Bank resolution, bailouts and the time consistency problem

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Abstract

This paper presents a theoretical model in which a government must decide how much to invest in the efficiency of its bank resolution regime. It is shown that, in the presence of moral hazard, the optimal policy can depend on whether or not the government can costlessly commit not to bail out failed banks. A government with access to costless commitment will see no extra benefit to investing in its bank resolution regime. A government with discretion, on the other hand, faces a time consistency problem which it can solve by making a large enough investment in its bank resolution regime. Thus, the benefits of improved bank resolution regimes and similar reforms may be greater than a consideration of their ex post benefits alone would suggest.

JEL: G21, G28, G33

1 Introduction

In the aftermath of the late-2000s financial crisis, new bank resolution regimes have been enacted or proposed in several countries. In the United Kingdom, the Banking Act 2009 established a Special Resolution Regime for failing banks. In the United States, the Dodd-Frank Act of 2010 created a new federal receivership process for failing financial companies deemed to pose a systemic risk. Also in 2010, the European Commission proposed the establishment of an EU network of bank resolution funds, and the International Monetary Fund issued proposals for cross-border bank resolution.

Such regimes allow for banks (and often other financial institutions) that are in imminent danger of failure to be dealt with outside the scope of normal corporate insolvency laws, on the grounds that this reduces the systemic risk such failures pose to the financial system. Under standard bankruptcy procedures, coordination failures among a bank's creditors might prevent them from maximising the value of its remaining assets. Furthermore, creditors might force the bank to sell off its assets at fire sale prices, without taking into account the effect of lower asset prices on other institutions' balance sheets. A normal bankruptcy procedure could also interrupt a bank's ability to provide payment services to its customers, with potentially far-reaching implications for the economy as a whole. The intended effect of bank resolution regimes, therefore, is to reduce the ex post social costs of financial institutions becoming insolvent.

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An alternative method of preventing a failing institution from posing a systemic risk is simply to prevent it from failing. Thus, the use of bank resolution regimes is a substitute for forms of direct and indirect public assistance such as capital injections, special liquidity facilities, asset purchase schemes and liability guarantees. This implies that efficient bank resolution regimes can serve to reduce governments' ex post incentives to engage in bailouts. Governments might wish to commit to a no-bailout policy in order to discourage financial institutions from taking excessive risks, but they may find themselves unable to relinquish their discretion. A government unable to tie its hands with respect to future bailouts might therefore choose to improve its bank resolution regime in order to solve its time consistency problem.

Such improvements come at a cost, however. The process of establishing or reforming a bank resolution regime usually requires the passage of legislation, which may delay other items on the government's legislative agenda or expend its political capital. Although bank resolution regimes may reduce the workload of normal bankruptcy courts, they place additional burdens on the authorities responsible for implementing them. Such regimes may call for additional monitoring of financial institutions by regulators, and for more extensive cooperation between different government agencies.

This paper will demonstrate the potential role of bank resolution regimes in reducing moral hazard in the financial sector. It will draw a link between the severity of the government's commitment problem and the importance of having an efficient bank resolution regime. It will do so by presenting a model of optimal government investment in such regimes, and comparing the results from two versions of the model: one in which the government can costlessly commit to a no-bailout policy, and one in which it has discretion. When the government has discretion, its optimal investment in the bank resolution authority is larger. This result holds both when there is a monopoly bank and when the banking sector is competitive. When we extend the model to introduce strategic interactions among banks, a government with discretion can use investment in its bank resolution authority to eliminate equilibria in which banks take socially inefficient risks.

This issue should be of direct interest due to the ongoing focus of institutions such as the European Commission and the International Monetary Fund on the topic of bank resolution. However, the normative implications of the paper also apply more broadly to any reforms that make financial sector bankruptcies less costly. If such reforms strengthen the government's commitment not to engage in bailouts, the associated reduction in moral hazard may make them more worthwhile than a consideration of their ex post benefits alone would suggest.

The rest of the paper is organised as follows: Section 2 surveys some of the related literature on moral hazard in the financial sector and the time consistency of government financial policy; Section 3 discusses the bank resolution regimes currently in place in the UK and the US; Section 4 presents a stylised model of optimal government investment in bank resolution regimes; and Section 5 concludes.

2 Literature review

Hellmann et al. (2000) consider a model with deposit insurance in which banks face a portfolio decision between a "prudent" asset and a "gambling" asset. Competition between banks erodes their franchise values, thus encouraging socially inefficient gambling. Capital requirements force banks to internalise the adverse effects of gambling, and so sufficiently strict capital requirements can induce them to invest prudently. However, forcing banks to hold more capital is costly and reduces their franchise values (which, ceteris paribus, increases their incentives to gamble). As such, gambling can be prevented more efficiently by a combination of capital requirements and deposit rate ceilings, which limit interbank competition and thereby preserve bank franchise values. Cooper and Ross (2002) study a similar environment in which Diamond and Dybvig (1983)-style runs are also possible. Since there are no special costs associated with holding bank capital in their model, they demonstrate that the first-best allocation can be achieved by a combination of full deposit insurance (to prevent runs) and capital requirements (to prevent gambling).

Optimal contracts can require ex post inefficiency in some states of the world, and therefore be time inconsistent. For example, a credible threat of bankruptcy might mitigate moral hazard problems, but if bankruptcy is costly then renegotiation will be optimal ex post. Chari and Kehoe (2009) argue that governments face stronger incentives than private agents to avoid bankruptcies ex post because they take fire sale effects into account. As a result, the time consistency problem is more severe for governments than for private agents. They study a dynamic contracting model incorporating reputation effects, and find that introducing a bailout authority without commitment reduces welfare in equilibrium. By reducing the government's incentive to intervene ex post, ex ante regulation limiting the size and leverage of firms can be welfare-improving.

Farhi and Tirole (2011) show that when bailouts are non-targeted and involve fixed costs there are strategic complementarities in banks' liquidity-hoarding and risk-taking decisions. When other banks hold fewer liquid (more toxic) assets, the expected size of the bailout increases and so any particular bank will want to become less liquid (more risky), too. In addition, because the incentives for a bailout are increasing in the number of banks that fail, banks will prefer to fail together than to fail alone and so will choose to correlate their assets. The authors find that, by imposing ex ante liquidity requirements (or, equivalently, leverage limits) on banks, a regulator can eliminate the central bank's temptation to pursue a low interest rate policy ex post. (In this model, the bailout takes the form of a subsidised interest rate.)

Unlike the papers just discussed, the model presented below will abstract away from ex ante regulation. Farhi and Tirole (2011) argue that if regulation is costly it should be confined to those institutions the authorities are most tempted to bail out ex post. They suggest that this corresponds to large retail banks and "other large financial institutions that are deeply interconnected with them through opaque transactions". However, the very opacity of these connections is likely to make identifying systemically important institutions ex ante very difficult. Chari and Kehoe (2009) focus on regulations that reduce firms' abilities to become too big or too leveraged to fail. However, financial innovation and the growth of the shadow banking system may render official capital requirements obsolete.

