***	1.9434***
	(15.18)	(10.60)	(6.54)	(15.19)	(10.73)	(6.55)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.0674	0.1856	0.0491	0.0671	0.1849	0.0491
Observations	155,980	155,980	155,980	155,980	155,980	155,980

Table 2.5 Relationship between Credit Supply and Wholesale Funding: TARP

This table reports the effect of wholesale funding on credit supply growth (total loans, loan commitments, credits, short-term, real estate, and C&I loans), controlling for the impact of the TARP. The quarterly growth in (short-term, real estate, C&I, and total) loan supply is scaled by beginning of period total assets. The quarterly growth in loan commitment and credit (loan plus loan commitment) supply are scaled by beginning of period total assets plus unused loan commitments. Detailed information on variables is provided in Table 2.1. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗ represent significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Total wholesale funding (WF)

	ΔLoans	*ΔCommitments*	*ΔCredits*	*ΔShort-term loans*	*ΔReal estate loans*	*ΔC&I loans*
	(1)	(2)	(3)	(4)	(5)	(6)
WF	0.0152***	-0.0010	0.0147***	0.0097***	0.0132***	0.0035***
	(5.04)	(-0.80)	(3.70)	(5.14)	(5.44)	(3.99)
CrisisI	0.0409***	0.0011	0.0433***	0.0324***	0.0204***	0.0068***
	(19.12)	(0.75)	(15.15)	(16.34)	(10.84)	(7.60)
*WF*CrisisI*	-0.0012	-0.0098***	-0.0122***	-0.0096***	-0.0028	0.0002
	(-0.36)	(-5.26)	(-2.63)	(-3.88)	(-0.97)	(0.15)
CrisisII	0.6038***	0.0054	0.6180***	0.4555***	0.2832***	0.0878***
	(20.24)	(0.23)	(15.38)	(15.17)	(10.69)	(6.53)
*WF*CrisisII*	-0.0159***	-0.0193***	-0.0382***	-0.0132***	-0.0134***	-0.0026**
	(-4.49)	(-10.36)	(-7.99)	(-5.35)	(-4.52)	(-2.51)
Postcrisis	2.8982***	0.0377	2.9737***	2.2123***	1.3452***	0.4206***
	(20.01)	(0.34)	(15.27)	(15.17)	(10.47)	(6.45)
*WF*Postcrisis*	-0.0325***	-0.0056***	-0.0412***	-0.0222***	-0.0257***	-0.0057***
	(-8.33)	(-3.89)	(-8.77)	(-9.89)	(-8.56)	(-4.89)
Ln(total assets)	-0.0254***	-0.0075***	-0.0344***	-0.0103***	-0.0187***	-0.0046***
	(-17.47)	(-17.49)	(-18.55)	(-15.00)	(-16.24)	(-12.38)
Capital ratios	0.2638***	0.0445***	0.3273***	0.0933***	0.1830***	0.0536***
	(21.03)	(9.53)	(20.38)	(12.93)	(18.21)	(15.36)
NPL	-0.4697***	-0.0605***	-0.5319***	-0.2049***	-0.3824***	-0.0618***
	(-44.16)	(-15.91)	(-40.69)	(-28.07)	(-44.50)	(-19.85)
Return on assets	-0.1401***	0.0469***	-0.1111***	0.0552**	-0.0863***	-0.0118
	(-4.30)	(3.39)	(-2.78)	(2.55)	(-3.34)	(-1.15)
Deposit-weighted HHI	0.0019	0.0141***	0.0227*	0.0082	0.0039	-0.0026
	(0.18)	(3.31)	(1.73)	(1.27)	(0.46)	(-0.84)
Deposit-weighted income growth	0.0519***	0.0313***	0.0835***	0.0284***	0.0482***	0.0026
	(8.01)	(10.89)	(10.08)	(6.27)	(8.83)	(1.28)
Deposit-weighted HPI	0.0005	-0.0014**	-0.0011	-0.0010	0.0020**	-0.0003
	(0.42)	(-2.45)	(-0.67)	(-1.39)	(2.06)	(-0.88)
M2/GDP	-25.9993***	-0.3013	-26.6349***	-19.8429***	-12.0418***	-3.7772***
	(-19.94)	(-0.30)	(-15.19)	(-15.11)	(-10.42)	(-6.43)
TARP amounts	-0.1304***	-0.0522***	-0.1826***	-0.0162	-0.0997***	-0.0324***
	(-4.72)	(-4.57)	(-5.13)	(-1.01)	(-4.55)	(-3.41)
Constant	13.2405***	0.1854	13.5972***	10.0605***	6.1570***	1.9304***
	(20.11)	(0.37)	(15.36)	(15.17)	(10.55)	(6.51)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.2120	0.0439	0.1928	0.0674	0.1859	0.0493
Observations	155,980	155,980	155,980	155,980	155,980	155,980

Panel B: Short-term wholesale funding (SWF)

