Runs versus Lemons: Fiscal Capacity and Financial Stability

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May 5 2014

Preliminary and Incomplete.

Abstract

We study the link between fiscal capacity and financial stability in an economy that is subject to runs and to adverse selection. The planner in our economy faces a rich set of policy options: it can disclose information about banks' assets, it can intervene to stop bank runs, recapitalize banks and intervene in credit markets. In any intervention, the planner faces a tradeoff between mitigating adverse selection and causing inefficient bank runs. Reducing adverse selection increases welfare by increasing investment in positive NPV projects, but revealing information can trigger bank runs and inefficient liquidation. We find that the optimal policy depends on the fiscal capacity available to the planner. When capacity is ample, the planner chooses to reveal information and provide liquidity to banks that are run on; conversely, when capacity is low, the planner prefers to hide information and mitigate adverse selection by intervening in credit markets. Our model sheds light on optimal intervention and provides an explanation for the different choices that countries make in response to financial crises.

JEL: E5, E6, G1, G2.

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1 Introduction

Since the beginning of the financial crisis, the balance sheets of sovereigns and their financial institutions have become intertwined. This is in fact a generic feature of financial crises as argued in Reinhart and Rogoff (2009). Gorton (2012) shows that government interventions always play an important role in stopping financial panics. Governments use various tools to intervene during financial crises, but different government use different tools and with varying degrees of success. Our goal is to understand these choices and their consequences.

In October 2008, the US government decided to inject cash into banks under the Troubled Asset Relief Program. In May 2009, the Federal Reserve publicly reported the results of the Supervisory Capital Assessment Program (SCAP). The SCAP, known as the banking stress test, was an assessment of the capital adequacy under adverse scenarios of a large subset of US financial firms. The exercise is broadly perceived as having been successful in reducing uncertainty about the state of the US financial system and helping to restore calm to financial markets.

The Committee of European Banking Supervisors (CEBS) also conducted an EU-wide stress test from May-October 2009, the results of which were not made public. A year later the exercise was repeated, but the results of the stress test, including bank-by-bank results, were published. In both cases, the stress tests are regarded as having been ineffective in restoring confidence to the financial sector. [1]

What explains this marked difference in the success of stress tests as a means of restoring financial stability? We propose a model that highlights the tradeoffs faced by a regulator in deciding how much information about the financial system to make public.

We study optimal interventions by a planner in an economy that features adverse selection in the spirit of Akerlof (1970) and Stiglitz and Weiss (1981) as well as bank runs as in Diamond and Dybvig (1983). Our economy is populated by short-term funded intermediaries that differ in the quality of their existing assets.[2] The quality of these legacy assets is private information to each bank. In order to invest in new projects with positive net present value, banks must raise additional funds from the credit market. Asymmetric information about the quality of existing assets creates adverse selection in the credit market, leading to inefficiently high interest rates and low investment in the decentralized equilibrium. The planner might be able to improve welfare by disclosing information about banks' types. But runs make information disclosure potentially costly. If short term creditors (depositors) learn that a particular bank is bad, they might decide to run. Runs are inefficient for two reasons: there is a liquidation discount on the assets of banks that suffer a run, and liquidated banks cannot invest in new projects.

In this environment, a planner has a large set of potentially welfare improving policy tools at its disposal: asset quality reviews and stress tests, recapitalizations, 'bad banks', liquidity support, among others. This paper provides a model through which the tradeoffs involved in the choice of these policies can be studied. We focus on combinations of two types of policies: information revelation (a 'stress test' or 'asset quality review') and fiscal

[1] Ong and Pazarbasioglu (2013) provide a thorough overview of the details and perceived success of SCAP and the CEBS stress tests.
[2] We have in mind all short term runable liabilities: MMF, Repo, ABCP, and of course large uninsured deposits. In the model, for simplicity, we refer to intermediaries as banks and liabilities as deposits.

intervention by the planner. The motivation for this focus is the ongoing interest in the academic literature and among practitioners in the (de)merits and perceived effectiveness of bank stress tests.

