Klüh, Ulrich:

Safety Net Design and Systemic Risk: New Empirical Evidence

Munich Discussion Paper No. 2005-12

Department of Economics
University of Munich

Volkswirtschaftliche Fakultät
Ludwig-Maximilians-Universität München

Online at https://doi.org/10.5282/ubm/epub.662

Safety Net Design and Systemic Risk: New Empirical Evidence

Uli Klueh*

June 29, 2005

Abstract

Recent econometric evidence has noticeably changed views on the desirability and the appropriate design of explicit Deposit Insurance Schemes (DIS). The purpose of this paper is to take a second look at the data. After surveying recent empirical work and providing a theoretical framework, we argue that existing studies may suffer from a selection bias. Building on a new database on explicit deposit insurance compiled by the author, we perform a variety of semi-parametric and parametric tests to see whether and how explicit deposit insurance (de)stabilizes banking systems. We find that the evidence indeed suggests that a selection bias is present. Controlling for this bias leads to a reassessment of recent studies. In particular, making deposit insurance explicit has a rather moderate and, if any, stabilizing effect on the probability of experiencing a systemic crisis.

Author's e-mail address: uli.klueh@lrz.uni-muenchen.de

*Department of Economics, Ludwig-Maximilians-University, Munich. This research was initiated during a research stay at the International Monetary Fund, Washington D.C. I thank David Hoelscher, Gerhard Illing, Stephan Sauer, Michael Taylor, Marc Quintyn as well as participants at an IMF seminar for valuable comments.

I. Introduction

During recent debates on the causes of increased financial fragility, the design of financial safety nets has been a controversial issue. Viewed from an integrated perspective, safety nets comprise a variety of functions, often being accomplished by different safety net participants: The "depositor protection function" serves to prevent runs, contagious banking problems, and losses to small depositors considered intolerable from a socio-economic perspective. Other functions provide support in a situation of excess liquidity demand by banks (the "Lender-of-last-Resort function"), provide monitoring services for small, uncoordinated and uninformed depositors ("the monitoring or supervisory function") or attenuate the increased risk-taking incentives caused by the mere presence of safety nets (the "intervention function").

While the deposit insurance function is only one of several elements, it has received a disproportionate amount of attention in recent years. In particular, a number of empirical studies suggest that explicitly insuring deposits increases the risk of experiencing a financial crisis. While it has been always understood that safety nets and excessive risk-taking by banks are closely related, the direct empirical link between *explicit* DIS and financial crises has a new quality. In particular, it raises the question why formally specifying the rules of the game should be inferior to the implicit protection frequently observed in recent episodes of individual and systemic banking crises.

Moreover, recent studies challenged (and changed) existing views on "best practice" in deposit insurance design. Table 1 provides a highly stylized overview of some design features, spelling out the views on best practice specified in Garcia (1999) and according to the views recently expressed (in particular, in the frequently cited contribution by Demirgüç-Kunt and Kane, 2002).

	Garcia	**Demirgüç-Kunt and Kane**
Desirability	Only if certain pre-conditions prevail. In this case, however, explicit DI can significantly improve financial system performance.	Only if certain pre-conditions prevail. However, DI will increase fragility even in proper environments. Moreover, very few countries fulfill the preconditions.
Membership	Compulsory, to prevent adverse selection and increase peer monitoring.	Compulsory, to prevent adverse selection and increase peer monitoring.
Funding	Ex ante funding	Ex post Funding
Risk-based premiums	Important	Difficult to implement properly
Government Funding	Emphasize private funding but provide credible back-up funding in case of insufficient funds.	Emphasize private funding

Coverage Limit	Not too high and not too low (1 or 2 times GDP per capita)	Low
General eligibility	Broad	Narrow
Foreign Currency Deposits	Depending on country circumstances; irrelevant for market discipline.	Exclusion important, to reinforce private monitoring
Inter-bank deposits	Not relevant, when the coverage limit is chosen sensibly	Exclusion very relevant, to reinforce peer monitoring
Co-insurance	Advantages (quick access to large depositors funds) and disadvantages (lack of simplicity and transparency)	Important to reinforce market discipline.
Administration	Depending on country circumstances; private administration raises several problems and has to be designed carefully.	Include private sector extensively in management and administration.

Table 1: Views on Deposit Insurance

To conclude, recent years saw a dramatic change of views on the desirability and the appropriate design of DIS. They also saw a strong increase in the number of safety nets incorporating an explicit scheme, and several important changes in the way existing schemes are structured. Since many countries are currently contemplate the introduction of a legal framework for depositor compensation, the issue is of prime policy relevance.

The purpose of this paper is to take a second look at theory and evidence to understand the effects of making depositor protection explicit. In particular, we argue that existing studies fail to take into account the presence of a potential selection bias. After all, the decision to introduce a DIS is not a random treatment, but a conscious decision by policymakers. Country authorities may "choose to be treated" because of country characteristics that are related to financial fragility. Their constituencies might have entered a stage in which the financial system is more prone to experiencing a financial crisis (or in which the social and economic costs of such an event would be much larger). Alternatively, countries that are characterized by particularly generous implicit schemes might be more likely to adopt a DIS.

Indeed, the evidence seems to support the idea that specific country characteristics related to financial fragility shape the decision of adopting explicit deposit insurance. For example, many recent deposit insurance schemes were introduced after the banking sector had experienced major difficulties, either to phase out existent blanket guarantees (like in East Asia) or to restore depositor confidence (like in many transition economies). Moreover, as will be shown below, several measures of financial fragility are strongly correlated with the decision to adopt an explicit scheme.

Section 2 will survey recent theoretical and empirical work on banking regulation and deposit insurance. Since we are not aware of any systematic discussion of the

fundamental differences between *implicit* and *explicit* depositor protection, we provide such an analysis. Section 3 discusses methodological problems of econometric studies on the relationship between financial safety net design and systemic crises, emphasizing the potential problems caused by not accounting for potential selection biases. It also presents the semi-parametric approach used to analyze the issues involved. Data and results are presented in section IV, section V concludes.

II. Un Update of Theory and Evidence

1. Theoretical Considerations

Spurred by the high incidence of banking crises in recent decades, numerous researchers have proposed explanations for increased financial fragility. While a canonical model of banking crises will probably never emerge, certain features are shared by most accounts of the developments. In particular, a large number of theoretical and empirical studies emphasize five interrelated aspects:

- External macroeconomic shocks, for example a deterioration of the terms of trade, contagion from other countries or rising interest rates in developed economies.
- Certain macroeconomic vulnerabilities, for example a high level of external indebtedness, high inflation or a significant overvaluation of the real exchange rate.
- Secular developments in financial markets, in particular domestic and external financial liberalization (Kaminsky and Reinhart, 1999, and Hellmann, Murdock and Stiglitz, 2000), and, partly as a consequence, increased competition among financial intermediaries (Keeley, 1990 and Dewatripont and Tirole, 1994).
- Lending booms and unsustainable asset price hikes, often associated with increased risk taking incentives on the side of bank managers. The latter are often described as a result of financial liberalization (Allen and Gale, 2000) or increased competition and falling charter values.
- The existence of (implicit or explicit) safety nets, combined with the inability of supervisory and political agents to effectively commit to intervention policies counteracting their consequences (Rochet, 2003).

How does explicit deposit insurance fit into this picture? Obviously, it is an integral part of many public safety nets. It therefore has the potential to distort monitoring incentives and increase risk taking. However, given the widely recognized importance of implicit guarantees and time inconsistent intervention policies, the central question is whether and how it matters to *explicitly specify* the nature of depositor protection. To answer this question, the following aspects should be borne in mind:

- Existing theories dealing with the effects of deposit insurance on the banking industry (section 1.1) do not distinguish different degrees of "explicitness". A comparison between explicit and implicit deposit insurance necessitates a clear understanding of the nature of banking without a legally specified arrangement (section 1.2 below). Why do bank stakeholders (management, depositors and shareholders) assign a positive probability to the event of being bailed out, i.e. what gives rise to implicit arrangements? What are the characteristics of such a regime?

- The way in which explicitness matters will depend on the characteristics of the formalized scheme and on certain preconditions (section 1.3). Obviously, different contracting environments (the effectiveness of bank supervision, the general quality of institutions etc.) will matter. In addition, the literature on banking fragility emphasizes the close relation between risk-taking, deposit insurance and charter values.[1] It is likely that some of the effects discussed in this literature apply to implicit and explicit schemes, yet to differing degrees. On the other hand, explicit schemes might exhibit characteristics that attenuate or amplify the mechanisms relating competition, safety net design, and risk-taking. The effects of a transition from implicit to explicit insurance should thus be viewed in the context of the market for banking services, with differing degrees of competitiveness and concentration.
- In this respect, the endogeneity of safety net structure has to be taken into account. If financial liberalization coupled with decreasing charter values and lower concentration is really a major cause of lending booms and financial instability, politicians could be tempted to shelter the financial system and small depositors from the short-run consequences of these (in the long run) potentially desirable policies. In terms of an econometric analysis, it will be necessary to appropriately control for the possibility that countries making their financial system vulnerable to enhance their long run growth potential have a higher propensity of introducing a formal scheme. We will discuss this problem in detail in section III.

1.1 Deposit Insurance in Economic Theory

The theoretical literature on deposit insurance has grown considerably in recent decades. Without aiming at a complete survey, we review some of the most important works to highlight three points:[2] First, the few articles on the rationale for deposit insurance generally suggest that the existence and design of a scheme are endogenous features of financial safety nets - certain industry characteristics imply a specific structure. Second, the issue of deposit insurance is closely related to issues of banking competition. Third, the existing literature largely neglects differences between explicit and implicit schemes.

Theoretical treatments of depositor protection can be divided into four different strands. A first group of articles deals with the economic rationale for deposit guarantees. Surprisingly, "few papers address the question of *why* deposit insurance schemes exist." (Morrison and White, 2004, page 1, italics in the original). Most commonly, the existence of deposit insurance is derived from the intrinsic maturity mismatch of bank balance sheets and the resulting proneness to self-fulfilling runs (Diamond and Dybvig, 1983). The individual fragility of banks is complemented with the fact that bank failures may cause large externalities in the form of contagion to other banks and a disruption of the payment system. While the literature usually confines itself to show that a deposit guarantee will eliminate undesirable equilibria, several recent papers emphasize the endogeneity of safety net arrangements. Hasanaliyev (2004) as well as Gorton and Huang (2002) show that some form of mutual insurance will naturally emerge as a response to costly fragility. Interestingly,

[1] Keeley (1990), Matutes and Vives (1996, 2000), Hellmann, Murdock and Stiglitz (2000) as well as Suarez (1994) are a few examples of this type of analysis.

[2] See Frolov (2004) for an extensive survey of the literature on deposit insurance.

both papers relate the propensity to explicitly safeguard the banking system to the degree of fragmentation of the industry. Gorton and Huang (2002) argue that dispersed banking systems are characterized by more frequent panics, increasing the likelihood that a fundamentally safe bank has to be liquidated. The fear of such a development makes sound banks willing to contribute to an insurance scheme. Hasanaliyev (2004) argues that industry solutions are difficult to achieve in very competitive environments. In this situation, a public involvement becomes more likely.

Apart from the desire to prevent speculative runs, several recent papers emphasize that there may be other reasons to introduce a scheme: First, the desire to increase competition in the banking sector could make such a step necessary. As shown in Matutes and Vives (1996), systems without any protection might lead to corner solutions characterized by complete disintermediation or local monopolies. Second, Morrison and White (2004) argue that informational problems lead to a situation where banks (which have a superior monitoring technology) receive too few deposits. Providing insurance encourages depositing and can thus improve on social welfare. Again, characteristics of the baking industry and the propensity to introduce a scheme are closely related. The need for extensive insurance is especially strong in weaker banking systems (those characterized by higher failure rates): Since the adverse selection problem leading to under-depositing is especially severe, optimal policy calls for larger deposit insurance subsidies.

The few papers dealing with the rationale of deposit insurance thus have an interesting implication: Specific circumstances may lead to the adoption of an insurance scheme with certain design features: The desire to open the market for banking services for new entrants, to encourage depositing when confidence in the system is low, or to stabilize possibly self-fulfilling expectations might thus endogenously lead to some form of protection.

An insurance scheme, however, could have adverse effects in the sense that it discourages monitoring by depositors. The second and by far largest strand of papers therefore deals with the pricing of deposit insurance and its effects on risk-taking (Merton, 1977). Initially, researchers emphasized the problems of risk-insensitive insurance, proposing risk-adjusted premium rates as a solution. Recently, however, some authors have advocated the view that the possibility and desirability of fair pricing may be limited in the presence of informational asymmetries (Freixas and Rochet, 1998): First, it may be infeasible to achieve a separating equilibrium in the presence of adverse selection. Second, even if such equilibria could be achieved, they would come at a cost. In particular, the cross-subsidies necessary to convince weak banks to reveal their type will allow overly inefficient banks to remain or enter the market, thus driving a wedge between static and dynamic efficiency.

While recent works raise some skepticism towards risk-related premiums, they do not imply that it cannot be a useful tool to limit the risk exposure of banks. In particular, insurance pricing may be combined with other regulatory instruments to yield efficient solutions.[3] Therefore, another approach models deposit insurance pricing together with other instruments of banking regulation. Acharya and Dreyfus (1989) jointly derive optimal bank closure *and* risk pricing rules. Sleet and Smith (2000) study the

[3] To be sure, the combination of capital adequacy regulation and deposit insurance pricing is not a sufficient condition for feasibility, as shown in Chan, Greenbaum and Thakor (1992). However, it may relax some of the constraints emphasized in the literature.

relationship between deposit insurance and the Lender-of-Last-Resort. Finally, a large literature (surveyed in Santos, 2000) looks at capital regulation and its relation to the insurance scheme. A more general message of this literature is that, in the presence of informational frictions, it may take several regulatory instruments to achieve an efficient solution (Giammarino, Lewis and Sappington, 1993).

Altogether, the literature on deposit insurance pricing establishes a stable relation between excessive risk-taking and the existence of safety nets. However, existing research does not imply that explicit deposit insurance is inferior to implicit arrangements, since the relevant mechanisms similarly apply to both, at least qualitatively. Moreover, many contributions do not model the effects of different market structures, an aspect that has received considerable attention in the empirical literature (see Carletti and Hartmann, 2002, pp. 25-30). Therefore, starting with Keeley (1990), a third group of articles looks at the relationship between deposit insurance, competition and stability. The great majority of studies suggest that more competition leads to an increase fragility (see, for example, Hellmann, Murdock and Stiglitz, 2000, and Cordella and Yeyati, 2002). While competition is not always a necessary condition for excessive fragility, its effects are present with and without deposit insurance. Most contributions simply compare the effects of DI in different market settings (or, alternatively, the effects of competition in different DI schemes), without endogenising market interaction. An exception is the work by Matutes and Vives (1996, 2000), who built a model of competition in an environment with fragile individual institutions. Their findings imply that the introduction of deposit insurance may entail complicated welfare trade-offs, whose exact nature will depend on market structure. On the positive side, an insurance scheme will eliminate undesirable equilibria (complete disintermediation due to coordination failures or local monopolies) and extend the market. However, deposit insurance may also intensify competition or lower diversification within a single bank. Since increased competition/decreased diversification may intensify risk-taking, the desirability of a scheme will depend on the prevailing market structure. Note, however, that the latter itself will be changed after the scheme has been launched.[4]

Finally, a fourth group of papers looks at the role of the Deposit Insurance Agency (DIA) within the general institutional structure of banking supervision. While the role of the central bank and the question of integrated supervision receive much more attention in the debate on bank regulatory structure, some recent theoretical studies convincingly argue that the question might be more relevant than often suggested (see, for instance, Repullo, 2000, Kahn and Santos, 2001, and Pages and Santos, 2003). In particular, since the objective function of the DIA will be different form the ones of other safety net players, it is reasonable to expect a different approach to supervision and intervention, depending on the allocation of control rights.

