Interbank Contagion: Evidence from Real Transactions[†]

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Abstract

Suppose there is a failure of a bank: Would balance sheet connections among banks arising from interbank commitments propagate a crisis? Would a bank's position in the interbank market affect its level of depositor runs? What role would the interbank market play during a crisis? How would the release of public information affect the financial crisis? Though these questions are at the heart of many debates, answering them has proven difficult because of lack of data on interbank exposures. We use a unique dataset from India that allows us to identify the interbank commitments in order to test contagion in the banking system of an idiosyncratic shock --caused due to a fraud in one of the banks. Interestingly, we find that the level of exposure with the failed bank is an important determinant of depositor runs. What makes this result even more intriguing is the fact that information on the exposure with the failed bank was not available to the depositors. We find that despite other controls, exposure level with the failed bank retains its explanatory power. We also find that release of information by media has a destabilizing effect on banks' deposits. Furthermore, we find that banks that have lower level of exposure with the failed bank voluntarily release information on their exposure level. Finally, we find that outstanding interbank claims among other banks intensify the negative impact of the initial shock. These results provide strong evidence in favour of financial linkages as an important mechanism for contagion and hold important implications for policy formulation.

Keywords: Financial contagion, interbank market, media and information aggregation.

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1 Introduction

The threat posed to the system due to balance sheet connections among financial institutions (especially banks) has frequently been put forward as an argument by regulators around the world for bailing out troubled institutions. While the danger posed by the mechanical breakdown of banking system assets due to financial linakges is one of the concerns of regulators, the more serious concern pertains to the uncertainity as to how depositors and creditors at other institutions would react to a large failure. The statement issued by the U.S. Comptroller of Currency, C.T. Conover (1984, pp. 287-88), justifying the bailout of Continental Illinois Bank aptly summarizes this concern. 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."

Thus addressing the issue of transmission of a crisis due to financial linkages among banks has important bearing on policy making.[1] Unfortunately, very little empirical work exists in the academic literature on transmission of a crisis due to balance sheet connections. One of the main problems that has hampered empirical work in this area is the lack of data. It is almost impossible to obtain data on the extensive web of interbank exposures. In this paper, we overcome this hurdle by using a unique dataset from India, which allows us to identify the interbank commitments. We use the data on interbank linkages in conjunction with an idiosyncratic shock – caused due to a fraud in one of the co-operative banks – to test the contagion in the banking system. In addition, we also use information disclosures by banks and media to shed light on the release of information during a crisis. In summary, we address the following questions: Do balance sheet connections

[1] The decision to bailout financial institutions and the provision of too-big-to-fail guarantee are examples of public policy formulation due to the fear of systemic risk.

among banks propagate a crisis? Are depositor runs purely random across banks or are depositors able to discern and run based on their bank's interbank linkages? Given a shock, does the interbank market reduce the intensity of the crisis? How does disclosure of information affect the unfolding of a crisis?

There are two leading views that have emerged in the theoretical literature concerning depositor runs on banks. One is the panic-based view pioneered by Diamond and Dybvig (1983), the other is the information-based view (Jacklin and Bhattacharya, 1988; Chari and Jagannathan, 1988). The panic-based approach argues that runs are the result of realization of a bad equilibrium due to self fulfillment of depositors' expectations concerning the behavior of other depositors. The information-based view argues that runs are the result of asymmetric information between the bank and its depositors regarding the quality of the bank's assets. Thus, while the panic-based approach predicts that runs are based on sunspots (runs by depositors are not based on fundamentals), the information-based view predicts that banks with weaker fundamentals will experience higher runs.

More relevant to our analysis is the theoretical work that analyzes contagion arising due to the failure of a bank. Allen and Gale (2000), Dasgupta (2004), and Iyer and Peydró-Alcalde (2004) build on the information-based approach and show that the failure of a bank could lead to contagion due to financial linkages among banks.[2] In the light of these models, while random runs by depositors on other banks in the system after the failure of a bank would be evidence in favor of 'pure' contagion, runs based on the extent of linkages with the failed bank would provide evidence in favor of information-based contagion.[3]

With regard to the effect of outstanding interbank claims among other banks (apart from the

[2] See Chen (1999) for a different approach on rational contagion.

[3] The term 'pure' has been used in the literature to refer to completely random contagion. See also Gorton and Winton (2002) for the definitions on contagion (page 85) and De Bandt and Hartmann (2002) for an excellent survey on systemic risk.

failed bank) on depositor runs, there are several possibilities. One possibility could be that banks that have a higher fraction of deposits outstanding in the interbank market could face higher depositor runs due to an increase in liquidity risk (Allen and Gale, 2000; Calomiris and Mason, 2003; Iyer and Peydró-Alcalde, 2004). Alternatively, it is also possible that higher fraction of outstanding interbank claims could reduce the intensity of depositor runs due to higher provision of liquidity (Allen and Gale, 2000; Dasgupta, 2004; Iyer and Peydró-Alcalde, 2004). Another channel by which outstanding interbank claims could affect depositor runs is via amplification of the initial shock. Iyer and Peydró-Alcalde (2004) predict that even if outstanding claims held by creditor banks do not directly affect depositor runs, they increase the sensitivity of banks to the initial shock, translating into higher depositor runs.

To conduct our analysis, we use the failure of a large co-operative bank in India – due to fraud – with extensive links to other banks in the system. Apart from analyzing the effect of linkages with the failed bank on depositor runs, we also explore the effect of outstanding interbank commitments among other banks in the system in propagating the shock. Interestingly, we find that the level of exposure with the failed bank is a significant predictor of depositor runs. What makes this finding extremely intriguing is the fact that the information on exposure to the failed bank was not available to depositors. To make sure that exposure with the failed bank was not a proxy for some other characteristic of the bank that was driving depositor runs, we conduct several robustness checks. Firstly, we check if banks that had higher exposure levels were ex-ante more risky. Secondly, it could be possible that the exposure level is just a proxy for distance from the failed bank or 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. In addition we find that other fundamental characteristics of banks that proxy for the ability of a bank to withstand the crisis are an important determinant of depositor runs. This provides strong

evidence in favor of information-based view of contagion.