	ΔLoans	*ΔCommitments*	*ΔCredits*	*ΔShort-term loans*	*ΔReal estate loans*	*ΔC&I loans*
	(1)	(2)	(3)	(4)	(5)	(6)
SWF	0.0179***	0.0008	0.0207***	0.0094***	0.0154***	0.0044***
	(4.76)	(0.49)	(4.26)	(3.96)	(4.99)	(4.25)
CrisisI	0.0400***	0.0014	0.0429***	0.0315***	0.0196***	0.0067***
	(18.62)	(0.97)	(15.00)	(15.91)	(10.38)	(7.57)
*SWF*CrisisI*	0.0053	-0.0152***	-0.0124**	-0.0070**	0.0024	0.0005
	(1.12)	(-6.05)	(-1.99)	(-2.14)	(0.59)	(0.32)
CrisisII	0.6064***	0.0056	0.6215***	0.4560***	0.2857***	0.0881***
	(20.32)	(0.25)	(15.46)	(15.19)	(10.78)	(6.55)
*SWF*CrisisII*	-0.0167***	-0.0263***	-0.0474***	-0.0172***	-0.0122***	-0.0043***
	(-3.39)	(-10.42)	(-7.31)	(-5.09)	(-2.99)	(-3.24)
Postcrisis	2.9128***	0.0407	2.9942***	2.2136***	1.3605***	0.4214***
	(20.11)	(0.37)	(15.36)	(15.17)	(10.59)	(6.46)
*SWF*Postcrisis*	-0.0339***	-0.0071***	-0.0441***	-0.0249***	-0.0250***	-0.0077***
	(-7.02)	(-3.50)	(-7.17)	(-8.64)	(-6.54)	(-5.28)
Ln(total assets)	-0.0256***	-0.0076***	-0.0348***	-0.0103***	-0.0190***	-0.0045***
	(-17.67)	(-17.95)	(-18.89)	(-15.13)	(-16.47)	(-12.17)
Capital ratios	0.2635***	0.0462***	0.3292***	0.0928***	0.1827***	0.0533***
	(20.96)	(9.93)	(20.56)	(12.89)	(18.17)	(15.24)
NPL	-0.4741***	-0.0616***	-0.5379***	-0.2084***	-0.3861***	-0.0623***
	(-44.59)	(-16.35)	(-41.17)	(-28.50)	(-44.85)	(-20.11)
Return on assets	-0.1380***	0.0472***	-0.1083***	0.0547**	-0.0836***	-0.0122
	(-4.22)	(3.41)	(-2.70)	(2.52)	(-3.23)	(-1.19)
Deposit-weighted HHI	0.0018	0.0138***	0.0223*	0.0080	0.0039	-0.0026
	(0.17)	(3.25)	(1.70)	(1.23)	(0.46)	(-0.85)
Deposit-weighted income growth	0.0520***	0.0315***	0.0840***	0.0278***	0.0485***	0.0024
	(8.05)	(11.01)	(10.16)	(6.16)	(8.91)	(1.18)
Deposit-weighted HPI	0.0005	-0.0014**	-0.0011	-0.0010	0.0020**	-0.0003
	(0.45)	(-2.42)	(-0.64)	(-1.30)	(2.09)	(-0.86)
M2/GDP	-26.1418***	-0.3282	-26.8304***	-19.8630***	-12.1887***	-3.7856***
	(-20.05)	(-0.33)	(-15.29)	(-15.12)	(-10.54)	(-6.44)
TARP amounts	-0.1373***	-0.0521***	-0.1901***	-0.0197	-0.1064***	-0.0328***
	(-4.97)	(-4.52)	(-5.31)	(-1.24)	(-4.87)	(-3.44)
Constant	13.3140***	0.1991	13.6977***	10.0714***	6.2328***	1.9346***
	(20.22)	(0.39)	(15.46)	(15.18)	(10.68)	(6.52)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.2114	0.0440	0.1923	0.0671	0.1853	0.0493
Observations	155,980	155,980	155,980	155,980	155,980	155,980

Table 2.6 Relationship between Credit Supply, Wholesale Funding, and Bank Risk: Quantity

This table shows regression estimates on whether a risky bank with more wholesale funds increases credit supply in term of loans, loan commitments, credits, short-term loans, real estate loans, and C&I loans. *Crisis I*, *Crisis II*, and *Postcrisis* are respectively defined as periods 2007:Q3 through 2008:Q2, 2008:Q3 through 2009:Q2, and 2009:Q3 through 2012:Q4. Detailed information on the variables is provided in Table 2.1. Robust standard errors are clustered by bank to control for heteroskedasticity and within-bank serial correlations. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗ represent significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Total wholesale funding (WF)

