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East Asia: Miracle or Bubble?

Financial institutions and the financial crisis in East Asia

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Abstract

This paper investigates institutional reasons for the soft-budget constraint problem; and how the soft-budget constraint problem creates conditions which may result in a financial crisis. As a consequence of soft-budget constraints, bad projects do not stop; bad loans accumulate; and banks and depositors do not receive bad news on time. Poorly informed depositors are then likely to herd to overinvest when there is no bankruptcy ('frenzy'); and they are likely to herd to panic when bankruptcy occurs ('crash'), which may be the result of excessive bad loans that are also a consequence of soft-budget constraints. In contrast, under hard-budget constraints information is disclosed quickly regarding liquidation. Better-informed investors are then less likely to herd wrongly.

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1. Introduction

The financial crisis in East Asia presents great challenges to economists. Before the crisis, the East Asian economies had been doing exceptionally well,

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and many economists often referred to them as 'miracles', even though the nature of such miracles were debatable. The economies had high growth rates, high savings rates, and sound fiscal policies. In this paper, we provide a theory to understand the causes of the recent financial crisis in East Asia by analyzing problems in financial institutions.

Among several explanations for the crisis, the following are some of the more popular, which link domestic conditions to the crisis: the run by panic investors on the economies, similar to the run by panic depositors on banks (Radelet and Sachs, 1998; Stiglitz, 1998; Diamond and Dybvig, 1983); the moral hazard in banking (Krugman, 1998; Akerlof and Romer, 1994); and the collapse of a bubble economy (Blanchard and Watson, 1982). Although these arguments are useful to identify potential problems, many questions have yet to be answered. This is because 'bubbles,' or the causes for the panic, may be related to institutions and to fundamentals.

We believe that the financial crisis in East Asia resulted from long-term accumulated problems in fundamentals (such as the large amount of bad loans in the Korean banking system) and it was triggered by bankruptcies of large firms/banks in the economy (together with speculative attacks), which destroyed the confidence of investors. The accumulated problems in fundamentals were caused mainly by financial institutions, leading to 'soft-budget constraints' (i.e. the lack of commitment to stop bad projects ex post) (Kornai, 1980; Dewatripont and Maskin, 1995).

A soft-budget constraint is created in an economy where large conglomerates and large banks play dominant roles in carrying out/financing high-uncertainty-type projects (Huang and Xu, 1998a; thereafter denoted as HXa). As a consequence, bad projects do not stop and bad loans accumulate. Moreover, bank lending to bad projects is always justified. In our model, the quality of information available to banks and depositors is very poor as they never get bad news on time. Depositors decide optimally either to put their money into banks – which may provide higher returns but also entails some risks since the banks may go bankrupt – or to keep their money at home based on their private signals regarding future returns from the banks and their observations of others' actions. Under an institution where a soft-budget constraint prevails, depositors are more likely to herd to overinvest when there is no bankruptcy ('frenzy'); and they are more likely to herd to panic when bankruptcy occurs ('crash'). Moreover, as a consequence of soft-budget constraints, the efficiency of investments in highly uncertain investments is low. This may result in excessive bad loans, thus exacerbating the macroeconomic situation. The bad loans will lead to the eventual inevitability of bankruptcy for some banks, which will then trigger a crash.

In comparison, an economy with a predominance of smaller firms and diversified financial institutions to carry out/finance high-uncertainty-type projects (e.g., Taiwan) will impose hard-budget constraints on firms (with a commitment to stop bad projects ex post). Under this kind of institution, there will be a swift information flow from the firms and the banks regarding liquidation. Then, as we show, better-informed investors are less likely to herd wrongly. Therefore, a diffused financial system may reduce the chances that a financial crisis will occur.

2. Financial institutions in Korea and Taiwan

Here, we present brief overviews of the Korean and Taiwan economies, although our theoretical analysis is applicable to other economies as well. Korea and Taiwan are at similar development stages, and they also have similar technologies, labor inputs, and high savings. However, while Korea is at the center of the crisis, Taiwan has been much less affected – even though it too has been attacked by international speculators. One clue to explain this difference may be the substantially different financial institutions in the two economies.

