Implicit Government Guarantees and Bank Herding Behavior

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Summary

During the past two decades 130 of the 182 IMF member countries have experienced serious problems in their banking sectors or an outright banking crisis. Among the stylized facts about these crises are their often systemic nature, a pronounced boom-bust cycle and substantial financial involvement by the government in the resolution process. This paper tries to tie these features together in a model of banks' herding behavior. Most existing models of herding behavior can explain the similarity of actions taken by different agents but do not necessarily imply excessive riskiness of these actions. On the other hand, many models that try to explain excessive risk-taking do not contain any incentive for herding. This paper develops a state-preference model of simultaneous herding and excessive risk-taking. Thus, the model can help in understanding the frequency as well as the systemic nature of banking crises.

The starting point of the model is the observation that in many countries which have experienced banking problems either no or only a limited formal deposit insurance scheme existed. Nonetheless, depositors were often protected by implicit government guarantees. Similar to the case of explicit guarantees, a moral hazard problem arises in such a situation due to the option value that such a guarantee implies for bank owners. However, unlike in the case of explicit deposit insurance, implicit guarantees may, in addition, result in herding behavior by banks. Through the coordination of investment behavior and the resulting synchronization of periods of financial distress, banks can in effect 'force' the government, given its preferences for a stable financial system, to support the banking system in times of need. The often observed price bubbles prior to banking crises may play an important role as a signaling and coordination device for banks in this context. In addition to analyzing the important differences between implicit and explicit deposit schemes, the paper studies some of the factors that determine the strength of such herding incentives stemming from implicit guarantees. It also analyzes the possibility of multiple equilibria and the potential dynamic implications of this multiplicity in a situation of massive capital inflows and financial liberalization.

Zusammenfassung

Während der letzten zwei Jahrzehnte haben 130 der 182 IWF-Mitgliedsländer ernsthafte Probleme in ihren Bankensystemen bis hin zu ausgewachsenen Bankenkrisen erfahren. Typische Merkmale dieser Krisen sind u.a. deren systemischer Charakter, ein ausgeprägtes „Boom-Bust"-Verlaufsmuster, sowie ein erhebliches finanzielles Engagement der Regierung in der Krisenabwicklung. In diesem Aufsatz wird versucht diese Kriesencharakteristika in einem Modell des Herdenverhaltens im Bankensektor zusammenfassend zu erklären. Obwohl die meisten existierenden Herdenmodelle in der Lage sind, gleichgerichtetes Verhalten von Wirtschaftssubjekten zu erklären, implizieren sie nicht notwendigerweise, daß sich die so entstehende Herde auch einem übermäßig hohen Risiko aussetzt. Umgekehrt enthalten die meisten Modelle, die eine solche übermäßige Risikowahl erklären könnten, keinen inhärenten Anreiz für gleichgerichtetes Herdenverhalten. Das vorliegende Papier entwickelt ein Zustandspräferenzmodell bei dem sich Herdenverhalten und übermäßige Risikowahl gleichzeitig aus dem Rationalkalkül der Akteure ergibt. Das Modell kann somit nicht nur die Häufigkeit sondern auch den systemischen Charakter von Bankenkrisen erklären.

Ausgangspunkt des Modells ist die Beobachtung, daß in vielen Ländern, die eine Bankenkrise erlebt haben, entweder kein oder lediglich ein begrenztes Einlagenversicherungssystem bestand. Gleichwohl waren Bankeinlagen i.d.R. durch implizite Garantien der Regierung abgesichert. Ähnlich wie im Fall von expliziten Garantien ergibt sich auch in solchen Situationen ein Moral Hazard Problem, welches mit dem Optionswert, welchen die Garantie für die Besitzer einer Bank darstellt, zusammenhängt. Anders als in der Situation mit expliziter Garantie können implizite Garantien jedoch zusätzlich mit einem Anreiz zu Herdenverhalten für Banken verbunden sein. Über die Koordination des Investitionsverhaltens und die dadurch bewirkte Synchronisation von Perioden finanzieller Schwierigkeiten, können Banken die Regierung - aufgrund ihres Interesses an einem stabilen Finanzsystems - ‚zwingen', das Bankensystem in schwierigen Zeiten zu unterstützen. Den oft beobachteten Preisblasen im Vorfeld von Bankenkrisen kommt u.U. eine wichtige Signal- und Koordinierungsfunktion für Banken in diesem Zusammenhang zu. Neben der Analyse einiger wichtiger Unterschiede zwischen expliziten und impliziten Garantien werden auch einige der Faktoren untersucht, die das Ausmaß derartiger Herdenanreize bestimmen. Darüber hinaus wird auch auf die Möglichkeit multipler Gleichgewichte und der daraus erwachsenden dynamischen Konsequenzen insbesondere im Zusammenhang mit massiven Kapitalzuflüssen oder in Perioden der Finanzmarktliberalisierung eingegangen.

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1. Introduction

For many countries the 1980s and 1990s were a period of severe financial system instability and repeated banking crises. More than 130 of the 182 IMF member countries experienced serious banking sector problems during those two decades (Lindgren et al. (1996)). This is true for the U.S. and other industrialized countries as well as a number of LDCs and transition economies. Since then the list of affected countries has been amended several times by new episodes, most notably by the crisis experience of several Asian countries beginning in the second half of 1997. Because of the crucial importance of the financial system for the smooth functioning of the economy, and especially for the growth performance of countries, episodes of banking crises are believed to be very costly -- costs which go beyond the direct losses to bank creditors and owners. Since these costs are, in general, believed to be too severe to be dealt with by the private sector alone, in most cases the government in question intervened and supplied large amounts of funds to keep the financial system functioning. These direct fiscal "costs" of banking crises have been estimated for some countries to exceed 20% of GDP (e.g. Honahan (1997)). A fragile financial sector can impose severe constraints on fiscal and monetary policy that may at times endanger important policy objectives. Furthermore, a close chronological connection between banking crises and balance-of-payment crises has been observed in many cases. For example, Kaminsky and Reinhart (1996) even find that the former can help to predict the latter, suggesting a possible causal relationship. In order to design policy strategies that attempt to avoid a continuation of the costly crisis trend of the past two decades a thorough understanding of the causes of banking system instability and banking crises is necessary.

A common feature of a large number of crisis episodes is the systemic dimension of the banking sector problems. In general, the crisis affects not only a few individual banking institutions but involves a large part of the banking and financial system in most cases. This simultaneous experience of distress by several institutions can in principle be explained as a mere coincidence or through possible contagion effects. However, this paper is based on the premise that such a systemic crisis may be due to the simultaneous and

* I am grateful to the participants of the Young Economist Meeting in Amsterdam, the 3rd METU/ERC conference in Ankara, the Summer School on International Macroeconomics at the Center for European Integration Research (Zentrum für Europäische Integrationsforschung, ZEI) and two Bundesbank seminars for helpful discussions and comments. Especially, I would like to thank George von Furstenberg, Dale W. Henderson, Martin Hellwig, and Heinz Herrmann for valuable intellectual input and the Bank of Finland for their hospitality and a stimulating research environment. Of course, any remaining errors are my own.

excessive exposure to similar risks by different banks, which in turn is caused by herding behavior on the part of banks. The existing literature on herding behavior to a large part explains the incentive for such behavior through problems of asymmetric information or information aggregation. Although these models are able to explain similarity of behavior, they do not in general imply that the herd should be characterized by excessive risk-taking. On the other hand, current theories that try to explain excessive risk-taking generally do not address why agents should exhibit herding behavior in their search for risks. However, this joint occurrence of herding and excessive risk-taking may be an important key to a better understanding of systemic banking crises.

There are a number of reasons why banks may deliberately choose the same kind of risks as other banks, and to do so excessively. This paper carefully analyzes the potential connection between banking crises and implicit government guarantees, which in many countries protect depositors, if not owners, of financial institutions and particularly banks[1]. Through coordination of their business strategies, banks can increase the correlation of their portfolio returns with that of the rest of the banking sector. This, in turn, increases the probability that the financial problems of a bank caused by a negative return realization will be shared by other institutions. Since the government is concerned about the smooth functioning of the financial system, this increases the likelihood of the government's financial support for the banking sector. To the extent that such support is forthcoming, the negative consequences of the banks' risky business strategies are reduced. The resulting behavior of the banking system differs markedly from the behavior that would be observed under an explicit insurance system, requiring different policy responses as well.

In the next section of this paper, a case is made for the potential usefulness of theories of herding behavior and excessive risk-taking as an explanation of recent banking crises. A brief review of existing explanations of herding and risk-taking is given as well. Section three illustrates the empirical importance of implicit guarantees and reviews some existing work on the connection between such guarantees and banking crisis. The differences in emphasis with respect to the "implicit" in implicit guarantees that distinguishes this paper from these other explanations is highlighted. Section four introduces a state-preference model of implicit guarantees and illustrates the basic herding result. This model is extended along several dimensions in section five. In section six, the importance of possible herding incentives in a situation of massive capital inflows or in the aftermath of

[1] Incentives for herding behavior associated with excessive risk-taking may also arise in a newly liberalized financial market. During the initial fight-for-market-share, banks may have an incentive to choose similar post-liberalization strategies. To the extent that they succeed in coordinating their business strategies, these banks may have an added incentive to take on more risks. A forthcoming Discussion Paper (Rüffer (2000)) studies this issue.

financial liberalization are discussed along with some policy implications. Section seven concludes.

2. Herding behavior as an explanation for systemic banking crises

In response to the recent increase in financial instability, a large literature has developed which attempts to identify some possible causes of banking crises. Several stylized facts about the developments leading up to a banking crisis, as well as about the actual crisis and its resolution, can be taken from the empirical branch of that literature. With respect to some macroeconomic correlates of banking crises, Kaminsky and Reinhart (1996) identify massive capital inflows in the run-up to a crisis as a leading indicator of banking crises. These flows subsequently reverse themselves either during the crisis or slightly before the crisis. In many cases, crises are also preceded by a period of financial liberalization and of real exchange rate overvaluation. Gavin and Hausmann (1996) emphasize the prevalence of a rapid credit expansion in the domestic banking sector prior to many crises, a finding that is supported by several other studies (e.g. IMF (1998)). The IMF study also implicates financial liberalization and an increase in short-term capital inflows in banking crises. Hardy and Pazarbasioglu (1998) offer evidence on the importance of real exchange rate overvaluations and increases in foreign-currency liabilities. Moreover, Eichengreen and Rose (1997) find that an increase in interest rates in industrialized countries or a slowdown in growth rates in OECD countries often precedes banking crises in emerging economies.

From these stylized facts it appears that the boom-bust nature of crisis episodes is one of the main features of banking crises that needs further explanations. In these episodes, a period of rapid credit expansion, soaring asset prices and massive capital inflows is followed by a sudden meltdown leading to a financial crisis. An understanding of the actual crisis therefore requires an examination of this preceding boom period, which already contains the seeds for the ensuing disaster. In addition, any potential explanation needs to be able to account for the systemic nature of most crises, which can be viewed as an additional stylized fact of recent banking crises. This implies that it does not suffice to explain fragilities merely at the level of the individual institution, but one needs to explain the simultaneous occurrence of such fragilities at a large number of institutions.

The systemic nature of banking crises can, in principle, be attributable to three not necessarily mutually exclusive causes: bad luck, contagion effects or a common negative shock. Although the simultaneous occurrence of banking problems at several institutions may theoretically be the result of an unfortunate clustering of individual problems, the frequency of recent systemic crises suggests that bad luck alone cannot account for them.

Contagion, on the other hand, may play an important role in explaining the spreading of a crisis from one country to another. However, there seems to be relatively little evidence that the systemic dimension of recent domestic banking crises has been due to healthy institutions being infected by the problems of some unhealthy members of the banking community. The simultaneous failure of several banks can also be the result of a negative development in some underlying variable, which affects a number of institutions in a similar way. Especially economy-wide macroeconomic shocks have been cited in this context. Unlike idiosyncratic risk, the risk of such aggregate macroeconomic shocks can be reduced only to a limited extent through diversification. Nonetheless, a bank can, in principle, control its overall vulnerability vis-à-vis such risks through the limitation of positions that are exposed to such shocks and/or by holding sufficient equity capital against such risks. This fact is illustrated by a recent study by Demsetz et al. (1997b). In that study the authors empirically analyze whether, as is often claimed, larger banks are actually less risky by virtue of their ability to better diversify risks. They find that this ability to diversify is countered by an increased debt-to-equity ratio, leaving larger banks by and large equally risky as smaller ones. By implication then, the relative inability to diversify -- be it because of the scale of the institutions or because of the type of risk -- does not necessarily have to translate into a riskier bank.