Surprisingly, the literature almost exclusively does not distinguish between explicit and implicit arrangements. In a survey paper, Frolov (2004, page 9) defines deposit insurance as „an explicit or implicit system which guarantees that an amount promised to depositors will be paid to all of them who withdraw“: It is thus simply assumed that a well-specified scheme exists, and that it makes no major difference whether it is

[4] Moreover, the exact nature of the scheme (flat versus risk-adjusted premiums) and of accompanying regulations (deposit rate regulation, investment restrictions) will strongly influence the results.

formally laid down in law.[5] For our purpose, however, it is central to make such a distinction, since we are interested in the effects of making DI explicit. In a next step, we therefore characterize implicit (section 1.2) and explicit (section 1.3) arrangements. Moreover, as discussed above, many theoretical studies suggest that the existence and the design of a certain arrangement may be endogenous. For this reason, section III discusses potential determinants of observed phenotypes of depositor protection.

1.2 Banking without (explicit) depositor protection

As a starting point, we look at an economy without any depositor protection, be it explicit or implicit. Even in such an environment, bank managers face several incentives to take excessive risks, in particular due to limited liability constraints and the fact that their performance is partly unobservable. If performance can be observed, depositors will take certain measures to prevent risk taking, either by charging higher deposit rates or by intervening in the bank. For example, intervention can take the form of "fundamentals-based" runs which serve as a mechanism to sort out weak banks or to implement an efficient risk sharing arrangement (Allen and Gale, 1998).

Two distinct coordination problems arise in this context. The first one stresses the inability of small depositors to effectively monitor the bank's management (Dewatripont and Tirole, 1994): If the course of action cannot be completely specified in advance (contracts are incomplete) it is possible to implement an ex post efficient solution by sensibly choosing the financial structure of the bank. In good states of the world, control rights will be allocated to agents that favor risk (shareholders), in bad states, depositors with a concave payoff function will be in charge. The latter, however, may not be able to effectively defend there interests, since they are dispersed and often uninformed. Consequently, they lack the ability to avoid the free rider problem associated with monitoring and the competence to judge performance appropriately. They therefore have to be represented by a regulatory agency, even in the absence of a deposit guarantee.

Two conclusions for further consideration arise from this analysis: First, *even in the absence of deposit insurance, there is scope for insufficient depositor monitoring.* As a consequence, some form of depositor representation/bank supervision is warranted. Second, *attempts to foster private monitoring of banks by small depositors seem to be less fruitful than attempts to encourage participation by large, possibly wholesale stakeholders.* Indeed, one rationale for introducing explicit deposit insurance is exactly to strengthen market discipline by limiting coverage ratios or by excluding certain types of deposits and depositors.

The second coordination problem emphasizes the fact that bank runs do not need to be based on fundamentals (Diamond and Dybvig, 1983). Due to their sometimes self-fulfilling nature, they expose the economy to potentially significant risks: Early liquidation of long term assets will be costly, and contagion to other banks and financial markets can result in a systemic crisis. These costs can be avoided by issuing a deposit guarantee. Even if the government refuses to issue a formal guarantee, politico-economic considerations combined with the potentially high costs of systemic risk will generate the perception of implicit guarantees: For example, if an institution possesses specific characteristics that strongly increase societies expected cost due to a failure, its managers will always attach some positive probability to the event of being bailed out.

[5] An exception is the paper by Gropp and Vesala (2004), which we discuss below.

The most prominent examples are the so called "too-big-" and "too-complex-to fail" problems: Fearing the systemic consequences of intervention or closure, a bank is allowed to keep operating even though it should be closed. Moreover, if several institutions fail at the same time, considerations of systemic risk again will play a central role in the authorities approach to intervention (the "too-many-to-fail-problem"). Last but not least, there will always be strong politico-economic pressures to bail out depositors in the event of a failure. To conclude, the reasons giving rise to implicit guarantees are manifold. They range from welfare-maximizing considerations to purely opportunistic behavior. Another rationale for the introduction of explicit schemes is therefore to make the objectives of a deposit guarantee transparent.

It is important to note that most of the mechanisms leading to implicit guarantees imply asymmetric bail-out schemes. Such asymmetries are obvious in the presence of "too-big-" and "too-complex-to fail" problems. However, there are other circumstances in which they are likely to be important. For example, a specific bank might be considered a national champion. Alternatively, some banks might be government-owned. Moreover, the failure of a specific institution is considered intolerable because of its role as lenders to specific industries or provider of payments services to a large number of very small depositors. Finally, stakeholders of different banks might differ in the extent of their political influence. In sum, the asymmetry of bail-out guarantees is one of the central characteristics of implicit regimes. Therefore, many proponents of legally formalized regimes argue that explicit deposit insurance might be a precondition for (a) providing a level playing field and (b) for effectively encouraging the entry of small banks.

Besides being asymmetric in nature, implicit regimes exhibit further particularities. For example, *depositor compensations will depend more strongly on specific circumstances than in a formalized regime*. Among other things, the magnitude of financial assistance to the banking sector will depend on the fiscal situation (in case of a public bailout) or the state of surviving banks (in case of an industry solution). *The resulting uncertainty might leave considerable room for depositor runs*. This has several implications. On the one hand, *market discipline, risk-sharing and reputation-building by banks could be encouraged*. This would then reduce the necessary scope for public intervention in the financial system. On the other hand, *the frequency of individual bankruptcies and the likelihood of contagion might increase*. If this is the case, it is likely that other safety net arrangements gain in importance. For example, the central bank as Lender-of-Last-Resort might become a much more prominent player: Since deposit insurance as one of the "circuit breakers"[6] of the financial safety net is less effective, other means of crisis management gain in importance.

Finally, it is important to distinguish (implicit) depositor protection and implicit guarantees for other bank stakeholders. Both are related, since even an implicit safety net partly eliminates the undesirable equilibrium of a pure speculative run. As a consequence, depositors' monitoring incentives are softened. Other disciplining devices have to be set in place, typically in the form of the implementation of capital adequacy regulation and supervisory intervention.[7] However, economic theory and recent

[6] Herring and Santomero, 2000

[7] In fact, both coordination problems mentioned above stress the need for some form of substitute for depositor monitoring even in the absence of explicit DI. The first one argues that depositor monitoring will be limited even in the absence of a guarantee. The second one derives it from the need to operate some form of safety net arrangement.

experience shows that such substitutes will be limited in their effectiveness. This leads to the perception that the scope for a replacement of the management or a haircut for shareholders is quite narrow. To start with, the politico-economic considerations as well as the "too-big-to-fail"-, "too-complex-to-fail" and "too-many-to-fail"-clauses mentioned above also apply to these classes of stakeholders. In addition, a number of further reasons can be mentioned:

- The objective function of supervisors might differ from the social objective function, leading to conflicts of interest and regulatory capture. For example, supervisors might want to develop a long-term relationship with the supervised to increase their job market opportunities. Alternatively, they may aim at developing a reputation for quality. If the public is incompletely informed about the latter, supervisors might fear to give a false signal by admitting a bank has to be closed, preferring to gamble for resurrection together with the bank (Boot and Thakor, 1993).
- The legal and supervisory preconditions might bias supervisory incentives towards forbearance. The supply of expertise for bank and corporate restructuring might be limited, causing authorities to delay intervention (Ingves, 2002). Furthermore, the protection from lawsuits after intervention might be insufficient.
- Even if a supervisor's incentives are perfectly aligned with the social objective function, political authorities might interfere to defend their own interests. A multitude of reasons can lead to political interference, ranging from concerns of re-election when a crisis is recognized to early to direct industry influences on political decision making.
- Finally, some conflicts of interest leading to forbearance are rooted in the nature of banking itself. These inherent characteristics of banks may create a wedge between ex ante and ex post optimality. Ex ante, the threat of closure and intervention is important to limit risk-taking. Ex post, it might be optimal to recapitalize banks with viable relationships.[8] Alternatively, tough bailout policies can have "counterproductive effects on bank managers incentives" to disclose loan losses.[9]

As a consequence of these mechanisms, not only depositors will assign a positive probability to the event of not suffering the consequences of a failure. An interesting question is whether and how the introduction of an explicit scheme influences expectations of these parties, in particular managers and shareholders. For example, in an analysis of the Argentinean experience, de la Torre (2000) argues that the introduction of explicit deposit insurance has considerably changed (and improved) resolution procedures and exit mechanisms.

To conclude, implicit protection schemes can be characterized as institutional frameworks implying a set of bailout expectations for depositors, shareholder and managers of different banks. Each stakeholder group j of each bank i will attach some positive probability p_i^j of not loosing its stake in the bank in case of a problem. In addition, there will be group-specific maximum coverage amount, C_i^j. Until the 1970s, most safety net arrangements could be characterized in this way: In some countries, the government publicly stated that depositors' losses would be borne by the taxpayer. In

[8] See Diamond (2001) and Diamond and Rajan (2001).
[9] Aghion, Bolton and Fries, 1999, p. 51.

other cases, safety nets simply consisted of public perceptions that depositors would not be held responsible for the mismanagement of (often government owned) banks. The introduction of an explicit scheme will lead to a revision of these expectations. We will discuss the nature and the potential consequences of such a step in the next section.

1.3 Effects of introducing explicit deposit insurance

When an explicit scheme is introduced, authorities will publicly announce a maximum coverage level C_i^j for deposits that is equal for all banks *i*. It will typically range from 0 for holders of inter-bank deposits, subordinated debt or for shareholders, to a specific positive amount for small depositors. At the same time, they will state that p_i^j (the probability of being bailed out) will be 1 for small depositors. When the scheme is introduced during normal times (times without major distress in the banking system), politicians will try to signal that the probability for other groups has been significantly reduced. Naturally, these announcements will never be fully credible. The most important question is therefore: How are expectations updated after the insurance scheme has been enacted? We argue that explicit arrangements will possess three important *characteristics:*

- Legal formalization of depositor compensation procedures,
- Availability of additional instruments and rules, and
- Reduced scope for asymmetric bail-outs

These characteristics will (together with a set of *preconditions*) finally determine the *consequences* of the decision to make depositor protection explicit.

1.3.1 Legal Specification of Depositor Compensation

The most obvious effect of a transition from an implicit to an explicit regime is the adoption of a legal framework for depositor compensation (*characteristic*). In systems where the rule of law is established (*precondition*), such a legal guarantee will reduce uncertainty concerning a bail-out (*consequence*), especially for small depositors: While a legal specification does not completely eliminate constructive ambiguity, it limits its scope. Moreover, the degree of flexibility is possibly reduced: Compensations for depositors will be less dependent on the availability of funds and/or the economic (and political) importance of the groups being affected by a bank failure.

To further investigate the consequences of a legal specification, it is necessary to distinguish between different groups. We start with smaller, individual depositors. With a legal right to compensation, a complete haircut will prove to be difficult, setting a lower limit to p_i^D and C_i^D, where *D* stands for depositors. As a result, the risk sensitivity of certain deposit rates will decrease. Whether this is a source of concern depends on the monitoring capacity of small depositors and on the effectiveness of other monitoring arrangements. At the same time, the lower bound to small depositors' bail-out expectations will eliminate uncoordinated runs, which is the single most

important purpose of the new policy.[10] If the possibly hazardous consequences of bank panics are large and runs are sufficiently likely, the new legal arrangement may indeed deliver significant benefits. The latter are twofold. First, the costs accruing in case of an actual panic (contagion to other intermediaries and markets, liquidation of long-term projects, loss of relationship capital and disintermediation) are avoided. Second, there may be costs of the mere possibility of a panic in the future. In particular, banking systems with a very low level of depositor confidence are often characterized by a reluctance to deposit money in banks. If explicit deposit insurance contributes to a stabilization of expectations, it may increase the willingness to channel funds through financial intermediation.

For large depositors and other stakeholders, the consequences could be quite different: Politicians planning to raise the coverage level above the legally specified amount will now have to defend their decision against a well-specified target level. Indeed, one of the major objectives of most explicit scheme is to limit the scope for widespread bail-outs. Whether this objective (the "credibility" of the scheme) can be achieved depends on a number of preconditions.[11] Most importantly, in countries were the *rule of law* is established, a formally specified system should provide a certain degree of accountability. Moreover, the interplay between the political environment and the banking industry will be a decisive element in determining bail-out expectations. In particular, a credible commitment to limited coverage is difficult to achieve in banking systems that have a close relationship to the government. Among other things, the degree of government ownership of banks, the importance of connected lending practices and the political influence of large stakeholders will be important determinants of the credibility of an explicit limit on coverage.

To conclude, the legal formalization of depositor compensation involves substantial trade-offs: On the one hand, runs will be less likely, which may increase the system's resilience to shocks and its' potential to absorb savings. On the other hand, if former implicit arrangements continue to co-exist with the now larger certainty for small depositors, risk-taking incentives may increase. The most important precondition for an effective introduction of explicit deposit insurance is thus that the government can credibly signal its intention to limit coverage. Gropp and Vesala (2004) formalize this general idea in a stylized model. Among other things, they show that an explicit scheme may indeed reduce the tendency for excessive risk-taking, provided that, ceteris paribus, the share of credibly uninsured liabilities (e.g. subordinated debt) is sufficiently high. Moreover, they emphasize the role of the counterfactual (i.e. the generosity of the implicit safety net) in determining the impact of the new regime.

1.3.2 Availability of Additional Instruments

Together with a legal guarantee, nearly all explicit schemes comprise additional instruments, rules and regulations: For example, the funding of depositor compensation is formalized. In addition, risks that could not be taken into account before can now be

[10] In contrast, if financial crises are "optimal" (as in Allen and Gale, 1998) or the only alternative to provide proper incentives to bank managers and borrowers (as in Diamond and Rajan, 2001) this is an undesirable outcome.

[11] Note that, at this stage, we only discuss the extension of bail-outs to stakeholders of an arbitrarily chosen bank. The implications of explicit schemes for an asymmetric treatment of the same group within different types of banks will be discussed below.

priced, using risk-adjusted premiums. Moreover, many countries introduce a new agency with extensive mandates in the area of bank supervision and resolution. Quite often, other areas of the financial safety net are reshaped when the explicit scheme is introduced. All these measures have the potential to attenuate or to aggravate risk-taking. While we do not provide an extensive discussion of all instruments[12], we want to highlight several of their potential implications, using funding arrangements and the reconfiguration of safety net structure as examples: We show that a potential advantage of explicit deposit insurance is that it allows for specific procedures not available within an implicit scheme. However, it is not a priori clear whether a specific design feature will increase or decrease the probability of experiencing a systemic crisis. Thus, the desirability of a specific design again depends on several preconditions.

