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JEL Codes: E44, G21

Key Words: Deposit Insurance, Bank Lending Channel, Japan, Natural Experiment

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Abstract

Finding the causal effects of liquidity shocks on credit supply is complicated by the endogenous relation between loan demand and liquidity position of banks. This paper attempts to overcome this problem by exploiting, as a natural experiment, the exogenous deposit outflow prompted by the removal of a blanket deposit guarantee on time deposits in Japan. We find that just as the government placed a cap on insurance for time deposits in 2002, weak banks suffered from a large outflow of partially insured time deposits. More importantly, we find that those weak banks were not able to raise a sufficient amount of fully insured ordinary deposits to make up for the loss of time deposits, which, consequently, forced them to cut back on loan supply. These results are consistent with the theory that the imperfect substitutability of insured deposits and uninsured deposits affects the tightness of banks' financing constraints and ultimately the supply of bank loans.

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1. Introduction

The question of how exactly liquidity shocks in a banking sector are transmitted to the real economy has long been a subject of active discussion in the field of both finance and macroeconomics. On the one hand, according to the Modigliani-Miller Theorem, even when exposed to periodic negative liquidity shocks, banks should be able to raise sufficient funds from alternative sources swiftly to make up for the temporary funding shortfall and thus be able to finance all profitable lending opportunities (Modigliani and Miller, 1958). On the other hand, in the presence of informational asymmetry on the value of bank assets (i.e., banks know more about the quality of their own assets than outside investors do), banks will face a lemon premium on external funds, which means that negative liquidity shocks would raise overall funding costs, thereby forcing banks to cut back on loan supply to non-financial sectors (Bernanke and Blinder, 1992; Stein 1998).[1]

The empirical work on the relationship between liquidity and bank lending has explored how bank lending responds to liquidity shocks in aggregate data (Bernanke and Blinder, 1992; Kashyap, Stein and Wilcox, 1993; Bernanke and Gertler, 1995). More recently, the empiricists have moved away from the use of aggregate data and have begun to use disaggregated bank-level data. The motivation for such a shift in the empirical focus is that the analysis of aggregate data suffers

[1] This type of information asymmetry also induces banks with high quality assets to hold an excessive amount of risk-free securities so as to avoid having to pay lemon adverse selection premium for external funds (Lucas and MacDonald, 1992).

from a serious identification problem (i.e., liquidity shocks are likely to coincide with shifts in a loan demand schedule).

Furthermore, the use of bank-level data reveals the exact mechanism of the bank lending channel: the effects of liquidity shocks on loan supply are much larger for smaller, less liquid, and less well-capitalized banks since the funding opportunities of these banks depend critically on the severity of an adverse selection problem (Kashyap and Stein, 2000; Kishan and Opiela, 2000; Jayaratne and Morgan, 2000).

However, even these recent empirical works potentially suffer from a subtle identification problem -- the lending opportunities of banks might not be completely orthogonal to their balance sheet characteristics and/or their deposit flows. For example, a flow of deposits into banks is not entirely exogenous. Banks with more or better lending opportunities might be willing to pay higher interest rates and attract more deposits so as to finance those lending opportunities. The low level of capitalization or liquidity is not entirely exogenous either. It is likely to be a symptom of a worsening economic environment that a particular bank is, or has been, facing; i.e., more often than not, banks become poorly capitalized and illiquid as they suffer from a large amount of financial losses on their investments.[2]

This paper examines the transmission of liquidity shocks to loan supply in Japan's banking sector. The main innovation of this paper is credible econometric

[2] It is also possible that the results might suffer from the bias in the opposite direction if weak banks pursue "gambling for resurrection" strategy by aggressively expanding deposits and risky loans (e.g., Brumbaugh and Carron, 1987; Kane, 1989; Barth 1991) although literature on the banking lending channel has not focused on this issue.

identification of liquidity shocks by exploiting the removal of a blanket deposit guarantee in Japan as a natural experiment. When the Japanese government lifted a blanket guarantee and imposed a limit on time deposits, Japan's banking system experienced a clear regime shift. In the old regime, depositors did not face the risk of putting their deposits into "lemon" banks, which in theory must have allowed banks to avoid adverse selection problems all together when raising external funds. In the new regime, the ability of banks, especially weak ones, to raise partially insured time deposits was severely undermined because depositors had incentives to ration funds to risky banks in order to protect themselves from financial losses.

This quasi-experiment is relatively clean because the change in the deposit insurance scheme was not driven by deterioration or improvement in banks' business environment. Rather, the lifting of a blanket guarantee was scheduled ahead of time so that the timing of the shocks was likely to be orthogonal to the demand condition of the banking sector.

We find four notable results. First, we find that banks seem to have been unconstrained during the period of a blanket guarantee: weak banks and strong ones expanded their deposits at a similar rate, and loan and deposit growth were uncorrelated. Second, we find that as the government placed a cap on deposit insurance in 2002, weak banks lost a large amount of partially insured time deposits as found in Imai (2006), Murata and Hori (2006), and Fueda and Konishi (2007). Third, we find that these weak banks were not able to raise a sufficient amount of other types of deposits to replace the loss of time deposits; that is, their *total* deposits declined along with time deposits which were directly affected by the deposit insurance reform. Fourth and last, bank deposit growth, when instrumented with bank financial strength, had statistically significant and economically important effects on loan growth during the period of transition from a blanket guarantee to a limited guarantee. These results highlight the role of imperfect substitutability of insured and uninsured deposits in the transmission of liquidity shocks to bank lending.

The present paper is also relevant to a large body of literature on the bank lending channel in Japan (e.g., Ogawa and Kitasaka, 2000; Ito and Sasaki, 2002; Woo, 2003; Taketa and Udell, 2007). The methodology of this paper is similar in spirit to more recent papers (Peek and Rosengren, 2000; Gan, 2007; Watanabe, 2007) that make an attempt to pursue more credible identification of financial shocks on the capital position of banks.[3] Our results are largely consistent with the commonly-held notion that the presence of problem banks led to a reduction in the flow of intermediated funds and exacerbated the recession in Japan.

This paper is also closely related to two recent papers (Khwaja and Mian, 2008; Paravisini, 2008) in terms of its methodology. Khwaja and Mian (2008) make use of the announcement of a nuclear test by the Pakistani government which precipitated a rapid outflow of foreign currency deposits from the Pakistani banks in order to cleanly identify a deposit shock. Paravisini (2008) uses the exogenous infusion of cash from the government to banks in Argentina to study the transmission of liquidity shocks to loan supply. The common key element that allows clean

[3] Peek and Rosengren (2000) use the Japanese stock market and real estate problems in the early 1990s to identify loan supply shocks to U.S. commercial real estate markets. Gan (2007) and Watanabe (2007) utilize the collapse of asset values in the early 1990s in Japan and banks' real estate exposure to instrument financial shocks to Japanese banks.

identification of liquidity shocks in both these papers and our paper is that the external shock is likely to be unrelated to loan demand and it has differential effects on the liquidity position of different banks.

The remainder of this paper is organized as follows: Section 2 briefly describes the background of Japan's financial system and the nature of the deposit insurance reform. Section 3 discusses our data and empirical strategy. Section 4 presents the results, followed by robustness checks in Section 5. Section 6 concludes with possible direction of future research.

1. Japan's Financial System

A. Corporate Reliance on Bank Borrowing

Banks have played an essential role in the financial system and have been a dominant source of external finance for business firms in post-war Japan. Until the mid-1980s, the ratio of bank borrowing to total corporate finance was steady at over 80 percent. Most of the remainder funds were raised by new equity issuance (Hoshi and Kashyap, 2001).[4] In the mid-1980s, the government deregulated restrictions on the issuing of corporate bonds and motivated firms to shift their finance to domestic and foreign bond financing. Bank borrowing, however, still constituted around 75 percent of the total corporate finance by 1995 and remained a principal means of financing for most of the firms.

