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# Financial Distress and Banks' Communication Policy in Crisis Times

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**ABSTRACT:**

This short paper analyzes banks' communication policies in crisis times and the role of imperfect information in enhancing banks' distress. If banks differ in their exposure to risky assets, fragile banks may claim to be solid only in order to manipulate investors' expectations. Then solid banks must pay a larger interest rate than in a perfect information set-up. A stronger sanction for false information would improve the situation of the low-risk banks but deteriorate the situation of the high-risk banks. The total effect on defaulting credit institutions is ambiguous. It is shown that, in some cases, the optimal sanction is lower than the sanction that rules out any manipulatory behaviour.

Key-Words:

- Banks
- Disclosure
- Financial crisis
- Financial crisis
- Transparency

**RESUME :**

Une analyse de la stratégie optimale de communication des banques dans un modèle a information imparfaite. Il permet d'étudier l'impact d'une plus grande transparence sur la fréquence des faillites.

Mots-clés :

- Banque
- Communication de crise
- Crise financière
- Risque de défaut

# FINANCIAL DISTRESS AND BANKS' COMMUNICATION

# POLICY IN CRISIS TIMES

## Damien Besancenot[*] and Radu Vranceanu[†]

### Abstract

This short paper analyzes banks' communication policies in crisis times and the role of imperfect information in enhancing banks' distress. If banks differ in their exposure to risky assets, fragile banks may claim to be solid only in order to manipulate investors' expectations. Then solid banks must pay a larger interest rate than in a perfect information set-up. A stronger sanction for false information would improve the situation of the low-risk banks but deteriorate the situation of the high-risk banks. The total effect on defaulting credit institutions is ambiguous. It is shown that, in some cases, the optimal sanction is lower than the sanction that rules out any manipulatory behavior.

*Keywords*: Financial distress, Financial crisis, Banks, Disclosure, Transparency.
*JEL Classification*: E44, G21, D82.

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# 1 Introduction

Many observers have foreseen the burst of the US housing bubble. Yet, when this finally happened in the early 2007, not a few were surprised to see that difficulties in the housing sector were only the tip of the iceberg.[1] Fuelled by the collapse of the housing market, a much insidious and harmful financial crisis took off and spread all over the world. This crisis affected not only the mortgage specialized institutions, but all participants to the financial market – commercial and investment banks, hedge funds, bond and credit insurers, rating agencies and central banks (Crouhy and Turnbull, 2008). Furthermore, although many of the "toxic assets" were "made in the USA", and US banks and insurers had a non negligible exposure to these securities, many European (commercial) banks appeared to have massively invested in such securities. With banks trying to clean their balance sheets, a sharp repricing of risk related to all structured products, and the market for asset-based securities almost closed in 2008, by the end of the year, it become obvious that real activity must pay the toll for a dysfunctional financial market, with sluggish growth and rising unemployment throughout the globe.

One important stylized fact during the going financial crisis was the bank and financial institutions reluctance to disclose their true exposure to risky assets, despite the call for transparence from policymakers. For instance, in November 2007 the French bank *Société Générale* declared to have little exposure to high-risk US MBS and CDOs; yet in January 2008 they wrote down as much as 1.2 billion euros related to such investment (WSJ, 22.01.08), and another 2.6 billions euros in May 2008 (WSJ, 14.05.08). At *Bear Stern*, the CEO declared two weeks before the bank's collapse that "we don't see any pressure on our liquidity, let alone a liquidity crisis" (WSJ, 19.03.07). On September 10, 2008, one day after the executive of *Lehman Brothers* calculated that the firm need sat least 3 billions US dollars in fresh capital, they assured investors on a conference call that the bank needed no capital at all (WSJ, 07.10.08). Such a lack of transparency brought about a generalized shortage of trust that has been captured, for instance, by the persistent wedge between interest rates in the unsecured interbank credit market and the secured central bank short-term

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[1] US housing prices bottomed in 2006, but January 2007 marked a sharp increase in delinquency rates on sub-prime loans (Borio, 2008).

lending.

This paper aims at analyzing the impact of imperfect information on the risk of bank default in crisis times, as well as banks' communication strategy during a financial crisis. In the model, there are two type of banks that differ in their exposure to risky assets. Private investors, called to lend to short-term funds to banks during the crisis, are assumed to have only imperfect information about the true exposure of a given bank. Bank managers can send either honest or misleading signals. In particular, the manager of a fragile bank (high exposure to risky assets) may want to claim that the exposure is small, in order to benefit of better financing terms until "the storm is over". If generalized, this strategy is harmful for solid banks that have no means to signal themselves and must borrow at a higher interest rate than in a perfect information set-up. The model builds on our early analysis of communication policy as pertaining to the corporate sector (Besancenot and Vranceanu, 2005), yet the banking sector model features additional complexity due to non-linear relationships.

The model is used to analyze the consequences of various policies, such as a tightening of the sanction against dishonest managers or a reduction in the short-term interest rate charged by the central bank on reverse/repo operations. Jean-Claude Trichet, the ECB governor, declared in October 2007:

> "In any case, we need more transparency. The illustration that what we have in front of our eyes as regards the functioning of commercial papers, asset-backed commercial papers in particular, is clearly that we presently pay a high price for the lack of transparency. And the same in the interbank money market, as I said".[2]

In the US, the Fed moved very aggressively toward reducing interest rates: between August 2007 and November 2008, the Fed slashed the target rate from 5.25% to 1%. Later on, the Fed also agreed on lending money to banks against a wider range of collateral, including investment-grade MBS. From August 2007 through the October 2008 the ECB keep the main target rate unchanged, while it granted in a rather loose way loans to the banking sector (it accepted MBS

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[2] Jean Claude Trichet, "ECB Introductory statement swith Q&A", 10.09.2007, http://www.ecb.int/press/ press-conf/ 2007 / html/ is070906.en.html.

as a collateral). It also reduced the interest rate in October 15, 2008, from 4.25% to 3.75% in a coordinated move with the other major central banks, at a moment when it become too obvious that the financial crisis will have a persistent impact on real activity (and, to be fair with the ECB, inflationary pressure declined).