Regulations that aim to prevent financial institutions from becoming too systemically important to fail do nothing to reduce the government's bailout incentives in the event that they are circumvented. As such, firms will face strong temptations of their own to evade the regulatory requirements. This line of argument implies the desirability of mechanisms that reduce ex post incentives for bailouts in general. Such mechanisms would complement regulatory restrictions on firms: if the authorities are more sanguine about the prospect of failures in general, then the expectation of bailouts will be reduced and the incentive to evade regulations will be smaller.

3 Examples of bank resolution regimes

United Kingdom

In the United Kingdom, the Banking Act 2009 permanently established a Special Resolution Regime (SRR), which provides the Bank of England, the Financial Services Authority (FSA) and HM Treasury (known collectively as the tripartite authorities) with a number of tools for dealing with failing banks. The special resolution objectives, which "are to be balanced as appropriate in each case", are as follows: to protect and enhance the stability of the financial systems of the United Kingdom; to protect and enhance public confidence in the stability of the banking systems of the United Kingdom; to protect depositors; to protect public funds; and to avoid interfering with property rights in contravention of a Convention right (within the meaning of the Human Rights Act 1998).[1]

The SRR provides three stabilisation options: sale of all or part of a banking institution's business to a private sector purchaser, transfer of the same to a bridge bank, and transfer of the institution into temporary public ownership. If none of these options are chosen, the bank insolvency procedure is used instead. In the case of partial sale or transfer, the bank administration procedure is invoked to ensure continuity of essential services from the residual bank. The FSA is responsible for determining whether a bank meets the criteria for being put into the SRR, whereas the Bank of England is responsible for deciding which of the tools to use. The implementation of the SRR is the responsibility of the Treasury in the case of temporary public ownership, and of the Bank of England in all other cases.

Since the Act's passage in February 2009, two institutions have been resolved under the SRR. In March 2009, the core parts of Dunfermline building society were transferred to Nationwide building society. Dunfermline's social housing loans and related deposits were held temporarily in a bridge bank, and then sold to Nationwide in July of that year. In June 2011, Southsea Mortgage and Investment Company Limited was placed into the bank insolvency procedure. The Financial Services Compensation Scheme covered deposits up to the insured limit of £85,000 per depositor, and all other creditors' claims were to be handled by the bank liquidator. The Banking (Special Provisions) Act 2008, the emergency precursor to the Banking Act 2009, was used to authorise: the nationalisation

[1] Banking Act 2009, Part 1, Section 4.

of Northern Rock in February 2008, the nationalisation of Bradford & Bingley's mortgage assets and the sale of its savings deposits and branch network to Abbey in September 2008, and the transfer to ING Direct of Heritable Bank and Kaupthing Edge in October of the same year.

United States

Title II of the Dodd-Frank Act of 2010 is entitled Orderly Liquidation Authority, and its stated purpose is "to provide the necessary authority to liquidate failing financial companies that pose a significant risk to the financial stability of the United States in a manner that mitigates such risk and minimizes moral hazard."[2] A failing financial company can be put into receivership under the provisions of the Act if the relevant regulatory authorities and the Secretary of the Treasury deem that it would pose a systemic risk to the financial system.

Once the authorities determine that a company poses a systemic risk, the Federal Deposit Insurance Corporation is appointed as receiver (except in the case of insurance companies, which are dealt with under state law). The directors and officers of the company have a right to contest the decision, but unless the US District Court for the District of Columbia determines within 24 hours that the Secretary's determination was "arbitrary and capricious", the appointment of the FDIC as receiver will go through.

Once it assumes control over a company, the FDIC may act without consulting or giving notice to the company's creditors, counterparties or shareholders. The powers granted to the FDIC as receiver are very similar to those granted to the tripartite authorities under the UK SRR. It may sell off the company's assets, or arrange for the company as a whole to be acquired by private buyers. It can also create a bridge company to hold some of the company's assets and liabilities while a buyer is being found. The FDIC has the power to review claims on the company, and may deviate from the principle of equal treatment for similarly-situated claimants in order to maximise the value of the company's assets.[3]

4 A model of optimal government investment in bank resolution regimes

4.1 Monopoly banking

4.1.1 Private equilibrium

At the start of each period, a unit measure of risk-neutral investors are each endowed with a single unit of resources to invest. They have access to an investment opportunity which yields a gross return of $b \geq 1$ with certainty, but they may also deposit their funds with a monopoly bank, which promises a gross interest rate r and whose shareholders are also risk-neutral. At the end of each

[2] Dodd-Frank Wall Street Reform and Consumer Protection Act, Public Law 111-203, 124 Stat. 1454 (2010), Section 204(a).

[3] See *ibid.*, Sections 210(b)(4)(A) and 210(h)(5)(E).

period, returns are realised, payments are made, and all resources are consumed by investors and bank shareholders—there is no inter-period storage technology.

Following Hellmann et al. (2000), each period the bank faces a portfolio decision between a risky ("gambling") asset and a safe ("prudent") asset. The risky asset pays a gross return of γ with probability θ and a gross return of β with probability $1-\theta$. The safe asset yields a gross return of $\alpha > b$ with certainty. The risky asset has a higher return than the safe asset in the good state of the world, but a lower expected return. That is, $\theta\gamma + (1-\theta)\beta < \alpha < \gamma$.

The bank can remain in business indefinitely provided it always repays its investors in full. However, if the bank is ever unable to meet its obligations, its assets are liquidated and its monopoly franchise is transferred to new owners. Consider a bank that chooses to gamble, and let s be the probability that the bank is solvent and can pay its investors the promised amount at the end of the period, with

$$s = \begin{cases} 1 & \text{if } r \leq \beta \\ \theta & \text{if } \beta < r \leq \gamma \\ 0 & \text{if } r > \gamma \end{cases} .$$[4]

Let λ be the fraction of the value of a failing bank's assets that is recovered in the event of liquidation. We stipulate that bank liquidation is always handled by a bank resolution authority, and that the efficiency of this authority determines the recovery fraction λ. The UK special resolution objective of protecting taxpayers, and the FDIC's discretion under the Dodd-Frank Act to prioritise asset value over equal treatment, demonstrate that recovering a high fraction of the value of a failing bank's assets is indeed a key purpose of bank resolution authorities. Other important objectives, such as mitigating fire sale effects and ensuring continuity of payment services, will not be modelled explicitly at this stage. The costs associated with the disruption of payment services could be modelled by introducing idiosyncratic liquidity shocks for investors, and supposing that some investors' demand for liquidity will go unsatisfied unless the bank resolution authority steps in. Section 4.5 will sketch a reduced form method of incorporating fire sale concerns.

