Banking Crises and Crisis Dating: Theory and Evidence

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Abstract

We formulate a simple theoretical model of a banking industry that we use to identify and construct theory-based measures of systemic bank shocks (SBS). These measures differ from "banking crisis" (BC) indicators employed in many empirical studies, which are constructed using primarily information on government actions undertaken in response to bank distress. Using both country-level and firm-level samples, we show that SBS indicators consistently predict BC indicators, indicating that BC indicators actually measure lagged policy responses to systemic bank shocks. We then re-examine the impact of macroeconomic factors, bank market structure, deposit insurance, and external shocks on the probability of systemic bank shocks (SBS) and on "banking crisis" (BC) indicators. We find that the impact of these variables on the likelihood of a policy response to banking distress (as represented by BC indicators) *is* frequently quite different from that on the likelihood of a systemic bank shock (SBS). We argue that disentangling the effects of systemic bank shocks and policy responses is crucial in understanding the roots of banking crises. We believe that many findings of a large empirical literature need to be re-assessed.

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I. INTRODUCTION

The financial crisis that began in 2007 has spurred renewed interest in banking crises. Some have stressed the similarities across countries and historical episodes (e.g. Reinhart and Rogoff, 2008a, 2009), while others have emphasized differences, both historical (e.g. Bordo, 2008) and as related to the specific mechanics of the shock triggering a crisis (e.g. Gorton, 2008). As pointed out by Allen and Gale (2007), the empirical literature on banking crises has mainly focused on documenting empirical regularities. Yet, the definition of a banking crisis —what it is, when it occurs, and how long it lasts—has been only loosely related to theory. As a result, this literature offers many—often contrasting—findings, which vary considerably in terms of samples used, banking crisis definitions and relevant dating.

This paper reexamines the empirical evidence on the determinants of banking crises. Our main contribution is to disentangle an adverse shock to the banking industry from the attendant restorative policy response. We demonstrate that disentangling these effects is crucial to understanding the determinants of banking crises   We derive measures of systemic bank shocks (SBS) using a simple model of a banking industry in which an adverse shock to the banking system, as well as a government response, are explicitly defined. The main objective of the theoretical exercise is to obtain well-defined measures of an adverse shock to banking that can be obtained from available data.

By contrast, a large portion of the empirical literature has employed "banking crisis" (BC) indicators based on dating schemes that identify: crisis beginning dates, ending dates, and indicate whether the crisis was "systemic" or not. As documented in Boyd, De Nicolò and Loukoianova (2009) (hereafter BDNL), these schemes do not rely on any theory to identify accounting or market measures that capture the *realization* of systemic bank shocks.

Rather, in virtually all cases what is measured is a government response to a perceived crisis—not the onset or duration of an adverse shock.

It is important to note that this literature has interpreted an SBS event and a BC event as one and the same. There are two fundamental problems with that approach. First, the two events actually tend to occur on different dates. Second, one event is bad for the industry (an SBS shock), while the other may be good for it (a BC shock). Thus, as stressed in De Nicolò et al (2004), a researcher using these BC indicators will be unable to disentangle the effects of an adverse shock to the banking industry and the effects of a restorative policy response.

A. The Data

We use two large samples: a country-level dataset and a firm-level dataset. While the use of country-level data is standard in the literature, employing individual bank data is novel. It allows us to significantly extend the empirical analysis in two ways. First, as will be explained, with the individual bank dataset we can obtain better SBS indicators. Second, the impact of systemic bank shocks and policy responses can be gauged taking into account the differential impact of these shocks on each bank in a country. Tests on this sample are more powerful, as we use random effect Logit regressions that exploit more fully the information contained in banks' heterogeneity.

The explanatory variables that we study are ones that the existing literature has identified as important determinants of the probability that a country will experience a banking crisis. These include the bank market structure, presence or lack of deposit insurance, and the occurrence of an external shock, (e.g. a currency crisis)[1]. We find that

[1] This is a very large literature and it is impossible to review all or even the majority of related articles. We have selectively chosen a few studies, but the issues we raise would be relevant to much work besides these studies.

these explanatory variables generally have different effects on the probability of an adverse bank shock (SBS indicators) and on the probability of a government intervention (BC indicators). As we will make clear, this has led to confusion in the interpretation of empirical results and, we shall argue, to unwarranted policy conclusions.

B. Findings

We obtain five key findings:

1. There are significant discrepancies among BC indicators (we study four of these) in their dating of the beginnings and durations of banking crises. Thus, there is considerable disagreement among researchers in dating the same modern episodes of financial distress.

2. Our SBS indicators consistently and robustly predict all four BC indicators. This suggests that BC indicators represent lagged government responses to adverse banking shocks. This interpretation is further supported by our investigation of the criteria used in constructing the BC measures (BDNL). Almost without exception, researchers obtain their information from government sources. Just as importantly, their definitions of what constitutes a banking crisis typically depend on government actions such as liquidity provision, bank resolution mechanisms, and so on.

3. More concentrated banking systems significantly increase the probability of a systemic bank shock (SBS). As will be discussed, this finding is totally at odds with what has been reported elsewhere in the literature.

4. The probability of a banking crisis arrival (SBS indicators) is unaffected by the presence or lack of a formal deposit insurance system. This finding is in marked contrast with previous research that has concluded that the presence of deposit insurance results in

greater moral hazard and riskier banking systems. Previous research, however, has employed BC indicators as measures of banking crisis arrival. When one separately employs SBS and BC indicators the interpretation of empirical results is totally different.

