Journal of Banking & Finance 54 (2015) 20–29

Contents lists available at ScienceDirect

Journal of Banking & Finance

journal homepage: www.elsevier.com/locate/jbf

Banking crises and the lender of last resort: How crucial is the role of information?

Hassan Naqvi *

SKK Graduate School of Business, 206 International Hall, Sungkyunkwan University, 25-2 Sungkyunkwan-ro, Jongro-gu, Seoul 110-745, Republic of Korea

ARTICLE INFO

Article history:
Received 5 February 2014
Accepted 6 January 2015
Available online 22 January 2015

JEL classification:
E58
G21
G28

Keywords:
Bank runs
Lender of last resort
Moral hazard

ABSTRACT

This article develops a model that studies how the presence of a lender of last resort (LOLR) affects the ex ante investment incentives of banks. We show that a perfectly informed LOLR induces a first-best outcome for small and medium sized banks but causes moral hazard in larger banks given the high contagion cost of their failure. On the other hand, an imperfectly informed LOLR causes allocational inefficiencies in the investment decisions of smaller banks but mitigates the moral hazard problem in larger banks due to the *constructive ambiguity* nature of bail-outs when the LOLR's information set is noisy. Policy implications include stricter supervision for smaller banks, and "buffer" requirements complemented with liquidity provision at penalty rates for larger banks.

1. Introduction

Banks are an integral part of the economy as they provide an important channel through which funds are transferred from investors to the entrepreneurial sector. However, history has shown that banks are subject to runs and panics. A bank run occurs when depositors fearing that the bank will be unable to fulfill its obligations, attempt to withdraw their funds immediately. Moreover, many banks have been increasingly using short-term wholesale funding to finance long-term assets. The providers of such funds are very sensitive to the underlying credit risk as well as the macroeconomic environment. Thus banks are subject to liquidity risk given the possibility of runs (either from individual depositors or wholesale funding providers). If the total withdrawals from a bank are high enough, then even healthy banks can ultimately become bankrupt as they are forced to prematurely liquidate their assets at fire sale prices. Such banking crises can seriously disrupt economic activity.[1] Because of the central position of financial intermediaries in the economy, the adverse impact of banking crises on economic activity cannot be overemphasized.

Since banks hold only a fraction of their deposits as reserves, they are vulnerable to liquidity shocks which might hit the economy as such shocks might induce panic and may affect the behavior of the depositors. The role of the central bank as a lender of last resort was thus a natural response to the fractional reserve system. Some economists claim that the LOLR is not necessary in a well developed financial system as the interbank market can provide liquidity to solvent banks facing liquidity problems.[2] However, as argued by Goodhart and Huang (2005), the interbank market cannot provide liquidity in two instances. First, the interbank market might not suffice in case of a market failure, for instance, when a large amount, which is too much for a single bank, is needed to bail out a solvent institution.[3] Second, the market mechanism cannot provide insurance against liquidity shocks which affect the whole economy.

In this paper we study the role of a LOLR in an economy characterized by heterogenous banks with different sizes. The LOLR

* Tel.: +82 2 740 1531; fax: +82 2 740 1503.
E-mail address: naqvi@skku.edu

[1] Bernanke (1983) claims that a substantial part of the decline in real output during the Great Depression was a consequence of the breakdown of economic institutions and the subsequent collapse of credit rather than the decline in the quantity of money. Dell'Arricia et al. (2008) also find evidence that banking crises have adverse real effects on the economy.

[2] See, for example, Goodfriend and King (1988).

[3] For example, on November 21st 1985, the Bank of New York required a bail-out because of a computer bug in its T-Bills clearing system which denied any incoming payments. The Fed then had to provide an emergency loan of $22.6 billion which was too much for a single bank and because of coordination problems could not be provided by the market as a whole.

http://dx.doi.org/10.1016/j.jbankfin.2015.01.004
0378-4266/

purports to provide liquidity to solvent banks who are facing liquidity problems so that the banks do not have to resort to the inefficient liquidation of their assets. Nevertheless, the provision of such liquidity affects the ex ante investment incentives of banks which can potentially cause moral hazard. Furthermore, the LOLR also needs to consider the contagion cost in the event of a failure of a bank. This contagion cost is generally increasing in bank size which impels the LOLR to bail-out larger banks. The *too big to fail* argument exacerbates the moral hazard problem in big banks.

We also analyze the role of information in LOLR bail-out policy. Interestingly, we find that if the LOLR is imperfectly informed then small banks with relatively good fundamentals underinvest (relative to the first-best benchmark) whereas small banks with relatively bad fundamentals overinvest (relative to the first-best benchmark). This is because an imperfectly informed LOLR may inadvertently make Type I errors (by not bailing-out a solvent bank) and Type II errors (by bailing-out an insolvent bank). In contrast, when the LOLR has imperfect information, the moral hazard problem prevalent in large banks is mitigated due to the uncertainty created in the bail-out policy of the LOLR as a result of noisy information. This provides a rationale for a policy of *creative ambiguity* in the bail-out decisions of larger banks.