[4] As it is consistent with a view that banks (partially) solves asymmetric information problem in credit market by monitoring and maintaining relationships with firms (Sharpe, 1990; Rajan, 1992; Diamond, 1984, 1991), Japanese firms that had a close tie with banks were found to be less liquidity constrained than those without strong bank ties (Hoshi, at al. 1990, 1991).

While large, reputable firms gained better access to open markets to raise external funds as a result of financial deregulation, small and medium-sized domestic firms continued to rely on bank financing (Hoshi and Kashyap, 2001). The fraction of small and medium-sized business loans to total loans that was 73 percent over the period 1977 to 1986 increased to 78 percent over the period 1987 to 1990 (Ogawa and Kitasaka, 2000)[5]. Hence, Japan's economy as a whole continued to be highly dependent on bank financing and banks seem to have played a central role in the economy even after financial deregulation.

B. Evolution of Deposit Insurance System in Japan

Following the financial turmoil and a number of bank failures in the 1990s, the government announced in 1995 that it would provide a blanket guarantee on all bank deposits from June 1996 to March 2001 under the objective of avoiding a potential systemic banking crisis.[6] Thus, the depositors never faced the real risk of losing their deposits during this time period.

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[5] The corporate reliance on bank borrowing was especially prevalent for small and medium-sized firms in the service, construction and real estate industries (Dekle and Kletzer, 2003).

[6] As in other countries the Japanese government gradually expanded deposit insurance coverage over time since it was first instituted up to one million yen in 1971. The government raised its cap to three million yen in 1972, and ten million yen in 1986. In addition to the formal explicit deposit insurance, the Japanese government implicitly guaranteed bank deposits traditionally in the form of the *convoy system*, in which the Ministry of Finance (MOF) encouraged a healthy bank to rescue a failed bank by providing both personnel and financial assistance using the reserves of Deposit Insurance Corporation (Hoshi, 2002).

The blanket guarantee, when it was first introduced, had an expiration date -- it was scheduled to be removed in March 2001. The Japanese government, however, expressed concern that the end of full guarantees might cause the rapid outflow of deposits and severely hurt small and medium-sized financial institutions.[7]

Consequently, in December 1999, the government decided to postpone the re-introduction of the insurance cap for time deposits by one year and by two years for ordinary deposits. In April 2002, the deposit insurance cap of ten million yen was placed on time deposits as promised. However, due to the continuing instability of the financial system, in October 2002 the government again postponed complete implementation of the insurance cap on all the other deposits until April 2005.[8]

Since the time deposits were no longer fully insured after April 1st of 2002, depositors quickly shifted their deposits from time deposit accounts to ordinary deposit accounts during the transition period of 2001-2002. Figure 1 illustrates the dramatic shift of the deposit composition. Figure 2 highlights the massive outflow of large time deposits (over ten million yen) before 2002, suggesting that the reform had disproportionately larger effects on large time deposits than small time deposits since time deposits less than ten million yen would not be exposed to any risk by the reform. In addition to the substantial substitution from time deposits to ordinary deposits,

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[7] Michio Ochi, chairman of the cabinet-level Financial Reconstruction Commission, expressed a concern that, "if 10% of credit cooperatives collapse, there will be an exodus of funds out of the entire credit cooperative industry. Such a development would rekindle anxiety toward not only those particularly small financial institutions but also the nation's financial industry as a whole." December 23, 1999. *Japan Economic Newswire.*

[8] See more details in Fukao (2007).

some studies show that the reform also prompted depositors to reallocate their deposits from risky banks to financially healthy banks (Imai, 2006; Murata and Hori, 2006; Fueda and Konishi, 2007).

Figure 1 and 2 also show that, time deposits began to decline gradually a year before the reinstatement of the insurance cap in April 2002. Since the deposit insurance reform was already announced, it is reasonable to infer that some depositors were anticipating the reinstatement and reallocated their large time deposits ahead of time. Moreover, earlier studies on the reform (Imai, 2006; Murata and Hori, 2006; Fueda and Konishi, 2007) show that most of the depositors reacted to the reform during the period of transition.

C. The Credit Crunch in 2002

Many economists argue that the credit crunch which followed the collapse of asset prices caused or exacerbated the long economic stagnation, so-called "Lost Decade" or "Great Recession" (Kuttner and Posen, 2001; Hoshi and Kashyap, 2004; Fukao, 2007). Figure 3 illustrates the fluctuation of lending attitude of financial institutions in Japan from The BOJ Tankan.[9] It shows two severe credit crunches in 1991 and 1998.

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[9] The BOJ Tankan is compiled by the Bank of Japan based on its quarterly survey about the present and future business conditions for Japanese business firms. It is considered to be one of the most important economic indicators with which the Bank of Japan conducts its monetary policy. See Motonishi and Yoshikawa (1999) and the relevant website in BOJ (http://www.boj.or.jp/en/theme/research/stat/tk/index.htm) for more details.

The first credit crunch followed the collapse of the bubble economy; the sharp decline in asset prices drastically undermined the value of wealth and collateral and led the economy to a severe recession. The second credit crunch occurred after a number of bank failures including the failure of Hokkaido Takushoku Bank, a large nation-wide bank, and Yamaichi Securities, one of the Japan's oldest and largest brokerage firms. These credit crunches have been studied extensively and reported to have had a significant adverse impact on financing costs and real economic activities (Motonishi and Yoshikawa, 1999; Peek and Resengren, 2001).

In addition to these two credit crunches, Figure 3 also displays an additional credit crunch in 2002. Figure 4 gives a closer look at the change in the lending attitude of financial institutions from 2001 to 2003. It shows that the lending attitude worsened sharply in the first quarter of 2002 and remained relatively low in the subsequent periods. The common explanation for this credit crunch is the collapse of the IT bubble in the 2000.[10] NASDAQ Composite peaked in March 2000 and sharply dropped down to one third of its peak in April 2001. As Figure 5 shows, Nikkei 225 Index also followed a similar path with NASDAQ Composite and consistently declined until late 2002.

However, while the collapse of the IT bubble might have been the culprit for the 2002 credit crunch, the timing of the credit crunch does not correspond perfectly

[10] For example, "waves from the U.S. high-tech and economic slump continue to crash onto Asian shores: Analysts fear the onset of a global recession and Japanese tech giant Fujitsu said Monday that it will cut 16,400 workers. The U.S. economy - especially the technology sector - was the primary locomotive for the export economies of Japan, Korea, Taiwan and Malaysia. Now that the bubble has burst here, it's having a devastating effect on Asia." August 21st, 2001. *USA TODAY*.

to the fall in the stock markets. Despite the sharp decline in stock markets in 2000, the lending attitude of Japanese banks remained strong and even improved slightly. Instead, the lending attitudes declined sharply much later in the first quarter of 2002, which coincided with the removal of a blanket deposit guarantee. According to these observations, one can speculate that the reform-induced deposit shock may have quickly led to the deterioration in the lending attitude of financial institutions in the first quarter of 2002, although it is difficult to make a definite conclusion based on the movement of the aggregate variable in response to a one-time shock.

2. Data and Empirical Strategy

A. Measurement of Bank Financial Strength

We choose to use the Moody's ratings because of well-known unreliability of balance sheet items during this particular period in Japan (e.g., Genay, 2002, Fukao, 2002).[11] While certainly not perfect, it has been shown that Moody's ratings are

[11] As the Japanese government failed to enforce rigorous prudential regulation, the accounting measures of bank risk were frequently manipulated by Japanese banks and subsequently began to lose its explanatory power for bank' share prices (Genay, 2002). For instance, banks issued subordinated loans to the group-affiliated life insurance companies in exchange for holding subordinated loans and surplus notes of those life insurance companies and they gained quasi capital on their balance sheet through this "double-gearing" (Fukao, 2002). Not surprisingly, when we use the accounting measures of bank risk, we do not find any meaningful results, indicating a serious measurement error. The results of these specifications are not reported in this paper to conserve space, but are available from the authors upon request.

relatively more reliable for evaluating performance of Japanese banks (Bremer and Pettway, 2002; Li, Shin, and Moore, 2006).