Thus, the mere existence of aggregate shocks can by itself not explain the frequent occurrence of systemic banking crises. One rather needs to explain why banks choose to expose themselves to certain risks to a suboptimally high degree during the pre-crisis boom period. In addition, one has to take into account that what constitutes an aggregate shock is not necessarily exogenously given to the financial system, but to an important part the endogenous outcome of the banking sectors' business decisions. For example, one of the salient features of the recent Asian crisis was the high stock of foreign-currency denominated short-term debt on the books of financial intermediaries. In such a situation, an exchange rate devaluation and a reversal of international capital flows, of course, constitutes a negative aggregate shock. However, it did so only because the banking sector chose to expose itself collectively to exactly this kind of risk during the boom period.

In this context it is also important to distinguish between the trigger of a crisis and the true cause of a crisis. Many of the macroeconomic correlates of banking crises merely precipitate a crisis. The true cause has to be sought in the reasons why banks choose certain risks excessively and for why a large part of the banking sector does so at the same time. The importance of this trigger-cause distinction is also underlined by the findings of Gonzales-Hermosillo (1996). The author tries to distinguish between factors that determine the likelihood of a crisis and those that influence the timing of a crisis. She finds that the likelihood of a crisis is largely determined by bank-specific variables responsible for the

financial vulnerability of an institution, whereas macroeconomic variables are mostly responsible for the timing of the crisis. Thus, macroeconomic variables should in large part be seen as simple crisis triggers. To some extent a similar argument applies to the contagion explanation of banking crises. Although problems at one bank can indeed cause distress at others, the failure of the initial bank is merely the trigger. The actual cause lies in the reasons why banks chose to expose themselves to this vulnerability to contagion to such a high degree in the first place.

Numerous explanations exist for the excessive risk-taking of economic agents, and in particular financial intermediaries, as well as for the boom-bust nature of banking crises. Minsky's financial instability hypothesis (Minsky (1982)), which attributes an inherent tendency towards instability to the capitalist system, is one of the early attempts to explain the boom-bust nature of financial crises. According to Minsky, the main reason for this inherent tendency lies in the existence of fundamental uncertainty -- a kind of uncertainty that can not be described by simple probabilistic measures. Whereas at the beginning of a economic upturn activity is mostly determined by so-called hedge units, with realistic expectations about their ability to repay loans, as the upturn continues speculative units increasingly dominate the scene. Thus, in the boom period leverage and by extension financial fragility gradually increases until an exogenous shock leads to a collapse of asset values and expectations. Although Minsky's financial fragility hypothesis accounts for the observed boom-bust pattern, it probably raises more questions than it is able to answer, especially since economic agents are assumed to exhibit a significant degree of systematically recurring irrationality. A possible behavioral foundation for this apparently irrational behavior during the recurring boom-bust cycles is offered by Guttentag and Herring (1993). Guttentag and Herring conclude that because of certain heuristics that people use in making decisions in complex environments, people's behavior may be characterized by disaster myopia. The possibility of a low-probability crisis outcome is increasingly discounted as time since the last crisis experience elapses. Although this explanation is based on individual non-rationality, it may nonetheless be able to shed light on some important aspects of the crisis phenomenon.

Another explanation of excessive risk-taking by financial institutions that is often cited as a cause of banking crises in the wake of financial liberalization is the lack of management experience in a newly liberalized environment. Similarly, capacity constraints in the financial system in the face of massive capital inflows combined with insufficient financial supervision can lead to the same outcome. Here again the extent to which inexperience translates into increased riskiness is, however, not exogenous and business strategies can be adjusted to the level of inexperience. A more promising approach to explaining risk-taking consists of analyzing the incentive structure in the financial sector. Under certain

circumstances this incentive structure may bias the decision-making of rational agents towards risky behavior. In this context moral hazard problems stemming from the existence of limited liability may play an important role. These problems may further be exacerbated by incentive-distorting government regulation and policies. Especially the existence of underpriced implicit and explicit deposit insurance can give rise to risky asset choices by financial intermediaries as will be discussed in the next section.

Although the different explanations can in principle explain some aspects of excessive risk-taking by banks, they generally do not contain any reason for why they should act in lockstep and expose themselves to the same kind of risks at the same time, thereby raising the likelihood of a systemic crisis. To explain this systemic aspect the large existing literature on herding behavior might offer some helpful insights.

A common definition of herding behavior in the theoretical literature is that of "a situation in which investors ignore their own information and imitate the actions of other investors" (Kortian (1995)). Especially in empirical studies herding is sometimes equated with similarity of actions. Although this latter working definition can be justified given the difficulties involved in trying to identify herding empirically, it is too broad a definition in the present context. For example, it also includes similar behavior that is merely the result of a change in a common variable that affects all economic agents in a similar way. This paper uses a definition of herding that lies in between the two aforementioned definitions. Herding behavior consists of an action being taken at least partially because other agents have chosen the same action. Thus, herding means more than similarity of behavior and it may or may not involve disregarding one's own information. Various approaches exist to explain herding behavior. In addition to irrational herd instincts or animal spirits which may play a role in creating herd-like behavior,[2] there may be perfectly rational reasons for an individual actor to take into consideration what other agents are doing and to go with the herd at times. In general, two types of models of rational herding behavior can be distinguished: models that focus on informational problems and models that involve direct pay-off externalities.[3] In all approaches, the main reason for being concerned about herding behavior derives from the fact that in situations of herding individual rationality does not necessarily coincide with optimality from a social point of view.

One prominent class of herding models that is based on information problems consists of so-called information cascades (e.g. Banerjee (1992), Bikhchandani et al. (1992)). The basic information cascade arises in a situation where several individuals need to make a

[2] Results from psychological experiments may in principle be used to augment the argument by Guttentag and Herring in order to introduce a herding element into it. The findings by Asch (1952) seem especially promising in this respect.

[3] Devenow and Welsh (1996) offer a good overview over herding behavior in financial economics.

sequential choice between alternative actions. Uncertainty exists with respect to the respective outcomes. This uncertainty is partially reduced by a private noisy signal that each agent individually receives prior to the decision. In addition, agents try to infer other agents' signals by observing the actions of earlier decision-makers. In such a situation it is possible that very little real information is accumulated in the sequential decision-making process. In the extreme outcome, everyone follows the first decision-makers despite their own information suggesting a different course of action. Thus, no new information is revealed through subsequent decisions and the whole cascade is actually based on the actions of a few initial decision-makers. The action chosen by the cascade is not necessarily the optimal one. Such cascades exhibit a high degree of fragility due to the low information content, and small amounts of new information can destroy an ongoing cascade.

Two crucial assumptions of the basic cascade model significantly limit its usefulness to explain behavior in financial markets. First, prices are assumed to not respond to individual actions, and second the set of possible actions has to be small relative to the set of signals. Both of these assumptions are likely to be violated in financial markets in which prices are extremely sensitive with respect to the arrival of new information, and where portfolios can be smoothly adjusted to newly arriving information. Some more recent versions of cascade models, however, try to deal with some of these issues.[4]

A different branch of the herding literature takes possible information asymmetries between different types of actors as its point of departure. Scharfstein and Stein (1990), for example, show that there may exist an incentive for fund managers to hide in the herd by choosing similar portfolios as other fund managers. In their model, fund owners do not know the quality of a given manager in advance, and neither does the manager herself. However, it is known that the signals which high-quality managers are able to obtain are highly correlated with the signals of other highly qualified managers. The signals of low-quality managers on the other hand do not exhibit a high correlation with other managers' signals due to the fact that they mainly consist of uninformative noise. Since similar signals will translate into similar actions, there is a possibility to complicate inferences about one's own quality by going with the crowd. Another example of a herding model that emphasizes principal-agent aspects is Zwiebel (1995). He finds that managers may have an incentive not to innovate but to stick with the established industry standard because of herding incentives. By doing so, managers facilitate an accurate relative performance evaluation by the principal. Due to the lack of a precise benchmark for evaluating innovative behavior this kind of behavior is discouraged.

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[4] See, for example, Avery and Zemski (1998) who introduce multi-dimensional uncertainty into the model. With this kind of uncertainty, changing price signals do not necessarily prevent the possibility of an information cascade occurring.

The other class of herding models derives an incentive for herding behavior through direct pay-off externalities. An example of herding due to negative pay-off externalities is a bank run (Diamond and Dybvig (1983)). In this case, the real or expected direct negative consequences that result from the deposit withdrawal of other depositors trigger the simultaneous withdrawal of all depositors[5]. On the other hand, Froot, Scharfstein and Stein (1992) construct a model with positive pay-off externalities. These externalities lead to herding behavior with respect to the acquisition of information. The larger the number of other investors that possess a certain type of information, the stronger will be the effect on prices, once investors are allowed to act upon that information. A piece of information that no other investor possesses is useless since it will never be reflected in prices, and will therefore not be profitable. Thus, investors try to obtain similar information as other investors and that information may be totally unrelated to any otherwise relevant fundamentals.

As this brief overview illustrates, there exists a variety of mechanisms through which socially suboptimal but individually rational herding behavior can be explained. Especially relevant in the banking context are models that are based on principal-agent problems or direct pay-off externalities. Information cascades, on the other hand, probably play only a minor role in financial markets. Herding models can help in understanding the striking parallels in the development of balance sheets at different financial institutions prior to a crisis. However, in general these models fail to explain why this similarity should be characterized by excessive riskiness. One could add an incentive for risk-taking into those models and thereby bias the herd towards risky behavior. However this paper develops a model in which the incentive to herd and the incentive to take on undue risks are intimately connected and, in a sense, are mutually reinforcing. It falls in the category of herding models where the herding incentive derives from positive pay-off externalities and is in the that sense similar to the model by Froot et al. (1992). As will be explained in the next section, the pay-off externality stems from the existence of implicit government guarantees. With such a guarantee, there may be safety in numbers for the individual bank if the government's concern about financial instability increases in the severity of the banking problems.

3. Implicit guarantees, risk-taking, and herding behavior

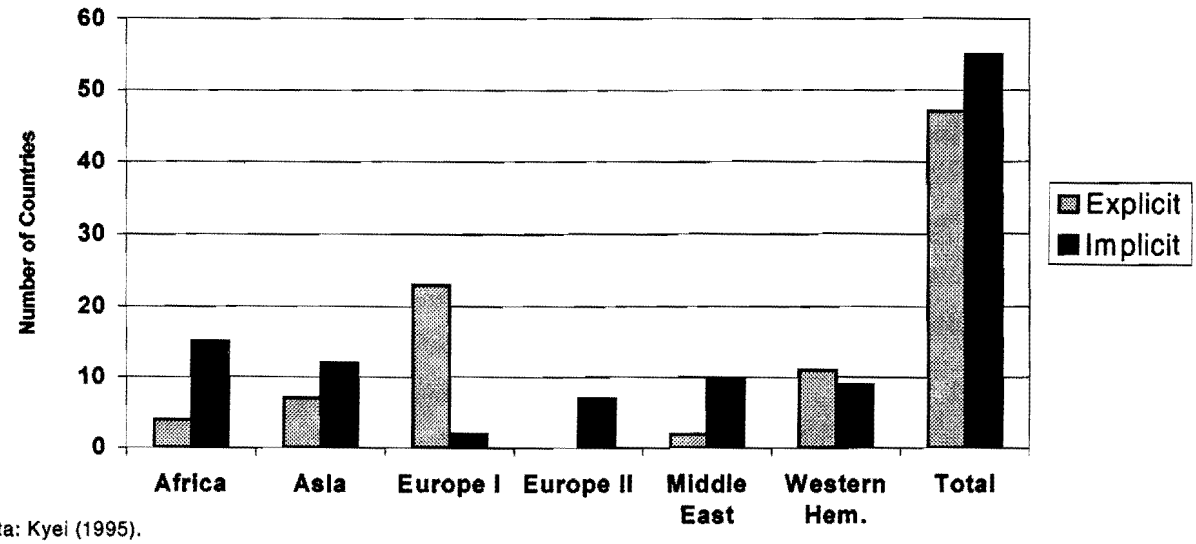
In addition to the stylized facts of banking crises discussed above the substantial financial involvement of the government in the resolution of banking crises should be considered a

[5] A bank run can trigger the failure of an individual bank. Without additional contagion effects it can not, however, account for the simultaneous failure of several banks.

further crucial ingredient. This involvement often takes the form of direct payments to the depositors and other creditors of the troubled banks, but can also take a more indirect and contingent form through the issuance of guarantees. In some cases, even bank owners have been supported by government intervention policies. Some government support policies were partly based on explicit laws or regulations, as in the case of an explicit deposit insurance scheme. More often, however, no firm legal basis for the government action existed, or the actual government support substantially exceeded the amount prescribed by such laws.