It is well documented that Korean development has been characterized by the establishment of large conglomerates (chaebols) through government-coordinated bank loans; while small- and medium-sized firms financed by dispersed financial institutions have been predominant in Taiwan: the market share of the largest 100 firms in Taiwan was approximately 22% in the late 1970s and early 1980s, while the comparable share was about 45 in Korea (Lee, 1998, p. 230).

The Korean government promoted the heavy and chemical industries in the 1970s and promoted specialization in the largest chaebols in the 1980s through both direct and indirect subsidized loans. In the two decades since the early 1970s, more than half of Korean domestic credits were distributed as policy loans with low rates (Stern et al., 1995; Cho and Kim, 1995). Closely related to the subsidies in credits, the lack of financial discipline was a common phenomenon such that there was almost no bankruptcy before 1997 (particularly of chaebols). As a consequence, firms were over-leveraged as their average debt–equity ratio was among the highest in the world beginning in the 1970s (Borensztein and Lee, 1998; Lee, 1998). Particularly, immediately before the outbreak of the 1997 crisis the average debt–equity ratio of the 30 top chaebols was about 4.5; the excessive leveraged expansion may ultimately result in the insolvency of five of the top 30 chaebols (Park, 1997, p. 1).

In comparison, Taiwan firms relied much less on debts: the average debt–equity ratio of all Taiwan firms during the 1985–1992 period was about 1.4 and the ratio of large firms was even lower (about 1.2) (Semkow, 1994, p. 84).

Not surprisingly, credits were not allocated efficiently to Korean firms. Systematic empirical work has shown that credits were allocated preferentially to those sectors with larger firms; with exports; and with poorer economic performance (Borensztein and Lee, 1998). Furthermore, there was no financial discipline in the sense that decisions to close down plants were not related to the efficiency of the plants (Aw et al., 1998). Firms in Taiwan, however, were subject to effective financial discipline: there were frequent bankruptcies in the corporate sector. Inefficient firms were indeed disciplined: the productivity of closed-down (disciplined) firms was 11.4–15.5% lower than that of the remaining firms (Aw et al., 1998).

The losses from projects financed by bank loans caused serious problems for Korean banks. At the end of 1986, non-performing loans at the five largest commercial banks amounted to three times those banks' total net worth (Park and Kim, 1994). To relieve the troubled banks, between 1985 and 1987 the Bank of Korea provided these banks with more than 3 trillion won in subsidized loans (Nam, 1994).

To reform the inefficient loan allocation scheme, in the mid-1970s the Korean government established a credit control system called a 'principal transactions' bank system. Under this system, the financially most involved bank with each chaebol was designated as the principal transactions bank to coordinate all lending activities. Any new credit to be issued by any bank to the chaebol was supposed to be evaluated by the principal bank to make sure that the allocation was efficient. However, this principal transactions bank system was ineffective. It was reminiscent of the persistent soft-budget syndrome in centralized economies before and after reforms (Kornai, 1980, 1986).

3. Financial institutions and soft-budget constraints

In this section, we show that the principal transactions bank system or government-coordinated financing (as in Korea) involves intrinsic problems in making commitments to discipline bad projects; while diversified and decentralized financial institutions (as in Taiwan) help to form commitment devices. To facilitate our analysis, we refer to the former cases as single-investor financing, since major investment decisions are made by one investor or institution; we refer to the latter as multi-investor financing, since major investment decisions are made by several investors. Investors here refer to financial institutions or large corporations. HXa argue that multi-investor co-financing can be used as a commitment device to reject bad projects when they are discovered ex post. However, in single-investor financing the commitment device, i.e. the ex post screening mechanism, does not exist.[1]

[1] We follow Dewatripont and Maskin's approach (1995). However, a major difference between our model and theirs is that our investors are not constrained by the liquidity of wealth to finance a project alone if they so choose, which allows us to endogenize the decisions of investors who are free from liquidity constraints.

