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Ari Hyytinen – Tuomas Takalo
Research Department
21.10.2003

# Preventing systemic crises through bank transparency

Suomen Pankin keskustelualoitteita
Finlands Banks diskussionsunderlag

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# Preventing systemic crises through bank transparency

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## Abstract

The banking system is known to be vulnerable to self-fulfilling crises that are caused by depositors' coordination failure. We show that transparency regulation may prevent certain types of systemic crises by eliminating the possibility of the coordination failure.

Key words: bank transparency, financial stability, disclosure regulation

JEL classification numbers: G21, G28

# Voidaanko pankkien tiedonantovelvollisuuden avulla parantaa pankkijärjestelmän vakautta?

## Suomen Pankin keskustelualoitteita 25/2003

Ari Hyytinen – Tuomas Takalo
Tutkimusosasto

## Tiivistelmä

Pankkien riskinotosta on tunnetusti vaikea saada luotettavaa ja kattavaa tietoa. Viimeaikaiset pankkien ja vakuutusyhtiöiden väliset yritysjärjestelyt ja luotto-riskien siirrot ovat entisestään lisänneet tarvetta saada tietoa rahoituspalvelusekto-rin yritysten ottamista riskeistä. Luotettavan tiedon puute saattaa tehdä pankkijär-jestelmistä epävakaita, koska järjestelmät tulevat alttiiksi itsensä toteuttaville kriiseille, joita tallettajien epäluottamus pankkijärjestelmää kohtaan voi saada aikaan. Tässä tutkimuksessa osoitetaan, että pankkien tiedonantovelvollisuussään-telyllä voidaan vähentää tämäntyyppisten kriisien syntymistä, sillä pankkitoimin-nan avoimuudella voidaan säännellä tilanteita, joissa tallettajien koordinaatio-ongelmat ja odotukset vaikuttavat pankkijärjestelmän toimintaan.

Avainsanat: tiedonantovelvollisuus, pankkitoiminan avoimuus, pankkijärjestel-mien vakaus

JEL-luokittelu: G21, G28

# Contents

# 1 Introduction

The banking sector is known to be vulnerable to systemic crises. This concern about the systemic crises has led to the creation of extensive safety nets. However, the existence of a safety net entails a widely recognized moral hazard problem. Safety nets in general, and depositor insurance schemes in particular, provide incentives for excessive risk taking by banks.[1] The aim of this paper is to demonstrate that certain types of systemic crises can be prevented without the safety net by enhancing bank transparency.

There is increasing evidence that banks are "black boxes", because weak transparency makes their asset risks opaque. Both stock market participants and professional credit-rating agencies, such as Moody's, and Standard and Poor's encounter difficulties in measuring banks' creditworthiness and risk exposures (Poon, Firth, and Fung 1999, Jordan, Peek and Rosengren 2000, Hyytinen 2002, and Morgan 2002). The recent growth of credit-risk transfers from banks and the emergence of financial conglomerates have made the lack of transparency all the more acute (Bank for International Settlements 2003). And academics stand in front of the same problems. It is not easy to interpret banks' accounting data (Beatty, Chamberlain and Magliolo 1995, Collins, and Shackelford and Wahlen 1995) nor disclosures of banks' credit losses (Ahmed, Takeda and Thomas 1999, and US General Accounting Office 1994). Rochet and Tirole (1996) note that interbank lending complicates assessment of banks' actual liquidity and solvency ratios. Banks themselves, of course, are not entirely blameless for their weak transparency. As Kaminsky and Reinhart (1999, p. 476) put it, 'Indicators of business failures and nonperforming loans are also usually available only at low frequencies, if at all; the latter are also made less informative by banks' desire to hide their problems for as long as possible.'