One of the central characteristics of explicit insurance schemes is that financing patterns are formalized. In most cases, banks are expected to "pre-fund" the scheme. The fact that ex ante funding is the preferred policy stands in sharp contrast to many recent commentaries, arguing that this practice aggravates the problem of moral hazard (see, for example, Demigurc-Kunt and Kane, 2002): Since funds are already "ear-marked" for insolvency resolution, pre-funding might give depositors a (false) sense of safety. Moreover, past contributions might be considered as sunk, decreasing the propensity of banks to participate in peer monitoring.

However, pre-funding does have some obvious benefits. In particular, it allows for a prompt reimbursement of depositors, preventing the possibility of a loss of confidence due to delayed compensations. In principle, this objective could also be achieved by offering a line of credit to the DIS. However, such an arrangement might prove to be dynamically inconsistent: Since bank failures often occur in a situation of weak macroeconomic fundamentals, banks could try to renegotiate the terms and conditions of payment. Closely related, there might be pro-cyclical effects, since levies will have to be raised in situations were balance sheets have already deteriorated. In contrast, levying premiums over a longer period allows for smoothing payments over the business cycle.

Given these arguments for and against pre-funding, it is tempting to boil down the issue to a simple trade-off between moral hazard and run prevention. There are several reasons why things are more complicated. As noted by Roy (2000, p. 4), "collecting premiums ex ante requires establishing rules and fosters transparency and information sharing. As an administrative body that has a fiduciary capacity, a deposit insurer is naturally lead to exercise some degree of supervision, which in turn improves risk measurement and risk control".[13] Importantly, this will facilitate the use of risk-adjusted premiums. In fact, one powerful argument for an explicit scheme is that it principally allows for such a policy. As explained above, risk-based premiums have the potential to attenuate problems of excessive risk-taking. While their feasibility and desirability may

[12] Beck (2003), Frolov (2004), Garcia (1999), Hoelscher, Klüh and Taylor (2005) as well as Lee and Kwok (2000) provide a comprehensive discussion of design issues. Coburn and O'Keefe (2003), Madan and Pennacchi (2003) and Suphap (2004) discuss practices to price risk, Roy (2003) deals with fundig alternatives. Bennett (2001) compares approaches to failure resolution and asset liquidation.

[13] Indeed, there is evidence that pre-funded schemes are more rule-based than those relying on ex post contributions (see Garcia, 1999).

be limited in situations of imperfect information, they certainly have a role to play in the overall toolbox of banking regulation.[14]

Less obviously, the availability of an established fund may increase the willingness of authorities to intervene in weak banks. For self-interested bureaucrats and politicians, the costs of admitting the existence of a problem and arranging funds to compensate depositors may outweigh the benefits of timely intervention (Boot and Thakor, 1993). While this is true for any system, an existing fund facilitates intervention during non-systemic events. In addition, it forces the responsible institution to regularly compare its (mostly implicit) liabilities with available assets. By making expected losses, assets and liabilities explicit, an additional element of accountability is introduced. The frequently observed tendency to cover up implicit costs to the taxpayer may thus be attenuated. This line of thinking brings us back to an important aspect of explicit deposit insurance. For several reasons, the introduction of a scheme may not only change depositors' perceptions, but also the expectations of other bank stakeholders. Very often, a new safety net player with the narrow mandate to limit the exposure of the fund is set up. Furthermore, the process of preparing the introduction of a scheme is often used to review other aspects of safety net design, like the appropriateness of the supervisory process. Whether these measures will lead to a more prudent behavior will finally depend on specific country circumstances. It is not unreasonable, however, that the mere process of preparing a new legal framework sensitizes politicians and the public for the challenges posed by financial fragility and moral hazard.

Since there are good arguments for and against pre-funding and premium differentiation, the final impact of these measures will again depend on the preconditions under which a scheme is introduced. For pre-funding to be feasible, the banking system needs to display a minimum level of stability and coherence. Moreover, the complexity of managing such a scheme is much larger, creating a demand for further rules (concerning fund targets, investment restrictions etc.) and resources. Likewise, risk-based premiums require exact supervisory information. The latter must be obtained in a timely manner and processed using quite sophisticated techniques. This, in turn, necessitates a substantial level of supervisory quality and coordination among safety net participants. Finally, fair pricing of deposit insurance may require changing other functions of the FSN. For example, prompt corrective action might be necessary, since undercapitalized banks may be tempted to gamble for resurrection in the time span between a bank's risk choice and the premium adjustment.[15] An effective intervention policy is needed to prevent such actions. The latter is a general requirement for a functioning safety net, but is particularly important in explicit, risk-adjusted schemes.

1.3.3 Reduced Scope for Asymmetric Bail-Out Policies

Finally, the explicit scheme will reduce the scope for asymmetric bail-out policies. While it is unlikely that bailout expectations will equalize across all banks (since "too-big-to-fail"-considerations will still be prevalent) the likelihood of being protected will increase unambiguously for depositors of small banks. For larger banks, expected relative increases in p and C will be smaller, or even negative, in particular if the explicit scheme

[14] An interesting application of that general idea was recently brought forward by Pennacchi (2004), who shows that the pro-cyclical effects of risk-based capital standards are likely to be larger than those of risk-adjusted deposit insurance. Consequently, he proposes to combine the two elements.
[15] Chan, Greenbaum and Thakor (1992).

has the stated objective to level the playing field. Since much of the recent literature emphasizes the close relationship between market structure and different safety net arrangements, we believe that reduced asymmetry should be regarded as a central feature of explicit regimes.

What are the likely consequences of a more equal treatment of all banks? Without referring to the distinction between "implicit" and "explicit", Hakanes and Schnabel (2004) provide some answers to this question. They show that asymmetric bail-out guarantees can strongly influence risk-taking incentives and market structure. In particular, a situation where selected ("large") banks are protected more heavily than others might lead to excessive risk-taking by small banks. The idea is that an asymmetric guarantee will depress margins at small banks, which induces them to choose riskier projects. The effects on risk-taking by large banks will be ambiguous. On the one hand, the asymmetric guarantee will increase charter values, leading to a more prudent investment behavior. On the other hand, a higher bail-out probability will intensify the problems caused by the put option character of risk-insensitive deposit insurance.

These considerations highlight an issue that was already raised above: The desire to encourage competition may go hand in hand with a necessity to introduce a formalized scheme. If an asymmetric guarantee leads to excessive risk-taking by small banks, and (in the extreme), to a highly concentrated market structure, the only way to level the playing field (and to attenuate small banks' risk profile) might be to provide some legal protection for all banks. However, it is worth noting that such a policy will be of very limited success if close relations between the government and specific banks remain.

To sum up, the three characteristics of explicit deposit insurance (legal formalization, availability of additional instruments, and reduced scope for asymmetric bail-outs) imply that the policy of introducing a scheme has benefits and costs. The net effect will largely depend on a set of preconditions. One of the most important questions faced by country authorities contemplating the introduction of a DIS is thus whether the macroeconomic environment, the economy as a whole, the banking system and the supervisory and regulatory framework support such a step. Whether this was the case in recent decades is an empirical question, an issue we discuss next.

2. Recent Empirical Work on Deposit Insurance Schemes

Recent years saw a strong growth in the number of econometric studies evaluating the economic consequences of introducing Deposit Insurance Schemes (DIS). Demirgüç-Kunt and Kane (2002) review this literature. In their view, an assessment of empirical evidence yields the following main conclusions:

- Explicit deposit insurance increases the risk of experiencing a systemic crisis. In proper institutional environments, this effect becomes weaker, but is still significant.
- Country authorities operating an existing scheme should consider funding their DIS ex post and to introduce co-insurance, lower coverage levels and apply a restrictive concept of eligibility, excluding inter-bank and foreign currency deposits from coverage.

- The reason why pre-funded explicit schemes with broad coverage exhibit a higher crisis probability is that they discourage private monitoring by small depositors and market discipline.
- According to cross-country studies, deposit insurance is impedimental to financial market development and deepening.

Overall, Demirgüç-Kunt and Kane (henceforth: D-K) arrive at a very pessimistic conclusion concerning the desirability of an explicit DIS. Consequently, the authors state that "officials in many countries should close their ears to the siren call of explicit deposit insurance" (p. 192). Even though the authors point out that the research summarized "by no means implies that all countries with explicit systems should close them down at the first opportunity", several of their findings (for example concerning the desirability of pre-funded schemes) stand in sharp contrast to earlier assessments of best practice and deposit insurance design (see Garcia, 1999). Because of this discrepancy, we will first give our own account of the literature, taking their results as a starting point.

Building on the results of Demirgüç-Kunt and Detragiache (2002), D-K argue that increased risk taking due to explicit DI manifests itself in an increased probability of experiencing a systemic crisis. While a strong institutional environment (proxied by measures of bureaucratic quality, lack of corruption, contract enforcement and legal efficiency interacted with deposit insurance variables) mitigates the effects to a certain degree (interaction terms are negative and significant), DI still significantly increases bank fragility. While the authors perform various robustness tests[16], this conclusion is not replicated in many other binary models of banking crises. For instance, Eichengreen and Arteta (2000), in an attempt to consolidate recent work on the determinants of banking crises, find that the effect of explicit schemes is highly sensitive to the use of different crisis lists, deposit insurance series, and the exclusion of several types of countries. A particularly striking feature is that the exclusion of OECD countries weakens the effect of deposit insurance on crises probability, since OECD countries are expected to have a contract environment favorable to a DIS.[17] The authors conclude that "there is at least as much evidence that deposit insurance has favorable effects ... as that it destabilizes banking systems..." (p. 25). In fact, this statement is reinforced when other binary studies are taken into account: Glick and Hutchinson (1999) do not find a significant effect, Hutchinson and McDill (1998) do, and in particular when deposit insurance is interacted with a variable measuring financial liberalization. The same ambiguity is present in earlier studies on U.S. data: While Thies and Gerlowski (1989) find a positive relationship between bank failure rates and deposit insurance, Karels and McClatchy (1999) and Wheelock and Wilson (1994) do not find a stable relation.

Besides analyzing the consequences of introducing an explicit DIS, D-K discuss the appropriate use of specific design features. Since "even in favorable circumstances, deposit insurance impacts financial fragility by reducing the degree of market

[16] Robustness tests include a two-stage procedure to control for the possibility that countries with weak banking systems are more likely to introduce a DIS, the use of a principal component measure of moral hazard instead of the deposit insurance characteristics, and the inclusion of other variables characterizing the banking system.

[17] Note that this result depends on the way explanatory variables are weighted to account for measurement errors.

discipline", country authorities are advised to use "appropriate design features...to control and offset these effects". Indeed, the results of Demirgüç-Kunt and Detragiache (2002) imply that most practices having the potential to foster private monitoring should also be adopted: Membership should be compulsory, coverage levels should be set at very low levels, most types of depositors and deposits (in particular foreign currency and inter-bank claims) should be excluded and co-insurance should be introduced. In addition, authorities should not participate in the funding of the DIS and involve the private sector in the management and administration of the Deposit Insurance Agency (DIA). Finally, the practice of pre-funding the system should be abandoned to secure that the pool of explicit liquid reserves is held small.

While further econometric evidence is scarce when it comes to specific design features, the few existing studies mostly support these claims, however with some exceptions on specific issues. For example, Demirgüç-Kunt and Huizinga (2000) find that market monitoring increases when foreign currency deposits are covered. Similarly, Cull, Senbet and Sorge (2004) have to drop the foreign currency dummy when calculating a principal component index of "generosity of deposit insurance coverage". Notwithstanding this evidence, some of the proposals mentioned above stand in sharp contrast to earlier evaluations of best practice (see Garcia, 2000).

What is the channel through which explicit deposit insurance increases banking fragility? D-K argue that an explicit scheme will be detrimental to private monitoring efforts, thus weakening market discipline. Before we turn to existing empirical evidence for this proposition, it is useful to recall that recent theories of banking regulation provide very different answers to this (superficially uncontroversial) question. Specifically, as argued in the seminal contribution by Dewatripont and Tirole (1994), small depositors are often uninformed and suffer from a coordination problem, thus lacking the incentives to acquire the necessary information to discipline banks effectively. According to this theory, the additional effect of making depositor claims less secure should be small.[18] Hence, one of the central questions is to what extend small depositors do efficiently monitor banks (see below).

Moreover, while it is obvious that the presence of a safety net will influence agent's risk-taking incentives, it is less clear whether explicit deposit insurance does so in a well-defined way. As mentioned above, the monitoring and risk-taking effects of making deposit insurance explicit will strongly depend on a-priori expectations of bank bailout policies and the way these expectations are updated when formal rules to payout depositors are introduced. An import implication for empirical research on DIS is that preconditions probably matter more than individual design features. In fact, the lack of appropriate control variables to account for such preconditions (government involvement in the banking system, market concentration, quality of regulatory and supervisory policies) is one of the most pronounced challenges and weaknesses of existing econometric studies on the effects of introducing an explicit scheme. In this respect, it should be noted that the majority of studies (including Demirgüç-Kunt and Detragiache, 2002) seriously try to account for such preconditions. However, since the relevant data is only available for single points in time, estimations have to be carried out under the assumption that the characteristic value was constant over the last 20 to 25 years.

[18] In addition, making small depositors responsible fort he safety of their claims involves a duplication of monitoring costs.

Keeping this limitation in mind, it is nonetheless useful to ask whether recent econometric studies provide a clear picture about risk-taking incentives in the presence of explicit DI. Based on a summary of the growing literature on the effectiveness of private monitoring in attenuating banks' risk taking incentives, D-K conclude that depositors lacking insurance coverage indeed exert such market discipline. In contrast, there is indirect evidence that the introduction of an explicit DIS will hamper market discipline, since small depositors will loose their incentive to privately discipline banks. Most of the studies cited to underpin this line of reasoning use U.S. data (Flannery, 1998, provides an extensive survey of the relevant literature), a country with a relatively high coverage level relative to GDP and with a highly developed financial system. As a consequence, it is not clear whether the results carry over to other environments.[19] Indeed, Martinez Peria and Schmukler (2001) find that depositors in Argentina, Chile and Mexico intensively disciplined banks during the 1980s and 1990s, and that deposit insurance did not significantly diminish the extent of market discipline.[20] In contrast, the work by Demirgüç-Kunt and Huizinga (2000) reaches the opposite conclusion. The authors use a sample of up to 2500 banks in 43 countries to examine how bank characteristics influence the interest cost and the growth rate of deposits for banks operating in countries with or without an explicit DIS. They find that an explicit scheme indeed lowers the sensitivity of banks' interest rate expenses to changes in risk profiles. Emphasizing the design features mentioned above, the measures believed to strengthen market discipline (ex post funding, co-insurance, restrictive coverage) turn out to do so in the given sample.

