Towards Time-Consistency in Bank Regulation

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Abstract

This paper presents a simple model of behavior of bank regulators when there is lack of commitment. In crises, regulators forbear because of social costs of bank closures. In the model the forbearance takes the form of capital injections, which gives rise to an excessive leverage inefficiency. The regulator could attempt to address this inefficiency through a leverage policy, but this imposes its own time consistency problem. If the regulator can commit to a time-inconsistent choice of leverage ratio, the ratio will be lower than the regulator would choose ex-post. Restricting leverage to its time-consistency level, on the other hand, induces bank policy choices which lead to greater likelihood of bailouts, and a higher expected cost of bailout to the regulator.

1 Introduction

No plan of action survives first contact with the enemy—be the enemy an army, a tsunami, or a financial crisis. Importantly, however, in the case of financial crises there are recurrent patterns in the failure of plans. The goal of this paper is to consider the implications of these recurring patterns within crises for the design of regulatory policy outside of periods of crisis.

In designing financial regulatory policy, researchers and regulators have given primary attention to the effects on incentives of the financial institutions being regulated. Capital requirements, liquidity standards, and deposit insurance premiums are designed to make financial institutions internalize the social costs of the risks they undertake. The fundamental moral hazard problem is that the desirability of the investment choices made by financial institutions can best be evaluated by the results. We want the bank to make the "right" investments and hold the "right" portfolio of assets, properly balancing risk and return as valued by the society. In the end, all we see is the result. Limited liability, along with deposit insurance and leverage, naturally place limitations on the effectiveness of rewarding and punishing based on results. Thus the focus nowadays on requirements based on financial structure, notably capital and liquidity requirements, and on compensation limits, as ways of altering the incentives of the owners and managers of the institutions.

Only limited attention has been devoted to the more nebulous effect of regulatory design on the incentives of the regulators.[1] Yet these incentives are critical for the performance of regulation. The standards for "prompt corrective action" in the U.S. were imposed legislatively to make it more difficult for regulators to ignore or underplay deteriorating conditions of depository institutions, in effect forcing regulators to internalize the costs of their forbearance. Similarly, the threat of penalties when the Fed's loans lead to losses to the insurance fund have the effect of increasing the incentives to lend to solvent banks.[2] In principle, legislation could be devised to tie the hands of regulators to ensure that certain kinds of activities cannot be engaged in at all. Consider the provisions within Dodd-Frank limiting Federal Reserve

[1] See Repullo (2000), Kahn and Santos (2005, 2006), and Espinosa et al. (2011) for studies of the effects of regulators' incentives.

[2] Following a US House of Representatives (1991) study claiming that Fed loans to troubled banks increased losses to the FDIC, Congress introduced though FDICIA a penalty for lending to banks that subsequently fail (loss of the interest income received from such banks). See Gilbert (1994) for details.

Emergency Lending under 13(3). The goal is to prohibit outright emergency programs which target a single lender—and the legislation in effect makes it extremely expensive to do so, by forcing the program to give the same benefits to all similarly situated firms.

Regulators, however, often respond to these legislative initiatives, giving rise to a process similar to the regulatory dialectic we have observed in the relationship between regulations and financial institutions.[3] Legislators prohibit a pattern of regulatory behaviors, a financial crisis arises, regulators improvise workarounds to undermine the prohibitions (often with the tacit acquiescence of the government), and, when calm is restored, new legislation is instituted to block the workarounds. Critics often blame these workarounds on lack of proper incentives for regulators. While it is certainly the case that the incentives of regulators do differ in systematic ways from some ideal social welfare function (whatever that in fact might be), an even more fundamental dilemma that this paper will focus on is the time-inconsistency of optimal regulatory policy.

Regulatory requirements serve a dual role: Ex ante they are intended, as described above, to reshape the incentives of the decision makers at the bank. But they have a second role ex post: they become the proxy for more fundamental measures of success or failure of the institution's efforts. As a sanction, however, it is costly for the regulator as well as for the regulated. In crisis environments, the regulator may well find itself unwilling to enforce mandated regulations. So the regulatory dialectic applies to the regulators as well. Regulations will not be able to constrain regulators when crises arise; when short-term considerations become paramount, the regulators' objective function cannot be artificially reinforced. If the immediate spillover costs of the failure of the institution are too high, then the regulators will find a way to keep the institution from failing. Attempts to harden the will of the regulators, to maintain financial discipline, to buttress the seawalls against the financial inundation, will not succeed.

Clearly the financial community expects precisely this kind of behavior. Markets are cynical about regulators' ability to maintain harsh standards, and adjust accordingly. Nonetheless, we tend to model the regulation of financial institutions without regard for time consistency. But if we focus on modeling the objectives of regulators, taking this inherent softness into account will have significant implications for the design of regulation.