We share Kaminsky's and Reinhart's view. In our companion paper (Hyytinen and Takalo 2002), we argue that at least some of the difficulties in measuring banks' creditworthiness arise from the banks' unwillingness to disclose information. In such circumstances, imposing strict accounting, auditing, and disclosure rules on banks should improve their transparency. It is then not surprising that various international institutions, such as the Basel Committee on

[1] There is a sizeable literature on the economics of bank regulation and design of safety nets. See Dewatripoint and Tirole (1994) and Bhattacharya, Boot and Thakor (1998) for general reviews. The link between moral hazard problems and the DIS is also well documented. Kane (1989), for instance, regards the US safety net and fixed-rate DIS as main reasons for the Savings and Loan crisis of the 1980s. Berlin et al (1991) provide a concise review of empirical literature on the DIS and banking problems. Their conclusion is that 'the moral hazard problem is operative and significant' (p. 738). Demirguc-Kunt and Detragiache (1998) find that an explicit DIS has increased the fragility of the banking system around the world.

Banking Supervision, G7 Finance Ministers, International Monetary Fund and the World Bank, have campaigned for improved accounting and disclosure practices in the banking sector (see eg, Basel Committee 1998, 1999). Numerous scholars, such as Berlin, Saunders and Udell (1991), Edwards and Mishkin (1995), Bhattacharya, Boot and Thakor (1998), Herring (1999), Rosengren (1999), Jordan, Peek and Rosengren (2000), and Mayes, Halme and Liuksila (2001)) also advocate a transparent banking system.

The calls for increased transparency seem to be well-founded given the experience of recent banking crises around the world. For instance, Rosengren (1999) argues that transparency reduces the cost of crises, Jordan et al (2000) suggest that transparency improves market discipline in crises, Summers (2000) consider transparency the best way to prevent crises and an effective policy response to crises, and Vishwanath and Kaufmann (2001) regard transparency regulation as a part of the institutional structure that enhance financial stability. Perhaps the most rigorous argument for the increased transparency is provided by Giannetti (2003) who shows how asymmetric information between investors and banks explains contagious banking crises both within a country and across countries.

The discussion on bank transparency can be clarified if we distinguish between the degrees of transparency before and after investments are made in the bank. In the ex post sense, the degree of a bank's transparency determines the degree of information available to its claim-holders on the bank's financial condition. If it transpires that the value of a bank's assets is low, the bank's creditors, and particularly its uninsured depositors, may withdraw their funds (Chari and Jagannathan 1988). The threat of a bank run can then discipline bankers in their risk-taking (see eg, Calomiris and Khan 1991, Chen 1999, and Niinimäki 2001).

Ex ante transparency implies that *potential* depositors and other creditors can appreciate a bank's financial condition prior to placing funds in it. This strengthens market discipline, because the better investors are able to evaluate banks' risk positions, the more risk-sensitive the banks' funding costs should be. The supply of funds to a bank is also directly related to the perceived soundness of the bank. The contention that lower quality banks attract fewer uninsured deposits than higher quality banks has sound empirical support (see eg, Park 1995, Billet, Garfinkel, O'Neal 1998, Park and Peristiani 1998, and Martinez Peria and Schmukler 2001). Despite its importance, the ex ante transparency and its effect on market discipline are relatively seldom addressed in a conceptual framework. For this reason, we equate transparency to its ex ante dimension.

Building on the idea in Matutes and Vives (1996) we propose a novel justification for transparency regulation. We show that when banks' risk profiles are unobservable, depositors' self-fulfilling expectations lead to multiple equilibria. Possible equilibria include a complete collapse of the banking sector

stemming from depositors' coordination failure. This systemic collapse is possible if there is *lack of* ex ante transparency. We argue that restoring transparency works, because it reduces the role of depositors' expectations to the extent that the systemic collapse equilibrium is removed.

Depositors' coordination failure also arises in the celebrated model by Diamond and Dybvig (1983), who show how banks' liquidity service and sequential service constraint render them susceptible to runs. In their model, insuring deposits can prevent the runs. In our model, there is neither liquidity service nor a sequential service constraint. Hence, there is no room for bank runs. There is, however, a possibility of depositors' coordination failure that can be prevented by the transparency requirement. In this sense the transparency requirement works in our model like deposit insurance in Diamond and Dybvig (1983).