Gropp and Vesala (2004), also using bank-level data, come to a very different conclusion. In their sample of 128 banks in 15 European countries, it appears that introducing explicit deposit insurance reduced the risk-taking of banks. The authors argue that, by making the safety net partly explicit, European authorities were able to effectively reduce the expected public subsidy in case of failures. While the observed effect might be partially due to other factors (like the increased perception that European competition policy will serve as a watchdog, effectively discouraging inadequate bail-out policies in member countries, or the fact that the countries that had introduced DI in the period under study had experienced a systemic crisis shortly before, causing authorities and depositors to be especially vigilant), the analysis includes some interesting features new to the empirical literature on safety net design. In particular, the authors estimate whether certain bank characteristics lead to a different reaction when a DIS is introduced. It turns out that institutions having lower charter values and a higher share of subordinated debt reinforce the risk-mitigating effect of explicitly reducing coverage. In contrast, very large banks do not change their policies in reaction to deposit insurance. This latter result points to the importance of an integrated view on the safety net and the way it shapes incentives.[21]

---

[19] Moreover, the question whether private depositors price risks adequately has to be assessed for instruments that are normally hold by wealthy, sophisticated investors, for example certificates of deposits or deposits exceeding the coverage limit of U.S. $100,000.

[20] It is worth noting that these countries had experienced financial fragility in the period under study. Consequently, depositors might have been particularly aware of the fragility of banks, causing them to closely monitor their banks performance. Indeed, the authors fund such an effect in the data.

[21] The relation between charter values, bank size and deposit insurance is well established in the literature.

To conclude, it is difficult to come to a firm conclusion regarding the effectiveness of private monitoring and the consequences of explicit DI on banks' risk taking incentives. Depositors seem to rationally respond to bank performance in most circumstances, in particular when they are not covered by a DIS. However, this does not rule out uncoordinated runs in the sense of Diamond and Dybvig (1983). It is important to see that this trade-off cannot be easily resolved. Most importantly, proponents of making the safety net partly explicit do not claim that depositors' incentives will be unaffected. They rather argue that the benefits of preventing runs outweigh the costs in terms of weaker market discipline, if and only if the latter can be substituted by appropriate regulation and supervision. This brings us back to the issue of preconditions mentioned above. Since one of the central rationales for the public surveillance of financial institutions is exactly the necessity of providing some form of safety net, any such arrangement will need to be accompanied by proper institutions that monitor and discipline intermediaries. A central question for future empirical research is thus how financial systems react to explicit deposit insurance under different supervisory regimes.

Finally, recent empirical work on deposit insurance has expanded to several new directions. We will only cover them briefly:

- First, turning to the effects of explicit DI on financial market development, D-K refer to cross-country studies asking whether explicit DI is conducive to financial development. Citing the contributions of Barth, Caprio and Levine (2001), Cull, Senbet and Sorge (2000) and Cecchetti and Krause (2000) it is argued that the opposite is true. Since the focus of this literature review is on the relation between financial stability and financial safety net design, we refer the reader to the original articles.
- Second, an interesting line of research tries to analyze the likelihood that a specific country adopts an explicit DIS. In fact, this question bears some importance for the issues discussed above, since it may well be the case that countries prone to financial fragility are also prone to adopt DIS. Laeven (2003) studies long run determinants of adoption probability, using a cross-country approach. He finds that countries with a large proportion of elderly people, a high share of small banks and poor creditor rights, are most likely to adopt a DIS. However, he dismisses the possibility that financial fragility is a determinant of the adoption probability, based on the observation that only 26 countries of his sample (36%) adopted an explicit scheme within three years following a banking crisis (a number appearing quite high to us), while 8 countries (10%) experienced a crisis three years following the adoption of a DIS (a number that could either express the adverse consequences of explicit insurance *or* anticipation of future distress in a fragile environment). We nonetheless believe that it would be important to further investigate this issue. In particular, it could well be the case that the desire to stabilize confidence in weak banking systems was much more important for recent adopters than for early schemes (see below).

III. Conceptual Problems and Econometric Approach

Before turning to our own account of the relation between safety net design, deposit insurance and financial fragility, it is useful to consider some major methodological challenges. Since Santor (2003) discusses many of the problems in detail, taking deposit insurance as one example, I concentrate on a short description of the issues most relevant for the study on hand (see also Eichengreen and Arteta, 2000): I first consider the potential for a selection bias, i.e. the problem that countries may "select to be treated" with explicit depositor protection for reasons related to financial fragility. Furthermore, I discuss problems of reverse causality, in particular concerning macroeconomic control variables, data availability, measurement error, and sample selection. Each section contains a short description of the way this study deals with potential distortions resulting from these factors.

1. Selection Bias

For the study on hand, the most pressing problems arise from a possible selection bias. In particular, the decision to adopt an explicit DIS is not a random treatment, but a conscious decision of policymakers facing a certain set of financial, economic and politico-economic circumstances. In our survey of the theoretical literature, we already mentioned that a number of recent contributions emphasize that specific developments might lead to the introduction of a scheme:

- More fragmented and competitive banking systems display a higher likelihood of experiencing a crisis, especially after financial liberalization. This, in turn, might increase the perceived need to protect depositors and sound banks, the latter fearing liquidation as a result of contagion. While industry solutions may endogenously emerge, they could be less likely in a situation of growing fragmentation (Hasanalyev, 2004), inducing the government to step in.
- Moreover, the desire to strengthen competition itself may induce politicians to introduce an explicit scheme. Many of the theoretical contributions reviewed above include corner solutions in which an insufficiently (or asymmetrically) protected banking system ends up with an overly concentrated market structure. Policies to strengthen competition might thus go hand in hand with the introduction of an explicit arrangement.
- Finally, weak banking systems might experience problems of under-depositing in equilibrium. To stabilize depositor confidence, a government might be tempted to provide a certain level of protection. Indeed, recent experiences show that a relatively large number of explicit schemes were introduced after major banking sector problems or after a prolonged period of low depositor confidence (see below).

To explain the nature of the problem from an econometric perspective, it is useful to describe it in terms of a standard treatment model. In our case, the treatment is the adoption of a deposit insurance scheme, represented by a dummy variable *DI* that takes the value of 1 if the country has in fact adopted a scheme and 0 otherwise. In addition, let Y_1 be the outcome variable of interest for an individual country that has received the treatment (has adopted explicit DI). The variable Y_0 represents the outcome variable for the same country, if it had not adopted an explicit scheme. The objective is to

determine the mean difference in the crisis probability that results from the fact that a country has implemented the policy instead of abstaining from it. This mean difference (the Average Effect of Treatment on the Treated, or ATT) can be formally expressed as:

$$E(Y_1 - Y_0 | DI = 1) = E(Y_1 | DI = 1) - E(Y_0 | DI = 1) \quad (1.)$$

Obviously, the last term in equation (x.x) cannot be observed, because it represents the mean value of the outcome variable for a country with deposit insurance, had it not adopted a scheme. With non-experimental data, it is therefore necessary to find an appropriate control group to calculate the ATT. However, the choice of this group is a non-trivial task, since the decision to adopt a DIS (to select to be treated) is not a random event and may be influenced by factors that also impact the probability of experiencing a systemic crisis: Countries with and without a scheme are different along dimensions that are related to the outcome variable. As a result, the expected value of the outcome variable for countries without deposit insurance is not a reliable estimator for the outcome variable of a treated country, had it not chosen to be treated:

$$E(Y_0 | DI = 0) \neq E(Y_0 | DI = 1) \quad (2.)$$

The treatment effect estimated in most econometric models of banking crises:

$$E(Y_1 | DI = 1) - E(Y_0 | DI = 0) \quad (3.)$$

is therefore potentially plagued with a selection bias. For example, the introduction of an explicit scheme may be an endogenous response to the new financial environment characterized by more competition, lower charter values and an increased exposure to volatile capital flows.

To show that this consideration may indeed influence the results, Table 2 reports correlation coefficients between the moral hazard index of DKD and different measures of banking concentration and financial liberalization. The moral hazard index is constructed using principal component analysis and contains information on several deposit insurance design features (mode of funding, coverage of inter-bank and foreign currency deposits, existence of coinsurance). The first column is taken from Beck, Demirguc-Kunt and Levine (2003) who use a sample very similar to that of DKD. The second and third columns are calculated using our own sample. As can be seen from the table, the moral hazard index as well as the DI dummy is indeed strongly correlated with most of the respective variables: It thus becomes more likely to observe an explicit deposit insurance scheme in financial systems that become less concentrated and more liberalized.

	Beck, Demiguc-Kunt, Levine	Own Sample (Index/Dummy)	
		Whole Sample	Excluding OECD countries
Concentration	-0.40	-0.21/-0.46	-0.22/-0.44
Fraction of Entry denied	-0.24	-/-	-/-
Activity Restrictions	-0.25	-/-	-/-
Financial Liberalization	-/-	0.13/0.29	0.12/0.21

Table 2: Deposit Insurance Moral Hazard and Banking System Development

Moreover, it is possible that countries that are more prone to crises for reasons other than financial liberalization and decreasing concentration introduce explicit deposit insurance. A history of recurrent bank runs and losses for small depositors will certainly increase the authorities' willingness to consider an explicit scheme. For example, experiences with banking failures sometimes lead to a situation in which small depositors refuse to deposit money in financial intermediaries, even though stability has been widely achieved. In such a "cash economy", restoring depositor confidence through some explicit protection becomes a primary policy objective. Likewise, countries with an extensive implicit safety net or a blanket guarantee might view an explicit and limited arrangement as the only possible way to smoothly progress to a less extreme regime. Indeed, Table 3 provides evidence that countries that introduce deposit insurance indeed are often characterized by a history of banking fragility: Clearly, having experienced a crisis does not have to be an informative indicator of future instability. At the same time, however, we cannot rule out the possibility that weaker financial systems select themselves out and adopt some form of explicit safety net.

Systemic Crisis...	*Laeven (2003)*	*Own Sample*
...shortly* before introduction of DI	36%	27%
...shortly* after introduction of DI	10%	13%
...only before introduction of DI	-	35%
...only after introduction of DI	-	15%
...before and after introduction of DI	-	7%
Number of schemes	72	51

Number of countries as a share of total countries having introduced a scheme
**Three years prior/after a crisis*

Table 3: Banking Crises and Deposit Insurance

Finally, one can find extensive anecdotal evidence for a relation between financial market developments, the likelihood of experiencing a systemic crisis, and the propensity to introduce an explicit DIS. For example, in its response to a survey conducted by the International Association of Deposit Insurers, the Korea Deposit Insurance Corporation (KDIC) responded to the question *"When and why was the DIS established?"* in the following way:

"The KDIC was established in June 1996. Prior to this date, there existed an implicit government guarantee on bank deposits. As for financial institutions in financial sectors other than the banks, each sector had its own method of depositor protection, usually in the form of a fund. However, financial liberalization and evermore-fierce global marketplace brought increased competition and ensuing aggressive marketing among the financial institutions. Such atmosphere envisaged heightened likelihood of financial institution failures. In light of such dynamic environment, the Depositor Protection Act (DPA) was enacted in December 1995, and the Korea Deposit Insurance Corporation (KDIC) was accordingly established in June 1996 to formally protect depositors of insured financial institutions and to maintain public confidence in the financial system." (CDIC, 2003)

Indeed, the expectation that financial fragility was around the corner proved to be correct. The example of Korea illustrates that the introduction of explicit deposit

insurance might be observed in a situation where financial fragility is likely to occur, without being causally related to the crisis probability.

2. Dealing with Selectivity

Depending on the nature of selectivity and on data availability, different empirical methods can be used to circumvent its potentially serious consequences. If selection is "on unobservables" a two-step procedure might be warranted, provided there is a valid and economically meaningful instrument. Since we are not sure whether such a variable exist, we use a two-step procedure only to cross-check our results, using variables proposed in earlier studies. Specifically we regress the binary variable deposit insurance on the fraction of the population older than 65 or the number of DIS already in place (see Laeven, 2003, and Demigurc-Kunt and Detragiache, 2002).

If selection is "on the observables" (i.e. can be explained by a vector of explanatory variables) other techniques are more appropriate. Approaches range from simply controlling for observed heterogeneity within parametric approaches, to fixed effects estimators, making more direct use of the panel nature of the sample. For the study on hand, we rely on a matching technique regularly applied in the labor economics literature. The use of such techniques for similar purposes was recently proposed by Santor (2003), Glick, Guo and Hutchison (2004) and Edwards and Magendzo (2003). The main idea is to find one or several non-treated unit(s) that are very similar to the treated country analyzed. "Similarity" refers to observable characteristics X influencing the probability of being treated as well as the outcome variable Y.

For our method to be viable, some conditions have to be fulfilled. In particular, the matching estimator is only appropriate when the so called Conditional Mean Independence (CMI) assumption holds:

$$E(Y_0|X, DI) = E(Y_0|X) \text{ and}$$

$$E(Y_1|X, DI) = E(Y_1|X) \qquad (4.)$$

where X is a vector containing all variables that influence the probability of being treated as well as the outcome variable Y. The CMI states that selection into the treatment depends on the realization of observable factors. As soon as one accounts for these factors, the expected outcome for a country in the non-participation (participation) state is independent of actual participation. As a consequence, matching techniques are only advisable giving a rich set of variables determining both participation and outcome.

If X contains many elements, the dimensionality of the problem makes it nearly impossible to find an exact match. Most studies therefore match treated and non-treated units on the basis of their respective probability of being treated, $p(X)$.[22] In our case, we first estimate a binary model for the probability of adopting deposit insurance. We then match each country that actually has adopted DI with a group of comparable control countries that has refused to do so even though they were similar in terms of the vector X. The difference in propensity scores $\left|p_i - p_j\right|$ determines the degree of

[22] Rosenbaum and Rubin (1983)

similarity between two countries *i* and *j*. Using this difference, we are able to determine weights $w(i,j) \in [0,1]$ for each non-treated unit that is to be compared to a treated unit. Let N represent the number of treated countries, and M the number of countries not having adopted DI. Given the weights w, we can calculate the ATT as

$$\frac{1}{N}\sum_{i=1}^{N}\left(Y_{1i} - \sum_{j=1}^{M} w(i,j)Y_{0j}\right) \tag{5.}$$

The choice among different matching estimators boils down to choosing among different weighting schemes. For the study on hand, a Kernel-based matching technique is applied. Results are cross-checked using alternative methods.

3. Other Problems

A problem closely related to selectivity is reverse causality. The selection bias outlined above refers to the problem that the same factors that lead to financial fragility might also lead to the adoption of a deposit insurance scheme. Reverse causality, on the other hand, refers to a situation where a systemic crisis itself leads to the adoption of explicit deposit insurance. While there is no indication in the data that authorities introduce a scheme in the year a crisis hits (normally, a blanket guarantee is enacted in such a situation) it is well possible that country authorities adopt a scheme because they expect a crisis in the foreseeable future (see above). In such a situation, it becomes nearly impossible to distinguish cause and effect.