We are particularly interested in the effect that the fiscal capacity available to a planner for the implementation of a given policy has on the optimal choice of policy. The planner in our model must pay for its interventions with distortionary taxation. It may also have pre-existing obligations that it must pay for in the future. The extent to which taxation is distortionary and the magnitude of pre-existing spending commitments determine fiscal capacity.

Our main result is that a planner's fiscal capacity shapes the optimal policy. When fiscal capacity is high, it is optimal for the planner to reveal information in a transparent manner and provide liquidity to at least a subset of banks that suffer a run, such that these banks survive and are able to invest in profitable projects. When capacity is low, the planner prefers to avoid runs by not revealing each bank's type, and then mitigate the resulting adverse selection in the credit market by providing loans and credit guarantees.

We study two extensions of our basic model. In one extension, we show that aggregate uncertainty reinforces our results. We find that government with low fiscal capacity are effectively risk averse, and this makes them unwilling to risk runs by disclosing information.

2 Related literature

Our work builds on the rich literature that studies asymmetric information, following Akerlof (1970), Spence (1974), and Stiglitz and Weiss (1981). If no information is revealed by the planner, our economy very closely resembles the one studied by Philippon and Skreta (2012) and Tirole (2012). The optimal policy in the case in which information is not fully revealed is similar to theirs.

Since we add bank runs to an economy with asymmetric information, we also build on the large literature started by Diamond and Dybvig (1983). Several recent papers study specifically the tradeoffs involved in revealing information about banks. Goldstein and Leitner (2013) focus on the tradeoff between a market breakdown due to asymmetric information and the Hirshleifer (1971) effect: revealing too much information destroys risk-sharing opportunities between risk-neutral investors and (effectively) risk averse bankers. These risk-sharing arrangements play an important role in Allen and Gale (2000). Parlatore Siritto (2013) studies a Diamond and Dybvig (1983) type economy with aggregate risk in which more precise information about realizations of the aggregate state can lead to more bank runs. A simple way to think about disclosure in models of bank runs is to view disclosure as a way to break pooling equilibria. Whether disclosure is good or bad then simply depends on whether the pooling equilibria is desirable. If agents pool on the "no run" equilibrium then there is no reason to disclose information. And of course this is more likely to happen in good times as long as we consider "refined" equilibria a la Carlsson and van Damme (1993) and Morris and Shin (2000) where fundamentals matter. On the other hand, in bad times, agents might run on all the banks, in which case it is better to disclose information to save at least the good banks.

This is the basic result of Bouvard, Chaigneau, and de Motta (2013), who also consider ex-ante disclosure rule that allow pooling across macroeconomic states. Gorton and Metrick (2012) investigate how uncertainty about bank insolvency (and, implicitly, the quality of bank portfolios) leads to increases in repo haircuts that, allied with declining asset values, cause several institutions to become insolvent. Shapiro and Skeie (2013) study reputation concerns by a regulator in a tradeoff between moral hazard and runs. None of these papers model new lending and borrowing by banks and therefore cannot address the tradeoff between unfreezing credit markets and triggering bank runs. Gorton and Ordonez (2014) consider a model where crises occur when investors have an incentives to learn about the true value of otherwise opaque assets. In our model it is optimal to disclose starting with bad types. This is consistent with what 19th century clearing houses did to stem financial panics, and also with current regulatory practice. (Gorton, 2012)

