



Bank capital, interbank contagion, and bailout policy



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ABSTRACT

This paper develops a theoretical framework in which asset linkages in a syndicated loan agreement can infect a healthy bank when its partner bank fails. We investigate how capital constraints affect the choice of the healthy bank to takeover or liquidate the exposure held jointly with the failing bank, and how the bank's ex ante optimal capital holding and possibility of contagion are affected by anticipation of bail-out policy, capital requirements and the joint exposure. We identify a range of factors that strengthen or weaken the possibility of contagion and bailout. Recapitalization with common stock rather than preferred equity injection dilutes existing shareholder interests and gives the bank a greater incentive to hold capital to cope with potential contagion. Increasing the minimum regulatory capital does not necessarily reduce contagion, while the requirement of holding conservation capital buffer could increase the bank's resilience to avoid contagion.

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1. Introduction

There is a longstanding and ongoing debate about whether government bailout is necessary during a financial crisis and, if so, in what form it should be provided. Some believe that government bailout of banks will save banks and their projects, minimizing a domino effect in the financial system and the loss of employment: "Bailing out Wall Street bankers is necessary to keep the US economy from crumbling even further and taking American workers down with it." (Barack Obama, US president, 29 September 2008).

However, others believe that banks can self-adjust, finding a new equilibrium without help from the government: "Bailout is not necessary. The banking industry can handle this mess internally and does not need subsidies." (Bert Ely, a leading expert on banking and finance in the Washington policy community, 24 September 2008).

Therefore, the banks' ability to self-adjust plays a key role in government bailout decisions. Given the potential drawbacks of government bailout, it is important to understand whether and to what

extent banks can absorb external shocks internally during a financial crisis. Improved understanding of this issue can help the authorities better balance the benefits of government bailout, in containing the contagion of a financial crisis, from its substantial costs.¹

In this paper, we develop a theoretical framework in which a healthy bank (Bank 1) can become infected when its partner bank (Bank 2) in a joint exposure to a syndicated loan fails and defaults on its share of loan. We analyze the impact of Bank 1's capital holding and the size of its exposure on contagion or continuation of joint exposures. Furthermore, we investigate how Bank 1's capital prior to the crisis and possibility of contagion are affected by anticipated bailout and regulation policies and a number of important factors related to Bank 1's exposure.

Our study employs the inventory theoretic framework of bank capital, which advocates that banks maintain a buffer of capital in

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¹ Government bailout increases the federal budget deficit and may even drag the country into a fiscal crisis. Hellmann et al. (2000) cite a World Bank study showing that the costs related to financial crises can reach 40 percent of GDP. During the 2008 global financial crisis, the US government spent \$250 billion to recapitalize the banks under the Troubled Asset Relief Program (TARP). European governments intervened to rescue financial institutions, such as Fortis by the Benelux countries (\$16 billion), Dexia by Belgium, France, and Luxembourg (€150 billion), Hypo Real Estate Bank by Germany (€50 billion), ING by Dutch government (€35 billion), and others.

excess of regulatory requirements to reduce future costs of illiquidity and recapitalization.² In our model, two banks jointly make a syndicated loan for an indivisible project. When an external shock leads the partner bank to discontinue its business operations, Bank 1 has two options: (a) accepting the liquidation of the syndicated project and receiving a comparatively low liquidation value, or (b) taking over all of the interest of Bank 2 in the indivisible project. Bank 1 also anticipates that the government may inject common equity or preferred equity into it if Bank 2 becomes distressed. If Bank 1's capital level after taking over or liquidating the distress loan is lower than the regulatory capital requirement, the bank will be liquidated with the loss of all future dividends payments to shareholders. Thus, the failure of Bank 2 forces Bank 1 into liquidation and contagion occurs.

In our analysis, we first provide the basic accounting analysis using balance sheet developments to examine when continuation of the joint project is possible, when contagion may emerge, and when bailout is needed to prevent contagion. Then we extend the analysis using the technique of dynamic stochastic optimization to investigate Bank 1's value to shareholders when it takes over or liquidates the joint project, and its value to shareholders prior to the shock allowing for the possible bank actions after the crisis. Bank 1's decision in the crisis is based on the relative values after taking over or liquidating the joint project. Then we characterize the optimal ex-ante capital holding and compare it with the regulatory capital requirement to examine whether contagion happens and how much capital in the form of common stock or preferred stock must be provided when bailout is necessary.

Our simulations show that contagion will not occur if the healthy bank properly anticipates Bank 2's failure and increases its ex-ante optimal capital holding to accommodate the joint project that may fail. However, if Bank 1 seriously underestimates the probability of the shock, its capital level will be lower than the regulatory requirement for taking over or liquidating the project, triggering contagion. In addition, if it has a high fraction of its assets invested in the joint project, a low bargaining power over the project, an exposure smaller than Bank 2's exposure in the joint project, or a large loss of market value of the project, its capital level is more likely to be lower than the required capital level to take over or liquidate the project. In sum, low capital ratios play a key role in promoting contagion and forcing liquidation. Interbank contagion can be minimized if the surviving banks are well capitalized and capable of making optimal choices in response to potential external shocks.