Our analysis is thus also related to the literature dealing with the moral hazard problem caused by a DIS. The proposed remedies include risk-based insurance premiums, capital adequacy requirements, incentive-compatible DISs, banks' equity investments, and intertemporal asset diversification (see eg, Chan, Greenbaum and Thakor 1992, Craine 1995, Santos 1999, and Niinimäki 2001). We complement these efforts by studying whether the transparency requirement could be substituted for the DIS.

The rest of the article proceeds as follows. In section 2, we set out a model of horizontal differentiation where banks compete for depositors on the basis of asset quality. To keep our analysis as simple and comparable with the previous literature as possible, we adopt the standard model of spatial competition developed by Salop (1979). This model – and its cousin, the Hotelling line – has been used extensively in the banking literature, eg, in Besanko and Thakor (1992), Chiappori, Perez-Castrillo and Verdier (1995), Matutes and Vives (1996), and Villas-Boas and Schmidt-Mohr (1999). In particular, the setup in Cordella and Levy Yeyati (1998) is quite similar to ours. In section 3 we prove our main finding. Transparency regulation may improve welfare by preventing the collapse of the banking sector. To present the main point as powerfully as possible, we make a number assumptions that certainly involve some loss of generality. Perhaps the most significant of these is that we ignore the disadvantages of the transparency regulation. As we have thoroughly addressed them elsewhere (Hyytinen and Takalo 2002), we only briefly discuss the reasons why banks may fail to disclose an optimal amount of information in section 4. Concluding remarks are given in section 5.

# 2 The model

Consider a universally risk-neutral economy with a horizontally differentiated banking industry where there are n banks, indexed by $i = 1, \ldots, n$. The banks locate themselves symmetrically on a unit circle.[2] There is a continuum of potential depositors uniformly distributed along the circle. All depositors incur a 'transportation cost' (ie, transaction or participation cost) when traveling to a bank, and the cost per unit of 'distance' is $\tau$. We normalize the size of deposits to unity and denote bank i's repayment obligation by $r_i$. Because our aim of is to show how systemic crises can be prevented without a safety net, there is no deposit insurance scheme in our model.

The banks invest the funds collected in risky projects (loans). The probability that a unit of deposit funds invested in bank i's portfolio will yield a positive return is denoted by $p_i$. The gross return on the investment portfolio for a unit of funds invested is y, resulting in a profit margin per deposit unit of $y–r_i$. The probability of a zero return is $1–p_i$. If a bank's projects fail, the bank itself also fails. We assume that the only cost of a bank failure is that its depositors suffer the loss of their funds.

Banks' lending and monitoring decisions affect the probability of bank failures. The success probability of a bank reflects the bank's screening and monitoring decisions and ultimately its ability to gather information for building a high-quality loan portfolio. In the spirit of modern banking theory, increasing $p_i$ is costly because of information gathering costs such as ex ante, interim and ex post monitoring costs. Some of the information gathering costs typically vary with the size of the asset portfolio, but some at least are fixed. The fixed costs that are independent of the size of the portfolio cannot fully be conveyed to deposit interest rates and therefore reduce bank profits. These costs might reflect maintenance of risk management infrastructure, including information systems, basic databases and credit scoring models, as well as the monthly salaries of monitoring personnel and the cost of sustaining a branch network to gather local information.

For brevity, we abstract from the costs that vary with the size of the asset portfolio, and assume that there are only costs of maintaining a monitoring infrastructure $C(p_i)$ that are independent of the size of the portfolio. The cost function is strictly increasing and convex in the success probability of a bank, ie, $\partial C/\partial p_i > 0$ and $\partial^2 C/\partial p_i^2 > 0$. Throughout the paper we assume that the monitoring cost function is sufficiently convex to satisfy the second-order

[2] Following the usual practice we take the number of banks, n, as given, and focus entirely on symmetric equilibria.

conditions and keep the model well-behaved. To ensure an interior solution, the usual boundary conditions are also assumed: $\partial C(0)/\partial p_i = 0$ and $\partial C(1)/\partial p_i = \propto$.