[3]See Kane (1981) and Hester (1981) for a discussion of the regulatory dialectic.

Consider the case of the lender of last resort function. Ex ante, it is optimal to commit to lend only to financial institutions experiencing liquidity problems but which are otherwise solvent in order to avert the moral hazard problem emanating from that support. However, as we observed during the recent financial crisis, denying liquidity support and forcing into bankruptcy a systemically important financial institution (or a group of financial institutions which in the aggregate are systemically important) has real costs; even an LLR which focuses solely on some ideal economic measure of social value might on occasion prefer to its lending standards. The expectation of these interventions alters the incentives of financial institutions ex ante and reduces the ex ante welfare. If the costs arising from these changes in incentives exceed the benefits of intervention during crises, the LLR could increase overall welfare, provided it was able to commit itself not to extend support to insolvent institutions. In reality, however, the LLR does not seem able to stick to such a commitment. The lack of commitment creates a time-inconsistency problem in that the results are worse without commitment than they are with commitment.

Researchers have documented the time-consistency problem in bank regulation. Mailath and Mester (1994), for example, show that the optimal closure policy is time inconsistent in a setting in which a bank chooses the risk level of its investments and the a regulator must decide whether to close a bank and pay off depositors. Acharya and Yorulmazer (2007), in turn, show that adding a bailout authority induces banks to take on correlated risks, making it optimal to forbear when they all fail together. Schneider and Tornell (2004), Ennis and Keister (2009), and Farhi and Tirole (2012) show that lack of commitment in bailout policy can lead to multiple equilibria: if banks expect to be bailed out, they choose to become riskier, making a government bailout optimal. If banks do not expect to be bailed out, then they do not take such actions, and bailouts are not optimal.

Only limited attention been devoted to the implications of the time-consistency problem for the design of bank regulation. Farhi and Tirole (2012), Keister (2012) and Chari and Kehoe (2015), build on the time-inconsistency problem that exists in the bank closure policy to advocate bank regulation and attempt to design ex ante policies that mitigate that problem. Farhi and Tirole (2012) and Chari and Kehoe (2015), for example, advocate the introduction of a cap on banks' leverage. These studies, however, consider the possibility that the regulations they advocate to address the time-inconsistency problem associated with bailout policy are

themselves susceptible to a time-inconsistency problem.

This is the subject of our investigation. We start by documenting the time consistency problem that a regulator faces on its decision to support versus liquidate banks experiencing financial difficulties. Ex ante, it is optimal for the regulator to commit not to bail out the bank in order to reduce the bank's incentives to rely on too much debt financing. Ex post, the regulator will fill compelled to bail out the bank when it experiences financial difficulties because of the costs a bankruptcy imposes on society. As has already been recognized in the literature, a way to address this time consistency problem is for the regulator to put a limit on the bank's leverage.

But, as we show, this leverage policy imposes its own time consistency problem. Specifically, if the regulator can commit to a time-inconsistent choice of leverage ratio, the ratio will be lower than the regulator would choose ex-post. Restricting leverage to its time-consistency level, on the other hand, induces bank policy choices which lead to greater likelihood of bailouts, and a higher expected cost of bailout to the regulator.

The rest of the paper is organized as follows. Section 2 introduces our model and discusses the time consistency problem associated with the regulator decision to close a bank experiencing financial difficulties. This section also shows the value of using a leverage policy to address that time consistency problem. Section 3, in turn, shows that this leverage policy may too be subject to a time consistency problem. This section also discusses solutions to this problem. Section 4 presents additional examples of bank regulation that is exposed to time-consistency problems and discusses some of the corresponding implications. Section 5 concludes the paper with some final remarks.

2 Model

For simplicity, all agents are risk-neutral; there is no time discounting. There are a three dates $\{0, 1, 2\}$. At date 0, the initial owners of the bank invest a fixed amount I in money and a variable amount e in effort, which will provide a stochastic payoff A at the terminal date, depending in part on the choice of e. The distribution of A at date 2 is denoted $F(A; e)$. For simplicity assume that the expectation of A conditional on $e = 0$ is greater than I, so that the initial owners always choose to make the initial investment.

In period 1, the bank owners can issue short term debt, to retire some of their initial

investment. We let D_2 denote the amount of period 2 repayment promised. If in the terminal period the face value of debt exceeds the value of the assets, then the bank is liquidated in bankruptcy unless the regulator bails it out.

In bankruptcy liquidation in period 2, the creditors are assumed to acquire βA in value, where β is a parameter representing the cost of bankruptcy. The two cases to consider are costless bankruptcy ($\beta = 1$) and costly bankruptcy ($0 < \beta < 1$).