Another important dimension that we explore is the release of public information during a crisis. After the failure, media released reports about some banks facing depositor runs. One unique feature about these reports were that they conveyed no fundamental information about the banks. Most of the reports just stated that bank X was facing a run. We find that banks that were mentioned in these reports suffered huge depositor withdrawals subsequent to the media release. We also find that banks that had a lower level of exposure with the failed bank voluntarily released information on their exposure level in the subsequent annual report. We, however do not find any significant effect of release of information about exposure levels on depositor runs.

To explore the transmission of the crisis due to outstanding interbank claims among surviving banks, we use the data on outstanding aggregate credit and debit position of each bank in the interbank market (with other banks excluding the failed bank). We find that higher level of outstanding interbank position of banks (either credit or debit) has no significant effect on depositor runs. Interestingly, we find that runs on banks were however increasing in the level of demandable debt outstanding from other banks conditional on the exposure with the failed bank, i.e. banks that had a higher fraction of their deposits held by other banks experienced higher runs if their exposure with the failed bank exceeded a certain threshold.

Our paper makes important contributions in the following aspects. To the best of our knowledge, our paper is the first to investigate contagion due to balance sheet connections – via depositor runs – using an actual bank failure. Existing studies on contagion have either been limited to simulations using balance sheet connections due to lack of actual failure events or those that used an actual failure lacked the information on balance sheet linkages. Thus, by studying the propagation of a crisis due to interbank linkages using depositor behavior we bridge this void and in turn provide

some direction for policy making. Furthermore, given our analysis is set in India where the level of transparency is low, the finding that runs are based on financial linkages holds important policy implications for settings that might have much higher levels of transparency. Another novel feature of our paper is that we shed light on the disclosure of information during a crisis. Though, we focus on banks, our results can be extended to other markets as well. For example, in the LTCM crisis, the bailout was motivated by the fear of an overall meltdown of the financial system due to linkages of financial institutions with LTCM.[4] Thus in general, our results have important public policy implications with respect to crisis management.

Most of the existing empirical studies on contagion focus primarily on measuring equity returns around large failures. They test whether all banks experienced negative abnormal returns or whether negative returns were limited to banks that had similar characteristics. 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. These papers find that surviving banks were most affected if they had portfolio characteristics similar to the failing institution. This, they, argue is evidence of information-based contagion. One problem with this interpretation is that it is also consistent with the learning hypothesis i.e., equity holders update the beliefs about their banks based on another failure. Furthermore, these studies do not address the risk of contagion due to depositor behavior, which is one of the prime concerns in the theoretical literature. Another feature that differentiates our paper from the literature cited above is that we use direct financial linkages among banks as compared to proxies for similarity with the failed bank. Thus we directly address the transmission of a crisis due to financial linkages.

[4] See Furfine (2003).

There is also an alternative stream of literature that studies the possibility of contagion due to direct interbank linkages via simulations (not taking into account depositor behavior). Humphrey (1986) uses data from the Clearinghouse Interbank Payments System (CHIPS) to simulate the impact of a settlement failure of a major participant in the payment system. He demonstrates that this could lead to a significant level of further settlement failures. Upper and Worms (2001) simulate contagion due to interbank exposures in the German interbank market and find that the failure of a single bank could lead to the breakdown of up to 15% of the banking system in terms of assets. In contrast, Furfine (2003) uses interbank federal funds exposure data to analyze the risk of contagion and finds it to be negligible. Similarly, Summer et al.(2002) use detailed data from the Austrian interbank market to simulate the possibility of contagious failures due to an idiosyncratic shock and find the probability to be low. Furfine (2002) studies the Federal funds market during the LTCM and the Russian crisis, and finds that risk premiums on overnight lending were largely unaffected and lending volumes increased. While the above papers explore the issue of contagion using simulations, our paper differs by using an actual failure to test the contagion in the banking system. More importantly, we study the role of depositors 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 banks based on fundamentals. Schumacher (2000) studies depositor behavior in Argentina following the Tequila Shock and finds that depositors primarily concentrated their run on banks that were fundamentally weak. 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 failed during the crisis. They find that banks that failed during the panic were 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) and finds them to be products of revisions in the perceived risk of the banking system based on the arrival of new information, thus providing evidence that panics were not random events. Our paper adds to this literature by studying depositor runs based on financial linkages in addition to other fundamental characteristics of 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, which they interpret as evidence in favor of information-based contagion. Our paper differs substantially from this paper as our focus is on the transmission of crisis due to financial linkages in the interbank market.

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 and summarizes the policy response by the central bank. 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 Indian banking System

Before we proceed to describe the event that we use to study the propagation of the crisis, a brief summary of the institutional setting would be 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.[5] Co-operative banks deposit base primarily constitutes of small depositors and their loan portfolio also relies heavily on soft information. Given the emphasis of co-operative banks for rural development, it is mandatory for co-operative banks to lend 60% of their loan portfolio to the 'priority' sector.[6]

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 Reserve Bank of India as well as 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 each account.[7] 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 as stipulated by the central bank.[8] The stipulated cash reserve ratio and statutory liquidity ratio to be maintained by the banks are 5.5% and 25% respectively.[9]

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

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

[6] The priority sector constitutes primarily of small scale industries. It is not mandatory for banks directly to lend to the priority sector, banks can fulfill this mandate 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).

[7] The deposit insurance is based on a flat premium.

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

[9] 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.

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.[10] The Central bank does not insure the funds transacted in the interbank market beyond the ordinary deposit insurance levels.

3 Event Description and Policy Response

We now turn to the description of the event that we use to study the propagation of the crisis. The whole episode basically started with a fraud in the largest co-operative bank in the state of Gujarat named Madhavpura mercantile co-operative bank (hereafter referred to as MMCB). MMCB had granted loans to stock brokers without appropriate collateral in contravention of the guidelines prescribed by the central bank.[11] 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

[10] 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.

[11] 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 were in physical format and up to Rs. 2 million if the shares are in demat (electronic) format.

beyond Rs. 1,000 per account.

An important aspect of the MMCB failure (apart from the fact that MMCB was one of the biggest co-operative banks in the state) was that it had a 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 was due to the fact that MMCB had a status of a scheduled bank, allowing it carry out multi-state operations.[12] Smaller co-operative banks in the state maintained deposits with MMCB, as MMCB provided remittance facilities within and across the state.[13] Many co-operative banks also used the deposits placed with MMCB to fulfill the statutory liquidity requirements.[14] Apart from the exposure banks had to MMCB due to direct placement of deposits, some banks were also exposed due to their call money lending and pay orders.[15]

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 options:

1) Closure

2) Merger or Takeover

3) Comprehensive financial and operational restructuring.