An increase in the sanction for dishonest communication comes with two antagonistic effects: on the one hand, since there are less liars in the economy, the interest rate required by investors to finance low risk institutions should decline and their frequency of defaults should diminish. On the other hand, managers who honestly announce that their bank has a high exposure to risky assets will have to pay a larger interest rate, and their frequency of defaults should increase. The theoretical analysis points out that the two effects tend to offset each other. We perform several numerical simulations in order to find out which is the dominant one. It turns out that in some cases the sanction that drives to zero the number of dishonest managers can be inefficient: a lower sanction would bring about a smaller number of defaults. In a related paper, Cordella and Yeyati (1996) have shown that if banks have no complete control over their risk exposure, the presence of uniformed investors may reduce the risk of bank failures.

A substantial literature on corporate financial distress has emphasized that the image clients and suppliers have about a company plays an important role in determining its actual financial stance. More precisely, if creditors start having doubts about the financial position of a company, they may ask for a higher risk premium, which represents an indirect cost for the firm (e.g., Altman, 1984; Wruck, 1990; Andrade and Kaplan, 1998). To avoid this additional strain, in difficult times the manager may well communicate on better than actual performances only to get more favorable contracting terms and push down these indirect costs. Our analysis can also be connected to traditional studies in the financial market micro-structure where accounting information is shown to have a bearing on a firm valuation (e.g., Diamond and Verrecchia, 1991; Baiman and Verrecchia, 1996; Bushman et al., 1996). The specific nature of information asymmetries and regulation of the banking sector were analyzed by Aghion, Bolton and Fries (1998), or Freixas and Jorgé (2007).

Inter alia, the going financial crisis has put an end to the myth of risk-sharing through widespread recourse to securitization. It turned out that risks of contagion, heard behavior and sys-

tematic crisis are alive and well, and even stronger in a world with more intervened players.[3]
If it is beyond the scope of this paper to address this extremely important question, for sure, in presence of mechanisms of transmitting shocks from one bank to another, additional strain on every individual bank – such as described in our paper – would foster the systemic risk.

The paper is organized as following. The next section introduces the main assumptions. The section 3 presents the equilibrium of the model. We work out several numerical simulations in Section 4. The last section presents the conclusion.

# 2   Main assumptions

We recall that the model is developed to analyze banks' disclosure decisions once that the crisis is unwinding. The composition of the assets portfolio is given, the banker cannot "get rid" of the high risk securities. The proportion of central bank funding is also determined by the CB. The model is cast as a game between investors – who must lend money to a financial institution, and the manager of the latter, who decides on the communication policy with the aim at maximizing the survival chances of his company. There are two types of financial institutions. The $H$-type institution has a high exposure to risky assets, the $L$-type has a low exposure. Let $q$ be the frequency of $L$-type, low risk banks in total population of banks.

Investors know the distribution of types, but do not know the type of each institution. The manager knows the true exposure of his institution and must issue a signal before he rises funds.

More in detail, the simplified balance sheet of a typical financial institution has the simplified form:

| Assets | Liabilities |
|---|---|
| $1 - \alpha^j$, Risk-free assets, bearing interest $R_b$ | $1 - \beta$, Central Bank funds, bearing interest $k$ |
| $\alpha^j$, Risky assets, bearing interest $\rho$ | $\beta$, Private funds, bearing interest $i^a$ |

Table 1: Simplified balance sheet of a bank

The total value of the bank is normalized to one. Then $\alpha^j$ can be interpreted as the proportion

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[3] See for instance the classical paper by Rochet and Tirole, (1996) on bank systemic risk originated in interbank lending.

of risky assets in total assets, $1 - \alpha^j$ being the proportion of risk-free assets. Banks of $H-$type have a proportion of risky assets $\alpha^H$, banks of $L$–type have a proportion $\alpha^L$, with $\alpha^H > \alpha^L$. Let $R_b$ be the interest rate on the risk-free assets of the bank, and let $\rho$ be the interest rate on risky assets.

On the liabilities side, $\beta$ is the proportion of funds borrowed from the central bank at a pre-determined interest rate $k$ and $1 - \beta$ is the proportion of funds that the institution must rise in the private market at an market-determined interest rate $i^a$. Private debt is subordinated to debt with the central bank.

The interest rate on private funds depends on the investors beliefs about the type of the bank, and these beliefs depend on the manager's announcement $a$. More precisely, the manager can state that the bank has a high exposure to risk, so the announcement is $a = h$, or a low exposure, that is $a = l$.

At the end of the game, a proportion $\tau$ of the risky assets will default (completely, their residual value is zero). The proportion $\tau$ is a random variable on the support $[0, 1]$; the p.d.f. is denoted by $f(\tau)$ and the c.d.f. will be denoted by $F(\tau)$.

The **sequence of decisions** is the following:

At time t=1, Nature chooses the type of bank $j \in \{L, H\}$ with $\alpha^j$ the share of risky assets in total assets.

At time t=2, the bank's manager announces the type, $a \in \{l, h\}$. He is honest if $a = j$, and dishonest if $a \neq j$.

At time t=3, given $a$, investors ask an interest rate $i^a$ to lend money to the bank (short term).

At time t=4, the shock $\tau$ is realized, and, depending on its true exposure $\alpha^j$ and its liabilities, the bank makes default or not. In case of default, the liar has to pay a fine. The game is over.