Reverse causality manifests itself not only in terms of the treatment variable, but also in terms of several control variables. In particular, most existing studies use contemporaneous variables to control for macroeconomic factors. Obviously, a low growth rate of GDP or devaluation in a specific year could be both the cause and the consequence of a systemic crisis in that year. The problem is aggravated by the fact that many crises are recognized with a lag, either because country authorities refuse to acknowledge the severity of distress or because of a lack of appropriate data. For these reasons, we lag all macroeconomic controls as well as other variables (including the deposit insurance dummy in parametric regressions) by one year. However, to guarantee comparability with earlier results, we check whether this procedure changes the results concerning explicit deposit insurance. Note that such a procedure does not interfere with the basic channels used to describe the link between safety net design and systemic crises. All of these channels would require some extended period of time in which monitoring activity is low and bad loans are accumulated in banks' balance sheets.

Another potential problem in parametric studies of banking crises is sensitivity to functional form. In the context of studies on systemic crises, it is particularly pressing: Since there are only very few crises dates, the choice of a specific technique (for example logit versus probit estimation) may well have an impact on the results. For this reason, we use a semi-parametric approach as our baseline specification. We thus estimate the average treatment effect directly, as in equation (5.). For sake of comparability, we perform "robustness tests" using parametric techniques.

Given the reasons for the increased incidence of systemic events described in section II, a further complication has to be mentioned: It is well possible that deposit insurance itself may change the very nature of competition in the banking industry. In particular, as argued by Matutes and Vives (1996, 2000) and Keeley (1990), deposit insurance shapes the playing field that finally determines the degree of competition and concentration. To control for this problem, we proceed as follows: First, we estimate propensity scores for the whole sample. Then, we check whether the concentration variable can explain the introduction of a scheme if only the first deposit insurance observation is used in the estimation. Finally, we restrict our sample to the period 1990-2000 to see whether yearly observations on concentration contain information on the likelihood of introducing a scheme.

Furthermore, an obvious problem of empirical studies on systemic crises is the lack of reliable data on the dependent variable. The issues involved are extensively discussed elsewhere (see Eichengreen and Arteta, 2000, Ho and von Hagen, 2004, and Das, Quintyn and Chenard, 2004) and range from the subjectivity of defining a systemic crisis to the problem of accurately dating the onset of the event. Moreover, binary measures neglect the magnitude of an event. In spite of these problems, we use such a binary measure to preserve comparability with earlier studies. In addition, we believe that binary measures based on circumstantial evidence have certain advantages that sometimes may outweigh the problems. For example, they are available for an extended period of time, ranging back to at least the 1970s. In addition, the problem of magnitude cannot be easily resolved. After all, (not) experiencing a systemic crisis is a binary event.

Finally, results could be sensitive to the sample of countries considered. Eichengreen and Arteta (2000) show that statistical significance and even the sign of certain coefficients (including the deposit insurance dummy) may change strongly as the number and type of countries is modified. While our matching technique partly accounts for this problem, we cross-check results using alternative samples. In particular, we present results for a sample of countries used in the study by D-K, for a larger sample including additional developing and emerging economies and a sample excluding OECD economies.

IV. Data and Results

1. Data

1.1 Dependent Variable

As mentioned above, the dependent variable is a binary measure of systemic crises. As it is standard in the literature, we only consider the onset of an event, dropping all subsequent crises observations from our sample. Alternatively, following Eichengreen and Arteta (2000), we apply three year exclusion windows around the first year of a crisis. Results remain largely unchanged, in particular regarding deposit insurance characteristics.

To guarantee that our results are not driven by the choice of a particular definition of systemic events, we employ several crises lists. As a benchmark, we use the

classification of Demirguc-Kunt and Detragiache (2002). Here, a crisis is defined as an episode where either the government intervened in a well-specified way, or where the share of non-performing assets or the costs of rescue operations exceeded a certain threshold. Intervention policies sufficient to classify an episode as systemic are the enactment of bank holidays, deposit freezes, blanket guarantees, or large-scale nationalizations. The threshold for non-performing loans is 10% of total assets, the critical value for the cost of rescue operations 2% of GDP. Using these criteria leads to 40 systemic banking crises in the panel of DKD (4,4% of all observations).

As a cross-check, we make use of the approach of Caprio and Klingenbiel (2003), henceforth CK. Systemic crises are identified using an anecdotal approach. A crisis is defined as an event where much or all of the banking system's capital had been exhausted. To identify the occurrence of such an event, CK use various sources of information, in particular World Bank staff resources and publications on specific events. In total, CK present information on 117 systemic crises in 93 economies. In our sample, this leads to 81 crises in 72 countries (approximately 5.5% of all observations).

While the two approaches differ, there is a significant overlap between different lists, since most existing classifications are based on the assessment of CK. As a final test, we therefore employ a list of crises that includes all events in the CK database, including non-systemic crises (so called borderline events).

1.2 Deposit Insurance Design and Macroeconomic Controls

We obtained macroeconomic information from the IMF's International Financial Statistics (IFS) and from the World Economic Outlook (WEO) for a set of 136 countries for the period 1975-2003. After excluding transition economies and countries where macroeconomic information is not available for at least 10 consecutive years, 87 countries remain. Missing data on other variables, in particular for concentration and other banking system characteristics, further reduce the sample to 72 countries. For the sake of comparability, we restrict our attention to the period 1980-1997, the time span used in Demirgüc-Kunt and Detragiache (2002). To check whether the choice of the period length drives our results, we experiment with alternative start and end dates. While the impact on the estimated effects of explicit deposit insurance is small, the macroeconomic part of parametric specifications reacts quite sensitive to different period lengths.

Information on the existence and design of explicit deposit insurance schemes comes from a database recently compiled by the author. It updates the surveys by Garcia (2000) and Kyei (1995), which form the basis of the World Bank dataset frequently used in earlier studies (see Demirgüc-Kunt and Sobaci, 2001, for a description of this data). A revision had become necessary because recent years saw a strong rise in the number of explicit schemes. Furthermore, several schemes had been changed or adjusted. In total, approximately 200 countries were examined. First, we identified those who already had an explicit DIS prior to 2000, adjusting Garcia's list in several respects.[23] In a second step, we added all new schemes. Furthermore, we checked for each country whether there were any significant changes or inconsistencies.

[23] In particular, several countries that already had adopted a scheme prior to 2000 but were not included in the sample had to be added. Furthermore, some countries (in particular the six African countries of the Central African Currency Union: Cameroon, Central African Republic, Chad, Republic of Congo,

The information on existing schemes was compiled using a variety of sources, for example a survey conducted by the International Association of Deposit Insurers (IADI) in co-operation with the Canada Deposit Insurance Corporation (CDIC)[24]. The latter was complemented with public information from Central Banks, Ministries of Finance and Deposit Insurance Agencies (DIAs), using annual reports and other material available at the web pages of these institutions. In most cases, it was also possible to cross-check available information with country laws and statutes, including bye-laws and regulations issued by supervisory authorities. In addition, using the 2003 update of the World Bank database on banking regulation (see Barth, Caprio and Levine, 2001), we compared our results for selected characteristics, in particular coverage limits, fund resources as a percentage of total bank assets, and mandates of the DIS. For the latter piece of information, we furthermore relied on results from a survey on bank resolution practices and DIS risk assessment policies conducted by the Federal Deposit Insurance Corporation (FDIC) in 2000 and 2001 (see Coburn and O'Keefe, 2003, and Bennett, 2001). Finally, ambiguous or contradictory details were discussed with country experts at the IMF and with local authorities.

1.3 Financial System Characteristics

Data on domestic financial liberalization is compiled using various sources. We start with information from Williamson and Mahar (1998) on the date of interest rate deregulation. We augment the resulting dataset with information from Demigurc-Kunt and Detragiache (1998), Kaminsky and Schmukler (2003), and various IMF and EIU country reports. Information on the institutional environment (measures of bureaucratic quality, the rule of law, democratic accountability and corruption) are from the International Country Risk Guide (ICRG) published by the PRS Group. We also use several measures capturing the stage of economic and financial development. In addition to GDP per capita, we use dummy variables for high-income or OECD countries (excluding transition countries, Mexico and Turkey), and for countries considered to be "emerging markets". The emerging market dummy is obtained using information from Standard & Poor's Emerging Markets Fact Book. It takes a value of 1 for all years in which a country was included in this report. We use this measure because it is highly correlated with variables measuring the degree of actual financial integration and development (see Prasad, Rogoff, Wei and Kose, 2003). Since we conjecture that countries are more likely to introduce an explicit scheme after they have entered a certain stage of financial development, the expected sign of the variable is positive.

Data on the concentration of the banking sector is computed along the lines of Beck, Demigurc-Kunt and Levine (2003). Specifically, we use data from Bankscope as well as the information in the 2003 update of the World Bank database on financial structure (see Beck, Demigurc-Kunt and Levine, 1999) to obtain the share of assets held by the three largest banks. Extracting that kind of information from Bankscope entails several problems. In particular, the first observations for a country normally do not include a large number of banks. Consequently, the first measures of concentration tend to be

---

Equatorial Guinea and Gabon) who had formally introduced a scheme that never became operational were removed.

[24] The completed questionnaires as well as a brief summary of findings are available at http://www.iadi.org/.

upward biased. In addition, data is only available for a period starting 1989. To minimize potential distortions, we follow other studies and average the concentration variable over the sample period. To check for robustness, we proceed as follows: First, we use a three year moving average as our measure of concentration. Second we take the actual values from Bankscope, holding the first observed value constant for periods without data. Third, we use the information contained in the World Bank Database on Financial Regulation.

Finally, we obtained data on country characteristics that could be important pre-conditions for a successful implementation of explicit deposit insurance. Given the list of factors derived in section II, we are particularly interested in information on the supervisory framework, the structure of the financial safety net apart from depositor protection and ownership variables. Information on foreign ownership of banks and supervisory powers are taken from the World Bank's Database on Banking Regulation. Data on government ownership of banks was taken from La Porta, Lopez and Shleifer (2002), data on central bank independence from De Haan and Sturm (2003). The last two sources have the advantage of providing information for two different time spans (prior to and after 1990).

2. Results: The explicitness of deposit insurance

2.1 Results from Propensity Score Matching

2.1.1 Estimation of Propensity Scores and Bias Reduction

In a first step, we estimate a participation equation by maximum likelihood, using a probit specification. At this stage, the sample is restricted to a one used in Demigurc-Kunt and Detragiache (2002), to preserve comparability with earlier studies.[25] As explanatory variables, one should include a large variety of measures that may influence the decision to introduce a scheme as well as the likelihood of experiencing a crisis. Moreover, many studies in the evaluation literature use a large number of interaction terms and squared variables. Since our sample is significantly smaller than usual samples in the labor market area, we abstain from this practice. only including three types of covariates: Lagged macroeconomic controls (real GDP growth, CPI Inflation, and the ratio of private credit to GDP), variables that characterize the structure of the financial system (the degree of market concentration, a dummy for domestic financial liberalization, and our measure for actual financial integration), and variables that characterize the stage of development in a more general way (in particular, GDP per capita). While the expected sign for the first group is a priori unclear, we anticipate positive signs for financial liberalization, financial integration and GDP per capita, and a negative sign for concentration.

As can be seen from Table 4 (Model I) in the appendix, results are consistent with our reasoning in section III: Financially liberalized countries with less concentrated banking systems are more likely to make their system of depositor protection explicit. In fact, the concentration variable is highly significant regardless of the specification (see below). Moreover, having experienced a crisis in the past (i.e. before deposit insurance was introduced) also increases the likelihood that a specific country enacts a DI

[25]Except for one country, that was dropped because of missing data (People's Republic of Kongo).

legislation.[26] Note that all specifications include several variables capturing the stage of development of a country: Consistent with the fact that high-income countries usually have a deposit insurance scheme, GDP per capita and the OECD dummy are positive and significant. More interestingly, the "emerging market dummy" also enters positively and is significant in all specifications. A possible interpretation for this finding is that countries that are more financially integrated have an additional incentive to shield their depositors from the consequences of abrupt reversals in capital flows.

How well does the data describe the decision to operate a financial system under explicit depositor protection? In all models (including the one reported below), the Pseudo R^2 as a measure of "Goodness-of-fit" reaches levels (between 0.35 and 0.5) that can be considered high compared to other, similar studies. As another test of predictive power, Table 5 reports the share of observations that are correctly predicted. Overall, 85% of all observations (82% of the explicit deposit insurance observations and 87% of the implicit schemes) are correctly predicted.

Before we discuss the results in terms of treatment effects, it is useful to examine whether matching indeed reduces covariate imbalances. Table 6 in the appendix therefore reports the "bias" observed before and after matching, using a subset of explanatory variables. Specifically, we calculate the difference in sample means in the treated and non-treated sub-samples before and after matching. We standardize the measures using the square root of the average of the sample variances in the respective groups, following Rosenbaum and Rubin (1983). As can be seen from the table, unmatched observations indeed show a strong and significant divergence between treated and non-treated units. At the same time, matching consistently reduces the standardized difference by large amounts, ranging from 74% to 98% of the original discrepancy. Moreover, kernel density estimates for treated and non-treated observations (Figure 1-3) show that matching visibly reduces differences in estimated distribution functions. For example, treatment and control groups become much more similar in terms of macroeconomic controls (figure 2 and 3) as well as financial system characteristics (figure 1).

2.1.2 Average Treatment Effects

In a next step, the probit estimates are used to predict the conditional probability of being treated, i.e. of choosing to introduce explicit deposit insurance.[27] Given these predictions, observations are matched using the Kernel approach.[28] Specifically, we match each treated unit *in a given year* with several non-treated countries, applying weights negatively related to the difference in propensity scores. This procedure guarantees that we do not compare a country in a specific period with itself in another period. In a specific year, a country of the treatment group (for example Chile since 1986) is matched to several countries of the control group (countries that did not have an explicit scheme in the same year). Countries that share similar characteristics concerning macroeconomic developments, financial liberalization, banking structure and stage of development (for example Korea in the first half of the 1990ies, after it had liberalized its financial system, but before it introduced an explicit scheme in 1996) receive high weights in the subsequent analysis.

[26] However, results do not depend on this feature, as explained below.

[27] To check for robustness, we performed linear and non-linear predictions of the fitted model. However, results remain largely unchanged.

[28] Matching is performed using the stata module psmatch2 (Leuven and Sianesi, 2003).

Table 7 presents the Average Treatment Effects on the Treated for the restricted sample (propensity scores from Model I). The ATT after matching is negative, implying that introducing an explicit scheme reduces the likelihood of experiencing a systemic crisis. The effect is surprisingly strong: The crisis probability is reduced by 5 percentage points and is significant at the 10% level (note that standard errors were corrected to account for the additional variance that is due to the prior estimation of propensity scores). However, as will become clear below, the magnitude of the effect of explicit deposit insurance is not very stable. Moreover, only a subset of estimates is significant. However, the sign of the ATT is consistently negative. We therefore do not conclude that explicit deposit insurance reduces the probability of distress by a specific amount. Nor do we argue that countries should introduce a scheme. Rather, we present evidence that countries that did choose to be treated in recent decades may have done so for well-specified reasons.