	ΔLoans	*ΔCommitments*	*ΔCredits*	*ΔShort-term loans*	*ΔReal estate loans*	*ΔC&I loans*
	(1)	(2)	(3)	(4)	(5)	(6)
WF	0.0267***	0.0010	0.0282***	0.0158***	0.0220***	0.0053***
	(7.36)	(0.77)	(6.10)	(7.27)	(7.79)	(5.01)
NPL	-0.3094***	-0.0558***	-0.3658***	-0.0919***	-0.2181***	-0.0565***
	(-6.43)	(-3.64)	(-6.13)	(-3.70)	(-6.22)	(-4.30)
*WF*NPL*	-1.1317***	-0.1718**	-1.3169***	-0.6134***	-0.8758***	-0.1652**
	(-4.42)	(-2.41)	(-4.17)	(-4.93)	(-4.93)	(-2.43)
CrisisI	0.0408***	0.0016	0.0443***	0.0322***	0.0209***	0.0068***
	(18.33)	(1.02)	(14.40)	(15.81)	(10.74)	(7.54)
*NPL*CrisisI*	-0.1312**	-0.0712**	-0.2368**	-0.0950*	-0.1565***	-0.0199
	(-2.04)	(-2.25)	(-2.42)	(-1.92)	(-3.19)	(-0.83)
*WF*CrisisI*	-0.0010	-0.0100***	-0.0145**	-0.0066**	-0.0027	-0.0006
	(-0.23)	(-4.23)	(-2.25)	(-2.15)	(-0.76)	(-0.38)
*WF*NPL*CrisisI*	0.4924*	0.1282	0.7981*	0.0811	0.3810**	0.1335
	(1.71)	(1.08)	(1.87)	(0.45)	(1.98)	(1.38)
CrisisII	0.6044***	0.0073	0.6214***	0.4519***	0.2811***	0.0893***
	(20.22)	(0.32)	(15.43)	(15.07)	(10.61)	(6.64)
*NPL*CrisisII*	-0.0714	-0.0356	-0.1259*	-0.0857**	-0.0725*	-0.0051
	(-1.25)	(-1.58)	(-1.78)	(-2.32)	(-1.67)	(-0.28)
*WF*CrisisII*	-0.0173***	-0.0204***	-0.0427***	-0.0088***	-0.0113***	-0.0046***
	(-3.70)	(-8.49)	(-6.83)	(-2.78)	(-3.02)	(-3.22)
*WF*NPL*CrisisII*	0.7704***	0.1799**	1.0363***	0.2899**	0.4746**	0.1796**
	(2.86)	(2.07)	(3.12)	(1.97)	(2.56)	(2.25)
Postcrisis	2.9067***	0.0457	2.9922***	2.1975***	1.3404***	0.4281***
	(20.03)	(0.41)	(15.33)	(15.07)	(10.43)	(6.56)
*WF*Postcrisis*	-0.0423***	-0.0091***	-0.0554***	-0.0232***	-0.0320***	-0.0079***
	(-8.63)	(-4.82)	(-9.20)	(-8.52)	(-8.80)	(-5.11)
*NPL*Postcrisis*	-0.1086**	0.0108	-0.1059*	-0.0527**	-0.1262***	0.0024
	(-2.18)	(0.69)	(-1.73)	(-2.06)	(-3.49)	(0.18)
*WF*NPL*Postcrisis*	1.0476***	0.1911***	1.2764***	0.4580***	0.7852***	0.1657**
	(3.98)	(2.60)	(3.96)	(3.58)	(4.29)	(2.32)
Ln(total assets)	-0.0251***	-0.0073***	-0.0340***	-0.0100***	-0.0186***	-0.0045***
	(-17.42)	(-17.40)	(-18.54)	(-14.78)	(-16.23)	(-12.17)
Capital ratios	0.2648***	0.0452***	0.3289***	0.0951***	0.1829***	0.0538***
	(21.18)	(9.75)	(20.55)	(13.22)	(18.22)	(15.48)
Return on assets	-0.1246***	0.0574***	-0.0847**	0.0575***	-0.0806***	-0.0060
	(-3.84)	(4.13)	(-2.13)	(2.67)	(-3.13)	(-0.58)
Deposit-weighted HHI	0.0005	0.0134***	0.0207	0.0072	0.0032	-0.0030
	(0.05)	(3.13)	(1.57)	(1.13)	(0.38)	(-0.97)
Deposit-weighted income growth	0.0506***	0.0303***	0.0815***	0.0262***	0.0471***	0.0025
	(7.82)	(10.56)	(9.85)	(5.82)	(8.63)	(1.23)
Deposit-weighted HPI	0.0009	-0.0012**	-0.0006	-0.0008	0.0022**	-0.0002
	(0.76)	(-2.16)	(-0.35)	(-1.06)	(2.38)	(-0.61)
M2/GDP	-26.0794***	-0.3779	-26.8074***	-19.7166***	-11.9971***	-3.8476***
	(-19.96)	(-0.38)	(-15.25)	(-15.02)	(-10.37)	(-6.54)
Constant	13.2769***	0.2229	13.6794***	9.9935***	6.1315***	1.9654***
	(20.12)	(0.44)	(15.41)	(15.07)	(10.49)	(6.62)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.2137	0.0444	0.1943	0.0691	0.1875	0.0497
Observations	155,980	155,980	155,980	155,980	155,980	155,980

Panel B: Short-term wholesale funding (SWF)

	ΔLoans	*ΔCommitments*	*ΔCredits*	*ΔShort-term loans*	*ΔReal estate loans*	*ΔC&I loans*
	(1)	(2)	(3)	(4)	(5)	(6)
SWF	0.0299***	0.0033*	0.0355***	0.0158***	0.0248***	0.0064***
	(6.56)	(1.80)	(6.12)	(5.82)	(6.84)	(5.03)
NPL	-0.3675***	-0.0598***	-0.4234***	-0.1224***	-0.2596***	-0.0632***
	(-9.17)	(-3.97)	(-8.47)	(-5.60)	(-8.55)	(-5.54)
*SWF*NPL*	-1.2466***	-0.2216**	-1.5177***	-0.6861***	-0.9920***	-0.1928**
	(-4.18)	(-2.21)	(-4.09)	(-4.49)	(-4.63)	(-2.26)
CrisisI	0.0395***	0.0016	0.0428***	0.0312***	0.0198***	0.0067***
	(17.64)	(1.03)	(14.32)	(15.40)	(10.06)	(7.34)
*NPL*CrisisI*	-0.0519	-0.0409	-0.1101	-0.0680	-0.1027**	-0.0048
	(-0.88)	(-1.42)	(-1.44)	(-1.44)	(-2.11)	(-0.23)
*SWF*Crisis1*	0.0088	-0.0140***	-0.0097	-0.0026	0.0045	0.0002
	(1.47)	(-4.56)	(-1.23)	(-0.66)	(0.93)	(0.11)
*SWF*NPL*Crisis1*	0.2668	0.0334	0.4800	-0.0487	0.2480	0.1134
	(0.76)	(0.22)	(1.03)	(-0.21)	(0.95)	(0.98)
CrisisII	0.6080***	0.0071	0.6253***	0.4525***	0.2844***	0.0897***
	(20.34)	(0.31)	(15.52)	(15.08)	(10.73)	(6.66)
*NPL*CrisisII*	-0.0174	-0.0279	-0.0643	-0.0377	-0.0514	0.0057
	(-0.36)	(-1.30)	(-1.07)	(-1.10)	(-1.32)	(0.36)
*SWF*CrisisII*	-0.0157**	-0.0271***	-0.0496***	-0.0085**	-0.0090*	-0.0064***
	(-2.50)	(-8.31)	(-5.96)	(-2.06)	(-1.77)	(-3.48)
*SWF*NPL*CrisisII*	0.7514**	0.2025*	1.0851***	0.1579	0.5041**	0.1981**
	(2.41)	(1.69)	(2.78)	(0.86)	(2.23)	(1.97)
Postcrisis	2.9285***	0.0464	3.0177***	2.2016***	1.3592***	0.4299***
	(20.17)	(0.42)	(15.44)	(15.10)	(10.57)	(6.58)
*SWF*Postcrisis*	-0.0472***	-0.0097***	-0.0617***	-0.0271***	-0.0327***	-0.0104***
	(-7.99)	(-3.86)	(-8.11)	(-7.76)	(-7.21)	(-5.67)
*NPL*Postcrisis*	-0.0734*	0.0195	-0.0677	-0.0380	-0.0966***	0.0066
	(-1.76)	(1.27)	(-1.31)	(-1.64)	(-3.03)	(0.54)
*SWF*NPL*Postcrisis*	1.2472***	0.2058**	1.5392***	0.5538***	0.9170***	0.2046**
	(4.09)	(2.00)	(4.06)	(3.48)	(4.14)	(2.32)
Ln(total assets)	-0.0254***	-0.0074***	-0.0345***	-0.0100***	-0.0189***	-0.0045***
	(-17.55)	(-17.84)	(-18.81)	(-14.85)	(-16.40)	(-11.93)
Capital ratios	0.2637***	0.0467***	0.3298***	0.0943***	0.1820***	0.0534***
	(21.05)	(10.09)	(20.68)	(13.14)	(18.13)	(15.33)
Return on assets	-0.1192***	0.0562***	-0.0799**	0.0584***	-0.0766***	-0.0061
	(-3.65)	(4.03)	(-2.00)	(2.69)	(-2.95)	(-0.59)
Deposit-weighted HHI	0.0004	0.0131***	0.0204	0.0069	0.0030	-0.0029
	(0.04)	(3.07)	(1.56)	(1.07)	(0.36)	(-0.96)
Deposit-weighted income growth	0.0506***	0.0304***	0.0817***	0.0255***	0.0473***	0.0023
	(7.84)	(10.63)	(9.88)	(5.68)	(8.69)	(1.13)
Deposit-weighted HPI	0.0009	-0.0012**	-0.0005	-0.0007	0.0023**	-0.0002
	(0.78)	(-2.09)	(-0.32)	(-0.97)	(2.42)	(-0.60)
M2/GDP	-26.2872***	-0.3866	-27.0508***	-19.7626***	-12.1778***	-3.8649***
	(-20.11)	(-0.39)	(-15.38)	(-15.05)	(-10.52)	(-6.57)
Constant	13.3846***	0.2274	13.8052***	10.0179***	6.2251***	1.9742***
	(20.28)	(0.45)	(15.54)	(15.11)	(10.65)	(6.64)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.2127	0.0445	0.1934	0.0686	0.1864	0.0497
Observations	155,980	155,980	155,980	155,980	155,980	155,980