**Default condition**

A bank of type $j$ defaults when the shock $\tau$ is realized if, given the announcement $a$ (thus $i^a$), its liabilities exceed its assets. This can happen if the default on risky assets exceeds a critical

threshold $\hat{\tau}^{ja}$. More precisely,

$$(1 - \alpha^j)(1 + R_b) + \alpha^j(1 - \tau)(1 + \rho) \quad < \quad \beta(1 + i^a) + (1 - \beta)(1 + k)$$

$$\Leftrightarrow \tau \quad > \quad \hat{\tau}^{ja} \equiv \frac{\alpha^j(\rho - R_b) + [R_b - \beta i^a - (1 - \beta)k]}{\alpha^j(1 + \rho)}. \quad (1)$$

We should keep in mind that $\hat{\tau}^{ja} < 1$ if $[R_b - \beta i^a - (1 - \beta)k] < \alpha^j(1 + R_b) \Leftrightarrow \alpha^j > \frac{R_b - \beta i^a - (1 - \beta)k}{(1 + R_b)} = \alpha_0$. Hence there is a risk of bank default only if the exposure to risky assets is large enough. We can further write $\hat{\tau}^{ja}(\alpha^j) = \frac{(\rho - R_b)}{(1 + \rho)} + \frac{[R_b - \beta i^a - (1 - \beta)k]}{\alpha^j(1 + \rho)}$, with $\frac{(\rho - R_b)}{(1 + \rho)} < 1$. This is a decreasing function in $\alpha^j$, $\frac{\partial \hat{\tau}^{ja}(\alpha^j)}{\partial \alpha^j} = -\frac{[R_b - \beta i^a - (1 - \beta)k]}{(\alpha^j)^2(1 + \rho)} < 0$, with $\lim_{\alpha^j \to \infty} \hat{\tau}^{ja}(\alpha^j) = \frac{(\rho - R_b)}{(1 + \rho)}$. Hence, $\hat{\tau}^{ja}(\alpha^j) > \frac{(\rho - R_b)}{(1 + \rho)}$.

The default probability of the bank can be written as:

$$\Pr[\tau > \hat{\tau}^{ja}] = 1 - F(\hat{\tau}^{ja}). \quad (2)$$

This probability of default increases with $\alpha^j$ : $\frac{d\Pr[\tau > \hat{\tau}^{ja}]}{d\alpha^j} = -f(\hat{\tau}^{ja})\left(\frac{\partial \hat{\tau}^{ja}}{\partial \alpha^j}\right) > 0$.

For a uniform distribution, we can easily check that the expected return on high-risk assets is lower than the return on normal assets:

$$\Pr[\tau > \hat{\tau}^{ja}](1 + \rho) = (1 - \hat{\tau}^{ja})(1 + \rho) < \left[1 - \frac{(\rho - R_b)}{(1 + \rho)}\right](1 + \rho) = (1 + R_b) \quad (3)$$

In case of the bank's default, investors, who have invested the amount $\beta$, get the residual value $(1 - \alpha^j)(1 + R_b) + \alpha^j(1 - \tau)(1 + \rho) - (1 - \beta)(1 + k)$. If the bank does not default, investors get $\beta(1 + i^a)$ and the bank makes a profit $\Pi(\tau|j, a) = \left[(1 - \alpha^j)(1 + R_b) + \alpha^j(1 - \tau)(1 + \rho)\right] - \left[\beta(1 + i^a) + (1 - \beta)(1 + k)\right]$. A bank's expected profit is thus $\int_0^{\hat{\tau}^{ja}} \Pi(\tau|j, a)d\tau$.

**The managers' payoff**. Managers are risk-neutral. To keep the model as simple as possible, we will assume that the manager aims at maximizing chances that his company survives during a temporary crisis; more specifically, the payoff of a manager of a type $j$ bank who announces $a$ is proportional to the survival probability $\Pr[\tau < \hat{\tau}^{ja}]$.[4] In addition, if the company defaults and the manger has issued a false signal, he will bear a fine $\theta$. We write the manager's payoff as:

$$Z(a|j) = \Pr[\tau < \hat{\tau}^{ja}] - \mathbf{1}_{j \neq a}\Pr[\tau > \hat{\tau}^{ja}]\theta. \quad (4)$$

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[4] Many senior executives, in general at the head of the fixed-income branches, loose their jobs during the 2007-2008 crisis. After Citigroup reported a huge loss in the third quarter, its CEO had to resign and so did the CEO of Merrill Lynch.

where the factor $\mathbf{1}_{j \neq a}$ the the value zero if $j = a$ and 1 if $j \neq a$.

# 3  Equilibrium of the game

A Nash equilibrium of this game is a situation where managers chose the optimal communication policy given investors' beliefs, and investors beliefs are correct given managers' optimal policies.

## 3.1  Managers' strategies and investors' beliefs

We represent the announcement strategy of a type $j$ manager by a function $a(j)$. In this game, managers strategies are:

$$
a(j) = \begin{cases} l, & \text{for } j = L \\ \mu l + (1 - \mu)h, \text{ with } \mu \in [0, 1], & \text{for } j = H \end{cases} .
\tag{5}
$$

where $\mu$ is the frequency of liars running the $H$-banks (they announce $l$).

Notice that a manager at the head of a low risk bank has no incentive to claim that the bank has a high exposure to risky assets, if else he would have to pay larger interest rates to private agents and chances that his institution defaults increase. To the contrary, managers at the head of $H$ banks may claim that the bank is of the $L$ type $(a = l)$ only in order to manipulate investors' expectations and benefit from a lower interest rate. Thus, they can push down the risk of default, but have to bear a larger expected fine if caught.