Our paper relates to the theoretical literature on bank bailouts. Gorton and Huang (2004) argue that the government can bail out banks in distress because it can provide liquidity more effectively than private investors. Diamond and Rajan (2005) show that bank bailouts can backfire by increasing the demand for liquidity and causing further insolvency. Diamond (2001) emphasizes that governments should only bail out the banks that have specialized knowledge about their borrowers. Aghion, Bolton, and Fries (1999) show that bailouts can be designed so as not to distort ex-ante lending incentives. Farhi and Tirole (2010) examine bailouts in a setting in which private leverage choices exhibit strategic complementarities due to the monetary policy reaction. Corbett and Mitchell (2000) discuss the importance of reputation in a setting where a bank's decision to participate in a government intervention is a signal about asset values, and Philippon and Skreta (2012) formally analyze optimal interventions when outside options are endogenous and information-sensitive. Mitchell (2001) analyzes interventions when there is both hidden actions and hidden information. Landier and Ueda (2009) provide an overview of policy options for bank restructuring. Philippon and Schnabl (2013) focus on debt overhang in the financial sector. Diamond and Rajan (2012) study the interaction of debt overhang with trading and liquidity. In their model, the reluctance to sell assets leads to a collapse in trading which increases the risks of a liquidity crisis.

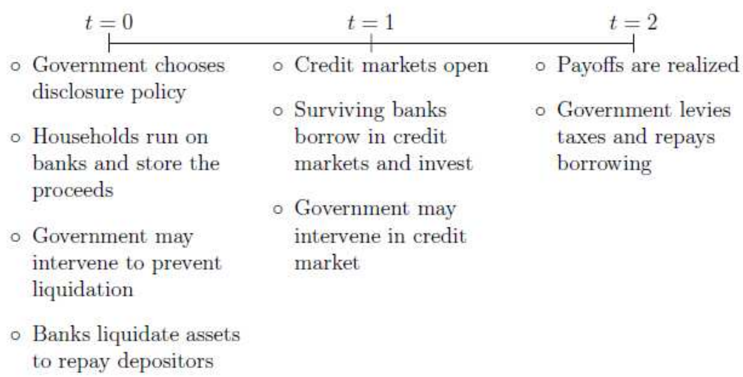
Goldstein and Sapra (2013) review the literature on the disclosure of stress tests results. They explain that stress tests differ from usual bank examinations in four ways: (i) traditional exams are backward looking, while stress tests project future losses; (ii) the projections under adverse scenarios provide information about tail risks; (iii) stress tests use common standards and assumptions, making the results more comparable across banks; (iv) unlike traditional exams that are kept confidential, stress tests results are publicly disclosed. They list two benefits of disclosure: (i) enhanced market discipline; (ii) enhanced supervisory discipline. Our model is based on another benefit, namely the unfreezing of the credit market. They list four costs of disclosure: (i) disclosure might prevent risk sharing through Hirshleifer (1971)'s effect, which is the focus of Goldstein and Leitner (2013); (ii) improving market discipline is not necessarily good for ex-ante incentives; (iii) disclosure might trigger runs; (iv) disclosure might reduce the ability of regulators to learn from market prices, as in Bond, Goldstein, and Prescott (2010). Our model is based on cost (iii).

3 Model

3.1 Technology and Preferences

The economy is populated by a continuum of households, a continuum $[0,1] \times [0,1]$ of financial intermediaries (banks), and a government. There are three dates, $t = 0, 1, 2$. Figure 1 summarizes the timing of decisions in the model, which are explained in detail below.

Figure 1: Timing



Households Households are risk-neutral and their utility depends only on consumption at $t = 2$. At times 0 and 1 they have access to a storage technology that pays one unit of consumption at time 2 per unit invested. There is no discounting. This allows us to treat total output at time 2 (which equals total consumption) as the measure of welfare that the government seeks to maximize.

Banks Banks may be of either good (g) or bad (b) type; a bank's type is private information. There is a continuum of classes of banks, each populated by a continuum of banks (hence a continuum $[0,1] \times [0,1]$ of banks). Classes are indexed by the proportion s_j of bad banks in the class. The key object in our model is the set of private sector beliefs about the proportion of bad banks in each class; we denote the private sector's prior beliefs by $s_{j,0}\ \forall\, j \in [0,1]$.