In our model there are numerous entrepreneurs, and M banks (M is large) as the investors. While the entrepreneurs have ideas, they lack the necessary wealth to finance them; the investors are wealthy enough to finance at least one project alone (or jointly with other investors of their choice). We consider that all projects can be either of a bad type (with a probability of λ), which requires three periods of investment ($I_1 + I_2 + I_3$) and is ex ante unprofitable (its ex post profitability depends on reorganization strategies); or of a good type (with a probability of $1 - \lambda$), which requires two periods of investment ($I_1 + I_2$) and is ex ante profitable.

With respect to information, we assume that ex ante (date 0) the distribution of the types of all projects is common knowledge, but neither the investors nor the entrepreneurs know precisely the type of each project. At date 1, after working on a project for one stage the entrepreneur discovers the type of the project, but the investor(s) still does not know its type.

We assume that an entrepreneur gets a private benefit from working on a project. Specifically, if the entrepreneur quits the project at date 1, he gets a low private benefit, b_1. At date 2, a completed good project generates a private benefit, b_{2g}, to the entrepreneur; a bad project will be liquidated or reorganized. If it is liquidated, the entrepreneur gets a still lower private benefit b_{2b}; if it is refinanced, it will be completed at date 3 and it will generate a private benefit b_3 to the entrepreneur. To summarize, we have $b_{2g} > b_3 > b_1 > b_{2b} \geq 0$.

In our model, there are two strategies to reorganize a bad project during the third stage, but only one of them can generate a profit ex post. The right decision in terms of the selection of strategies depends on signals s_A and s_B, where $s_J \in [\underline{s}, \bar{s}]$, $\underline{s} < \bar{s}$ and $J = A, B$. Here, we suppose that signal s_J can only be observed by investor J after I_3 is invested (for an analysis based on more primitive assumptions, see HXa).

We assume that strategy b makes the project ex post profitable if signal s_A is higher than s_B, i.e. $V^b(s_A, s_B) - I_3 > 0 > V^a(s_A, s_B) - I_3$, when $s_A > s_B$, and vice versa (A-1.1). Moreover, the outcome of a wrong strategy is bad enough that the expected net payoff of randomizing between the two strategies is worse than liquidation. That is, $qV^b(s_A, s_B) + (1 - q)V^a(s_A, s_B) - I_3 < 0$, where $q = \Pr(s_A > s_B)$ (A-1.2). Finally, we suppose that a higher s_J is more beneficial to investor J if the project is reorganized under strategy j than under another strategy. That is, for any $s^h > s^l$, $V^a_A(s^h_A, s_B) - V^a_A(s^l_A, s_B) > V^b_A(s^h_A, s_B) - V^b_A(s^l_A, s_B) > 0$, and $V^b_B(s_A, s^h_B) - V^b_B(s_A, s^l_B) > V^a_B(s_A, s^h_B) - V^a_B(s_A, s^l_B) > 0$ (A-2).

In the case of multi-investor co-financing, at date 2 when the co-investors discover that the project is a bad one, they should decide either to liquidate or to reorganize. If they decide to reorganize the project, they need to decide how to share their private information in order to choose the right reorganization strategy. Finally, at date 3, the reorganized bad project is completed with a return of V going to the investor(s) and a private benefit of b_3 going to the entrepreneur.

In the following, we show that given the above-described asymmetric information and conflicts of interest between the co-investors, there exists no reorganization scheme which is better than liquidation and which can be agreed upon by both investors. As a result, the two investors will terminate a bad project at date 2 if the project is co-financed by multi-investors.

