Bailouts, Contagion, and Moral Hazard *

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Abstract

We revisit the link between bailouts and bank risk taking. The expectation of government intervention in favor of failing banks (bailout) creates moral hazard and encourages risk-taking. However, when a bank's success depends on both its idiosyncratic risk and the overall stability of the banking system, a government's commitment to shield banks from systemic risk may increase their incentives to invest prudently. We explore these issues in a simple model of financial intermediation where a bank's survival depends on another bank's success. We show that the positive effect from systemic insurance may dominate the classical moral hazard effect when the risk of contagion is high.

*The view expressed in this paper are those of the authors and do not necessarily represent those of the IMF. We thank Stijn Claessens and Anjan Thakor for helpful comments. Contact: lratnovski@imf.org.

1 Introduction

In the recent crisis, governments in the U.S. and elsewhere provided massive support to distressed financial institutions (directly through bailouts and indirectly through unprecedented fiscal and monetary expansions). The literature accepts that such support was essential to prevent the failure of multiple institutions that would have had devastating effects on the real economy. However it is also forceful in pointing out that, in the long run, such support carries significant costs in the form of moral hazard. First, when banks expect to be supported in a crisis, they will take more risk, because they can shift some negative realizations to the taxpayer. Second, banks choose correlated risks, because support is more likely to come when there are multiple failures. Then, the expectation of support creates moral hazard problems at both the individual and collective levels, and increases the probability of the kind of systemic crisis that government wants to avoid in the first place (Acharya and Yorulmazer, 2007, Diamond and Rajan, 2009, Farhi and Tirole, 2011).

This time inconsistency is a defining theme for policy design. It suggests that governments should create conditions where banks believe that a bailout might not be forthcoming. Crisis management starts to resemble a game of chicken: government refutes a notion of intervention until the very last moment, when the financial system is truly on the brink, and then changes its course. The threat of doom can be made more credible by increasing bureaucratic or political obstacles to intervention (such as those entailed by some provisions of the Dodd-Frank Act). Like the game of chicken, the strategy is risky (support may not come in time), but the risk is compensated by the fact that it prevents a further distortion of ex-ante incentives.

In this paper, we revisit the link between bailouts and bank risk-taking. We argue that the commonly held view that government support in a financial crisis necessarily worsens banks' ex-ante incentives is not always correct. The reason is that government support, while exacerbating one inefficiency (moral hazard stemming from the implicit 'put' to the government), ameliorates another (the risk externality associated with contagion). The interaction between the effects of bailouts and the threat of contagion on banks' incentives is the focus of this paper.

The risk of contagion is one of the reasons that makes banks special. While a car company going bankrupt is an opportunity for its competitors, a bank going bankrupt is a potential threat to the industry, especially when the failing bank is large. Banks are exposed to each other directly through the interbank market, and indirectly through the real economy, reputation channels, and financial markets. While banks may control direct exposures, the indirect links are largely beyond an individual bank's control. The risk that a bank fails simply because some other banks have failed is especially sharp in times of economic or financial fragility, or in particularly interconnected systems.

The threat of contagion affects bank incentives. The key mechanism is that when a bank can fail due to exogenous circumstances, it does not invest as much to protect itself from idiosyncratic risk. Indeed, would you watch your cholesterol intake while eating on a plane that is likely to crash? Or save money for retirement when living in a war zone? Moreover, making the threat of contagion endogenous to the risk choices of all banks generates a strategic complementarity that amplifies initial results: banks take more risk when other banks take more risk, because risk-taking of other banks increases the threat of contagion.

Under these circumstances, when the government provides systemic insurance (the promise of intervention to stem the systemic effects of bank failure), it has two effects. The first is the classical moral hazard effect described in much of the literature. The second is an insurance effect that increases banks' incentives to monitor loans (this is similar to the effect identified for macro shocks by Cordella and Levy-Yeyati, 2003).

Going back to our risky flight parable, how would your choice of meal change if you had a parachute? Under certain conditions, the insurance effect prevails and the promise of government support reduces risk-taking of all banks despite the fact that the government may have to leave bailout rents to failing and potentially imprudent ones.