[12] Co-operative banks have branching restrictions similar to that which existed in the United States. A scheduled bank status allows banks to carry out multi-state operations. A scheduled bank status is granted by the central bank if the bank meets certain norms in terms of deposit base and capital adequacy

[13] 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.

[14] 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)

[15] 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. In fact, the exposure to MMCB via pay orders primarily constitutes of one public sector bank which discounted pay orders to the tune of Rs. 1 billion.

Based on the recommendations of the committee, it was finally decided in 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 the deposits that banks already held with MMCB.[16] 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 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.[17] 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

[16] 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.

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

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.[18] The central bank, however, was ready to provide liquidity to banks against appropriate collateral if need arose.[19] The central bank also noted that parking of funds by co-operative 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. 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. Immediately after the failure, the central bank also collated information on stock exposures (direct or indirect) from all banks in the system and issued a public statement that all banks had adhered to the prescribed norms.

4 Data

To begin with, our first task was to obtain balance sheet information of banks. As there was no single source that had all the balance sheet information (either in paper or in electronic format), we had to hand collect annual reports of banks. Given the enormity of the task, we decided to streamline the data collection. We first limited 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 limited our sample to banks that have a deposit base more than Rs. 250 million as on March 31st, 2001.[20] We found that using this cut off would lead to a total

[18] There was however no restriction on lending in the call money market.

[19] The central bank issued a statement that some co-operative banks were facing liquidity problem 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.

[20] Banks headquartered in the region of Kutch were also excluded from the analysis as there was a earthquake which severely affected this region on Jan 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

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. Also, these banks cover a major portion of the linkages with the failed bank.[21] For the 142 banks in the sample, we obtained data on their deposit figures as on March 31st, 2001 and December 31st, 2001 along with the relevant balance sheet variables. Note that the December 31st, 2001, deposit data was obtained from the central bank as co-operative banks only report their deposit data publicly on the 31st of March every year. This balance sheet data was supplemented with information on the outstanding exposure each bank had with MMCB and the aggregate level of exposure of each bank with/from other banks in the interbank market as on 31st of March 2001. We also collected information on media articles about banks that were published during the crisis. We first collected information on the articles that appeared in the national newspapers and then looked for additional information in the regional newspapers.[22] Finally, we also compiled deposit rates offered by banks from the annual reports, if they were available.

5 Empirical strategy

We now return to the central question of whether contagion was information based. Specifically, we investigate whether depositors were running on banks based on the level of exposure with the failed bank, or whether the runs were purely random across banks. To answer this question we make use of the data on outstanding exposures of banks with the failed bank. We utilize a cross-sectional deposit flow regression approach to test whether level of exposure with the failed bank is

a huge increase in deposits in banks in this region as aid agencies opened accounts to help facilitate the rehabilitation process.

[21] 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.

[22] 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.

a significant predictor of depositor runs. The regression we run has the following functional form:

$$\Delta D_i = \alpha + \beta(controls)_i + \gamma(exposure)_i + e_i \quad (1)$$

where ΔD_i is the deposit flow for each bank i. The dependent variable is the percentage of total deposit flow for each bank in the sample. The controls represent ex-ante characteristics that proxy for the ability of the banks to survive the crisis. In order to analyze the effect of linkages with the failed bank on depositor runs, we examine the sign and the significance of the exposure variable which represents the level of exposure with the failed bank. If deposit loss is unrelated to the level of exposure, it would provide evidence in favor of the null hypothesis that contagion was purely random in nature. Note that though the rejection of the null does provide evidence in favor of information based contagion, it does not rule amount some amount of panic in the runs. So, it is important to examine the sign as well as the magnitude of the exposure variable to examine the relevance of information based contagion. We then proceed to test whether outstanding interbank claims among banks (apart from the failed bank) led to further propagation/intensification of the shock. We divide the empirical investigation into two parts. Section A explores the contagion due to linkages with the failed bank. Section B investigates the propagation of the shock due to outstanding interbank claims among other banks.

Section A: To study whether depositors were running randomly across banks or whether the runs were based on the level of exposure with the failed bank, we first construct a variable called 'exposure' that represents exposure of a bank with the failed bank as fraction of its total assets. We then compute the change in the level of deposits between March 31st, 2001 and December 31st, 2001.[23] Even though the runs began on the 14th of March 2001, we measure the change in deposits

[23] 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.

beginning March 31st, 2001.[24] Non inclusion of the initial period can only mitigate our chances of a finding a relation 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 bailout.[25]

To control for other factors that could influence depositor runs on banks, we construct several measures using 31st of March 2001 balance sheet information. We measure bank profitability by return-on-assets ratio. We also use the ratio of equity capital-to-assets as measure of financial health of the bank. The measures that we use to proxy for riskiness of banks or susceptibility to a crisis are: the ratings by 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.[26] As for borrowings-to-deposit ratio, other studies have also found that share of borrowed money to be 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 the bank and zero otherwise.[27] Finally,

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

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

[26] 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.

[27] An important point to note is that most of the media articles just stated that bank X was facing a huge depositor withdrawal. Also the articles appeared immediately after the failure i.e. between 13th of March 2001 and 31st of March 2001 (before our sample begins). The use of the media dummy helps addressing the possibility of herding due to public release of information (Banarjee, 1992; Bikhchandani et al., 1992; Yorulmazer 2003)

to control for local macro economic factors that could affect deposits, we use dummies for districts where banks are headquartered.[28]

Table 1 provides summary statistics of the data. We find that on average, banks experienced a 4% loss in deposits. The average exposure that banks had 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 ratio are 1% each. The average credit-to-deposit ratio is 63%.