Given these manager strategies, investors' belief can be represented as:

$$
\Theta = \begin{cases} \Pr[l|H] = \mu, \text{ where } \mu \in [0, 1] \\ \Pr[l|L] = 1 \end{cases},
\tag{6}
$$

Given these available strategies, it will turn out that this game presents a *separating equilibrium* where $a(L) = l$ and $a(H) = h$, a *pooling equilibrium* where $a(j) = L, \forall j$ and a *hybrid equilibrium* where a fraction $\mu$ of the managers at the head of $H-$banks announce $l$ and the rest of them announce $h$. In the following, we will focus on this hybrid equilibrium $(\mu \in ]0, 1[)$, given that the pooling and the separating situations appear to be special cases that correspond to $\mu = 1$ and respectively $\mu = 0$.

## 3.2 Interest rates

Private investors are risk neutral. They have access to risk free assets bearing an interest $R$. We assume that in a world with trade frictions banks have better risk free opportunities than private agents, so $R < R_b$.

a) If the manager announces $a = h$, then the bank must be $H$. With risk neutral investors, the interest rate $i^h$ is implicitly defined by the zero trade-off condition:

$$\beta(1+R) = \begin{cases} \beta(1+i^h) \text{ if } \tau \leq \hat{\tau}^{hH} \\ (1-\alpha^H)(1+R_b) + \alpha^H(1-\tau)(1+\rho) - (1-\beta)(1+k) \text{ if } \tau > \hat{\tau}^{hH} \end{cases}, \qquad (7)$$

which is equivalent to:

$$1+R = (1+i^h)\int_0^{\hat{\tau}^{hH}} dF(\tau) + \beta^{-1}\left[(1-\alpha^H)(1+R_b) - (1-\beta)(1+k)\right]\int_{\hat{\tau}^{hH}}^1 dF(\tau) + \beta^{-1}\alpha^H(1+\rho)\int_{\hat{\tau}^{hH}}^1 (1-\tau)dF(\tau), \qquad (8)$$

where, according to Eq.(1):

$$\hat{\tau}^{hH} = \frac{\alpha^H(\rho - R_b) + \left[R_b - \beta i^h - (1-\beta)k\right]}{\alpha^H(1+\rho)}. \qquad (9)$$

We remark that for a given c.d.f. $F()$, Eq.(8) can be solved for $i^h$. The latter is independent of $\theta$; it depends on $k$.

b) If the the manager announces $a = l$, the bank can be either $H$ with $\Pr[H|l]$ or $L$ with $\Pr[L|l] = 1 - \Pr[H|l]$. The interest rate $i^l$ is implicitly defined by the zero trade-off condition:

$$\beta(1+R) = \begin{cases} \text{with } \Pr[H|l] \begin{cases} \beta(1+i^l) \text{ if } \tau \leq \hat{\tau}^{lH} \\ (1-\alpha^H)(1+R_b) + \alpha^H(1-\tau)(1+\rho) - (1-\beta)(1+k) \text{ if } \tau > \hat{\tau}^{lH} \end{cases} \\ \text{with } \Pr[L|l] \begin{cases} \beta(1+i^l) \text{ if } \tau \leq \hat{\tau}^{lL} \\ (1-\alpha^L)(1+R_b) + \alpha^L(1-\tau)(1+\rho) - (1-\beta)(1+k) \text{ if } \tau > \hat{\tau}^{lL} \end{cases} \end{cases} \qquad (10)$$

which, with notation $S^H = \left[(1-\alpha^H)(1+R_b) - (1-\beta)(1+k)\right]$ and $S^L = \left[(1-\alpha^L)(1+R_b) - (1-\beta)(1+k)\right]$, is equivalent to:

$$\begin{aligned} 1+R = \ & \Pr[H|l]\left\{(1+i^l)\int_0^{\hat{\tau}^{lH}} dF(\tau) + \beta^{-1}S^H\int_{\hat{\tau}^{lH}}^1 dF(\tau) + \beta^{-1}\alpha^H(1+\rho)\int_{\hat{\tau}^{lH}}^1 (1-\tau)dF(\tau)\right\} + \\ & \Pr[L|l]\left\{(1+i^l)\int_0^{\hat{\tau}^{lL}} dF(\tau) + \beta^{-1}S^L\int_{\hat{\tau}^{lL}}^1 dF(\tau) + \beta^{-1}\alpha^L(1+\rho)\int_{\hat{\tau}^{lL}}^1 (1-\tau)dF(\tau)\right\} \end{aligned} \qquad (11)$$

8

with

$$\hat{\tau}^{lH} = \frac{\alpha^H(\rho - R_b) + \left[R_b - \beta i^l - (1-\beta)k\right]}{\alpha^H(1+\rho)}, \tag{12}$$

and

$$\hat{\tau}^{lL} = \frac{\alpha^L(\rho - R_b) + \left[R_b - \beta i^l - (1-\beta)k\right]}{\alpha^L(1+\rho)}. \tag{13}$$

For a given c.d.f., Equation (11) becomes a relationship between the interest rate $i^l$ and $\Pr[H|l]$, that is $\Phi(i^l, \Pr[H|l]) = C$.