Orszag and Stiglitz (2002) use the risk of fires and fire departments as a parable to describe how risk taking incentives are affected by externalities and public policy. In their model (like here), individuals do not take into account the effects safer houses have in reducing the risk of fire damages to their neighbors' homes. Hence, they invest too little in fire safety measure. The introduction of a fire department reduces the risk of a fire, but further worsens individual incentives, as it reduces the probability that a fire spreads from one house to another. To extend their parable to our paper, think about condo buildings rather than single-family houses. Fire safety measures in each apartment become complements rather than substitutes. If the rest of the building burns down and collapses, a condo owner gets little benefit from having fireproofed her own apartment. Then, the introduction of a fire department can make safety measures more valuable as it reduces the probability of total meltdown.

Formally, we develop a model of financial intermediation where banks raise deposits (or debt) and use their own capital to fund a portfolio of risky loans. The bank portfolio is subject to two sources of risk. The first is idiosyncratic and under the control of the bank. Think about this risk as dependent on the quality of a bank's borrowers, which the bank can control through costly monitoring or screening. The second source of risk is contagion. Think about this as a form of macro risk. When a bank of systemic importance fails, it has negative effects on the real economy, possibly triggering a recession. A deep enough recession can lead even the best borrowers into trouble and, as a consequence, can cause the failure of another bank independently of the quality of its own portfolio. This second source of risk is exogenous to the bank (it cannot be managed or diversified), but is endogenous to the financial system as a whole, since it depends on risk-taking of all banks.

These two sources of risk are associated to two inefficiencies. First, banks are protected by limited liability and informational asymmetries prevent investor from pricing risk at the margin. As a result, in equilibrium banks will tend to take excessive idiosyncratic risk. As in other models, this problem can be ameliorated through the imposition of capital requirements. The second inefficiency stems from the fact that individual banks do not take into account the effect their risk taking has on other banks. As with limited liability, this also leads to a level of risk that is too high relative to the coordinated solution. However, capital requirements are not effective in correcting this externality. Even a bank fully funded by capital will take excessive risk because it does not internalize the effects of own risk on other banks.

Against this background, government intervention in support of banks has two effects on incentives. It exacerbates the moral hazard problem stemming from limited liability but reduces the externality problem associated with contagion. The latter effect dominates when the probability of contagion is high, but the rents that the government leaves to bailed out banks are low. In that case, government intervention leads to lower bank risk and better ex-ante outcomes. (We do not focus on ex-post optimality, but that would depend on the difference between the economic costs of bank bankruptcy and that of the use of public funds.)

In an extended model, we show that similar offsetting effects exist for the impact of bailouts on the bank's choice of the correlation of risk with other banks. Farhi and Tirole (2011) show that when the government has undertake a bailout in a joint (systemic) bank failure, banks have incentives to correlate risks, because that maximizes their bailout rents. That correlation is undesirable because it increases the probability of joint failures that the government wants to avoid in the first place. In our model, the correlation of risks arises even without bailouts, since banks use it as a means of protecting against contagion. At this stage we speculate that, in our framework, bailouts have two effects: they increase incentives to correlate because of rents, but reduce incentives to correlate because they protect from contagion. When rents are small, contrary to Farhi and Tirole (2011), bailouts can reduce the correlation of bank default risks.

The observation that by removing the threat of an exogenous risk a government can improve a bank's monitoring incentives was first made by Cordella and Levy-Yeyati (2001), in the context of macroeconomic shocks. Our model of contagion consider shocks that are exogenous to a bank, but endogenous to the banking system, offering a link to aggregate risk-taking and systemic risk.

Several recent papers have explored the effects of expected government support on systemic risk, the simultaneous failure of multiple banks (Acharya and Yorulmazer, 2007, Diamond and Rajan, 2009, Farhi and Tirole, 2011). We add to that literature by introducing a risk externality in the form of an undiversifiable contagion risk. In that respect, the paper builds on the literature on government intervention as a means of preventing contagion (Freixas et al., 2000, Allen and Gale, 2001, Diamond and Rajan, 2005).

While we focus on the risk that a bank failure imposes on other banks, other papers have focused on the potential benefits for competing banks that can buy assets of a distressed institution at firesale prices, possibly with the help of proactive government merger policy and of targeted liquidity support to the buyer (Perotti and Suarez, 2002, Acharya and Yorulmazer, 2008A).

