Interbank Contagion: Evidence from Real Transactions*

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April 2006

Abstract

This paper tests financial contagion due to interbank linkages using a natural experiment caused by a large-bank failure due to fraud. First, we find that a bank with higher level of exposure to the failed bank experiences higher depositor runs. Second, a bank with higher fraction of its deposits held by other banks experiences considerably higher depositor runs provided its exposure to the failed bank is sufficiently high. Furthermore, as the exposure to the failed bank increases, the runs stemming from higher fraction of deposits held by other banks drastically increase. Third, media reports have destabilizing effects on runs.

Keywords: Financial contagion, banking crisis, interbank market, bank runs, bank capital structure, bailout, LoLR, prudential regulation, media, information aggregation
JEL Classification: G21, G28, G14, E58

*We would like to thank the Reserve Bank of India and the Gujarat Urban Co-operative Banking Federation for their help through the study. We would especially like to thank Dr. R. B. Barman and Mr. Gokul Parikh. We are extremely grateful to Xavier Vives for all his help and guidance. We would also like to thank Viral Acharya, Paolo Angelini, José Manuel Campa, Amil Dasgupta, Bernard Dumas, Reint Gropp, Philipp Hartmann, Ed Kane, Paul Kupiec, Joseph Mason (our discussant), Robert Merton, Sendhil Mullainathan, Elias Papaioannou, Urs Peyer, Manju Puri, Rafael Repullo (our discussant), Martin Summer, Christian Upper and seminar participants at the Bank of Spain, European Central Bank, IESE Business School, Indian Institute of Management, Ahmedabad, INSEAD, University of Amsterdam, Workshop on "Systemic Risk in the Financial Sector" at Collegium Budapest, 4th Joint Central Bank Research Conference on Risk Measurement and Systemic Risk organized by CGFS in cooperation with the ECB, the Fed and Bank of Japan, and the 5th Annual Banking Research Conference at FDIC for helpful comments and suggestions. Any errors are our own, and the views expressed in this paper are those of the authors and do not reflect the views of the European Central Bank.

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1 Introduction

The idea that interbank markets can act like a double-edged sword is widely acknowledged. On the one hand, interbank markets play a very important role for the provision of liquidity among banks, for the disciplining and monitoring of banks, and for the conduct of monetary policy.[1] On the other hand, if a bank fails, the interbank market could transmit the shock thereby increasing the likelihood of a banking crisis. Given the economic importance of interbank markets and, the huge economic costs associated with banking crises (Friedman and Schwartz, 1963; Bernanke, 1983; Calomiris and Mason, 2003b; Dell'Ariccia et al., 2005), understanding the role of the interbank market in transmission of shocks is of utmost importance.[2]

The failure of a large bank raises the risk of contagion to the rest of the banking system. There is contagion if the failure of a bank causes a significant negative externality to other banks.[3] The three types of contagion that may arise (Gorton and Winton, 2002, pp. 85-87; De Bandt and Hartmann, 2002, pp. 251-256; Allen and Gale, 2000) are the following: The first type is financial contagion due to interbank linkages. The failure of a bank leads to a loss in value for its creditor banks which hold interbank claims in the failed bank. Furthermore, the loss for the creditor banks may increase due to the (over)reaction of their depositors and other creditors (Allen and Gale, 2000; Freixas et al., 2000; Dasgupta, 2004; Iyer and Peydró-Alcalde, 2005).[4] The second type of contagion is "information" based. The failure of a bank could

[1] See Meulendyke (1998), Hartmann et al. (2001), and Cocco et al. (2004).

[2] Hoggarth et al. (2002) find that, for banking crises, direct resolution costs are approximately 5% of GDP, and cumulative output losses incurred during crisis periods are found to be roughly 15%-20% of annual GDP. Furthermore, they find that output losses incurred during crises in developed countries are as high, or higher, on average, than those in emerging market economies.

[3] For a very similar definition of contagion, see Kaminsky and Reinhart (2000). For an excellent survey on bank contagion, see Kaufman (1994).

[4] In Rochet and Tirole (1996), a bank failure signals to the rest of the banking system that monitoring has not been effective, in turn increasing the probability of systemic risk. In Aghion et al. (2000), a bank failure signals an aggregate liquidity shortage. In Diamond and Rajan (2005), the failure of a bank causes a negative externality through the reduction of available liquidity. In Cifuentes et al. (2005), the sale of assets by a distressed bank creates a negative externality through the reduction of the market price for assets.

lead depositors and creditors to update their beliefs about the likelihood of failure of other banks with similar characteristics as the failed bank (Chen, 1999).[5] Finally, the third type is "pure" contagion. In this case, the contagion is purely random and has no relation either with interbank linkages or with information commonalities.[6] The statement issued by the U.S. Comptroller of Currency C.T. Conover, justifying the bailout of Continental Illinois Bank, aptly summarizes these concerns.[7] In his testimony before the Congress, he asserted that: "*Had Continental failed and been treated in a way in which depositors and creditors were not made whole, we could very well have seen a national, if not an international financial crisis, the dimensions of which were difficult to imagine. None of us wanted to find out.*"

Among the different types of contagion, financial contagion due to interbank linkages has most often been posited as a great threat for the stability of the banking system. Yet there is a lack of empirical work on the transmission of a crisis due to interbank linkages. The main problem that has hampered empirical work is the lack of interbank data during a crisis. In this paper, we overcome this hurdle by using a unique dataset from India, which allows us to identify the interbank linkages. We use the data on interbank linkages in conjunction with an idiosyncratic shock caused by the failure of a large co-operative bank due to a fraud to test contagion in the banking system. The fact that the cause of the failure was a fraud allows us to abstract away (to a great deal) from "information" based contagion. In consequence, the shock provides us with a natural experiment to cleanly test the risk of financial contagion due to interbank linkages versus "pure" contagion.

[5] See also Acharya and Yorulmazer (2005).

[6] This taxonomy of contagion builds on the theoretical literature of bank runs, i.e. information-based theory of bank runs (Chari and Jaganathan, 1988; Jacklin and Bhattacharya, 1988; and Allen and Gale, 1998) versus the sunspot-based theory of bank runs (Diamond and Dybvig, 1983). See also Bhattacharya and Gale (1987) and Bhattacharya and Fulghieri (1994) on the role of the interbank market to cope with bank specific liquidity shocks.

[7] See U.S. Congress, House of Representatives, Subcommittee on Financial Institutions Supervision, Regulation and Insurance, Inquiry into Continental Illinois Corp. and Continental Illinois National Bank (98-111), (98th Congress 2nd session, 1984).

To conduct our analysis, we study the effect of financial linkages among banks on the deposit flow for on-going banks. More specifically, we address the following questions: First, if a bank has more credit outstanding with the failed bank (hereafter referred to as exposure), does it experience more depositor runs? That is, we study whether the shock is transmitted from a debtor-bank to its creditor banks. Second, do creditor-banks in the interbank market affect the liquidity risk of their debtor-banks? Finally, we use information disclosures by banks and media to shed light on the release of information during a crisis and its effect on the evolution of the financial crisis.

We find that the level of credit outstanding with the failed bank is a significant determinant of depositor runs –i.e., we find that banks with higher level of exposure to the failed bank suffer higher level of depositor runs. We, then, conduct several robustness checks to make sure that exposure to the failed bank is not a proxy for other bank characteristics that could be driving the depositor runs. First, we check if banks that have higher exposure levels are ex-ante more risky or less profitable. Second, we check if exposure level is just a proxy for distance from the failed bank or a proxy for correspondent banking relationship with the failed bank. We find that, despite these controls, the level of exposure to the failed bank is significant in explaining depositor runs. Third, even after controlling for other fundamental characteristics of banks that proxy for the ability of a bank to withstand the crisis, we find that exposure to the failed bank retains its explanatory power. These results provide strong evidence in favour of financial contagion due to interbank linkages (Allen and Gale, 2000; Freixas et al., 2000; Dasgupta, 2004; and Iyer and Peydró-Alcalde, 2005).[8]

[8]See also Flannery (1996), Leitner (2005) and Brusco and Castiglionesi (2005).

