Mitchell Berlin
Federal Reserve Bank of Philadelphia

Disclosure of Stress Test Results

Mitchell Berlin[*]

Federal Reserve Bank of Philadelphia

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Abstract

Should regulatory bank examinations be made public? Regulators have argued that the confidentiality of the examination process promotes frank exchanges between bankers and examiners and that public disclosure of examination results could have a chilling effect. I examine the tradeoffs in a world in which examination results can be kept confidential, but regulatory interventions are observable by market participants, as they typically are for stress tests. Inducing banks to communicate truthfully requires regulators to engage in forbearance, which is priced into banks' uninsured debt and raises the costs of inducing truthful communication. Regulators that disclose exam results bear higher monitoring costs and impose excessive capital requirements because interventions are not as sensitive to underlying risks. My model predicts that disclosure is optimal when the regulator's model is relatively inaccurate.

Keywords: stress tests, disclosure, bank regulation

JEL classification: G2, G21 G28

1. Introduction

Should the results of bank examinations be made public? This question has been a recurrent subject of debate, both among scholars and policymakers. Most recently, the debate has centered on whether bank-specific stress test results should be made public, and if so, at what level of detail. One concern, often expressed by bank regulators, is that detailed public disclosure would have a chilling effect on communication between bankers and regulators. In particular, it has been argued that bankers will be less likely to communicate frankly if regulators are required to disclose bad news uncovered during the examination process. For example, the former vice chairman of the Federal Deposit Insurance Corporation said, "Banks need to know that the information they provide to their supervisors will be maintained in the strictest confidence, and examiners need to know that the sanctity and integrity of the examination process will be preserved."[1]

In my model, disclosure of stress test results does inhibit truthful communication of bad news by bankers to their examiners. If regulatory interventions were secret, this would be the end of the story, regulatory disclosure would be undesirable. When regulatory interventions are public, however, some fundamental trade-offs arise. Since the regulatory interventions that follow a negative finding during a stress test—such as limiting dividend payments or requiring banks to raise more capital—are observable, inducing truthful communication requires a policy of (partial) regulatory forbearance. In turn, the regulatory policy will be priced into the banks' uninsured claims, thereby raising the costs of inducing truthful communication.

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[1]Statement of Andrew C. Hove Jr, vice chairman, Federal Deposit Insurance Corporation on Regulatory Bureden Relief, Subcommittee on Financial Institutions and Consumer Credit, U.S. House of Representatatives, May 12, 1999. See also the Office of the Comptroller of the Currency's Interpretive Letter #972, September 2003, 12 CFR 4.31. This letter contains references to court cases that have outlined the public policy grounds for supervisory confidentiality, which include ensuring frank communication between bankers and examiners.

So, the choice between disclosure and nondisclosure depends on weighing the benefits of inducing frank communication from banks—increasing the sensitivity of capital requirements to the state of the world—against the costs of regulatory forbearance—requiring too little capital in high-risk states of the world. In addition, the regulator's monitoring costs are lower when it does not disclose results. I also find that when the regulator's own model is very noisy, a policy of disclosure is more likely to dominate a policy of nondisclosure.

1.1 Related Literature

Goldstein and Sapra (2013) and Leitner (2014) contain excellent reviews of the recent debate on disclosure.[2] The paper most closely related to my paper is the one by Prescott (2008), who also argues that regulatory disclosure undermines truthful communication by bankers. The fundamental difference between my model and Prescott's is that I assume that regulatory interventions are public, which creates the link between nondisclosure and forbearance in my model. This link doesn't appear in Prescott's paper because regulatory interventions are secret in his model.

Leitner (2012) shows that an intermediary, such as an exchange, might optimally choose not to disclose its members' trades to ensure that agents truthfully report their trades with counterparties to the exchange. In his model, truthful reporting to the exchange requires that agents be subject to a sufficiently large risk of their counterparty defaulting, an interesting mechanism very different than mine. My paper shares with Bond and Goldstein (forthcoming) the feature that regulatory disclosure might undermine private sector incentives to generate information that would be useful to regulators. In their model, disclosure may undermine incentives for investors to trade on their own information, thereby reducing the informativeness of market

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[2]Schuermann (2014) and Hirtle and Lehnart (2014) provide interesting general discussions of the optimal design of stress tests. Goldstein and Sapra (2013) provide references to the broader literature on disclosure regulation outside of the banking context.

prices. My model also shares with a number of papers, the feature that investors draw inferences about regulatory policy from the regulator's actions and that these inferences are affected by the disclosure policy. In Shapiro and Skeie (forthcoming), regulators differ in their capacity to close down weak banks so they must take actions to signal that they are tough. Committing to perform stress tests and to disclose the results enhances regulators' ability to signal toughness in bad states of the world by separating regulatory statements from regulatory actions. In a model in which regulators have private information about the quality of their regulatory model, Morrison and White (2013) show that disclosure of troubled banks might lead to banking panics by undermining creditors' confidence in the quality of the regulator. In their model, regulators might optimally exercise forbearance—for reasons very different from those in my model—and choose not to disclose. Bouvard, Chaigneau, and De Motta (forthcoming) make the point that depositors may draw conclusions about the underlying state of the world from the regulator's disclosure policy. In particular, depositors sometimes run on all banks when the regulator doesn't reveal its own information.