The rest of the paper is structured as follows. Section 2 presents the model. Section 3 extends the model to the case of correlated risks. Section 4 concludes and discusses the policy implications of the analysis.

2 A Simple Model of Contagion and Risk-Taking

Consider a market with two identical risk-neutral and profit-maximizing banks. Banks are protected by limited liability and repay depositors only when successful. If they fail, bank owners lose the invested capital. Each bank i has a loan portfolio of size 1. The portfolio is financed by equity, k_i, and deposits (or debt), $1-k_i$. The gross interest rate on deposits is r_D and, for now, not risk-sensitive thanks to deposit insurance.

Loan portfolio are exposed to two sources of risk. First, they are idiosyncratically risky: (in the absence of a crisis, defined below) they return R when successful and zero otherwise. However, banks can limit their risk by investing in monitoring/screening activities. Each bank i can choose its monitoring effort q_i which also represents the probability of idiosyncratic portfolio success (that is the probability of success conditionally on the other bank being solvent). This monitoring effort entails a cost equal to $\frac{1}{2}cq_i^2$ per dollar lent.

Second – and this is the key feature of the model – each bank's portfolio is exposed to the risk of contagion. We assume that when a bank fails, there is a probability α that (absent government intervention) the other bank's portfolio will also become non performing (call this a state of crisis). We assume that failure due to contagion occurs independently of monitoring. Put differently, we assume that this indirect bank exposure cannot be managed or diversified. This can be interpreted as a form of macro risk. When a bank of systemic importance fails, it has negative effects on the real economy, possibly triggering a recession. A deep enough recession can lead even the best borrowers into trouble and, as a consequence, can cause the failure of another bank independently of the quality of its own portfolio. However, it could also be construed as the effect of deposit/funding runs associated with widespread financial panic that are too difficult or costly to protect against. The critical assumption is that this second source of risk cannot be fully diversified.

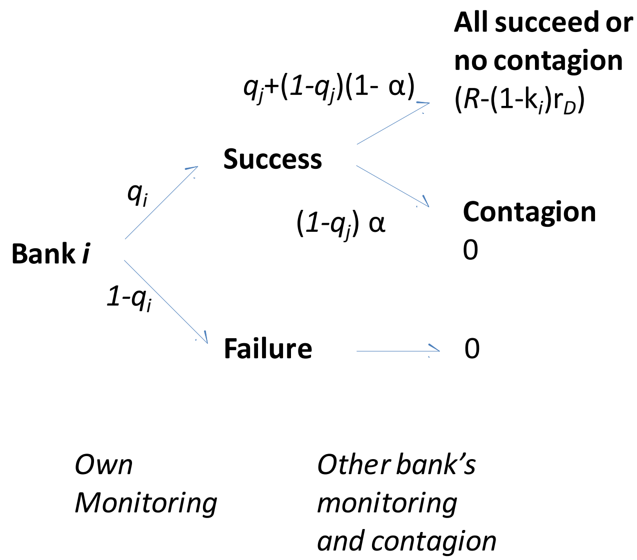

Figure 1: Bank effort choices, contagion, and payoffs.

Banks choose their monitoring effort simultaneously and cannot observe each other's choice. Through the analysis, we assume that the parameter values are such that the model admits an internal solution (later we provide a numerical example of such an equilibrium). The game tree capturing bank effort choices and contagion is shown on Figure 1.

2.1 Contagion and Bank Risk-Taking

We start by deriving the Nash equilibrium of bank monitoring choices and showing that the risk of contagion reduces bank monitoring.

We can write the expected profits of bank i:

$$E(\Pi_i) = q_i \left((1-\alpha) + \alpha q_j\right) \left(R - (1-k_i)\, r_D\right) - \frac{c}{2} q_i^2 \tag{1}$$

From the first order conditions of (1) with respect to q_i, we obtain the reaction function:

$$\widehat{q}_i(q_j) = \min\{\frac{(1-\alpha)+\alpha q_j}{c}(R-(1-k_i)r_D), 1\} \quad (2)$$

And, imposing symmetry on (2), we obtain the Nash equilibrium:

$$\widehat{q} = \min\{\frac{(1-\alpha)(R-r_D(1-k))}{c-\alpha(R-r_D(1-k))}, 1\}. \quad (3)$$

From 3 it is immediate to see that the model entails two sources of inefficiency. The first is a classical moral hazard problem. Banks are protected by limited liability and their risk taking cannot be priced at the margin because of asymmetric information (and for now deposit insurance). Being levered, they will tend to take on too much risk relative to what would be socially optimal. The second (focus of this paper) is the externality associated with contagion risk. The undiversifiable risk of a crisis reduces a bank's incentives to monitor its loans. The result is a banking system characterized by excessive risk taking.