Banks start with existing assets and liabilities which can be thought of as any type of short-term demand liabilities: demand deposits, money market funds, repo, etc., but which we refer to as deposits for simplicity. Legacy assets deliver a payoff $a = A^i$ for $i \in \{g, b\}$ at $t = 2$. The short-term demand liabilities entitle a depositor to $D > 1$ at $t = 2$ or their face value of 1 if withdrawn earlier. We impose the following ordering of magnitudes

Assumption 1 *Good banks are safe, bad banks are risky*

$$A^g > D > 1 > A^b \geq 0,$$

This assumption implies that legacy assets of good banks are large enough to cover liabilities, but those of bad banks are not. Demand deposits are senior to any other claims on the bank, and may be withdrawn at any time. This induces a maturity mismatch problem, and makes banks vulnerable to runs.

At $t = 0$, before credit markets open, banks have access to a liquidation technology that yields $\delta \in [0, 1]$ units of the consumption good per unit of asset liquidated. The liquidation value of assets is δA^i for $i \in \{g, b\}$. In the event of a run, banks use this liquidation technology to meet depositors' demand for funds.

At $t = 1$, banks receive investment opportunities. All new investments cost the same fixed amount k and deliver random income v at $t = 2$, which does not depend on the type. Investment income is $v = V$ with probability q and 0 with probability $1 - q$.

3.1.1 Government

The government in our model has access to three policies: a *disclosure* technology (via an asset quality review for instance)[3] that can reveal each bank's type, and two types of *fiscal intervention*. The government can provide deposit insurance to prevent runs on banks, and it can provide loans directly to banks (equivalently, provide credit guarantees). To fund these fiscal interventions, the government borrows in international markets at the storage rate. At $t = 2$ borrowing is repaid in full and the government raises distortionary taxes to pay for the costs of programs.

The disclosure technology makes public the type of a bank, eliminating asymmetric information. We summarize the information set of the private sector after disclosure by common posterior beliefs $s_{j,1}$, $\forall\ j \in$, $[0, 1]$ about the proportion of bad banks in each class. The advantage of disclosure is that changing beliefs about the proportion of bad banks in a class may mitigate adverse selection in a given class' credit market; as we explain below, this may come at the cost of triggering costly runs on banks. We assume the disclosure technology is available at $t = 0$.

The fiscal interventions are described in section 5.

To pay for costs arising from fiscal interventions, the government levies distortionary taxes at $t = 2$. We assume that the deadweight costs of taxation are quadratic and scaled by a parameter γ. Denoting by Ψ the costs of fiscal interventions, the total welfare loss from taxation is $\gamma\Psi^2$.

3.1.2 Runs on Deposits at $t = 0$

Demand depositors can withdraw their deposits from banks at any time. The structure of our economy is such that new information about banks is not revealed at any time after $t = 0$, so we only consider the possibility of banks runs in that period. Before $t = 2$, when asset payoffs are realized, banks have to liquidate assets in order to pay

[3]Note that without aggregate uncertainty there is no meaningful distinction between a stress test and an asset quality review.

depositors that withdraw using an inefficient liquidation technology that yields δA^i per unit of asset liquidated. To simplify the analysis, we assume that banks that make use of this technology loose the investment opportunity at $t = 1$.

We denote by λ the fraction of assets that is liquidated and x the fraction of depositors in a given bank that run. If a fraction λ of a banks assets are liquidated, the bank generates $\lambda\delta A^i$ at $t = 0$ and $(1 - \lambda)A^i$ at $t = 2$.

We assume that good banks are safe even under a full run, $\delta A^g > 1$. Consider the decision problem of a depositor in a bank that is known to be good. Withdrawing early yields 1 with certainty even if every other depositor runs. Waiting yields the minimum of the promised payment D and a pro-rata share of the residual value of the bank,

$$\min\left(D, \frac{(1-\lambda)A^g}{1-x}\right)$$

When a full run occurs $x = 1$ and $\lambda = \frac{1}{\delta A^g} < 1$, so the above expression is always equal to D. The implication is that even if every other depositor runs, a depositor prefers to wait because $D > 1$, so the unique equilibrium for a bank known to be good is no run, $x = 0$ and $\lambda = 0$.