Finally, it is important to note that the result above (a relatively large and significant reduction in the crisis probability) does not imply negative probabilities. To understand why and to see what drives our results, it is useful to ask how the estimates in Table 7 compare to those using unmatched data. As can be seen from Table 8, the major difference between matched and unmatched data is a very high crisis probability for the matched control group. The difference between those countries that received the treatment and the original control group is zero - explicit insurance seems to have no effect on systemic risk. In contrast, the crisis probability for the matched control group is very high (approximately 10%): Countries similar to the ones that introduced a scheme, but did not do so, thus run a high risk of experiencing a systemic crisis.[29] This is another way of stating our main argument: Explicit deposit insurance may be the response to specific structural changes that imply more financial fragility; accounting for this possibility may significantly alter policy assessments.

2.2 Robustness Tests and Parametric Estimates

2.2.1 Alternative Matching Techniques

To check whether our results are driven by the choice of a specific matching technique, we repeat the procedure above using nearest neighbor matching. Table 9 in the appendix presents results for the ATT using one as well as five nearest neighbors (to facilitate the comparison, Kernel estimates are also included). While the sign and the magnitude of the ATT are relatively stable (ranging from -5.6 percentage points with only one matched observation to -6.1 with 5 nearest neighbors), not all estimates are significant. In particular, matching with only one control observation yields a p-value of only 0.115. It is worth noting that, given our small sample, nearest neighbor matching with only 1 match per treated observation is very unlikely to produce significant results. In contrast, matching with five control observations confirms the result from section 2.1.2. Moreover, nearest neighbor matching once more illustrates the effects at work (Table 10): Since all treated units now have a common support, the sole factor driving our results is a strong increase in the susceptibility of control countries to a systemic event.

[29] Note that the effect does not depend on the exclusion of a relatively small number of observations that received the treatment, but were excluded from the sample because of a lack of common support (see section IV.2.2.1 for details).

In Table 11, we examine whether and how the restriction that only different countries can be matched together affects our results. Lifting the restriction (i.e. allowing the matching of a country with itself in another period, provided it introduced a scheme in the meantime) does not influence the results when Kernel matching is applied: A significant negative effect of comparable magnitude (-5.2 percentage points) can be observed.

2.2.2 Robustness of Selection Equation

Since the reliability of our semi-parametric estimation technique strongly depends on the quality of propensity scores (i.e. extend to which observable factors explain the treatment status), we present several rather extreme robustness tests of the participation equation. Table 12 in the appendix reports results for two different models, labeled Model II and III. While Model I above is restricted to the sample used in Demigurc-Kunt and Detragiache (2002), Model II uses our own, enlarged sample and the crisis list compiled from information in Caprio and Klingenbiel (2003). Model III, again using the larger sample, excludes all observations following the year in which an explicit scheme was enacted. The objective of this exclusion is to account for the possibility that explicit deposit insurance itself determines relevant country characteristics.

Using our enlarged sample and the crisis dummy compiled from Caprio and Klingenbiel (2003) raises several interesting points. In general, the results obtained above are confirmed: First, matching again significantly reduces covariate imbalances (Table 13). Second, financially liberalized and integrated countries that have a less concentrated banking system are more likely to have explicit deposit insurance. While the values of coefficients do change to some extent, their signs remain unchanged. Moreover, all relevant variables remain significant. Somewhat surprisingly, some of the lagged macroeconomic variables now significantly influence the treatment decision. Model III is used as an extreme check of our results. In particular, explicit deposit insurance itself may be responsible for structural change in the financial system and the overall economy. We therefore exclude all observations following the year in which an explicit scheme was enacted and use the actually observed concentration variable in a specific year as explanatory variable. Since the second specification has only very few observations for which the deposit insurance dummy takes a value of 1 (1 observation per country that actually has a scheme), it is clear that its predictive power is reduced significantly. However, the signs of all coefficients are unchanged. Most importantly, the variables describing the fragility and concentration of the banking sector remain significant. In light of this evidence, we believe that the observed relationships are not the result of reverse causality. In particular, since all variables enter with a lag and Model II excludes observations after the introduction of DI, it is unlikely that deposit insurance itself (via its potential effect on market structure and systemic risk) drives the results.

As a further test, we estimated a version of the selection equation that accounts for potential heteroscedasticity (Model IV/Table 14). In particular, we allow the variance of the cumulative distribution function to vary as a function of independent variables, in particular GDP per capita. This procedure allows us to test for heteroscedasticity and to check whether our results are affected by its presence. While there is some indication for the presence of heteroscedasticity, results for propensity scores and the ATT remain largely unchanged (see below).

Finally, we performed a variety of other robustness tests that are only reported in extracts (Table 15). Specifically, we test whether our results are driven by a particular definition of the concentration variable (by using a three-year moving average and the concentration variable from the World Bank Database on Banking Regulation – Model V), the inclusion of a specific set of covariates (like past crisis, regional dummies, or financial integration – Model VI) or the presence of hyperinflationary outliers. Neither the use of alternative definitions of concentration, nor the exclusion of variables as "past crisis" or regional dummies impact the selection equation decisively. In conclusion, very different specifications of the participation equation yield qualitatively similar results. Moreover, matching significantly reduces covariate imbalances in all cases.

2.2.3 Average Treatment Effects after Alternative Selection Equations

Based on the above results in section 2.1 and 2.2.1, we could conclude that introducing explicit deposit insurance significantly reduces the risk of experiencing a systemic crisis. How robust are these results to different sample sizes, crisis definitions, and specifications of the propensity score estimations? Table 16 and Table 17 present Treatment Effects for Model II and III. In both specifications using the enlarged sample, matching reduces the insignificantly positive effect explicit deposit insurance has on the probability of experiencing a crisis substantially – the ATT becomes negative. We view this result as an illustration of the general mechanism at work – as soon as one controls for covariate imbalances, the tendency to confuse cause and effect of explicit deposit insurance are attenuated. However, corrected standard errors increase somewhat when the larger sample is used.

In all other robustness test, results are very similar: Independent of the definition of the concentration variable (Table 19), we get negative estimates of the ATT that are of comparable magnitude (around 5%). When certain variables are excluded (Table 20), the ATT is no longer significant in all cases, but still negative. An exception is the ATT based on propensity scores from the model that accounts for potential heteroscedasticity. Here the (negative) ATT is strongly significant and increases substantially, to a value of around 8% (Table 18). Together with the results in section 2.1 and 2.2.1, these estimates hint to the following conclusion: The negative sign of the ATT seems to be a stable characteristic in all estimations. The relatively low variability in the value of the ATT reinforces this result. While the negative coefficient is significant in most of our preferred specifications, statistical interference does not always yield a clear outcome. However, in most cases using the Kernel approach (which can be considered the appropriate method given our relatively small sample), the Null Hypotheses of no difference between the treated and the untreated is rejected. Moreover, the 95% confidence interval of most estimates ranges from a negative value to a value very close or equal to zero. Consequently, we are confident that our results do indeed show that explicit deposit insurance *does not* increase financial system vulnerability.

2.2.4 Parametric Estimates

As a final test of our results, we run logistic regressions in the spirit of earlier studies, controlling for the level of concentration and for financial liberalization in a binary regression (Table 21). Our objective is to check whether our results carry through using a more standard parametric technique that controls for characteristics that jointly

determine the likelihood of being treated and of having a systemic crisis. We again use both samples and crisis lists, but only report results for the restricted sample.

The upper part of Table 21 replicates the estimation in DKD, using our own dataset on deposit insurance. As in DKD, the deposit insurance dummy is positive and significant. However, as soon as we control for the level of concentration and/or financial liberalization (the second and third part of Table 21), it looses significance. More strikingly, the coefficient of deposit insurance changes its sign and becomes negative as soon as we jointly control for the level of financial liberalization, concentration and financial integration. At the same time, the three other variables remain significant at the 5% and 10% significance level. We interpret these results as confirmation of our earlier results: Accounting for country characteristics that may jointly determine the adoption of a scheme and the likelihood of experiencing a systemic crisis may substantially alter the results of policy impact studies.

3. Design Features of Explicit Schemes

The preceding analysis suggests that existing studies on the effects of explicit deposit insurance may suffer from a selection bias: Countries that enter a specific stage of (financial) development are more likely to introduce an explicit scheme. If this new stage implies a higher vulnerability to crises, the relation between the explicitness of an arrangement and financial fragility is likely to become spurious. Does this result also bias results for specific design features? We believe that this is likely for two reasons. First, the selection bias for explicitness is likely to carry through to design features: Specific characteristics are only observed in explicit regimes, and certain design features like pre-funding are the predominant way to implement a scheme. Second, DI characteristics themselves might be the consequence of a set of preconditions related to financial fragility. For example, observing an unusually high coverage ratio or the protection of inter-bank deposits might simply be a political reaction to a lack of depositor confidence and a pronounced vulnerability to bank runs. In fact, some of the insurance schemes introduced recently seem to serve as substitutes for blanket guarantees, and not as a policy tool to foreclose runs on individual banks.

Instead of going through a detailed analysis of these important issues, we exemplify the consequences, again using semi-parametric and parametric techniques. In particular, we estimate the effect of the treatment "Pre-funding depositor protection" (Table 22). Moreover, we calculate a "moral hazard index" in the spirit of earlier studies, using principal component analysis. Subsequently, we check whether its predictive power is impacted by outliers in terms of the coverage ratio (coverage ratios above 5 times GDP). The first type of test is intended to check whether the "explicitness bias" outlined above carries through to individual design features. The second type of analysis checks whether there is an additional effect on design features independent of the "explicitness bias". Table 22 and Table 23 largely confirm our reasoning. Not surprisingly, the measured effect of pre-funding is very similar to the one of making protection explicit. Since the large majority of formalized regimes require banks to pay a premium ex ante, Average Treatment Effects on the Treated should not display a large variation. The moral hazard index (which includes such design features as the exclusion of inter-bank and foreign currency deposits, coverage relative to GDP per capita, and funding arrangements) does significantly increase systemic risk for the whole range of coverage ratios (Table 23, upper part). As soon as we exclude

observations for which the ratios exceed a value of 5, the effect becomes insignificant (Table 23, upper part). It is important to note that the estimates in Table 23 do not include the whole range of covariates responsible for the first type of bias. The effect thus seems to be due to the exclusion of countries that operate their scheme under unusually high coverage.

V. Conclusion

The purpose of this study is not to promote a specific form for financial safety net design, namely an arrangement including explicit deposit insurance. Rather, we have the more modest objective to take a second look at theory and evidence. Our analysis emphasizes three interrelated aspects. First, the adoption of a certain structure for the financial safety net should be understood as an endogenous response to certain developments in the financial system. Indeed, the evidence presented above clearly suggests that specific circumstances increase the likelihood of a specific arrangement: The degree to which a system of depositor protection exhibits "explicitness" will depend on certain characteristics of the banking industry. Specifically, as financial markets develop and become less concentrated, the political authorities' propensity to introduce a scheme will increase.

Second, the fact that safety net features are endogenous might lead to a problem of selectivity. Econometric evaluations of safety net policies should account for this possibility: Country characteristics related to the probability of experiencing a systemic crisis could also increase the likelihood of adopting an explicit scheme. Not accounting for such selectivity leads to biased results and wrong policy advices. As the analysis above shows, the average effect of the treatment "explicit deposit insurance" on the probability of experiencing a systemic crisis indeed seems to be highly sensitive to this problem. To a more limited extend, the same holds true for specific design characteristics, like coverage limits, funding arrangements, or the exclusion of certain deposit types. Here, the results may be additionally influenced by the fact that some countries exhibit a certain structure (for example, a high coverage level) because they are in a situation in which the likelihood of runs is very large and the desire to stabilize expectations particularly pronounced.

Finally, the evidence presented here suggests that it is questionable whether recent contributions blaming explicit deposit insurance for increased fragility survive closer inspection. Indeed, our results indicate that the relation between the degree of explicitness of depositor protection and financial fragility is modest, and, if anything, negative. The potentially stabilizing effect of explicit schemes, however, should not be overemphasized. Rather, our results should be interpreted in the sense that explicit deposit insurance cannot be blamed for increased vulnerability to crises in recent decades.

What are the implications of our analysis for policymakers contemplating the introduction of an explicit scheme? First, our analysis does not show that developing countries should introduce explicit deposit insurance as soon as possible. Rather, we present evidence that the countries that had introduced a scheme in the 1970ies, 80ies and 90ies did so without destabilizing their banking system. Second, this does not imply that explicit protection cannot be the root of major problems in the banking sector. In fact, we believe that the each country has to carefully check whether the different

preconditions necessary to support such a step are fulfilled. In this respect, further research on the nature of these preconditions is of paramount importance.

VI. References

Acharya, S., and J. F. Dreyfus (1989). "Optimal bank reorganization policies and the pricing of federal deposit insurance", *Journal of Finance* 44 (5), 1313-33.

Allen, Franklin and D. Gale (1998). "Optimal Financial Crises", *The Journal of Finance* Vol. LIII, No. 4, 1245-1284.

Beck, T. (2003), "The Incentive-compatible Design of Deposit Insurance and Bank Failure – Concepts and Country Studies", *World Bank Policy research Working Paper* 3043, May 2003.

Bennett, R. L. (2001). "Failure Resolution and Asset Liquidation: Results of an International Survey of Deposit Insurers", *FDIC Banking Review* 14 (1), 1-26.

Boot, Arnoud W. A. and Anjan V. Thakor (1993), "Self-Interested Bank Regulation", *American Economic Review* 83 (2), Papers and Proceedings of the Hundred and Fifth Annual Meeting of the American Economic Association, 206-212

Calomiris, C. (1999). "Building an Incentive-compatible Safety Net", *Journal of Banking and Finance* 23, 1499-1519.

Carletti, Elena and Hartmann, Philipp (2002). "Competition and Stability: What's Special About Banking?", *ECB Working Paper* No. 146, European Central Bank.

Carapella, F. and G. Di Giorgio (2004). "Deposit Insurance, Institutions and Bank Interest Rates", *Working Paper*.

CDIC (2003), "International Deposit Insurers Survey". Canadian Deposit Insurance Corporation.

Chan, Y. S., S. I. Greenbaum and A. V. Thakor (1992). "Is fairly priced deposit insurance possible?", Journal of Finance 47, 227-45.

Coburn, J. F. and J. P. O'Keefe (2003), "Risk Assessment: Results of an International Survey of Deposit Insurers", *FDIC Banking Review* 15 (1), 17-35.

Cull, R., L.W. Senbet and M. Sorge (2002). "The effect of deposit insurance on financial depth: a cross country analysis", *Quarterly review of economics and Finance* 42.

Cull, R., L.W. Senbet and M. Sorge (2003). "Deposit Insurance and Financial Development", *forthcoming: Journal of Money, Credit and Banking.*

Das, Ubadir S., M. Quintyn and K. Chenard (2004). "Does Regulatory Governance Matter for Financial System Stability – An Empirical Analysis", in: *The Evolving Financial System and Public Policy*. Proceedings of a conference held by the Bank of Canada, December 2003. Ottawa: Bank of Canada.

De la Torre, Augusto (2000). "Resolving Bank Failures in Argentina: Recent Developments and Issues", Policy Research Working Paper 2295, The World Bank.

Demirgüç-Kunt, A. and E. Detragiache (2002). "Does Deposit Insurance Increase Banking System Stability? An Empirical Investigation", *Journal of Monetary Economics* 49, 1373-1406.