The efficiency of the bank resolution authority is determined at the beginning of each period, before investors decide where to place their funds. We denote the minimum and maximum attainable values of λ as $\underline{\lambda}$ and $\bar{\lambda}$ respectively, with $0 \leq \underline{\lambda} < \bar{\lambda} \leq 1$. In the baseline model without a government we shall assume that $\lambda = \underline{\lambda}$, but later we will make λ depend on an up-front investment made by the government.

If investors anticipate that the bank will invest prudently, their participation constraint is

$$r \geq b, \tag{1}$$

[4]To guarantee that the bank is insolvent if it gambles and loses, we must have $\beta < r$, which implies $\beta\,(\theta + (1-\theta)\lambda) < b$ given participation constraint (2) below. A sufficient condition is therefore $\beta < b$.

whereas if they anticipate that the bank will gamble, their participation constraint is

$$\theta r + (1-\theta)\lambda\beta \geq b, \text{ or}$$
$$r \geq \frac{b-(1-\theta)\lambda\beta}{\theta}. \tag{2}$$

Since the bank is a monopolist, these constraints will be satisfied with equality.

The franchise value of a bank that invests prudently is

$$\sum_{t=0}^{\infty}\delta^t(\alpha - r) = \frac{\alpha - r}{1-\delta},$$

where δ is the per-period discount factor. As such, the no-gambling condition is

$$\theta\left(\gamma - r + \delta\frac{\alpha - r}{1-\delta}\right) \leq \frac{\alpha - r}{1-\delta}, \text{ or}$$
$$r \leq \frac{(1-\delta\theta)\alpha - (1-\delta)\theta\gamma}{1-\theta}, \tag{3}$$

which says that the bank will not gamble as long as its expected payoff from gambling in a single period and returning to prudence thereafter is less than or equal to the expected payoff of investing prudently forever.[5]

Since the safe asset's expected return exceeds that of the risky asset, and since b is the lowest possible interest rate that will induce participation, the bank's expected profits from credibly promising to invest prudently will be higher than those from promising to gamble. As such, if the no-gambling condition is satisfied for $r = b$, the bank will offer this, investors will accept, and the bank will invest prudently. In this case, the private equilibrium is Pareto efficient.

However, if condition (3) is not satisfied for $r = b$, investors will anticipate the bank's ex post temptation to gamble and will therefore refuse to invest unless participation constraint (2) is satisfied. In this case, as long as $\theta\gamma + (1-\theta)\lambda\beta \geq b$, the bank will offer $r = (b - (1-\theta)\lambda\beta)/\theta$, investors will accept, and the bank will gamble. If instead $\theta\gamma + (1-\theta)\lambda\beta < b$, then investors will reject whatever interest rate the bank offers in favour of their outside investment opportunity. In both these cases there is an inefficiency arising from the bank's inability to commit to prudence, and since the bank is a monopolist this inefficiency manifests itself as forgone profits. Since our main aim here is to study the government's (as opposed to the bank's) time consistency problem, these cases will not be the focus of our analysis.

4.1.2 Government equilibrium with commitment

We now introduce a government into the above model. At the beginning of each period, before investors choose whether to deposit their funds in the bank, the government commits to a policy for dealing with banks that are unable to repay their investors. It can either commit to a no-bailout policy,

[5] Comparing the payoffs from gambling forever and investing prudently forever yields exactly the same condition on r.

in which case failed banks are liquidated by a bank resolution authority and the proceeds distributed proportionally to investors; or it can commit to a bailout policy, in which case the government makes up the difference between the amount owed to investors and the value of the bank's assets, and the bank is allowed to continue trading.

In addition to choosing a policy for failed banks, the government decides at the beginning of each period how much to invest in the bank resolution authority. This investment determines the fraction λ of the value of a bank's assets that is recovered in the event of liquidation, and depreciates fully at the end of each period. Thus, in each period we have

$$\lambda = f(g), \tag{4}$$

where g is the amount the government invests. Sometimes it will be more convenient to think of the government as choosing λ directly, and making whatever investment is necessary to achieve its chosen value. Hence, we will also be interested in the inverse of the function above,

$$g = c(\lambda), \tag{5}$$

which gives the amount the government must invest to attain any given value of λ.

Institutional investments and bailouts are paid for out of a fund R that is raised through the sale of government-owned resources, or equivalently through lump-sum taxation of another population under the government's jurisdiction. The government is risk-neutral, and is concerned with the total value V of resources under its jurisdiction. In addition, the government's objective function is reduced by an amount η if it engages in a bailout. This represents the amount of resources that the government would be willing to give up to avoid the negative consequences of a bailout. Plausible reasons why governments might find bailouts undesirable include: the need in practice to use distortionary taxation to pay for them; the fact that they could involve redistribution from poor to rich, as in Cooper and Kempf (2011); and the prospect of angry taxpayers punishing governments for bailouts at the ballot box. However, incorporating these ideas explicitly would require adding a production sector, heterogeneous agents, and a political economy dimension respectively. Using the reduced form parameter η as a stand-in for these motivations allows us to focus on the moral hazard and time consistency aspects of our model.

If the government commits to a no-bailout policy, the bank's no-gambling condition will be identical to condition (3) above. However, if instead the government commits to a bailout policy, the bank's no-gambling condition becomes

$$\theta(\gamma - r) + \delta \frac{\alpha - r}{1-\delta} \leq \frac{\alpha - r}{1-\delta}, \text{ or}$$
$$r \leq \frac{\alpha - \theta\gamma}{1-\theta}. \tag{6}$$

Comparing conditions (3) and (6), we can see that the no-gambling condition is tighter when a bailout is anticipated. Hence, if condition (6) is satisfied for $r = b$, the bank will not gamble regardless of whether it anticipates a bailout. This ensures that the bank will never fail, so the government's bank failure policy becomes irrelevant and its optimal investment in the bank resolution authority is zero.

From our perspective, the most interesting case is where

$$\frac{\alpha - \theta\gamma}{1 - \theta} < b \leq \frac{(1 - \delta\theta)\alpha - (1 - \delta)\theta\gamma}{1 - \theta},$$

which implies that the bank will gamble if and only if it anticipates a bailout. If the government commits to a no-bailout policy, therefore, the expected value of its objective function is

$$R - c(\lambda) + \alpha,$$

whereas if it commits to a bailout policy, the expected value of its objective function is

$$R - c(\lambda) + \theta\gamma + (1 - \theta)(\beta - \eta).$$

Since $\alpha > \theta\gamma + (1 - \theta)\beta$ by assumption, the government will optimally commit to a no-bailout policy, and since this ensures that the bank will never fail, its optimal investment in the bank resolution authority is zero.