In the absence of regulatory intervention the choice of e and the choice of financial structure period by period can be described quite simply:

Theorem 1 *In the absence of regulatory intervention, the firm chooses e to maximize the expectation of $A - I - e$. If bankruptcy is costly the firm is structured to be entirely equity. If bankruptcy is costless, then the stakeholders are indifferent among all possible financial structures for the firm.*

Next we consider the incentives of the regulator. The regulator (and society) incur a fixed cost X from the bankruptcy of a firm. The regulator also suffers a (political) cost if it is seen to be providing public moneys to bail out a firm. For example in the terminal period, the regulator will need to provide $(D_2 - A)_+$ if it is to prevent a bankruptcy. (We therefore conceive of a bailout in its simplest form as a payment of the required funds to the debtholders. Assume the debtholders are dispersed, so that any attempt to buy them out for less than the stated value of the debt will result in a holdout problem. This dispersion in effect commits them to demanding D_2 or forcing the bankruptcy. Once the regulator acquires the debt in its entirety, it unilaterally reduces the amount owed it to A, avoiding the default).

Finally we consider the feature that makes banks and their regulators distinctive, namely, that the debt of banks is, for its creditors, an asset which provides liquidity. In fact the key feature is not that this liquidity is valuable to the holders of the debt, but that this liquidity provides an external benefit which the regulators wish to encourage. To show this effect as starkly as possible, we will deal with a situation in which *only* the regulator attaches additional benefit to the liquidity provided by debt. That is to say, the regulator places a value $\alpha(B_1)$ on privately held short term bank debt in period 1, where B_1 is the market value of that debt in period 1, and α is an increasing concave function with $\alpha(0) = 0$. (In examples we will set the function to αB_1). In period 1, in the absence of regulatory intervention this is equal to $E[\min\{D_2, A\}]$ in general and to D_2 in particular if the debt is riskless. (We conjecture that

the situation in which debtholders also attach some liquidity premium to the debt will work in a parallel fashion).

2.1 Regulatory behavior in terminal period

In period 2, a regulator that has the power to do so will bail out the bank whenever the shortfall is less than the cost of a default. That is, bailout occurs if the shortfall is in the range:

$$D_2 - A \in [0, X]$$

If there is no shortfall, there is no need for a bailout, and if the shortfall exceeds X, the regulator is unwilling to engage in a bailout.

We can also consider cases where the regulator has a financial stake in the bank. The most natural one is the case where the regulator is a senior claimant. Suppose that the regulator owns S units of debt which is senior to the public debt D_2.

Theorem 2 *If $D_2 < X$, the defaulting firm is always bailed out. If $D_2 > X$, then the defaulting firm is bailed out whenever $D_2 - X < \max\{A(1-\beta), A - \beta S\}$.*

In other words, a firm never has an incentive to sell less than X in debt to private parties.

(The appendix also considers cases where the regulator enters period 2 with other financial stake in the bank. It shows, that the regulator could also hold debt which is of equal or junior priority, as well as an equity stake in the bank, nonetheless, the bail out decision depends only on its senior holdings in the case of efficient bankruptcy.)

2.2 Bank behavior in period one

At the end of period 1, the bank chooses a financial structure which maximizes shareholder value. This is the same as maximizing the value of its debt plus its equity. With foreknowledge of the regulator's bailout behavior in the terminal period, this means maximizing the following quantity:

$$\int_0^{\underline{A}} \beta A \, dF_1(A) + \int_{\underline{A}}^{\overline{A}} D_2 \, dF_1(A) + \int_{\overline{A}}^{\infty} A \, dF_1(A). \tag{1}$$

where $[\underline{A}, \overline{A}]$ is the interval of values A in which the bailout will occur in the terminal period, and the distribution F_1 is dependent on any information available at date 1.

Thus the behavior of the bank depends on the bailout policy. If the regulator commits never to bail out a bank, then the bank chooses, $D_2 = 0$. If the regulator cannot commit to a policy in advance, then $\underline{A} = D_2 - X$, $\overline{A} = D_2$, and the bank chooses the profit maximizing debt level D_2^* accordingly. First-order conditions for the choice of D_2^* are

$$f(D_2^* - X)[D_2^* - \beta(D_2^* - X)] = [F(D_2^*) - F(D_2^* - X)]$$

so that under natural restrictions on F, we have that increases in β or X increase the chosen level of D_2^*. Indeed, as the political costs of bankruptcy become arbitrarily high, the bank approaches 100% debt financing.

(Again, the appendix shows how this first order condition generalizes when the regulator has financial claims on the bank. In the case of senior claims, an increase in them generally reduces the bank's choice of D_2^*, but less than one-for-one.)