To further explore the effect of outstanding interbank claims among surviving banks on depositor withdrawals, we use data on outstanding aggregate credit and debit positions of each bank with other banks in the interbank market (excluding the failed bank).[9] Thus for each bank, we know its exposure to the failed bank and, also, its outstanding aggregate credit and debit positions in the interbank market. We find that the outstanding interbank positions of banks (either credit or debit) have no significant effect on depositor withdrawals. Interestingly, we find that an on-going bank with higher fraction of its deposits held by other on-going banks experiences considerably higher depositor runs provided its exposure to the failed bank is sufficiently high. Furthermore, as the exposure to the failed bank increases, the runs stemming from higher fraction of deposits held by other banks drastically increase. These findings support the view that liquidity risk stemming from creditor-banks increasingly matters as the debtor-banks' exposure to the failed bank increases (Iyer and Peydró-Alcalde, 2005).

Another dimension, which we explore in the paper, is the release of public information during a crisis. After the failure, newspapers released reports about some banks facing depositor runs. One unique feature about these media reports was that they conveyed no information about the fundamentals of the banks. Most of the reports just stated that a bank was facing a run. We find that banks that are mentioned in these media reports suffer huge depositor withdrawals subsequent to the media release. In addition, we also find some banks voluntarily released their levels of exposure to the failed bank in their annual audited reports. The voluntary release of information is more prevalent among banks with lower levels of exposure to the failed bank. We, however, do not find any significant effect of voluntary release of information on depositor withdrawals.

[9] In our sample, as it will be explained later, there was only one bank failure, and none of the on-going banks were debtors of the failed bank.

The most important contribution of our paper is the following: We use a natural experiment caused by a large bank failure due to a fraud, in conjunction with precise data on interbank exposures, to cleanly test for financial contagion due to interbank linkages. Existing studies on financial contagion due to interbank linkages have been limited to simulations due to lack of actual failure events. Furthermore, papers that test for contagion using an actual failure do not address the issue of financial contagion due to lack of data on interbank linkages. Our paper bridges this void and also highlights the risk of contagion due to depositor behavior which is one of the prime concerns of the theoretical literature. In consequence, we are able to test the hypothesis of financial contagion due to interbank linkages against the hypothesis of "pure" contagion, in turn providing some directions for policy-making. Finally, our paper sheds some light on the issue pertaining to the release of public information and its effects during a financial crisis.

Related Literature: Most of the existing empirical studies on contagion focus primarily on measuring equity returns around large failures. They test whether all banks experience negative abnormal returns, or whether negative returns are limited to banks with similar characteristics to the failed banks. Aharony and Swary (1983) study the market reaction to the three biggest US bank failures prior to Continental Illinois. Swary (1986) and Jayanti and Whyte (1996) examine the market effect of the failure of Continental Illinois. Aharony and Swary (1996) study the market reaction in the context of five large bank failures that occurred in the Southwest region of the U.S. during the mid-1980s.[10] These papers find that surviving banks are most affected if they have portfolio characteristics similar to the failing institution. This, they argue, is evidence of "information" based contagion. The most important feature

[10]More recently, Gropp et al. (2005) use the tail properties of distance to default to study contagion risk in Europe; they find that contagion risk in Europe is important. Hartmann et al. (2005) study tail risk in major banks in the Euro Area and United States; they find that multivariate tail risks among major banks have recently increased.

that differentiates our paper from the literature cited above is that we use direct financial linkages among banks –i.e., we test financial contagion due to interbank linkages whereas their focus is on testing "information" based contagion.

There is an alternative stream of literature that studies the possibility of financial contagion due to interbank linkages via simulations. Humphrey (1986) uses data from the Clearing House Interbank Payments System (CHIPS) to simulate the impact of a settlement failure of a major participant in the payment system. He shows that this failure could lead to a significant level of further settlement failures. Upper and Worms (2004) study financial contagion due to interbank exposures in the German interbank market. Through a simulation, they find that the failure of a single bank could lead to the breakdown of 15% of the banking system. In contrast, Furfine (2003) uses exposure data on interbank federal funds to simulate the risk of financial contagion and finds it to be negligible.[11] Elsinger et al. (2003) use detailed data from the Austrian interbank market and study the possibility of contagious failures due to an idiosyncratic shock. In their simulations, they find the probability to be low.[12] While the above papers explore the issue of financial contagion due to interbank exposures, they do not capture the endogenous response of depositors and creditors during a crisis.[13] Our paper differs from the papers cited above by using an actual failure in order to test financial contagion in the banking system, in turn allowing us to study the endogenous response of depositors and creditors in the propagation of the crisis.

Another related strand of empirical literature investigates depositor runs on banks during a crisis. This literature explores whether depositors run randomly across banks or run on

[11] Furfine (2002) studies the federal funds market during the LTCM and Russian crises; he finds that risk premiums on overnight lending were largely unaffected and lending volumes increased.

[12] Although the probability of contagious default is low, there are cases in which up to 75% of the defaults are due to contagion.

[13] See also Sheldon and Maurer (1998), Cifuentes (2003), Müller (2003), Lelyveld and Liedorp (2004), Wells (2004), Degryse and Nguyen (2005), and Mistrulli (2005).

banks based on fundamentals (i.e., a test between the sunspot-based theory of bank runs by Diamond and Dybvig, 1983, versus the information-based theory of bank runs by Chari and Jaganatthan, 1988, Jacklin and Bhattacharya, 1988 and Allen and Gale, 1998). Schumacher (2000) studies depositor behavior in Argentina following the Tequila Shock, and finds that depositors primarily concentrate their runs on fundamentally weak banks. Martinez Peria and Schmukler (2000) also find evidence of depositor discipline in Argentina, Mexico and Chile. Calomiris and Mason (1997) look at the Chicago Banking Panic of 1932, and investigate whether solvent banks fail during the crisis. They find that banks that fail during the panic are ex-ante weak banks. They also provide some evidence in support of interbank cooperation helping prevent failures of solvent banks. Gorton (1988) studies the banking panics during the U.S. National Banking Era (1865-1914). He finds them not random events but products of revisions in the perceived risk of the banking system based on the arrival of new information. Our paper adds to this literature by studying depositor runs, not only through fundamental characteristics of banks, but also through financial linkages of banks with other banks.

The paper that is closest to ours in spirit is the one by Kho et al. (2000). They analyze the impact of emerging market currency crises, and the subsequent bailouts, on bank stock prices. They categorize banks into groups of exposed and non-exposed banks based on whether they had exposure to the crisis country. They find that the market was able to discern between exposed and non-exposed banks. Our paper differs substantially from this paper as we study whether a shock, due to the failure of a bank, is transmitted due to interbank linkages. Furthermore, we use exact interbank linkages of banks with the failed bank.

The rest of this paper is organized as follows. Section 2 describes the institutional details of the Indian banking system. Section 3 provides a description of the event. Section 4 summarizes the data used in the analysis. Section 5 discusses the empirical strategy of the

paper along with a discussion of the results. Section 6 provides conclusions and suggests some policy measures.

2 Institutional Details

Before we proceed to describe the event that we use to study contagion, a brief summary of the institutional setting is helpful to set things in perspective. The Indian banking system primarily constitutes of three types of banks: public sector banks, private banks and co-operative banks. The public sector banks and private banks dominate the urban areas, while the co-operative banks are very important source of finance in semi-urban and rural areas. The co-operative banks in each state have a three tier structure. At the top of the chain is the state co-operative bank, followed by the local district central co-operative bank, and then the urban co-operative banks.[14] Co-operative banks' deposit base primarily constitutes of small depositors. Their loan portfolio relies heavily on soft information. Given the emphasis of co-operative banks for rural development, it is mandatory for co-operative banks to lend at least 60% of their loan portfolio to the 'priority' sector.[15]

The main regulatory authority of the banking system in India is the Reserve Bank of India (RBI). Co-operative banks, however, come under dual regulation, i.e. they are supervised by the RBI as well as by the local state government. The RBI is responsible for monitoring the banks portfolios while the state government is responsible for governance issues. The insurance cover granted under the deposit insurance scheme is Rs. 100,000 (approximately 2,000$) for

[14]The state co-operative bank and district central co-operative bank can be considered as public banks as they are under control by the local governing body of the state.