The rating used here is Moody's Long-Term Bank Deposit Ratings (*MBDR*), which measure a bank's ability to repay punctually its foreign and/or domestic currency deposit obligations. I assign numerical values to each rating in the ascending order: *MBDR* = 1 for "Aa3"; *MBDR* = 2 for "A1"; *MBDR* = 3 for "A2"; *MBDR* = 4 for "A3"; *MBDR* = 5 for "Baa1"; *MBDR* = 6 for "Baa2"; *MBDR* = 7 for "Baa3"; *MBDR* = 8 for "Ba1". The assigned number reflects degree of bank risk (i.e., the riskier the bank, the higher the *MBDR*).

B. Loans and Deposits

The main variables of our interest are loans and deposits. Those financial variables including total, time, and ordinary deposit and total loan are drawn from *Nikkin Shiryo Nenpo* (Annual Report on Japan's Financial Institutions) published by the Japan Financial News. Loan and deposit variables are calculated into annual growth.[12]

C. Empirical Strategy

We expect a bank's liquidity constraints to be tight only when depositors face the significant possibility of default under the partial guarantee and are concerned about the risk of picking "lemon" banks. Thus, there is no compelling reason to

[12] See Tables A1 and A2 in Appendix A for the complete list of data descriptions, sources and summary statistics.

expect deposits at weak banks to grow slower than those at strong banks during the period of full guarantees. On the other hand, we expect that under the partial guarantee, weak banks will suffer from an outflow of uninsured deposits. As a result, if uninsured and insured deposits are not perfect substitutes, their total deposits will fall, which, in turn, translates into the leftward shift of the loan supply schedule.

To implement this empirical strategy, we relate bank deposits to banks' risk profiles in the first stage regression. In the second stage, we explore how a deposit shock affects loan supply. We identify deposit shocks by an instrumental variable approach. Since the reform made deposits sensitive to bank default risk and the deposit supply was reallocated largely based on bank financial strength, we can use the bank financial strength as an instrument to purge the endogenenous components of deposits that are correlated with loan demand.

Hence, we first examine a simple statistical relationship between the growth of various types of deposits and bank financial strength:

$$\Delta Deposit_i = \alpha_0 + \alpha_1 MBDR_i + \varepsilon_i \tag{1}$$

$\Delta Deposit$ is growth of time, ordinary or total deposit. *MBDR* is Moody's Bank Deposit Ratings at the beginning of fiscal year. A subscript i indicates the bank. Using cross-sectional bank-level data, we estimate the equation for 2001-2002, the transition period when the reform provided depositors with the incentive to reallocate their funds across different types of deposit accounts and different banks. Therefore, we expect *MBDR* to be negatively correlated with partially insured time deposits. However, in the equation for ordinary deposit, we expect the coefficient on *MBDR* to be positive since risky banks should attempt to make up for the shortfall of time deposits by issuing more ordinary deposits which were still fully insured unlike time deposits.

If insured deposits are perfect substitute for uninsured deposits, then weak banks would be able to raise a sufficient amount of funds from other types of deposits to fully compensate for the loss of time deposits and, consequently, total deposits should remain the same. Under this scenario, the coefficient on *MBDR* in the equation for total deposits will be small and statistically insignificant. If, on the other hand, insured and uninsured deposits are not perfect substitutes, then weak banks would face increasing marginal costs as they attempt to raise additional funds, which, in turn, forces banks to cut bank on loan supply. Under this scenario, the coefficient on *MBDR* in the equation for total deposits will be negative, just like in the equation for time deposits.

We also estimate the same equation for 2000-2001, the period of a full deposit guarantee, as a falsification exercise. During this period, given that all deposits were fully guaranteed, there is no reason to expect *MBDR* to have had any effects on the supply of deposits. If deposit growth turns out to be negative correlated with *MBDR* even during 2000-2001, we would have to suspect that there might have been systematic relation among loan demand, deposit demand, and *MBDR*.

In the second stage, we relate loan growth to deposit growth while instrumenting the latter with *MBDR*:

$$\Delta Loan_i = \beta_0 + \beta_1 \widehat{\Delta Deposit_i} + \gamma_i \qquad (2)$$

$\Delta Loan$ is total loan growth and $\widehat{\Delta Deposit_i}$ is the predicted value of the deposit growth from the first stage regression.[13] We use Limited Information Maximum Likelihood (LIML) method as it is shown to be more robust to weak instrument problems, compared to Two Stage Least Squares (TSLS) (Stock and Yogo, 2002). If banks are liquidity-constrained, loan supply should be positively correlated with the change in deposit; that is, the coefficient on $\widehat{\Delta Deposit_i}$ should be positive.

3. Baseline Results

Table 1 reports the estimation results of simple OLS regressions of loan growth on deposit growth for 2001-2002 and 2000-2001 in columns 1-4 and the results of the IV regression (Equations (1) and (2)) for 2001-2002 and 2000-2001 in columns 5-10. Panels A and B report the results of the first stage and second stage equations, respectively. The third row gives dependent variables that are estimated for. *TIME*, *ORDI*, *TOTAL*, and *LOAN* represent growth of time deposits, ordinary

[13] In this specification, we relate the loan growth during 2001-2002 to a contemporaneous deposit shock that is caused by the reform; that is, we assume that bank loan responds rather quickly to deposit shocks. It might be reasonable to question this assumption: it might take bank loans much longer to respond to deposit shocks. We try relating the 2002-2003 loan growth to the 2001-2002 deposit shocks but we do not find any meaningful results (the results are available from the author upon request), suggesting that bank lending responds to deposit shocks relatively quickly. The quick response of loan supply to deposit shocks is documented in other papers as well. Paravisini (2008) finds that financial shocks to constrained banks in Argentina have an immediate effect on loan supply and the lending response occurs within a quarter from the shock. Khwaja and Mian (2008) also find that loan supply shifts swiftly in response to liquidity shocks in their study of Pakistani banks.

deposits, total deposits and total loans, respectively. The coefficients on *MBDR* capture sensitivity of the deposit growth to bank default risk.

In OLS, the coefficient on *Time Deposit Growth* turns out positive and statistically significant for loan growth for the transition period in 2001-2002 (column 1) whereas loan growth was uncorrelated with deposit growth during 2000-2001 (columns 3-4). These results are consistent with the view that the availability of time deposits was indeed a major determinant of loan supply during 2001-2002 while it was not a constraint for banks to expand loans during the period of the blanket guarantee. Although the deposit growth in these regression equations is endogenous (and the results should be interpreted with caution), these pieces of evidence seem to confirm the view that the nature of the deposit insurance scheme is related to the tightness of liquidity constraints in the banking sector.

The IV results also show a strong negative correlation between bank default risk (*MBDR*) and time deposit flows in the post-reform period (column 5, Panel A), indicating that depositors became sensitive to bank default risk in the selection of banks and withdrew more time deposits from those poorly rated (or financially weak) banks.

The coefficient on *MBDR* is positive but not statistically significant in the equation for ordinary deposit (column 6, Panel A). These results are in accordance with the fact that the reinstatement of the insurance cap was placed *only* on time deposits. Since the ordinary deposit was still fully insured, depositors switched their time deposit accounts to ordinary deposit accounts. If all the depositors just switched their time deposit account to an ordinary deposit account within the same bank, we should observe a statistically significant rise in ordinary deposits absorbing all the losses of time deposits. The fact that the coefficient is positive but not statistically significant, however, implies that some depositors might not have simply switched the accounts but moved away from financially weak banks to strong ones or to other financial tools.

These results on ordinary deposits also confirm that the observed decline in time deposits was not driven by a decline in loan demand; i.e., if the leftward shifts in loan demand schedule had been the culprit, ordinary deposits at weak banks would have declined along with time deposits.