Table 2.7 Relationship between Loan Spreads, Wholesale Funding, and Bank Risk: Price

This table reports regression estimates on whether a risky bank with more wholesale funds raises loan interest rates. Spreads on total loans and C&I loans (real estate loans) are defined as the difference between the implicit loan rates and the 3-year (10-year) treasury constant maturity rate. *WF*NPL*Crisis* represents an interaction between *WF*, *NPL*, and *Crisis*. Detailed information on the variables is provided in Table 2.1. Robust standard errors are clustered by bank. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗ represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Total wholesale funding (WF)			Panel B: Short-term wholesale funding (SWF)		
	Spreads on total loans	*Spreads on real estate loans*	*Spreads on C&I loans*	*Spreads on total loans*	*Spreads on real estate loans*	*Spreads on C&I loans*
	(1)	(2)	(3)	(1)	(2)	(3)
WF (SWF)	0.0015**	0.0028***	0.0033*	0.0042***	0.0056***	0.0053**
	(2.10)	(3.34)	(1.94)	(5.06)	(5.86)	(2.52)
NPL	0.0100	0.0102	0.0459*	0.0133	0.0147	0.0275
	(1.11)	(0.89)	(1.91)	(1.56)	(1.39)	(1.33)
*WF (SWF)*NPL*	-0.1224***	-0.1269***	-0.3188***	-0.2035***	-0.2193***	-0.3358**
	(-3.35)	(-2.87)	(-2.76)	(-4.19)	(-3.75)	(-2.36)
CrisisI	0.0046***	0.0092***	0.0103***	0.0044***	0.0090***	0.0105***
	(13.25)	(21.71)	(10.02)	(12.76)	(21.37)	(10.29)
*NPL*CrisisI*	-0.0485***	-0.0465***	-0.0608*	-0.0504***	-0.0497***	-0.0456
	(-3.03)	(-2.82)	(-1.67)	(-3.25)	(-3.18)	(-1.36)
*WF (SWF)*Crisis1*	0.0006	0.0012	-0.0008	0.0012	0.0020*	-0.0025
	(0.97)	(1.44)	(-0.41)	(1.37)	(1.87)	(-0.99)
*WF (SWF)*NPL*Crisis1*	-0.0190	-0.0633	0.1798	0.0004	-0.0512	0.1632
	(-0.40)	(-1.12)	(1.33)	(0.01)	(-0.68)	(0.94)
CrisisII	0.0299***	0.0202***	0.0395***	0.0299***	0.0202***	0.0396***
	(8.59)	(3.90)	(3.02)	(8.60)	(3.90)	(3.03)
*NPL*CrisisII*	-0.0853***	-0.0878***	-0.0941***	-0.0881***	-0.0930***	-0.0693**
	(-6.55)	(-6.19)	(-2.62)	(-7.03)	(-6.80)	(-2.14)
*WF (SWF)*CrisisII*	-0.0097***	-0.0111***	-0.0103***	-0.0155***	-0.0169***	-0.0133***
	(-11.05)	(-10.79)	(-4.49)	(-13.78)	(-13.21)	(-4.36)
*WF (SWF)*NPL*CrisisII*	0.0905**	0.0762	0.3279**	0.1532***	0.1454**	0.3184*
	(2.06)	(1.59)	(2.26)	(2.60)	(2.26)	(1.73)
Postcrisis	0.0880***	0.0607**	0.1325**	0.0874***	0.0600**	0.1345**
	(5.21)	(2.41)	(2.08)	(5.18)	(2.38)	(2.11)
*WF (SWF)*Postcrisis*	-0.0054***	-0.0071***	-0.0089***	-0.0101***	-0.0125***	-0.0118***
	(-5.42)	(-5.49)	(-3.06)	(-8.78)	(-8.80)	(-3.69)
*NPL*Postcrisis*	-0.0574***	-0.0661***	-0.0676**	-0.0579***	-0.0675***	-0.0497**
	(-5.75)	(-5.41)	(-2.51)	(-6.15)	(-5.88)	(-2.10)
*WF (SWF)*NPL*Postcrisis*	0.0868**	0.0913**	0.3241**	0.1366***	0.1483**	0.3408**
	(2.25)	(2.02)	(2.56)	(2.72)	(2.50)	(2.19)
Ln(total assets)	0.0005*	0.0008***	-0.0007	0.0006**	0.0009***	-0.0007
	(1.83)	(3.12)	(-1.38)	(1.97)	(3.38)	(-1.44)
Capital ratios	0.0164***	0.0162***	0.0039	0.0172***	0.0167***	0.0045
	(7.41)	(6.92)	(0.80)	(7.77)	(7.17)	(0.92)
Return on assets	0.1426***	0.1335***	0.1227***	0.1405***	0.1311***	0.1223***
	(22.82)	(20.02)	(8.88)	(22.60)	(19.90)	(8.80)
Deposit-weighted HHI	0.0096***	0.0049*	0.0096	0.0092***	0.0045	0.0095
	(3.55)	(1.70)	(1.58)	(3.43)	(1.56)	(1.56)
Deposit-weighted income growth	0.0148***	0.0166***	0.0160***	0.0148***	0.0166***	0.0160***
	(10.86)	(10.24)	(4.84)	(11.00)	(10.35)	(4.85)
Deposit-weighted HPI	-0.0008***	-0.0003	0.0002	-0.0007***	-0.0003	0.0003
	(-2.62)	(-1.21)	(0.40)	(-2.58)	(-1.13)	(0.40)
M2/GDP	-0.6479***	-0.3915*	-1.0068*	-0.6419***	-0.3856*	-1.0258*
	(-4.27)	(-1.73)	(-1.76)	(-4.23)	(-1.70)	(-1.79)
Constant	0.3589***	0.2143*	0.5410*	0.3555***	0.2110*	0.5507*
	(4.68)	(1.87)	(1.87)	(4.64)	(1.84)	(1.90)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.7440	0.4229	0.2122	0.7453	0.4252	0.2121
Observations	155,980	155,980	155,980	155,980	155,980	155,980