Our model provides several important policy implications. First, a higher anticipated probability of bailout will lead Bank 1 to hold less capital, reflecting the risk of moral hazard. Second, when the government injects funds in the form of common equity rather than preferred stock, it dilutes existing shareholder interests more and hence provides a stronger incentive for Bank 1 to hold more capital, reducing moral hazard. Third, increasing the minimum regulatory capital ratio per se may increase the possibility of contagion if Bank 1's increase of optimal capital buffer is not sufficient to match the increased capital requirement. Finally, the require-

ment of holding conservation capital buffer (as in Basel III) outside periods of stress could increase the bank's resilience to avoid contagion during the crisis. These results, collectively, provide theoretical support for the global government efforts to promote robust supervision and regulation of financial firms and give new insight into how this task can be best undertaken.³

Three contributions of our analysis are noted. First, our study adds to the theoretical bank contagion literature by examining interbank contagion due to banks' joint exposure to a common asset. In our model, contagion arises from uncertainties of banks' assets side, which differs from the common theoretical framework (such as bank-run models) for analyzing contagion from liabilities-side risk due to maturity mismatch. In the seminal paper by Diamond and Dybvig (1983), bank-run is caused by a shift in depositors' expectations due to some commonly observed factor such as a sunspot. In more realistic settings, Chari and Jagannathan (1988), Gorton (1985) rely on asymmetric information between the bank and its depositors on the true value of loans to induce bank runs, while Chen (1999) relies on Bayesian updating depositors who learn from interim bank failures that lead to bank runs. Allen and Gale (2000) propose that contagion arises because a liquidity shock in one region can spread throughout the economy due to interregional claims of one bank on other banks.

While the above bank contagion literature has focused mainly on deposit withdrawals as a propagation mechanism, a disturbance on the lending side can propagate and infect the system. This possibility deserves more attention from the theoretical perspective. Honohan (1999) shows disturbances can be transmitted through lending decisions due to banks over-committing to risky lending. Our paper adds to this strand of studies by examining contagion arising from lending-side risk, in particular, due to banks' joint exposure to a syndicated loan. This is supported by empirical evidence in Ivashina and Scharfstein (2010), who find that banks co-syndicated with Lehman suffered more stresses of liquidity, indicating that Lehman's failure put more of the funding burden on other members of the syndicate and exposed them to increased likelihood that more firms would draw on their credit lines.

Although our model deals with potential contagion arising from exposure to a syndicated loan agreement, the implications can be extended to more general situations of interbank linkages, for example, exposure to a common asset market such as sub-prime mortgage backed securities, or a situation with direct counterparty exposure. The counterparty contagion hypothesis predicts that firms with close business or credit relationships with a distressed firm will suffer adverse consequences from the financial troubles of the distressed firm (Davis and Lo, 2001; Jarrow and Yu, 2001).⁴ Given the complexity of interbank linkages, counterparty risk is even more worrisome for financial institutions. In the spirit of our model, whether other banks will fail in the wake of the collapse of a counterparty bank depends on whether their optimal capital holding before the shock exceeds the minimum

² This strand of literature posits that banks treat their capital holding strategy as an inventory decision that allows them to be forward-looking by increasing their capital levels as necessary or adjusting their asset portfolios in response to any future breach of regulatory capital requirements. The buffer stock model of bank capital was first proposed by Baglioni and Cherubini (1994), later developed by Milne and Robertson (1996), Milne and Whalley (2001), Milne (2004), and in discrete time by Calem and Rob (1996). Peura and Keppo (2006) extend the continuous-time framework to take account of delays in raising capital. Milne and Robertson (1996) state that banks maintain extra capital in excess of minimum regulatory requirements in order to reduce the potential future costs of illiquidity and recapitalization. Milne (2002) further examines the implications of bank capital regulation as an incentive mechanism for portfolio choice. Milne (2004) argues that banks' risk-taking incentives depend on their capital buffer, not on the absolute level of capital. Our focus is different. We consider the bank's optimal capital decision and interbank contagion using the inventory framework.

³ For example, the US Department of the Treasury states that "capital and liquidity requirements were simply too low. Regulators did not require firms to hold sufficient capital to cover trading assets, high-risk loans, and off-balance sheet commitments, or to hold increased capital during good times to prepare for bad times." (Financial regulatory reform: a new foundation, 2010. See http://www.financialstability.gov/docs/regs/FinalReport_web.pdf)

⁴ Empirically the counterparty contagion hypothesis is supported by Hertzel et al. (2008), Jorion and Zhang (2009), Brunnermeier (2009), Chakrabarty and Zhang (2012), Iyer and Peydro (2011), among others. As Helwege (2009) points out, government bailout is necessary if counterparty contagion is a major contagion channel for financial firms. The related interbank contagion literature relies on contractual dependency such as a bilateral swap agreement to induce contagion when one party is unable to honor the contract (e.g., Gorton and Metrick, 2012). Another interbank contagion channel is when fire-sale of illiquid assets by one bank depresses asset prices and prompts financial distress at other institutions (e.g., Shleifer and Vishny (1992), Allen and Gale (1994), Diamond and Rajan (2005), Brunnermeier (2009), Wagner (2011)).

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