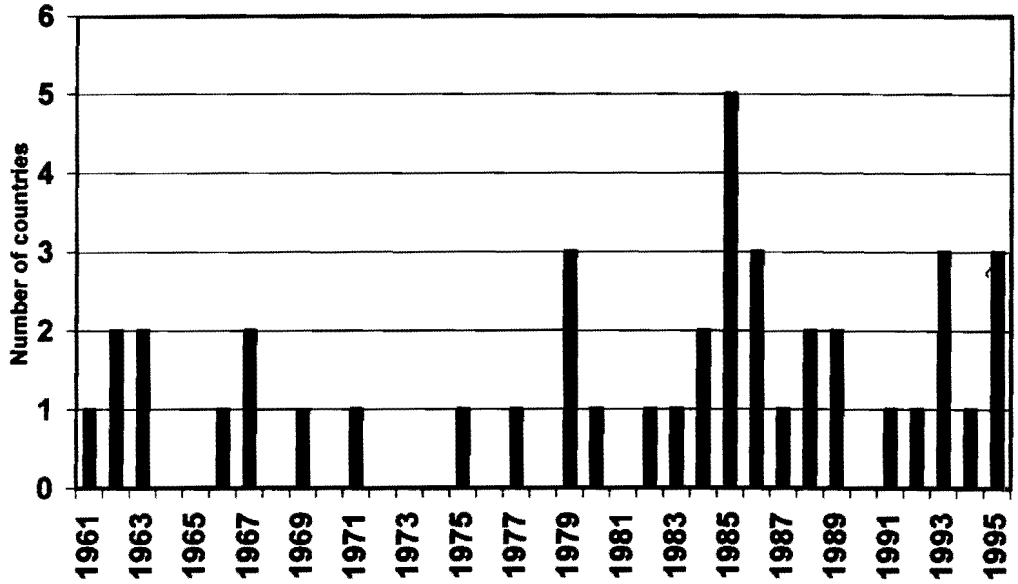
In his description of deposit insurance schemes in IMF member countries Kyei (1995) points out that most countries do not have explicit deposit insurance. Implicit schemes dominate especially in Africa, Asia, Europe II, and the Middle East (Figure 1). In addition, many of the countries that have explicit deposit insurance introduced such insurance schemes only in the face of mounting problems in their respective banking and financial systems during the 1980s and 1990s (Figure 2). Therefore, many problems started to develop in an environment where no explicit insurance scheme was in place. Because of time inconsistency problems, however, it is questionable whether a policy of no insurance can in fact be credible. The fact that in the end most governments bailed out their financial systems at least partially when there was the danger of a systemic financial breakdown proves right all those who assumed that they were, to some degree, protected by a government guarantee.

Figure 1
Deposit insurance schemes (1995)



Data: Kyei (1995).
Note: Europe I consists of the 15 EU countries, Bulgaria, Czech Rep., Hungary, Iceland, Norway, Poland, Romania, Slovakia, Switzerland, and Turkey.
Europe II consists of Estonia, Latvia, Lithuania, Kazakstan, Kyrgyz Rep., Russia, Ukraine.

Figure 2
Year of establishment of explicit insurance scheme

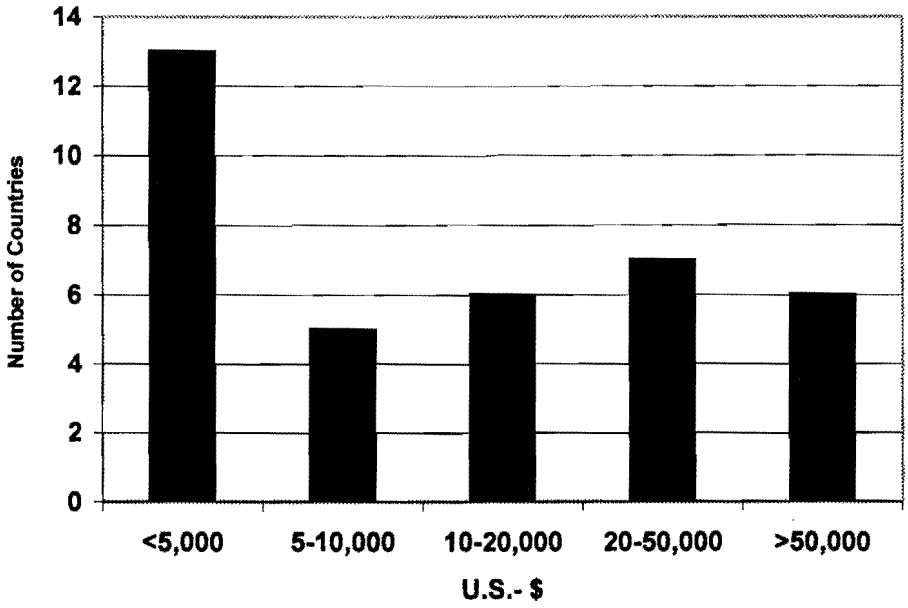


Data: Kyei (1995)

The Chilean banking crisis in the early 1980s, the Finnish crisis of the early 1990s and the Mexican crisis of 1995-96 are examples of massive government assistance provided to save all but some relatively small banks,[6] though at sometimes considerable cost to their owners. In a more recent example the Japanese government assured depositors that deposits will be guaranteed by the government following the failure of Yamaichi Securities in December 1997. The current financial involvement of the IMF in different rescue operations for troubled financial systems further highlights the importance of an analysis of such guarantees, and the expectation thereof for financial sector stability. Even where an explicit insurance scheme is in place, in general it is of a limited nature, as illustrated by Figure 3. Therefore, some implicit government guarantees may apply to the uninsured part of claims, and thus may influence the behavior of agents protected by it. This paper will take this widespread use of implicit government guarantees as its starting point.

[6] For example, the resolution which the Finnish parliament issued during the crisis contained the following passage: „ ... Parliament requires the state to guarantee that Finnish banks are able to meet their commitments on time under all circumstances. Whenever necessary, Parliament shall grant sufficient appropriations and powers to be used by the Government for meeting such commitments." (quoted from Nyberg and Vihriälä (1994), p. 33.)

Figure 3
Coverage limits of explicit deposit schemes



Data: Kyei(1995)

Despite the prevalence of implicit deposit insurance schemes, most of the literature deals with the case of explicit insurance and its consequences for the functioning of the financial system. For example, Merton (1977) and Keeley (1990) show that an explicit deposit insurance represents a put option from the point of view of the bank owners. The banks' owners will exercise this option and hand the insolvent bank over to the insuring agency in the case that the gross portfolio returns fall short of the promised payments to depositors. This possibility enables bank owners to attract deposits at basically risk-free interest rates, and simultaneously gives them an incentive to seek risky investment projects. This moral hazard problem could, in principle, be avoided by an adequate pricing strategy for the deposit insurance. However, in practice, most explicit insurance schemes do not charge rates that are commensurate with the risk involved, and thus leave room for incentives for excessive risk-taking. Such incentives are, however, independent of the actions of other banks and therefore can not by themselves explain the observed similarity in the choice of risks.

In addition to the policy relevance that is derived from their widespread use, implicit guarantees or deposit insurance schemes are also often cited together with their explicit counterparts as one important contributing factor in recent banking crises. Corsetti et al. (1999), for example, identify overlending and overborrowing due to the existence of

implicit and/or explicit government bail-out guarantees as one of the main causes for the recent Asian crisis. Some theoretical treatments have also included implicit guarantees into the analysis in response to the growing acknowledgment of the potential practical importance of such guarantees. Although the applicability of those models is thereby widened considerably in principle, in many cases implicit guarantees are treated analytically very similar to explicit guarantees. Therefore these approaches leave them with the same inability to account for the similarity of behavior that characterizes models of explicit guarantees.

McKinnon and Pill (1996) use the existence of some form of government guarantee to explain international overborrowing by the financial sector in the wake of financial liberalization, leading to inefficiently high investment and in the end possibly to banking crises. Due to the government guarantees, financial intermediaries can attract funds at low costs. Competition among intermediaries means that these low funding costs will be passed on as favorable credit conditions to the banks' customers. The customers face a signal extraction problem because they do not know whether the credit conditions reflect a positive evaluation of their investment projects by the bank or merely a poorly regulated financial system enjoying government guarantees. The main feature that may distinguish the guarantees in this model from a more conventional explicit guarantee[7] is the uncertainty about the extent and existence of such guarantees on the part of borrowers. However, the uncertainty about the quality of banking supervision seems to be more relevant for the model, and the same result could be obtained with a purely explicit government guarantee.

Like Corsetti et al., Krugman (1998) also views implicit government guarantees as an important ingredient in the Asian crisis. According to Krugman, these guarantees led to a similar overinvestment as in the model by McKinnon and Pill. In contrast to the case of McKinnon and Pill's model this is, however, not due to an information problem between banks and their customers, but rather to the moral hazard distortions on the part of the banks' owners. The elimination of the downside risks brought about by the government guarantee leads to „Panglossian" investment behavior: the capital stock is increased until the return in the most favorable outcome (the outcome "in the best of all worlds") is equal to the world interest rate. In such a situation, competition among intermediaries can give rise to asset price bubbles. Such bubbles will be even more pronounced in the case of a multi-period version of the model, in which a bad return realization may trigger the cancellation of the guarantee scheme by the government. The concept of implicit guarantee used in this model is again very close to that of the traditional explicit scheme. The main

[7] In this respect the model contains a crucial asymmetry. Although borrowers do not know about insurance and supervision depositors must implicitly be assumed to have such information. Otherwise they would not be willing to accept low rates of interest for their deposits.

difference lies in the fact that the government may decide to renege on its promises in the case of a bad return realization.

However, there is an aspect of implicit guarantees that distinguishes them from explicit ones and that is highly relevant for the understanding of systemic banking crises: Unlike in an explicit deposit insurance scheme, the payment to bank creditors is often conditional on the severity of the crisis in the case of an implicit guarantee scheme. With explicit guarantees the conditions under which payments are made and the extent of such payments is in general clearly specified in advance. Without such a written commitment the government has a considerable degree of freedom in deciding on a case by case basis about a possible bail-out for certain groups of creditors or even owners. One important criterion that governments generally apply in deciding about support measures is the systemic risk that emanates from a given banking problem. Such considerations may result in a "too-big-to-fail" policy if an individual institution poses a large enough systemic risk. However, the systemic risk increases not only with the size of the affected institution, but also with the number of troubled institutions, or more generally with the share of the banking sector - as for example measured by total assets - that is affected. Disruptions in the payment system or problems in the control of monetary aggregates are more likely when this share is large. At the same time, markets have increasing difficulty distinguishing between illiquidity and insolvency of troubled institution, making the voluntary supply of private liquidity assistance less likely. In addition, a possible credit crunch will gain in severity because more institutions may have to cut back lending and because fewer healthy institutions will be left as an alternative source of funding.