Demirgüç-Kunt, A. and E. J. Kane (2002). "Deposit Insurance Around the Globe: Where Does It Work?" *Journal of Economic Perspectives* 16, 175-195.

Demirgüç-Kunt, A. and T. Sobaci (2000). "Deposit Insurance Around the World: A Data Base", mimeo, Washington: World Bank.

Dewatripont, M. und J. Tirole (1994), "The Prudential Regulation of Banks". Cambridge, Massachusetts, The MIT Press.

Diamond, D. W. and P. Dybvig (1983). „Bank runs, deposit insurance and liquidity", *Journal of Political Economy* 91, 401-419.

Diamond, D. W. and R. G. Rajan (2001). "Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking". *Journal of Political Economy* 109, 287-327.

Diamond, D. W. (2001). "Should banks be recapitalized?", *Federal Reserve Bank of Richmond Economic Quarterly* 87(4), 71-96.

Edwards, Sebastian and I. Magendzo (2003). "A Currency of One's Own? An Empirical Investigation on Dollarization and Independent Currency Unions", *NBER Working Paper* No. 9514 (February 2003).

Eichengreen, B. and C. Arteta (2000). "Banking Crises in Emerging Markets: Presumptions and Evidence", Working Paper C00_115, *Center for International and Development Economics Research*, University of California, Berkeley.

Freixas, Xavier and J.-C. Rochet (1998). „Fair Pricing of Deposit Insurance. Is it Possible? Yes. Is it Desirable? No.", *Research in Economics,* Vol. 52, No. 3, 217-32.

Frolov, Mikhail (2004). „Deposit Insurance and Its Design: A Literature Review", *KUMQRP Discussion Paper Series* 2004-004, Keio University Market Quality Research Project.

Garcia, G. G. (1999). „Deposit Insurance: A Survey of Actual and Best Practices", *IMF Working Paper* 99/54. Washington: International Monetary Fund.

Giammarino, R., T. Lewis, and D. Sappington (1993). 'An Incentive Approach to Banking Regulation", *Journal of Finance* 48 (4), 1523-42.

Glick, R., X. Guo, and M. Hutchinson (2004). "Currency Crises, Capital Account Liberalization, and Selection Bias", *Federal Reserve Bank of San Francisco Working Paper Series* 2004-15.

Gorton, Gary and L. Huang (2002). „Bank Panics and the Endogeneity of Central Banking", *NBER Working Paper Series* No. 9102.

Gropp, R. and J. Vesala (2004). "Deposit Insurance, Moral Hazard and Market Monitoring", *ECB Working Paper Series* No. 302, February 2004.

Hakanes, Hendrik, and I. Schnabel (2004). "Banks without Parachutes – Competitive Effects of Government Bail-out Policies", *Working Paper*, Max-Planck Institute for Research on Collective Goods, Bonn.

Hasanaliyev, Orkhan (2004). "Competition, Bank Runs and Deposit Insurance?", *Working Paper*, University of Iowa.

Hellmann, Thomas F., K. Murdock and J Stiglitz (2000). "Liberalization, Moral Hazard in Banking and Prudential Regulation: Are Capital Requirements Enough?", *American Economic Review* 90(1), 147-165.

Herring, Richard J. and Anthony M. Santomero (2000). "What is optimal financial regulation?", in: Gup. Benton E. (Ed.), *"The New Financial Architecture, Banking Regulation in the 21st Century"*, Quorum Books, London, 51-84.

Ho, Tai-Kuang and J. von Hagen (2004). "Money Market Pressure and the Determinants of Banking Crises", *CEPR Discussion Paper* No. 4651, October 2004.

Ingves, Stefan (2002). "The Nordic Banking Crisis from an International Perspective", Speech given at a Seminar on Financial Crises, Kredittilsynet, The Banking, Insurance and Securities Commission of Norway, Oslo, September 11, 2002.

Kaminsky, Graciela and S. Schmukler (2003). "Short-run Pain, Long-run Gain: The Effects of Financial Liberalization, *NBER Working Paper* No. 9787 (June 2003).

Kahn, C. M. and Santos, J. A. C., 2001. "Allocating bank regulatory powers : lender of last resort, deposit insurance and supervision," *BIS Working Papers* 102, Bank for International Settlements.

Karels, G. and C. McClatchey (1999). "Deposit Insurance and Risk-Taking Behavior in the Credit Union Industry", *Journal of Banking and Finance* 23(1), 105-34.

Keeley, M. (1990). "Deposit Insurance, Risk, and Market Power in Banking", *American Economic Review* 80, 1183-1200.

Kyei, A., (1995). Deposit Protection Arrangements: A Survey. *IMF Working Paper* 96/83. Washington: International Monetary Fund.

La Porta, Rafael, F. L.opez de Silanes and A. Shleifer (2002). "Government Ownership of Banks", Journal of Finance 57(1), 256-301.

Laeven, L. (2003)."The Political Economy of Deposit Insurance", *Working Paper*, The World Bank.

Lee, W. S. and C. C. Y Kwok (2000), "Domestic and International Practice of Deposit Insurance", *Journal of International Financial Management* 10, 29-62.

Leuven, E. and B. Sianesi (2003), "PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing", *[http://ideas.repec.org/c/boc/bocode/s432001.html]*.

Madan, D. and G Pennacchi (2003), "Introduction: Special Issue on Pricing the Risks of Deposit Insurance", *Journal of Financial Services Research* 24(2), 89.

Martinez Peria, M. S., and S. L. Schmukler (2004)."Do Depositors Punish Banks for Bad Behavior? Market Discipline, Deposit Insurance, and Banking Crises", *Journal of Finance* Vol. 56, No. 3, June 2001.

Matutes, C. and X. Vives (1996). "Competition for deposits, fragility, and insurance", *Journal of Financial Intermediation* 5, 184-216.

Matutes, C. and X. Vives (2000). "Imperfect Competition, Risk Taking, and Regulation in Banking", *European Economic Review* 44, 1-34.

Merton, R. (1977). "An Analytical Derivation of the Cost of Deposit Insurance Loan Guarantees", *Journal of Banking and Finance* 1, 3-11.

Morrison, Alan and L. White (2004). "Is Deposit Insurance A Good Thing, And If So, Who Should Pay for It?", *CEPR Discussion Paper Series No. 4424*, Centre for Economic Policy Research.

Pagès, Henri and Santos, Joao A. C. (2003). "Optimal Supervisory Policies and Depositor-Preference Laws", *BIS Working Papers* 131, Bank for International Settlements.

Pennacchi, George G. (2004). "Risk-Based Capital Standards, Deposit Insurance, and Procyclicality", *FDIC Center for Financial Research Working Paper No. 2004-5*, Federal Deposit Insurance Corporation, November 2004.

Prasad, S., K. Rogoff, S.-J. Wei and M. A. Kose (2003). "Effects of Financial Globalization on Developing Countries: Some Empirical Evidence", *IMF Occasional Paper 220*.

Repullo, Rafael (2000). "Who Should Act as Lender of Last Resort? An incomplete Contracts Model", *Journal of Money, Credit and Banking*, Vol. 32, No. 3 (August 2000, Part 2).

Roy, J. (2003). "A preliminary analysis of Deposit Insurance Funding Issues", *Working Paper,* IADI.

Santor, Eric (2003). "Banking Crises andContagion: Empirical Evidence", *Bank of Canada Working Paper* No. 2003-1 (February 2003).

Santos, Joao A. C. (2000). "Bank Capital Regulation in Contemporary Banking Theory: A Review of the Literature", *BIS Working Paper* No. 90, Bank for International Settlements.

Sleet, Christopher and B. D. Smith (2000) „Deposit insurance and lender-of-last-resort functions", Proceedings, Federal Reserve Bank of Cleveland, 518-579.

Standard & Poor's (2003). Emerging Stock Market Factbook 2003, New York: The McGraw-Hill Company.

Suphap, W. (2004), „Toward effective risk-adjusted bank deposit insurance: a transnational strategy", Columbia Journal of Transnational Law 42 (3), 829-862.

Williamson, Williamson, John, and M. Mahar (1998). "A Survey of Financial Liberalization", Princeton Essays in International Finance 211. Princeton University, Princeton, N.J.

VII. Appendix

Crisis_CK	Coef.	Robust Std. Err.	z
Growth_1	-.0196898	.0179542	-1.10
Inflation_1	-.0012597	.0022423	-0.56
Credit/GDP_1	-.0004093	.0004628	-0.88
GDP/Capita	.0000295	7.63e-06	3.87
Fin.Lib	.353151	.1511717	2.34
Concentration	-.0122694	.0030942	-3.97
Fin.Integration	1.125342	.1804661	6.24
Crisis	.6292606	.1727723	3.64
Constant	-1.710605	.3760789	-4.55
Number of obs	870		
Wald chi2(12)	172.09		
Prob > chi2	0.0000		
Pseudo R2	0.3491		

Table 4: Probit Estimates of Propensity Scores (Model I)

Predictive Power of Probit Estimates

Sensitivity	Pr(+| D)	82.17%
Specificity	Pr(-|~D)	86.51%
Positive predictive value	Pr(D| +)	77.48%
Negative predictive value	Pr(~D| -)	89.57%
False + rate for true ~D	Pr(+|~D)	13.49%
False - rate for true D	Pr(-| D)	17.83%
False + rate for classified +	Pr(~D| +)	22.52%
False - rate for classified -	Pr(D| -)	10.43%
Correctly classified		84.94%

Classified + if predicted Pr(D) >= .5
True D defined as di != 0

Table 5: Predictive Power of Model I

Variable	Sample	Mean Treated	Mean Control	%bias	%reduct |bias|	t-test t	t-test p>|t|
Inflation	Unmatched	12.836	26.263	-8.4		-1.06	0.483
	Matched	11.961	11.381	0.4	95.7	0.80	0.570
Credit/GDP	Unmatched	106.34	56.28	43.2		6.67	0.095
	Matched	111.85	116.83	-4.3	90.0	-0.97	0.509
GDP/Cap	Unmatched	16207	6786.6	85.5		12.82	0.050
	Matched	15222	13918	11.8	86.2	2.40	0.251
Fin.Lib	Unmatched	.88917	.58813	72.9		9.77	0.065
	Matched	.86299	.87024	-1.8	97.6	0.74	0.594
Concentration	Unmatched	50.795	68.342	-89.5		-12.23	0.052
	Matched	52.871	53.851	-5.0	94.4	-2.10	0.283
oecd	Unmatched	.65605	.24281	91.2		13.11	0.048
	Matched	.61417	.51029	22.9	74.9	3.79	0.164

Table 6: Reduction in Covariate Imbalances

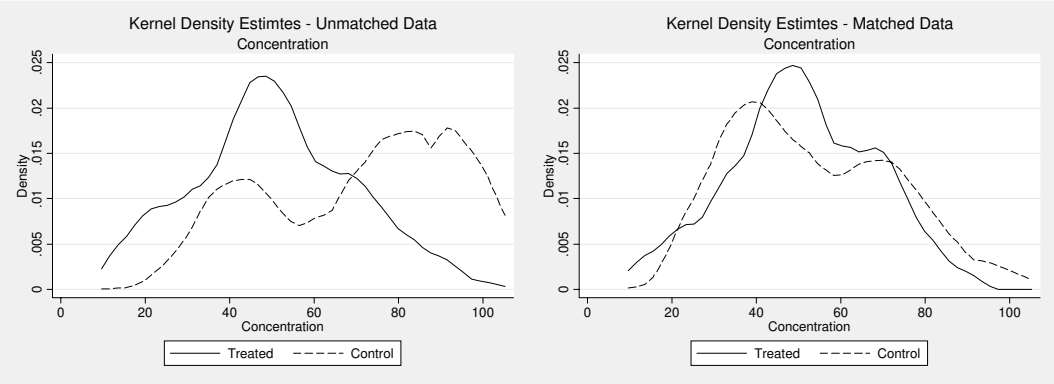

Figure 1: Kernel Density Estimates for Concentration

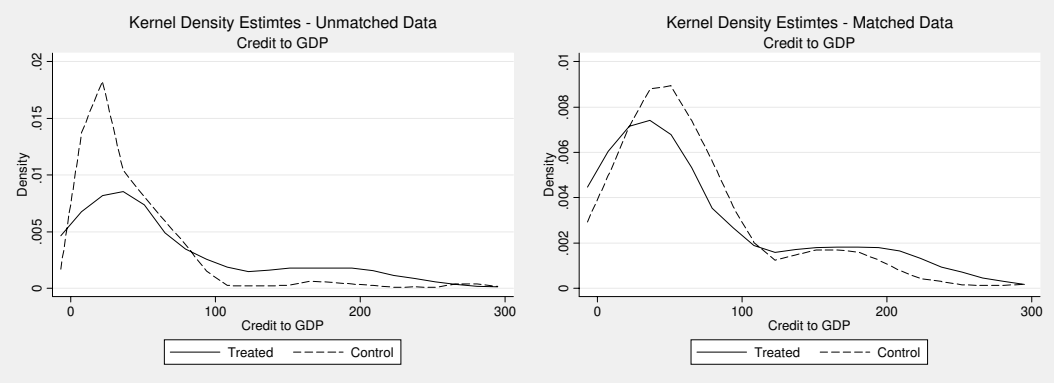

Figure 2: Kernel Density Estimates for Credit to GDP

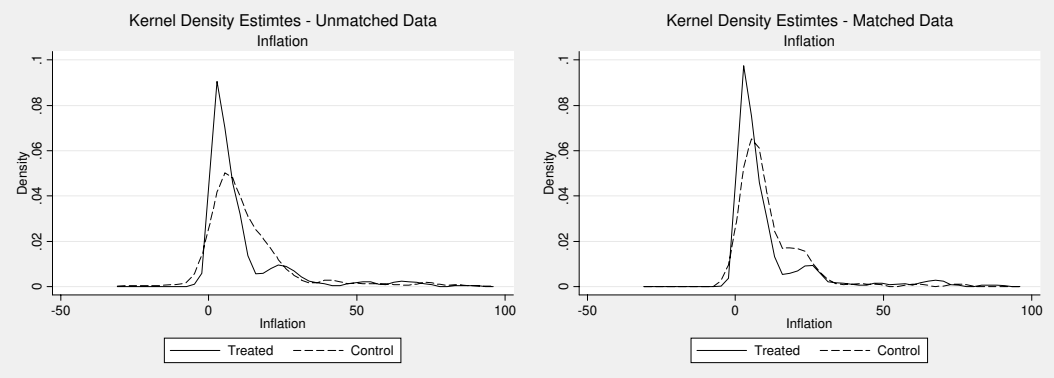

Figure 3: Kernel Density Estimates for Inflation

	Estimate	Std. Err.	t	P>|t|
ATT (Kernel)	-.0573461	.0314012	-1.83	0.068

Table 7: Average Treatment Effect on Treated (Restricted Sample, Kernel Matching)

Estimation Details	Treated	Controls	Difference
Unmatched	.047770701	.04856115	-.00079045
ATT	.041666667	.099012722	-.05734605
Treatment Assignment	**Off support**	**On support**	**Total**
Untreated	0	556	556
Treated	32	282	314
Total	32	838	870