2.3 Regulatory behavior in period one

The expected payoff of the regulator as of period 1 depends on the bank's choice of financial structure. On the one hand, increasing the value of its debt is directly useful to the regulator. On the other hand, it can cause an increase in the expected amount that the regulator will have to pay in a bailout in period 2.

The regulator's objective as of period 1 is

$$\alpha(B_1) - \int_0^{\underline{A}} X \, dF_1(A) - \int_{\underline{A}}^{D_2} (D_2 - A) \, dF_1(A)$$

where $\underline{A}$ is the cutoff for rescuing insolvent banks, and B_1 is the market value in period 1 of the bank's debt. This is the expectation of its value in period 2:

$$\int_0^{\underline{A}} \beta A \, dF_1(A) + D_2(1 - F_1(\underline{A}))$$

Intuitively, holding the level of the cutoff fixed, increases in the debt level improve liquidity but increase the cost of bailouts. Holding the debt level fixed, increasing the lower cutoff for bailouts (that is, making bailouts rarer) reduces the value of the debt in period 1, the cost of bailouts is minimized at $\underline{A} = (D_2 - X)_+$, thus taking into account the effect on the value of debt, for a given level of debt, the optimal cutoff would be somewhat lower than $D_2 - X$.

However, overall the cost of debt is minimized by setting $D_2 = \underline{A} = 0$, and by continuity we have,

Theorem 3 *For $\alpha'(0)$ sufficiently small, it is optimal for the regulator who can do so to commit never to bailout a bank.*

Because if the regulator can make this commitment, the bank will choose zero level of debt. More generally, the optimal choice of D_2 and $\underline{A}$ from the regulator's point of view will differ from the choices that will be made if the regulator cannot commit to a bailout plan in advance: $(D^*,\ D^* - X)$.

On the other hand, if the regulator cannot commit in advance to a bailout policy, a partial alternative can arise if it has the power to restrict the bank's leverage. Again by continuity we have

Theorem 4 *For $\alpha'(0)$ sufficiently small, it is optimal for the regulator who can do so to restrict the bank to zero leverage.*

In general, neither the power to set leverage, nor the power to commit ahead of time to a bailout policy will achieve the full optimal combination of D_2 and $\underline{A}$.

Theorem 5 *If the regulator can limit the bank's leverage, but not commit to a bailout policy, the bailout policy will be less lenient than the regulator would prefer ex-ante.*

The intuition for this result is that greater leniency in the bailout policy will also affect the value of the debt that the bank issues in period 1. This value is a sunk benefit when the regulator decides on whether to bail out the bank in period 2.

3 Leverage policy and time consistency

So far we have only considered a leverage policy that is instituted at time 1. As we have seen, when the bailout policy must be time consistent, it is helpful for the regulator to be able to impose a leverage policy at time 1. However, this choice also influences the effort chosen by the bank at time 0. Clearly the optimal arrangement for the regulator is to be able to commit at time 0 to leverage policies. But this imposes its own time consistency problem.

If the bailout policy must be time consistent, then the period 0 objective of the regulator is

$$\alpha\Big(\int_0^{D_2-X} \beta A \; dF_1(A;e) + D_2(1 - F_1(D_2 - X;e))\Big) \tag{2}$$
$$- \int_0^{D_2-X} X \; dF(A;e) - \int_{D_2-X}^{D_2} (D_2 - A) \; dF(A;e)$$

where the first term is the value of the liquidity to the regulator $\alpha(B_1)$. The value $e.$ is chosen by the bank to maximize

$$\int_0^{D_2-X} \beta A \; dF_1(A;e) + \int_{D_2-X}^{D_2} D_2 \; dF_1(A;e) + \int_{D_2}^{\infty} A \; dF_1(A;e). \tag{3}$$

In this case time consistency becomes in effect a question of first-mover advantage. If the regulator can commit to a leverage requirement D_c then it is chosen to maximize (2) subject to $e = e(D_c)$ defined by the bank's maximization problem (3).

On the other hand, if the regulator is restricted to a time-consistent policy, then its choice depends on the choice of e. That is to say, $D_t(e)$ is the maximization of (2) given e, and the bank maximizes (3) subject to $D_t = D_t(e)$.