For bad banks, because $\delta A^b < 1$, when $x = 1$, $\lambda = 1$ and the payoff to waiting is 0, so a full run is an equilibrium. Suppose now that there is no run. Withdrawing yields 1 and waiting yields $qD + (1 - q)A^b$. We assume:

$$qD + (1-q)A^b \leq 1 \Leftrightarrow q \leq \frac{1 - A^b}{D - A^b}$$

Therefore running is a dominant strategy even no one else runs. This means that a full run is the only equilibrium if the bank is known to be bad.

The above logic means that for $s_{j,0} = 0$, no run is the only equilibrium and for $s_{j,0} = 1$, a full run is the only equilibrium. What if $s_{j,0} \in (0, 1)$? We can derive conditions $\underline{s}_0$ and $\bar{s}_0$ that bound the unique equilibrium regions (from below and above respectively). The no run bound $\underline{s}_0$ must be such that a depositor with prior belief $s_{j,0} = \underline{s}_0$ is indifferent between running or not if a full run takes place. Conversely, a depositor with belief $s_{j,0} = \bar{s}_0$ is indifferent between running or not if no other depositors run. These bounds are

$$\underline{s}_0 = \frac{D - 1}{D - 1 + \delta A^b} \in (0, 1)$$

and

$$\bar{s}_0 = \frac{D - 1}{(1-q)\left(D - A^b\right)} \leq 1$$

For beliefs in the set $[\underline{s}_0, \bar{s}_0]$ multiple equilibria exist. We follow a common approach in the literature on equilibrium selection in models of bank runs (for example, Cooper and Ross (1998)) and use the realization of an exogenous sunspot variable as an equilibrium selection device. Let $\sigma \sim F$ with support $[0, 1]$ be a random variable that defines a class s_0^σ given by

$$s_0^\sigma = \sigma \underline{s}_0 + (1-\sigma)\,\bar{s}_0$$

such that all classes $s_{j,0} > s_0^\sigma$ suffer a full run and classes below this cutoff are spared from runs.

3.1.3 Borrowing Contracts at $t = 1$

At $t = 1$, banks do not have any cash and need to borrow l to take advantage of the investment opportunity. As is standard in the security design and corporate finance literature, we assume that only total income at time 2, $y = a + v$ is contractible

$$y(i) = a + i.v$$

where $i = 1$ if the bank invests and $i = 0$ otherwise. The amount that banks need to borrow to invest is $l = k \cdot i$. This new borrowing is junior to deposits. Letting r denote the (gross) interest rate between time 1 and 2, we have the following payoffs for long term debt holders (depositors), new lenders (at time 1) and equity holders

$$\begin{aligned} y^D &= \min(a + v \cdot i + D, D) = D \\ y^l &= \min(a + v \cdot i, rl) \\ y^e &= a + v \cdot i - y^l \end{aligned}$$

Assumption 4 *(Positive NPV)*: $\mathbb{E}[v] > k$

Finally, we assume that households receive an endowment y_1 at time 1 that is enough to sustain full investment.

Assumption 5 *(Full Investment is Feasible)*: $y_1 > k$

4 Equilibrium

4.1 Welfare at time 2

We start by analyzing output (and welfare) at time 2, when payoffs from long-term assets, investment, deposits and storage are realized. The government repays its $t = 0, 1$ borrowing by levying distortionary taxes τ that entail a real resource cost.

Since we assume that households are risk-neutral, aggregate welfare coincides with aggregate output. Given a sunspot σ and government intervention Ψ, welfare is

$$
\begin{aligned}
W(\sigma,\Psi) = y_1 &+ \int_0^{\bar{s}_1} \left[sA^b + (1-s)A^g + qV - k\right] \mathrm{d}H(s) \\
&+ \int_{\bar{s}_1}^{s_0^\sigma} \left[sA^b + (1-s)A^g + s(qV-k)\right] \mathrm{d}H(s) \\
&+ \int_{s_0^\sigma}^{1} \delta \left[sA^b + (1-s)A^g\right] \mathrm{d}H(s) - \gamma\Psi^2
\end{aligned}
$$

The first term is households' period 1 endowment. The second term corresponds to the total output generated by banks in classes that do not suffer a run or adverse selection in the credit market. The third term corresponds to the output of classes that do not suffer a run but have suboptimally low investment and the fourth term is the value in liquidation of the assets of banks that suffer full runs. The final term is the deadweight loss of taxation.