If the co-investors decide to reorganize a bad project, in order to choose an optimal reorganization strategy, ex post they need to share their private information. This is equivalent to saying that B buys the private information s_A from A, or A buys s_B from B. Then, based on signals s_A and s_B, the co-investors decide what reorganization strategy should be selected (i.e., the investors assign probabilities of $1-q(s_A, s_B)$ and $q(s_A, s_B)$ to use reorganization strategy a and b, respectively). Since investors A and B are symmetric in our model, we need to analyze only investor A's incentive problem. For this purpose, we fix s_B at an arbitrary value $s^* \in (0,1)$. Investor A will tell the true value of s_A only when the price that B pays, $T(s_A, s_B)$, is high enough such that the expected payoff of telling the truth is not worse than false reporting. That is, the incentive compatibility (IC) condition is

$$q(s_A, s_B)V_A^b(s_A, s_B) + (1-q(s_A, s_B))V_A^a(s_A, s_B) + T(s_A, s_B)$$
$$\geq q(\hat{s}_A, s_B)V_A^b(s_A, s_B) + (1-q(\hat{s}_A, s_B))V_A^a(s_A, s_B) + T(\hat{s}_A, s_B),$$

where $\hat{s}_A$ is the false reporting of the signal.

By combining the incentive compatibility conditions under the cases that $s_A = s_A^h > s^*$, and $s_A = s_A^l < s^*$, we get

$$(q(s_A^h, s_B) - q(s_A^l, s_B))\,(V_A^a(s_A^h, s_B) - V_A^a(s_A^l, s_B))$$
$$\leq (q(s_A^h, s_B) - q(s_A^l, s_B))\,(V_A^b(s_A^h, s_B) - V_A^b(s_A^l, s_B)).$$

According to (A-2), $V_A^a(s_A^h, s_B) - V_A^a(s_A^l, s_B) > V_A^b(s_A^h, s_B) - V_A^b(s_A^l, s_B) > 0$. Thus, the incentive compatibility implies $q(s_A^h, s_B) \leq (s_A^l, s_B)$, i.e., $q(s_A^l, s_B)$ should be non-increasing in s_A.

However, by (A-1), for any given s_B when s_A increases from $s_A < s_B$ to $s_A > s_B$, for any $q(s_A, s_B) = \bar{q}$, where $\bar{q} \in [0, 1)$ is a constant, the efficiency can be improved by increasing $\bar{q}$, i.e. by $\bar{q} + \varepsilon$, where $\varepsilon > 0$. Thus, the efficiency requires $q(s_A, s_B)$ to be non-decreasing in s_A.

Therefore, to satisfy both the incentive and the efficiency requirements, $q(s_A, s_B)$ must be constant, i.e. $q(s_A, s_B) = \bar{q}$. However, for any $\bar{q} \in [0, 1]$, reorganization based on any $\bar{q} \neq q = \Pr(s_A > s_B)$ is worse than q. Moreover, by (A-1.2), a reorganization decision based on q is worse than liquidation. Thus, the two investors will liquidate a bad project when it is discovered at date 2. Moreover, this threat to liquidate bad projects has a deterrent effect on an entrepreneur who is involved in bad projects; an entrepreneur with a bad project will choose to quit once he discovers it is a bad project.

In contrast, under single-investor financing, the investor will have all information s_A and s_B and will be able to use this information to choose an ex post efficient strategy to reorganize the project. Therefore, the investor is not able to commit to terminating a bad project ex post. Moreover, the fact that the investor cannot commit to terminating a bad project affects the entrepreneur's ex ante incentives to reveal information. An entrepreneur will always choose to continue a bad project after he privately discovers its type.

Now we will move our discussion to internal financing (a special case of single investor financing) and external financing (multi-investor financing implies the involvement of external financing). In addition to the benefits associated with external financing as shown above, however, it is well known that external financing may incur additional costs. The most popular explanation for this is that due to the asymmetric information between a firm and its investors in the case of external financing, there exist both moral hazard and adverse selection problems.