A bank competes for depositors via its interest rate and monitoring decisions, ie, its success probability. In practice, it is relatively easy to verify the bank's interest rate offer from catalogs and advertisements, but the same does not necessarily apply to the monitoring decision. We thus assume the bank can commit itself to its interest rate announcements but encounters moral hazard temptations regarding the monitoring decision (see also Rochet and Tirole 1996 and Cordella and Levy Yeyati 2002). As a result, the level of p is only imperfectly known to depositors before they invest their funds. In line with Boot and Schmeits (2000), we assume that with probability $\alpha$ the depositors are able to 'detect' $p_i$, the actual monitoring choice of banks. With complementary probability $1–\alpha$, the actual monitoring choice remains undetected. In such a case, the depositors rationally evaluate bank i's asset risk positions according to the expectation $E(p_i) = p_i^e$. In equilibrium, these beliefs are fulfilled, as the depositors infer that the banks' failure probabilities are those that prevail in the Nash equilibrium.

The observability of the monitoring level depends on the information disclosure policy of the banks. We normalize the banks' voluntary information disclosure to zero, and argue in section 4 that under plausible conditions the normalization is not restrictive. The parameter $\alpha$ can thus be identified as *a transparency requirement* imposed by the regulatory authority.

The timing of events is that depositors are endowed with a common assessment of the success probability of each bank $p_i^e$. The banks then simultaneously choose their deposit interest rates and monitoring efforts, knowing that the deposit interest rates become observable with probability one and that the actual monitoring choices will be observed with probability $\alpha$. The depositors then detect the monitoring choices (with probability $\alpha$) or do not detect them (with probability $1–\alpha$) and, subsequently, they choose their banks.

Let us now focus on the behavior of a depositor located at distance $x \in [0, 1/n]$ from bank i. Depositing in bank i yields an expected return of $E(R_i) = \left[\alpha p_i + (1-\alpha)p_i^e\right]r_i$. The bank is able to attract the depositor only if the expected return covers the cost and if its repayment contract is more lucrative than those offered by rival banks, ie, if $E(R_i) - 1 - \tau x \geq E(\overline{R}) - 1 - \tau(1/n - x)$ where $E(\overline{R}) = \left[\alpha\overline{p} + (1-\alpha)\overline{p}^e\right]\overline{r}$ with $\overline{p} = p_j$ and $\overline{r} = r_j$ for $j \neq i$.

In the terminology of Villas-Boas and Schmidt-Mohr (1999), we focus on *full-scale competition*, ie, we assume that $\tau$ is small enough to guarantee that the

market will be covered in equilibrium.[3] Under full-scale competition, the total supply of funds for bank i is

$$D_i = \frac{1}{n} + \frac{1}{\tau}\left[\alpha\left(p_i r_i - \overline{pr}\right) + (1-\alpha)\left(\overline{p}^e r_i - \overline{p}^e \overline{r}\right)\right] \tag{2.1}$$

The profits of the bank can then be written as

$$\pi_i = A_i D_i - C(p_i). \tag{2.2}$$

where $A_i \equiv p_i(y - r_i)$ captures the profit per deposit unit.

Bank i chooses $p_i$ and $r_i$ so as to maximize the profits in (2.2). By using symmetry and rational prior beliefs, $p_i = p_i^e = \overline{p} = \overline{p}^e \equiv p$ and $r_i = \overline{r} \equiv r$, the first-order conditions $\partial\pi/\partial p = 0$ and $\partial\pi/\partial r = 0$ can be simplified to

$$\frac{\alpha r A}{\tau} + \frac{\partial A}{n\partial p} - \frac{\partial C}{\partial p} = 0 \tag{2.3}$$

and

$$A - \frac{\tau}{n} = 0, \tag{2.4}$$

where $A = p(y - r)$ is the equilibrium profit per deposit unit. Equations (2.3) and (2.4) implicitly determine the equilibrium success probability and the deposit interest rate as a function of the model parameters. It is straightforward but tedious to isolate the effect of the transparency requirement, $\alpha$, on the success probability, p.[4]

*Remark.* Increasing the level of transparency improves financial stability.