More formally, we can state the following result:

Lemma 1 *When $\widehat{q}$ admits an internal solution, the equilibrium monitoring effort is decreasing in the probability of contagion: $d\widehat{q}/d\alpha < 0$.*

In particular $\widehat{q} = 0$ for $\alpha = 1$ (full contagion), and $\widehat{q} = \frac{1}{c}(R - r_D(1-k))$ for $\alpha = 0$ (no contagion). The externality associated with contagion lowers a bank's incentives to reduce idiosyncratic risk. Put differently, the risk of contagion reduces the payoff to monitoring: relative to the no-contagion case, for a given monitoring effort, the probability that a bank i receives $(R - r_D(1-k))$ is reduced by $((1-\alpha)+\alpha q_j)$. The bank, then, adjusts its monitoring effort as to equalize its marginal cost to this lower marginal revenue.

The risk of contagion is exogenous to each bank but endogenous to the financial system. As a result, in equilibrium, the banking system will bear an inefficiently high level of risk. This stems from two different, but connected effects. First, a bank does not internalize the positive effect that its monitoring has on another bank's expected profits. The private return to monitoring is lower than its social return leading to a too low level of monitoring (as in any classic externality). The second effect stems from strategic interaction. As the private return to monitoring depends positively on the other bank monitoring effort, each bank reduces its monitoring effort further than if it were the only one facing the externality.

2.2 The Role of Bank Capital

We can formally assess the externality by comparing the banks' risk choices to a benchmark where the two banks are jointly owned. Then their optimal effort q would be obtained by maximizing the joint profit (similar to (1)):

$$E(\Pi_i) = 2\left[q\left((1-\alpha)+\alpha q\right)\left(R-(1-k)\,r_D\right)-\frac{c}{2}q^2\right]$$

giving:

$$\tilde{q} = \begin{cases} \min\{\frac{(1-\alpha)(R-r_D(1-k))}{c-2\alpha(R-r_D(1-k))},1\}, \text{if } \alpha < \frac{c}{2(R-r_D(1-k))} \\ 1,\ \text{otherwise} \end{cases}$$

Note immediately that $\tilde{q} > \widehat{q}$. Put differently, the risk of contagion leads to a market equilibrium that entails a level of monitoring that is lower than what would be chosen if the effect risk taking has on other banks were taken into account.

This is different (albeit interconnected with) from the effect of moral hazard associated with limited liability. In models where moral hazard is the source of inefficiency, capital requirements can help discourage excessive risk taking. Higher bank capital reduces the agency problem associated with leverage and limited liability. As shareholders' skin in the game increases, they internalize a larger share of bank risk. This is also true in this model. Indeed:

$$d\hat{q}/dk > 0 \text{ and } d\tilde{q}/dk > 0 \tag{4}$$

And, trivially, in the absence of contagion risk, a bank fully funded with equity will choose a level of monitoring consistent with the social optimum $q^* = \frac{R}{c}$.

However, capital requirements are not effective in dealing with excess risk-taking driven by the threat of contagion. The reason is that this stems from externalities that affect other banks, not the bank's own creditors. In an interconnected banking system, even a bank funded entirely with equity will take more risk than what is socially optimal. More formally, for α such that the model admits an internal solution, we have

$$\widehat{q}|_{k=1} = \frac{(1-\alpha)\,R}{c-\alpha R} < \frac{(1-\alpha)\,R}{c-2\alpha R} = \tilde{q}|_{k=1}.$$

3 Bailouts

Now consider the case where the government can intervene in support of the banking system when a bank's failure threatens the system's stability. Consistent with existing literature, we assume that any form of intervention will leave some rents to the failing bank (perfectly targeted bailouts would reinforce our results). What we have in mind is a situation where in response to the threat of bank failure a government engages in expansionary fiscal or monetary policy, assets purchases, or direct support. All these activities are expected to reduce the probability of default and contagion.