Table 8: Estimation Details for Table 7

	Estimate	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ATT (Kernel)	-.0573461	.0314012	-1.83	0.068	-.1190157	.0043236
ATT (1 NN)	-.0562633	.0356417	-1.58	0.115	-.1262681	.0137416
ATT (5 NN)	-.0617834	.0330996	-1.87	0.062	-.1267792	.0032123

Table 9: Robustness: Alternative Matching Techniques

Kernel	Treated	Controls	Difference
Unmatched	.047770701	.048561151	-.00079045
ATT	.041666667	.099012722	-.057346056
1NN	**Treated**	**Controls**	**Difference**
Unmatched	.047770701	.048561151	-.00079045
ATT	.047770701	.10403397	-.05626327
5 NN	**Treated**	**Controls**	**Difference**
Unmatched	.047770701	.048561151	-.00079045
ATT	.047770701	.10955414	-.061783439

Table 10: Estimation Details for Table 9

	Estimate	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ATT (Kernel)	-.0520383	.0281828	-1.85	0.065	-.1073543	.0032776
ATT (1 NN)	-.0329087	.0322249	-1.02	0.308	-.0962166	.0303991
ATT (5 NN)	-.0350318	.0303295	-1.16	0.249	-.0946061	.0245424

Table 11: Robustness: Allowing for Matching between Different Periods

	Model II			Model III		
Crisis_DKD	Coef.	Robust Std. Err.	z	Coef.	Robust Std. Err.	z
Growth_1	-.0332712**	.0132037	-2.52	-.0175052	.020343	-0.86
Inflation_1	-.0023702*	.0013575	-1.75	-.0000152	.0000772	-0.20
Credit/GDP_1	.0000262	7.57e-06	3.46	-.0007365	.0010573	-0.70
GDP/Capita	.0000262***	7.63e-06	3.87	7.11e-06	.0000115	0.62
Fin.Lib	.2170845**	.1115843	1.95	.2814932**	.1694585	1.66
Concentration	-.0108183***	.002751	-3.93	-.0095467**	.0046051	-2.07
Fin.Integration	1.093942***	.1312635	6.33	.4413147**	.2036066	2.17
Constant	-1.710605***	.3760789	-4.55	-1.948298	.4202613	-4.64
Number of obs	1465			1204		
Wald chi2(12)	729.15			48.43		
Prob > chi2	0.0000			0.0000		
Pseudo R2	0.4103			0.1410		

Table 12: Propensity Score Estimation using the Enlarged Sample

Variable	Sample	Mean Treated	Mean Control	%reduct |bias|		t-test t	t-test p>|t|
inflation_1	Unmatched	13.81	37.944	-7.9		-1.17	0.451
	Matched	13.88	14.138	-0.1	98.9	-0.10	0.934
credittogd~1	Unmatched	97.868	41.643	54.6		11.17	0.057
	Matched	100.8	96.544	4.1	92.4	0.17	0.890
gdpcap	Unmatched	15257	4645.2	103.6		20.26	0.031
	Matched	13453	13224	2.2	97.8	2.71	0.225
filib	Unmatched	.85	.54405	70.7		11.59	0.055
	Matched	.8142	.85819	-10.2	85.6	-0.38	0.771
concentrat~n	Unmatched	49.602	72.088	-112.4		-18.58	0.034
	Matched	52.296	54.139	-9.2	91.8	-3.96	0.157

Table 13: Reduction in Covariate Imbalances for Model II

Model IV

Number of obs	870
Zero outcomes	556
Nonzero outcomes	314
Wald chi2(10)	190.53
Log likelihood = -331.2412	Prob > chi2 = 0.0000

di	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
di						
Growth_1	-.0064335	.0027643	-2.33	0.020	-.0118515	-.0010155
Inflation_1	-.0051224	.0014492	-3.53	0.000	-.0079627	-.0022822
Credit/GDP_1	-6.76e-06	.0000596	-0.11	0.910	-.0001236	.0001101
GDP/Capita	-7.08e-07	5.93e-07	-1.19	0.233	-1.87e-06	4.55e-07
Fin.Lib	.144487	.0590825	2.45	0.014	.0286874	.2602865
Concentratio	-.0042508	.0013464	-3.16	0.002	-.0068897	-.001612
oecd	1.246472	.1228965	10.14	0.000	1.005599	1.487344
Fin.Integr	1.194749	.1175749	10.16	0.000	.9643069	1.425192
_cons	-1.220289	.1244098	-9.81	0.000	-1.464128	-.9764504
lnsigma2						
gdpcap	-.0001033	.0000111	-9.32	0.000	-.0001251	-.0000816

Likelihood-ratio test of lnsigma2=0: chi2(1) = 106.34 Prob > chi2 = 0.0000

Table 14: Heteroscedastic Probit Model (Model IV)

	Model V			Model VI		
Crisis_DKD	Coef.	Robust Std. Err.	z	Coef.	Robust Std. Err.	z
Growth_1	-.0043398	.0171779	-0.25	-.0291237*	.015573	-1.87
Inflation_1	-.0002862	.0009283	-0.31	-.0001442	.0004725	-0.31
Credit/GDP_1	-.000664	.0005367	-1.24	.0000865	.0005135	0.17
GDP/Capita	.0000407***	7.99e-06	5.10	.0000559***	5.99e-06	9.342
Fin.Lib	.5377175***	.1338901	4.02	.4712328***	.1291761	3.65
Concentration	-.0238112***	.0036734	-6.48	-.0202935***	.0027909	-7.27
Fin.Integration	1.205976***	.1567331	7.69			
Crisis	.6027807**	.1846732	3.12			
Constant	-.4934666	.3093914	-1.59	-.3266406	.225315	-1.45
Number of obs	870			870		
Wald chi2(12)	380.09			327.58		
Prob > chi2	0.0000			0.0000		
Pseudo R2	0.3340			0.2879		

Table 15: Robustness: Alternative Specifications for Selection Equation

	Estimate	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ATT (Kernel)	-.0312195	.0319227	-0.98	0.329	-.0939442	.0315053
ATT (1 NN)	-.0374065	.0401023	-0.93	0.351	-.1161732	.0413602
ATT (5 NN)	-.0438903	.0300292	-1.46	0.144	-.1028326	.0150521

Table 16: ATT for Enlarged Sample (Model II)

	Estimate	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ATT (Kernel)	-.0503336	.0803235	-0.63	0.531	-.208028	.1073609
ATT (1 NN)	-.0263158	.1110523	-0.24	0.813	-.2477477	.1951161
ATT (5 NN)	-.0894737	.0864713	-1.03	0.302	-.2600826	.0811352

Table 17: ATT for Enlarged Sample – Only First DI Observation (Model III)

	Estimate	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ATT (Kernel)	-.08339	.0463668	-1.80	0.073	-.1744796	.0076996
ATT (5 NN)	-.0828025	.034895	-2.37	0.018	-.1513406	-.0142645

Variable	Sample	Treated	Controls	Difference
cri_dkd	Unmatched	.047770701	.048561151	-.00079045
	ATT	.047770701	.130573248	-.082802548

Table 18: ATT after accounting for Heteroscedasticity (Model IV)

	Estimate	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ATT (Kernel)	-.0509749	.0326388	-1.56	0.119	-.1150378	.013088
ATT (5 NN)	-.0656051	.0509808	-1.29	0.199	-.1657593	.0345491

Table 19: ATT with Alternative Concentration Variable (Model V)

	Estimate	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ATT (Kernel)	-.0329489	.0225441	-1.46	0.144	-.0771988	.0113011
ATT (5 NN)	-.0121019	.0216481	-0.56	0.576	-.0546193	.0304155

Table 20: ATT with Reduced Model (Model VI)

Model A

				Number of obs	= 884
				LR chi2(9)	= 39.17
				Prob > chi2	= 0.0000
Log likelihood = -146.3576				Pseudo R2	= 0.1180

Model A	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
growth	-.144991	.0389138	-3.73	0.000	-.2212606	-.0687214
tot	.0072401	.0094113	0.77	0.442	-.0112057	.0256859
i_real	.0155953	.0055991	2.79	0.005	.0046212	.0265694
inflation	.0004083	.0072823	0.06	0.955	-.0138648	.0146813
mores_ratio	4.62e-06	.0000559	0.08	0.934	-.0001049	.0001141
depreciation	.0171755	.01158	1.48	0.138	-.005521	.039872
docryoy_1	.0238757	.0141612	1.69	0.092	-.0038798	.0516311
gdpcap	-.0000493	.000021	-2.35	0.019	-.0000905	-8.12e-06
di	.7149437	.3846726	1.86	0.063	-.0390007	1.468888
_cons	-2.907247	.2907238	-10.00	0.000	-3.477056	-2.337439

Model B

				Number of obs	= 884
				LR chi2(10)	= 45.33
				Prob > chi2	= 0.0000
Log likelihood = -143.27771				Pseudo R2	= 0.1366

Model B	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
growth	-.1650556	.0402016	-4.11	0.000	-.2438493	-.0862619
tot	.0115153	.0101336	1.14	0.256	-.0083462	.0313768
i_real	.0142719	.0055541	2.57	0.010	.003386	.0251578
inflation	.0021524	.0072426	0.30	0.766	-.0120428	.0163477
mores_ratio	-8.42e-06	.000079	-0.11	0.915	-.0001632	.0001464
depreciation	.0119938	.0116368	1.03	0.303	-.0108139	.0348015
docryoy_1	.0290248	.0148114	1.96	0.050	-4.98e-06	.0580545
gdpcap	-.0000604	.0000224	-2.70	0.007	-.0001043	-.0000165
di	.4577392	.3948202	1.16	0.246	-.3160941	1.231573
concentrat~n	-.0216826	.0088847	-2.44	0.015	-.0390963	-.0042689
_cons	-1.35441	.6621805	-2.05	0.041	-2.65226	-.05656

Model C

				Number of obs	= 832
				LR chi2(12)	= 57.61
				Prob > chi2	= 0.0000
Log likelihood = -131.61771				Pseudo R2	= 0.1795

Model C	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
growth	-.2069257	.0449379	-4.60	0.000	-.2950024	-.1188489
tot	.0096264	.0112596	0.85	0.393	-.012442	.0316948
i_real	.0144062	.0059128	2.44	0.015	.0028172	.0259951
inflation	.0019563	.0076584	0.26	0.798	-.0130539	.0169664
mores_ratio	4.25e-06	.0000651	0.07	0.948	-.0001233	.0001318
depreciation	.0132636	.0121503	1.09	0.275	-.0105506	.0370777
docryoy_1	.0298179	.015214	1.96	0.050	-8.58e-07	.0596367
gdpcap	-.0000297	.0000255	-1.16	0.244	-.0000796	.0000202
di	-.0925054	.4175005	-0.22	0.825	-.9107914	.7257806
concentrat~n	-.0165515	.0097478	-1.70	0.090	-.0356568	.0025539
filib	.7619965	.4655481	1.64	0.102	-.150461	1.674454
em_all	1.260437	.4577236	2.75	0.006	.3633157	2.157559
_cons	-2.610123	.8253637	-3.16	0.002	-4.227806	-.9924402

Table 21: Parametric Estimates

```
Probit estimates                                  Number of obs   =        870
                                                  LR chi2(10)     =     226.03
                                                  Prob > chi2     =     0.0000
Log likelihood = -399.41492                       Pseudo R2       =     0.2206

------------------------------------------------------------------------------
   prefunded |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    growth_1 |   -.022025    .016807    -1.31   0.190    -.0549661     .010916
 inflation_1 |  -.0001103   .0004638    -0.24   0.812    -.0010193    .0007986
credittogd~1 |  -.0005296   .0004951    -1.07   0.285    -.0014999    .0004407
      gdpcap |   .0000124   7.45e-06     1.67   0.096    -2.19e-06     .000027
       filib |   .2031152   .1337014     1.52   0.129    -.0589346    .4651651
concentrat~n |  -.0161375   .0029672    -5.44   0.000    -.0219532   -.0103219
        oecd |   1.021305   .2409312     4.24   0.000     .5490887    1.493522
      em_all |   1.127917   .1535948     7.34   0.000     .8268767    1.428957
         eur |   .0772212   .1895888     0.41   0.684    -.2943661    .4488085
    americas |   .3726973   .1432365     2.60   0.009     .0919589    .6534358
       _cons |  -.7420618   .2695887    -2.75   0.006    -1.270446   -.2136777
------------------------------------------------------------------------------
------------------------------------------------------------------------------
             |   Estimate   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 ATT (Kernel)|  -.0585931   .0325475    -1.80   0.072    -.1225039    .0053177
------------------------------------------------------------------------------
```

Table 22: Treatment Effect of Pre-funding Deposit Insurance

```
Probit estimates                                  Number of obs   =       1499
                                                  LR chi2(9)      =      45.12
                                                  Prob > chi2     =     0.0000
Log likelihood =  -229.3159                       Pseudo R2       =     0.0896

------------------------------------------------------------------------------
     cri_sys |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    growth_m |  -.0488463   .0169615    -2.88   0.004    -.0820902   -.0156023
 inflation_1 |  -.0001103   .0006854    -0.16   0.872    -.0014537    .0012331
  ireal_lag1 |  -.0002677   .0006774    -0.40   0.693    -.0015954    .0010601
credit_gro~2 |   .0022707   .0021122     1.08   0.282     -.001869    .0064104
   deficit_1 |   .0297763   .0120775     2.47   0.014     .0061047    .0534478
   int_north |   .0269332   .0213082     1.26   0.206    -.0148301    .0686966
   pcgdp_ppp |  -.0000447   .0000112    -3.99   0.000    -.0000666   -.0000227
       filib |   .0867511   .1373067     0.63   0.528    -.1823651    .3558674
mhazard_co~e |   .0269283   .0110487     2.44   0.015     .0052732    .0485834
       _cons |  -1.487618   .1861985    -7.99   0.000    -1.852561   -1.122676
------------------------------------------------------------------------------
Probit estimates                                  Number of obs   =       1464
                                                  LR chi2(9)      =      38.45
                                                  Prob > chi2     =     0.0000
Log likelihood = -221.66456                       Pseudo R2       =     0.0798

------------------------------------------------------------------------------
     cri_sys |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    growth_m |  -.0468426   .0170551    -2.75   0.006    -.0802699   -.0134153
 inflation_1 |  -.0005501   .0023309    -0.24   0.813    -.0051185    .0040184
  ireal_lag1 |  -.0006613    .002328    -0.28   0.776    -.0052242    .0039015
credit_gro~2 |    .004431   .0028786     1.54   0.124     -.001211    .0100731
   deficit_1 |   .0314309   .0122234     2.57   0.010     .0074736    .0553882
   int_north |   .0294491   .0216322     1.36   0.173    -.0129492    .0718475
   pcgdp_ppp |  -.000046   .0000116    -3.97   0.000    -.0000687   -.0000233
       filib |   .0781949   .1391863     0.56   0.574    -.1946052     .350995
mhazard_co~e |   .0437991   .0356621     1.23   0.219    -.0260973    .1136955
       _cons |  -1.516532   .1934849    -7.84   0.000    -1.895755   -1.137308
------------------------------------------------------------------------------
```

Table 23: Banking Crisis and the Moral Hazard Index