*Proof.* In the appendix.

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[3] An implication of this assumption is that we leave aside the local monopoly and touching markets cases. For a characterization of such market structures and the associated equilibria, see eg, Salop (1979), Matutes and Vives (1996), Villas-Boas and Schmidt-Mohr (1999). A further restriction on the scope of the present analysis is that we focus on local interactions between banks, ie, on local competition, so that the potential market share of a bank consists of depositors located between the bank and its immediate neighbours (see Stole 1995).

[4] For brevity, we abstract from analyzing the effects of parameters $\tau$, and n in detail. Similarly, we abstract from analyzing the sign of $dr/d\alpha$. These comparative statics exercises are available from the authors on request.

The campaigns of increased transparency are usually based on the assumption that a stringent transparency requirement enhances market discipline and hence the soundness of the banking sector. The above remark uncovers the disciplinary mechanism underlying this common view: The supply of funds to a bank is directly related to the perceived soundness of the bank. As a result, enhancing bank transparency strengthens market discipline that, in turn, discourages risk taking. However, the argumentation has a prominent defect, since it ignores the disadvantages of transparency regulation. We postpone the discussion of the disadvantages for the moment, and turn to the main point of this article, which is to show that there is another, previously overlooked rationale for transparency.

# 3 A rationale for transparency

It is often argued that deposit insurance is needed in order to avoid systemic crises arising from the inherent fragility of the banking industry. It turns out that the same argument applies to the transparency requirement. Matutes and Vives (1996) show how the banking sector may be vulnerable to self-fulfilling crises if there is a minimum size requirement for banks. If a bank does not obtain the minimum market share, it cannot invest and fails with probability one. Depositors' expectations then become self-fulfilling and the model therefore exhibits multiple equilibria, one of which is a collapse of the entire banking system. In Matutes and Vives (1996) the introduction of deposit insurance prevents financial collapse by eliminating the 'no-banking' equilibrium.

Let us now consider the role of transparency in a model where a minimum market share is needed to make a bank operative. The presence of the economies of scale in banks' production technology might give a raise to such minimum size requirement (Williamson 1986, Matutes and Vives 1996). As we shall show at the end of this section, the minimum size requirement can also emerge from the economies of scale created by a balance sheet constraint.

Suppose initially that no transparency regulation is in place. Depositors then know that the banks cannot commit themselves ex ante to the repayment probability. Because there is no deposit insurance, the depositors can lose the amount deposited if their bank fails. As a result, there is a coordination game on the depositors. A coordination failure causing systemic crisis may occur.

**Proposition 1.** Without transparency regulation, a collapse of the banking system is possible.

*Proof.* When $\alpha = 0$, all depositors rationally evaluate bank i's asset risk positions according to the expectation $E(p_i) = p_i^e$ and $E(R_i) = r_i p_i^e$. If all depositors expect

that $p_i = 0$, ie, that $p_i^e = 0$, then $E(R_i) = 0$, and bank i has no customers for any $p_i$ that it may choose. Because bank i cannot acquire the minimum market share, it cannot credibly choose a positive repayment probability. Bank i is then certain to fail. As i is arbitrary, the same reasoning applies to the entire industry, ie, if $\alpha = 0$, a systemic collapse with $D_i = 0$ and $p_i = p_i^e = 0$ (i = 1,2, …, n) is possible.

Q.E.D

This result follows from the depositors' self-fulfilling expectations. The weaker the transparency of a bank, the less responsive the supply of deposits is to the bank's *actual* monitoring choice and the more important is the role of the depositors' expectations. Because we have assumed that banks voluntary disclose no information, the deposit supply is completely independent of the actual monitoring choice without any transparency regulation. In such circumstances, it is impossible to acquire the minimum market share by increasing the success probability, if the depositors' expectations are 'bad' to start with (ie, $p_i^e = 0$). This can lead to a systemic crisis because the depositors' expectations of $p_i^e = 0$ are realized in the equilibrium, and no one finds it profitable to unilaterally deviate from these strategies.