Formally, assume that, with some probability θ, the government successfully intervenes when a bank is about to fail. Assume that θ is known in advance. We use θ to capture the notion that the government reaction function may not be public knowledge, or more likely that it is not certain that, even in the case of intervention, default and contagion can be avoided. Assume that intervention acts asymmetrically

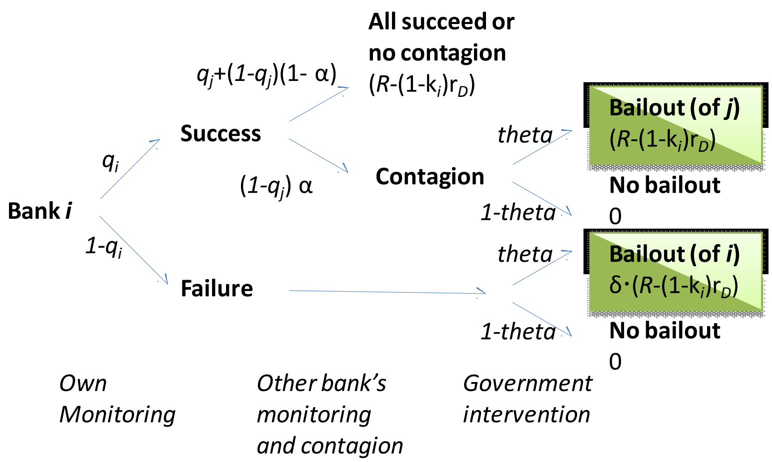

Figure 2: The effects of government intervention.

across banks. It fully prevents banks from contagion. But it may shield only partially a bank that fails because of idiosyncratic risk. Put differently, the "failing bank" only gets to keep a fraction $0 < \delta \leq 1$ of its profits. The game tree with government intervention is shown in Figure 2.

Under these assumptions a bank's expected profits become:

$$E(\Pi_i) = (q_i\left((1-\alpha)+\alpha\left(q_j+(1-q_j)\,\theta\right)\right)+(1-q_i)\,\theta\delta)\left(R-(1-k)\,r_D\right)-\frac{c}{2}q_i^2 \quad (5)$$

Equation 5 has two extra elements relative to the model without intervention (Equation **??**). First, with probability θ, bank i will remain successful even if bank j were to fail and contagion were to occur: $\alpha\,(1-q_j)\,\theta$. Second, also with probability θ, a public bailout would preserve a portion δ of bank i's profits, should bank i itself fail.

We obtain the reaction functions by solving the first order conditions for (5) with respect to q_i:

$$\widehat{q_i} = \frac{\left((1-\alpha)+\alpha\left(q_j+(1-q_j)\,\theta\right)\right)\left(R-(1-k)\,r_D\right)}{c} - \frac{\theta\delta\left(R-(1-k)\,r_D\right)}{c} \quad (6)$$

From (6) it is immediate that

$$\frac{\partial\widehat{q_i}}{\partial\theta} = \frac{\alpha\,(1-q_j)\,\theta\left(R-(1-k)\,r_D\right)}{c} - \frac{\delta\left(R-(1-k)\,r_D\right)}{c}.$$

That is, for a given monitoring effort by bank j, the effect of change in the probability of bailout will affect bank i's monitoring through two channels. First (the first term), there is the positive effect of systemic insurance. This effect is stronger when the other bank is riskier (when q_j is smaller) and when the threat of contagion, α,is greater. Second, there is a classical moral hazard effect (the second term). The expectation of retaining a portion δ of its profits in case of failure and bailout reduces the bank's incentives to monitor its loan portfolio. This effect is obviously stronger when the rents left to a failing bank in case of intervention a larger.