3.1 Intuition

To see the intuition for the time consistency problem in leverage, take the case where X is prohibitively high, so that *all* banks are bailed out ex post. In other words, the regulator's terminal payoff is

$$\alpha D - (D - A)_+$$

Now the ex post value of the bank (equity plus debt) is

$$\max\{D, A\}$$

when the bank owner issues debt in period 2, he obtains the market price for it, taking into account the fact that the debt will always be bailed out by the regulator. Thus the objective of the bank owner in period 2 is to issue as much debt as permitted. If the regulator makes a choice of leverage at the beginning of period 2 (in other words, taking e as given), then he chooses so as to maximize

$$\alpha D - \int_0^D (D - A) \; dF(A;e).$$

This is a concave function and the maximum occurs when

$$\alpha = F(D)$$

–that is,

$$D = F^{-1}(\alpha).$$

On the other hand, if the regulator can commit ex ante to a particular level of D, the choice will influence the banker's choice of effort. The banker's expected payoff is

$$\begin{aligned} & \int \max\{D, A\}\, dF(A; e) - e \\ = \quad & D + \int_D (A - D)\, dF(A; e) - e \end{aligned}$$

In short, the regulator worries about the downside, and the bank is concerned with the upside. Thus lower values of D will more closely align the bank's incentives with the regulators.

In other words, if the regulator can commit to a time-inconsistent choice of leverage ratio, the ratio will be lower than the regulator would choose ex-post. Restriction to time consistent levels of leverage means that the bank chooses effort levels which lead to greater likelihood of bailouts, and a higher expected cost of bailout to the regulator.

4 Additional examples

Most of the existing literature, including the model we presented in this paper, focuses on the inability of regulators to commit not to forbear when it is ex post socially desirable to highlight the challenges that time-consistency pose to bank regulation. However, as we will discuss in this section time-consistency problems extend well beyond regulators' bailout decisions. We start by considering examples of recent ad hoc government support, which the model we presented most closely resembles. Then we will go farther afield and consider how lack of commitment affects some policies related to deposit insurance funding and to developing of centralized counterparties for financial markets.

4.1 Rescue Packages

The central aspect of so-called "bailouts" of financial institutions is not the rescue of shareholders or management, but the rescue of uncollateralized, uninsured creditors. The analysis

described thus far, is therefore applicable to a variety of recent rescue packages whether they take the form of loans or guarantees. Even policies which legally placed the government agency prior to the other uninsured creditors can act as subsidies in several ways. First, they can buy time for uninsured creditors to restructure their arrangements, drawing down some of the cash provided. Second, they can be taken as signals of the willingness of the regulator to intervene further down the line. Third, strict priority rules may be readjusted ex post on legitimate incentive and liquidity grounds, and this may be anticipated ahead of time.

Perhaps the less-than-stellar performance of prompt corrective action needs to be re-examined in this light. The basic arguments explaining forbearance by regulators have been of the "gambling-for-resurrection" form: the regulator bears the consequences of a bank failure but not in proportion to the magnitude of the failure. Meanwhile he receives no benefit from an early closure. Thus he has the incentive to delay the closure in the hopes of the chance of it becoming no longer necessary. But the experience of recent times argues that this forbearance becomes even more dramatic when closure is perceived as expensive. If closure destroys the systemic value, it becomes desirable for regulators to devise means of providing the subsidy to maintain them. Explicit subsidies are politically costly: the cheapest subsidy to provide is an overly-rosy view of the institution's prospects. It is understood that the regulator may have to pay bailout costs in the future, but there is a chance that these will be avoided. Meanwhile the borrowing costs for the bank today fall as a result.

Another twist on this same story is for the regulator or the government to enhance the value of the financial institution's loan portfolio by providing guarantees or insurance for their repayment to the institution. In the first place, this works just like any other subsidy would: it reduces the likelihood of the costly bank failure and reduces the likelihood of the need for a costly intervention. The guarantees will in general require no upfront payment; thus the expense to the regulator is nil. However the consequences will likely be more expensive than a direct subsidy because the increase in the value of the assets of the institution will increase the subsidized leverage of the financial institution.

For example, the Interim Report of the U.K. Independent Commission on Banking (2011), devotes a section to financial stability in which it makes proposals to reduce to the effect of government subsidies on risk taking. In particular it proposes "ring fencing" of retail activities in universal banks as a mechanism for improving financial stability: retail activities

would be housed in separate subsidiaries of the bank. The benefits include 1) the possibility of easier resolution, enabling rapid separation of retail activities from the rest in case of the bank's failure , 2) the ability to establish separate capital requirements for the retail activities, while still allowing various portions of the bank to support one another (an argument reminiscent of the "sources of strength" doctrine of the Federal Reserve, see Ashcraft (2008), 3) reduction in perceived government guarantees to the large institutions. To this list could be added the possibility of improved incentives from segregating risks in separate limited liability subsidiaries, as noted by Kahn and Winton (2004).

Of these arguments, our analysis indicates that the questionable one is the claim that perceived government guarantees will be reduced by ring fencing. As the report admits, "One argument against separation is that perceived government guarantees do not apply only to retail banking." [[**?**], p.88]. In fact, in a financial crisis, it would seem clear that the costs associated with failure to protect the wholesale portions of the bank are likely to be at least as great as the costs associated with failing to protect the retail portions. The effectiveness of the argument relies on two parts: that at least in some circumstances there will be a higher political benefit to saving some functional portions of the bank than to saving others, and that by drawing a clear separation between subsidiaries with different functions the piecewise protection will become easier.