Some other significant papers on regulatory disclosure are less closely related to my paper. Goldstein and Leitner's (2014) optimal (partial) disclosure policy provides banks with enough information to facilitate interbank trading by identifying seriously troubled banks without shutting all troubled banks out of the interbank market. Their model exploits a very general insight, first stated by Hirshleifer (1971), that disclosure can limit risk sharing opportunities. In a general setting, Angeletos and Pavan (2007) show that disclosure can be suboptimal when strategic complementarities lead agents to put excessive weight on the information made public by some focal agent such as a regulator (an insight first articulated by Morris and Shin (2002)).

2. The Model

There are three types of agents: a bank, a regulator, and a continuum of investors on the unit interval and there are two dates, $t = 1, 2$. (See Figure 1 for a timeline.) All agents are risk neutral and consume the single good only at date 2. Investors are endowed with one unit of the good at date 1 and nothing at date 2. Each investor has access to a storage technology that allows him to invest one unit of the good at date 1 and receive one unit back at date 2.

The bank has no initial wealth but does have access to a risky project that requires an investment of one unit of the good at date 1. At date 2, the project yields R units of the good when it succeeds and 0 units of the good when it fails. The probability of success depends both on the state of the world and on whether the bank exerts effort. There are two states of the world, $i \in \{h, l\}$, and I will refer to these as the high and low states. I will refer to a bank in state h as a high-type bank and a bank in state l as a low-type bank. The prior probability of the high state is $\eta \in [0, 1]$, which is common knowledge. If the bank exerts effort, the project succeeds with probability α_i in state i, with $\alpha_h > \alpha_l$, and fails with probability $(1 - \alpha_i)$, and if the bank shirks, the project succeeds with probability β_i with $\beta_h = \beta_l = \beta < \alpha_l$. If the bank doesn't exert effort, it also captures a nontransferable payoff, B. While I interpret B as the disutility of effort for concreteness, it might also be interpreted as the consumption of private benefits, control rents, perks, etc.

2.1 Information and Financial Claims

The bank costlessly learns the state of the world at the beginning of date 1, prior to deciding whether to exert effort. After the bank has become informed, the regulator bears a fixed monitoring cost $c > 0$ to learn the state of the world with probability $m \in [0, 1]$; with probability $1 - m$, the regulator learns nothing. I interpret this monitoring technology as a regulatory model and discuss disclosure regimes in detail in the next section.

At date 1, investors can purchase one of two types of claims. At cost $k > 1$ per unit of funds invested, investors can become equity claimants on the firm, increasing bank type i's net worth to A_i. I assume that the firm's equity claimants become full insiders of the firm, in the sense that they share in the bank's revenues and the costs of effort.[3] After the bank observes the state, and following any regulatory interventions by the regulator, the bank announces publicly and credibly that it will sell A_i dollars of equity and $1 - A_i$ dollars of debt. Depositors do not have a monitoring technology, but note that they observe the bank's announced capital level when they provide funds.

2.2 Regulatory Regimes

I consider two regulatory regimes. In the nondisclosure (ND) regime, the regulator precommits to keep the information it receives in the regulatory process—both communications from the bank and the outcome of it investigation of the bank—private. In the full disclosure (D) regime, the regulator precommits to announce publicly all information collected. In either case, the regulator can impose a minimum capital level on the bank, which is observable by depositors when claims are priced. This is a simple way to represent real-world regulatory interventions following stress tests. Following stress tests, bank regulators typically have limited dividend distributions or, in more extreme cases, have required firms to raise capital. It is an essential feature of my model that these interventions are public, whether or not the regulator makes any disclosure.

I assume that the regulator's objective is to maximize total surplus. It is important to consider the types of commitments that the regulator can make. I assume that the regulator can precommit to an *ex ante* optimal policy. However, I restrict the

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[3]Although the assumption that equity is more costly than debt is standard in the literature, in this setting, the organizational costs of ensuring the identity of interests between insiders and new equity claiments are most relevant.

regulator's ability to punish a bank for misrepresenting the state. Specifically, the worst punishment the regulator can impose on the bank is to force it to choose the efficient capital level, given the information available to the regulator. The regulator's only possible interventions are to monitor, impose capital levels, and make announcements; there are no other pecuniary or non-pecuniary penalties that the regulator can impose on bankers. It is essential for my results that the regulator is not free to impose very large punishments on the bank. Furthermore, it is realistic to think that a surplus-maximizing regulator might find it difficult to impose hugely inefficient penalties on a bank as a punishment for making a misleading communication. Finally, I assume that the regulator commits to a monitoring policy; for example, precommitting to monitor whenever the bank claims to be a high-type bank.