Imposing symmetry on (6), we obtain the Nash equilibrium (again assuming the parameters are such that an internal solution exists):

$$\widehat{q}\,(\theta) = \frac{(1 - \theta\delta - \alpha\,(1 - \theta))\,(R - (1 - k)\,r_D)}{c - \alpha\,(1 - \theta)\,(R - (1 - k)\,r_D)} \tag{7}$$

We can now state the following proposition:

Proposition 1 *For $\delta < 1$, there exists $\alpha^* = \frac{c\delta}{c-(R-(1-k)r_D)(1-\delta)}$, $\alpha^* < 1$, such that for $\alpha > \alpha^*$, equilibrium monitoring increases with the probability of government intervention: $\frac{d\widehat{q}(\theta)}{d\theta} > 0$, and for $\alpha < \alpha^*$, the opposite occurs: $\frac{d\widehat{q}(\theta)}{d\theta} < 0$.*

Proposition 1 is the key result of our paper. It shows that in states of the world where the probability of contagious is high, it may be optimal for the government to insure banks against contagion. This result stems from the two countervailing effects described above. A higher probability of bailout increases moral hazard since it leaves rents on the table for failing banks. But, at the same time, it corrects for the externality stemming from the threat of contagion, as it protects banks from a risk they cannot control. When this threat is high, and the rents left to a failing bank are not "too high", the second effects prevails. The balance between the two effects is affected by a bank's capitalization. For well capitalized banks the classical moral hazard effect is stronger. They stand to loose more in case of default and, thus, to gain more from a bailout. This means that the region in which equilibrium monitoring is an increasing function of the probability of bailout shrinks with the degree of bank capitalization, k. That is $\frac{\partial \alpha^*}{\partial k} > 0$. This mainly reflects that fact that in system with more capitalized banks default risk is lower, and thus the externality stemming from contagion is also reduced.

3.1 Bailouts under Correlated Risk

Another key type of bank moral hazard is correlated risk-taking. Bank correlate risks to protect against contagion (Acharya and Yorulmazer, 2008B) and to increase the probability of a bailout in case of failure (Acharya and Yorulmazer, 2008A, and Farhi and Tirole, 2011) when bailouts are driven by the too-many-to-fail problem. Correlated risk-taking is costly because it leads to a misallocation of resources [as in our model; the cost of correlation related to comparative advantages or excess competition] or because it increases systemic risk associated with joint failures of banks [not in out model].

In the base model of Section 3, banks were choosing the risk of uncorrelated projects. We introduce correlation in steps. First, we describe bank risk choice when projects are exogenously correlated. Correlation reduces the risk of contagion, leading to a smaller positive "risk insurance" effect of bailouts. This means that, to be ex-ante beneficial, bailouts need to be more targeted (leave smaller rents to banks) than under the baseline model.

Second, we endogenize bank correlation. In out setup, banks have incentives to correlate their default ptobability to reduce the risk of contagion (as in Acharya and Yorulmazer, 2008B). Then, government bailouts of banks in a joint (systemic) failure have two effects on the banks' choice of the correlation. On the one had, they increase incentives to correlate because correlation increases the probability of a joint failure and bailout rents (as in Farhi and Tirole, 2001). On ther hand bailouts reduce incentives to correlate because they protect from contagion. When rents are small, contrary to the Farhi and Tirole (2011) result, bailouts can reduce the correlation of bank risks.

3.2 Exogenously Correlated Risk

In this section, we explore how our results change when individual bank risks are exogenously correlated (later we examine how banks have an incentive to choose correlated risks).

Recall that, in the base model, bank risks were not correlated:

$$p\left(s_i = 1 | s_j = 1\right) = p\left(s_i = 1\right) = q_i,$$

where s_i is an indicator variable that takes value 1 when bank i is successful and 0 otherwise. Once we introduce correlation, however, banks will tend to succeed/fail together. More formally, $p\left(s_i = 1 | s_j = 1\right) > p\left(s_i = 1\right)$.

Consider, first, the case of the maximum correlation. Without loss of generality assume $q_i \leq q_j$, then for given q_i, q_j, the projects succeed/fail most often together when:

$$\begin{aligned} p\left(s_i = 1 | s_j = 1\right) &= \frac{q_i}{q_j} \\ p\left(s_j = 1 | s_i = 1\right) &= 1 \end{aligned}$$

That is, whenever a bank with a lower q succeeds, the bank with a higher q succeeds too. All the mass of success realizations of the bank with a lower q overlaps with the mass of success realizations of the banks with a higher q. Note that, similarly, when the bank with a higher q fails, the the bank with a lower q fails too.