We now proceed to investigate if exposure levels were an important predictor of depositor runs. Table 2, column (1), presents the basic results. We see that exposure with the failed bank is significant predictor of deposit loss, i.e. banks that had a higher exposure with the failed bank suffer enhanced deposit loss. The coefficient on exposure is 0.44. This translates into a 4.4% loss in deposits for a bank that had 10% of its assets with the failed bank. In columns (2) through (4), we introduce controls for ex-ante characteristics of the banks that could also influence depositor runs. We find that banks that had a higher return on assets suffered significantly lower deposit loss. We also find that banks which were classified as weak by the regulator experienced significantly higher depositor runs. Furthermore, banks that have a higher fraction of illiquid assets experience significantly more depositor runs. Interestingly, the media dummy is highly significant in explaining deposit loss, i.e. depositors withdrew 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 suffered an additional deposit loss of approximately 20%. One unique feature of the media reports that appeared, were that all of them just stated that bank X was facing huge rush of depositors. In

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

a sense, they were not conveying any information about the fundamental attributes of the banks but were conveying the actions of other depositors who moved before. 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. In fact, the magnitude of deposit loss for banks that had 10% of their assets with the failed bank increases to approximately 7%.

The results in table 2 clearly show that exposure to the failed bank was an important driver of depositor runs. The significance of ex-ante fundamentals of banks in explaining deposit flow further provides evidence that depositors were concerned about the ability of the banks to withstand the shock. The deposit loss experienced by banks that had 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).[29] As all the media reports about banks (except one) appeared before the period we measure our deposit loss, our results are robust to the criticism that banks which had faced a run, in turn had a media report appear about them.[30]

While the deposit runs on banks with higher level of exposure with the failed bank is consistent with the information-based models of contagion (Allen and Gale 2000; Dasgupta 2004, Iyer and Peydró-Alcalde, 2004), the result is still surprising considering that depositors were not aware of the exposure levels. Thus, before drawing conclusions based on significance of the exposure levels in predicting deposit loss, several questions need to be addressed. Firstly, were banks that had higher levels of exposure ex-ante more risky? Secondly, did the exposure level proxy for some other characteristics of banks that depositors used to condition their runs? Finally, if indeed depositors were running on banks based on the level of exposure, how did they figure out the exposure levels?

[29] See also Peydró-Alcalde, 2004.

[30] 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.

To address the concern that banks which had a higher exposure were ex-ante more risky, we first divide the banks into two categories. One category are the banks that have exposure level lower than 10% of the assets, we call this group the unexposed group.[31] We call the other group of banks the exposed group. Table 3, columns (1) through (3) 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, size or deposit premium charged by depositors. Thus, the results in table 3 show that banks with higher levels exposure were not ex-ante more risky.

While the results in table 3 show that banks with higher levels exposure were not ex-ante more risky, it could be possible that exposure levels are a proxy for some other characteristic 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 distance from the failed bank, in the regression.[32] As results in table 4, columns (1) and (2) show, we did not find any significant effect of correspondent banking relationship or distance from the failed bank on deposit change. Thus, even after controlling for alternative proxies for likelihood of exposure 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 with 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

[31] We also find no difference in the results if we use 1% or 5% exposure level to conduct the comparisons.

[32] Distance from the failed bank refers to the physical distance between the district a bank is head quartered and the district where the failed bank was head quartered.

deposit premium paid by banks is related to the level of exposure.[33] As results in table 4, column (3) show, we do not find any significant relationship between change in the deposit premium and exposure level. 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 3 and 4 show that exposure levels are not likely to be proxies for other characteristics of a bank and are independently an important factor in influencing depositor runs. This leaves us with the question as to how depositors figured out the level of exposure. To explore this question we look at various alternatives. Firstly, we check if banks voluntarily disclosed their level of exposure in their subsequent annual report.[34] We simultaneously also investigate the characteristics of banks that released information and check if information release had any effect on depositor reaction.

To investigate the possibility of banks voluntarily releasing information in the period we measure our deposit loss, we check if information on balances with other banks is provided by the banks in their 2001 annual report – released between July and December 2001 – i.e. we check if banks reported their exposure with MMCB in their annual report. We did find that some banks voluntarily released information on their exposures with MMCB in their annual report. In order to further investigate the characteristics of the banks that released information on their exposures, we run a probit, the results of which are reported in table 5. We find that banks that have lower exposure with the failed bank are more likely to release information.[35] Banks that are larger in size are also more

[33] We use deposit rates prevailing on March 31st, 2002 to calculate the change in the risk premium.

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

[35] 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.

likely to release information on their exposure. We also find that banks that have a media release were 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 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 had any impact on change in deposits, we include, in our regression specification, a dummy which takes the value of one if banks reported their exposure to MMCB. As results in table 6, column (1) show, there is no significant 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 they 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 did not find any effect of disclosure variable on deposit change.[36] In our opinion, a more plausible explanation for this finding could be that the

[36] 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.

information was redundant, as depositors already had information on exposures through rumors or word of mouth communication. We find support for this claim by re-estimating the model specified by equation (1) excluding the banks that released information. As results in table 6, column (2) show, exposure to the failed bank is still a highly significant predictor of deposit loss in this sub-sample. In other words, even for banks that had reported no information on exposure to MMCB, the exposure level was an important factor in influencing depositor runs suggesting that depositors might have received this information through alternative channels.

In summary the results in table 2 through 6 show that exposure with the failed bank was an important factor in influencing depositor runs. Despite depositors not having information on the level of exposure with the failed bank, on average runs on banks were not random and linked to the exposure with the failed bank. This provides strong evidence in support of information based contagion. Our results also suggest that information on exposures over and above that revealed by banks may have been obtained by depositors through rumors or word of mouth communication.

Section B: Did interbank connections among the on-going banks further propagate/intensify the crisis?

So far, we have discussed the effect of linkages with the failed bank on depositor runs. Given that there were also other interbank claims outstanding at the time of the failure, we investigate whether these claims could have propagated or intensified the crisis. Ex-ante, there are several possibilities pertaining to how these claims could affect depositor runs. One might expect that banks that have a higher proportion of deposits held by other banks are more susceptible to liquidity risk as these deposits could be withdrawn due to liquidity crunch faced by creditor banks (Allen and Gale, 2000; Calomiris and Mason 2003; Iyer and Peydró-Alcalde, 2004). On the other hand, it is also possible that banks with higher proportion of deposits held by other banks might face lower level

of depositor runs due to higher provision of liquidity (Allen and Gale, 2000; Dasgupta, 2004; Iyer and Peydró-Alcalde, 2004). Another possibility is that higher proportion of deposits held by other banks could amplify the effect of the initial shock. Iyer and Peydró-Alcalde (2004) predict that even when creditor banks do not directly play an important role on the financial distress of their borrower banks, they amplify the sensitivity of the initial shock on their borrower banks. This translates into higher depositor runs for banks with higher fraction of deposits held by other banks conditional on the level of exposure to the initial shock.