3. The Planner's Problem

Consider the surplus maximizing allocations. It is convenient shorthand to denote an allocation by the amount of equity raised by the two types of banks, $\langle A_h, A_l \rangle$, and we denote the face value of an i-type bank's deposits by $d_i(A_h, A_l)$. I consider only allocations in which the planner can observe the state but can't observe whether the bank exerts effort. Furthermore, I will impose parametric restrictions so that the optimal allocation requires the bank to exert effort in both states.

The bank's payoff when it exerts effort is given by

$$\Pi_i^e(A_h, A_l) = \alpha_i \left(R - d_i(A_h, A_l) \right) - k A_i,$$

and the bank's payoff when it shirks is given by

$$\Pi_i^n(0,0) = \beta \left(R - d_i(A_h, A_l) \right) + B - k A_i$$

for each state $i \in \{h, l\}$. A bank exerts effort if and only if $\Pi_i^e(A_h, A_l) \geq \Pi_i^n(A_h, A_l)$, that is,

$$(\alpha_i - \beta)(R - d_i(A_h, A_l)) \geq B \tag{1}$$

for each state $i \in \{h, l\}$. Depositors' participation constraints are given by,

$$\alpha_i d_i(A_h, A_l) \geq 1 - A_i,$$

for state $i \in \{h, l\}$.

Consider first the optimal separating allocation. Substituting the participation constraints into the bank's incentive compatibility conditions (1), we have two conditions for an optimal separating allocation

$$(\alpha_h - \beta)\left(R - \frac{1 - A_h}{\alpha_h}\right) \geq B$$

and

$$(\alpha_l - \beta)\left(R - \frac{1 - A_l}{\alpha_l}\right) \geq B.$$

I assume that the high-type bank will exert effort even without posting capital, that is,

Assumption 1: $(\alpha_h - \beta)\left(R - \frac{1}{\alpha_h}\right) > B,$

but that the low-type bank can only be induced to exert effort when it posts capital. Since capital is costly, surplus is maximized by requiring the minimum level of capital that will induce effort, so the optimal allocation is $\langle 0, \overline{A}_l \rangle$, where $\overline{A}_l$ satisfies the low-type bank's incentive compatibility condition with equality,

$$\overline{A}_l \equiv 1 - \alpha_l\left(R - \frac{B}{\alpha_l - \beta}\right). \tag{2}$$

The total surplus under the separating allocation is

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$$S(0, \overline{A}_l) = (\eta \alpha_h + (1-\eta)\alpha_l) R - (1-\eta)(k-1)\overline{A}_l - 1. \tag{3}$$

It is also useful to consider another benchmark, the optimal pooling allocation, in which both types exert effort, i.e., $A_h = A_l = A$ and $d_h(A, A) = d_l(A, A) = d(A, A)$. In the pooling allocation, the depositors' participation constraint is

$$(\eta \alpha_h + (1-\eta)\alpha_l) d(A, A) = 1 - A$$

and substituting this into the incentive compatibility constraints (1), we get

$$(\alpha_i - \beta) \left(R - \frac{1 - A}{\eta \alpha_h + (1-\eta)\alpha_l} \right) \geq B \tag{4}$$

for state $i \in \{h, l\}$. I make the following assumption:

Assumption 2: $(\alpha_h - \beta) \left(R - \frac{1}{\eta \alpha_h + (1-\eta)\alpha_l} \right) \geq B > (\alpha_l - \beta) \left(R - \frac{1}{\eta \alpha_h + (1-\eta)\alpha_l} \right).$

Assumption 2 says the high-type bank exerts effort even without posting capital but the low-type bank shirks unless it posts sufficient capital. Since capital is costly, the optimal pooling allocation in which both types exert effort is $\langle \overline{A}, \overline{A} \rangle$, where $\overline{A}$ satisfies (4) with equality,

$$\overline{A} = 1 - (\eta \alpha_h + (1-\eta)\alpha_l) \left(R - \frac{B}{\alpha_l - \beta} \right). \tag{5}$$

The total surplus for allocation $\langle \overline{A}, \overline{A} \rangle$ is

$$S(\overline{A}, \overline{A}) = (\eta \alpha_h + (1-\eta)\alpha_l) R - (k-1)\overline{A} - 1. \tag{6}$$

Comparing (3) and (6), we find that the separating allocation yields higher expected surplus than the pooling allocation, that is,

$$S(0, \overline{A}_l) - S(\overline{A}, \overline{A}) = (k-1)\overline{A} - (1-\eta)(k-1)\overline{A}_l > 0$$

if and only if the following assumption holds, which I will maintain throughout:

Assumption 3: $1 - \alpha_h \left(R - \frac{B}{\alpha_l - \beta} \right) > 0.$

Intuitively, both allocations induce the bank to exert effort in each state, so the separating allocation dominates the pooling allocation when the capital costs under the separating outcome are lower. The term, $\alpha_h \left(R - \frac{B}{\alpha_l - \beta} \right)$ is a measure of the wasted capital required of the high-type bank under the pooling allocation.