When comparing across economies with different correlations, it is useful to write the conditional probabilities of success as a weighted average of the full correlation and zero correlation conditional probabilities. Specifically, when projects have success probabilities q_i and q_j ($q_i \leq q_j$):

$$\begin{aligned} p\left(s_i = 1 | s_j = 1\right) &= \left(1-\xi\right) q_i + \xi \frac{q_i}{q_j} \\ p\left(s_j = 1 | s_i = 1\right) &= \left(1-\xi\right) q_j + \xi \end{aligned}$$

where ξ is an exogenous parameter. Note that for given q_i and q_j, their correlation is a linear function of ξ, and it is identical to ξ for $q_i = q_j$. Since we limit our analysis to the case of symmetric equilibria (or put differently to the case of banks with symmetric monitoring costs) in what follow we will refer liberally to ξ as "correlation".[1]

Consider now how non-zero correlation $\xi > 0$ affects the result of Proposition 1.

The profit of bank i can be written as

$$E(\Pi_i) = \left(q_i\left(\left(1-\alpha\right) + \alpha\left(\tilde{q}_j + \left(1-\tilde{q}_j\right)\theta\right)\right) + \left(1-q_i\right)\theta\delta\right) A - \frac{c}{2} q_i^2 \tag{8}$$

where $\tilde{q}_j$ is the probability of bank j success conditional bank i success:

$$\tilde{q}_j = \left(1-\xi\right) q_j + \xi \min\left\{\frac{q_j}{q_i}; 1\right\}$$

and $A = \left(R - \left(1-k\right) r_D\right)$ is the interest rate margin.

From (8) we can determine the optimal response. There are two cases. When $q_i \geq q_j$, (8) takes form:

$$\begin{aligned} E^{*}(\Pi_i) &= (q_i\left(\left(1-\alpha\right) + \alpha\left(\left(\left(1-\xi\right) q_j + \xi\frac{q_j}{q_i}\right) + \left(1 - \left(\left(1-\xi\right) q_j + \xi \frac{q_j}{q_i}\right)\right)\theta\right)\right) \\ & \quad + \left(1-q_i\right)\theta\delta)A - \frac{c}{2} q_i^2 \end{aligned}$$

[1] More precisely, we have

$$corr(s_i, s_j) = \frac{\left(1-\xi\right) q_i q_j + \xi q_i - q_i q_j}{\sqrt{q_i\left(1-q_i\right)}\sqrt{q_j\left(1-q_j\right)}}.$$

Which, by using FOC, is maximized on $q_i \geq q_j$ in:

$$\begin{aligned} q_i &= q_i^*(q_j) \\ &= \frac{(1-\alpha)+\alpha\left(\left(1-\xi\right)\left(q_j+(1-q_j)\theta\right)+\xi\theta\right)-\theta\delta}{c}A \end{aligned}$$

for

$$q_j \leq q_j^* = \frac{1-\alpha+\theta\alpha-\theta\delta}{c-\alpha\left(1-\theta\right)\left(1-\xi\right)A}A$$

and in $q_i = q_j$ for $q_j \geq q_j^*$.

When $q_i \leq q_j$, (8) takes form:

$$\begin{aligned} E^{**}(\Pi_i) &= \left(q_i\left((1-\alpha)+\alpha\left(\left(\left(1-\xi\right)q_j+\xi\right)+\left(1-\left(\left(1-\xi\right)q_j+\xi\right)\right)\theta\right)\right)\right. \\ &\quad \left.+\left(1-q_i\right)\theta\delta\right)A-\frac{c}{2}q_i^2 \end{aligned}$$

Which, by using FOC, is maximized on $q_i \leq q_j$ in:

$$\begin{aligned} q_i &= q_i^{**}(q_j) \\ &= \frac{(1-\alpha)+\alpha\left(\left(1-\xi\right)\left(q_j+\left(1-q_j\right)\theta\right)+\xi\right)-\theta\delta}{c}A \end{aligned}$$

for

$$q_j \geq q_j^{**} = \frac{1-\alpha+\alpha\left(\theta+\xi\left(1-\theta\right)\right)-\theta\delta}{c-\alpha\left(1-\theta\right)\left(1-\xi\right)A}A$$

and in $q_i = q_j$ for $q_j \leq q_j^{**}$

Note that $q_j^* \leq q_j^{**}$ and $q_j^* = q_j^{**}$ for $\xi = 0$. Overall, the optimal response is:

$$\begin{aligned} q_i &= q_i^*(q_j) \text{ for } q_j \leq q_j^* \\ q_i &= q_j \text{ for } q_j^* \leq q_j \leq q_j^{**} \\ q_i &= q_i^{**}(q_j) \text{ for } q_j \geq q_j^{**} \end{aligned}$$