One problem we encounter in conducting this analysis is that we only have data on aggregate exposure for each bank in terms of deposits placed with other banks and deposits held by other banks, i.e. for each bank we only know the aggregate claims outstanding with/from each of the categories of banks (co-operative, public and private).[37] Thus, we primarily have two measures to conduct our analysis. One is the amount of deposits each bank had with other banks (excluding deposits with the failed bank). And the other one is the amount of deposits each bank had from other banks. In a true accounting sense, these two measures should be identical (if we take the entire system into account), however, given that we limit our analysis to a sub-sample of banks, these claims do not perfectly match. To conduct our analysis, we regress the change in the level of deposits during the crisis on the fraction of total deposits that a bank had from other co-operative banks.[38] and also the outstanding level of deposits that a bank held in other co-operative banks

Table 1, row (7) and row (8) presents the summary statistics of the linkages between banks excluding the failed bank. Out a total of 124 banks for which we have data on the outstanding

[37] The claims are outstanding as on March 31st, 2001.

[38] Private and public banks did not place any deposits with co-operative banks, thus by restricting our analysis to this measure, we rule out the possibility of transmission of contagion to private and public banks. However given that size of the claims co-operative banks had with private and public banks is very small as compared to the latter's size, we do not expect any significant effect. Also, we do not include call money borrowing as they could have been entered after the crisis began, thus creating a possibility of a spurious linkage between outstanding call money borrowings and deposit loss.

deposits held by other banks, 28 banks had a positive fraction of their deposits held by other co-operative banks (defined as deposits from co-operative banks/total deposits). The average fraction of deposits held by co-operative banks is 0.8%. Furthermore, for the 121 banks that we have data on the outstanding deposits held in other co-operative banks, 70 banks held deposits in other co-operative banks (defined as the deposits with other co-operative banks/total assets) with the average holding being 2%.

We now proceed to see if outstanding claims in the interbank market had any impact on deposit flow. As the results in table 7, column(1) show, we do not find that banks that have higher fraction of total deposits held by other banks face significantly higher level of runs. This finding suggests that banks in general did not liquidate their claims in other banks in response to the shock. This finding also addresses another concern regarding the importance of the central bank mandate requiring banks to unwind their interbank claims before June 2002.[39] If banks unwound their claims primarily due to the central bank mandate, we should expect to find a significant negative relationship between change in the total deposits and the fraction of deposits that banks had from other co-operative banks. We also do not find that banks that had a higher fraction of funds invested in other co-operative banks faced higher depositor runs (column (2)). Note that the size and significance of other variables analyzed in section A are not altered much by this analysis. Overall, the findings presented above suggest that liquidity risk by itself was not of first order importance in amplifying or attenuating the crisis.

To explore if the effect of outstanding interbank claims in propagating the crisis is contingent on the exposure of banks had with the failed bank, we first generate an interaction term between fraction of total deposits held by other banks and a dummy that takes the value of one if the

[39] Even though we conduct our analysis before the 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.

bank has an exposure with MMCB. Results in table 7, column (3) show that the interaction term does not turn out to be significant. We then generated the interaction term defined above using different thresholds of exposure with the failed bank. We report the results for the interaction term generated using the 1 % threshold in table 7, column (4). Interestingly, now the coefficient on the interaction term is significantly negative, i.e. banks that have an exposure level greater than 1% face increasing runs with higher fraction of total deposits held by other banks.[40] Moreover, the magnitude of the effect is large (coefficient of 2.67). We also experimented with other thresholds like 2% and 3% and find that the results obtained above hold. Thus, we find that outstanding claims held by banks amplified runs for banks having an exposure higher than a critical threshold with MMCB. Part of this finding could be explained by either creditor-banks liquidating their claims from banks that had higher exposure with MMCB due to the fear of transmission of the shock (Iyer and Peydró-Alcalde, 2004) or, alternatively, by creditor-banks liquidating their claims with weaker banks (banks that had a higher exposure) to access liquidity (Iyer and Peydró-Alcalde, 2004).[41] However, given the size of the effect, these outstanding claims seem to have triggered additional runs by ordinary depositors.[42] As we do not have disaggregated deposit data (in terms of outstanding interbank deposits) as on December 31st, 2001, we cannot claim with absolute certainty as to which of the explanation is driving our results. However, these findings suggest that outstanding interbank claims played a role in amplifying the overall level of level of depositor runs

[40] We did not find that that banks that have a positive fraction of deposits held by other banks and exposure level higher than 1% were ex-ante different in terms of profitability.

[41] Another possible explanation for this finding could be that, banks that had an exposure with MMCB above the 1% threshold also had claims of lower maturity from other banks, which in turn were liquidated due to the central bank mandate (the directive was binding for those group of banks). However, given that we could not find any ex-ante differences in characteristics between banks that had exposure higher than 1% and un-exposed banks, it seems unlikely that they would have claims with different maturity. Thus, it seems highly unlikely that our results are driven due to the central bank mandate.

[42] As the data we have on outstanding claims is as on March 31st, 2001, one could argue that the banks that faced higher level of runs in the intervening period (between the failure of MMCB and 31st of March, 2001) due to higher level of exposure, entered into contracts with other banks to access liquidity. Though, this interpretion is consistent with the finding reported above, it seems highly unlikely that other banks would enter into demand deposit contracts with banks that have higher exposure to the shock.

in banks that were more exposed to the initial shock.

In summary, we find that even though outstanding deposits held by other banks does not directly increase the fragility of their debtor banks, they however amplify the negative effect of the initial shock on their debtor banks that had higher exposure to the initial shock. Thus, our results suggest that outstanding claims in the interbank market could further intensify the crisis.

6 Conclusion

This paper conducts a study of contagion due to balance sheet connections among banks. We use detailed data on interbank commitments to test the propagation of a shock (due a fraud at one large bank) in the banking system. In addition, we also shed light on the disclosure of information during a crisis. We find that depositors run on banks based on the level of exposure with the failed bank and, hence, the runs are not purely random in nature. This finding coupled with the fact that depositors did not have information on the linkages among banks provides strong evidence in favor of information-based view of contagion. Given that the analysis is carried out in the context of the Indian banking system (primarily co-operative banks), where transparency levels are not high, our findings suggest that the risk of purely random transmission of panic in an institutional setting with higher transparency levels may be low. If this is indeed the case (as our results suggest), that could have important implications for regulatory policy for banks. Bailouts of banks are generally motivated by the fear of systemic risk due to linkages among institutions. If random transmission of panic is not a serious threat, then regulators could exercise forbearance in use of bailouts and thereby reduce the moral hazard problems that arise. Regulators and banks can also devise ex-ante risk management systems to curtail excessive exposure to a single institution to limit the risk of idiosyncratic shocks having destabilizing effects.