Let us call the costs incurred by external financing institutional costs, c (which can be endogenized). Then there is a trade-off between internal and external financing. On the one hand, there is a savings of investment in a bad project under external financing, $\lambda(I_2 + I_3 - V)$. On the other hand, there is an extra cost of external financing, $c(2 - \lambda)$. From this trade-off, we show that there exists a critical level of the uncertainty of the project, λ^*, such that if the uncertainty is low, that is, $\lambda < \lambda^*$, internal financing is more efficient than external financing; if the uncertainty is high, that is, $\lambda > \lambda^*$, multi-investor financing is more efficient. Here, λ^* is an increasing function of c but a decreasing function of I_2 and I_3. Moreover, the advantage of external financing (hard-budget constraints) over internal financing (soft-budget constraints) increases as the uncertainty of the project, λ, increases.

The above results have important implications for our understanding of the impacts of various financial institutions on economies at different development stages. On the one hand, because of low-uncertainty in imitation, internal financing can be more efficient for work on catching-up projects. Thus, financial institutions which make internal financed R&D easier can greatly accelerate the catching-up process. On the other hand, however, advanced economies face frontiers of technological innovations which are associated with high uncertainties. If the uncertainties associated with such projects can only be reduced when a project is carried out, ex post selection (such as product competition in markets) is more effective than ex ante selection (such as the bureaucratic approval process). However, an ex post screening mechanism requires a commitment that a bad project will be stopped even when refinancing is ex post profitable (Qian and Xu, 1998; HXa). Therefore, the consequence of the soft-budget constraint problem becomes serious when an economy is moving onto technological frontiers. In such a case, the low institutional costs for multi-investor financing are critical. Unfortunately, some of those financial institutions which are efficient to finance catching-up (imitation or perfection) projects, such as principal transactions bank system/government-coordinated financial institutions, may not be efficient to finance highly uncertain projects.

4. Soft-budget constraints and the financial crisis

In this section we endogenize the creation and burst of 'economic bubbles' under different financial institutions. To simplify our language, we call an economy where all projects are financed through single-agent coordination (government or principal bank) a SBC economy; and an economy where all projects are financed through multi-investors a HBC economy.[2]

In a stripped-down model, in both the SBC and HBC economies there are M banks and each bank has N risk-neutral depositors with the same preferences. Each depositor has \$1 endowment at the beginning of each period, which she can either deposit in a bank to earn interest γ, or can hold as cash which does not change in value. Here, γ is determined by competitive capital markets. Continuing from the last section, the interest in a SBC and in a HBC are $\gamma^{S} = (\lambda V + (1-\lambda)\hat{V})/(I_1 + I_2 + \lambda I_3) - 1$ and $\gamma^{H} = (1-\lambda)\hat{V}/(I_1 + (1-\lambda)I_2) - 1$, respectively. Depositors consume goods at the end of the period. By assuming that depositors maximize their expected payoffs, they either deposit their entire \$1 in a bank if the expected return is more than \$1, or otherwise they hold the entire \$1 in cash. Depositing or withdrawing a portion of the endowment in a bank is not an equilibrium. We allow each depositor to deposit only in one bank.[3]

We assume that depositors receive all information from markets and from bank reports. Moreover, they do not know the distribution of projects, λ, thus they cannot infer the differences of economic efficiencies between these two economies (recall that when λ is low, a SBC can be more efficient than a HBC). Depositors receive signals from markets: payment of interest from a bank, $\rho_t = \{1, 0\}$; liquidation of bad projects, $l_t = \{1, 0\}$; and bankruptcy of bank, $b_t = \{1, 0\}$, with 1 and 0 denoting whether or not the described event occurs. A combination of market signals is: $\varepsilon_t = a_1\rho_t + a_2 l_t + a_3 b_t$, where $a_1 > 0$ (for good news), $a_2 < 0$ (for bad news), and $a_3 < 0$ (also for bad news). For the sake of simplicity, we set $a_1 = 1$, $a_2 = -1/\lambda$, and $a_3 = -\alpha/(1-\beta)$.

[2] We treat both SBC and HBC as closed economies. See Huang and Xu (1998b); thereafter as HXb) for a more detailed description of the model and analysis.

[3] We are interested in the herding behavior in investment and the transimission mechanism of panic by (many) risk-neutral depositors each of whom depositing in one bank. Moreover, as long as there is a small transaction fee in dealing with each bank, with the same interest rate in all the banks, a risk-neutral depositor should deposit in only one bank.