Column 7 in Panel A shows that *MBDR* is negative and statistically significant for the growth of total deposits, which also suggests that financially weak banks could not fully replace the loss of time deposits with other deposits. This implies that time deposits and other deposits are not perfect substitutes.[14]

In contrast to the results for the period 2001-2002, bank default risk did not have any significant effects on deposit flows in the pre-reform period (columns 8-10, Panel A). Before the implementation of the insurance cap, depositors had no incentive

[14] These results also highlight the violation of the Modigliani-Miller theorem. Modigliani-Miller theorem states that, in the absence of taxes, bankruptcy costs and asymmetric information, firms have perfect substitutability between any financing methods and that market will supply the funds for all projects that yield an expected positive net present value (Miller and Modigliani, 1958). Thus, if the assumptions of Modigliani and Miller theory hold, total funding growth should be unaffected by the availability of time deposits. The empirical fact that the total deposit growth was affected by financial weakness and the shift in the availability of time deposits suggests that financial markets are not perfect.

to actively select financially strong banks, and therefore, banks' financial strength was irrelevant to deposit flows under the full deposit guarantee. Those extremely low R-squared and F-Statistic also underscore that bank default risk is uncorrelated with the deposit flow. These results also serve as placebo tests. If *MBDR* is spuriously correlated, in a systematic fashion, with lending opportunities and thus demand for external funds across individual banks, *MBDR* should have a statistically significant coefficient even during the 2000-2001; i.e., in order to finance their good lending opportunities, highly rated banks should aggressively pursue deposits. The results suggest that such phenomena did not occur in 2000-2001, which indicates that *MBDR* is likely to be a valid instrument which is strongly correlated with the deposit growth but uncorrelated with the lending opportunities of individual banks in 2001-2002.

Finally, even when instrumented with *MBDR*, the coefficient on *Time Deposit Growth* is positive and statistically significant (column 5, Panel B), meaning that poorly rated banks reduced loan supply in response the outflow of time deposits. The positive and statistically significant coefficient on *Total Deposit Growth* (column 7, Panel B) also indicates that there is a strong correlation between loan growth and the exogenous component of total deposit growth.[15] In particular, this coefficient is approximately equal to one, suggesting that the magnitude is economically important: a loss of deposit by 1 percent leads to a contraction of loan supply by 1 percent. In

[15] Note, however, that the results on the total deposit growth (column 7) are not as reliable as those on the time deposit growth, given the results seem to exhibit a weak instrument problem with F-Statistic of 6.045.

sum, these results suggest that banks view insured and uninsured funds as imperfect substitutes, which makes bank loans more sensitive to funding shocks.

4. Robustness Checks

While our simple framework generates evidence for the presence of the bank lending channel, it is possible that there might be some missing confounding factors that we have not accounted for. In particular, isolating shifts in loan supply schedule from shocks affecting loan demand is always a formidable task in the bank lending channel literature since the interaction of loan demand and supply determines the observed loan quantity. The omission of the loan demand factor thus could cause overestimation bias when estimating loan supply if determinants of loan supply are allowed to absorb the effects of loan demand on loan quantity. In our case, although we have established that Moody's rating was likely to be uncorrelated with loan demand (and deposit demand) during 2000-2001, we cannot rule out the possibility that such correlation arose during 2001-2002 for some reasons that are unknown to us. In this section, we make various attempts to control for heterogeneity across banks.

A. Geographical Differences

Those banks in our sample operate in different parts of Japan and thus face different demand conditions, depending on the performance of local economies. To control for heterogeneity in local loan demand, we use four different prefecture-level variables: land price, GDP, bankruptcy, and job opening ratio. Land price is the average annual price indices of commercial sites of prefectures and obtained from

Japan Statistical Yearbook published by Statistics Bureau, Director-General for Policy Planning (statistical standards) and Statistical Research and Training Institute of Ministry of Internal Affairs and Communication. GDP is annual prefecture level GDP complied by Cabinet Office of the Government of Japan. The number of bankruptcies is from Teikoku Bank Data. The job opening rate is calculated as the number of job seekers divided by the number of job openings and drawn from Ministry of Health, Labor and Welfare. All the variables are calculated into annual growth.

Since these loan demand controlling variables are at a prefecture-level while the rest of the variables in the data set are at a bank-level, we construct the branch-weighted average of each controlling variable for each bank as follows:

$$BANK\_DEMAND_i = \frac{1}{TOTAL\_BRANCH_i} \sum_j (PREF\_DEMAND_j * PREF\_BRANCH_{i,j})$$

where *BANK_DEMAND* is the branch-weighted average of a loan demand variable for a bank *i*, *TOTAL_BRANCH* is the total number of branches of bank *i*, *PREF_DEMAND* is a loan demand variable for prefecture *j*, and *PREF_BRANCH* is the number of branches of bank *i* in prefecture *j*. This equation is used to calculate each loan demand variable separately. For instance, a branch-weighted land price for bank *i* is calculated as follows:

$$BANK\_LAND_i = \frac{1}{TOTAL\_BRANCH_i} \sum_j (PREF\_LAND_j * PREF\_BRANCH_{i,j})$$

where *PREF_LAND* is the growth rate of the land price index in commercial sites for prefecture *j*.

Table 2 displays the results. The coefficients on *MBDR* remain negative and statistically significant for both time and total deposit growth in the first stage (Panel A). Similarly, in the second stage results, the coefficients on *Time Deposit Growth* and *Total Deposit Growth* are positive and statistically significant (Panel B). Hence, our main results are statistically robust to the inclusion of these additional control variables. The coefficients on deposits in columns 7-8 in Panel B are slightly smaller in magnitude compared to the results without any demand controls in Panel B of Table 1. This aligns with our anticipation that controlling for demand corrects the overestimation bias that was expected to be present in the results for Equation (2) in Table 1.

B. Bank Type

Banking literature shows that banks of different sizes serve different types of borrowers. In particular, large banks tend to serve large borrowers while small banks tend to serve small opaque borrowers (Berger, Miller, Petersen, and Rajan, 2005). Thus, if demand condition changes for a particular segment of borrowers in a way that is correlated with bank size, excluding the size of banks might give misleading results. Although financial deregulation blurred the difference between small local banks and large nation-wide banks in Japan, it might still be the case that small local banks serve mainly small opaque borrowers relative to large banks (Uchida, Udell and Watanabe, 2008). To address this issue, we include the log of bank assets to capture bank size and dummy variables for trust banks, tier I regional banks, and tier II regional banks as additional controls.[16]

Table 3 reports the results of these specifications. Even after including these controls, the results largely match the previous findings that bank default risk has negative and significant effects on deposit flows in the first stage (Panel A) and that the instrumented values of deposit growth are positively correlated with loan growth in the second stage (Panel B). Bank size turns out to be positive and statistically significant for total deposit growth (column 2, Panel A) and negative and statistically significant for loan growth (column 2, Panel B). These results suggest that depositors reacted to the deposit insurance reform by putting their money into large banks which happen to have had limited lending opportunities relative to the average bank in our sample.

Trust and *Tier I Regional Banks* have a positive and statistically significant coefficient for time deposit growth (column 3, Panel A). This indicates that those non-city banks or smaller banks attracted more time deposits or suffered less from the time deposit outflow holding everything else constant. In the second stage, the coefficients on regional bank dummies are positive and statistically significant

[16] There are four major types of commercial banks in Japan; city bank, Tier I and Tier II regional bank, and trust bank. City banks are large major commercial banks that base their headquarters in a big city and have nation-wide operation. Regional banks are small or medium-sized banks that operate in specific local areas. They are divided into Tier I and Tier II regional banks: Tier I regional banks are generally larger than Tier II. Trust banks are commercial banks that specialize in being a trustee of various kinds of trusts and in managing estates. These four types of banks constitute over 80 percent of the total assets held by all the banks operated in Japan.

(column 3, Panel B), suggesting that the lending opportunities of small regional banks had improved, relative to that of large nationwide banks, during the sample period. For total deposits, the coefficients on the bank type dummy variables in the first stage are negative but none of them is statistically significant (column 4, Panel A).