Table 2.8 Relationship between Credit Supply, Wholesale Funding, and Bank Risk: Z-score
This table shows the effect of an interaction between wholesale funding and bank risk—proxied by Z-score—on the credit supply growth: loans, loan commitments, credits, short-term loans, real estate loans, and C&I loans. Detailed information on the variables is provided in Table 2.1. Robust standard errors are clustered by bank. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗ represent significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Total wholesale funding (WF)

	ΔLoans	*ΔCommitments*	*ΔCredits*	*ΔShort-term loans*	*ΔReal estate loans*	*ΔC&I loans*
	(1)	(2)	(3)	(4)	(5)	(6)
WF	0.0203***	-0.0069*	0.0085	0.0090*	0.0176***	0.0044**
	(2.61)	(-1.69)	(0.74)	(1.85)	(2.71)	(2.01)
Z-score	0.0003	-0.0051*	-0.0056	-0.0016	-0.0003	-0.0003
	(0.07)	(-1.93)	(-0.79)	(-0.54)	(-0.08)	(-0.20)
*WF*Z-score*	0.0200	0.0296**	0.0641*	0.0115	0.0160	0.0039
	(0.96)	(2.37)	(1.94)	(0.95)	(0.90)	(0.64)
CrisisI	0.0048**	-0.0049***	0.0008	0.0022	0.0013	0.0011
	(2.05)	(-4.00)	(0.26)	(1.24)	(0.70)	(1.48)
*Z-score*CrisisI*	0.0001	0.0059**	0.0049	0.0028	0.0012	0.0005
	(0.05)	(2.05)	(0.66)	(0.65)	(0.25)	(0.29)
*WF*Crisis1*	-0.0124	-0.0043	-0.0166	-0.0159**	-0.0109	-0.0024
	(-1.45)	(-0.97)	(-1.48)	(-2.40)	(-1.52)	(-0.89)
*WF*Z-score*Crisis1*	0.0018	-0.0203	-0.0224	0.0018	0.0037	0.0003
	(0.08)	(-1.64)	(-0.71)	(0.10)	(0.18)	(0.04)
CrisisII	-0.0139***	-0.0059***	-0.0204***	-0.0092***	-0.0067***	-0.0050***
	(-5.65)	(-4.34)	(-6.16)	(-4.82)	(-3.33)	(-6.63)
*Z-score*CrisisII*	0.0096	0.0127***	0.0271***	0.0119***	0.0034	0.0041**
	(1.62)	(3.57)	(3.19)	(2.74)	(0.69)	(2.16)
*WF*CrisisII*	-0.0240***	-0.0086	-0.0249**	-0.0173***	-0.0247***	-0.0007
	(-2.88)	(-1.64)	(-2.00)	(-2.87)	(-3.51)	(-0.30)
*WF*Z-score*CrisisII*	0.0005	-0.0388**	-0.0708*	0.0055	0.0156	-0.0107*
	(0.02)	(-2.31)	(-1.84)	(0.34)	(0.76)	(-1.73)
Postcrisis	-0.0158***	-0.0060***	-0.0217***	-0.0032**	-0.0131***	-0.0030***
	(-7.66)	(-5.81)	(-7.64)	(-2.23)	(-7.60)	(-4.76)
*WF*Postcrisis*	-0.0490***	-0.0008	-0.0468***	-0.0311***	-0.0367***	-0.0080***
	(-6.35)	(-0.19)	(-4.02)	(-5.96)	(-5.46)	(-3.43)
*Z-score*Postcrisis*	0.0157***	0.0070***	0.0248***	0.0087***	0.0135***	0.0025*
	(3.43)	(2.67)	(3.53)	(3.07)	(3.54)	(1.73)
*WF*Z-score*Postcrisis*	0.0072	-0.0341**	-0.0480	0.0094	0.0021	-0.0015
	(0.33)	(-2.38)	(-1.33)	(0.71)	(0.12)	(-0.21)
Ln(total assets)	-0.0189***	-0.0080***	-0.0283***	-0.0093***	-0.0138***	-0.0036***
	(-11.03)	(-12.91)	(-12.45)	(-10.19)	(-10.32)	(-8.24)
Capital ratios	0.1542***	0.0244***	0.1794***	0.0399***	0.0985***	0.0350***
	(8.03)	(3.30)	(7.07)	(3.41)	(6.39)	(6.91)
Return on assets	0.5461***	0.1697***	0.7314***	0.2961***	0.5066***	0.0927***
	(16.77)	(11.40)	(18.06)	(11.98)	(19.33)	(9.33)
Deposit-weighted HHI	0.0079	0.0108**	0.0202	0.0174**	0.0109	-0.0020
	(0.65)	(2.13)	(1.25)	(2.03)	(1.02)	(-0.56)
Deposit-weighted income growth	0.0509***	0.0252***	0.0760***	0.0266***	0.0433***	0.0019
	(7.69)	(8.47)	(8.97)	(5.38)	(7.81)	(0.92)
Deposit-weighted HPI	0.0045***	-0.0016***	0.0034*	-0.0005	0.0043***	0.0004
	(3.20)	(-2.88)	(1.75)	(-0.75)	(3.66)	(1.35)
M2/GDP	0.1468***	0.0353***	0.1812***	0.0282***	0.0889***	0.0326***
	(13.44)	(7.95)	(13.57)	(3.51)	(10.42)	(9.05)
Constant	-0.0175	0.0270***	0.0150	0.0204**	-0.0089	-0.0017
	(-1.24)	(5.07)	(0.83)	(2.45)	(-0.76)	(-0.47)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.1275	0.0364	0.1197	0.0474	0.1154	0.0307
Observations	103,502	103,502	103,502	103,502	103,502	103,502