We suppose that depositors understand bank reports only in a statistical sense that their conclusions about bank performance from reading bank reports are independent random draws. In this sense, depositors draw private signals from bank reports, which is a probability, π_t^i, that the bank i's performance at time t is good.

The depositors use all signals – market signals, private signals, and each one's own beliefs from the last period – to calculate their beliefs about bank performance: the probability that the bank's performance is high or low. Formally, the believed performance of bank i at time t is x_t^i where $x_t^i = \{H, L\}$, and the depositor thinks that her belief x_t^i is correct at a probability of $p_t^i = (1-\alpha)\pi_t^i + \alpha p_{t-1}^i + \beta\varepsilon_t$, where $0 < \alpha < 1$; $0 < \beta < (1-\alpha)(1-p)$. To simplify, we set $\pi_t^i = p = 1/(1+\gamma)$.

Given depositors' beliefs, x_t^i and p_t^i, their expected return in period t is, $E(R_t^i) = p_t^i(1+\gamma_t)$, if $x_t^i = H$; and $E(R_t^i) = (1-p_t^i)(1+\gamma_t)$, if $x_t^i = L$. According to the previous section, in a SBC when no bank goes bankrupt, we have $\rho_t = 1$, $l_t = 0$ and $b_t = 0$. Therefore, we have $E(\varepsilon_t^{\mathrm{S}}) = 1$, and $E(p_t^{\mathrm{S}}) = p + (1-\alpha^t)\beta/(1-\alpha)$, which increases in t. That is, without knowledge of bad projects being financed in a SBC, depositors become more optimistic over time.

Similarly, in a HBC when no bank goes bankrupt, we have $\rho_t = 1$, $l_t = 1$ with probability λ, and $b_t = 0$. Therefore, we have $E(\varepsilon_t^{\mathrm{H}}) = 0$, and $E(p_t^{\mathrm{H}}) = p$. That is, in observing liquidations of bad projects in markets, the depositors' beliefs are stable over time.

It is easy to see that in a SBC the depositor's independent decision rule (independent means a decision is made without looking at others' decisions) is: D (deposit), if $x_t^i = H$; W (withdraw), if $x_t^i = L$. This is because when a depositor observes H, her expected return from investing is higher: $p_t(1+\gamma) = [p + (\beta/(1-\alpha))(1-\alpha^t)](1+\gamma) > 1$; and, if she observes L, her expected return is higher if she withdraws: $(1-p_t)(1+\gamma) = [1 - p - (\beta/(1-\alpha))(1-\alpha^t)](1+\gamma) < 1$.

However, in a HBC a depositor's independent decision rule is: D, if $x_t^i = H$ and $p_t^i \geq p$; W, if $x_t^i = L$, or $p_t^i < p$. This is because if a depositor observes H, her expected return from investing is $p_t^i(1+\gamma)$, which is greater than one if $p_t^i > p$. However, when there are many bad projects being liquidated in a HBC, $p_t^i < p$, then depositors may withdraw even when they receive H. This feature contributes to the mechanism which makes a HBC more stable.

We assume that all depositors make decisions (and they move immediately after a decision is made) sequentially following a queue, $\tau = 1, 2, \ldots, MN$, which is exogenously determined by their speed of receiving private information (say, if their speed of reading a bank report differs). Moreover, we suppose that depositor τ's decision is also affected by her observation of the actions of previous $n_{\tau-1}$ depositors (Banerjee, 1992; Bikhchandani et al., 1992). Specifically, in a SBC a depositor τ's decision rule is: D, if $n_{\tau-1}^{\mathrm{d}} > n_{\tau-1}^{\mathrm{w}} + 1$, or if $x_t^i = H$ and $n_{\tau-1}^{\mathrm{d}} = n_{\tau-1}^{\mathrm{w}}$; W, if $n_{\tau-1}^{\mathrm{d}} + 1 < n_{\tau-1}^{\mathrm{w}}$, or if $x_t^i = L$ and $n_{\tau-1}^{\mathrm{d}} = n_{\tau-1}^{\mathrm{w}}$;