While I assume that the optimal allocation involves effort in both states, it is instructive to consider the pooling allocation, $\langle 0, 0 \rangle$, in which the low-type bank shirks. I assume that the high-type bank exerts effort even without posting capital. Given depositors' participation constraint when only the high-type bank exerts effort,

$$(\eta \alpha_h + (1-\eta)\beta) \, d(0,0) = 1,$$

the high-type bank exerts effort as long as the following holds.

Assumption 4: $(\alpha_h - \beta) \left(R - \frac{1}{\eta \alpha_h + (1-\eta)\beta} \right) \geq B.$

Note that the second inequality of Assumption 1 implies that the low-type bank will shirk in pooling allocation $\langle 0, 0 \rangle$, since $\alpha_l > \beta$. The total surplus in this allocation is

$$S(0,0) = (\eta \alpha_h + (1-\eta)\beta) \, R + (1-\eta)B - 1.$$

Throughout I assume that $S(\overline{A}, \overline{A}) > S(0,0)$, or

Assumption 5: $(1-\eta)[(\alpha_l - \beta)R - B] - (k-1)\overline{A} \geq 0.$

The first term measures the higher surplus when the low-type bank exerts effort while the second term is the cost of the higher capital required to induce effort by

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the low-type bank, but which must be held by both types.[4]

4. Equilibrium Without Regulation

First I show that the first-best allocation can't be supported in equilibrium. Consider any separating equilibrium, $\langle A_h, A_l \rangle$ with $A_h < A_l$. The low-type bank would always deviate by announcing A_h, which would both reduce its capital costs and lower its cost of debt. In particular, the first best allocation $\langle 0, \overline{A}_l \rangle$ is infeasible. But three types of equilibrium allocations are feasible

Given Assumptions 2 and 3, there are two pooling Bayesian equilibria. The $\langle 0, 0 \rangle$ allocation is an equilibrium, supported by investor beliefs that the bank is a low-type bank with probability one if it chooses any $A > 0$, and the $\langle \overline{A}, \overline{A} \rangle$ allocation is also an equilibrium, supported by investor beliefs that the bank is a low-type bank with probability one if it chooses any $A \neq \overline{A}$. Finally, there are a multitude of money burning equilibria of the form $\langle A_h^+, A_l^+ \rangle$, where $A_h^+ > A_l^+$, supported by investor beliefs that the bank is a low-type bank with probability one if it chooses any $A \neq A_i^+$.

All of these equilibria are inefficient. In the $\langle 0, 0 \rangle$ equilibrium, low-type banks inefficiently shirk; in the $\langle \overline{A}, \overline{A} \rangle$ equilibrium, effort is efficient, but high-type banks raise too much capital; the money-burning equilibria yield both shirking and inefficient capital levels.

Now, turn to equilibria that can be attained with a regulator.

5. No Disclosure

In the ND regime, the regulator commits to a policy that induces the bank to truthfully reveal its type. Before writing out the regulator's maximization problem, we need to derive incentive compatibility conditions for the bank to truthfully reveal

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[4]When Assumption 5 is reversed, nondislosure always dominates disclosure, as will be shown in Proposition 1.

its type. It is straightforward that the incentive compatibility constraint for low-type bank is the binding constraint.

5.1 Incentive Compatibility

Consider the low-type bank's incentive compatibility condition when the regulator can commit to monitor a bank whenever it claims it is a high-type bank. I assume that the regulator can commit to a mixed strategy. In particular, whenever the bank communicates that its type is $i \in \{h, l\}$, it is required to raise capital level $\overline{A}_{ND}$ with probability $1 - p_i$, and it is allowed to operate with zero capital with probability p_i.[5] When it imposes a capital requirement, the regulator imposes the minimum level that will induce the low-type bank to exert effort and which satisfies investors' participation constraint.

If the bank communicates that it is a high-type bank, then the regulator monitors; there is no need to monitor when the bank communicates that it is a low-type bank.[6] When it monitors, the regulator learns the true state with probability m and forces the bank to raise new capital $\overline{A}_{ND}$ if it learns that the low-type bank was lying about the

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[5]Some readers may be bothered by the assumption that the bank can commit to an ex-post inefficient outcome in equilibrium when the bank communicates bad news. In a stark way, this captures the more realistic situation in which the regulator offers the bank more time to achieve its appropriate capital level, even though the regulator knows that this is a riskier policy than it would choose myopically. My model proposes that forbearance need not be due to regulatory capture, political constraints—as in Shapiro and Skeie (forthcoming)—or the attempt by the regulator to cover past mistakes—as in Boot and Thakor (1993) or Morrison and White (2013).