4.1.1 First-Best Equilibrium

New projects have a positive net present value (assumption 3.1.3), bank runs entail costly asset liquidation and taxation is distortionary. This means that in the first-best equilibrium, every bank invests and there is no distortionary taxation. First-best welfare is then

$$
W^{FB} = y_1 + \int_0^1 \left[sA^b + (1-s)A^g + qV - k\right] \mathrm{d}H(s)
$$

4.2 Equilibrium at time 1

To proceed we assume that the junior debt taken on by good banks to finance the investment opportunity is safe: $A^g - D > rk$. Good banks find it profitable to invest if and only if

$$
\begin{aligned}
A^g - D + qV - rk &\geq A^g - D \\
r &\leq r^g \equiv \frac{qV}{k}
\end{aligned}
$$

Bad banks earn $q(V - D + A^b - rk)$ if they invest, and 0 otherwise, so they invest if and only

$$
\begin{aligned}
q(V - D + A^b - rk) &\geq 0 \\
r &\leq r^b \equiv \frac{V - \left(D - A^b\right)}{k}
\end{aligned}
$$

Our interest is in studying situations where the information asymmetry in our economy induces adverse selection in the $t = 1$ credit market, creating a role for government interventions via information disclosure or credit market polices (as in Philippon and Skreta (2012)). This requires that the fair interest rate when only bad types invest exceeds the maximum interest rate at which good types are willing to invest, which is equivalent to imposing

$q \le \sqrt{\frac{k}{V}}$. Since liabilities are risky in our model it may be the case that even in the absence of assymetric information underinvestment occurs in the private equilibrium due a debt overhang problem as in Philippon and Schnabl (2013). For most of the paper we ensure that this is not the case by imposing $q \ge \frac{k}{V-D}$.

Assumption 2 *The private equilibrium of the $t = 1$ credit market features adverse selection but no debt overhang.*

$$\frac{k}{V-D} \le q \le \sqrt{\frac{k}{V}}.$$

Since bad banks repay junior creditors with probability q and storage yields a gross return of 1, the fair interest rate for bad types is equal to $\frac{1}{q}$. It follows that if only bad types invest, the market interest rate is $\frac{1}{q}$. At that rate, under the assumptions above, the good types would not invest. This means that $r = \frac{1}{q}$ and $i(1) = 0$ is always a possible equilibrium and this can create potentially multiple equilibria in the credit market. We rule them out by assuming that the best pooling equilibrium happens[4].

If good types also invest, the interest rate must satisfy the break-even condition for lenders

$$k = (1 - s_{j,1})rk + s_{j,1}qrk$$

yielding

$$r_j = \frac{1}{1 - s_{j,1} + s_{j,1}q}$$

Note that for good types to invest, the interest rate must satisfy $r \le \frac{qV}{k}$. Equating good banks' participation constraint with lenders' breakeven constraint we can define a threshold posterior $\bar{s}_1$ such that below this threshold all banks invest and above it only bad banks do so:

$$\bar{s}_1 = \frac{1 - \frac{k}{qV}}{1 - q}$$

To summarize, the credit market equilibrium is:

- If $s_{j,1} > \bar{s}_1$, only bad types invest in market j and the interest rate is $r_j = \frac{1}{q}$
- If $s_{j,1} \le \bar{s}_1$, both good and bad types invest and the interest rate is $r_j = \frac{1}{1-s_{j,1}+s_{j,1}q}$

The nature of the equilibrium at time 1, when the credit market opens, depends on whether the planner decides to disclose or not at $t = 0$. We proceed by analyzing the two equilibria separately.