We have shown that, as long as $b \leq \frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta}$, adding a government with commitment does not affect the results of the baseline model. In equilibrium there will be no bailouts, no gambling, no bank failures and, as a result, no investment in the efficiency of the bank resolution authority. We will contrast this result with the case where the government has discretion below, but first let us complete our discussion of the commitment case by briefly considering what happens when $b > \frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta}$.

If

$$\frac{(1 - \delta\theta)\alpha - (1 - \delta)\theta\gamma}{1 - \theta} < b \leq \theta\gamma + (1 - \theta)\underline{\lambda}\beta,$$

then investors will accept $r = (b - (1 - \theta)\underline{\lambda}\beta)/\theta$ and the bank will gamble even if they do not expect a bailout. If the government adopts a no-bailout policy, its optimal choice of λ (assuming an interior solution) will satisfy

$$c'(\lambda^*) = (1 - \theta)\beta, \text{ so}$$
$$\lambda^* = c'^{-1}\left((1 - \theta)\beta\right).$$

If, on the other hand, it adopts a bailout policy, then its optimal choice of λ is $\underline{\lambda}$ since the bank resolution authority will never be called upon to liquidate a bank. The government will therefore commit to a no-bailout policy if

$$R - c(\lambda^*) + \theta\gamma + (1 - \theta)\lambda^*\beta \geq R + \theta\gamma + (1 - \theta)(\beta - \eta), \text{ or}$$
$$(1 - \theta)\left(\eta - (1 - \lambda^*)\beta\right) \geq c(\lambda^*), \tag{7}$$

and to a bailout policy otherwise.

If $\theta\gamma + (1-\theta)\underline{\lambda}\beta < b < \theta\gamma + (1-\theta)(\beta-\eta)$, then the government will commit to a bailout policy (and choose $\lambda = \underline{\lambda}$) in order to induce investors to deposit their funds with the bank. If $b \geq \theta\gamma + (1-\theta)(\beta-\eta)$, then the government will commit to a no-bailout policy (and choose $\lambda = \underline{\lambda}$) and investors will choose their outside option.

4.1.3 Government equilibrium with discretion

Now suppose that the government is unable to commit in advance to a policy for failed banks, and must decide on a case-by-case basis whether or not to bail a failed bank out. The government's ex post no-bailout condition is

$$(1-\lambda)\beta \leq \eta, \text{ or}$$
$$\lambda \geq 1 - \frac{\eta}{\beta}, \tag{8}$$

that is, it will not bail out a bank as long as the resources that would be saved by avoiding liquidation are less than or equal to the costs of the bailout itself. To allow for the possibility, but not the inevitability, of bailouts, we must have $\underline{\lambda} < 1 - \frac{\eta}{\beta} \leq \bar{\lambda}$, which implies $\eta < \beta$.

We can now see that whether or not the government's ex post no-bailout condition is satisfied may depend on its initial investment in the bank resolution authority. Looking at condition (8), we see that it is more likely to be satisfied when the recovery fraction λ is higher. From equation (4), we see that λ depends on the government's initial investment. As such, the government can effectively commit itself to a no-bailout policy by making a sufficiently large investment in the bank resolution authority. This is the crucial mechanism through which the bank resolution authority can reduce moral hazard. By observing the government's up-front investment in the authority, the bank and investors will be able to infer whether the bank will be bailed out in the event of failure.

We now consider the optimal government policy, and the equilibrium outcomes this generates, for different partitions of the parameter space. If $b \leq \frac{\alpha-\theta\gamma}{1-\theta}$, then the bank will invest prudently even if it anticipates a bailout. As such, the government will optimally choose to make no investment in the bank resolution authority, and so the equilibrium outcome will be the same as in the private and commitment cases above.

The most interesting case is again where $\frac{\alpha-\theta\gamma}{1-\theta} < b \leq \frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta}$, and so the bank will gamble if and only if it anticipates a bailout. The minimum value of the recovery fraction that satisfies the government's ex post no-bailout condition is $\lambda = 1 - \frac{\eta}{\beta}$, which requires an up-front investment of $g = c\left(1-\frac{\eta}{\beta}\right)$. We can think of this as the cost the government must pay to establish its commitment to a no-bailout policy. Since paying this cost will ensure the bank invests prudently, and by assumption the prudent asset never fails, there is no benefit to investing more than this amount in the bank resolution authority. Making any lesser investment will guarantee bailouts ex post, and thus ensure that the authority is never used. As such, if the government decides not to invest enough to establish its commitment, then there is no reason for it to invest more than zero.

If the government decides to pay the commitment cost, the expected value of its objective function will be

$$R - c\left(1 - \frac{\eta}{\beta}\right) + \alpha.$$

If instead it decides to invest zero, the expected value will be

$$R + \theta\gamma + (1-\theta)(\beta - \eta).$$

Comparing these two values tells us that if

$$\alpha \geq c\left(1 - \frac{\eta}{\beta}\right) + \theta\gamma + (1-\theta)(\beta - \eta), \tag{9}$$

then a government with discretion will choose $\lambda = 1 - \frac{\eta}{\beta}$ and so invest $g = c\left(1 - \frac{\eta}{\beta}\right)$ in its bank resolution authority. This is in contrast to the case of costless commitment above, where the government's optimal investment is zero.

Since the prudent asset never fails, the only role of the strengthened bank resolution authority is to convince the bank that it would be liquidated if it gambled and failed. As with deposit insurance in the Diamond and Dybvig (1983) model, the bank resolution authority is beneficial despite not being used in equilibrium. If we were to relax our assumption that the prudent asset never fails, then a government with costless commitment might also wish to invest a positive amount in its bank resolution authority. Nevertheless, there would still exist values of the parameters for which it would optimally invest less than a government with discretion.

If condition (9) is not satisfied, the cost of commitment is too high and so the government chooses $\lambda = \underline{\lambda}$, the bank gambles and the government bails it out if the gamble fails.

To complete our discussion of the government equilibrium with discretion, let us briefly consider the cases where $b > \frac{(1-\delta\theta)\alpha - (1-\delta)\theta\gamma}{1-\theta}$. If $\frac{(1-\delta\theta)\alpha - (1-\delta)\theta\gamma}{1-\theta} < b \leq \theta\gamma + (1-\theta)\underline{\lambda}\beta$, then neither the bank's nor the investors' optimal behaviour depends on whether they anticipate a bailout. As such, the equilibrium outcome will be the same as in the case of commitment above. The government will either choose $\lambda = c'^{-1}\left((1-\theta)\beta\right)$ and refrain from ex post bailouts if condition (7) is satisfied;[6] or, if the condition is not satisfied, choose $\lambda = \underline{\lambda}$ and bail the bank out if it fails.