[15]The priority sector constitutes primarily of small scale industries. It is not mandatory for banks directly to lend to the priority sector. Another way banks can fulfill this mandate is by placing their money in other government institutions that are engaged in priority sector lending. For a detailed discussion on priority sector lending see Banerjee and Duflo (2002).

each account.[16] Though deposit insurance is present, there are several delays in processing the claims of depositors, as the central bank first suspends convertibility when a bank approaches failure. After suspension of convertibility, the central bank takes a decision of whether to liquidate a bank or arrange a merger with another bank. During this period depositors are allowed a one time nominal withdrawal up to a maximum amount that is stipulated by the central bank.[17] The stipulated cash reserve ratio and statutory liquidity ratio to be maintained by the banks are 5.5% and 25% respectively.[18] One point to take note of is that depositors of co-operative banks are not required to hold a equity claim in the co-operative bank. Thus the co-operative structure of the banks does not lead to significant differences in characteristics of depositors as compared to banks with other ownership structures. Also, shareholders of co-operative banks have limited liability.

The interbank market for funds in India is primary composed of two parts. One is the call money market which is similar to the Fed overnight market for funds. The call money market is primarily dominated by private banks and public sector banks, though some large co-operative banks do have a presence. The other interbank market is the market for direct placement of deposits and borrowings by banks among one another. This market mainly functions through private negotiations. The co-operative banks are generally very active in this market and use this market to park their surplus funds (mostly with other co-operative banks). The contracts entered in this market take the form of demandable debt unlike those in the call money market which are standard debt contracts.[19] While the funds transacted in

[16] The deposit insurance is based on a flat premium. See www.dicgc.org.in.

[17] In most cases, depositors are allowed a one time withdrawal of up to Rs. 5,000 (100$) per account.

[18] Statutory Liquidity Ratio (SLR) is the one which every banking company shall maintain in India in the form of cash, gold or unencumbered approved securities, an amount which shall not, at the close of business on any day be less than such percentage of the total of its demand and time liabilities in India as on the last Friday of the second preceding fortnight.

[19] The contracts in the call money market are entered for a stipulated period of time and cannot be liquidated before maturity, unlike the demandable debt contracts.

the call money market are not insured, the funds placed by banks as deposits in other banks are only insured up to the ordinary deposit insurance levels.[20]

3 Event Description

We now turn to the description of the event that we use to study contagion. The whole episode started with a fraud in the largest co-operative bank named Madhavpura Mercantile Co-operative Bank (hereafter referred to as MMCB) in the state of Gujarat.[21] MMCB had granted loans to stock brokers without appropriate collateral in contravention of the guidelines prescribed by the central bank.[22] The amount of loans given to stock brokers amounted to nearly 80% of the deposit base (Rs. 10 billion were advanced as industrial loans to stock brokers without appropriate collateral). In early March 2001, as the stock market experienced a major downward trend, rumors were floating around that MMCB was experiencing liquidity problems due to over-stretched lending to stock brokers. This led to a run on the bank on 10th, 11th, and 12th of March 2001. As the bank failed to repay depositors on the 13th of March 2001, the central bank temporarily suspended convertibility and restrained the bank from making payment to depositors beyond Rs. 1,000 per account.[23]

An important aspect of the MMCB failure (apart from the fact that MMCB was the biggest co-operative bank in the state) was that it had a significant number of banks connected to it via interbank transactions. Out of the total deposit base of Rs. 12 billion, deposits from other banks constituted about Rs. 6 billion. The primary reason for a large number of connections

[20] See Demirguc-Kunt et al. (2005).

[21] See www.manupatra.com/downloads/JPC/part%201.pdf.

[22] Co-operative banks were not allowed to have direct exposure to stock market or lend to stock brokers. They were, however, allowed to lend to an individual against collateral of shares up to Rs. 1 million if the shares are in physical format, and up to Rs. 2 million if the shares are in demat (electronic) format.

[23] See the report of the Joint Parliamentary Committee at www.manupatra.com/downloads/JPC/part%201.pdf.

was due to the fact that MMCB had a status of a scheduled bank, allowing it to carry out multi-state operations.[24] Smaller co-operative banks in the state maintained deposits with MMCB, as MMCB provided remittance facilities within and across the state.[25] Many co-operative banks also used the deposits placed with MMCB to fulfill the statutory liquidity requirements.[26] Apart from the linkages banks had to MMCB due to direct placement of deposits, some banks were also linked to MMCB due to their call money lending and pay orders.[27] This setup is similar to the reserve pyramiding that prevailed in the U.S. prior to the passing of the Federal Reserve Act that lead to the establishment of Federal Reserve Banks.[28]

After the collapse of MMCB there was a huge debate whether MMCB should be bailed out. A committee was constituted to study the possibility of its revival. The fundamental aspect of the revival plan addressed by the committee was to choose one of the three following options: closure, merger or takeover, or comprehensive financial and operational restructuring. Based on the recommendations of the committee, it was finally decided on August 2001, that MMCB would be revived. The revival scheme was organized in terms of a privately arranged bailout. The revival package required the participation of all the co-operative banks in the state, contributing 4% of their deposit base to the revival fund. This money was to be insured by a guarantee provided by the government. The revival package, however, did not insure

[24] Co-operative banks have branching restrictions similar to those which existed in the United States. A scheduled bank status is granted by the central bank if the bank meets certain norms in terms of deposit base and capital adequacy.

[25] Remittance facility is a mechanism to transfer funds to other areas. For example a bank which does not have a branch in location X might use the services of another bank that has a branch at X to transfer funds to that location. MMCB had provided remittance facility/cheque collection services free of charge to other banks.

[26] Smaller co-operative banks in the state normally maintain deposits with the scheduled banks as these deposits can be used to fulfill their SLR requirements (statutory liquidity requirements).

[27] The issuing bank is supposed to debit the account of the person who takes a pay order. MMCB had issued pay orders to the brokers without debiting their account and these pay orders were discounted by other banks to the tune of Rs. 1.2 billion.

[28] See Broaddus (1993).

the deposits that banks already held with MMCB.[29] The deposits and call money exposures that banks had with MMCB prior to its failure were to be retained and converted into term deposits for a period of four years at 7.5% per annum.

Though there was a guarantee provided by the government, the revival scheme was a non-starter. Most of the co-operative banks in the state were reluctant to contribute funds and even as late as January 2002, hardly any funds had been mobilized to implement the revival package. The committee in charge of implementing the revival scheme also noted that the recovery of the amount lent to the stock brokers was very unlikely.

After the failure of MMCB, the immediate concern of the central bank was to limit the contagion. The central bank was primarily concerned with the propagation of the crisis due to interbank connections. The prominence of this fact was highlighted in the statement made by the Governor of the central bank in his monetary policy address 2001-2002.[30] He stated that "*recent experience has shown that irresponsible and unethical behavior on the part of even a few co-operative banks in the country can have some contagion effect beyond the particular area or the state concerned.*"

The immediate policy response by the central bank was to limit the amount of exposure banks could have in the call money market. As on April 2001, co-operative banks were not allowed to borrow more than 2% of their deposit base as on the end of March in the previous year.[31] The central bank, however, was ready to provide liquidity to banks against appropriate collateral if need arose.[32] The central bank also noted that parking of funds by co-operative

[29]The central bank also made it clear that it would not waive penalties for non compliance of cash reserve requirements and SLR requirements by banks that had exposure to MMCB.

[30]Monetary policy statement 2001-2002, page no. 47 (www.rbi.org.in).

[31]There was however no restriction on lending in the call money market. See circular DS.PCB.CIR. 40 /13.01.00/2000-01 at www.rbi.org.in.