The systemic-crisis equilibrium coexists with the interior symmetric equilibrium characterized by full-scale competition in (2.3)–(2.4). It is, however, possible to eliminate the systemic-crisis equilibrium by enhancing bank transparency,

**Proposition 2.** A sufficiently stringent transparency regulation eliminates the systemic-crisis equilibrium.

*Proof.* When $\alpha \to 1$, there is no room for moral hazard and therefore depositors' decisions cannot be based on expectations. Because the depositors' expectations play no role, bank i can attract more customers by increasing $p_i$. Bank i can acquire the minimum market share under the assumption of full-scale competition and, accordingly, it can choose a positive repayment probability and the systemic crisis equilibrium is eliminated.

Q.E.D

The explanation of the result is that the better the transparency of a bank, the less responsive the supply of deposits to the depositors' expectations. Simultaneously the bank's actual monitoring choice becomes increasingly effective in attracting

deposits and hence a means to acquire the minimum market share even at the margin.

Proposition 2 suggests that in our model transparency requirement works like the deposit insurance in Matutes and Vives (1996) in removing the 'bad' equilibrium, ie, the collapse of the banking sector. To be a bit more explicit about the equivalence between transparency and deposit insurance, let us sketch a deposit insurance scheme where depositors receive a fraction σ of the promised repayment if a bank defaults. For brevity, we abstract from the pricing of deposit insurance.[5] Then, the only change to the basic model is that the total supply of funds for bank i should be rewritten as $D_i = \frac{1}{n} + \frac{1}{\tau}\left\{(1-\sigma)\left[\alpha(p_i r_i - \overline{pr}) + (1-\alpha)\left(p_i^e r_i - \overline{p}^e \overline{r}\right)\right] + \sigma(r_i - \overline{r})\right\}$. It is clear that when σ approaches to unity, depositors' decisions cannot based on expectations and the systematic crisis equilibrium will be eliminated by using the similar argumentation as in the proof of Proposition 2. A similar equivalence result of transparency and deposit insurance can be found in Matutes and Vives (2000) and Cordella and Levy Yeyati (2002) who prove that full transparency and a risk-based deposit insurance scheme lead to an equal risk-taking incentive.

Finally, we make the minimum size requirement explicit. There are various ways to introduce the economies of scale into the model. We simply assume that the bank's balance sheet holds, ie, that

$$a_i + \frac{C_i}{D_i} = 1, \tag{3.1}$$

where $a_i$ denotes bank i's asset portfolio investments per deposit unit. When the balance sheet constraint is imposed, bank i's deposits have to cover all its investment expenses so that bank i can lend only amount $a_i$. The funds invested in monitoring directly reduce the amount of funds invested in the projects. The profits of bank i from (2.2) can in this case be rewritten as

$$\pi_i = p_i D_i (y a_i - r_i) - C_i. \tag{3.2}$$

Solving (3.1) for ai and substituting it for (3.2) yields

$$\pi_i = p_i (y - r_i) D_i - C_i (1 + p_i y). \tag{3.3}$$

[5] The introduction of risk-based or flat-premium pricing of deposit insurance would not add much here. See Matutes and Vives (2000) for a comprehensive analysis of the pricing issue, and Hyytinen and Takalo (2002) for the effects of a risk-based, fairly priced deposit insurance in this kind of a model.

Comparing (3.3) with (2.2) clearly demonstrates the existence of economies of scale. Suppose that all depositors expect that $p_i = 0$. Despite our assumption that $\partial C(0)/\partial p_i = 0$, the derivative of (3.3) with respect to $p_i$ when evaluated at $p_i = 0$ (and at $D_i = 0$) is negative. In other words, under a binding budget constraint, it is optimal for bank i not to be operative. This is consistent with the depositors' expectations. Thus, because of the costs caused by monitoring investments, bank i needs a minimum market share to operate.