As in the case of commitment, the government will engage in bailouts (and choose $\lambda = \underline{\lambda}$) if $\theta\gamma + (1-\theta)\underline{\lambda}\beta < b < \theta\gamma + (1-\theta)(\beta - \eta)$. However, due to the extra cost of ensuring that its ex post no-bailout condition is satisfied, a government with discretion will also engage in bailouts (and choose $\lambda = \underline{\lambda}$) if $\theta\gamma + (1-\theta)\underline{\lambda}\beta < b < \theta\gamma + (1-\theta)(\beta - \eta) + c\left(1 - \frac{\eta}{\beta}\right)$. If $b \geq \theta\gamma + (1-\theta)(\beta - \eta) + c\left(1 - \frac{\eta}{\beta}\right)$,

[6] Here we are implicitly assuming that $c'^{-1}\left((1-\theta)\beta\right) > 1 - \frac{\eta}{\beta}$. (Otherwise, the government's ex post no-bailout condition would not be satisfied.) If this inequality were reversed, then condition (7) would be replaced by the condition

$$2(1-\theta)(\beta - \eta) \geq c\left(1 - \frac{\eta}{\beta}\right) \tag{10}$$

for a government with discretion.

then a government with discretion will choose $\lambda = 1 - \frac{\eta}{\beta}$ and thus persuade investors to choose their outside option.

4.2 Competitive banking

We now introduce competition into the banking sector of our model, and show that our key result is robust to this change. As in the monopoly case, there is a region of the parameter space for which the government's optimal investment in the bank resolution regime is greater when it has discretion than when it has costless commitment.

4.2.1 Private equilibrium

Since banks are competitive, they will effectively attempt to maximise investors' utility subject to a non-negative profit constraint. Without the prospect of a bailout, banks' no-gambling conditions are identical to condition (3) above. This means that the maximum interest rate banks can promise if they are to invest prudently is $r_P \equiv \frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta}$. If they are instead to gamble, the highest interest rate banks can pay out without making negative profits is $r_G \equiv \gamma$. Competition between banks will ensure that they offer whichever of these interest rates maximises investors' expected utility. As such, banks will offer r_P if

$$\frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta} \geq \theta\gamma + (1-\theta)\underline{\lambda}\beta, \text{ or}$$
$$\alpha \geq \frac{(2-\delta-\theta)\theta\gamma + (1-\theta)^2\underline{\lambda}\beta}{1-\delta\theta}, \tag{11}$$

and r_G otherwise.

As long as

$$b \leq \max\left\{\frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta}, \theta\gamma + (1-\theta)\underline{\lambda}\beta\right\}, \tag{12}$$

then investors will deposit their funds in the banks. (We assume for simplicity that the total volume of resources to be invested is split equally among all banks.) If this condition is not satisfied, then investors will reject the banks' offers and invest in their outside option instead.

4.2.2 Government equilibrium with commitment

We now introduce a government with the ability to commit to a bank failure policy and to invest in a bank resolution authority, as in the monopoly banking case above. If banks anticipate that they will be bailed out if they gamble and fail, then their no-gambling conditions will be identical to condition (6) above. Since bailouts take the form of full ex post deposit insurance, if investors anticipate bailouts they will simply choose the bank offering the highest interest rate.

If all banks are offering $r < \gamma$, it will be a profitable deviation for a given bank to increase its interest rate. However, once all banks are offering $r = \gamma$, this is no longer the case. Thus, even though investors would benefit from higher interest rates (since they would receive guaranteed transfers from the government), we stipulate that banks will offer at most $r = \gamma$. Plugging this interest rate into condition (6) shows that under competitive banking, gambling is inevitable whenever a bailout is anticipated.

If condition (11) is satisfied, then a government with commitment will commit to a no-bailout policy and choose $\lambda = \underline{\lambda}$ (that is, invest nothing in the bank resolution authority). This will be the most interesting case for our purposes.

If condition (11) is not satisfied, then the government knows that there will be gambling even if it commits to a no-bailout policy. It will nevertheless commit to a no-bailout policy (and choose $\lambda = \tilde{\lambda} \equiv c'^{-1}\left((1-\theta)\beta\right)$ if

$$(1-\theta)\left(\eta - (1-\tilde{\lambda})\beta\right) \geq c\left(\tilde{\lambda}\right). \tag{13}$$

If this condition is not satisfied, the government will commit to a bailout policy and choose $\lambda = \underline{\lambda}$.

If investors' no-bailout participation constraint (12) is not satisfied, and $b < \theta\gamma + (1-\theta)(\beta - \eta)$, then the government will commit to a bailout policy in order to induce investors to deposit their funds in the banks, and choose $\lambda = \underline{\lambda}$. If condition (12) is not satisfied, but $b \geq \theta\gamma + (1-\theta)(\beta-\eta)$, then the government will commit to a no-bailout policy and choose $\lambda = \underline{\lambda}$.

4.2.3 Government equilibrium with discretion

Just as in the version of the model with a monopoly bank, a government with discretion must raise the recovery fraction to $\lambda = 1 - \frac{\eta}{\beta}$ in order to convince banks and investors that there will be no ex post bailouts. If both equations (9) and (11) hold, then it will be worth the government's while to invest in the bank resolution authority in order to establish a credible commitment not to bail out failed banks. This is in contrast to a government with costless commitment, which would optimally make no such investment. Therefore we have shown that our key result from the monopoly model—namely that an efficient bank resolution authority is more valuable when the government faces a commitment problem—continues to hold when we introduce competition.

We round off our section on competitive banking with a brief discussion of the other cases. If equation (11) holds but equation (9) does not, then the commitment cost is so high that the government will be better off investing nothing in the bank resolution authority, and bailing out failed banks ex post.

If equation (11) is not satisfied, then the government knows that it cannot prevent gambling as long as equation (12) holds. Nevertheless, as long as equation (9) holds, it will be worthwhile for the government to invest in the bank resolution authority, choosing $\lambda = c'^{-1}\left((1-\theta)\beta\right)$.[7] If equation (9) does not hold, then a government with discretion will choose $\lambda = \underline{\lambda}$ and bail out failed banks ex post.

If investors' no-bailout participation constraint (12) is not satisfied, then as long as $b < \theta\gamma + (1-\theta)(\beta-\eta) + c\left(1 - \frac{\eta}{\beta}\right)$, a government with discretion will optimally choose $\lambda = \underline{\lambda}$ and bail out failed banks ex post. If $b \geq \theta\gamma + (1-\theta)(\beta-\eta) + c\left(1-\frac{\eta}{\beta}\right)$, then the government will prefer to set $\lambda = 1 - \frac{\eta}{\beta}$ and thus deter investors from depositing their funds in the banks.

[7] Again, we are implicitly assuming that $c'^{-1}\left((1-\theta)\beta\right) > 1 - \frac{\eta}{\beta}$.