In the second stage, the coefficients on all the dummy variables, however, are positive and statistically significant (column 4, Panel B), which is consistent with the earlier result that non-city banks issued more loans on average. When bank size and dummy variables for bank types are included at the same time, the coefficients on these variables lose statistical significance in the second stage, suggesting some collinearity problem (columns 5-6, Panel B).

C. Controlling for Loan Write-Off

Peek and Rosengren (1995) point out that it might be misleading to use the change in outstanding loans as a measure of the change in the credit availability because the change in the outstanding loans reflects more than just new loan origination but also includes charge-offs, transfer of real estate loans to other real estate owned due to foreclosures, and net loan sales. One might worry that this criticism is especially applicable to our study because the Japanese banks accumulated a large number of non-performing loans and might have been compelled to write off a large number of non-performing loans from their balance sheets. Moreover, if weak banks had to write off more bad loans than strong ones in a systematic fashion during the sample period, then *MBDR* is no longer valid instrument since it is mechanically correlated with loan growth through differential amounts of loan write-offs. In this robustness check, we add these write-offs back to the total amount of loans and calculate the loan growth so that the changes in loans are not attributed to the loan write-offs.

Table 4 reports the results with write-off adjusted loan growth. While the size of coefficients on the deposit growth decreases slightly compared to the baseline results (Panel B, Table 1), these results are qualitatively similar. The results also suggest that, although the amount of write-offs during the sample period was relatively large, they had no systematic relation to the weakness of banks, leaving our main results intact.

D. Panel IV Estimation

The last possible confounding factor we consider is time-invariant bank specific demand conditions; i.e., if unobserved bank specific characteristics that are correlated with loan demand are also correlated with *MBDR*, then the results are biased. To address this issue, we pool the data from 2000 to 2002 and carry out panel IV estimation with bank fixed effects, which should purge out the effects of unobserved bank characteristics that are time-invariant.

Table 5 reports the results. *REFORM*MBDR* is an interaction term of a dummy variable for 2001-2002 and *MBDR*. This variable captures sensitivity of the deposit growth to bank default risk during the period of transition. *REFORM*SIZE* is an interaction term of a dummy variable for 2002 and *SIZE* that is lagged by one. This captures sensitivity of deposit and loan to *SIZE* after the reform in 2002.

The coefficients on *REFORM*MBDR* are negative and statistically significant in the equations for time deposits (columns 1, 3 and 5, Panel A), implying that the deposit insurance reform made time deposits sensitive to bank default risk. Furthermore, those coefficients on *Time Deposit Growth* are positive and also statistically significant in all the equations (columns 1, 3, and 5, Panel B), suggesting a positive correlation between instrumented deposit growth (i.e. exogenous deposit shock) and loan growth.[17] The coefficient on *REFORM*SIZE* is negative and statistically significant in both the first and second stage (column 5), suggesting that larger banks lost more time deposits and made fewer loans during the transition from the full guarantee to the limited one from 2001-2002. *REFORM*SIZE* is statistically significant in neither the first nor second stage (column 6). These results are all in line with all the previous findings and support our main conclusions.

5. Conclusion

This paper utilizes the exogenous deposit outflow caused by the removal of a blanket deposit guarantee in Japan to investigate the impact of liquidity constraints on loan supply in Japan's banking sector. The empirical results show that as the government placed a cap of deposit insurance in April 2002, depositors began to reallocate deposits based on banks' financial strength and bank deposit became sensitive to bank default risk. Furthermore, weak banks that experienced a large outflow of time deposits could not fully make up for the loss with other types of funds due to imperfect substitutability of insured and uninsured deposit.

[17] The results on total deposits seem to exhibit the sign of weak instrument problem (e.g., low first stage F-statistics and large standard errors in the second stage results).

More importantly, we find that bank deposit growth, when instrumented with bank financial strength, had a statistically significant and economically important impact on loan growth during the period of transition from a blanket to a limited guarantee. These results suggest that liquidity shocks matter to loan supply precisely in an environment where the adverse selection problem becomes an issue when raising uninsured deposits.

While this paper presents strong evidence for the presence of liquidity constraints in the particular context of Japan's deposit insurance reform, one may wonder whether the results can be generalized to other settings. In particular, one can speculate that these results are likely to depend on the fragility of financial institutions, informational environments and liquidity of financial systems as a whole. Similar to the case of Japan, as many as 14 countries have also adopted a temporary blanket guarantee during the financial crisis and shifted back to a limited guarantee (Laeven and Valencia, 2008). Hence, a similar experience in deposit insurance regime in other countries provides a suitable test ground to replicate our results, which should be a fruitful area for future research.

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Appendix A

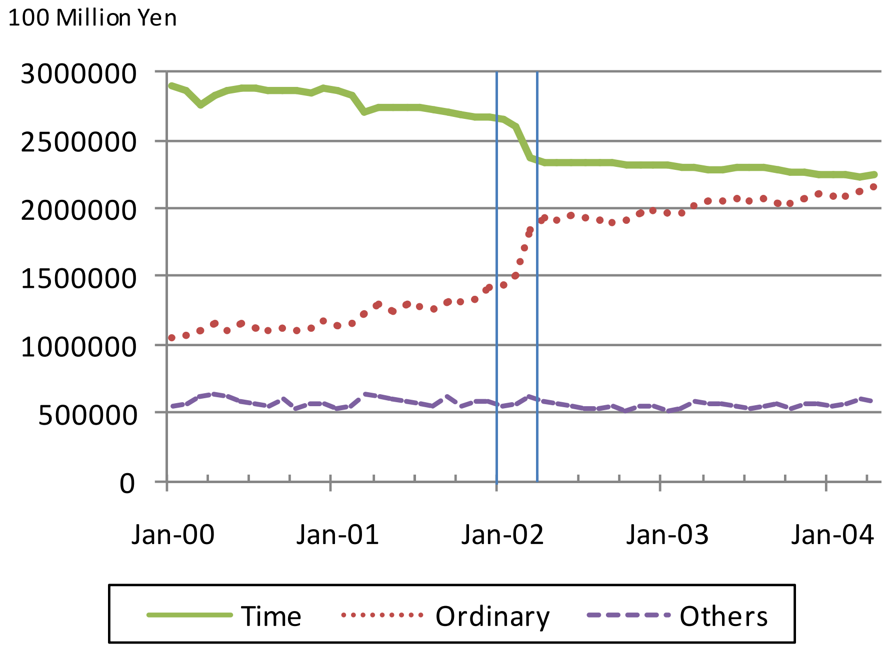
Table A1
Data Description and Source

Variables	Description	Source
Total Loan Growth	Annual growth of total loans	Nikkin Shiryo Nenpo (Annual Report on Japan's Financial Institutions) from the Japan Financial News
Total Deposit Growth	Annual growth of total deposits	Nikkin Shiryo Nenpo (Annual Report on Japan's Financial Institutions) from the Japan Financial News
Time Deposit Growth	Annual growth of time deposits	Nikkin Shiryo Nenpo (Annual Report on Japan's Financial Institutions) from the Japan Financial News
Ordinary Deposit Growth	Annual growth of ordinary deposits	Nikkin Shiryo Nenpo (Annual Report on Japan's Financial Institutions) from the Japan Financial News
SIZE	Log of total assets	Nikkin Shiryo Nenpo (Annual Report on Japan's Financial Institutions) from the Japan Financial News
MBDR	Moody's long-term bank deposit ratings	Lexis-Nexis Academic Universe
Land Price Growth	Growth of average prefectural land price of commercial sites	Japan Statistical Yearbook
GDP Growth	Growth of average prefectural GDP	Kenmin Keizai Keisan Nenpo (Annual Report on Economic Statistics in Prefecture) from the Office of Cabinet
Bankruptcy Growth	Growth of the number of bankruptcies	Zenkoku Kigyo Tosan Shukei (National Bankruptcy Statistics) from Teikoku Databank
Job Opening Rate Growth	Growth of ratio of job opening to job applicants	Rodo Shijo Nenpo (Annual Report on Labor Markets) from Ministry of Health, Labor and Welfare