[6]I've chosen to model the lower costs of monitoring a truthful bank in this way for its extreme simplicity. In fact, regulators carrying out stress tests do not choose whether to operate the regulatory model depending on the information communicated by the bank. However, banks are certainly subject to closer (and more costly) scrutiny when they communicate suspiciously optimistic information. Also, without added insight, but some more complexity, I could model the lower monitoring costs by assuming that the regulator's model is more likely to be correct when the information is truthful.

state. Remember, I am assuming that the regulator has limits on the punishments it can inflict. Here, I assume that the worst punishment is one that imposes the efficient level of capital.[7] With probability $1 - m$, the regulator observes nothing. In this case, the regulator imposes the high-type bank's allocation; that is, with probability $1 - p_h$, the bank raises capital $\overline{A}_{ND}$, and with probability p_h, the bank operates with zero capital.

So, when the regulator precommits not to disclose, the truth-telling constraint for the bank is given by

$$p_l[\beta (R - d(0,0)) + B] + (1 - p_l) \left[\alpha_l(R - d(\overline{A}_{ND}, \overline{A}_{ND})) - k\overline{A}_{ND}\right] \geq$$
$$m[\alpha_l(R - d(\overline{A}_{ND}, \overline{A}_{ND})) - k\overline{A}_{ND}]$$
$$+ (1 - m) \left[p_h[\beta (R - d(0,0)) + B] + (1 - p_h) \left[\alpha_l(R - d(\overline{A}_{ND}, \overline{A}_{ND})) - k\overline{A}_{ND}\right]\right].$$

Rearranging, we can rewrite this constraint as follows:

$$(p_l - (1 - m)p_h) \left[\beta (R - d(0,0)) + B - (\alpha_l(R - d(\overline{A}_{ND}, \overline{A}_{ND})) - k\overline{A}_{ND})\right] \geq 0.$$

The term in square brackets is always positive as long as the low-type bank prefers not to raise more capital—which holds under very general conditions and which I assume.[8] If this were not true, the ND policy would achieve first best even without the threat of monitoring. So, the truth-telling constraint can be written in a very simple form

$$p_l - (1 - m)p_h \geq 0. \tag{7}$$

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[7]Assuming that the maximal punishment for lying is the ex-post efficient level simplifies the incentive compatiability condition significantly, but it is not essential for my results. It is essential that regulators can't impose very large punishments. If they could, the ND regulatory regime would always be optimal because it would be nearly costless to induce truth-telling.

[8]The specific condition for this to hold is that $\frac{\beta}{\alpha_l} \left(1 - \frac{\eta\alpha_l + (1-\eta)\alpha_l}{\eta\alpha_h + (1-\eta)\beta}\right) + \left(k - \frac{\beta}{\alpha_l}\right) \overline{A}_{ND} > 0$. Note that the second term of the inequality is always positive since $k > 1$.

Intuitively, inducing the bank to reveal bad news requires forbearance; that is, with probability p_l the low-type bank must be allowed to hold too little capital and it will shirk. The degree of forbearance increases with the probability that the high-type bank operates with zero capital (p_h) and decreases with the effectiveness of the regulator's model (m), and, thus, the potency of the threat to impose the higher capital level should the bank misrepresent its type.

5.2 The Optimal ND Contract

Recall that depositors observe the amount of capital that the bank raises. If the bank doesn't raise capital, investors know that either the true state is high or that the true state is low and the regulator has exercised forbearance. Given, the regulator's strategy, depositors will price the claims accordingly. Let f denote the probability that the true state is high when the bank has not raised capital,

$$f \equiv \frac{\eta p_h}{\eta p_h + (1 - \eta)p_l},$$

and let g denote the probability that the true state is high when the regulator requires the bank to raise capital

$$g \equiv \frac{\eta(1 - p_h)}{\eta(1 - p_h) + (1 - \eta)(1 - p_l)}.$$

Then, the depositors' two participation constraints are

$$(f\alpha_h + (1 - f)\alpha_l)\, d(0, 0) = 1, \tag{8}$$

$$(g\alpha_h + (1 - g)\alpha_l)\, d(\overline{A}_{ND}, \overline{A}_{ND}) = 1 - \overline{A}_{ND}, \tag{9}$$

where $\overline{A}_{ND}$ is the minimum value that induces the bank to exert effort in the low state,

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$$(\alpha_l - \beta)\left(R - d(\overline{A}_{ND}, \overline{A}_{ND})\right) = B. \tag{10}$$

The regulator's objective is to choose capital levels and the probabilities of imposing different capital levels to maximize total surplus, $S_{ND}(p)$; that is, to maximize

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\begin{aligned}
S_{ND}(p_h, p_l) \;=\; & \eta p_h \left[\alpha_h(R - d(0,0))\right] \\
& + \eta(1 - p_h)\left[\alpha_h(R - d(\overline{A}_{ND}, \overline{A}_{ND})) - k\overline{A}_{ND}\right] \\
& + (1 - \eta)p_l[\beta\left(R - d(0,0)\right) + B] \\
& + (1 - \eta)(1 - p_l)\left[\alpha_l(R - d(\overline{A}_{ND}, \overline{A}_{ND})) - k\overline{A}_{ND}\right] - \eta c,
\end{aligned}
$$

subject to the depositors participation constraints (8) and (9), the truth-telling constraint (7), and the incentive compatibility constraint (10).