4.3 Strategic interactions among banks

Implicit in the discussion of competitive banking above is the assumption that the cost η of bailouts is a per-bank cost. Since the resources at stake are also expressed in terms of a single bank, and the recovery fraction λ is invariant to the measure of banks being liquidated, this leaves no room for strategic interactions among banks.

Consider now a government with discretion, and suppose instead that the cost η is paid whenever the government engages in bailouts, regardless of how many banks are bailed out or what fraction of total industry liabilities those banks represent.[8] Let ϕ represent the fraction of banks that choose to gamble, and let μ be the fraction of such banks whose projects succeed i.e. yield the high payoff γ. Let the remaining fraction of gambling banks $1-\mu$ be those whose projects fail (yielding β) and who therefore end up "distressed" i.e. unable to cover their liabilities without a bailout.

Due to our assumption that investors' funds are split evenly between banks offering the same interest rate, all distressed banks will be of the same size. As such, there is no distinction between the government's decision about what fraction of distressed banks to rescue and what fraction of distressed banks' total liabilities to cover (we rule out partial bailouts of individual banks). The ex post value of the government's objective function when it bails out a fraction ν of distressed banks will then be as follows:

$$R + (1-\phi)\alpha + \phi\left[\mu\gamma + (1-\mu)\left(\nu\beta + (1-\nu)\lambda\beta\right)\right] - \mathbf{1}_{\nu>0}\eta, \tag{14}$$

where $\mathbf{1}_{\nu>0}$ is an indicator variable that takes the value one if the government engages in bailouts and zero otherwise. Inspecting this expression, we can see that the relevant choice for the government is between bailing out all distressed banks and abstaining from bailouts completely. Since the cost η does not increase as further banks are bailed out, the government has no reason to limit the scope of bailouts once it has paid the cost (since bailouts avoid the loss of resources associated with liquidation). As such, the government's ex post no-bailout condition is as follows:

$$\begin{gathered}\phi(1-\mu)\beta - \eta \leq \phi(1-\mu)\lambda\beta, \text{ or}\\ \lambda \geq 1 - \frac{\eta}{\phi(1-\mu)\beta}.\end{gathered} \tag{15}$$

We now consider how knowledge of this ex post condition will affect competitive banks' ex ante behaviour. Due to the symmetry of distressed banks, we assume that each one has an equal probability of being bailed out. This probability will be equal to ν, the fraction of distressed banks that the government decides to bail out. Banks' no-gambling condition will be:

[8]This undermines the interpretation of η as the cost of distortionary taxation or undesirable redistribution, and instead encourages its interpretation as something akin to the fixed costs of abandoning a currency peg in models of speculative attack.

$$\theta\left(\gamma - r + \delta\frac{\alpha - r}{1-\delta}\right) + (1-\theta)\nu\delta\frac{\alpha - r}{1-\delta} \leq \frac{\alpha - r}{1-\delta}, \text{ or}$$

$$r \leq \frac{\left[1-\delta\left(\theta+(1-\theta)\nu\right)\right]\alpha - (1-\delta)\theta\gamma}{(1-\theta)(1-\delta\nu)}. \tag{16}$$

From our discussion of the government's decision above, we know that in equilibrium the fraction ν of distressed banks bailed out will be either zero (if condition (15) is satisfied) or one (if it is not). Substituting these values in turn into condition (16) yields conditions (3) and (6) respectively. However, whether or not condition (15) is satisfied may depend on banks' portfolio decisions. For a given value of the recovery fraction λ, the more banks that choose to gamble ex ante, the less likely is the government's no-bailout condition to hold ex post. As such, whether or not a given bank anticipates a bailout may depend on how many other banks it expects to gamble. This introduces the prospect of strategic interactions among banks and of multiple equilibria.

As above, the most interesting case from our point of view will be the one in which equation (11) is satisfied, and so banks will not gamble if they anticipate a zero probability of being bailed out. Rearranging equation (15), we can see that banks will expect to be bailed out with probability zero if

$$E(\phi) \leq \frac{\eta}{\left(1 - E(\mu|y_i = \beta)\right)(1-\lambda)\beta} \equiv \phi^*, \tag{17}$$

and with probability one if this condition does not hold. The expression $E(\mu|y_i = \beta)$ denotes a bank's expectation of the proportion of gambling banks that will end up distressed, conditional on itself being distressed. In the case where gambling banks' asset returns are independent, μ will be equal to θ regardless of an individual bank's return y_i. In the opposite case in which gambling banks' asset returns are perfectly correlated, we will have $E(\mu|y_i = \beta) = 0$, that is, if one gambling bank is distressed then so are all the others.

We introduce the binary variable ϕ_i to denote a given bank's portfolio decision, with one representing gambling and zero representing prudent investment. Then from equation (17), we can see that the bank's reaction function will be

$$\phi_i = \begin{cases} 1 & \text{if } E(\phi) > \phi^* \\ 0 & \text{otherwise} \end{cases}. \tag{18}$$

In equilibrium, banks' expectations about ϕ will be correct, and so we will have $\phi = E(\phi)$. Since banks are symmetric, in equilibrium we will also have $\phi = \phi_i$. This leads us immediately to the conclusion that there are only two possible equilibrium values of ϕ: zero and one. Given our assumption that equation (11) is satisfied, $\phi = 0$ will always be an equilibrium, regardless of government policy. However, from equation (17) we can see that whether or not the gambling equilibrium with $\phi = 1$ also exists depends on the value of λ, and thus on the government's up-front investment in the bank resolution authority.

In order to eliminate the gambling equilibrium, the government would have to make an investment in the bank resolution authority sufficient to raise the recovery fraction to $\lambda \geq 1 - \frac{\eta}{(1-\mu)\beta}$ for all possible values of μ. In the independent returns case, we always have $\mu = \theta$, whereas in the perfectly correlated returns case, the highest possible value of μ is one. This implies that it is more costly for the government to commit to a no-bailout policy (and hence induce banks to invest prudently) when banks' asset returns are more highly correlated. This leads naturally to the question of how banks choose to correlate their assets, which we consider in the following section.