The model by Penati and Protopapadakis (1988) to some extent incorporates this crucial aspect of implicit guarantees. They analyze the effects of explicit and implicit deposit insurance in the framework of a state-preference model. They distinguish between two loan markets in which banks are active to introduce a role for implicit guarantees: A local market in which banks enjoy monopoly power, and a common market in which perfect competition prevails. Default on any of the loans will lead to the bank's bankruptcy. Whereas the risk associated with the local market represents idiosyncratic risk for the individual banks, the common market exposes a bank to aggregate risk. Even deposits that are not explicitly insured will be implicitly protected against the latter risk because this risk is assumed to be of a systemic nature. Penati und Protopapadakis show that the existence of the implicit guarantee biases the insurance subsidies towards systemic risks, and thus can lead to excessive exposure to such risks. Although this model captures important aspects of implicit guarantees -- specifically that the insurance coverage is conditional -- the model does not directly motivate this conditionality. The coverage is not endogenously determined by the severity of the crisis, but simply depends on the type of loan.

In contrast to the model by Penati and Protopapadakis, the model developed in this paper tries to capture the conditional nature of implicit guarantees more directly. A state-preference model similar in spirit to the ones by Keeley (1990), Furlong and Keeley (1987, 1989) and Penati and Protopapadakis (1988) is employed for that purpose. When insurance coverage depends directly on the severity of the crisis, there may be an incentive for banks to herd towards certain risks which ex ante do not necessarily differ in any relevant sense from other risks. Through the simultaneous exposure by a sufficiently large number of institutions, a risk obtains its systemic character, which may then justify the systemic concern of the government. In this model, banks choose to live dangerously, and they also have an incentive to do so together. Unlike many other theories of excessive risks-taking and herding behavior, implicit guarantees in the conditional sense can potentially help explain the frequent occurrence of systemic banking crises.

4. A model of implicit guarantees and herding behavior

To concentrate on the main features of implicit deposit insurance, this section assumes that the financial system consists only of two banks. Each of these banks has to make a portfolio decision with respect to two risky assets, A and B. The payoffs from those assets are denoted as a and b. The payoff for each asset can take either a high value (h) or a low value (l), with the two corresponding states (s) denoted s_{hi} and s_{li}. The letter i stands here for the asset under consideration. The payoffs in state s_{hi} (s_{li}) are a_h (a_l) with $a_h > a_l$ for asset A, and analogously b_h (b_l) with $b_h > b_l$ for asset B. The value of a payment of \$1 in a given state is given by the respective state prices, $p(s_{ji})$, which are, together with the underlying state probabilities, determined outside the model. For now it is assumed that the markets for the two assets are competitive so that asset prices p_A and p_B are given by the sum of the payoffs in the two states evaluated at the current state prices: $p_A = a_h\, p(s_{ha}) + a_l\, p(s_{la})$ and $p_B = b_h\, p(s_{hb}) + b_l\, p(s_{lb})$.

Each bank can only choose one of the two assets and, in this section, a realization of the low state s_{li} for the chosen asset i will lead to bankruptcy. The government is assumed to have an interest in the smooth functioning of the financial system, which would be severely disrupted if both banks failed at the same time. In that case the government ensures that the depositors will be paid in full. The consequences of the failure of a single bank, however, are not deemed severe enough to trigger such a response by the authorities. Therefore, the combination of realizations for the two asset returns is of crucial importance and four states of nature need to be distinguished: s_{hh}, s_{hl}, s_{lh}, s_{ll}, where the first subscript now indicates the

realization for asset A and the second subscript that for asset B. The assumption about the government response to banking problems is believed to capture a crucial element of implicit guarantees: the magnitude and scope of government assistance depends positively on the perceived systemic danger that such problems pose.

Each bank maximizes its value, V, which is given by the following expression for the case of a bank that invests in asset A:

$$V = \frac{(e+d)}{p_A}[(p(s_{hh}) + p(s_{hl})) \cdot a_h + (p(s_{lh}) + p(s_{ll})) \cdot a_l] - \frac{d}{p_d} \cdot [(p(s_{hh}) + p(s_{hl})) \cdot dp_h + (p(s_{lh}) + p(s_{ll})) \cdot dp_l] \quad (1)$$

where e is paid-in-equity-capital and d are deposits, p_d is the price of deposits, and dp_h and dp_l are the promised returns on deposits. The first term on the right hand side represents the current value of the asset portfolio of the bank, with $(e + d)/p_A$ being the amount of asset A that can be acquired with the existing equity and deposits. The second term represents the current value of the payments that have to be made to depositors. With neither implicit nor explicit deposit insurance and competitive asset and deposit markets $p_A = (p(s_{hh}) + p(s_{hl}))$ $a_h + (p(s_{lh}) + p(s_{ll}))$ a_l and $p_d = (p(s_{hh}) + p(s_{hl}))$ $dp_h + (p(s_{lh}) + p(s_{ll}))$ dp_l. In what follows it is assumed that the contractually promised return is not contingent on the realized state of nature, as is typical for a standard deposit contract. This promised return is normalized to be $dp_l = dp_h = 1$. If there is no risk of bankruptcy, the price of deposits must be such that they yield the risk-free rate of return, i.e. $p_d = p(s_{hh}) + p(s_{hl}) + p(s_{lh}) + p(s_{ll}) = (1+r_{rf})^{-1}$, where r_{rf} is the risk-free rate of return. If, however, in any of the states the bank were to default on its promised payments, this will be reflected in the price of deposits and thus in the return in the no-default states. From this it follows that, without deposit insurance, the value of the bank is equal to the equity financing, e.

$$V = e \quad (2)$$

In this case, any change in the payoff structure on deposits will change the rate of return that will have to be offered to depositors leaving the value of the bank for shareholders unchanged. If, for example, the bank were to offer a lower payment should the chosen asset perform poorly, the price depositors would be willing to pay for such deposits would

decrease. This reduction in p_d would exactly offset the advantage for the bank that results from the lower payment in the low-return state. Thus, V will not be affected and no incentive exists for the bank owners to take on additional risks through the choice of leverage or assets.

This result no longer necessarily holds if deposits are partially or completely guaranteed by some third party.[8] Due to the contingent nature of implicit deposit insurance, the payoff structure of a bank depends on the investment decision of the other bank. First, the case where the two banks choose different assets in their portfolios is considered. The value of the bank that chooses asset A is now given by the difference between the value of the bank's assets and its liabilities to depositors in the no-bankruptcy states as described in the following expression:

$$V' = \frac{(e+d)}{p_A}(p(s_{hh}) + p(s_{hl})) \cdot a_h - \frac{d}{p'_d} \cdot (p(s_{hh}) + p(s_{hl})) \cdot dp_h \qquad (3)$$

$$\text{where} \quad p'_d = p(s_{hh}) + p(s_{hl}) + p(s_{ll}) + p(s_{lh}) \frac{(e+d) \cdot p'_d \cdot a_l}{p_A \cdot d}$$

$$\text{or} \qquad p'_d = \frac{p(s_{hh}) + p(s_{hl}) + p(s_{ll})}{1 - \frac{(e+d)a_l \cdot p(s_{lh})}{d \cdot p_A}} \; .$$

If asset A performs poorly but asset B performs well, only the bank investing in asset A will fail and no government support will be forthcoming in state s_{lh}. Depositors receive a share of the value of the bank's assets proportionate to the amount of their deposits. In the case that both assets realize a low rate of return, both banks will go bankrupt and the government will step in and pay the promised return to the depositors.[9] Thus, the bank no longer has to compensate depositors ex ante for the possibility of a low return realization of its portfolio to the extent that the other bank tends to have a low return on its portfolio at the same time.

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[8] Equation (2) would still hold if banks were charged a risk-dependent and fair insurance premium. This case, however, is of limited practical interest and only the case of underpriced deposit insurance will be discussed. The explicit price of insurance is assumed to be zero, as is normally the case for implicit insurance schemes.

[9] Solvency of the guarantor is assumed throughout the paper. However, this may not always be a good assumption as the case of the U.S. Federal Savings & Loan Insurance Corporation (FSLIC) has shown. For a discussion of the case of guarantor's insolvency see, for example, Cook and Spellman (1991).

The value of this implicit deposit insurance for the bank can be seen by comparing the value of the bank to its equity:

$$O' = V' - e = \left(\frac{d}{p'_d} - \frac{e+d}{p_A} a_l\right) \cdot p(s_{II}). \tag{4}$$

Equation (4) represents the excess value of the bank over its equity and can be interpreted as the option value of the implicit insurance. It is given by the difference between the promised return on deposits and the actual value of the bank's assets in the case of bankruptcy evaluated at the state price $p(s_{II})$. This difference will be provided by the insurer and the bank can price its deposits as if there were no bankruptcy in the case that both banks fail. The option value of the implicit guarantee will be positive as long as

$$1 > \frac{e+d}{p_A} a_l \frac{p'_d}{d}, \tag{5}$$

i.e., as long as a low asset return actually triggers bankruptcy.

The option value is increasing in the state price $p(s_{II})$. Assuming that the state prices are proportional to the probability of the state occurring,[10] this can be interpreted as meaning that the value of the deposit insurance increases with the likelihood of the simultaneous occurrence of bankruptcy. Or put differently, the value of a bank increases in the correlation between bank portfolio returns. Furthermore, it can be shown that the excess value of the bank depends negatively on the amount of equity. This holds true independent of whether e is changed alone or whether d is changed in the opposite direction by the same amount in order to hold the overall size of the banking firm constant. The excess value also increases as the spread between a_l and a_h widens such that the price of the asset stays constant.[11] Thus, as with explicit insurance, there is an incentive for banks to increase leverage and asset risk in the presence of implicit deposit insurance. The same regulatory concerns about moral hazard that arise in the context of the former system therefore also apply here.

The other possibility for the investment strategies of the banks is that both banks choose the same portfolio. Assuming that the commonly chosen asset is A, the value of a bank is:

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[10] See for example Penati and Protopapadakis (1988) for a discussion of this assumption.

[11] Such a price-preserving increase in the spread is equivalent to a mean-preserving spread if the state prices are assumed to be proportional to the probability of a state occurring. However, the interpretation of the mean becomes problematic if the probabilities are risk-adjusted probabilities as suggested by Penati and Protopapadakis (1988).

$$V'' = \frac{(e+d)}{p_A}(p(s_{hh}) + p(s_{hl})) \cdot a_h - \frac{d}{p_d''} \cdot (p(s_{hh}) + p(s_{hl})),$$

where $p_d'' = p(s_{hh}) + p(s_{hl}) + p(s_{lh}) + p(s_{ll})$. (6)

And the option value of the implicit deposit insurance now is

$$O'' = (\frac{d}{p_d''} - \frac{e+d}{p_A} a_l) \cdot (p(s_{lh}) + p(s_{ll})) \ . \tag{7}$$

In this case there is no state of nature in which the depositors do not receive the promised return. The price of deposits, p_d'', is therefore equal to the inverse of the risk-free gross interest rate. The option value is again positive as long as the low asset return realization triggers bankruptcy. This case is algebraically the same as that of a complete explicit deposit insurance scheme. By coordinating their behavior with respect to their portfolio decisions, the banks in effect force the authorities to grant their depositors the same coverage as conveyed by an explicit scheme. This apparent similarity, however, conceals important differences.

The main difference between explicit and implicit insurance coverage lies precisely in the fact that in order to achieve complete coverage, banks have to coordinate their behavior, which is not necessary in the case of an explicit insurance scheme. This coordination of investment strategies is effective because it coordinates at the same time the occurrence of bankruptcy. Thus implicit deposit insurance could potentially lead to herding behavior with the consequence that any banking problem tends to be systemic, rather than being a problem on the level of the individual bank. Furthermore, successful coordination may exacerbate any existing moral hazard problems.