Panel B: Short-term wholesale funding (SWF)

	ΔLoans	*ΔCommitments*	*ΔCredits*	*ΔShort-term loans*	*ΔReal estate loans*	*ΔC&I loans*
	(1)	(2)	(3)	(4)	(5)	(6)
SWF	0.0321***	-0.0033	0.0224	0.0140**	0.0272***	0.0053**
	(3.19)	(-0.57)	(1.43)	(2.19)	(3.17)	(2.13)
Z-score	0.0020	-0.0045*	-0.0038	-0.0009	0.0006	-0.0008
	(0.43)	(-1.66)	(-0.53)	(-0.34)	(0.16)	(-0.61)
*SWF*Z-score*	0.0162	0.0373**	0.0760	0.0109	0.0150	0.0084
	(0.59)	(2.02)	(1.61)	(0.67)	(0.63)	(1.26)
CrisisI	0.0042*	-0.0046***	0.0006	0.0013	0.0009	0.0006
	(1.83)	(-3.70)	(0.19)	(0.70)	(0.48)	(0.86)
*Z-score*CrisisI*	-0.0032	0.0057*	0.0016	0.0020	-0.0018	0.0017
	(-0.57)	(1.94)	(0.22)	(0.47)	(-0.41)	(1.05)
*SWF*Crisis1*	-0.0185	-0.0082	-0.0265*	-0.0192**	-0.0161*	-0.0014
	(-1.59)	(-1.27)	(-1.67)	(-2.14)	(-1.67)	(-0.44)
*SWF*Z-score*Crisis1*	0.0229	-0.0277	-0.0126	0.0086	0.0234	-0.0064
	(0.73)	(-1.58)	(-0.28)	(0.35)	(0.93)	(-0.76)
CrisisII	-0.0136***	-0.0046***	-0.0183***	-0.0071***	-0.0078***	-0.0046***
	(-5.70)	(-3.36)	(-5.63)	(-3.85)	(-3.96)	(-6.38)
*Z-score*CrisisII*	0.0086	0.0093***	0.0219***	0.0084**	0.0040	0.0036**
	(1.53)	(2.59)	(2.62)	(2.05)	(0.87)	(2.10)
*SWF*CrisisII*	-0.0315***	-0.0184**	-0.0401**	-0.0286***	-0.0297***	-0.0023
	(-2.76)	(-2.41)	(-2.27)	(-3.46)	(-3.07)	(-0.75)
*SWF*Z-score*CrisisII*	0.0096	-0.0362	-0.0692	0.0271	0.0219	-0.0130*
	(0.30)	(-1.49)	(-1.25)	(1.24)	(0.79)	(-1.80)
Postcrisis	-0.0159***	-0.0052***	-0.0208***	-0.0024	-0.0143***	-0.0030***
	(-7.51)	(-4.82)	(-7.07)	(-1.63)	(-8.23)	(-4.77)
*SWF*Postcrisis*	-0.0499***	0.0010	-0.0426***	-0.0314***	-0.0361***	-0.0090***
	(-4.80)	(0.15)	(-2.59)	(-4.62)	(-4.05)	(-3.26)
*Z-score*Postcrisis*	0.0177***	0.0067**	0.0268***	0.0104***	0.0146***	0.0032**
	(4.00)	(2.42)	(3.80)	(3.88)	(3.99)	(2.56)
*SWF*Z-score*Postcrisis*	-0.0033	-0.0446**	-0.0791	0.0017	-0.0032	-0.0056
	(-0.11)	(-2.13)	(-1.55)	(0.10)	(-0.13)	(-0.74)
Ln(total assets)	-0.0194***	-0.0083***	-0.0293***	-0.0096***	-0.0143***	-0.0036***
	(-11.40)	(-13.43)	(-12.91)	(-10.63)	(-10.72)	(-8.36)
Capital ratios	0.1567***	0.0276***	0.1858***	0.0422***	0.1006***	0.0352***
	(8.15)	(3.71)	(7.30)	(3.61)	(6.52)	(6.92)
Return on assets	0.5581***	0.1719***	0.7467***	0.3027***	0.5155***	0.0928***
	(17.00)	(11.57)	(18.32)	(12.17)	(19.63)	(9.27)
Deposit-weighted HHI	0.0075	0.0107**	0.0198	0.0169**	0.0107	-0.0021
	(0.61)	(2.09)	(1.22)	(1.98)	(1.01)	(-0.60)
Deposit-weighted income growth	0.0461***	0.0240***	0.0691***	0.0218***	0.0415***	0.0006
	(6.81)	(7.78)	(7.95)	(4.37)	(7.34)	(0.30)
Deposit-weighted HPI	0.0046***	-0.0016***	0.0034*	-0.0005	0.0043***	0.0005
	(3.20)	(-2.94)	(1.75)	(-0.69)	(3.68)	(1.38)
M2/GDP	0.1216***	0.0286***	0.1448***	0.0022	0.0812***	0.0272***
	(9.36)	(5.05)	(9.08)	(0.23)	(8.00)	(6.42)
Constant	-0.0018	0.0313***	0.0376**	0.0353***	-0.0021	0.0013
	(-0.12)	(5.53)	(1.99)	(4.06)	(-0.17)	(0.35)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.1260	0.0365	0.1183	0.0467	0.1140	0.0305
Observations	103,502	103,502	103,502	103,502	103,502	103,502