4.4 Endogenous correlation of banks' asset returns

Following Farhi and Tirole (2011), suppose that there is a continuum of states of the world indexed by $\xi \in [0,1]$. Let the distribution of ξ be uniform, meaning that each state is equally likely. If bank i chooses to gamble, it may freely choose the probability $\theta_{\xi i}$ of its asset succeeding in a given state ξ, subject to the constraint that:

$$\int_0^1 \theta_{\xi i} \, \mathrm{d}\xi i \leq \theta$$

In a stationary equilibrium, a gambling bank's franchise value will be:

$$\frac{\theta(\gamma - r)}{1 - \delta \underbrace{\int_0^1 \theta_{\xi i} + (1-\theta_{\xi i})\nu_\xi \, \mathrm{d}\xi i}_{x}},$$

where ν_ξ is the proportion of banks the government chooses to bail out in state ξ. It is clear that for a given interest rate r the bank will choose to maximise the expression labelled x. As such, the bank's problem reduces to the following:

$$\max_{\xi i} \int_0^1 (1-\theta_{\xi i})\nu_\xi \, \mathrm{d}\xi i \quad \text{subject to} \quad \int_0^1 \theta_{\xi i} \, \mathrm{d}\xi i = \theta$$

One way the bank can solve this problem is by setting $\theta_{\xi_i} = 1$ for the state with the lowest value of ν_ξ, and repeating this process until the constraint is satisfied. Due to the existence of a continuum of banks, the proportion μ_ξ of gambling banks whose projects succeed in a given state will be non-stochastic and equal to $\int_0^1 \theta_{\xi i} \, \mathrm{d}i$, even if banks choose values of θ_{ξ_i} in the interval $(0,1)$. Combining this observation with equation (15), we can infer that:

$$\nu_\xi = \begin{cases} 1 & \text{if } \int_0^1 \theta_{\xi i} \, \mathrm{d}i < 1 - \frac{\eta}{\phi(1-\lambda)\beta} \\ 0 & \text{otherwise} \end{cases}.$$

This tells us that, as with the decision to gamble, there may be policy-induced strategic complementarities in banks' risk decisions. For a given value of the recovery fraction λ, the probability of a bank receiving a bailout in state ξ is increasing in the measure of other banks that become distressed in that state. This depends not only on the proportion ϕ of banks that choose to gamble, but also on

$\int_0^1 1 - \theta_{\xi i}\,\mathrm{d}i$, the proportion of gambling banks whose assets fail in that state.

Given our assumption that equation (11) holds i.e. that banks will not gamble if they expect a zero probability of being bailed out, we can say something about the possible equilibria of the model when we endogenise the correlation of banks' assets.

Rearranging equation (16), we see that banks will only gamble if:

$$\mathrm{E}(\nu_\xi | y_i = \beta) = \frac{\int_0^1 (1-\theta_{\xi i})\nu_\xi\,\mathrm{d}\xi}{1-\theta} > \frac{(1-\delta\theta)\alpha - (1-\delta)\theta\gamma - (1-\theta)r}{\delta(1-\theta)(\alpha - r)}, \text{ or}$$

$$\int_0^1 (1-\theta_{\xi i})\nu_\xi\,\mathrm{d}\xi > \frac{(1-\delta\theta)\alpha - (1-\delta)\theta\gamma - (1-\theta)r}{\delta(\alpha - r)}. \qquad (19)$$

Thus, any equilibrium in which banks choose to gamble will be one in which banks expect to coordinate their choices of $\theta_{\xi i}$ such that equation (19) holds.

When the correlation of banks' asset returns is endogenous, a cautionary note regarding policy is in order. Suppose that $\underline{\lambda}$ is low enough that, with $\lambda = \underline{\lambda}$, the government would find it optimal to bail out all distressed banks even if banks' asset returns were completely independent (i.e. set $\nu_\xi = 1\ \forall\xi$ even if $\theta_\xi = \theta\ \forall\xi$). If the government were to raise λ such that its ex post no-bailout condition would always be satisfied in the uncorrelated returns ($\theta_\xi = \theta\ \forall\xi$) case, but not necessarily when banks' asset returns were correlated, then this would create an incentive for banks to correlate their asset returns where none existed before. A situation of this sort would not be an equilibrium of the model—if the government anticipated that its investment in the bank resolution authority would fail to rule out a gambling equilibrium, it would either raise its investment such that its ex post no-bailout condition would hold even in the case of perfect correlation, or make no investment at all. Nevertheless, this example highlights the potential pitfalls of the government raising λ without knowing all the parameters of the model. If the government tries but fails to establish its commitment to avoid bailouts even in the worst-case scenario, then the effect of its attempt may simply be to induce the private sector to coordinate on less frequent but more severe banking crises.[9]

4.5 Fire sale effects

Fire sale effects are another potential source of policy-induced strategic interactions among banks. If the recovery fraction λ is a function not only of the government's investment g in the bank resolution authority, but also the proportion $\chi \equiv \phi(1-\mu)(1-\nu)$ of banks that are liquidated in a given period, then the government's optimal bailout policy ex post may depend on the number of distressed banks, as in the version of the model with a fixed bailout cost η in Sections 4.3 and 4.4 above.

Let η be a per-bank cost as in Sections 4.1 and 4.2, and specify

$$\lambda = f\left(g, \phi(1-\mu)(1-\nu)\right),$$

[9] A more complete discussion of this issue would specify an equilibrium selection mechanism by which banks would coordinate their portfolio and risk correlation decisions.

with $\lambda_\chi < 0$. Then the ex post optimal bailout fraction ν^* (assuming an interior solution) will depend on the proportion ϕ of banks that choose to gamble and the fraction μ of those whose assets yield the high payoff and hence are not distressed as follows:

$$\nu^*_\phi(g, \phi, \mu) = \frac{1 - \nu^*(g, \phi, \mu)}{\phi} > 0,$$

and

$$\nu^*_\mu(g, \phi, \mu) = -\frac{1 - \nu^*(g, \phi, \mu)}{1 - \mu} < 0.$$

This tells us that, as above, there will be strategic complementarities in banks' decisions about whether or not to gamble, and in which states of the world they choose to succeed and fail in.

5 Conclusion

The model presented in this paper demonstrates that an efficient bank resolution regime can indeed reduce moral hazard in the financial sector. Under certain parameter values (see regime B in Table 1 and regime A in Table 2), the government's optimal investment in such a regime is higher than it would be if it could costlessly commit to a no-bailout policy. Since the purpose of this investment is to make the government's no-bailout commitment credible, and thus deter banks from gambling, the resolution regime will never be used in equilibrium (under the maintained assumption that prudent banks never fail). Similarly, when investment in banks is socially inefficient (see regime H in Table 1 and regime G in Table 2), a government with discretion may choose to invest more in its bank resolution regime in order to deter investors from depositing their funds in banks.

The abstract nature of the model suggests that its normative conclusions could apply not just to bank resolution regimes, but also to any other means of reducing the ex post costs of financial sector failures. For example, if reforms requiring banks to draw up living wills (describing how their assets would be divided up in the event of failure) make governments more willing to allow banks to fail, then they could also serve to reduce moral hazard.