The extent to which an incentive to coordinate portfolio decisions exists and the strength of any such incentive is determined by the costs and benefits of coordination. One possible benefit is, as discussed, the extension of insurance coverage to a larger set of states of

nature. Equation (8) expresses the difference in option values of the implicit government insurance in the cases with and without coordination.

$$
\begin{aligned}
O'' - O' &= \frac{d \cdot (p(s_{ll}) + p(s_{lh}))}{p_d''} - \frac{(e+d) \cdot a_l \cdot p(s_{lh})}{p_A} - \frac{d \cdot p(s_{ll})}{p_d'} \\
&= \frac{d \cdot p(s_{ll})}{p_d''} - \frac{d \cdot p(s_{ll})}{p_d'} + \left[\left(\frac{d}{p_d''} - \frac{(e+d) \cdot a_l}{p_A} \right) \cdot p(s_{lh}) \right] .
\end{aligned} \tag{8}
$$

The expression in the second line illustrates the origin of the difference between the two option values. On the one hand, coordination changes the value of the option in the case that both assets have a low outcome. This case is covered by the insurance with or without coordination. However, with coordination the promised return to depositors is lower since compensation for default is no longer required to the same extent. Hence the value of being covered by the implicit government guarantee in state s_{ll} actually decreases, i.e., the difference between the first two terms is negative. On the other hand, coordination achieves that insurance coverage is extended to state s_{lh}, and this has a positive value for the bank, as represented by the term in brackets. However, it can be shown that the latter effect dominates the former and that therefore an incentive to choose the same types of investments always exists. The size of the difference crucially depends on the relative size of $p(s_{ll})$ and $p(s_{lh})$ which act as weights on the gains and losses. The dependence on these state prices is, however, more complex since they also enter into the price of deposits.

There may, however, also be situations in which a herding incentive is absent. An example is given by the case where the realized return on the asset in the low state is very close to the required payment to depositors in the case of no coordination. If the banks manage to coordinate in that case, the required payment to depositors is reduced to the risk-free rate of return and the low return from the assets may suffice to cover the promised repayment. The risk of bankruptcy is eliminated and therefore the value of the implicit deposit insurance, which has been positive in the case without coordination, will drop to zero. More generally, a sufficient drop in the probability of failure can mean that there will be no incentive to coordinate investment behavior. These cases are, however, not directly reflected in the model, since constancy of state prices and probabilities as well as bankruptcy in the low return case were the maintained assumption. A further aspect that is not captured by the model are the potential costs associated with herding behavior, which may reduce the net benefit from coordination. These may, for example, result from the need for regulatory avoidance or the necessity to gather information about the behavior of other banks in order to achieve coordination.

For regulatory and supervisory purposes it is important to understand how changes in certain observable variables relate to changes in the incentive for coordination. This can help to identify situations in which special caution is warranted. Two such variables are leverage, as measured by equity if deposits are held constant, and portfolio return variability. The change in the difference in option values in response to a change in equity is given by the following expression:

$$\frac{\partial(O'' - O')}{\partial e} = -\frac{a_l \cdot p(s_{lh}) \cdot (p(s_{hh}) + p(s_{hl}))}{(p(s_{hh}) + p(s_{hl}) + p(s_{ll})) \cdot p_A} < 0 . \qquad (9)$$

As the amount of equity is increased, holding debt constant, the difference in option values decreases. Well-capitalized banks therefore have less of an incentive to coordinate their investment behavior, i.e., to engage in herding behavior. As in the case of explicit deposit insurance, minimum capital requirements will also reduce the moral hazard temptation of implicit guarantees. A different interpretation of this result is that the value of the derivative represents the difference in the incentive to increase leverage in the situation with and without coordination. Thus, a negative value of the derivative also implies that the incentive for the bank to increase its leverage is higher with coordination. Minimum capital standards may therefore be especially important when banks have achieved a certain degree of coordination or, more generally, can easily achieve it in their operating environment.

What happens to the incentive to coordinate as the riskiness of the portfolio is increased? Such an increase is represented by a widening of the spread between a_h and a_l, holding the price of the asset constant. To what extent is the incentive to coordinate stronger in an economic environment that is characterized by volatile investment returns or a high degree of uncertainty about those returns?

$$\left.\frac{\partial(O'' - O')}{\partial a_h}\right|_{p_A = const} = \frac{(e+d) \cdot p(s_{lh})}{p_A} - \frac{p(s_{lh}) \cdot p(s_{ll}) \cdot (e+d)}{(p(s_{hh}) + p(s_{hl}) + p(s_{lh})) \cdot p_A} > 0 \qquad (10)$$

Equation (10) shows that the difference in option values and thus the incentive to coordinate investment strategies is an increasing function of the variability of the returns from asset A. Volatile international capital flows can be associated with an increase in the

volatility of asset returns. They could therefore increase the incentive of banks to concentrate their investment behavior in a coordinated fashion on a narrow group of assets with high positive return correlation. A similar argument applies to the unfamiliar environment in which banks find themselves immediately after a period of financial liberalization. Alternatively, this result can also be interpreted as meaning that a bank's incentives to increase the riskiness of its portfolio are stronger in the case with coordination. Thus, as in the case of leverage, there is the danger of a vicious cycle. As asset returns become more volatile, the incentive to coordinate rises. To the extent that this coordination can be achieved, the incentive to increase the volatility and riskiness of the portfolio is magnified. Furthermore, the partial cross derivatives are negative, which means that the effect on the herding incentive of the two variables are mutually reinforcing. Special care is therefore necessary on the part of bank supervisors in a poorly capitalized banking system in a volatile environment where strong coordination incentives exist.

Despite the simplicity of this two-bank model of implicit government guarantees, some important insights into the potential dangers associated with a system of implicit government guarantees can be gained and contrasted with those of an explicit insurance system. As in the case with explicit deposit insurance, moral hazard problems can lead to excessive risk-taking through portfolio choice or leveraging. The relative strength of this moral hazard effect in the two systems depends on the degree of portfolio return correlation in the banking sector. This correlation, which can be influenced by a coordination of investment behavior by banks, emerges as an additional strategic variable in the implicit guarantee case. With perfect correlation the incentives to take on excessive risks are the same under the two regimes, whereas with less than perfect correlation this incentive is stronger under explicit insurance.

With explicit deposit insurance, coordination is not necessary to gain insurance coverage. The investment strategies in the banking sector are therefore presumably more diverse, and the occurrence of banking problems is spread more evenly over the different states of nature. Although poor performance in asset B will not affect banking system stability in the case of implicit insurance with coordination on asset A to the same extent that it would in the case of explicit insurance, the effect of poor performance in asset A is magnified. If the social costs of bank failures are a convex function of the share of the banking system affected, this trade-off may be undesirable. Unlike in the case of explicit deposit insurance, portfolio decisions may be distorted in such a way that certain asset categories or sectors of the economy are severely underfunded. To make matters worse, there is nothing that will guarantee that the assets that are chosen are the ones which would yield the highest social or private returns in the absence of an implicit government guarantee. As will be discussed below, the ease with which coordination can be achieved on a certain asset may, for

example, play a more important role. Once coordination has been achieved, it may not be in the interest of an individual bank to switch to a socially superior investment since it would give up the insurance coverage created by herding.

A further difference between implicit and explicit insurance lies in the incentives for different agents to engage in monitoring. In the case of complete explicit coverage there is no incentive for depositors to monitor the investment strategies of their banks. Similarly, there is no incentive for banks to monitor each others' behavior. With implicit insurance, however, the riskiness of deposits depends on the investment strategy of one's own bank relative to the rest of the banking industry. Depositors, being interested in the business decisions of their banks relative to the rest of the banking sector, therefore, have an incentive to monitor not only their own banks but also other banks. The benefits from coordinated behavior accruing to a bank crucially depend on the information of depositors and thus their monitoring efforts. Only if depositors are aware of the coordination and its implied extension of insurance coverage will they accept a reduction in deposit returns. Bank owners, thus, actually have an interest in being monitored by depositors. However, monitoring by depositors does not have the beneficial function of giving banks an incentive to invest wisely in a social sense, as it would have without implicit insurance. Instead it directs banks to exploit the existence of the government safety net.

Implicit government guarantees may therefore help to understand why banks in countries with no or only limited deposit insurance may act in concert and take on undue risks. The problem is exacerbated if not only depositors can expect to be bailed-out but other creditors or owners as well. This has been the case in numerous crisis episodes and a prior expectation of such a more general bail-out, therefore, frequently seems to have existed. Explicit insurance, despite being able to account for excessive risk-taking, fails to explain the systemic aspect of that phenomenon. To further highlight the implications of implicit guarantees for the behavior and the stability of the banking system, the basic model will be extended along several important dimensions in the next section.

5. An extension of the basic model

As a first extension, the model is generalized to the case of many banks. This allows an analysis of questions relating to the potential herd size and its determinants and not only of the question of whether or not herding incentives exist. Second, the assumption of perfect competition in the markets for assets and deposits is relaxed. With imperfect competition in the asset market, banks can, for example, make positive net present value loans. The extent to which this is possible depends on the degree of competition in a certain market

segment. Furthermore, depending on the degree of competition in the overall deposit market, it may be possible to sell deposits above the value that would be implied in the presence of perfect arbitrage and of a competitive market for state-contingent (Arrow-Debreu) securities. Third, an additional period is added which introduces the possibility of a positive charter value for banks. The existence of such a charter value can exert an additional disciplining effect on banks.

A further change is that a low-return outcome for asset B no longer triggers bankruptcy. This changed assumption better reflects the choice that banks face, for example, in the presence of capital inflows or after financial sector liberalization. Banks can either choose a safe and highly liquid investment that can always be sold or collected near par. Or they can choose higher-yielding but less liquid assets that may lead to serious problems and possibly bankruptcy if, for example, the direction of capital flows starts to reverse. However, the value of deposit insurance for the banks that choose the safe and liquid asset B is zero. This assumption of B being a safe asset helps to focus attention on the main problem of interest: Why do banks expose themselves excessively to the possibility of failure, as in the case of a significant maturity mismatch between assets and liabilities, although safe alternative investment strategies are available? Although a low return outcome for asset B no longer triggers bankruptcy, it is assumed that it will significantly weaken the financial position of banks with investment in asset B. Thus, as before, banks having invested in asset A will be supported by the government in the case of a low return realization in both assets, since the combination of weak and insolvent banks poses a sufficiently serious systemic problem.

The overall number of banks in the banking market is N, which is normalized to 1, and the number of banks that choose asset A is designated by n ($n \leq N$). N and n can also be interpreted as the total amount of assets of the banking sector and the share of assets that is invested in asset category A, respectively. It is assumed that the likelihood that the government bails out troubled banks increases with the share of the banking sector that is threatened by bankruptcy. Instead of modeling this probability directly, the approach here is to model changes in the bail-out probability as changes in the amount of repayment depositors will receive from the bank and the government in the case of bankruptcy. If, for example, only a few banks are affected by a bad return realization in asset A, the payment to depositors is close to the payment without deposit insurance. On the other hand, if the crisis has systemic traits, the payment will be much closer to the promised return in the no-bankruptcy case. The payment under bankruptcy thus is an convex combination of the promised return and the value of bank assets per depositors. The exact combination is

captured by the parameter μ, as illustrated by the modified expression for the price of deposits, p_d^*, where $0 \leq \mu(n) \leq 1$ and $\mu'(n) \geq 0$:

$$p_d^* = p(s_{ll}) + p(s_{hl}) + p(s_{hh}) + p(s_{lh}) \cdot \left(\mu(n) + (1 - \mu(n)) \cdot \frac{(e+d) \cdot a_l \cdot p_d^*}{p_A \cdot d} \right)$$

or (11)

$$p_d^* = \frac{(\mu(n) \cdot p(s_{lh}) + p(s_{ll}) + p(s_{hl}) + p(s_{hh})) \cdot p_A \cdot d}{d \cdot (a_h (p(s_{hl}) + p(s_{hh})) + a_l \cdot (\mu \cdot p(s_{lh}) + p(s_{ll}))) + e \cdot a_l \cdot p(s_{lh})(\mu(n) - 1)} .$$

From this it follows that the price of deposits at a bank that invests in asset A is also an increasing function of n. The same is true for the option value of implicit deposit insurance. This implies that the incentive to coordinate that stems from this option value increases with the number of banks that choose asset A.