# 4 Voluntary information disclosure

In a more general model banks could conceivably compete on the information they disclose to attract depositors. A straightforward way to model this is to let $\alpha_i$ refer to the transparency of bank i, and assume it is a decision variable for bank i. Suppose that $\alpha_i \in [0, 1]$ and that it is simultaneously chosen with $p_i$ and $r_i$. The profit function of bank i remains otherwise identical to (2.2) except that the total supply of funds for bank i becomes $D_i = \frac{1}{n} + \frac{1}{\tau}\left[\alpha_i p_i r_i - \overline{\alpha p r} + (1-\alpha_i)p_i^e r_i - (1-\overline{\alpha})\overline{p}^e \overline{r}\right]$. Imposing then rational prior beliefs on the first-order condition $\partial\pi_i/\partial\alpha_i = 0$ shows that the level of $\alpha_i$ is indeterminate. As Herring (1999) points out, however, information disclosure may be costly for banks as it may reveal proprietary information and undermine confidential relationships. Introducing even small direct or indirect costs for achieving transparency would make the derivative of $\partial\pi_i/\partial\alpha_i$ strictly negative. In our companion paper (Hyytinen and Takalo 2002) we argue that such costs of information disclosure can dilute the market-discipline justification for transparency, ie, the Remark in section 2 might no longer hold if achieving transparency were costly for banks. But our analysis in this paper suggests that there is a possibility for welfare-improving transparency requirement even in that case.

In looking merely at the first-order condition, our discussion of the voluntary disclosure admittedly remains sketchy. There are reasons why information disclosure might be remunerative. The above analysis suggests that this is possible if the depositors systemically underestimate the success probability. Building on the insights offered by cognitive psychology, Herring (1999) argues that the subjective probability of a bank failure is likely to be high immediately after a major bank insolvency jarring perceptions. Our model predicts that if the solvent banks do not suffer the same disaster magnification heuristic as depositors, they might have an incentive to disclose information to prevent the bank failure from developing to a systemic crisis.

The above analysis also hints that information disclosure might be remunerative if the depositors' risk preferences differ systematically from those of the banks. Information disclosure might also work as a signaling devise, and it is also clear that if the information created by monitoring investments is a public good, the banks have an incentive to engage in information exchange after the investments are sunk. One could perhaps construct games where such gains from trading information are realized. It is however difficult to see why transparency would be an issue in the first place, if it were very remunerative for banks. We, moreover, think that our claims would hold even if information were disclosed voluntarily, provided that the mandatory disclosure requirements were stronger than the voluntary information disclosure and that the level of voluntary information disclosure did not guarantee the ability to secure the minimum market share.

# 5 Conclusions and policy implications

In this paper we propose a novel justification for transparency regulation. It may prevent a complete collapse of the banking sector arising from the self-fulfillment of depositors' expectations. Transparency regulation in our model works like the deposit insurance in the influential article by Matutes and Vives (1996), where it may prevent systemic confidence crises. Deposit insurance, however, entails a widely recognized moral hazard problem. By enhancing bank transparency, certain types of systemic crises can be avoided without the creation of the safety net. Hence, the adverse incentive effects of the insurance can also be avoided.

In assessing the reliability of this finding, however, some caveats should be borne in mind. It is well understood that a bank's charter value can discipline banks by increasing the private cost of risk-taking (eg, Herring and Vankudre 1987, and Bhattacharya et al 1998, and Hellmann, Murdock and Stiglitz, 2000). In Hyytinen and Takalo (2002) we show how transparency regulation may cause compliance costs for banks, reducing the charter value and, accordingly, the private costs of increasing risk profile. This can dilute the beneficial effect of transparency regulation on market discipline to the extent that the regulation eventually destabilizes the banking sector. Moreover, in our model all depositors have access to the same information about the probability of a bank failure. If some depositors in our model could also observe a private signal of the success probability, an increase in common information might be detrimental to the bank stability, as suggested by the recent contributions by Morris and Shin (1999, 2002). However, we believe that our key argument here remains robust even if achieving transparency is costly for banks or if some depositors possess private information. A sufficiently large increase in the amount of common information

created by the transparency regulation should help to avoid the self-fulfilling crises arising from a minimum size requirement regardless of the burden it may cause on banks. Nonetheless, whether such a regulatory move is welfare enhancing if the depositors' private information is accurate and if the public information is costly to increase is obviously a good question.