4.2 Deposit Insurance

An debate of recurrent interest with respect to the policy for deposit insurance regards the form which a country's deposit insurance should take: Should it be funded ex ante or ex post–that is to say, should the insurer rely on funds collected beforehand, with premiums risk adjusted for the contributing banks, or should the fund be "mutual," with surviving banks responsible for contributing the amounts needed to payoff the depositors of failed institutions? Many studies have emphasized the benefits of risk-based pricing and the disincentives of survivor-pays arrangements. In particular comparison with survivor-pays arrangements in other areas of financial intermediation emphasize the increased need to monitor and to provide membership standards for potential members of the arrangement (this phenomenon arises for example in payment and settlement systems; see Kahn and Roberds (2009a) for an overview). More recently the parallel issue has arisen with respect to proposals for liquidation funds. While

Dodd-Frank provides for funds to be collected ex post in the event of a bank failure in the new resolution regime, Acharya et al (2009) call for ex ante provision of the liquidation fund, arguing that ex post funding increases both moral hazard and systemic risk.

However, while previous studies have emphasized the effects of arrangements on the behavior of the institutions participating in the insurance system, this current paper emphasizes the importance of regulatory design for regulator incentives. In this respect choices proposed in the debate also make a difference. Various arrangements will make it more or less expensive for the regulator to utilize funding for rescues. And for ex ante funding, it will be important to distinguish the source of the funding: funds earmarked separately for the use of the deposit insurer are likely to be less politically costly to use than funds that have been returned to the general revenues of the government whose redeployment for rescue will automatically create tighter scrutiny. (Indeed for the purposes of discussion of incentives of the regulator as opposed to incentives of the financial institutions, the actual source of the funds is immaterial. An existing fund works in a manner similar to a line of credit as currently exists for the FDIC with the US Treasury. Pre-authorized funds are less expensive than those that are not pre-authorized).

In our model, we did not specify whether bank debt would be in the form of deposits. However if deposits give the bank access to funds from the deposit insurer, and the deposit insurer is not limited strictly to providing funds to depositors of failed institutions (that is, if it has discretion to engage in alternate resolution regimes, including subsidies to an acquirer) then the bank has an incentive to take in deposits, even when deposit insurance is correctly adjusted to the risk of having to repay depositors. The only way to prevent this from occuring is to adjust the deposit insurance to include the costs of subsidies to non-insured creditors that would arise from other resolution regimes. (In the case of multiple regulators as in Kahn and Santos (2005), it would be necessary for the adjustment to include costs borne in the bank's resolution by all of the regulators, not just by the deposit insurer).

In any event, as long as the deposit insurer values the continuance of the bank ex post, the analysis proceeds as before: even if the bank has not already suffered a run, a deposit insurer may find it desirable to provide assistance if a run seems a significant possibility. The cheaper the funds are to the deposit insurer, the more likely the subsidized assistance is to arise. Thus, if it is desired to reduce the incentives for ex post subsidy, funds should *not*

be provided beforehand to the deposit insurance scheme explicitly. Instead revenues collected from the financial institutions should be returned to the general funds. (More realistically, if we believe that small institutions will not trigger the lack of commitment problem, then this is an argument for limiting the amount of funding available to the deposit insurer to be below the scale likely to be needed by systemic institutions). The importance of the distinction will be reduced to the extent that forbearance and gambling for resurrection is an option, for then the comparison will not be between allocated and unallocated funds today but between allocated and unallocated funds in future contingencies. In general, however, these problems argue for the reduction of the powers and discretion of a deposit insurer when dealing with systemically important institutions.

4.3 Centralized Clearing in Financial Markets

One of the dramatic aspects of the recent financial crisis is the drying up of liquidity in the wake of failures of institutions and markets whose function was the provision of that liquidity. Observers have noted the fact that these markets were generally over-the-counter markets, without properly functioning collateral facilities and clearing mechanisms. In contrast, such markets and clearing systems—for example futures markets and payments systems—functioned well throughout the crisis, despite severe strains placed on them.