Imperfect competition in the asset markets means that banks are able to acquire an asset for less than the sum of its state-price-weighted returns, i.e., $p_A \leq a_l(p(s_{ll})+p(s_{lh}))+a_h(p(s_{hl})+p(s_{hh}))$. The parameter ε_A measures the degree of market power in the asset market and is defined as follows:

$$\varepsilon_A = \frac{a_l \cdot (p(s_{ll}) + p(s_{lh})) + a_h \cdot (p(s_{hl}) + p(s_{hh}))}{p_A} \geq 1 \qquad (12)$$

A similar definition applies to ε_B, which captures the degree of market power in the market for asset B.

$$\varepsilon_B = \frac{b_l \cdot (p(s_{ll}) + p(s_{hl})) + b_h \cdot (p(s_{lh}) + p(s_{hh}))}{p_B} \geq 1 . \qquad (13)$$

Both, ε_A and ε_B, are functions of n. It is assumed that as n increases, the degree of market power in the market for asset A decreases whereas it increases in the market for B, i.e., $\varepsilon_A'(n) \leq 0$ and $\varepsilon_B'(n) \geq 0$. This assumption is more likely to be met if n is interpreted as the actual number of banks rather than as the share of assets invested in asset A.

The value of the banking firm in excess of its book equity no longer depends only on the value of the option of the implicit deposit insurance but has in addition a rent component

from imperfect competition. This excess value is of special importance in the case considered here, where an additional period is introduced. Demsetz et al. (1996, 1997a) and Keeley (1990) among others have pointed out the potentially important role of the bank franchise value in disciplining risk-taking by banks. Bankruptcy means that the bank is shut down and the bank owners lose the franchise value that is associated with running the bank an additional period. The last-period franchise value of a bank that invests in asset A is therefore zero in the states s_{ll} and s_{lh}. In the two high return states, s_{hl} and s_{hh}, the franchise value of operating in the last period is the one-period value times the state prices.

A bank that invests all its funds in asset B will by assumption be able to avoid bankruptcy in all states. In the case that asset A performs well the franchise value for the last period for such a bank will be the single-period excess bank value. However, in the case that asset A has a low return realization in the first period the overall number of banks in the financial sector will be reduced by n, the number of bankrupt banks. This translates into an increase in market power for the surviving banks which had invested in asset B. This gain in market power may come either from the deposit or the asset side. Thus, in the states s_{lh} and s_{ll} the value of the last-period franchise value is larger than in the other two states. The factor $\phi(n)$, with $\phi(n) \geq 1$ and $\phi'(n) \geq 0$, captures this survival gain.

The one-period franchise values that result from the two different investment strategies are given by the following expressions:

$$V^B - e = (\varepsilon_B(n) - 1) \cdot (e + d) \tag{14}$$

$$V^A - e = (\varepsilon_A(n) - 1) \cdot (e + d) \cdot \frac{a_h (p(s_{hl}) + p(s_{hh}))}{\varepsilon_A(n) \cdot p_A}$$

$$+ \left(\frac{d}{p_d^*} - \frac{(e + d) \cdot a_l}{\varepsilon_A(n) \cdot p_A} \right) \cdot (p(s_{ll}) + p(s_{lh}))$$

with $p_d^*(\mu(n))$ as defined above. The total value of the banks in excess of the book value of equity capital under the two investment options is therefore:

$$V_B = (V^B - e) + [(p(s_{ll}) + p(s_{lh}))\phi(n) + (p(s_{hl}) + p(s_{hh})] \cdot (V^B - e) \tag{15}$$

$$V_A = (V^A - e) + [p(s_{hh}) + p(s_{hl})] \cdot (V^A - e) \ . \tag{16}$$

The discount factor is assumed to be one. For its choice of asset, an individual bank now only has to compare V_A and V_B. The relative value of the two alternative actions depends crucially on the parameter n. V_B increases with n for two reasons. First, as more and more banks invest in asset A, pulling their funds out of the market for asset B, the B market becomes less and less competitive. This implies increasing rents for the remaining banks. Second, in the case that asset A has a low return realization, the size of the overall banking sector decreases, as bankrupt banks are closed down. The magnitude of this shrinkage increases with n, and so does the corresponding gain in market power for the remaining banks. Such gains can be viewed more broadly as any gains that accrue to surviving banks on account of the government's intervention policies. Large gains can, for example, be associated with the takeover of bankrupt banks and any government subsidies, grants, or guarantees that come with it. Thus, in addition to the existence of an implicit guarantee, the way in which banking crises are expected to be handled by the government in a more general sense has important consequences for the likelihood and severity of such a crisis. Past experience and government announcements may be important in forming these expectations.

With respect to V_A the effect of an increase in n is ambiguous. On the one hand, an increase in n implies an erosion of market power and thus a decrease in V_A. On the other hand, an increase in n means that the likelihood and extent of a government bail-out increases and the increase in option value of this implicit insurance has a positive effect on V_A. The relative strength of these two effects determines the slope of the V_A curve, which in general will also be a function of n.

It seems reasonable to assume that the effect that a given change in the dimension of the banking problem has on the willingness of the government to intervene is not constant but rather depends on the overall level of the crisis dimension. The limiting case of such a situation is illustrated by the following government intervention function $\mu(n)$:

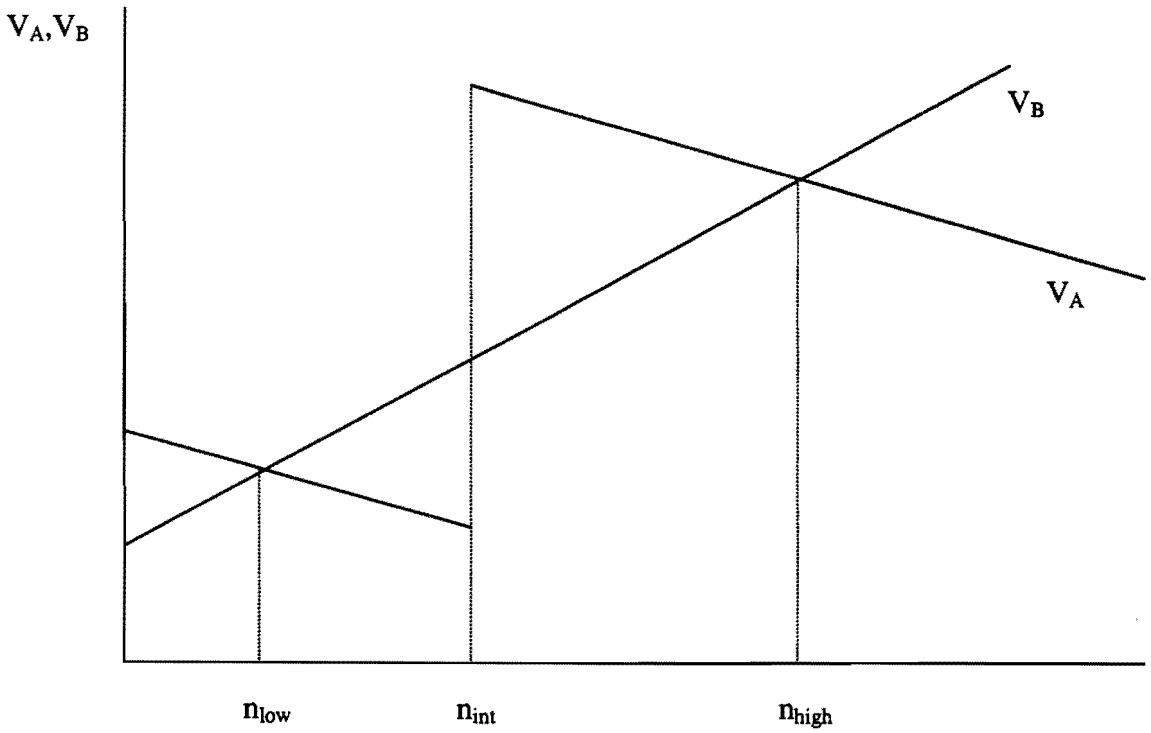
$$\mu(n) = \begin{cases} 0 & for \quad n < n_{int} \\ 1 & for \quad n \geq n_{int} \end{cases} . \qquad (17)$$

This function describes a situation where the government has a concrete value of n that it considers a threshold for intervention. Below n_{int} the government does not intervene at all, and at or above n_{int} depositors receive the whole amount promised by the bank in the case of bankruptcy. In this case the willingness of the government to intervene is completely unresponsive to changes in n for any value of n below or above n_{int}. The market-power

effect, therefore, dominates the shape of V_A over most of the range of n and the option value effect is concentrated at n_{int}. Although certainly not a very realistic description of reality, this case already highlights some general features of the model, which can also occur under less extreme assumptions about the functional form of $\mu(n)$.

Figure 4 illustrates a possible scenario for such an intervention function. Because of the variable responsiveness of the government to changes in n, the possibility of a multiplicity of equilibria arises. Starting at a low level of n, the banking system will converge to n_{low}, at which point the value of the bank is the same for the two investment options. Thus, there is no incentive for any bank to change its investment behavior. For any value below n_{low} the value of investment in asset A exceeds that of investment B and banks will have an incentive to switch from asset B to asset A, thereby gradually raising n. For values of n between n_{low} and n_{int} the reverse holds and there will be a tendency for n to decrease. In the equilibrium at n_{low} decisions are not distorted by the existence of an implicit government guarantee.[12] The fraction of the banking system exposed to failure is distorted only by the direct market-power effect and the indirect effect stemming from the impact of the government's crisis resolution policies on the survival gains. Banking failures in this case are bound to occur, but they will only affect a small fraction of the banking system.

Figure 4
The case of a binary reaction function



[12] This result is an artifact of the special $\mu(n)$ function and does not hold for more general cases of multiple equilibria, as will be seen below.

If, however, the initial situation is one in which the number of banks investing in asset A exceeds n_{int}, the equilibrium towards which the banking system converges will be n_{high}. This equilibrium is characterized by an excessive exposure to failure of a large portion of the banking system brought about by the existence of an implicit government guarantee. Both equilibria are locally stable. Since the value of the banks in the equilibrium at n_{high} exceeds the value for the lower n, there is in general an incentive for banks to coordinate their behavior in order to achieve the high-value herding equilibrium. In the preceding discussion it was assumed that an individual bank can not influence n. If, however, the banking system consists of only a few large banks or several banks manage to collude, a change in n in excess of n_{int}-n_{low} may be achieved. Following that the banking sector would in a herd-like fashion converge towards the herding equilibrium at n_{high}. The likelihood of such an outcome increases, as the distance between n_{low} and n_{int} decreases.

Both equilibria will be affected by changes in the competitive environment in the two market segments as well as by changes in government resolution policies. An increase in the overall level of market power in the market for A (B) will tend to increase (decrease) both equilibrium values of n. The same holds true for a decrease (increase) in the responsiveness of the degree of market power to the number of banks engaged in the A (B) market. An increase in the responsiveness of the survival gains to n will also tend to reduce n in both equilibria. A change in the threshold value at which the government believes the problems in the banking sector to be of a systemic nature will have no effect on the two equilibria as long as the value stays within the interval n_{low}, n_{high}. As soon as the threshold value falls below n_{low}, the no-herding equilibrium will disappear and the banking system will converge towards an unchanged n_{high}. An analogous result holds for an increase beyond n_{high}. A similar elimination of equilibria may be brought about by other changes in the operating environment of banks. The magnitude of the resulting response of the banking sector depends on the relative size of the effect on the two equilibria. In a linear specification of the model, for example, an increase in the general degree of market power in the A market will change both equilibria by an equal amount. However, a change in the responsiveness of market power to n will have a larger effect on n_{high} than on n_{low}. A gradual decrease in this responsiveness will therefore push the two equilibria further and further apart. The resulting rush towards the herding equilibrium will be more pronounced in that case compared to a situation where the same equilibrium reduction is brought about by changes in overall market power. Therefore it may be important to know the source of potential disturbances to an established equilibrium to assess the dynamic dangers that are associated with implicit guarantees and a possible switch between equlibria