[32]The central bank issued a statement that some co-operative banks were facing liquidity problems and were not able to raise funds in the call money market. In view of this, the central bank announced that co-operatives could avail liquidity from the central bank against appropriate collateral. See press release no.

banks with other co-operative banks posed a systemic risk. In response, it issued a directive asking all the co-operative banks not to renew/place fresh deposits with other co-operative banks.[33] It was, however, left to the discretion of the banks if they wanted to unwind their deposits prematurely, though it was stipulated that by the end of June 2002, they should unwind their deposits with other co-operative banks. Another regulatory response of the central bank, immediately after the failure, was to collate information on stock exposures (direct or indirect) from all banks in the system. Subsequently, the central bank issued a public statement that all banks had adhered to the prescribed norms.[34]

4 Data

To begin with, our first task was to obtain balance sheet information of banks. As there is no single source that has all the balance sheet information (either in paper or in electronic format), we have to hand collect annual reports of banks. Given the enormity of the task, we decided to streamline the data collection. We first limit our analysis to co-operative banks located in the state of Gujarat as there were only a few banks outside the state of Gujarat which had connections with the failed bank. We further limit our sample to banks that have a deposit base with more than Rs. 250 million as on March 31st, 2001.[35] We find that using this cutoff would lead to a total of 142 banks, constituting 87% of the total deposit base of the co-operative banks in Gujarat and 13% of the total banking system in the state. Moreover,

1371 on April 4th, 2001, at www.rbi.org.in.

[33] See circular BR. 43/16.20.00/2000-01 at www.rbi.org.in.

[34] See www.financialexpress.com/fe/daily/20010316/fec16032.html.

[35] Banks headquartered in the region of Kutch were also excluded from the analysis as there was an earthquake which severely affected this region on January 26th, 2001 (prior to the MMCB failure). The central bank and the state government provided several concessions to banks located in this region to facilitate economic growth. Also there was a huge increase in deposits in banks in this region as aid agencies opened accounts to help facilitate the rehabilitation process.

these banks cover a major portion of the linkages with the failed bank.[36] For the 142 banks in the sample, we obtain data on their deposit figures as on March 31st 2001, and as on December 31st 2001, along with the relevant balance sheet variables. Note that the deposit data as on 31st of December is obtained from the central bank as co-operative banks only publicly report their deposit data as on the 31st of March of every year.

We also have data on the outstanding credit/debit position each bank has with MMCB as on March 13th, 2001. In addition, we have data on the aggregate outstanding level of claims of each bank has with/from other banks in the interbank market as on 31st of March 2001. All this data is obtained from the central bank. Thus for each on-going bank, we know: (i) Its exposure to the failed bank (MMCB); (ii) the amount of credit outstanding it has with other on-going banks in the system; (iii) the amount of funds it has from other on-going banks in the system. We also compile deposit rates offered by banks from the annual reports (i.e., on March 31st, 2001, and on March 31st, 2002), if they were available. Finally, we collect information on media articles about bank runs that were published during the crisis. We first collect information on the articles that appeared in the national newspapers and then looked for additional information in the regional newspapers.[37] In addition, we also look in the annual reports of banks to check for voluntary release of information pertaining to the credit/debit outstanding with MMCB.

[36] The placement of deposits and dealings between co-operatives and private and public banks is limited, there are no private or public banks that had deposits placed with MMCB.

[37] We found a perfect overlap between the coverage in national and regional newspapers. One reason for this could be that national newspapers generally outsource regional news from various correspondents. Also, another reason could be that given that banking panics attract reader attention, it is therefore likely that most of the news is covered in national newspapers.

5 Empirical strategy

We now return to the central question of whether there is financial contagion due to interbank linkages. We divide our analysis in two parts. First, we analyze the effect of interbank linkages to the failed bank on depositor runs. Then, we proceed to examine how outstanding interbank claims among banks (apart from the failed bank) affect depositor runs.

5.1 The effect of exposure on depositor withdrawals

To study the transmission of the shock due to interbank linkages with the failed bank, we first construct a variable called *exposure* that represents the credit outstanding of a bank with the failed bank (MMCB) as fraction of its total assets. One point to take note of is that we do not find banks in our sample to be debtors of MMCB. We then construct a variable called *deposit flow* that for each bank captures the change in the level of deposits between March 31st, 2001, and December 31st, 2001.[38] Even though the runs began on the 14th of March 2001, we measure the change in deposits beginning March 31st, 2001.[39] Non inclusion of the initial period can only mitigate our chances of finding a relation between exposure and deposit flow if all the withdrawals happened before our sample period begins. Also, we do not have deposit data prior to the agreement on trying to revive the bank, however, given that the proposed bailout package did not insure the exposure that banks had with the failed bank, there was still a degree of uncertainty for the banks that had exposure. Another aspect, which added to the uncertainty, were doubts regarding the successful implementation of the

[38] We use change in the aggregate level of deposits to construct the measure as data on uninsured versus insured level of deposits is not available. Though insured depositors should not have an incentive to run, the delays in payment due to partial suspension of convertibility reduces the effectiveness of the deposit insurance scheme. Martinez Peria and Schmukler (2000) find that insured depositors disciplined banks in Argentina, Mexico and Chile. They attribute this behavior to problems in the implementation of the deposit insurance scheme.

[39] Prior to March 31st, 2001, we only have data as on 31st March, 2000.

bailout.[40]

To control for other factors that could influence depositor withdrawals on banks, we construct several measures using 31st of March 2001 balance sheet information. We measure bank profitability by return-on-assets ratio (see the appendix for exact definitions of all the variables). We also use the capital-to-asset ratio as measure of financial health of the bank. We also control for the size of banks. The measures that we use to proxy for riskiness of banks, or susceptibility to a crisis, are: the ratings by the regulator, borrowing-to-deposit ratio and credit-to-deposit ratio. Ideally, we would have also liked to use the level of non-performing assets as a measure of riskiness, but, co-operative banks are not required to disclose this variable. The ratings by the regulator provide a close substitute for the level of non-performing assets.[41] As for borrowings-to-deposit ratio, other studies have also found that share of borrowed money to be a reliable predictor of bank failure (White, 1984; Calomiris and Wheelock, 1995; Mason, 2003). The credit-to-deposit ratio captures the illiquidity risk of a bank. We also define a dummy variable called 'media' which takes value of 1 for a bank if a report appeared in the newspapers about runs in the bank and zero otherwise.[42] Finally, to control for local macro economic factors that could affect deposits, we use dummies for districts where banks are headquartered.[43]

[40] The government had initially asked for an extension up to 31st December, 2001, for mobilization of funds; however, as on December 31st, 2001, there was still uncertainty whether banks would contribute to fund the bailout.

[41] Banks whose owned funds have been eroded to the extent of 25% or more by un-provided for bad and doubtful debts are classified as weak. Banks that have overdues exceeding 50% of loans outstanding, or banks not complying with minimum share capital requirements or viability norms prescribed by the central bank are also classified as weak. Banks that are classified as weak have restrictions placed on them interms of dividend payouts and disposal of assets. Though this information is not publicly available, we believe that it is plausible to assume that depositors can infer this information.

[42] An important point to note is that most of the media articles just stated a bank was facing a huge depositor withdrawal. Also all the articles except one appeared immediately after the failure, i.e. between 13th of March 2001 and 31st of March 2001 (before our sample begins).

[43] Generally, the bulk of a co-operative bank's business and deposit base is in the district where it is head quartered.

We utilize a cross-sectional deposit flow regression approach to test whether the level of exposure to the failed bank is a significant predictor of depositor runs. The regression, we run, has the following functional form:

$$deposit\ flow_i = \alpha + \beta\ controls_i + \gamma\ exposure_i + e_i \quad (1)$$

In order to analyze the effect of banks' linkages with the failed bank on depositor withdrawals, we examine the sign and statistical significance of the coefficient γ of the variable exposure. If deposit loss is related to the level of exposure (i.e., $\gamma \neq 0$), we would reject the null hypothesis that contagion is purely random in nature. Note that though the rejection of the null does provide evidence in favor of financial contagion due to interbank linkages, it does not rule out some amount of panic in the depositor withdrawals. Hence, it is important to examine the sign as well as the magnitude of the coefficient γ to examine the relevance of financial contagion due to interbank linkages.