This experience has led to provisions in Dodd-Frank strongly encouraging the use of clearing mechanisms and centralized exchanges. Title 7 of the act mandates the movement of swaps contracts to exchanges where feasible, as determined by the regulators, along with centralized clearing and regulated capital and margin requirements for them (and even higher requirements for those which do not migrate to clearing arrangements)

Risk reduction in derivatives trading is important, and the consequent increase in systemwide financial stability are potentially great. Nonetheless a note of caution is required in considering these proposals. Kahn and Roberds (2009b) show that decentralized ("tiered") arrangements are sometimes helpful because they place the onus on informed agents for monitoring the quality of counterparties. Centralized systems instead substitute collateral arrangements for this monitoring function. Which system is appropriate therefore depends on the details of the dispersion of information about traders, and the ease of evaluating collateral quality in particular markets, and the extent to which the financial assets being traded

are amenable to standardization. Forcing trading into centralized clearing will abolish the incentives of individual traders to monitor counterparty quality; if the contracts traded are too specialized then margin and haircuts may be an inadequate substitute.

If we take the fear of systemic consequences as the intractable source of forbearance by regulators, then there is nothing special about banks relative to other financial institutions. A centralized market itself is naturally a systemic institution, and it is one which will may not in general have sufficient incentives to monitor the quality of its membership, since it will not bear the full social cost of a failure of trading in its market. As long as contracts are easily marked to market and collateral easily obtained, the problem of member quality remains manageable. A too-rapid expansion of the sets of exotic contracts centrally traded and cleared could lead to a new institution whose failure is unthinkable, and to which the regulator becomes hostage.

5 Final remarks

When crises arise, systemically important institutions will be protected. "Never again," is the shout after each such crisis. In the political heat of the aftermath, such a cry is understandable. But new crises bring the same result. This is not because the regulators are ignorant of the consequences at the time of protection. Regulators (and government officials) are fully aware of the long run costs of yielding in crisis, of the incentives to future moral hazard that regulatory weakness encourages. Nor can it really be argued that they are making a mistake in acting as they do in the middle of a crisis. For the fact is that the damage that will be inflicted by failure to save the institution is real, is large and is immediate. The remedies must be built in the post-crisis period, but they must be built intelligently enough not to depend on suddenly-developed backbone withstanding the next crisis.

There is some limited ability on the part of the government to design regulation to minimize discretion. Deposit insurance, for example, can be established without the regulator having facilities to establish special resolution regimes, or scrutiny can be imposed in such a way as to make every penny spent extremely high cost to the regulator. But not too much confidence should be placed in these measures. After all, the failure to take on the discretionary actions will be extremely expensive in the midst of a crisis. A key reason for imposing the restrictions is to change the behavior of actors beforehand. If those behaviors do not change (or worse even if they do change, and the draw still come out unlucky) maintaining a lack of

discretion may be too high a price to pay. Even the attempt may be futile: the government may be able to bind the regulator, but it has no way to bind itself.

One alternative is simply to accept the consequence: there are systemic institutions; there always will be systemic institutions and they will be rescued. The superior alternative is to attempt to gauge the costs and benefits of the existence of systemic institutions: is the value of the institution worth the inevitable rescue? If not, how can the systemic importance of the institution be reduced? This in itself is a difficult task to consider. Institutions have incentives to make themselves systemic. Becoming systemic means doing something essential and valuable, and probably more than a little bit mysterious. It is going to be difficult for a regulator to withstand the pressure to allow that—particularly when a government decides to join in the pressure.

One imperfect, but at least tractable way to reduce systemic importance is to keep institutions small. Dodd-Frank contains provisions putting greater restrictions on mergers of large financial institutions, and stricter regulatory standards on larger institutions. The Independent Commission's Interim Report on the other hand dismisses size limits as blunt tools. As it points out, they lead to incentive problems when institutions grow too close to the limits. If there are economies of scale out in the far reaches of financial institution size, then limits will harm efficiency. Still, the case against limits has to depend on one of two claims about the possibility of a financial institution becoming too big to withstand. Either it isn't a big enough problem, or it is one for which other techniques are adequate. For neither claim is the evidence sufficient.

6 Appendix

6.1 Regulator with financial stake in bank in terminal period

This appendix consider the extensions where the regulator has a financial stake in the bank. We concentrate attention to the case of efficient bankruptcy ($\beta = 1$).

First, suppose the regulator's debt holding J is junior to the other debt holders. Then the following table shows the payoff the regulator receives if it does not intervene in the bankruptcy, and if it intervenes to bail out the bank:

If	and regulator does not intervene	and regulator bails out bank
$A > D + J$	J	(no default)
$D < A < D + J$	$\beta(A - D) - X$	$A - D$
$A < D$	$-X$	$A - D$

In other words, if the value of the firm is adequate to pay off senior debt holders, the regulator prefers to reduce his claim to the remaining value rather than trigger a default. If the value of the firm is inadequate to pay senior claimants, the regulator's value in default is zero anyway, and his decision is the same as it would have been in the previous case. That is, intervention takes place for $A \in [D - X, D + J]$ Taking this into account, the payoffs of the private stake holders are as follows:

If	private debtholders	equity holder
$A > D + J$	D	$A - D - J$
$D - X < A < D + J$	D	0
$A < D - X$	βA	0

In the case of a regulator holding a senior debt claim, S, the regulator's payoff is

If	and regulator does not intervene	and regulator bails out bank
$A > S + D$	S	(no default)
$S < A < S + D$	$\beta S - X$	$A - D$
$A < S$	$\beta A - X$	$A - D$

Thus in the case $\beta = 1$, intervention takes place as long as $A \in [S + D - X, S + D]$ if $X < D$ and as long as $A \in [0, S + D]$ if $X > D$. And in general the bank will not choose a private debt level less than X if it is free to choose its leverage.

Given this is the case, the payoffs to the private stake holders are as follows (again for $\beta = 1$):

If	private debtholders	equity holder
$A > S + D$	D	$A - S - D$
$S + D - X < A < S + D$	D	0
$A < S + D - X$	$(A - S)_+$	0

If the regulator holds an equity stake, κ, its payoff is as follows:

If	and regulator does not intervene	and regulator bails out bank
$A > D$	κA	(no default)
$A < D$	$-X$	$A - D$

and the region for a bailout is the same as in the case of no financial holdings by the regulator.

Finally if the regulator holds a share of the bonds τ of equal seniority with the outstanding debt

If	and regulator does not intervene	and regulator bails out bank
$A > D$	τD	(no default)
$A < D$	$\tau\beta A - X$	$A - (1 - \tau)D$

Putting it all together, suppose that a regulator has the following stakes in a firm: S senior debt, J junior debt plus a share τ of the main debt D and a share κ of the equity. Then for the case of $\beta = 1$,

If	and regulator does not intervene	and regulator bails out bank
$A > S + D + J$	$S + \tau D + J + \kappa(A - S - J - D)$	(no default)
$S + D < A < S + D + J$	$S + \tau D - X$	$A - (1 - \tau)D$
$S < A < S + D$	$S + \tau(A - S) - X$	$A - (1 - \tau)D$
$A < S$	$A - X$	$A - (1 - \tau)D$

Theorem 6 *If* $D < \frac{X}{1-\tau}$, *the defaulting firm is always bailed out. If* $D > \frac{X}{1-\tau}$, *then the defaulting firm is bailed out whenever* $D - \frac{X}{1-\tau} < A - S$.

In other words, a firm never has an incentive to sell less than X in debt to private parties. (This part of the result continues to hold for $\beta < 1$).

Proof. From the inequalities, a bailout occurs if

1. $S + D < A < S + D + J$ and $A - (1-\tau)D > S + \tau D - X$

or

2. $S < A < S + D$ and $A - (1-\tau)D > S + \tau(A - S) - X$

or

3.$A < S$ and $A - (1-\tau)D > A - X$.

or simplifying, if

1. $S + D < A < S + D + J$ and $A - D > S - X$

2. $S < A < S + D$ and $A - D > S - X/(1-\tau)$

3. $A < S$ and $0 > D - X/(1-\tau)$

In the first condition, the last inequality is redundant. If it holds, then the last inequality in the second condition holds a fortiori. Thus the two conditions may be combined as

1′. $A - S > 0$ and $A - S > D - X/(1-\tau)$

Combining with the third condition yields the result. ■

6.2 Regulator with financial stake in bank in terminal period

If the regulator has already established a financial stake in the terminal period, consisting of a fixed amount of senior and junior claims S, J,and an equity share κ then D is chosen to maximize

$$\int_S^{\underline{A}} \beta(A - S)\, dF_1(A) + \int_{\underline{A}}^{\overline{A}} D\, dF_1(A) + \int_{\overline{A}}^{\infty} (1-\kappa)(A - S - J)\, dF_1(A).$$

Again, if the regulator commits never to bail out a bank, the choice of D is zero. If commitment is not possible, then $\overline{A} = S + J + D$, $\underline{A} = S + D - X$

Using the transformation $A_S = A - S$, $F_S(A_S) = F_1(A_S + S)$, rewrite the maximand:

$$\int_0^{D-X} \beta(A_S)\, dF_S(A_S) + \int_{D-X}^{D+J} D\, dF_S(A_S) + \int_{D+J}^{\infty} (1-\kappa)(A_S - J)\, dF_S(A_S).$$

in parallel with the expression in the text. First order conditions become

$$f(D^* - X + S)[D^* - \beta(D^* - X)] = [F(D^* + J + S) - F(D^* - X + S)] + f(D^* + J + S)\kappa D^*$$

so that typically increases in κ or J increase choice of D^*, and increases in S reduce D^*, but less than one-for-one.

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