We also find that outstanding interbank claims among other banks (after the initial failure) further intensified the crisis. Our results show that conditional on the exposure to the failed bank, banks that had a higher fraction of their deposits held by other banks faced more runs. This suggests that interbank market can amplify the initial shock. This provides 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.[43]

Furthermore, we find that provision of public information (conditional on the nature of information released) during a crisis has destabilizing effects. We find that banks that had a media report about the extent of depositor withdrawals, faced heightened depositor pressure. We also find that banks voluntarily released information on the level of exposures with the failed bank to attenuate the impact of the crisis. We, however, do not find any impact of information disclosure by banks, on depositor withdrawals.

How far can one generalize these conclusions? Would changes in the institutional setting alter the results? Answering these questions would require analysis of other failures using detailed data similar to the one we have used for this analysis. Our analysis also leaves some other open questions which could have important bearing on the conclusions. For example, are the magnitude of the runs justified given the level of 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 on transmission of crises.

[43] See Rochet and Vives, 2004.

References

Aharony, Joseph and Itzhak, Swary (1983), "Contagion Effects of Bank Failures: Evidence from Capital Markets," *Journal of Business*, vol. 56, 305-322.

Aharony, Joseph and Swary, Itzhak (1996), "Additional evidence on the information-based contagion effects of bank failures," *Journal of Banking & Finance*, vol. 20, 57-69.

Allen, Franklin and Douglas, Gale (2000), "Financial Contagion," *Journal of Political Economy*, vol. 108, 1-33.

Banarjee, Abhijit, (1992), "A simple model of Herd Behavior," *Quarterly Journal of Economics*, 107(3), 797-817.

Banerjee, Abhijit and E. Duflo, (2002) "Do Firms Want to Borrow More? Testing Credit Constraints Using a Directed Lending Program," Working paper, MIT.

Bikhchandani, Sushil; David, Hirshleifer and Ivo, Welch **(**1992), "A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades," *Journal of Political Economy*, vol. 100, 992–1026.

Calomiris, Charles and David Wheelock, (1995) "The Failures of Large Southern Banks During the Depression," Working Paper, Columbia University.

Calomiris, Charles and Joseph, R. Mason (1997), "Contagion and Bank Failures during the Great Depression: The June 1932 Chicago Banking Panic," *American Economic Review*, vol. 87, 863-883.

Calomiris, Charles and Joseph, R. Mason (2003), "Fundamentals, Panics and Bank Distress During the Depression," *American Economic Review*, vol. 93, 1615-1647.

Chari, Varadarajan, and Ravi Jagannathan (1988), "Banking Panics, Information, and Rational Expectations Equilibrium," *The Journal of Finance*, XLIII, 749-763.

Chen, Yehning (1999), "Banking panics: The role of the first-come, first-served rule and information externalities," *Journal of Political Economy*, vol. 107, 946-968.

Cocco, Joao; Francisco Gomes and Nuno Martins (2004), "Lending Relationships in the Interbank Market," Working Paper, London Business School.

Dasgupta, Amil (2004), "Financial Contagion through Capital Connections: A model of the Origin and Spread of Bank Panics," forthcoming *Journal of European Economic Association*.

Diamond, Douglas, and Philip Dybvig, (1983), "Bank Runs, Deposit Insurance, and Liquidity," *Journal of Political Economy*, 91, 401-419.

Freixas, Xavier; Parigi, Bruno. M and Rochet Jean-Charles (2000), "Systemic Risk, Interbank Relations, and Liquidity Provision by the Central Bank," *Journal of Money, Credit, and Banking*, vol. 32, 611-638.

Furfine, Craig (2002), "The Interbank market during a crisis," *European Economic Review*, vol. 46, 809-820.

Furfine, Craig (2003), "Interbank Exposures: Quantifying the Risk of Contagion," *Journal of Money, Credit & Banking*, vol. 35, 111-128.

Gorton, Gary (1988), "Banking Panics and Business Cycles," *Oxford Economic Papers*, vol. 40, 751-781.

Gorton, Gary and Andrew Winton (2002), "Financial Intermediation," NBER Working paper No. W8928.

Humphrey, David B. (1986), "Payments Finality and Risk of Settlement Failure," in A. Saunders and L. White (editors), *Technology, and the Regulation of Financial Markets: Securities, Futures, and Banking*, Lexington Books, Lexington, MA, 97-120.

Iyer Rajkamal and José-Luis Peydró-Alcalde (2004), "How does a Shock Propagate? A Model of Contagion in the Interbank Market due to Financial Linkages," Working paper, INSEAD.

Jacklin, Charles, and Sudipto Bhattacharya, (1988) "Distinguishing Panics and Information-based Bank Runs:Welfare and Policy Implications," *Journal of Political Economy*, 96, 568-592.

Jayanti, S.V. and Ann Marie Whyte (1996), "Global Contagion Effects of the Continental Illinois Failure," *Journal of International Financial Markets, Institutions & Money*, vol. 6, 87-99.

Kho, Bong-Chan; Lee, Dong and Rene Stulz, (2000), "U.S. Banks, Crises, and Bailouts: From Mexico to LTCM," *American Economic Review*, vol. 90, 28-31.

Martinez Peria, Maria Soledad and Sergio, Schmukler (2001), "Do Depositors Punish Banks for Bad Behavior? Market Discipline, Deposit Insurance, and Banking Crises," *Journal of Finance*, Vol. 56, 1029-1051.

Mason, Joseph, R., (2003) "The political economy of Reconstruction Finance Corporation assistance during the Great Depression," *Explorations in Economic History*, 40, 101-121.

Okuno-Fujiwara, Masahiro; Andrew Postlewaite and Kotaro Suzumura. 1990. "Strategic Information Revelation," Review of Economic Studies, 57, 25-47.