5.1.1 Results

Table I provides summary statistics of the data. We find that on average banks experienced a 5% loss in deposits. The average exposure that banks have to MMCB is 3% of their total assets. In the total sample of 142 banks, 121 banks are connected to MMCB, with the highest exposure level being 23% of total assets. Out of the total of 121 banks that were connected to MMCB, 20 banks had more than 10% of their assets invested in MMCB, 13 banks had exposure levels between 5% and 10%. The average capital-to-asset and return-on-asset ratios are 11% and 1% respectively. The average credit-to-deposit ratio is 64%, while the ratio of borrowings-to-asset is 3%.

We now proceed to investigate whether exposure levels are an important predictor of depositor withdrawals. Table II, column 1, presents the most basic result. We see that

exposure with the failed bank is a significant predictor of deposit loss. In columns 2 through 4, we introduce controls for ex-ante bank characteristics that could also influence depositor withdrawals. We find that banks that have a higher return on assets suffer significantly lower deposit loss. We also find that banks that are classified as weak by the regulator experience significantly higher depositor withdrawals. Furthermore, banks that have a higher fraction of illiquid assets –proxied by the credit-to-deposit ratio– experience significantly more depositor withdrawals. The significance of ex-ante fundamentals of banks in explaining deposit flow further provides evidence that depositors are concerned about the ability of the banks to withstand the shock. Note that, even after controlling for ex-ante characteristics of banks, the exposure with the failed bank is still highly significant in predicting depositor runs. The variable exposure is significant at 1% and the magnitude of its coefficient is quite high. Note that the magnitude of the coefficient is surprising considering that there is high level of deposit insurance, there was a promise of a bailout and some runs occurred before our sample period begins. In particular, a coefficient of –0.71 implies that, on average, a bank with 10% of exposure has 7% of deposit withdrawals. In consequence, the results in table II clearly show that exposure to the failed bank is an important driver of depositor runs. This result is consistent with the models of financial contagion due to interbank linkages (Allen and Gale 2000; Freixas et al., 2000; Dasgupta 2004, Iyer and Peydró-Alcalde, 2005).

Finally, we can see in table II that the media dummy is highly significant in explaining deposit loss, i.e. depositors withdraw more from banks that had a media report about them. What is even more striking is the magnitude of the effect. Banks that had a media report about them suffer an additional deposit loss of approximately 20% after the media release. One unique feature of the media reports that appeared is that all of them just state that a bank was facing huge rush of depositors. In a sense, they are not conveying any information

about the fundamental attributes of the banks but conveying the actions of other depositors who moved before.[44] The deposit loss experienced by banks that have a media report about them lends support to the claim in the herding literature that release of information on the actions of other individuals could cause depositors to disregard their own private signals and join the herd (Banerjee, 1992; Bikhchandani et al., 1992; Yorulmazer, 2003).[45]

Robustness checks: To address the concern that banks with higher exposure levels could be ex-ante more risky, we divide the banks into two categories. One category comprises of banks with exposure levels lower than 1% of their assets, we call this group the unexposed group.[46] We call the other group of banks (with exposure equal to or higher than 1%) the exposed group. Table III, columns 1 through 4, provide results of the univariate differences in means between the two groups. Results show that there is no significant ex-ante differences between the two groups in terms of return-on-assets, credit-to-deposit ratio, size or deposit premium charged by depositors. Thus, the results in table III show that banks with higher levels of exposure are not ex-ante more risky or less profitable.

While the results in table III show that banks with higher levels of exposure are not ex-ante more risky, it could be possible that exposure levels are a proxy for some other characteristics that depositors use to condition their runs. For example, banks that have a higher level of exposure might be the ones that have a correspondent banking relationship with MMCB. Thus, the exposure variable could just be picking up the effect of the correspondent banking relationship, which could be the real driver of depositor runs. To make sure this is not the case, we include other covariates like ex-ante banking relationships with MMCB, and also the

[44] We also checked using univariate tests if banks that had a media report about them had lower fundamentals ex-ante. Our results did not show any differences in fundamentals.

[45] See also Peydró-Alcalde (2004).

[46] We also find no difference in the results if we use 5% or 10% exposure levels to conduct the comparisons.

distance from the failed bank, in the regression equation. As results in table IV, columns 1 and 2, show, we did not find any significant effect of correspondent banking relationship or distance from the failed bank on deposit withdrawals. Thus, even after controlling for alternative proxies for likelihood of linkages with MMCB, we find that actual exposure levels retain their explanatory power.

Another mechanical explanation for our findings could be that banks with higher exposure to the failed bank reduced their rate offered on deposits due to regulatory pressure, thereby attracting lower level of deposits. In order to investigate this possibility, we analyze whether changes in the deposit premium paid by banks is related to the level of exposure. As results in table IV, column 3, show, we do not find any significant relationship between change in the deposit premium and exposure levels. Alternatively, one might expect that banks with higher exposure might be required to pay a higher premium, but given that exposure levels were not revealed to the depositors, banks might have been reluctant to increase rates as this could have increased the depositor perception of risk.

The results in table III and IV show that exposure level is not likely to be a proxy for other bank characteristics and is independently an important factor in influencing depositor runs. This leaves us with the question as to whether runs are driven by depositors' actions or are the runs driven by the actions of banks in the interbank market. To test this, we exclude banks that have outstanding debit positions in the interbank market from the sample and see whether exposure is still an important determinant of depositor runs. We find that exposure to the failed bank is still a significant determinant of depositor runs (not reported). Thus even for banks that have no other banks as creditors, exposure is significant. This implies the runs are driven by depositor actions.

Communication of exposure in the banks' annual reports: The finding that runs on banks with exposure to the failed bank is a result of depositor actions raises the question of whether depositors have access to the information on the outstanding credit position of banks with MMCB. One possible way depositors might get this information is through voluntary disclosure by banks of their interbank positions in their annual report. To investigate the possibility of banks voluntarily releasing information in the period**,** which we measure our deposit loss, we check whether information on exposure to MMCB is provided by the banks in their 2001 annual report –released between July and December 2001.[47] We find that some banks voluntarily release information. In order to further investigate bank characteristics that explain the release of information on exposures to MMCB, we run a probit, the results of which are reported in table V, column 1. We find that banks with lower exposure to the failed bank are more likely to release information.[48] Banks that are larger in size are also more likely to release information. We also find that banks that have a media release are less likely to release information. Interestingly, we find that banks that have a correspondent banking relationship with MMCB are more likely to release information. These results are partially consistent with the predictions of games of voluntary disclosure with verifiable information, where good types have an incentive to disclose their type (Okuno-Fujiwara et al., 1990; Vives, 2004). However, we do not find complete unravelling of information.

To see if disclosure has any impact on depositor withdrawals, we include, in our regression specification, a dummy which takes the value of one if banks reported their exposure to MMCB (and 0 otherwise). As results in table V, column 2, show, there is no significant

[47]Banks release their audited annual report generally around August, but their deadline is December. Furthermore, the annual reports are not mailed to depositors but only circulated among members of the co-operative.