1.1. Outline of the paper

In Section 2.1 we set up our base model which provides a platform to build up the rest of our model involving the LOLR. Our basic setup is an extension of Acharya and Naqvi (2012) with heterogenous banks, whereby each bank has its own deposit base and thus differs in size, as well as the riskiness of its assets. In our base model, we consider a bank which receives deposits from investors and then allocates a fraction of these deposits to investment projects and retains the rest of the endowments in the form of reserves. In the interim period, the bank is subject to runs whereby some depositors withdraw early. If the total amount of withdrawals exceeds the amount of reserves then the bank is forced to inefficiently liquidate its assets in order to service the withdrawals. Such premature liquidation is costly due to the fire-sale nature of the sale of assets. Finally, in the final period the proceeds from bank projects, if any, are divided between the stakeholders according to the contractual terms. In this base model, the bank needs to determine how much investments to make, given that if it makes too many investments it may have to bear the cost of premature liquidation. In the base model, the bank's problem is solved in the absence of a LOLR.

In Section 2.2 we establish the solvency and failure thresholds of banks. If a bank fundamentals are bad enough then it is insolvent. Nevertheless, the failure threshold exceeds the solvency threshold since a solvent bank can also fail due to liquidity problems in the interim period. This may happen if there are too many withdrawals forcing the bank to prematurely liquidate its assets. Hence, we may have an inefficient scenario such that solvent banks fail due to liquidity problems. This provides a rationale for the role of a LOLR to provide liquidity to solvent banks.

Section 2.3 analyzes the problem of a LOLR. In order to solve for the optimal bail-out policy we identify the associated costs of a bail-out. If the LOLR bails-out an insolvent bank then it induces an ex ante moral hazard problem in banks which encourages over-investment. Furthermore, any loan provided to an insolvent bank is defaulted upon and thus the LOLR has to face the cost of default. On the other hand, if the LOLR does not help an ailing bank then the bank faces a cost of premature liquidation. More importantly, the LOLR faces the risk of a contagion cost if it does not provide liquidity to a bank with liquidity problems. The problem of the LOLR is to choose a bail-out policy so as to minimize the expected costs of a bail-out. We show that if the LOLR is perfectly informed then its dominant strategy is to bail-out all solvent banks. However, the LOLR also finds it optimal to bail out some insolvent banks as long as they are large enough given that the cost of contagion is increasing in the size of a bank. For the purpose of the model, we proxy bank size by the amount of deposits received by a bank, i.e. a bank is larger the bigger is its deposit base. Even though such a proxy is plausible, but nevertheless our qualitative results are not dependent on this assumption and any other reasonable measure of bank size leads to similar results.

We next show that if the LOLR is imperfectly informed, such that it receives a noisy signal about bank fundamentals, then it bails out a bank as long as the signal received is good enough and exceeds a certain threshold. We show that this bail-out threshold is decreasing in bank size, i.e. the LOLR bail-out policy is lenient towards larger banks but stricter towards smaller banks.

In Section 2.4 we augment our base model by studying the investment allocation decision of a bank in the presence of a perfectly informed LOLR. We show that for smaller or medium sized banks the presence of a perfectly informed LOLR leads to a first-best outcome whereby there is neither underinvestment nor over-investment by any small or mid-sized bank. In the absence of a LOLR, as in our base model, the smaller and medium sized banks make too little investments (relative to first-best) so as to avoid the likelihood of incurring a cost of premature liquidation. This underinvestment problem is alleviated by the introduction of a LOLR who is willing to bail out all banks that are solvent.

For larger banks, however, the first-best outcome is not achieved in the presence of a perfectly informed LOLR. This is because larger banks are aware that they will be bailed out irrespective of whether or not they are solvent due to the high contagion costs associated with their failure. Consequently, larger banks underprice risk and set the lending rate lower than the first-best level resulting in an overinvestment problem. Hence, even though a perfectly informed LOLR alleviates the underinvestment problem of smaller and medium sized banks but nevertheless creates a moral hazard problem in the case of larger banks.

In Section 2.5 we further augment our model by introducing noise in the information set of the LOLR. We show that in the presence of an imperfectly informed LOLR there is a deviation from the first-best outcome for small and medium sized banks. The deviation from first-best is dichotomous in the sense that for 'good' banks with relatively strong fundamentals there is a problem of underinvestment. However, for 'bad' banks with relatively weaker fundamentals there is now a moral hazard problem of overinvestment. Intuitively, if the LOLR is imperfectly informed, then good banks which are likely to be solvent fear that the LOLR may make a *Type I error* whereby it may inadvertently not bail out solvent banks. The possibility of a Type I error discourages investment by good banks since they prefer to keep a buffer (in the form of higher reserves) to avoid the cost of premature liquidation. On the contrary, bad banks which are likely to be insolvent are now incentivized to overinvest since there is now a likelihood that an imperfectly informed LOLR may make a *Type II error*whereby it may inadvertently bail out insolvent banks. This leads to a moral hazard problem for small and medium sized banks with relatively weak fundamentals.

We then analyze the investment decisions of larger banks in the presence of an imperfectly informed LOLR. We show that the moral hazard problem in large banks, that was identified in Section 2.4, is increasing in the size of the banks, i.e. the bigger the bank the more severe the moral hazard problem. Intuitively, the contagion cost of bigger banks is higher and thus the LOLR's bail-out policy becomes more and more lenient as the size of the bank increases. This is conducive to an ex ante moral hazard problem in big banks. Nevertheless, we show that the severity of the moral hazard problem in large banks is not as high when the LOLR has imperfect