Peydró-Alcalde, José-Luis, (2004) "The Impact of a Large Creditor and its Capital Structure on the Financial Distress of its Borrower," Working Paper, INSEAD.

Rochet, Jean Charles and Xavier Vives, (2004) "Coordination Failures and the Lender of Last Resort: Was Bagehot Right After All?," forthcoming in *Journal of the European Economic Association*

Schumacher, Liliana (2000), "Bank runs and currency run in a system without a safety net: Argentina and the 'tequila' shock," *Journal of Monetary Economics*, vol. 46, 257-277.

Statement on Monetary and Credit policy for the year 2001-2002, *Reserve Bank of India*.

Statistical handbook (2001), Gujarat Urban Co-operative Banks Federation.

Summer, Martin; Helmut Elsinger and Alfred Lehar (2002), "Risk Assessment for Banking Systems," Working Papers 79, Oesterreichische Nationalbank (Austrian National Bank).

Swary, Itzhak (1986), "Stock Market Reaction to Regulatory Action in the Continental Illinois Crisis," *Journal of Business*, vol. 59, 451-473.

Upper, C and A. Worms (2002), "Estimating bilateral exposures in the German Interbank Market: Is there a Danger of Contagion?" *Deutsche Bundesbank, Dicussion paper* 09/02.

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), 1984 (98th Congress 2nd session).

Vives, Xavier (2004), "Complementarities and Games: New Developments," Working paper, INSEAD.

White, Eugene. N, (1984) "A Reinterpretation of the Banking Crisis of 1930," *Journal of Economic History*, 44(1), 119-38.

Yorulmazer, Tanju (2003), "Herd behavior, Bank runs and Information disclosure," Working paper, NYU.

Table 1: Summary statistics

This table provides sample statistics for the banks in the sample. Deposit change 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. Credit Ratio is the total loans of a bank divided by its total deposits. Size is the log of total assets of the bank. Exposure is the exposure of a bank to the failed bank in the first shock divided by its total assets. Return on asset is the profit of the bank divided by its total assets. Capital Ratio is the book value of shareholder equity divided by its total assets. Borrowing ratio is borrowings divided by total deposits. From_other is the ratio of deposits held by other co-operative banks to total deposits. With_other is the ratio of deposits held in other co-operative banks to total assets. All balance sheet variables are defined as on 31st of March 2001. All variables are book values.

	Obs	Mean	Std. Dev.
Deposit change	142	-0.04	0.12
Exposure	142	0.03	0.05
Return on asset	142	0.01	0.01
Capital ratio	142	0.01	0.008
Credit ratio	142	0.63	0.16
Borrowing ratio	142	0.03	0.05
From_other	124	0.008	0.02
With_other	121	0.02	0.05
Size	142	9.16	0.77

Table 2: Effect of exposure with the failed bank on deposit flow

The dependent variable is 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. 'Weak' refers to a bank that has been classified as weak by the central bank. 'Media' takes the value of 1 if a report about the bank appeared in newspapers. Credit ratio is total loans of a bank divided by its total deposits. Size is the log of total assets of the bank. Exposure is the exposure of a bank to the failed bank in the first shock divided by its total assets. Return on asset is the profit of the bank divided by its total assets. Borrowing ratio is the total borrowings divided by total deposits. Capital Ratio is the book value of shareholder equity divided by its total assets. All balance sheet variables are defined as on 31st of March 2001. All variables are book values. 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. Heteroscedasticity- robust standard errors are in parentheses. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively.

	1	2	3	4
Exposure	-0.44**	-0.63***	-0.71***	-0.63***
	(0.20)	(0.23)	(0.23)	(0.24)
Return on asset		2.65*	3.29**	2.12**
		(1.38)	(1.36)	(0.91)
Size		-0.01	-0.01	-0.01
		(0.01)	(0.01)	(0.01)
Media		-0.19***	-0.19***	-0.19***
		(0.05)	(0.04)	(0.06)
Weak		-0.07*	-0.07*	-0.07
		(0.04)	(0.03)	(0.04)
Credit ratio			-0.17*	
			(0.09)	
Borrowing ratio				-0.07
				(0.36)
Capital ratio		-0.46	0.51	-0.42
		(1.21)	(1.39)	(1.22)
cons	-0.03***	0.14	0.16	0.14
	(0.01)	(0.17)	(0.17)	(0.17)
district controls	no	yes	yes	yes
No.of Obs	142	142	142	142
Adj R-squared	0.03	0.25	0.28	0.24

Table 3: Comparison of means

'Unexposed' refers to banks with exposure level less than 10% of their assets. 'Exposed' refers to banks with exposure level greater than 10% of their assets. Return on asset is the profit of the bank divided by its total assets. Size is the log of total assets of the bank. Deposit rate is the rate prevailing as on 31st of March 2001 offered to depositors for a deposit of 1 year maturity. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively, in a two sided t test of the mean of Unexposed banks with Exposed banks.

	Return on asset	Size	Deposit rate
Unexposed			
Mean	0.0105	9.1734	0.0872
Std.Err	(0.0007)	(0.0729)	(0.0014)
No. of Obs	122	122	68
Exposed			
Mean	0.0114	9.1142	0.0896
Std.Err	(0.0016)	(0.1280)	(0.0032)
No. of Obs	20	20	16
Tests of differences between means (t-statistics)			
Unexposed, Exposed	-0.4512	0.3154	-0.7193

Table 4: Robustness

This table presents several robustness checks. In column (1) and column (2), the dependent variable is 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. In column (3), the dependent variable is log (DR_t/DR_{t-1}) where DR_t is deposit rate prevailing as on 31st of March 2002 and DR_{t-1} is deposit rate prevailing as on 31st of March 2001. 'MMCB banker' refers to banks that a have correspondent banking relationship with the failed bank. 'Distance' refers to the physical distance between the headquarters of a bank and the failed bank. 'Weak' refers to a bank that has been classified as weak by the central bank. 'Media' takes the value of 1 if a report about the bank appeared in newspapers. Credit ratio is total loans of a bank divided by its total deposits. Size is the log of total assets of the bank. Exposure is the exposure of a bank to the failed bank in the first shock divided by its total assets. Return on asset is the profit of the bank divided by its total assets. Borrowing ratio is the total borrowings divided by total deposits. Capital Ratio is the book value of shareholder equity divided by its total assets. All balance sheet variables are defined as on 31st of March 2001. All variables are book values. 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. Heteroscedasticity- robust standard errors are in parentheses. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively.