[48]While interpreting the results from the probit, one should keep in mind that we do not have deposit changes before the information release by banks, which could have influenced the decision to release information thereby biasing our results.

effect of disclosure on deposit change. There could be several potential explanations for this finding. One reason could be that depositors were not sure of the credibility of the disclosure. However, given that we found that none of the banks had lied about their exposures and also given the regulatory scrutiny of banks, it is highly unlikely that banks would provide false information in their annual reports. Thus, we do not think credibility should have been an issue. Alternatively, given that we do not have data on the deposit changes before the information disclosures by banks, it might just be the case that banks that had experienced runs released their true exposure levels and their deposits recovered after the release of information. This confounding effect in deposit change before and after information release could also be the reason why we are unable to find any significant effect of information disclosure on deposit change. To further investigate this explanation, we checked if information disclosure between July and December had any effect on deposit changes between December 31st 2001**,** and March 31st 2002 (not reported). We still do not find any effect of the disclosure variable on deposit change.[49] When we re-estimate the model specified by equation (1) excluding the banks that released information, as results in table V, column 3, show, we find that exposure to the failed bank is still a highly significant predictor of deposit withdrawals in this sub-sample. In other words, even for banks that reported no information on exposure to MMCB, the exposure level is an important factor in influencing depositor runs suggesting that depositors might be acting on private information obtained through monitoring (Calomiris and Kahn, 1991) or alternative channels like rumors or word of mouth communication.

[49] One could also attribute the insignificant finding to lack of power of the statistical tests or to the bias introduced by the lack of data between the beginning of the crisis and the public release of information.

5.2 Did interbank linkages among on-going banks affect depositor withdrawals?

So far, we find that banks with higher exposure to the failed bank experience higher depositor withdrawals –i.e., the failure of a debtor-bank significantly affects its creditor-banks (Allen and Gale, 2000; Freixas et al., 2000; Dasgupta, 2004; Iyer and Peydró-Alcalde, 2005). We now investigate whether there is further propagation of the shock due to outstanding interbank claims among other surviving banks. More specifically, we analyze whether a bank's depositor structure (fraction of deposits held by other banks) affects its level of depositor withdrawals –i.e., we are interested in studying whether creditor-banks affect the depositor withdrawals of their debtor-banks.

From a theoretical perspective, there is no clear-cut prediction. On the one hand, a bank with higher proportion of deposits held by other banks might face lower depositor withdrawals due to a better provision of interbank liquidity (Allen and Gale, 2000; Dasgupta, 2004; Iyer and Peydró-Alcalde, 2005). On the other hand, a bank with higher proportion of deposits held by other banks may be more susceptible to liquidity risk as these deposits can be withdrawn due to liquidity crunch faced by its creditor-banks (Allen and Gale, 2000; Calomiris and Mason 2003a; Iyer and Peydró-Alcalde, 2005). Finally, if a bank with higher fraction of its deposits held by other banks is (highly) exposed to the failed bank (MMCB), its liquidity risk may be amplified because its creditor-banks have an incentive to withdraw their deposits in order to avoid potential contagion (Iyer and Peydró-Alcalde, 2005).

To test the previous theories, we generate the variable *from_ other*, which is defined as the fraction of deposits held by other co-operative banks to total deposits.[50] Also, as we explain

[50]Private and public banks did not place any deposits with co-operative banks. Thus, without loss of generality, we can restrict our analysis to this measure.

in the next paragraph, we generate interaction variables between from_other and exposure. We have data on the variable from_other for 124 banks, out of which 28 banks have a positive value. The average value of from_other is 1% and the standard deviation is 3% (see table I).

Table VI presents the econometric results. Column 1 shows that the fraction of total deposits held by other banks does not significantly affect the level of depositor withdrawals. This finding suggests that, on average, banks do not liquidate their claims in other banks in response to the shock. Besides, this finding also addresses a concern regarding the importance of the central bank's mandate requiring banks to unwind their interbank claims before June 2002.[51] If banks unwound their claims primarily due to the central bank mandate, we should have found a significant negative relationship between the variables from_other and deposit flow.

The previous result suggests that on average creditor-banks do not increase liquidity risk of their debtor-banks. We now explore whether the potential liquidity risk induced by creditor-banks is contingent on the exposure banks have with the failed bank. To do this, we first generate a variable called *interaction_0pct* that is defined as the variable from_other times a dummy that takes the value of one if the bank has a positive exposure to MMCB (and 0 otherwise). Results in table VI, column 2, show that the interaction term does not turn out to be significant. This is not surprising since the behavior of creditor-banks may only increase the liquidity risk when their fear of contagion is high –i.e., when the level of exposure of their debtor-banks with the failed bank is significant. Hence, we generate the interaction term defined above using higher thresholds of exposure to the failed bank. We report in table VI the results for the interaction terms generated using as exposure thresholds 0.2% (*inter-*

[51] Even though we conduct our analysis well before the deadline of this mandate, as we cannot decompose the claims into individual exposures based on maturity, the mandate could create a problem in our analysis.

action_ 02pct), 1 % (*interaction_ 1pct*), 2% (*interaction_ 2pct*) and 5% (*interaction_ 5pct*).[52] First, as we can see from column 3 to 6, the coefficients on the interaction terms are significantly negative; i.e., on average, a bank with high exposure to the failed bank faces increasing depositor withdrawals as its fraction of total deposits held by other banks increases.[53]

Variable	Coefficient
Interaction_ 02pct	−1.580
Interaction_ 1pct	−2.611
Interaction_ 2pct	−3.706
Interaction_ 5pct	−4.179

Second, the magnitude of the effect is very high. For instance, the coefficient for the variable interaction_5pct is –4.179. This implies that an exposed bank (exposure to the failed bank higher than 5%) vis-à-vis an unexposed bank (lower than 5%) faces more than 12.5% depositor withdrawals as its fraction of deposits held by other banks increases by 3% (one standard deviation). Third, as the threshold which separates exposed versus unexposed banks increases, the absolute value of the coefficient of the interaction term increases drastically (see the previous chart).[54] This non-linearity of the results is consistent with a higher incentive for creditor-banks to withdraw as the exposure levels of their debtor banks increase (i.e., higher

[52] If we split the sample in two categories, one category consisting of exposed banks (exposure equal to or higher than 1%) and the other consisting of unexposed banks (exposure lower than 1%), we find that the coefficient of the variable from_other is positive for the unexposed subsample and, negative and significant at 5% for the exposed subsample.

[53] We did not find that banks that have a positive interaction term vis-à-vis those that have 0 are ex-ante different in terms of profitability or risk. More importantly, the results in table 6 are robust to the introduction of a control dummy variable that takes the value of 1 if exposure is greater than 0.2% (and then for 1%, 2% and 5% respectively) and 0 otherwise.

[54] This result is very general. Until the threshold of 0.2%, the interaction term is not significant. For thresholds higher than 0.2%, the coefficient is always significant and increasing in the level of the threshold (we have checked this result for the following thresholds: 0.3%, 0.4%, 0.5%, 1%, 2%, 3%, 4%, 5%, 6%, 7%, 8%, 9%, 10% and 15%).

fear of contagion). Fourth, as it can be seen from the table above, the coefficients of the interaction variables are always (in absolute value) greater than 1. This finding suggests that, in a bank with a significant exposure to the failed bank, as higher is the fraction of deposits held by other banks, higher is the incentive to run by other depositors – i.e., the strategy to run by creditor banks and the strategy to run by other depositors are strategic complements.[55] These results are consistent with the predictions from Iyer and Peydró-Alcalde (2005).

6 Conclusion

We use a natural experiment caused by a large bank failure due to a fraud, in conjunction with precise data on interbank exposures, to cleanly test for financial contagion due to interbank linkages. Interestingly, we find that a bank with higher level of exposure to the failed bank experiences higher depositor runs. This result is robust to the introduction of several controls. We also find that an on-going bank with higher fraction of its deposits held by other on-going banks experiences considerably higher depositor runs provided its exposure to the failed bank is sufficiently high. Furthermore, as the exposure to the failed bank increases, the runs stemming from higher fraction of deposits held by other banks drastically increase. These results lend support to the theories of financial contagion due to interbank markets (Allen and Gale, 2000; Iyer and Peydró-Alcalde, 2005).[56] Finally, we find media reports about a bank have a destabilizing effect on the bank's deposits. In addition, banks with low level of exposure to the failed bank voluntarily release information on their exposure levels.

[55] The variable *dep_with*, which is defined as deposits placed in other co-operative banks divided by total assets, has an average of 3% and a standard deviation of 5%. As the results in table VI, column 1, shows, we find that banks that have higher fraction of total deposits held in other banks do not face significantly different level of depositors withdrawals.