That gives the following result on Nash equilibria:

Lemma 2 *Bank risk choices under correlated risks have a continuum of Nash equilibria, given by* $q_i = q_j = q_{corr}$ *where* $q^* \leq q_{corr} \leq q^{**}$*. Among the equilibria,* $q_{corr} = q^{**}$ *maximizes the profit of banks and can be achieved through cheap talk.*

We can now establish how exogenous correlation of projects affects bank risk choices and the impact of bailouts.

Observe that:

$$\frac{dq^{**}}{d\xi} = \frac{(c - A(1-\theta\delta))\, A\alpha\, (1-\theta)}{(c - A\alpha + A\theta\alpha + A\alpha\xi - A\theta\alpha\xi)^2} > 0$$

Therefore. higher correlation increases effort. The intuition is that correlation reduces externalities. [*We need to specify somewhere the assumption* $c > A$ *(interior solution) which we use throughout.*] Note that for $\xi = 0$, q_{corr} collapses to $\widehat{q}$ (7).

Now consider the effects of government intervention.

Proposition 2 *For* $\delta < \frac{(1-\xi)(c-A)}{c-A(1-\xi)}$*, there exists* $\alpha^{**} = \frac{\delta c}{(c-A(1-\delta))(1-\xi)}$ *such that for* $\alpha > \alpha^{**}$ *equilibrium monitoring increases with the probability of government intervention:* $\frac{dq^{**}(\theta)}{d\theta} > 0$*; for* $\alpha < \alpha^{**}$ *the opposite occurs. Note that* a^{**} *increases in* ξ*; and that government intervention is never optimal under full correlation* $\xi = 1$*.*

Next, we turn to the analysis of banks' incentives to correlate their default risks under the threat of contagion. Farhi and Tirole (2011) show that when the government has to bailout banks in a joint (systemic) failure, banks have incentives to correlate risks, because that maximizes their bailout rents. That correlation is undesirable because it increases the probability of joint failures that the government wants to avoid in the first place. In our model, the correlation of risks arises even without bailouts, since banks use it as a means of protecting against contagion. At this stage we speculate that, in our framework, bailouts have two effects: they increase incentives to correlate because of rents, but reduce incentives to correlate because they protect from contagion. When rents are small, contrary to the Farhi and Tirole (2011) result, bailouts can reduce the correlation of bank risks.

4 Discussion and Conclusions

This paper revisits the link between bailouts and bank risk-taking. It is accepted that bailouts have a moral hazard effect that encourages risk-taking. However, we also show that, when there are risk externalities across banks, this effect coexists with an opposite one: bailouts protect prudent banks against contagion. This encourages monitoring effort, reduces bank risk-taking, and reduces the correlation of risks in the banking system. A government's commitment to save systemic banks when the threat of contagion is high can reduce risk-taking by all banks, even if a bailout leaves banks with some rents.

Our simple model lends itself to a number of extensions. One could rewrite the model in the context of banks' short-termist behavior that was prevalent in the run-up to the recent crisis. Indeed, the concept of "insufficient monitoring" can be interpreted as a variety of business practices that generate short-term return at expense of higher long-term risk: fee- and volume-based banking, lending with teaser rates, or the use of cheaper but unstable short-term funding. Our analysis shows that banks will have more incentives to engage in such patterns when they are exposed to contagion risk that affects primarily their long-term returns, especially if other banks are also engaging in such behavior.

Another avenue is to endogenize the strength of contagion (or the fragility of the banking system), α. One way to do so would be to introduce multiple banks, and link the threat of contagion to the probability of multiple banks failing together.

The results caution that the recent policy initiatives that create impediments to timely and targeted intervention may in effect destabilize financial system by creating an expectation of more macro, less targeted bailouts (bail outs that leave grater rents to failing banks). The results suggest that a more promising policy direction might be to focus on the efficiency of interventions: create environment (legal and implementation) where intervention is designed to leave bank stakeholders as little rents as possible.

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