[4]When we consider credit market internventions, this assumption is without loss of generality because the government can always costlessly implement the best pooling by setting the interest rate appropriately.

4.2.1 Equilibrium at time 1 with no disclosure

4.2.2 Equilibrium at time 1 with full disclosure and bank runs

Suppose now that the government adopts a policy of full disclosure at $t = 0$. As we have seen, banks with $\theta \leq \tilde{\theta}$ suffer a run and their assets are liquidated at cost λ. The total number of banks that suffer a run is then given by $\delta = H\left(\tilde{\theta}\right)$. All banks that survive the run have their portfolio quality disclosed, allowing each of them to borrow at a fair interest rate r_θ. The break-even condition for lenders becomes

$$k = \rho(\theta, r_\theta k)$$

Since $\bar{v} > k$ by assumption 3.1.3, all banks invest at the fair interest rate.

Proposition 1. *With full disclosure about bank types θ, there is a run on all banks with $\theta \leq \tilde{\theta}$, and all surviving banks invest. The efficient outcome is sustainable without government intervention if and only if $\tilde{\theta} = 0$.*

Proof. Total welfare under full disclosure is given by

$$W^{\mathcal{D}} \equiv W\left(\left[0, \tilde{\theta}\right], \left[\tilde{\theta}, 1\right], g_0\right) = y_1 + \lambda \int_0^{\tilde{\theta}} (D + \theta A)\, \mathrm{d}H(\theta) + \int_{\tilde{\theta}}^1 (D + \theta A)\, \mathrm{d}H(\theta) + \left[1 - H\left(\tilde{\theta}\right)\right](\bar{v} - k) - \gamma g_0^2 \quad (1)$$

The simplification arises from the fact that regardless of the size of the run, $\lambda(D + \theta A) < \frac{\lambda(D+\theta A) - x(\theta)}{\chi} + x(\theta)$, so the output of banks that suffer a run is simply equal to $\lambda(D + \theta A)$.

$$W^{\mathcal{D}} = W^{\star} - (1 - \lambda) \int_0^{\tilde{\theta}} (D + \mathbb{E}[a|\theta])\, \mathrm{d}H(\theta) - H\left(\tilde{\theta}\right)(\bar{v} - k),$$

so $W^{\mathcal{D}} = W^*$ if and only if $\tilde{\theta} = 0$. □

5 Fiscal Interventions

5.1 Credit Bailout: Optimal Intervention to Unfreeze Credit Market without Disclosure

In classes that do not suffer a run but are subject to underinvestment due to adverse selection, $s_j \in [\min(\bar{s}_1, s_0^\sigma), s_0^\sigma]$, the government can promote full investment by offering a credit subsidy to certain banks in the class. This consists on setting the interest rate $r_j = r^g = \frac{qV}{k}$, so that good banks in these classes are willing to invest. Note that for any class s_j, the policy consists of either setting $r = r^g$ or doing nothing, since setting $r \in \left(r^g, \frac{1}{q}\right]$ is costly for the government and does not contribute to mitigating adverse selection. Setting $r_j < \frac{qV}{k}$ is also expensive and cannot increase investment further.

Let us look at how this policy works for a specific class s_j. Let t_j be the number of banks in this class that borrow directly from the government at interest rate $r_j = \frac{qV}{k}$. Since all banks in this class have the opportunity of participating in the program and borrowing from the government, this number t_j must be such that the private credit market clears at the same interest rate $r_j = r^g$. The government then seeks to set t_j such that the break-even condition for private lenders is satisfied at this interest rate. This means that the government will necessarily have to support bad banks only, so as to make private investors willing to lend at a lower interest rate. The break-even condition is

$$(1 - t_j)k = (1 - s_j)r^g k + (s_j - t_j)qr^g k$$

This yields

$$t_j = \frac{1 - r^g[1 - s_j(1 - q)]}{1 - qr^g} = \frac{1 - \frac{qV}{k}[1 - s_j(1 - q)]}{1 - q\frac{qV}{k}}$$

This means that the government lends $t_j k$ at $t = 1$ for an expected return of $t_j qr^g k$ at $t = 2$. The total (net) cost of supporting class s_j is then

$$\Psi^b(s_j) = t_j k(1 - qr^g) = k - qV + (1 - q)qV s_j$$

Note that this cost is always strictly positive, since $s_j \geq \bar{s}_1$, and is increasing in s_j. It is more costly to mitigate adverse selection in classes with a higher proportion of bad types.