[56] Notice that our results cannot rule out some element of "pure" contagion.

Our results have important policy implications, both for prudential regulation and for crisis management. Since interbank linkages transmit shocks, regulators and banks can devise ex-ante risk management systems to curtail excessive exposure to single institutions in order to limit the destabilizing effects that could arise from idiosyncratic shocks. A potential solution could be that bank capital requirements take into account the concentration risk of large single exposures. In addition, given that we find that the depositor structure (fraction of the deposits held by other banks) affects liquidity risk in banks with a significant exposure to the failed bank, bank capital requirements (apart from the maturity of debt) could take into account the type of debtholders.[57]

From the perspective of crisis management, our results can be used to shed some light on the desirability of bailout and lender of last resort (LoLR) policies. Since our analysis is carried out in the context of the Indian banking system where transparency levels are not high, our findings suggest that the risk of pure contagion in institutional settings with higher transparency levels may be low.[58] As bailouts of banks are generally motivated by the fear of systemic risk due to random transmission of shocks, if random transmission is not a very serious threat, then regulators could exercise forbearance in use of bailouts and thereby reduce moral hazard problems. Also, since we find that creditor-banks may increase the liquidity risk of their debtor-banks with a high exposure to the failed bank, there can be a rationale for the central bank to provide liquidity to solvent but illiquid banks, as there could be a possibility of a liquidity squeeze in the interbank market during a crisis (see Rochet and Tirole, 1996;

[57] A recent paper by J.P. Morgan (2005) concludes that Basel II does not deal with liquidity and concentration risks, thus a Basel III will be necessary: "*Basel II should not really be seen as the finished article in global banking regulation; that will come, we believe, with Basel III. That said, it is important to consider what Basel II does not cover. The first thing of major note that is being left practically untouched by Basel II is the trading book. Additionally, interest rate risk – a subject of obvious critical importance for any bank – is not covered. Neither is liquidity risk nor is there any adjustment for the business cycle and concentration risks.*"

See also Committee on the Global Financial System (2005) for a reference on the stress testing of credit risks, in particular for large single exposures.

[58] This risk could be in principle even lower once Basel II (in particular, Pilar III) comes into force.

Rochet and Vives, 2004).

Our analysis also leaves some open questions which could have important bearing on the conclusions. For example, is the magnitude of the runs justified given the level of financial linkages? Did the social costs of the runs exceed those that would have been incurred had there been a bailout? How does information dissemination occur during the crisis? We believe that answering these questions is an important area for future research.

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Table I
Summary statistics

	No. of Obs.	Mean	Std. Dev.
Deposit Flow	*142*	*-0.05*	*0.13*
Exposure	*142*	*0.03*	*0.05*
Return on Assets	*142*	*0.01*	*0.01*
Capital ratio	*142*	*0.11*	*0.04*
Credit ratio	*142*	*0.64*	*0.16*
Borrowing ratio	*142*	*0.03*	*0.05*
From_other	*124*	*0.01*	*0.03*
Size	*142*	*9.17*	*0.78*

Please refer to the appendix for the definition of the variables.

Exposure:

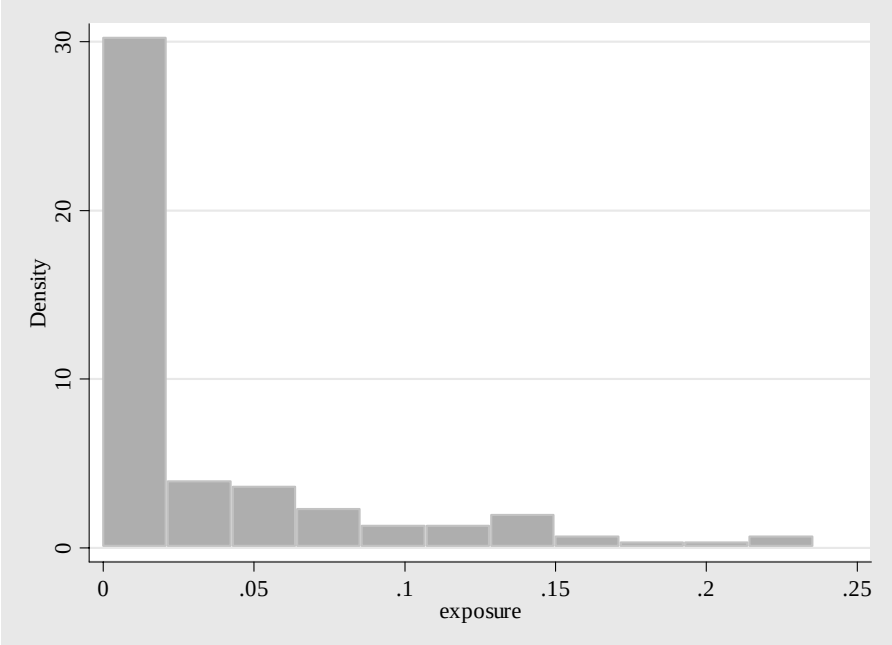

Table II

Effect of Exposure with the Failed Bank on Deposit Flow

	Deposit Flow			
	(1)	(2)	(3)	(4)
Exposure	*-0.45***	*-0.47***	*-0.71****	*-0.63****
	(0.20)	*(0.22)*	*(0.26)*	*(0.24)*
Return on Assets			*3.33***	*2.76***
			(1.35)	*(1.29)*
Size			*-0.02*	*-0.02*
			(0.02)	*(0.02)*
Media			*-0.19****	*-0.19****
			(0.05)	*(0.06)*
Weak			*-0.07**	*-0.08*
			(0.04)	*(0.04)*
Credit ratio			*-0.17***	
			(0.08)	
Borrowing ratio				*-0.08*
				(0.36)
Capital ratio			*-0.11*	*-0.17*
			(0.25)	*(0.27)*
Constant	*-0.03****	*-0.03****	*0.22*	*0.13*
	(0.01)	*(0.01)*	*(0.19)*	*(0.17)*
District Controls	*no*	*yes*	*yes*	*yes*
No. of Obs.	*142*	*142*	*142*	*142*
Adj. R-squared	*0.03*	*0.02*	*0.28*	*0.25*

Please refer to the appendix for the definition of the variables. All balance sheet variables are defined as on 31st of March 2001. All variables are book values. Heteroscedasticity- robust standard errors are in parentheses. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively.

Table III

Comparison of Means

	Return on Assets	Credit Ratio	Size	Deposit Rate
Unexposed				
Mean	*0.010*	*0.642*	*9.162*	*0.086*
Standard Error	*(0.001)*	*(0.019)*	*(0.095)*	*(0.002)*
Number of Observations	*82*	*82*	*82*	*42*
Exposed				
Mean	*0.011*	*0.630*	*9.169*	*0.089*
Standard Error	*(0.001)*	*(0.019)*	*(0.084)*	*(0.002)*
Number of Observations	*60*	*60*	*60*	*42*
Tests of Differences between Means (t-statistics)				
Unexposed vs. Exposed	*-0.79*	*0.43*	*-0.05*	*-0.92*

'Unexposed' refers to banks with exposure levels less than 1% of their assets. 'Exposed' refers to banks with exposure levels equal to or greater than 1% of their assets. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively, in a two-sided t-test of the mean of unexposed banks versus exposed banks. Please refer to the appendix for the definition of the variables.