$\sim$ (indifferent), if $x^i_t = H$ and $n^{\mathrm{d}}_{\tau-1} + 1 = n^{\mathrm{w}}_{\tau-1}$, or if $x^i_t = L$ and $n^{\mathrm{d}}_{\tau-1} = n^{\mathrm{w}}_{\tau-1} + 1$, where, $n^{\mathrm{d}}_{\tau-1}$ and $n^{\mathrm{w}}_{\tau-1}$ are the number of depositors before depositor τ who have deposited and who have withdrawn, respectively. Correspondingly, in a HBC depositor τ's decision rule is: D, if $n^{\mathrm{d}}_{\tau-1} > n^{\mathrm{w}}_{\tau-1} + 1$, or if $x^i_t = H, p^i_t \geq p$ and $n^{\mathrm{d}}_{\tau-1} = n^{\mathrm{w}}_{\tau-1}$; W, if $n^{\mathrm{d}}_{\tau-1} + 1 < n^{\mathrm{w}}_{\tau-1}$, or if $x^i_t = L$ or $p^i_t < p$, and $n^{\mathrm{d}}_{\tau-1} = n^{\mathrm{w}}_{\tau-1}$; $\sim$, if $x^i_t = H, p^i_t \geq p$ and $n^{\mathrm{d}}_{\tau-1} + 1 = n^{\mathrm{w}}_{\tau-1}$, or if $x^i_t = L$ or $p^i_t < p$ and $n^{\mathrm{d}}_{\tau-1} = n^{\mathrm{w}}_{\tau-1} + 1$.

Given the above decision rules, it is easy to see that the probability that 'correct herding' ('correct' in the sense of a subjective belief) of investing occurs after an even number of depositors, n, is

$$\theta(\sigma) = \frac{\sigma(\sigma + 1)[1 - (\sigma - \sigma^2)^{n/2}]}{2(1 - \sigma + \sigma^2)},$$

where σ is the subjective probability that her evaluation of the bank performance is correct, and $\sigma = p^{\mathrm{S}}_t$ and $\sigma = p^{\mathrm{H}}_t$ in SBC and HBC, respectively.[4] Since θ increases in σ, given $p^{\mathrm{S}}_t > p^{\mathrm{H}}_t$, we have $\theta(p^{\mathrm{S}}_t) > \theta(p^{\mathrm{H}}_t)$. That is, a SBC is more likely to generate herding to over-invest than a HBC – the creation of bubbles. This is because with the signals of bad projects hidden in a SBC, poorly informed depositors are misled to be overly optimistic.

Following an over-investment, there will be a high probability of a crash, even without an exogenous shock. The reason is the following: Although hidden loss-making projects can be covered financially due to over-investment ('bubbles'), eventually accumulated losses may result in a bankruptcy in one of the banks. The unexpected bankruptcy may have a bad enough influence that some depositors will withdraw from the surviving banks. Their withdrawals are observed by others who may then follow. This can finally result in a herding of panic – a crash. Moreover, it is easy to see that in a SBC, with accumulated loss-making projects, the probability of having a crash following over-investment is high when there is a not too large exogenous shock, such as a moderate speculative attack.

In contrast, in a HBC over-investment is unlikely; the occurrence of a crash is random, with a low probability. When the number of liquidations is small, depositors are optimistic and are likely to herd to invest. However, when the number of liquidations is large, depositors are pessimistic and they may herd to withdraw. Therefore, depending on the occurrence of liquidations, the depositors' 'sentiments' change directions frequently. This in turn correct investments on time. Moreover, without accumulation of loss-making projects financed by

[4] For the derivation of the formula and a different interpretation of σ and $\theta(\sigma)$ see Bikhchandani et al. (1992).

banks, the probability of having a crash is low even when there is a relatively large shock.

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