What are the welfare gains of this policy? In the absence of intervention, the social surplus generated by class s_j would be

$$s_j A^b + (1 - s_j)A^g + s_j(qV - k)$$

with the policy in place, the surplus is the same with the difference that all types now invest. The net gain is then

$$(qV - k)(1 - s_j)$$

Note that the welfare gains are decreasing in s_j: the benefit of this policy is to make good banks in class s_j invest. However, classes with higher s_j have a lower proportion of good banks, so the total gains of making good banks invest are smaller. Since benefits are decreasing and costs are increasing, the government chooses an optimal threshold s^b such that all classes $s_j \in [\min(\bar{s}_1, s_0^\sigma), s^b]$ are bailed out, while classes $s_j \in [s^b, s_0^\sigma]$ suffer no intervention. The total costs of this policy are

$$\Psi^b = \int_{\bar{s}_1}^{s^b} [k - qV + (1 - q)qVs] \, \mathrm{d}H(s)$$

and total welfare is

$$
\begin{aligned}
W(\sigma, \Psi^b) = y_1 &+ \int_0^{\min(s^b, s_0^\sigma)} \left[sA^b + (1-s)A^g + qV - k\right] \mathrm{d}H(s) \\
&+ \int_{\min(s^b, s_0^\sigma)}^{s_0^\sigma} \left[sA^b + (1-s)A^g + s(qV-k)\right] \mathrm{d}H(s) \\
&+ \int_{s_0^\sigma}^{1} \delta \left[sA^b + (1-s)A^g\right] \mathrm{d}H(s) - \gamma(\Psi^b)^2
\end{aligned}
$$

The first line is the endowment and the surplus generated by all classes that feature full investment. The second line corresponds to all classes that are not intervened upon but do not suffer a run. The third line is the surplus generated by all banks that suffer a run and liquidate their assets, minus the fiscal costs of the program. The government solves

$$
\max_{s^b} W(\sigma, \Psi^b)
$$

The first-order condition is

$$
\mathbf{1}[s^b \leq s_0^\sigma](qV-k)(1-s^b) = 2\gamma\Psi^b[k - qV + (1-q)qVs^b]
$$

Clearly, the government sets $s^b \in [\bar{s}_1, s_0^\sigma]$, not intervening if this interval is degenerate (in this case, all adverse selection is "cleaned" by bank runs). Note that marginal benefits are positive or $s^b < 1$, while marginal costs are zero for s^b close to $\bar{s}_1$. This implies that the optimal intervention is strictly positive, conditional on $[\bar{s}_1, s_0^\sigma] \neq \varnothing$. It is also easy to show that $\frac{\mathrm{d}s^b}{\mathrm{d}\gamma} < 0$: the size of the optimal intervention is increasing in fiscal capacity.

5.2 Deposit Guarantees

5.3 Disclosure Choice with Fiscal Capacity

A Calibration

To generate all the Figures, we use the calibration in the following table.

Table 1: Calibration for Numerical Examples

Parameter	Description	Value
A	Asset Payoff	2.4
D	Deposits	1.2
V	Project Payoff	$\frac{k(1+R)}{q}$
q	Prob. Success	0.4
k	Investment Cost	2
γ	MC Govt. Spending	1
φ	Cost of Deposit Replacement	$0.5/D$
χ	Bank Storage	0.85
$H(\theta)$	Distr. Types	$\mathcal{U}[0,1]$

When not varying, we set $\frac{\bar{v}}{k} - 1 = 0.3, \lambda = 0.5$.

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