Table IV
Robustness

	Deposit Flow	Deposit Flow	Deposit Rate change
	(1)	(2)	(3)
Exposure	*-0.74***	*-0.65***	*-0.08*
	(0.28)	*(0.21)*	*(0.28)*
Return on Assets	*3.31***	*2.23***	*-0.94*
	(1.33)	*(0.99)*	*(1.21)*
Size	*-0.02*	*-0.02*	*-0.03*
	(0.02)	*(0.01)*	*(0.02)*
Media	*-0.19****	*-0.20****	*0.06**
	(0.05)	*(0.05)*	*(0.04)*
Weak	*-0.07**	*-0.07**	*-0.14****
	(0.04)	*(0.04)*	*(0.05)*
Credit ratio	*-0.17***		*-0.03*
	(0.08)		*(0.08)*
Borrowing ratio		*-0.01*	
		(0.31)	
Capital ratio	*-0.10*	*-0.28*	*0.58*
	(0.25)	*(0.24)*	*(0.48)*
MMCB banker	*0.02*		
	(0.02)		
Distance		*0.00*	
		(0.00)	
Constant	*0.22*	*0.16*	*0.19*
	(0.18)	*(0.17)*	*(0.19)*
District Controls	*yes*	*no*	*yes*
No. of Obs.	*142*	*142*	*70*
Adj. R-squared	*0.28*	*0.30*	*0.33*

Please refer to the appendix for the definition of the variables. All balance sheet variables are defined as on 31st of March 2001. All variables are book values. Heteroscedasticity- robust standard errors are in parentheses. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively.

Table V
Release of Information by Banks

	Information Release	Deposit Flow	Deposit Flow
	(1)	(2)	(3)
Exposure	*-5.65***	*-0.72****	*-0.69***
	(2.33)	*(0.26)*	*(0.33)*
Return on Assets	*-2.19*	*3.33***	*5.01****
	(13.73)	*(1.37)*	*(1.54)*
Size	*0.46***	*-0.02*	*-0.00*
	(0.20)	*(0.02)*	*(0.02)*
Media	*-1.28***	*-0.19****	*-0.18****
	(0.60)	*(0.05)*	*(0.05)*
Weak	*-0.23*	*-0.07**	*-0.04*
	(0.38)	*(0.04)*	*(0.04)*
Credit ratio	*-0.52*	*-0.17***	*-0.21**
	(0.81)	*(0.08)*	*(0.11)*
Capital ratio	*-3.11*	*-0.12*	*-0.09*
	(3.06)	*(0.25)*	*(0.30)*
MMCB banker	*1.03****		
	(0.24)		
Information Release		*-0.00*	
		(0.02)	
Constant	*-4.26***	*0.22*	*0.17*
	(1.88)	*(0.18)*	*(0.21)*
District Controls	*no*	*yes*	*yes*
No. of Obs.	*142*	*142*	*97*
Adj. R-squared	*0.18*	*0.28*	*0.27*

Column 1 is a probit regression and Pseudo R-squared is reported. In column 3, the sample is restricted to banks that did not release information on exposure to the failed bank. Please refer to the appendix for the definition of the variables. All balance sheet variables are defined as on 31st of March 2001. All variables are book values. Heteroscedasticity- robust standard errors are in parentheses. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively.

Table VI
Effect of Outstanding Inter-Bank Claims (Excluding the Failed Bank) on Deposit Flow

	Deposit Flow					
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	*-0.65***	*-0.67***	*-0.66***	*-0.61***	*-0.61***	*-0.61***
	(0.31)	*(0.29)*	*(0.29)*	*(0.28)*	*(0.29)*	*(0.29)*
Size	*-0.01*	*-0.01*	*-0.01*	*0.00*	*-0.01*	*-0.01*
	(0.01)	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*	*(0.01)*
Return on Assets	*3.08***	*3.15***	*3.29***	*3.23***	*3.16***	*3.08***
	(1.56)	*(1.56)*	*(1.59)*	*(1.58)*	*(1.57)*	*(1.58)*
Media	*-0.16****	*-0.17****	*-0.17****	*-0.16****	*-0.17****	*-0.17****
	(0.05)	*(0.05)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.05)*
Credit Ratio	*-0.12*	*-0.11*	*-0.11*	*-0.10*	*-0.09*	*-0.09*
	(0.07)	*(0.07)*	*(0.07)*	*(0.06)*	*(0.07)*	*(0.07)*
Weak	*-0.08*	*-0.08*	*-0.08*	*-0.09**	*-0.08*	*-0.08*
	(0.05)	*(0.05)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.05)*
Capital Ratio	*0.03*	*0.02*	*0.07*	*0.06*	*0.02*	*0.03*
	(0.27)	*(0.26)*	*(0.25)*	*(0.25)*	*(0.26)*	*(0.26)*
MMCB_Banker	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
	(0.02)	*(0.02)*	*(0.02)*	*(0.02)*	*(0.02)*	*(0.02)*
From_other	*-0.39*	*-0.10*	*0.47*	*-0.25*	*-0.33*	*-0.31*
	(0.48)	*(0.96)*	*(0.58)*	*(0.39)*	*(0.47)*	*(0.47)*
With_other	*-0.11*					
	(0.15)					
Interaction _0pct		*-0.36*				
		(1.08)				
Interaction _0.2pct			*-1.58***			
			(0.74)			
Interaction _1pct				*-2.61****		
				(0.58)		
Interaction _2pct					*-3.70****	
					(1.42)	
Interaction _5pct						*-4.18****
						(1.39)
Constant	*0.12*	*0.08*	*0.10*	*0.05*	*0.06*	*0.07*
	(0.17)	*(0.16)*	*(0.16)*	*(0.17)*	*(0.17)*	*(0.16)*
District Controls	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Adj. R-squared	*0.32*	*0.33*	*0.35*	*0.38*	*0.35*	*0.35*
No. of Obs.	*119*	*124*	*124*	*124*	*124*	*124*

Please refer to the appendix for the definition of the variables. Heteroscedasticity- robust standard errors are in parentheses. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively.

Appendix

Deposit Flow is defined as the log (D_t/D_{t-1}) where D_t is deposits as on 31st of December 2001 and D_{t-1} is deposits as on 31st of March 2001.

Deposit Rate change is the log (DR_t/DR_{t-1}) where DR_t is deposit rate (offered to depositors for a deposit of 1-year maturity) prevailing as on 31st of March 2002 and DR_{t-1} is deposit rate prevailing as on 31st of March 2001.

Exposure is the credit outstanding of a bank with the failed bank divided by its total assets as on 13th of March 2001.

Credit Ratio is the total loans of a bank divided by its total deposits as on 31st of March 2001.

Size is the log of total assets of the bank as on 31st of March 2001.

Return on Assets is the profit of the bank divided by its total assets as on 31st of March 2001.

Capital Ratio is the book value of shareholder equity plus reserves divided by total assets as on 31st of March 2001.

Borrowing ratio is borrowings divided by total deposits as on 31st of March 2001.

From_other is the ratio of deposits held by other co-operative banks to total deposits as on 31st of March 2001.

With_other is the ratio of deposits held in other co-operative banks to total assets as on 31st of March 2001.

Deposit rate is the rate prevailing as on 31st of March 2001 offered to depositors for a deposit of 1-year maturity.

MMCB banker refers to banks that a have correspondent banking relationship with the failed bank.

Distance refers to the physical distance between the headquarter of a bank and the headquarter of the failed bank.

Weak refers to a bank that was classified as weak by the central bank as on 31st of March 2001.

Media takes the value of 1 if a report about the bank appeared in newspapers on March, 2001.

Information release is a dummy that takes the value of 1 if the bank released information on its exposure with the failed bank in the year 2001 annual report.

District controls are dummy variables that take the value of one if the bank is headquartered in a district. There are 16 different districts in our sample.

Interaction_0pct is defined as from_other times a dummy that takes the value of 1 if the bank has a positive exposure to the failed bank (and 0 otherwise).

Interaction_02pct is defined as from_other times a dummy that takes the value of 1 if the bank has an exposure to the failed bank greater than 0.2% (and 0 otherwise).

Interaction_1pct is defined as from_other times a dummy that takes the value of 1 if the bank has an exposure to the failed bank greater than 1% (and 0 otherwise).

Interaction_2pct is defined as from_other times a dummy that takes the value of 1 if the bank has an exposure to the failed bank greater than 2% (and 0 otherwise).

Interaction_5pct is defined as from_other times a dummy that takes the value of 1 if the bank has an exposure to the failed bank greater than 5% (and 0 otherwise).