Table 2.9 Relationship between Loan Spreads, Wholesale Funding, and Bank Risk: Z-score

This table shows the effect of an interaction between wholesale funding and bank risk—proxied by Z-score—on spreads on total loans, real estate loans, and C&I loans. Spreads on total loans and C&I loans (real estate loans) are defined as the difference between the implicit loan rates and the 3-year (10-year) treasury constant maturity rate. *WF*NPL*Crisis* represents an interaction between *WF*, *NPL*, and *Crisis*. Detailed information on the variables is provided in Table 2.1. Robust standard errors are clustered by bank. T-statistics are in parentheses. ∗∗∗, ∗∗, and ∗ represent significance at the 1%, 5%, and 10% levels, respectively.

	Panel A: Total wholesale funding (WF)			Panel B: Short-term wholesale funding (SWF)		
	Spreads on total loans	*Spreads on real estate loans*	*Spreads on C&I loans*	*Spreads on total loans*	*Spreads on real estate loans*	*Spreads on C&I loans*
	(1)	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
WF (SWF)	0.0008	0.0026	0.0027	0.0061**	0.0093***	0.0069
	(0.40)	(1.30)	(0.68)	(2.55)	(3.91)	(1.46)
Z-score	-0.0001***	-0.0001***	-0.0000	-0.0000***	-0.0001***	-0.0000
	(-4.31)	(-4.00)	(-1.50)	(-4.35)	(-4.01)	(-1.27)
*WF (SWF)*Z-score*	0.0001**	0.0001**	0.0001	0.0001**	0.0002**	0.0000
	(2.28)	(2.58)	(0.69)	(2.06)	(2.48)	(0.27)
CrisisI	0.0225***	0.0149***	0.0224***	0.0219***	0.0144***	0.0218***
	(54.72)	(27.42)	(19.02)	(50.59)	(29.21)	(19.36)
*Z-score*CrisisI*	0.0000***	0.0000*	0.0000	0.0000***	0.0000**	0.0000
	(3.02)	(1.88)	(0.91)	(3.41)	(2.35)	(1.50)
*WF (SWF)*CrisisI*	-0.0050***	-0.0067***	-0.0030	-0.0057**	-0.0089***	-0.0026
	(-2.95)	(-3.46)	(-0.79)	(-2.11)	(-3.83)	(-0.52)
*WF (SWF)*Z-score*CrisisI*	-0.0000	-0.0000	-0.0000	-0.0001	-0.0000	-0.0001
	(-0.79)	(-0.39)	(-0.45)	(-1.21)	(-0.74)	(-1.07)
CrisisII	0.0179***	0.0016**	0.0127***	0.0193***	0.0024***	0.0140***
	(28.78)	(2.16)	(8.91)	(33.16)	(3.34)	(10.32)
*Z-score*CrisisII*	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
	(6.80)	(4.99)	(3.00)	(7.56)	(5.51)	(2.87)
*WF (SWF)*CrisisII*	-0.0118***	-0.0169***	-0.0059	-0.0200***	-0.0254***	-0.0112**
	(-5.32)	(-7.04)	(-1.33)	(-7.14)	(-8.31)	(-1.98)
*WF (SWF)*Z-score*CrisisII*	-0.0001*	-0.0000	-0.0002*	-0.0001*	-0.0001	-0.0002
	(-1.66)	(-0.68)	(-1.75)	(-1.79)	(-0.84)	(-1.41)
Postcrisis	0.0175***	-0.0095***	0.0169***	0.0203***	-0.0076***	0.0193***
	(31.71)	(-14.80)	(12.76)	(39.12)	(-12.21)	(14.86)
*WF (SWF)*Postcrisis*	-0.0076***	-0.0123***	-0.0049	-0.0170***	-0.0194***	-0.0124**
	(-3.30)	(-5.54)	(-1.04)	(-6.20)	(-7.19)	(-2.26)
*Z-score*Postcrisis*	0.0001***	0.0001***	0.0001**	0.0001***	0.0001***	0.0001**
	(6.97)	(6.57)	(2.48)	(7.23)	(6.65)	(2.20)
*WF (SWF)*Z-score*Postcrisis*	-0.0001**	-0.0001**	-0.0002*	-0.0001**	-0.0001*	-0.0002
	(-2.40)	(-2.05)	(-1.84)	(-2.03)	(-1.80)	(-1.25)
Ln(total assets)	-0.0009**	-0.0004	-0.0023***	-0.0008*	-0.0005	-0.0023***
	(-2.05)	(-0.83)	(-3.39)	(-1.91)	(-1.10)	(-3.40)
Capital ratios	0.0162***	0.0180***	-0.0034	0.0179***	0.0205***	-0.0033
	(4.68)	(4.95)	(-0.45)	(5.25)	(5.71)	(-0.44)
Return on assets	0.2022***	0.2028***	0.1399***	0.1999***	0.2019***	0.1397***
	(25.91)	(23.92)	(9.62)	(26.00)	(24.16)	(9.63)
Deposit-weighted HHI	0.0104***	0.0090**	0.0016	0.0096***	0.0079**	0.0013
	(2.82)	(2.34)	(0.21)	(2.63)	(2.11)	(0.17)
Deposit-weighted income growth	0.0222***	0.0175***	0.0210***	0.0187***	0.0147***	0.0178***
	(16.04)	(10.91)	(6.33)	(13.32)	(9.05)	(5.21)
Deposit-weighted HPI	-0.0001	0.0004	0.0014	-0.0001	0.0004	0.0015
	(-0.31)	(0.99)	(1.54)	(-0.31)	(0.96)	(1.59)
M2/GDP	0.0621***	0.2545***	0.0808***	0.0395***	0.2368***	0.0608***
	(27.15)	(101.77)	(12.51)	(13.81)	(77.81)	(7.94)
Constant	-0.0064*	-0.1170***	-0.0049	0.0047	-0.1074***	0.0050
	(-1.91)	(-32.48)	(-0.65)	(1.43)	(-29.97)	(0.65)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.7653	0.3855	0.2485	0.7685	0.3886	0.2488
Observations	103,502	103,502	103,502	103,502	103,502	103,502