Table A2
Descriptive Statistics

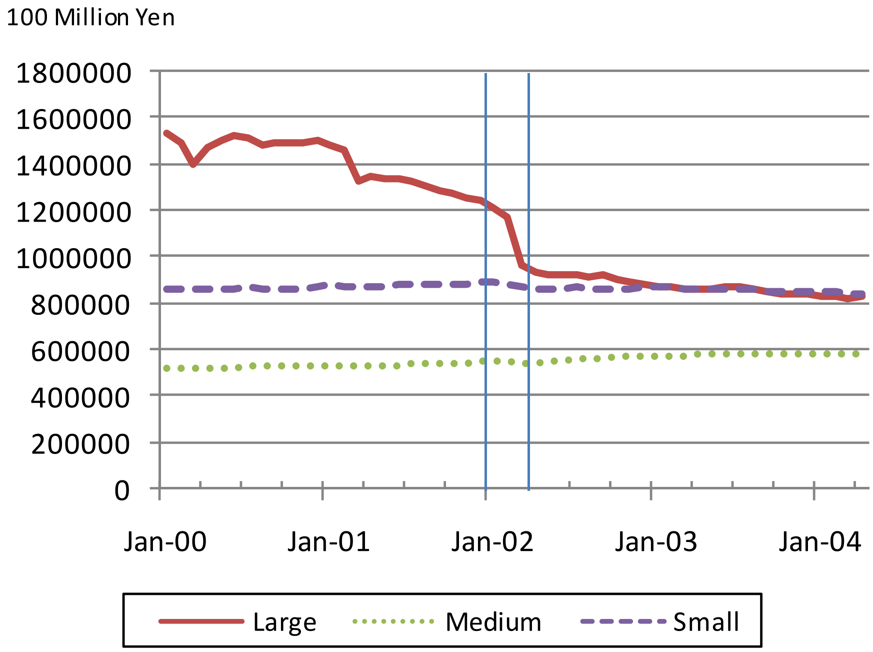
Variables		2000-2001	2001-2002	2000-2002
Total Loan Growth	Mean	-.00321	-.01979	-.01150
	S.D.	.04303	.07062	.05870
Total Deposit Growth	Mean	.02567	.01571	.02069
	S.D.	.04473	.05666	.05097
Time Deposit Growth	Mean	.00163	-.15587	-.07712
	S.D.	.08279	.09374	.11833
Ordinary Deposit	Mean	.08649	.39869	.24259
Growth	S.D.	.06298	.17368	.20377
SIZE	Mean	15.759	15.793	15.775
	S.D.	.88365	.89775	.88525
MBDR	Mean	4.75	5.025	4.8875
	S.D.	1.5317	1.8326	1.6838
Land Price Growth	Mean	-.08721	-.14558	-.11640
	S.D.	.03025	.22057	.15916
GDP Growth	Mean	-.01915	-.00247	-.01080
	S.D.	.02345	.02257	.024370
Bankruptcy Growth	Mean	-.09466	.00423	-.04521
	S.D.	1.0560	.09098	.74635
Job Opening Rate	Mean	-.10516	-.01101	-.05808
Growth	S.D.	.08272	.05839	.08547

Figure 1: Amount of Outstanding Deposits by Account Type



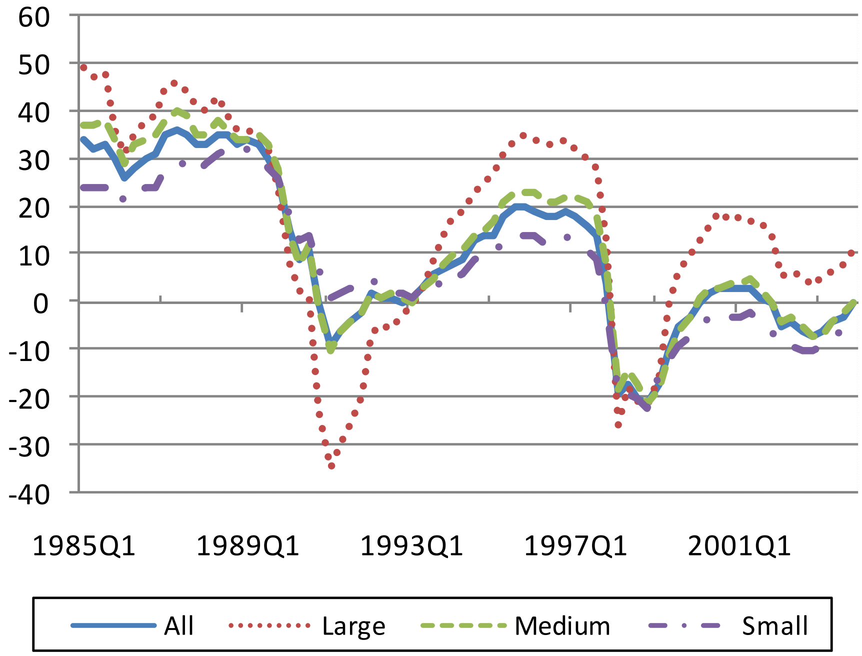
Source: Bank of Japan (http://www.boj.or.jp/en/)

Figure 2. Amount of Outstanding Time Deposits by Size



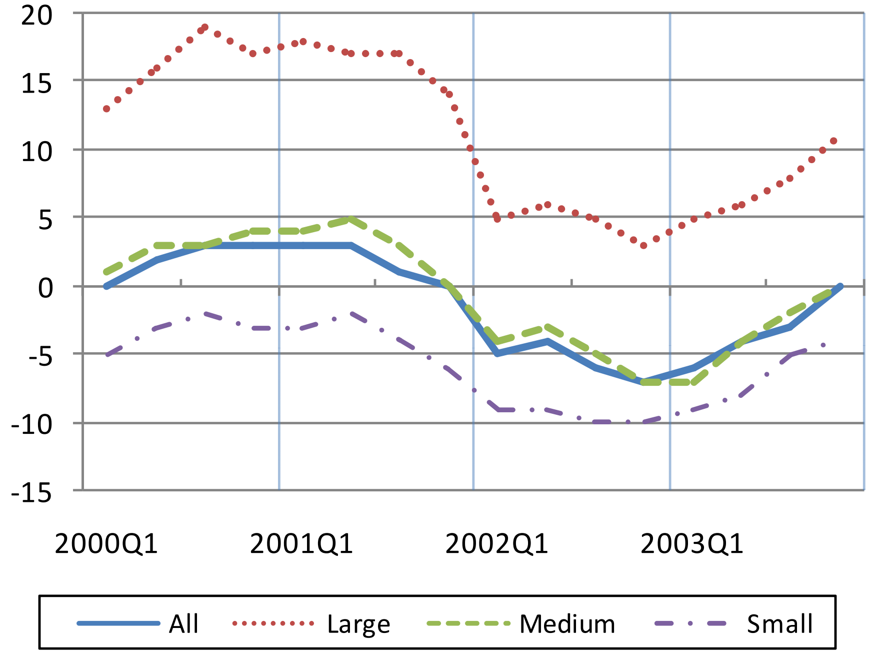
Source: Bank of Japan (http://www.boj.or.jp/en/)

Figure 3: Lending Attitude of Financial Institutions Diffusion Index from 1985 -2003