## 3.3 The indifference condition

As already mentioned, we assume that the managers' payoff is proportional to chances that the bank survives, and there is a sanction $\theta$ for liars when their bank defaults (Eq. 4). So, for a honest manager, we have:

$$Z(h|H) = \Pr[\tau < \hat{\tau}^{hH}] \tag{14}$$

and for a liar:

$$Z(l|H) = \Pr[\tau < \hat{\tau}^{lH}] - \theta \Pr[\tau > \hat{\tau}^{lH}]. \tag{15}$$

The **indifference condition** $Z(h|H) = Z(l|H)$ allows us to determine the interest rate $i^l$ for which the manager is indifferent between policies $h$ or $l$.

$$
\begin{aligned}
Z(h|H) &= Z(l|H) \\
\Pr[\tau < \hat{\tau}^{hH}] &= \Pr[\tau < \hat{\tau}^{lH}] - \theta \Pr[\tau > \hat{\tau}^{lH}] \\
F(\hat{\tau}^{hH}) &= F(\hat{\tau}^{lH}) - \theta\left[1 - F(\hat{\tau}^{lH})\right] \\
F(\hat{\tau}^{hH}) - F(\hat{\tau}^{lH}) &= \theta\left[1 - F(\hat{\tau}^{lH})\right]
\end{aligned}
\tag{16}
$$

As $\hat{\tau}^{lH} = \hat{\tau}^{lH}(i^l)$ and $\hat{\tau}^{hH} = \hat{\tau}^{hH}(i^h)$, Equation (16) determines $i^l$ with respect to $i^h$.

We would like to show that $i^l < i^h$. For so doing, we assume that $i^l > i^h$. Then $\hat{\tau}^{hH} < \hat{\tau}^{lH}$, and $F(\hat{\tau}^{hH}) < F(\hat{\tau}^{lH})$. We have $F(\hat{\tau}^{hH}) - F(\hat{\tau}^{lH}) < 0$, while $\theta\left[1 - F(\hat{\tau}^{lH})\right] > 0$, which is false. So $i^l < i^h$ : the $H-$bank has an incentive to claim that it is of $L$-type.

We can show that an increase in the sanction pushes down the interest rate of the banks that announce $l$: $di^l/d\theta < 0$. We recall that $\hat{\tau}^{lH} = \frac{\alpha^H(\rho - R_b) + \left[R_b - \beta i^l - (1-\beta)k\right]}{\alpha^H(1+\rho)}$; $\frac{\partial \hat{\tau}^{lH}}{\partial i^l} =$

$-\dfrac{\beta}{\alpha^H(1+\rho)}$. Differentiating expression (16):

$$0 = f(\hat{\tau}^{lH})\frac{\partial\hat{\tau}^{lH}}{\partial i^l}di^l - d\theta\left[1 - F(\hat{\tau}^{lH})\right] + \theta f(\hat{\tau}^{lH})\frac{\partial\hat{\tau}^{l,H}}{\partial i^l}di^l$$

$$d\theta\left[1 - F(\hat{\tau}^{lH})\right] = (1+\theta)\frac{\partial\hat{\tau}^{l,H}}{\partial i^l}f(\hat{\tau}^{lH})di^l$$

$$\frac{di^l}{d\theta} = \frac{1 - F(\hat{\tau}^{lH})}{f(\hat{\tau}^{lH})(1+\theta)}\frac{1}{\partial\hat{\tau}^{lH}/\partial i^l} = -\frac{1 - F(\hat{\tau}^{lH})}{f(\hat{\tau}^{lH})}\frac{\alpha^H(1+\rho)}{\beta(1+\theta)} < 0$$

In turn, as $d\hat{\tau}^{lj}/di^l < 0$, we get $d\hat{\tau}^{lj}/d\theta > 0$ : when the sanction increases, the probability of

default decreases for all banks that announced $l$.

$$\frac{d\hat{\tau}^{l,j}}{d\theta} = \frac{\partial\hat{\tau}^{l,j}}{\partial i^l}\frac{di^l}{d\theta} = \frac{\beta}{\alpha^j(1+\rho)}\left[\frac{1 - F(\hat{\tau}^{lH})}{f(\hat{\tau}^{lH})}\frac{\alpha^H(1+\rho)}{\beta(1+\theta)}\right] = \left(\frac{\alpha^H}{\alpha^j}\right)\frac{1 - F(\hat{\tau}^{lH})}{(1+\theta)f(\hat{\tau}^{lH})} > 0$$

For instance, with a uniform p.d.f., the condition $Z(h|H) = Z(l|H)$ implies :

$$\frac{\alpha^H(\rho - R_b) + \left[R_b - \beta i^h - (1-\beta)k\right]}{\alpha^H(1+\rho)} = \frac{\alpha^H(\rho - R_b) + \left[R_b - \beta i^l - (1-\beta)k\right]}{\alpha^H(1+\rho)} - \theta\left[1 - \frac{\alpha^H(\rho - R_b) + \left[R_b - \beta i^l - (}{\alpha^H(1+\rho)}\right.$$

$$i^l = i^h - \theta\beta^{-1}\left[\alpha^H(1+R_b) + \left[R_b - \beta i^l - (1-\beta)k\right]\right]$$

with $i^l < i^h$. It turns out that $di^l/d\theta < 0$:.

$$\frac{di^l}{d\theta} = -\beta^{-1}\left[\alpha^H(1+R_b) + \left[R_b - \beta i^l - (1-\beta)k\right]\right] < 0. \tag{18}$$

## 3.4  Solution and policy

We have here a system of three equations, Eq. (8), Eq. (11) and Eq. (16) and three unknown, $i^h$,

$i^l$ and $\Pr[H|l]$. To solve the model, we remark that Eq. (8) alone allows us to determine $i^h$ and

Eq. (16) alone allows us to determine $i^l$ as a function of the exogenous variables. Then, for given

$i^l$ and $i^h$, Eq. (11) determines the probability $\Pr[H|l]$.