Finally, while our findings suggest that transparency could sometimes work like a deposit insurance scheme, substituting transparency for the DIS is not necessarily a robust policy conclusion. For instance, in contrast to deposit insurance, transparency does not help in a Diamond-Dybvig type environment where banks' provision of liquidity service under the sequential service constraint leaves them susceptible to runs. We conjecture that transparency can be substituted for deposit insurance to prevent systemic crises when they stem from banks' moral hazard temptations. Isolating more carefully the conditions where the substitution works and where it does not clearly deserves more research.

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# Appendix 1

## Proof of remark

Let us first explicitly write the first-order-conditions as

$$F^p \equiv \frac{\alpha A(p)}{\tau} - \frac{\partial A(p)}{n\partial p} - \frac{\partial C(p)}{\partial p} = 0, \tag{A1.1}$$

$$F^r \equiv A(p) - \frac{\tau}{n} = 0, \tag{A1.2}$$

where $A(p) = p(y-r)$. Equations (A1.1) and (A1.2) determine p and r as functions of $\alpha$. The comparative statics can then be derived in a standard way:

$$\begin{bmatrix} \frac{\partial F^p}{\partial p} & \frac{\partial F^p}{\partial r} \\ \frac{\partial F^r}{\partial p} & \frac{\partial F^r}{\partial r} \end{bmatrix} \begin{bmatrix} dp \\ dr \end{bmatrix} = - \begin{bmatrix} \frac{\partial F^p}{\partial \alpha} \\ \frac{\partial F^r}{\partial \alpha} \end{bmatrix} d\alpha. \tag{A1.3}$$

Then, by using Cramer's rule

$$\frac{dp}{d\alpha} = \frac{1}{|J|} \begin{vmatrix} -\frac{\partial F^p}{\partial \alpha} & \frac{\partial F^p}{\partial r} \\ -\frac{\partial F^r}{\partial \alpha} & \frac{\partial F^r}{\partial r} \end{vmatrix} \tag{A1.4}$$

where

$$J = \begin{bmatrix} \frac{\partial F^p}{\partial p} & \frac{\partial F^p}{\partial r} \\ \frac{\partial F^r}{\partial p} & \frac{\partial F^r}{\partial r} \end{bmatrix}. \tag{A1.5}$$

By assuming that the cost-function C is sufficiently convex in p we know that $\partial F^p/\partial p < 0$ and $|J| = \frac{\partial F^p}{\partial p}\frac{\partial F^r}{\partial r} - \frac{\partial F^p}{\partial r}\frac{\partial F^r}{\partial p} > 0$. By noting that $\partial F^r/\partial \alpha = 0$, the sign of $dp/d\alpha$ is given by the sign of

$$\begin{vmatrix} -\frac{\partial F^p}{\partial \alpha} & \frac{\partial F^p}{\partial r} \\ 0 & \frac{\partial F^r}{\partial r} \end{vmatrix} = -\frac{\partial F^p}{\partial \alpha}\frac{\partial F^r}{\partial r}. \tag{A1.6}$$

Taking the partial derivatives of $F^p$ and $F^r$ with respect to $\alpha$ and r from (A1.1) and (A1.2) yields

$$\frac{\partial F^p}{\partial \alpha} = \frac{\alpha r A}{\tau}, \tag{A1.7}$$

$$\frac{\partial F^r}{\partial r} = -\frac{p}{\tau}, \tag{A1.8}$$

Substituting (A1.7)–(A1.8) for (A1.6) and simplifying proves our claim that $dp/d\alpha > 0$.

Q.E.D

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