국문초록

금융시장에서의 시장규율에 관한 연구
-2008년 미국 금융위기를 중심으로-

본 논문은 2002년 1분기~2012년 4분기 기간 동안 미국 상업은행들의 패널데이터를 이용하여, 2008년 금융위기를 전·후로 가장 중요한 문제들 중 하나로 떠오른 시장성수신 자금 공급자들의 시장규율 여부와 시장성수신에 많이 의존한 은행들이 경제상황에 따라 신용공급을 어떻게 변화시키는지에 대해 분석하는 두 개의 장으로 구성되어 있다.

첫 번째 장에서는 시장성수신 자금 공급자들이 고위험 은행들에게 높은 이자율을 요구하거나 이들에 대한 투자를 감소시키는 형태로 시장규율을 수행하는지를 2008년 미국 금융위기를 중심으로 분석하였다. 연구결과, 금융위기 전 기간에는 시장성수신 자금 공급자들이 시장규율을 수행함을 발견하였다. 그러나 금융위기 기간과 금융위기 이후 기간에는 시장규율의 증거를 발견할 수 없었다. 이는 금융위기 기간 동안 이루어진 구제금융 및 대규모의 경기부양정책으로 인해 시장성수신 자금 공급자들이 은행을 감시할 유인이 줄어들었음을 시사한다. 대형은행과 중소형은행으로 구분한

분석에서도 결과는 동일하게 나타났으나, 고액정기예금자들의 경우 금융위기 전 기간에도 대형은행들에 대해서는 시장규율을 수행하지 않았다. 또한 시장성수신 자금 공급자들을 단기 자금 공급자(연방기금이나 환매조건부채권매매 시장 투자자)와 장기 자금 공급자(고액정기예금자)로 나누어 분석한 결과, 각 투자자들 별로 시장규율의 행태가 다르게 나타났다. 금융위기 전 기간에 단기 자금 공급자들은 가격과 수량을 모두 변화시켜 시장규율을 수행하는 반면, 장기 자금 공급자들은 가격은 변화시키지 않고 수량 만을 감소시키는 형태로 시장규율을 수행하였다. 또한 금융위기 기간 중에는 단기 및 장기 자금 공급자들이 모두 시장규율을 하지 않았지만, 장기 자금 공급자들은 높은 이자를 제공하는 부실 은행들에 대한 투자를 증가시켜 정부 안전망을 더욱 적극적으로 이용하려는 경향을 보였다. 이러한 결과들은 2008년 금융위기 기간 동안 수행되었던 양적완화정책(Quantitative Easing)과 부실자산구제프로그램(Troubled Asset Relief Program)과 같은 정부지원과 대출에 대한 수요를 통제하고 난 후에도 강건하게 나타났다.

두 번째 장에서는 시장성수신에의 의존 정도가 은행들의 신용공급에 영향을 미치는지에 대해 2008년 금융위기 기간을 중심으로 분석하였다. 연구결과, 시장성수신 자금 비중이 높은 은행들이 금융위기 전 기간에 대출을 증가시킨 것으로 나타났다. 이는 금융위기 전 기간에 시장성수신이 대출 급증에 기여하여 은행들의 건전성을 저해하고 경제시스템 전체의

안정성을 약화시킨 것으로 해석된다. 반면, 금융위기 기간에는 이들 은행들이 신용공급을 크게 감소시켜 시장성수신의 감소가 금융위기 동안 신용경색을 유발한 중요한 요인이었음을 알 수 있다. 뿐만 아니라 시장성수신 자금 공급자들이 고위험 은행들이 위험이 높은 투자를 하지 않도록 감시하는지를 분석한 결과, 시장성수신 의존도가 높은 고위험 은행들은 호황기였던 금융위기 전 기간에는 고위험 대출을 감소시켰으나, 신용경색이 발생한 금융위기 기간 동안에는 오히려 고위험 대출을 증가시킨 것으로 나타났다. 이러한 결과는 리만 브라더스 파산 이후에 더욱 강하게 나타나, 리먼 브라더스 파산 이후 시행된 강력한 경기부양정책이 시장성수신 자금 공급자들의 규율 유인을 감소시켰다는 첫 번째 장의 결과와 동일한 결과가 도출되었다. 즉, 금융위기 전 기간에는 시장성수신 자금 공급자들이 시장규율을 수행하지만 금융위기 기간 및 그 이후 기간에는 구제금융의 여파로 시장규율이 저해되었음을 시사한다.

.....

주요어: 시장성수신, 시장규율, 신용공급, 은행 위험, 금융위기

학 번: 2008-30839