Once we obtain $\Pr[H|l]$, we can determine $\mu$, the frequency of liars. According to Bayes rule :

$$\Pr[H|l] = \frac{\Pr[l|H]\Pr[H]}{\Pr[l|H]\Pr[H] + \Pr[l|L]\Pr[L]} = \frac{\mu(1-q)}{\mu(1-q) + q}. \tag{19}$$

So:

$$\mu = \begin{cases} 1, \text{ if } \dfrac{q\Pr[H|l]}{(1-q)(1-\Pr[H|l])} \geq 1 \\ \dfrac{q\Pr[H|l]}{(1-q)(1-\Pr[H|l])}, \text{ if } \dfrac{q\Pr[H|l]}{(1-q)(1-\Pr[H|l])} \in\, ]0,1[ \\ 0, \text{ if } \dfrac{q\Pr[H|l]}{(1-q)(1-\Pr[H|l])} \leq 0 \end{cases} \tag{20}$$

If $\mu = 1$ ($\mu = 0$) the pooling (respectively) separating equilibrium prevails; if $\mu \in ]0, 1[$, managers at the head of the high risk banks play a mixed strategy.

In order to study the consequences of various policies we need an aggregate objective for the government. One main objective of the government during the 2007-2008 financial turmoil was to prevent banks from defaulting. Indeed, a few banks in the UK (Northern Rock), Germany (IKW, Hypo Real Estate), Belgium (Dexia), or the United States (Citigroup) were saved from bankruptcy thanks to massive inflows of public money; some of them were nationalized. Our model allows to analyze the impact of market mechanism on the frequency of defaults, by varying sanction for liars (transparency) $\theta$ or the cost of borrowed resource $k$. Policies aiming at reducing the borrower's individual risk of default on credits backed with high-risk securities (like subprime MBS) may be interpreted as a move towards skewing the distribution $f(\tau)$ to the left.[5] Hence, this analysis of default abstracts from systemic risk, that is the risk that the default of one bank might trigger a chain of defaults by other banks that have either lent resources to this bank, or have committed to cover the losses related to the former bank's default.

Let us denote by $V$ the total number of defaulting banks; it is made up of defaults of $L$-banks and defaults of $H$-banks, knowing that a proportion $\mu$ of the latter declare that they are of the $L$-type.

$$
\begin{aligned}
V &= q \Pr[\tau > \hat{\tau}^{lL}] + (1-q)\left\{\mu \Pr[\tau > \hat{\tau}^{lH}] + (1-\mu)\Pr[\tau > \hat{\tau}^{hH}]\right\} \\
&= q[1 - F(\hat{\tau}^{lL})] + (1-q)\left\{\mu[1 - F(\hat{\tau}^{lH})] + (1-\mu)[1 - F(\hat{\tau}^{hH})]\right\}
\end{aligned}
\tag{21}
$$

- Variations in $k$

We can now study the impact on $V$ of variations in $k$.

$$
\begin{aligned}
\frac{dV}{dk} &= -qf(\hat{\tau}^{lL})\frac{d\hat{\tau}^{lL}}{dk} + (1-q)\left\{\frac{d\mu}{dk}[1 - F(\hat{\tau}^{lH})] - \mu f(\hat{\tau}^{lH})\frac{d\hat{\tau}^{lH}}{dk} - \frac{d\mu}{dk}[1 - F(\hat{\tau}^{hH})] - (1-\mu)f(\hat{\tau}^{hH})\frac{d\hat{\tau}^{hH}}{dk}\right\} \\
&= -qf(\hat{\tau}^{lL})\frac{d\hat{\tau}^{lL}}{dk} + (1-q)\left\{\frac{d\mu}{dk}[F(\hat{\tau}^{hH}) - F(\hat{\tau}^{lH})] - \mu f(\hat{\tau}^{lH})\frac{d\hat{\tau}^{lH}}{dk} - (1-\mu)f(\hat{\tau}^{hH})\frac{d\hat{\tau}^{hH}}{dk}\right\}
\end{aligned}
\tag{22}
$$

---

[5] In December 2007 the US Administration worked out an emergency plan aiming to switch subprime borrowers to more sustainable loans. In particular, those with high credit scores should be able to get a secure loan from the Federal Housing Administration. Those who do not qualify for these loans may benefit from a temporary interest rate freeze (FT, 6.12.07).

with $F(\hat{\tau}^{hH}) - F(\hat{\tau}^{lH}) < 0$. When the cost of borrowing from the central bank increases, the interest rate $i^l$ increases too. We have therefore $\dfrac{d\hat{\tau}^{lL}}{dk} < 0$ and $\dfrac{d\hat{\tau}^{lH}}{dk} < 0$, the risk of default increases for both banks. If $\dfrac{d\mu}{dk} > 0$, the outcome is $\dfrac{dV}{dk} > 0$.

- Variations in $\theta$

If the sanction $\theta$ goes up, more managers at the head of $H$-banks honestly state that their bank is $h$; they are charged the large interest rate $i^h$ and their chances of default increase sharply. On the other hand, if there are less liars, the value of the signal $l$ improves, and the interest rate $i^l$ goes down; managers who announce $l$ have better chances to survive (the $L$ banks and the remaining liars $H$). The overall effect is ambiguous.

$$
\begin{aligned}
\frac{dV}{d\theta} &= -qf(\hat{\tau}^{lL})\frac{d\hat{\tau}^{lL}}{d\theta} + (1-q)\left\{\frac{d\mu}{d\theta}[1 - F(\hat{\tau}^{lH})] - \mu f(\hat{\tau}^{lH})\frac{d\hat{\tau}^{lH}}{d\theta} - \frac{d\mu}{d\theta}[1 - F(\hat{\tau}^{hH})]\right\} \\
&= -qf(\hat{\tau}^{lL})\frac{d\hat{\tau}^{lL}}{d\theta} + (1-q)\left\{\frac{d\mu}{d\theta}[F(\hat{\tau}^{hH}) - F(\hat{\tau}^{lH})] - \mu f(\hat{\tau}^{lH})\frac{d\hat{\tau}^{lH}}{d\theta}\right\}
\end{aligned}
\tag{23}
$$

with $F(\hat{\tau}^{hH}) - F(\hat{\tau}^{lH}) < 0$, $\dfrac{d\hat{\tau}^{lL}}{d\theta} > 0$, $\dfrac{d\hat{\tau}^{lH}}{d\theta} > 0$ et $\dfrac{d\mu}{d\theta} < 0$.