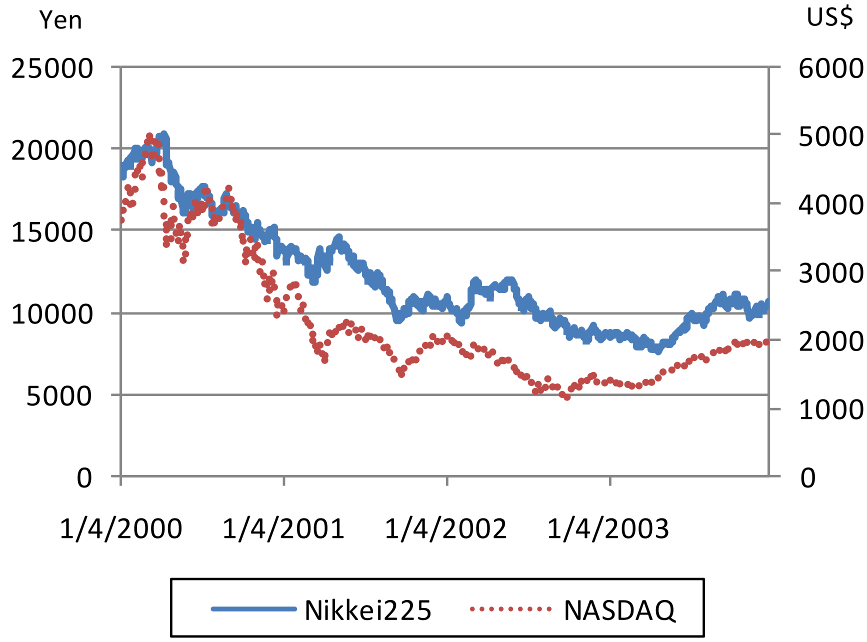
Source: The Bank of Japan *Tankan* Diffusion Indices

Figure 4: Lending Attitude of Financial Institutions Diffusion Index from 2001-2003



Source: The Bank of Japan *Tankan* Diffusion Indices

Figure 5: Nikkei 225 and NASDAQ Composite from 2000-2003



Source: Yahoo Finance (http://finance.yahoo.com/)

Table 1
Relationship between bank risk, deposit and loan in 2001-2002 and 2000-2001

This reports the results of the simple OLS regression of the loan growth on the deposit growth (columns 1-4) and the first stage equation (Equation 1) in Panel A and the second stage equation (Equation 2) in Panel B in columns 5-10. *TIME, ORDI, TOTAL* and *LOAN* represents the growth of time deposit, ordinary deposit, total deposit, and loan. *MBDR* represents Moody's Bank Deposit Ratings. The coefficients on *MBDR* capture sensitivity of the deposit growth to bank default risk. *Time Deposit Growth* and *Total Deposit Growth* in the second stage regression (Panel B) represents the predicted values of the time deposit growth and the total deposit growth based on the first stage regression, respectively. F-Statistic for Panel A is Kleibergen-Paap Wald rk F-Statistic (weak identification test).

					Panel A (1st Stage of IV Regression)					
	2001-2002		2000-2001		2001-2002			2000-2001		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable	LOAN	LOAN	LOAN	LOAN	TIME	ORDI	TOTAL	TIME	ORDI	TOTAL
MBDR					-0.0282***	0.0178	-0.0116**	-0.00343	0.000717	-0.00280
					(0.00689)	(0.0119)	(0.00470)	(0.00744)	(0.00425)	(0.00428)
Time Deposit Growth	0.390***		-0.00915							
	(0.111)		(0.130)							
Total Deposit Growth		0.456		0.125						
		(0.295)		(0.167)						
Constant	0.0411**	-0.0269**	-0.00320	-0.00643	-0.0139	0.309***	0.0738***	0.0179	0.0831***	0.0390*
	(0.0172)	(0.0121)	(0.00673)	(0.00518)	(0.0342)	(0.0644)	(0.0226)	(0.0386)	(0.0218)	(0.0202)
R-squared	0.269	0.134	0.000	0.017	0.305	0.035	0.140	0.004	0.000	0.009
F-Statistic	12.45	2.383	0.00493	0.565	16.80	2.245	6.045	0.212	0.0284	0.428
					Panel B (2nd Stage of IV Regression)					
					2001-2002			2000-2001		
Dependent Variable					LOAN		LOAN	LOAN		LOAN
Time Deposit Growth					0.449***			-0.168		
					(0.162)			(1.128)		
Total Deposit Growth							1.098**			-0.205
							(0.538)			(1.435)
Constant					0.0503*		-0.0370**	-0.00294		0.00205
					(0.0266)		(0.0145)	(0.00801)		(0.0408)
Observations	40	40	40	40	40	40	40	40	40	40

*** p<0.01, ** p<0.05, * p<0.1

Heteroskedasticity-robust standard errors in parentheses

Table 2

Robustness check with additional controls for loan demand in 2001-2002

Panels A and B report first stage and second stage results, respectively. *TIME, TOTAL* and *LOAN* represents the growth of time deposit, total deposit, and loan, respectively. *MBDR* represents Moody's Bank Deposit Ratings. The coefficients on *MBDR* capture sensitivity of the deposit growth to bank default risk. *Time Deposit Growth* and *Total Deposit Growth* represent the predicted values of the first stage equation. *Land Price Growth, GDP Growth, Bankruptcy Growth, and Job Opening Ratio Growth* is the growth of branch-weighted land price index, GDP, bankruptcies and active job opening, respectively. F-Statistic is Kleibergen-Paap Wald rk F statistic (weak identification test).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A (1st Stage of IV Regression)							
Dependent Variable	TIME	TOTAL	TIME	TOTAL	TIME	TOTAL	TIME	TOTAL
MBDR	0.0283***	0.0116**	0.0292***	0.0112**	0.0282***	0.0116**	0.0295***	0.0113**
	(0.00703)	(0.00478)	(0.00703)	(0.00487)	(0.00648)	(0.00479)	(0.00668)	(0.00514)
Land Price Growth	-0.00320	-0.0111					-0.0259	-0.0107
	(0.0401)	(0.0250)					(0.0420)	(0.0262)
GDP Growth			0.385	-0.166			0.269	-0.175
			(0.602)	(0.505)			(0.646)	(0.525)
Bankruptcy Growth					-0.153	0.0105	-0.160	0.00344
					(0.114)	(0.0694)	(0.117)	(0.0715)
Job Opening Ratio Growth							0.315*	0.0628
							(0.164)	(0.102)
F-Statistic	16.18	5.902	17.23	5.260	18.88	5.827	19.51	4.839
	Panel B (2nd Stage of IV Regression)							
Dependent Variable	LOAN	LOAN	LOAN	LOAN	LOAN	LOAN	LOAN	LOAN
Time Deposit Growth	0.456***		0.352**		0.452***		0.361**	
	(0.165)		(0.145)		(0.162)		(0.141)	
Total Deposit Growth		1.108**		0.920*		1.102**		0.943*
		(0.547)		(0.515)		(0.532)		(0.511)
Land Price Growth	-0.0353	-0.0245					-0.0148	-0.0140
	(0.0311)	(0.0356)					(0.0313)	(0.0378)
GDP Growth			-1.133**	-0.845*			-1.093**	-0.831*
			(0.575)	(0.505)			(0.551)	(0.501)
Bankruptcy Growth					0.176*	0.0955	0.140	0.0792
					(0.106)	(0.113)	(0.0922)	(0.102)
Job Opening Ratio Growth							0.0167	0.0711
							(0.0874)	(0.102)
Observations	40	40	40	40	40	40	40	40

*** p<0.01, ** p<0.05, * p<0.1

Heteroskedasticity-robust standard errors in parentheses

Table 3
Robustness check with additional controls for size and type in 2001-2002
Panels A and B report first stage and second stage results, respectively. *TIME, TOTAL* and *LOAN* represents the growth of time deposit, total deposit, and loan, respectively. *Time Deposit Growth* and *Total Deposit Growth* in the second stage are the predicted values of the time and total deposit growth based on the first stage. *SIZE* is log of total asset. *Trust Bank, Tier I Regional Banks* and *Tier II Regional Banks* are dummy variables for those types of banks. F-Statistic is Kleibergen-Paap Wald rk F statistic (weak identification test).