In the high state, the bank always exerts effort, but with probability $1 - p_h$, the bank is required to hold too much capital at cost $k\overline{A}_{ND}$. In the low state, the regulator exercises forbearance (and the bank shirks) with probability p_l, while with probability $1 - p_l$ the bank exerts effort because it is required to raise capital. Note that the regulator only has to monitor when the bank announces that the true state is h. This is a simple way to model the lower expected monitoring costs that are required when the banker is induced to communicate truthfully.

It is convenient to write $p_h = p$ and $p_l = p(1 - m)$, since expected surplus is maximized when truth-telling is satisfied with equality. Substituting these terms and (8) and (9) into S_{ND}, we get the expression:

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\begin{aligned}
S_{ND}(p) \;=\;& \eta p \alpha_h R \\
&+ \eta(1-p)\left[\alpha_h R - k\overline{A}_{ND}\right] \\
&+ (1-\eta)p(1-m)[\beta R + B] \\
&+ (1-\eta)\left(1 - p(1-m)\right)\left[\alpha_l R - k\overline{A}_{ND}\right] - 1 - \eta c, \qquad (11)
\end{aligned}
$$

where $\overline{A}_{ND} = 1 - (g\alpha_h + (1-g)\alpha_l)\left(R - \frac{B}{\alpha_l - \beta}\right)$, from (9) and (10).

I now derive the optimal ND regulatory policy. Maximizing $S_{ND}(p)$ with respect to p, we have the following lemma, which is proved in the appendix.

Lemma 1: The optimal ND policy is to set $p = 1$ when m is above some critical value $\widehat{m}$. For $m \leq \widehat{m}$, the optimal ND policy is to set $p = 0$.

Intuitively, the social cost of the ND policy is the level of forbearance required to induce truthful communication from the low-type bank, measured by $p(1-m)$. The better the regulator's model, the more powerful the regulator's threat to force the low-type bank to raise capital in the event of a untruthful communication, and thus, the less often the regulator has to allow the low-type bank to operate with too little capital. As long as the required level of forbearance is not too large, that is, as long as m is large enough, the regulator prefers to minimize the requirement that the high-type bank be forced to raise capital by setting $p = 1$. But if the cost of forbearance is too high, the optimal ND contract is to always require banks to raise capital and to induce effort in both the low- and high-states.[9] This follows from the assumption that the optimal pooling allocation requires efficient levels of effort, i.e., Assumption 5.

Now, let's turn to the regime with disclosure.

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[9] In principle, we could imagine cases in which p_h takes on a value between 0 and 1. We have no interior solution because S_{ND} is convex in p, as we show in the appendix.

6. Disclosure

The regulator commits to announce any information that it collects in the regulatory process, so the depositor faces no complicated inference problem. In turn, it is obvious that the low-type bank has no incentive to truthfully reveal its type to the regulator. In response to a truthful revelation that $i = l$, the regulator would announce that the state is low and would require the bank to raise capital. So, I assume that in both states, the bank claims to be a high-type bank and the regulator always monitors. When the regulator learns the true state through monitoring, it allows the high-type bank to operate without capital and requires the low-type bank to raise capital level $\widetilde{A}_D$. When the regulator's examination yields no information, Assumption 5 implies that its is optimal for the regulator to require the bank to raise capital level $\overline{A}_D$.

Depositors' participation constraints are given by

$$\alpha_h d_h(0, \widetilde{A}_D) \;=\; 1, \tag{12}$$

$$\alpha_l d_l(0, \widetilde{A}_D) \;=\; 1 - \widetilde{A}_D \tag{13}$$

when the regulator has observed the true state, and

$$(\eta \alpha_h + (1 - \eta)\, \alpha_l)\, d(\overline{A}_D, \overline{A}_D) = 1 - \overline{A}_D \tag{14}$$

when the regulator's monitoring has not been successful. The capital levels are the minimum levels required to satisfy incentive compatibility for the low-type bank,

$$(\alpha_l - \beta)\left(R - d_l(0, \widetilde{A}_D)\right) \;=\; B, \tag{15}$$

$$(\alpha_l - \beta)\left(R - d(\overline{A}_D, \overline{A}_D)\right) \;=\; B. \tag{16}$$

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The regulator's objective is to choose capital levels to maximize total surplus,

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\begin{aligned}
S_D \ = \ & m\eta\alpha_h \left[R - d_h(0, \widetilde{A}_D) \right] \\
& + m(1-\eta) \left[\alpha_l(R - d_l(0, \widetilde{A}_D)) - k\widetilde{A}_D \right] \\
& + (1-m)\eta \left[\alpha_h(R - d(\overline{A}_D, \overline{A}_D)) - k\overline{A}_D \right] \\
& + (1-m)(1-\eta) \left[\alpha_l \left(R - d(\overline{A}_D, \overline{A}_D) \right) - k\overline{A}_D \right] - c
\end{aligned} \tag{17}
$$

subject to depositor participation constraints (12)-(14) and bank incentive compatibility constraints (15) and (16).