## 4 The numerical simulation

The model can be solved numerically for a specific p.d.f. $f(\tau)$. We choose a uniform distribution on the interval $[0, 1/3]$. With this upper bound, no more than $1/3$ of the risky assets of a bank can default. The other parameters are: interest rates $R = 0.02$, $R_b = 0.05$, $k = 0.04$, $\delta = 0.15$, the proportion of central bank funding, $\beta = 0.95$, the proportions of risky assets $\alpha^H = 0.25$, $\alpha^L = 0.10$ and the frequency of highly exposed banks $q = 1/3$. We allow the sanction to vary between $\theta = [0.035, 0.046]$ with a step of $0.001$.

We obtain $i^h = 0.04085$. As expected, when the sanction increases, the low interest rate $i^l$ and the frequency of liars $\mu$ both decline. For $\mu = 0$ we are in the separating equilibrium, there are no more liars.
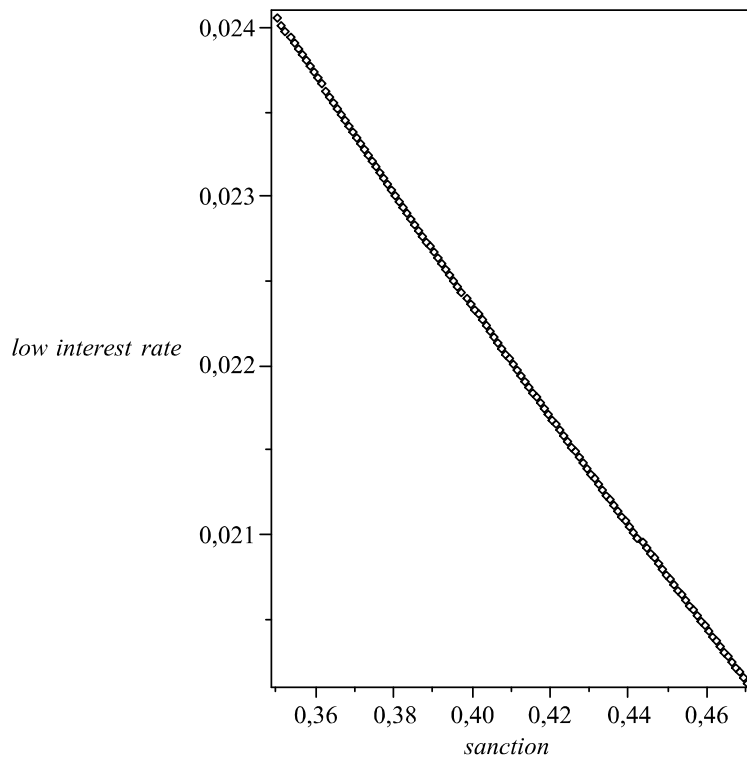
Interest rates for banks that announce $l$
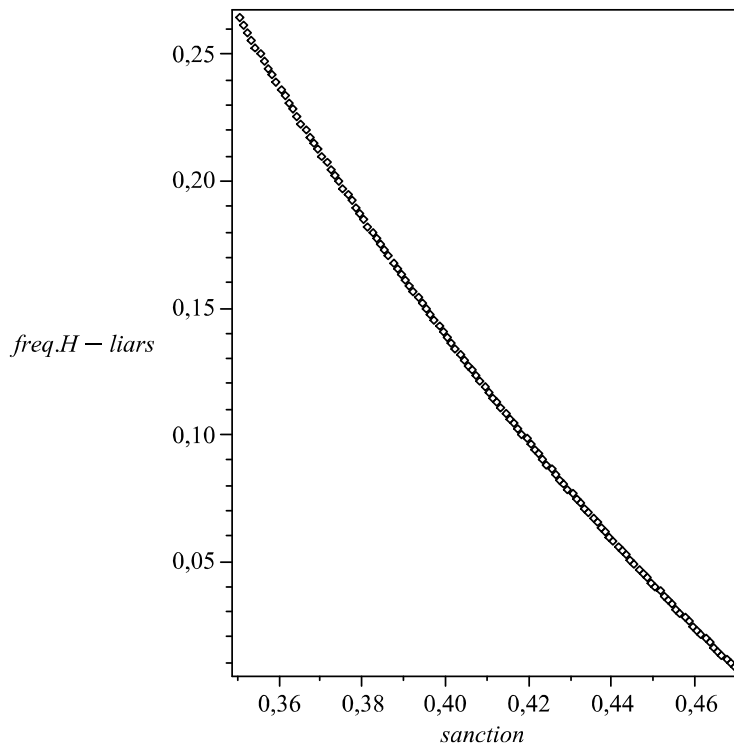
Frequency of $H$-banks liars (announce $l$)