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A (1st Stage of IV Regression)					
Dependent Variable	TIME	TOTAL	TIME	TOTAL	TIME	TOTAL
MBDR	-0.0312***	-0.00876*	-0.0275***	-0.0103**	-0.0251***	-0.00692
	(0.00750)	(0.00476)	(0.00672)	(0.00456)	(0.00695)	(0.00479)
SIZE	-0.0192	0.0290***			0.0358*	0.0510*
	(0.0164)	(0.0100)			(0.0208)	(0.0295)
Trust Bank			0.170***	0.00137	0.199***	0.0422
			(0.0618)	(0.0484)	(0.0560)	(0.0548)
Tier I Regional Banks			0.0918**	-0.0421	0.162***	0.0587
			(0.0366)	(0.0351)	(0.0497)	(0.0847)
Tier II Regional Banks			0.0354	-0.0549	0.108	0.0482
			(0.0653)	(0.0663)	(0.0730)	(0.103)
Land Price Growth	-0.0258	-0.0109	0.00283	-0.0175	0.0172	0.00301
	(0.0519)	(0.0147)	(0.0467)	(0.0221)	(0.0358)	(0.0163)
GDP Growth	0.424	-0.410	0.167	-0.448	0.202	-0.398
	(0.640)	(0.517)	(0.481)	(0.638)	(0.461)	(0.492)
Bankruptcy Growth	-0.130	-0.0426	-0.00218	0.00995	-0.0373	-0.0401
	(0.113)	(0.0730)	(0.139)	(0.0869)	(0.137)	(0.0777)
Job Opening Ratio Growth	0.248	0.163	0.259*	0.108	0.314*	0.187*
	(0.150)	(0.103)	(0.141)	(0.111)	(0.163)	(0.105)
Constant	0.305	-0.399**	-0.0929**	0.0971***	-0.722*	-0.801
	(0.274)	(0.168)	(0.0399)	(0.0324)	(0.360)	(0.531)
R-squared	0.403	0.335	0.570	0.251	0.592	0.370
F-Statistic	17.29	3.385	16.70	5.097	13.08	2.088

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel B (2nd Stage of IV Regression)					
Dependent Variable	LOAN	LOAN	LOAN	LOAN	LOAN	LOAN
Time Deposit Growth	0.422***		0.394**		0.354*	
	(0.119)	`	(0.157)		(0.183)	
Total Deposit Growth		1.504**		1.052***		1.285**
		(0.629)		(0.379)		(0.556)
SIZE	-0.0207	-0.0724***			0.0166	-0.0363
	(0.0128)	(0.0270)			(0.0263)	(0.0370)
Trust Bank			0.0475	0.113***	0.0675	0.0836
			(0.0605)	(0.0411)	(0.0714)	(0.0546)
Tier I Regional Banks			0.0634*	0.144***	0.0999	0.0819
			(0.0354)	(0.0286)	(0.0705)	(0.0587)
Tier II Regional Banks			0.0774*	0.149**	0.112	0.0885
			(0.0435)	(0.0752)	(0.0704)	(0.0902)
Land Price Growth	-0.0130	-0.00754	-0.00243	0.0171	0.00437	0.00660
	(0.0239)	(0.0165)	(0.0291)	(0.0280)	(0.0371)	(0.0241)
GDP Growth	-0.942*	-0.146	-0.856**	-0.319	-0.833**	-0.250
	(0.518)	(0.532)	(0.436)	(0.359)	(0.391)	(0.445)
Bankruptcy Growth	0.183**	0.192***	0.178**	0.167**	0.162*	0.200**
	(0.0793)	(0.0723)	(0.0866)	(0.0850)	(0.0831)	(0.0846)
Job Opening Ratio Growth	-0.0738	-0.214	-0.0503	-0.0623	-0.0145	-0.143
	(0.0957)	(0.134)	(0.0867)	(0.0753)	(0.0993)	(0.115)
Constant	0.367*	1.096***	-0.0140	-0.153***	-0.310	0.463
	(0.195)	(0.412)	(0.0495)	(0.0279)	(0.477)	(0.614)
Observations	40	40	40	40	40	40

*** p<0.01, ** p<0.05, * p<0.1

Heteroskedasticity-robust standard errors in parentheses

Table 4
Robustness check with write-off adjusted loan from 2000-2002
TIME, TOTAL and *LOAN2* represents the growth of time deposit, total deposit, and loan adjusted for write-offs, respectively. *Time Deposit Growth* and *Total Deposit Growth* in the second stage are the predicted values of the time and total deposit growth based on the first stage. This is the same equation as in Table 1 but write-off adjusted loan is used instead of unadjusted loan. The results of the first stage regression are identical to those reported in Panel A of Table 1, and thus not reported.

	2001-2002		2000-2001	
	(1)	(2)	(3)	(4)
	Panel B (2nd Stage of IV Regression)			
Dependent Variable	LOAN2	LOAN2	LOAN2	LOAN2
Time Deposit Growth	0.425***		-0.320	
	(0.149)		(1.217)	
Total Deposit Growth		1.038**		-0.391
		(0.510)		(1.541)
Constant	0.0489**	-0.0337**	-0.00141	0.00810
	(0.0249)	(0.0138)	(0.00856)	(0.0432)
Observations	40	40	40	40

*** p<0.01, ** p<0.05, * p<0.1

Heteroskedasticity-robust standard errors in parentheses

Table 5
Robustness check with pooled panel regression with bank fixed effects (2000-2002)

Panels A and B report first stage and second stage results, respectively. *TIME, TOTAL* and *LOAN* represents the growth of time deposit, total deposit, and loan, respectively. *Time Deposit Growth* and *Total Deposit Growth* in the second stage are the predicted values of the time and total deposit growth based on the first stage. *REFORM*MBDR* is an interaction term of *MBDR* and the reform dummy variable for the period 2001-2002 to capture sensitivity of the deposit growth to bank default risk in 2001-2002. *REFORM*SIZE* is an interaction of one lagged log of asset and the reform dummy variable. F-Statistic is Kleibergen-Paap Wald rk F statistic (weak identification test). The standard errors are clustered by each bank.

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A (1st Stage of IV Regression)					
Dependent Variable	TIME	TOTAL	TIME	TOTAL	TIME	TOTAL
REFORM*MBDR	-0.0230***	-0.00800	-0.0257***	-0.00807	-0.0266***	-0.00666
	(0.00684)	(0.00486)	(0.00537)	(0.00488)	(0.00539)	(0.00560)
SIZE					0.412***	0.173
					(0.146)	(0.230)
REFORM*SIZE					-0.0687***	0.00186
					(0.0154)	(0.0151)
Land Price Growth			-0.0548	-0.00616	-0.0606	-0.00857
			(0.0465)	(0.0263)	(0.0544)	(0.0259)
GDP Growth			0.569	0.0543	0.533*	0.105
			(0.567)	(0.346)	(0.315)	(0.277)
Bankruptcy Growth			-0.0125	0.00134	-0.00198	0.00110
			(0.00796)	(0.00807)	(0.00845)	(0.00751)
Job Opening Ratio Growth			0.472***	0.0254	0.169*	0.0353
			(0.139)	(0.0780)	(0.0904)	(0.0676)
1st Stage F-Statistic	11.26	2.705	22.92	2.732	24.31	1.412
	Panel B (2nd Stage of IV Regression)					
Dependent Variable	LOAN	LOAN	LOAN	LOAN	LOAN	LOAN
Time Deposit Growth	0.569**		0.501**		0.560***	
	(0.244)		(0.208)		(0.199)	
Total Deposit Growth		1.632		1.596		2.237
		(1.034)		(0.990)		(1.671)
SIZE					-0.263*	-0.419
					(0.153)	(0.635)
REFORM*SIZE					0.00814	-0.0344
					(0.0187)	(0.0342)
Land Price Growth			-0.00315	-0.0208	0.00375	-0.0110
			(0.0186)	(0.0322)	(0.0162)	(0.0420)
GDP Growth			-0.216	-0.0172	-0.303	-0.240
			(0.314)	(0.539)	(0.250)	(0.517)
Bankruptcy Growth			0.00932	0.000927	0.00876	0.00520
			(0.00697)	(0.0150)	(0.00731)	(0.0171)
Job Opening Ratio Growth			-0.0829	0.113	-0.0768	-0.0612
			(0.123)	(0.116)	(0.0716)	(0.121)
Observations	80	80	80	80	80	80

*** p<0.01, ** p<0.05, * p<0.1

Heteroskedasticity-robust standard errors in parentheses