Under the D regime, the bank exerts effort in all states of the world. When monitoring reveals that the true state of the world is high, the regulator does not need to require the bank to raise more capital to ensure that it exerts effort. When monitoring reveals that the true state of the world is low or when monitoring is unsuccessful, the regulator requires the bank to raise enough capital to enforce the efficient level of effort given the regulator's information. Because the regulator can't rely on truthful communication from the bank, the regulator always has to monitor.

7. The Choice Between No Disclosure and Disclosure

Let Δ denote the difference between the total surplus under the D and ND regimes. I will restrict attention to the case in which m is large enough that the ND regulator chooses $p = 1$. (For the moment, required capital levels are not written out in terms of the model parameters.)

$$\Delta \;\; = \;\; S_D - S_{ND}(1),$$

$$= \;\; \{m\eta\alpha_h R$$

$$+m(1-\eta)\left[\alpha_l R - (k-1)\widetilde{A}_D\right]$$

$$+(1-m)\eta\left[\alpha_h R - (k-1)\overline{A}_D\right]$$

$$+(1-m)(1-\eta)\left[\alpha_l R - (k-1)\overline{A}_D\right] - 1 - c\}$$

$$-\{\eta\alpha_h R$$

$$+(1-\eta)(1-m)[\beta R + B]$$

$$+(1-\eta)m\left[\alpha_l R - (k-1)\overline{A}_{ND}\right] - 1 - \eta c\}. \tag{18}$$

I have described the intuition for each term previously. (See the discussions preceding expression (11) and the discussion following expression (17).) Note that $p = 1$ means that in the ND regime, the high-type bank never has to raise capital; that is, $\eta(1-p) = 0$, and the ex-ante probability of the low-type bank having to raise capital—in the final line of (18)—is $(1-\eta)(1-p(1-m)) = (1-\eta)m$.

Proposition 1:

The D regime is preferred to the ND regime if and only if:

$$\Delta = (1-m)\left[(1-\eta)[(\alpha_l - \beta)R - B] - (k-1)\overline{A}_D\right] - (1-\eta)c \geq 0,$$

where,

$$\overline{A}_D = 1 - (\eta\alpha_h + (1-\eta)\alpha_l)\left(R - \frac{B}{\alpha_l - \beta}\right).$$

Proposition 1 is very intuitive. The ND regulator's policy of forbearance (plus the threat to force the bank to raise capital when it misrepresents the state) induces truthful communication from the bank, thereby requiring lower expected monitoring costs by $(1-\eta)c$. The expression in the square brackets is positive as long as $\langle \overline{A}_D, \overline{A}_D \rangle$ yields higher surplus than $\langle 0,0 \rangle$, which follows from Assumption 5. The cost of the ND regime is forbearance; that is, the bank operates with too little capital to induce effort in the low state with probability $(1-m)(1-\eta)$. The expected allocative cost of forbearance is measured by $(1-m)(1-\eta)[(\alpha_l - \beta)R - B]$. On the other hand, the D regulator always requires the bank to exert the efficient level of effort. The allocative cost of disclosure is that the bank is required to hold too much capital in the high state when the regulator's model is not informative, leading to expected net costs of $(1-m)(k-1)\overline{A}_D$.

The comparative statics—stated in Proposition 2—are straightfoward:

Proposition 2:

$$\frac{\partial \Delta}{\partial c} < 0, \frac{\partial \Delta}{\partial m} < 0,$$

$$\frac{\partial \Delta}{\partial \eta} \geq 0 \Leftrightarrow (1-m)\left[-[(\alpha_l - \beta)R - B] + (k-1)(\alpha_h - \alpha_l)\left(R - \frac{B}{\alpha_l - \beta}\right)\right] + c \geq 0.$$

Clearly, as monitoring costs (c), rise the D regime is less likely to dominate because the ND regime economizes on monitoring costs. Less obviously, as the quality of the regulator's model increases, that is, as m increases, the ND regime is more likely to dominate. Here, the intuition is that the allocative inefficiency of forbearance in the ND regime, relative to the inefficiency of requiring too much capital in the D regime, becomes less important as the regulator's model becomes more accurate. (In the limit, as the regulators' model perfectly identifies the state, there are no allocative

inefficiencies in either regime.) Near this limit, the ND regime dominates because it economizes on monitoring costs. Thus, our model predicts that disclosure is more likely to dominate when the regulator's model is not very accurate.