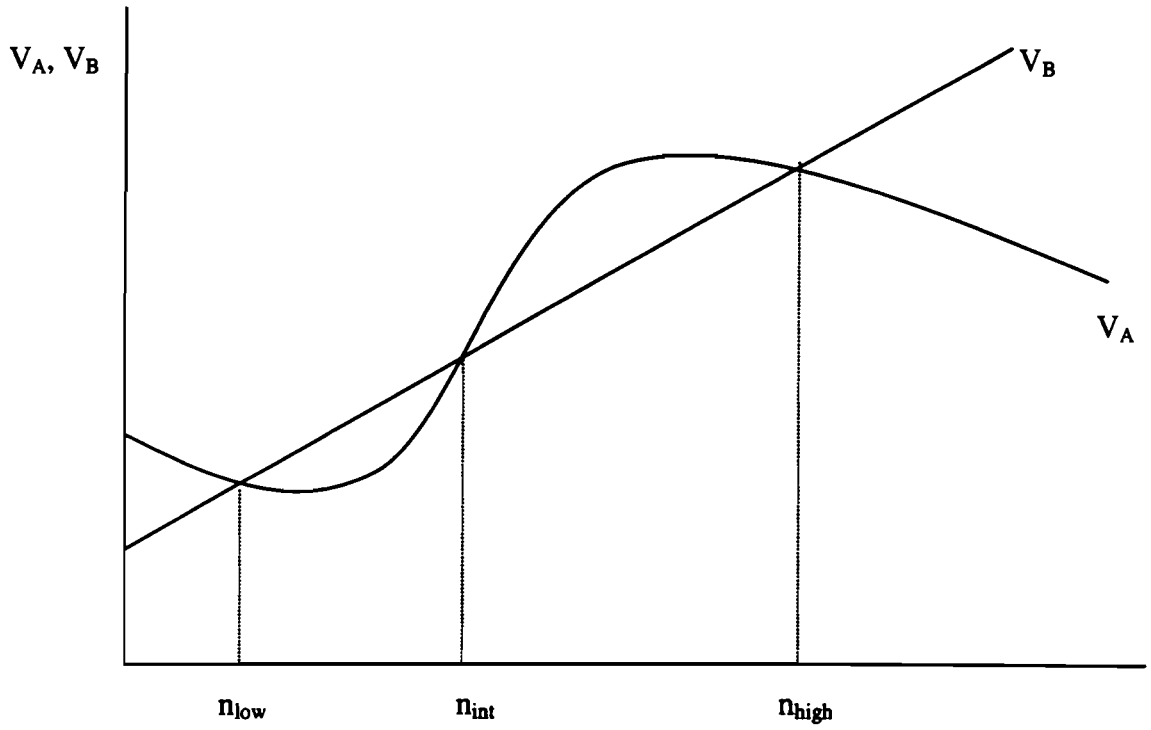
In general, the government will not react as abruptly at a certain threshold value, as it is suggested by the above step function in equation (17). The government's concern about the stability of the financial system and its resulting willingness to bail out troubled institutions will, however, be increasing in the dimension of the crisis, as captured by the parameter n. The logistic formulation in equation (18) tries to give a more accurate description of the government reaction function.

$$\mu^*(n) = \frac{1}{1+e^{(x-y\cdot n)}} - \frac{1-n}{1+e^{x}} + n\frac{e^{x-y}}{1+e^{x-y}} \qquad (18)$$

This function satisfies $\mu^*(0) = 0$ and $\mu^*(1) = 1$, so that at the boundaries there will be either no or a complete bail-out. The parameters x and y determine the concrete shape of the function, including the particularly interesting case of an s-shaped reaction function. It seems reasonable to assume that over a certain low range of values for n, the expected probability of a bail-out is likely to be rather low as well. It seems equally plausible that, for sufficiently high n, the sensitivity of the bail-out probability to further increases in n is also low. In between those two regions where the $\mu(n)$ function is relatively flat, there will be a fairly narrow interval in which the policy reaction of the government is significantly affected by marginal changes in n, resulting in an s-shaped reaction function. In that case, the parameter y measures the degree to which the change in the government's attitude in response to changes in n is concentrated around a certain value of n. As y increases, the function $\mu^*(n)$ approaches the discrete case of (17) in which the attitude of the government toward the banking sector is a binary variable and the change in attitude is concentrated at one particular value of n. The parameter x determines the value of n around which the change in the bail-out probability is concentrated. A high value of x corresponds to a high tolerance for bank failures by the government.

Figure 5 depicts a possible equilibrium constellation for this type of government reaction function. In addition to the two equilibria n_{low} and n_{high}, there is a third equilibrium in this case, n_{int}. Unlike the first two equilibria, this third equilibrium is, however, not stable. Another difference to the case of a discrete $\mu(n)$ function lies in the fact that the equilibrium at n_{low} is also distorted by the existence of the implicit guarantee. However, this distortion is small compared to the one in the equilibrium at n_{high}. A further difference

Figure 5
The case of a logistic reaction function



lies in the reaction pattern of the equilibria to changes in the parameters. This difference is especially interesting in the case of a gradual increase in the parameter capturing the concern of the government for the banking sector. In the binary case, the degree of concern was captured by n_{int} and over a wide range of values, changes in n_{int} had no effect on the realized equilibrium constellation. In the case of equation (18), an increase in the government concern about the stability of the banking system, as captured by a decrease in the parameter x will, however, always affect both equilibria. This is shown in Figure 6 and Figure 7.

Figure 6 illustrates that a decrease in x implies a shift of the V_A function to the left and up. Giving this increase in the government's concern a dynamic interpretation, this will result in a gradual increase of the low herding equilibrium from n_0 to n_3 and of the high herding equilibrium from n_4 to n_2, as well as a corresponding decrease in the intermediate equilibrium. A further decrease would eliminate the low equilibrium and a 'stampede' towards a value close to n_2 would be set in motion. In Figure 7 a linear parametrization of the model is used to generate the different equilibrium values for n as a function of x. If x changes at a constant rate over time, the x-axis can be directly interpreted as depicting the time dimension. Abstracting from problems of adjustment lags, the banking system evolves along the solid line. The dotted lines represent the intermediate and the high equilibrium,

respectively. Starting at n_{low}, a decrease in x leads to an increase of the distortionary component of V_A and increases the equilibrium value for n_{low}. Up to a certain point, this increase is very gradual. This point is defined as the x at which $n_{low} = n_{int}$. Any further decrease in x will result in $V_A > V_B$ at the former equilibrium value for n. The adjustment in n that is needed to bring about equality between V_A and V_B is no longer gradual but much larger since the two lower equilibria cease to exist. It is only at n_{high} that a new equilibrium is achieved. This result once again illustrates the possible dynamic implications of a switch from a low to a high herding equilibrium under implicit government guarantees. In addition, it raises the issue of discontinuities in the reaction of the banking sector to gradual changes in the environment. These discontinuities imply that there may be very little advance indication of developing problems in the banking systems, adding to the problems of the supervisory authorities.

Figure 6
An increase in the government's concern for the stability of the financial system ($x_1 > x_2$)

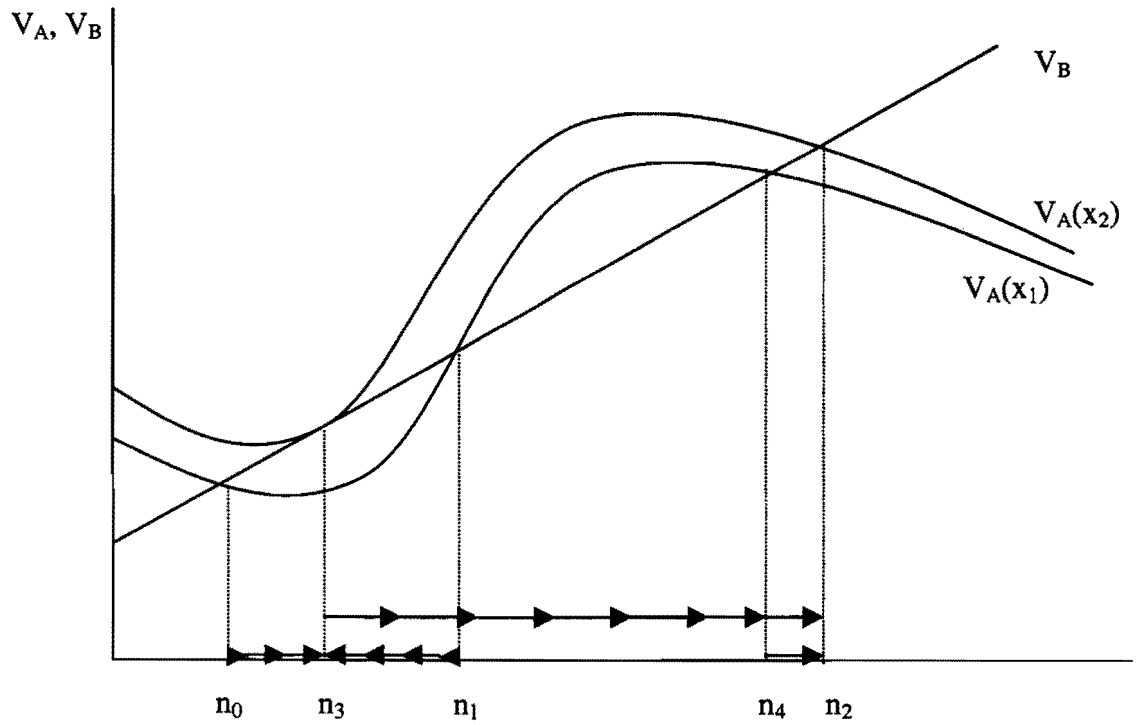
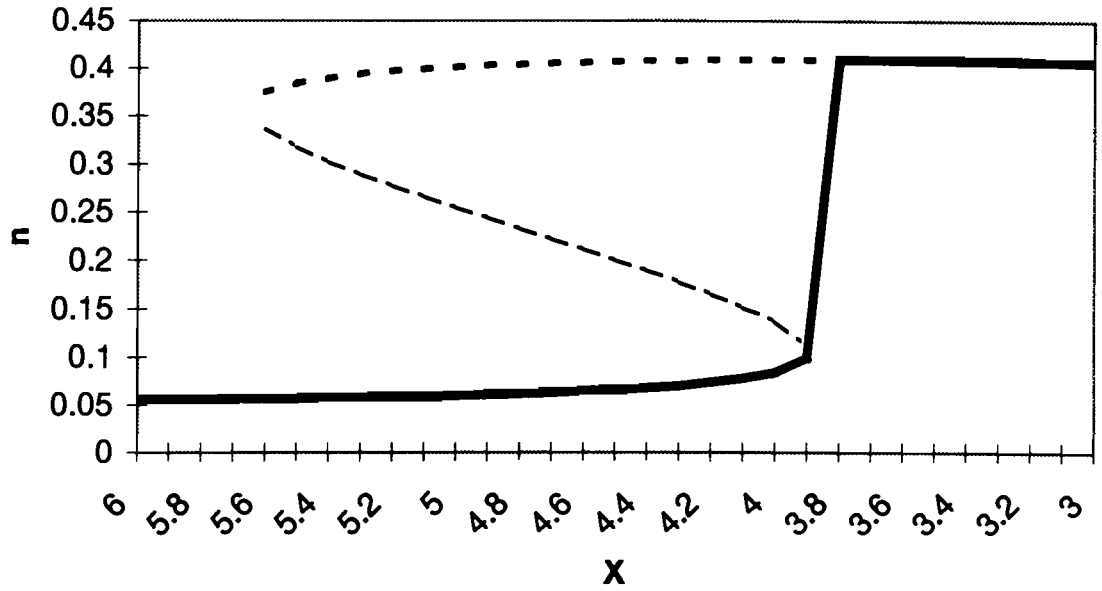


Figure 7
Equilibrium values for n as a function of the government's concern for the stability of the financial system



6. Discussion and policy implications

The above analysis of the connection between implicit guarantees and systemic instabilities in the financial system has a very broad range of applicability. However, the analysis may be especially relevant in the typical post-liberalization environment in the financial sector and in periods of massive capital inflows. Such circumstances are often associated with major changes in the economic environment in which banks operate and may thereby increase the danger of herding-related excessive risk-taking in the banking sector. Both situations may, for instance, increase the volatility of asset returns and may be associated with increased uncertainty about the returns from different investment projects. As seen in the case of two banks, such an increase in the return variance may increase the incentive to coordinate investment behavior. Liberalization of a tightly regulated financial system may also open the possibility for independent investment policies of banks and may thereby for the first time create the possibility for herding. Liberalization of the financial sector and the resulting increase in competition may also reduce the rents previously derived from market power. This effect may apply differently to different assets, and the overall effect on the herding distortion therefore depends on the relative strength of these asset-specific effects. The overall reduction in rents will, however, also mean a reduction in the franchise value of banks. With less to lose from risky investment strategies, banks therefore have more of an incentive to engage in herding behavior. Similar effects on the competitive structure of

the banking industry may also result during a period of massive capital inflows with similarly distortionary implications for the portfolio choice of banks.