<table>
<tr><th colspan="2"></th><th>Private equilibrium</th><th>Government equilibrium with commitment</th><th>Government equilibrium with discretion</th></tr>
<tr><td colspan="2">(A) $b \leq \frac{\alpha-\theta\gamma}{1-\theta}$</td><td rowspan="3">Bank offers $r = b$; investors accept; bank invests prudently.</td><td>Bank failure policy irrelevant; $\lambda^* = \underline{\lambda}$; outcome same as private equilibrium.</td><td>$\lambda^* = \underline{\lambda}$; outcome same as private equilibrium.</td></tr>
<tr><td rowspan="2">$\frac{\alpha-\theta\gamma}{1-\theta} < b \leq \frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta}$</td><td>(B)$\alpha \geq c\left(1-\frac{\eta}{\beta}\right)+\theta\gamma+(1-\theta)(\beta-\eta)$</td><td rowspan="2">Government commits to no-bailout policy; $\lambda^* = \underline{\lambda}$; outcome same as private equilibrium.</td><td>$\lambda^* = 1-\frac{\eta}{\beta}$; outcome same as private equilibrium.</td></tr>
<tr><td>(C)$\alpha < c\left(1-\frac{\eta}{\beta}\right)+\theta\gamma+(1-\theta)(\beta-\eta)$</td><td>$\lambda^* = \underline{\lambda}$; bank gambles; government bails out failed banks ex post.</td></tr>
<tr><td rowspan="2">$\frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta} < b \leq \theta\gamma+(1-\theta)\underline{\lambda}\beta$</td><td>(D)$(1-\theta)\left(\eta-(1-\tilde{\lambda})\beta\right) \geq c\left(\tilde{\lambda}\right)$, where $\tilde{\lambda} \equiv c'^{-1}\left((1-\theta)\beta\right)$</td><td rowspan="2">Bank offers $r = \frac{b-(1-\theta)\lambda\beta}{\theta}$; investors accept; bank gambles.</td><td>Government commits to no-bailout policy; $\lambda^* = c'^{-1}\left((1-\theta)\beta\right)$; outcome same as private equilibrium.</td><td>$\lambda^* = c'^{-1}\left((1-\theta)\beta\right)$; outcome same as private equilibrium; no ex post bailouts.</td></tr>
<tr><td>(E)$(1-\theta)\left(\eta-(1-\tilde{\lambda})\beta\right) < c\left(\tilde{\lambda}\right)$, where $\tilde{\lambda} \equiv c'^{-1}\left((1-\theta)\beta\right)$</td><td rowspan="2">Government commits to bailout policy; $\lambda^* = \underline{\lambda}$; bank offers $r = b$; investors accept; bank gambles.</td><td rowspan="3">$\lambda^* = \underline{\lambda}$; bank offers $r = b$; investors accept; bank gambles; government bails out failed banks ex post.</td></tr>
<tr><td colspan="2">(F) $\theta\gamma+(1-\theta)\underline{\lambda}\beta < b < \theta\gamma+(1-\theta)(\beta-\eta)$</td><td rowspan="3">Investors reject whatever interest rate bank offers in favour of their outside option.</td></tr>
<tr><td colspan="2">(G) $\theta\gamma+(1-\theta)(\beta-\eta) \leq b < \theta\gamma+(1-\theta)(\beta-\eta)+c\left(1-\frac{\eta}{\beta}\right)$</td><td rowspan="2">Government commits to no-bailout policy; $\lambda^* = \underline{\lambda}$; outcome same as private equilibrium.</td></tr>
<tr><td colspan="2">(H) $b \geq \theta\gamma+(1-\theta)(\beta-\eta)+c\left(1-\frac{\eta}{\beta}\right)$</td><td>$\lambda^* = 1-\frac{\eta}{\beta}$; outcome same as private equilibrium; no ex post bailouts.</td></tr>
</table>

Table 1: Summary of theoretical results with a monopoly bank

			Private equilibrium	Government equilibrium with commitment	Government equilibrium with discretion
$b \leq \max\left\{\frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta}, \theta\gamma + (1-\theta)\underline{\lambda}\beta\right\}$	$\alpha \geq \frac{(2-\delta-\theta)\theta\gamma+(1-\theta)^2\underline{\lambda}\beta}{1-\delta\theta}$	**(A)** $\alpha \geq c\left(1-\frac{\eta}{\beta}\right) + \theta\gamma + (1-\theta)(\beta-\eta)$	Banks offer $r = \frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta}$; investors accept; banks invest prudently.	Government commits to no-bailout policy; $\lambda^* = \underline{\lambda}$; outcome same as private equilibrium.	$\lambda^* = 1-\frac{\eta}{\beta}$; outcome same as private equilibrium.
		(B) $\alpha < c\left(1-\frac{\eta}{\beta}\right) + \theta\gamma + (1-\theta)(\beta-\eta)$			$\lambda^* = \underline{\lambda}$; banks offer $r = \gamma$; investors accept; banks gamble; government bails out failed banks ex post.
	$\alpha < \frac{(2-\delta-\theta)\theta\gamma+(1-\theta)^2\underline{\lambda}\beta}{1-\delta\theta}$	**(C)** $(1-\theta)\left(\eta-(1-\tilde{\lambda})\beta\right) \geq c\left(\tilde{\lambda}\right)$, where $\tilde{\lambda} \equiv c'^{-1}\left((1-\theta)\beta\right)$	Banks offer $r = \gamma$; investors accept; banks gamble.	Government commits to no-bailout policy; $\lambda^* = c'^{-1}((1-\theta)\beta)$; outcome same as private equilibrium.	$\lambda^* = c'^{-1}((1-\theta)\beta)$; outcome same as private equilibrium; no ex post bailouts.
		(D) $(1-\theta)\left(\eta-(1-\tilde{\lambda})\beta\right) < c\left(\tilde{\lambda}\right)$, where $\tilde{\lambda} \equiv c'^{-1}\left((1-\theta)\beta\right)$		Government commits to bailout policy; $\lambda^* = \underline{\lambda}$; banks offer $r = \gamma$; investors accept; banks gamble.	$\lambda^* = \underline{\lambda}$; banks offer $r = \gamma$; investors accept; banks gamble; government bails out failed banks ex post.
$b > \max\left\{\frac{(1-\delta\theta)\alpha-(1-\delta)\theta\gamma}{1-\theta}, \theta\gamma + (1-\theta)\underline{\lambda}\beta\right\}$	**(E)** $b < \theta\gamma + (1-\theta)(\beta-\eta)$		Investors reject whatever interest rate banks offer in favour of their outside option.		
	(F) $\theta\gamma + (1-\theta)(\beta-\eta) \leq b < \theta\gamma + (1-\theta)(\beta-\eta) + c\left(1-\frac{\eta}{\beta}\right)$			Government commits to no-bailout policy; $\lambda^* = \underline{\lambda}$; outcome same as private equilibrium.	
	(G) $b \geq \theta\gamma + (1-\theta)(\beta-\eta) + c\left(1-\frac{\eta}{\beta}\right)$				$\lambda^* = 1-\frac{\eta}{\beta}$; outcome same as private equilibrium; no ex post bailouts.

Table 2: Summary of theoretical results with competitive banks

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