The effect of an increase in the probability of the high state η depends on the parameters in a sensible way. The two terms in the square brackets summarize how an increase in the probability of the high state affects the relative allocative efficiency of the two regimes. Forbearance is the allocative cost of the ND regime; a rise in the probability of the high state reduces the expected costs of forbearance and the ND regime is more likely to dominate. The second term in the square brackets measures the effect of a rise in the probability of the high state on the excess capital required by the D regulator. Since the probability of default is lower when η is higher, the amount of capital required to induce effort by the low-type bank is lower and the D regime is more likely to dominate. Finally, since the ND regulator always monitors in the high state, a rise in the probability of the high state increases the expected monitoring costs of the ND regulator and, thus, increases the likelihood that the D regime dominates.

8. Conclusion

Although the debate about disclosure of stress test results has been particularly active during the years since the financial crisis, there is a long-running debate about whether regulatory bank examinations should be made public and, if so, at what level of detail. Of concern in the regulatory community is that the confidentiality of the examination process promotes frank exchanges between bankers and examiners and that public disclosure of examination results would have a chilling effect. My model takes this concern seriously and examines the tradeoffs in a world where examination results can be kept confidential, but regulatory interventions are observable by market participants, as they typically are for stress tests.

In this setting, regulators must engage in forbearance to ensure truthful communications from bankers and this policy of forbearance is priced into the firms uninsured debt, thereby raising the costs of inducing frank communication. The regulator that discloses examination results does not engage in forbearance, but bears higher monitoring costs and imposes excessive capital requirements because it cannot tailor its interventions as sensitively to underlying risks as the regulator that has received more information from bankers. My model predicts that disclosure is more likely to be optimal when the regulatory model is relatively inaccurate.

Figure 1 Timeline of actions and information

Date 1

↓

Bank observes state i

↓

Bank communicates with regulator

↓

Regulators monitors state at cost c

↓

Regulator imposes capital requirement

↓

Bank sells debt and equity claims

↓

Bank chooses effort level

Date 2

Project returns are realized

↓

Bank makes payments to claimants

Appendix

Proof of Lemma 1

Differentiating S_{ND} with respect to p and collecting terms,

$$
\begin{aligned}
\frac{\partial S_{ND}(p)}{\partial p} &= -(1-\eta)(1-m)\left[(\alpha_l - \beta)R - B\right] \\
&\quad - \left[\eta(1-p) + (1-\eta)(1-p(1-m))\right](k-1)\frac{\partial \overline{A}_{ND}}{\partial p} \\
&\quad + \left[\eta + (1-\eta)(1-m)\right](k-1)\overline{A}_{ND}
\end{aligned}
$$

and

$$
\begin{aligned}
\frac{\partial^2 S_{ND}(p)}{\partial p^2} &= 2\left[\eta + (1-\eta)(1-m)\right](k-1)\frac{\partial \overline{A}_{ND}}{\partial p} \\
&\quad + \left[\eta(1-p) + (1-\eta)(1-p(1-m))\right](k-1)\frac{\partial^2 \overline{A}_{ND}}{\partial p^2}
\end{aligned}
$$

where,

$$
\frac{\partial \overline{A}_{ND}}{\partial p} = -\frac{\partial g}{\partial p}(\alpha_h - \alpha_l)\left(R - \frac{B}{a_l - \beta}\right) > 0,
$$

and

$$
\frac{\partial^2 \overline{A}_{ND}}{\partial p^2} = -\frac{\partial^2 g}{\partial p^2}(\alpha_h - \alpha_l)\left(R - \frac{B}{a_l - \beta}\right) > 0.
$$

So $\frac{\partial^2 S_{ND}(p)}{\partial p^2} > 0$. and $S_{ND}(p)$ is maximized either at $p = 0$ or $p = 1$. Note, if $p = 0$ maximizes $S_{ND}(p)$, there is no value in truthful communication and no reason for the regulator to bear costly monitoring expenses to induce truthful communication. In this case, either there is no value to regulation or the D regime is optimal. Now,

$$S_{ND}(0) - S_{ND}(1) = (1 - \eta)(1 - m) \left[(\alpha_l - \beta)R - B \right]$$
$$- (k - 1) \left[1 - (1 - \eta)m - [\eta\alpha_h + (1 - \eta)(1 - m)\alpha_l] \left(R - \frac{B}{\alpha_l - \beta} \right) \right],$$

so,

$$[S_{ND}(0) - S_{ND}(1)]_{m=0} = (1 - \eta) \left[(\alpha_l - \beta)R - B \right]$$
$$- (k - 1) \left[1 - (\eta\alpha_h + (1 - \eta)\alpha_l) \left(R - \frac{B}{\alpha_l - \beta} \right) \right]$$
$$= (1 - \eta) \left[(\alpha_l - \beta)R - B \right] - (k - 1)\overline{A} > 0,$$

by Assumption 5 and

$$[S_{ND}(0) - S_{ND}(1)]_{m=1} = -(k - 1)\eta \left[1 - \alpha_h \left(R - \frac{B}{\alpha_l - \beta} \right) \right] < 0,$$

by Assumption 3. Finally, we note that $[S_{ND}(0) - S_{ND}(1)]$ is linear in m. This proves Lemma 1.

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