Figure 3 shows the impact of a rising sanction on the overall frequency of defaults. In a first step, a higher sanction brings about a reduction in the frequency of defaults. The positive effect that comes with an improvement in the value of the $l$ signal and the lower $i^l$ offsets the increasing frequency of banks who declare to be of the $H-$type (and are thus subject to a higher probability of default). However, in our simulation, there is a critical sanction ($\theta = 0.45$) above which the latter negative effect takes over the positive effect. If the policymaker pushes the sanction up to the point where the frequency of liars becomes zero, the overall frequency of default is larger than is some lies were tolerated.
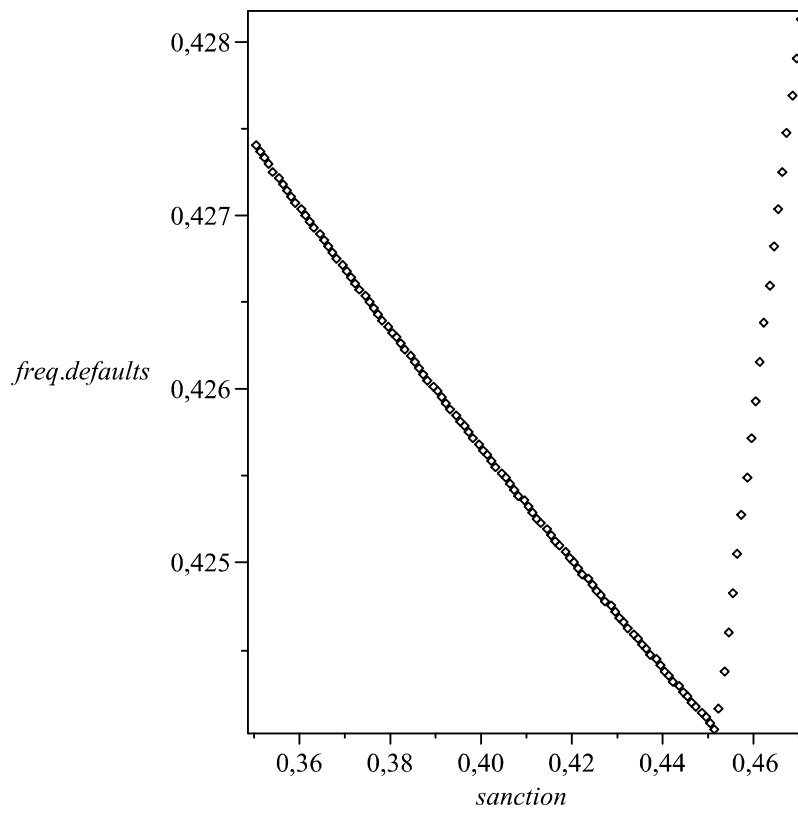
Frequency of defaults and the optimal sanction level ($k = 0.04$)

Figure 4 shows the consequences from reducing the interest rate of central bank funds ($k$) by 1/4 percentage point, a move that corresponds to the US main response to the going crisis.
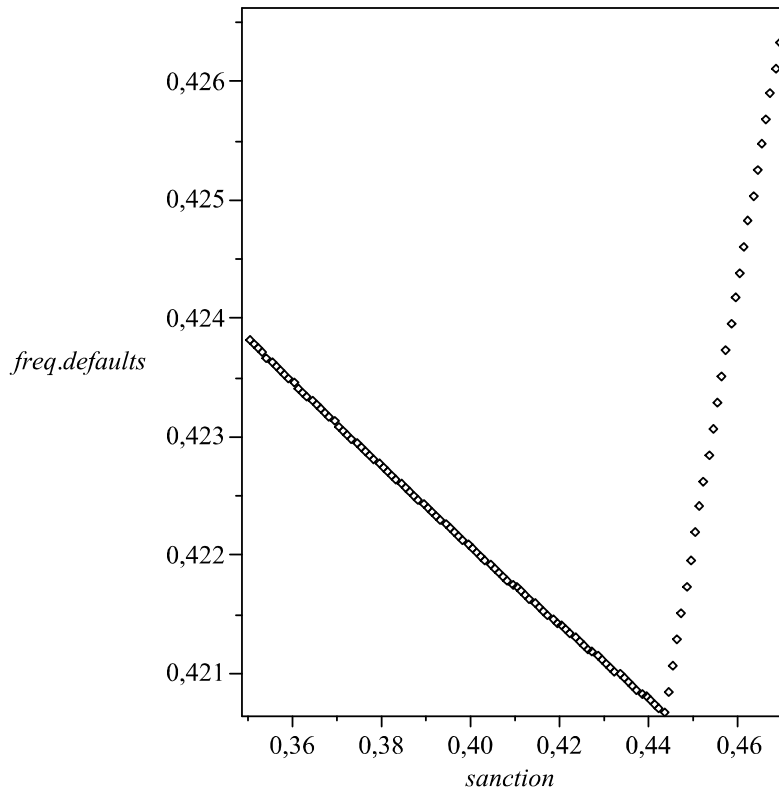
Frequency of defaults and optimal sanction ($k = 0.0375$)

As expected, the overall frequency of defaults declines for all $\theta$; the optimal sanction is also lower. As long as the banking sector's economy makes it operating to the left of the optimal sanction, increasing the sanction or reducing repo rates may bring about similar effects in terms of reducing the frequency of defaults. Yet, if there is an uncertainty on whether the sanction is to the left or to the right of the critical level, policymakers should reduce the repo rate.

## 5   Conclusion

The 2007-2008 financial crisis that developed on the foundations of the US subprime mortgage shake-up recalled with strength the role of trust in the good functioning of financial markets. This paper analyzes the banks' communication behavior in a crisis time. It emphasizes the impact of a manager's communication strategy on the financial distress of his bank and claims that a dose of uncertainty could be, in some cases, welfare improving.

It has been shown that when investors have only imperfect information about the banks' true exposure to risky assets, some fragile bank may claim that they are strong only to manipulate investors expectations. As the latter do figure out this strategy, they ask for a larger interest rate that penalizes the genuine solid banks. A policy of increasing the sanction on liars may help reducing the frequency of defaults up to a point. If the sanction is too strong and the frequency of liars too small, losses from further tightening the sanction can offset the benefits, since more fragile banks are pushed to unveil their true situation and are subject to a larger risk of default.

A reduction in the repo interest rate at which the central bank provides funding to all banks appears to be a more efficient policy, at least in the short run. In a long run perspective other considerations, such as moral hazard or inflation risks should be brought into the picture.

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