	1	2	3
Exposure	-0.74***	-0.66***	0.003
	(0.28)	(0.20)	(0.25)
Return on asset	3.27**	1.93**	-0.81
	(1.34)	(1.00)	(1.07)
Size	-0.01	-0.02	-0.03
	(0.01)	(0.01)	(0.02)
Media	-0.19***	-0.19***	0.05
	(0.04)	(0.05)	(0.04)
Weak	-0.07*	-0.07*	-0.13***
	(0.03)	(0.03)	(0.04)
Credit ratio	-0.18*		0.03
	(0.09)		(0.08)
Borrowing ratio		0.002	
		(0.31)	
Capital ratio	0.42	-0.81	-1.48
	(1.39)	(0.99)	(1.87)
MMCB banker	0.01		
	(0.01)		
Distance		0.00	
		(0.00)	
cons	0.19	0.16	0.30
	(0.17)	(0.17)	(0.21)
district controls	yes	no	yes
No.of Obs	142	142	70
Adj R-squared	0.28	0.29	0.31

Table 5: Characteristics of banks that released information on their exposures

This table presents results of a probit where the dependent variable is 1 if the bank released information on exposure with the failed bank in the year 2001 annual report. Weak' refers to a bank that has been classified as weak by the central bank. 'Media' takes the value of 1 if a report about the bank appeared in newspapers. Credit ratio is total loans of a bank divided by its total deposits. 'MMCB banker' refers to banks that a have correspondent banking relationship with the failed bank. Size is the log of total assets of the bank. Exposure is the exposure of a bank to the failed bank in the first shock divided by its total assets. Return on asset is the profit of the bank divided by its total assets. Borrowing ratio is the total borrowings divided by total deposits. Capital Ratio is the book value of shareholder equity divided by its total assets. 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.

Exposure	-5.93**
	(2.37)
Return on asset	-4.80
	(13.68)
Size	0.53**
	(0.21)
Media	-1.36**
	(0.59)
MMCB banker	1.11***
	(0.25)
Weak	-0.31
	(0.40)
Capital ratio	20.26
	(15.88)
Credit ratio	-0.87
	(0.79)
cons	-5.42**
	(2.13)
Pseudo R2	0.18
No. of obs	142

Table 6: Effect of information release on deposit flow

The dependent variable is 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. 'Information' is a dummy variable that takes the value of 1 if banks released their exposures with the failed bank in the year 2001 annual report. 'Weak' refers to a bank that has been classified as weak by the central bank. 'Media' takes the value of 1 if a report about the bank appeared in newspapers. Credit ratio is total loans of a bank divided by its total deposits. Size is the log of total assets of the bank. Exposure is the exposure of a bank to the failed bank in the first shock divided by its total assets. Return on asset is the profit of the bank divided by its total assets. Capital Ratio is the book value of shareholder equity divided by its total assets. All balance sheet variables are defined as on 31st of March 2001. All variables are book values. 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. Column (2) presents the results for banks that did not release information on exposure with the failed bank Heteroscedasticity-robust standard errors are in parentheses. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively.

	1	2
Exposure	-0.72***	-0.68**
	(0.27)	(0.33)
Return on asset	3.28**	4.9***
	(1.37)	(1.56)
Size	-0.01	-0.01
	(0.01)	(0.01)
Media	-0.19 ***	-0.17***
	(0.04)	(0.05)
Weak	-0.07*	-0.03
	(0.03)	(0.03)
Credit ratio	-0.17*	-0.20
	(0.09)	(0.14)
Information	-0.002	
	(0.02)	
Capital ratio	0.54	-0.30
	(1.45)	(2.2)
cons	0.18	0.17
	(0.17)	(0.19)
district controls	yes	yes
No.of Obs	142	97
Adj R-squared	0.27	0.27

Table 7: Effect of outstanding inter-bank claims (excluding failed bank) on deposits

The dependent variable is 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. 'From_other' is the ratio of deposits held by other co-operative banks to total deposits. 'With_other' is the ratio of deposits held in other co-operative banks to total assets. 'Interaction' is the product of a dummy takes the value of one if a bank has positive exposure with the failed bank and From_other. Interaction_1pct is the product of a dummy takes the value of one if a bank has exposure with the failed bank greater than 1% and From_other. 'Weak' refers to a bank that has been classified as weak by the central bank. 'Media' takes the value of 1 if a report about the bank appeared in newspapers. Credit ratio is total loans of a bank divided by its total deposits. Size is the log of total assets of the bank. Exposure is the exposure of a bank to the failed bank in the first shock divided by its total assets. Return on asset is the profit of the bank divided by its total assets. Capital Ratio is the book value of shareholder equity divided by its total assets. All balance sheet variables are defined as on 31st of March 2001. All variables are book values. 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. Heteroscedasticity- robust standard errors are in parentheses. *, **, *** denote statistical significance at the 10, 5 and 1% levels, respectively.

	1	2	3	4
Exposure	-0.66**	-0.60**	-0.65**	-0.60**
	(0.28)	(0.29)	(0.28)	(0.27)
Return on asset	3.16*	3.42**	3.16*	3.18**
	(1.61)	(1.52)	(1.62)	(1.65)
Size	-0.006	-0.014	-0.006	0.000
	(0.01)	(0.01)	(0.01)	(0.01)
Media	-0.16***	-0.17***	-0.17***	-0.16***
	(0.05)	(0.05)	(0.05)	(0.05)
from_other	-0.47		-0.16	-0.03
	(0.48)		(0.94)	(0.38)
With_other		-0.13		
		(0.15)		
Interaction			- 0.34	
			(1.07)	
Interaction_1pct				-2.67***
				(0.58)
Credit ratio	-0.10	-0.11	-0.10	-0.08
	(0.06)	(0.07)	(0.06)	(0.06)
Weak	-0.08	-0.07	-0.08	-0.08*
	(0.05)	(0.04)	(0.05)	(0.05)
Capital ratio	-0.09	-0.20	-0.08	-0.63
	(1.47)	(1.43)	(1.47)	(1.42)
cons	0.08	0.16	0.08	-0.08
	(0.18)	(0.18)	(0.18)	(0.16)
district controls	yes	yes	yes	yes
No of obs	124	121	124	124
Adj R-squared	0.34	0.32	0.33	0.38