In addition to a general increase in the incentive for herding, the possibility of a switch between equilibria, as described in the previous section, may also increase. Financial liberalization may, for example, be associated with significant shifts in the attitude of the government towards the financial sector. Depending on the degree of previous financial regulation, the concern for financial stability may have played only a minor role prior to financial liberalization. Financial deregulation will naturally increase the possible instability of the financial system and therefore the policy concern. The resulting likelihood of a bail-out in times of crisis will be magnified to the extent that the government believes that bank owners and managers should not be held responsible for problems resulting from alleged bad luck or lack of experience in the new regulatory environment.

Again, capital inflows may increase the government's concern for financial stability in a similar fashion. In a world of highly mobile capital and costs of information acquisition, international investors may react to small pieces of negative information with massive withdrawals of funds (Calvo (1995)). As capital inflows continue over time, this sensitivity as well as the dependence of the receiving country on these funds may increase. For this reason, governments may become increasingly concerned about the financial system and the confidence of international investors. Foreign capital flows may also have an effect on the way in which the government reacts to a banking crisis. In order to calm foreign investors, the government may prefer the option of keeping troubled banks afloat rather than closing them down. Had the dependence on foreign funds been lower, the government might have been much more willing to choose the latter option. This possible change in the government's stance may reduce the gain in market power that healthy banks can expect to realize in the case of crisis. The relaxation of financing constraints may furthermore induce the government to increase its debt financing. When capital inflows are reversed, at least some of this debt will need to be repaid, limiting the funds that are available for a restructuring of the financial system. The survival of troubled banks will therefore be less likely to be guaranteed through an outright government takeover. Mergers of these banks with healthy banks seem more likely. In this case, a large part of the cost can be expected to be borne by those healthy banks because the government is lacking the resources to make these arranged mergers more palatable, for example, by taking over the bad debt on the books of the troubled banks. The survival gains that can be obtained through a prudent investment strategy thus may be reduced.

So far it has been assumed that banks as well as depositors have perfect information. They were, for example, assumed to know with certainty the true value of n and the actual

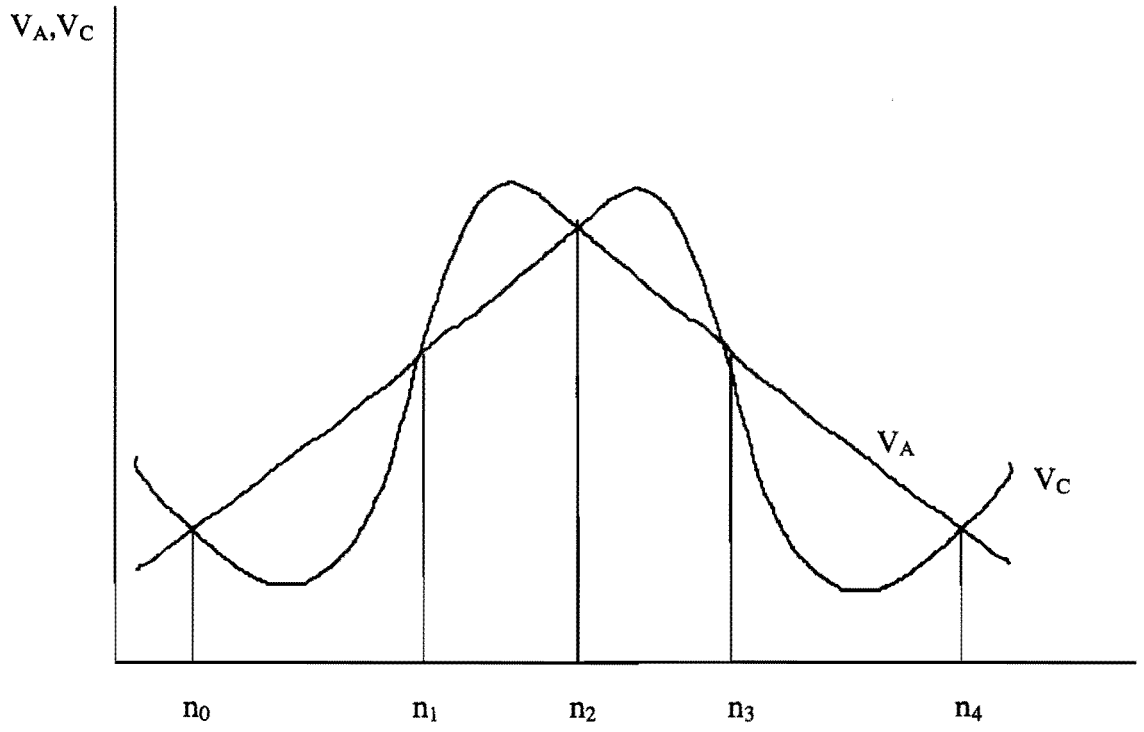
probability and size of a government bail-out. In reality this information is, of course, less complete. Because of the potentially important role of uncertainty, agents' expectations play an important role in determining which equilibrium will be realized. In particular the $\mu(n)$ function will generally contain a large expectational component, which may be to some extent independent from the actual policy stance. If, for example, depositors started to believe that the likelihood of a bail-out was actually higher than previously thought, the low equilibrium could disappear and a sudden herding on asset A could occur. Such changes in the assessment of likely government behavior could again be endogenous to major events like massive capital inflows or episodes of financial liberalization.

Besides incomplete information about the governments response function, individual depositors may have only limited information on n. Even in the absence of explicit deposit insurance especially small depositors often lack the proper incentive to monitor just their own banks. Thus, it seems unlikely that they have an incentive to obtain direct information on a larger number of banks. A similar information problem may also exist between banks themselves with respect to their competitors' investment behavior. The issue of how coordination is achieved therefore arises. Asset prices may perform the important role of a signal and coordination device. With less than perfectly elastic supply of a given asset, an increase in the demand for that asset will lead to an increase in the price of that asset. A change in the price of an asset can therefore indicate the demand situation in that asset's market. To the extent that banks or other financial institutions are major players on the demand side, asset price movements allow inferences about the investment behavior of banks. In general, the information content, of course, depends on the relative importance of supply versus demand factors that affect the price. Massive capital inflows or financial liberalization may reduce the cost of coordination by facilitating the use of asset price signals. Whereas in normal times of business expansion many different factors influence asset prices, during such extraordinary periods price movements may be dominated by demand from banks or other financial institutions. With price signals more informative, the herding problem may be more severe.

If price signals are important one might expect coordination to occur on assets for which given demand changes have a particularly strong influence on prices. This will be the case for markets with relatively inelastic short-run supply functions. In addition, the market should be large enough to allow for a larger number of investing banks, and prices should be fairly public. These conditions are to a large extent met in the markets for stocks and commercial real estate. Although the issue of the coordination mechanism is not explicitly addressed in the model, the price effect stemming from the elimination of market power, which is incorporated in the model, could be reinterpreted as the coordination device. Coordination through asset prices may thus help to explain the often observed phenomenon

of substantial increases in such prices in these markets prior to a banking crisis. However, these price bubbles by far exceed any price increase that could be explained by the erosion of market power alone. Some kind of 'supercompetition' (Shaffer (1993)) in the asset market may play a role here and a more careful analysis of the asset price dynamics that are implied by a model of implicit deposit insurance and imperfect information may be of interest. The price of an asset may deviate from its „fundamental" value to the extent that the investment in that asset brings with it a reduction in required deposit rates due to the existence of implicit government guarantees[13].

Figure 8
The case of two risky assets



The extended model focused on the choice between a bankruptcy-threatening asset and an asset that does not result in bankruptcy in any state of nature. A similar analysis could be conducted for the case of two assets, A and C, of the riskier kind. A possible equilibrium constellation that could emerge in that case is depicted in Figure 8. There are three stable equilibria in this case: n_0, n_2, and n_4. Under the assumption that investment is characterized by decreasing returns to scale and that the two assets differ with respect to the states of

[13] A similar argument has been made by Krugman (1998) in his explanation of the Asian crisis. Krugman argues that due to the existence to implicit guarantees asset prices no longer reflect a properly weighted assessment of all possible outcomes. According to Krugman, asset prices are rather predominantly driven by positive outcomes and can thus deviate from their fundamental values.

nature in which they are associated with a low outcome but are identical otherwise, the social optimal would be achieved at an equal division of the banking sector between the two assets. This optimum would be achieved at n_2. The other two stable equilibria illustrate the possible allocative distortions that may be associated with herding behavior. In either equilibrium one of the market segments remains underfunded. Thus, herding incentives may not only imply excessive risk-taking but also a socially inefficient way in which this excessive level of risk is achieved. Furthermore, there may be a trade-off with respect to these two distortions. Since the value from investing in the risky assets A and C is highest at n_2, the incentive to move funds out of low-risk assets may also be strongest. A reduction in the allocative distortion between A and C may therefore result in a larger distortion in the choice of the overall risk-level. The case of two risky assets also highlights the fact that the extent to which a shock has a systemic nature depends to a large part on the endogenous choices of economic agents. Whereas a shock to the returns of asset A presumably has a systemic dimension in equilibrium n_1, it may have only institutionally very limited effects in the equilibrium at n_3.

7. Conclusions

The model developed in this paper offers a potential explanation for why banks may rationally choose to expose themselves to certain risks to a socially excessive degree so that systemic banking crises are the frequent outcome. This explanation is based on the insight that living dangerously may be less dangerous if it is done collectively. Such a „safety in numbers" effect can be created by implicit government guarantees that are believed to be increasing in the seriousness of the banking problems. The chosen model and its extensions bring together several of the stylized facts that have been identified with respect to banking crises. Herding behavior, possibly reinforced by contagion effects, translates into a banking crisis of systemic proportions when there is a negative shock to asset returns. This may explain the observed explanatory power of certain macroeconomic shocks for banking crisis. However, those shocks should be viewed as crisis triggers rather than as an independent cause of the crisis. The true cause lies rather in the investment strategies of banks in the pre-crisis boom period during which the systemic vulnerability to such shocks is created.

In addition to the static herding distortions associated with implicit guarantees, the dynamic effects of a switch between equilibria may be a particular policy concern as well. Such a switch may be especially likely in the presence of volatile international capital flows and after periods of financial liberalization. Furthermore, strong bubble-like increases in asset prices, such as share prices and prices for commercial real estate, may figure importantly in

the coordination efforts in the banking sector. The herding model also takes seriously the high fiscal costs that stand at the end of so many crises. These government expenses are taken from their chronological end position to the causal front.

The attempted identification of situations in which herding problems may be particularly severe is especially important in light of the fact that the empirical detection of herding behavior proves to be extremely difficult[14]. One of the main difficulties is to distinguish between similarity of behavior that is optimally driven by changes in common fundamentals and similarity of behavior that is brought about by socially inefficient herding incentives. The problems associated with implicit guarantees can at least partly be contained through the prudential supervision of banks. Alternatively, those problems could also be avoided by a credible commitment to a policy of no bail-out. However, because of the crucial importance of the financial system the announcement of such a policy will lack credibility in practice. With respect to the special case of deposit insurance, this implies that policy-makers have to make a choice between an explicit or an implicit system. The model highlights some of the trade-offs that are involved in this decision. Most importantly among these is that, although an explicit insurance scheme may be associated with more severe moral hazard problems, it does not involve herding incentives. The containment of moral hazard may thus be achieved at the expense of increased systemic instabilities in the banking sector and a well-designed explicit insurance scheme may thus be the preferable option.

[14] Due to these difficulties, only a few studies exist that try to identify herding behavior in the banking sector empirically. For example, Chang et al. (1997) analyze the branching decisions of banks in New York City. Rüffer (1999) studies the behavior of Finnish savings and cooperative banks in the run-up to the banking crisis of the early 1990s.

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The following papers have so far been published:

May	1995	The Circulation of Deutsche Mark Abroad	Franz Seitz
June	1995	Methodology and technique for determining structural budget deficits	Gerhard Ziebarth
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