5. The occurrence of currency crises increases both the probability of a systemic bank shock (SBS) and of a government response to bank distress (BC). However, while financial openness and the flexibility of exchange rate arrangements may affect the probability of government (BC) response, only the latter variable has a significant negative impact on the probability of a systemic bank shock (SBS).

The rest of the paper proceeds as follows. Section II presents a theoretical model in which banking problems are produced by the arrival of exogenous shocks to the industry. Section III presents BC indicators based on four major crisis classifications that have been employed extensively in the literature. In Section IV we employ a large country-level panel dataset similar to those employed by others in this literature, and show that our SBS indicators consistently and robustly predict the BC indicators. Furthermore, we assess the impact of bank concentration, deposit insurance, and external shocks on the probability of a systemic bank shock (SBS) and, separately, on the probability of a government response to bank distress (BC). In section V we carry out a similar empirical analysis using the firm-level dataset. Section VI concludes.

II. A SIMPLE BANKING MODEL

In this section we present a simple model of a banking industry and a government deposit insurer, and use its comparative statics to identify measures of systemic bank shocks.[2] The banks in the model are Cournot-Nash competitors that raise insured deposits, make risky loans, and hold risk free government bonds. The deposit insurer bails out the banks when they fail. Thus, the economy is composed of a "government" and three classes of agents: entrepreneurs, depositors, and banks. All agents are risk-neutral, and time is discrete.

Entrepreneurs

There is a continuum of entrepreneurs indexed by their reservation income levels $a \in [0,1]$, which is distributed uniformly on the unit interval. Entrepreneurs have no initial resources but have access to identical risky projects that require a fixed amount of date t investment, standardized to 1, and yield a random output at date $t+1$. Specifically, at date t the investment in a project yields Y with probability $P_{t+1} \in (0,1)$, and 0 otherwise. The probability of success P_{t+1} is a random variable independent across entrepreneurs. Its realization is observed by them at date $t+1$. Hence, entrepreneurs make their date t decisions on the basis of their conditional expectations of P_{t+1}, denoted by $E_t P_{t+1}$.

[2] The shocks we model are exogenous to the banking industry and may, but need not, be exogenous to the economy. This will become clear when the analysis proceeds.

Entrepreneurs are financed by banks with simple debt contracts. The contract pays the bank a loan interest rate R^L if the project is successful. Thus, an entrepreneur with reservation income level a will undertake the project if

$$E_t P_{t+1}(Y - R^L) \geq a \quad . \tag{1}$$

Let a^* denote the value of a that satisfies (1) at equality. The total demand for loans is then given by $X_t \equiv F(a^*) = \int_0^{a^*} f(a)da$, where $f(.)$ is the density of the uniform distribution function. This defines implicitly the inverse loan demand function:

$$R^L(X_t, E_t P_{t+1}) = Y - (E_t P_{t+1})^{-1} X_t \tag{2}$$

Bonds

One-period bonds are supplied by the government in amounts specified below. For simplicity, we assume that only banks can invest in bonds.[3] A bond purchased at date t yields a gross interest rate r_t at date $t+1$.

Depositors

Depositors invest all their funds in a bank at date t to receive interest plus principal at date $t+1$. Deposits are fully insured, so that the total supply of deposits does not depend on risk, and is represented by the upward sloping inverse supply curve $R^D\left(Z_t\right) = \alpha_t Z_t$, where Z_t

[3] If we assume that deposits provide valued services to depositors besides the interest they pay, then they may be held even if they have a rate or return dominated by bonds. For present purposes, modeling all this is a needless complication.

denotes total deposits. The slope of this function is a random variable, to be described below, whose realization is observed at date t.

Banks

Banks collect insured deposits, and pay a flat rate insurance premium standardized to zero. On the asset side, banks choose the total amount of lending and the amount of bonds. In both loan and deposit markets banks are symmetric Cournot-Nash competitors. Banks are perfectly diversified in the sense that for any positive measure of entrepreneurs financed, $P_{t+1} \in (0,1)$, is also the fraction of borrowers whose project turns out to be successful at date $t+1$. Banks observe the realization of P_{t+1} at date $t+1$. Hence, as for the entrepreneurs, banks make their date t decisions on the basis of their conditional expectations $E_t P_{t+1}$.

Government

The government supplies a fixed amount of bonds to the market, denoted by $\overline{B}$. The government also guarantees deposits. It will *intervene* whenever bank deposits payments cannot be honored in part or in full. When this occurs, the government will pay depositors all the claims unsatisfied by banks and all banks will be bailed out. These payments will be financed by issuing additional bonds, which will be purchased by banks which collect new deposits at date $t+l$, where $l \geq 1$.[4]

[4] In this very simple set-up, banks are identical and exposed to the same risks. Thus, if one bank fails, all banks fail. This causes the logical problem that, in bankruptcy states, government bonds must be sold to failed banks. A more realistic assumption would be that some banks fail and some do not. It would be relatively easy to augment the current model with this feature, for example, by assuming that the shock to the loan portfolio involves not all banks but just a fraction of them. For our purposes, however, this is not essential, since the comparative statics on which our systemic bank shock indicators are based would be essentially the same.

The realization of a systemic banking shock occurs at date $t+1$ and, by definition, occurs when the banking system's profits are negative. The government's response to such a shock will be triggered when the government is able to ascertain that the banking system has become insolvent. If the government observes date $t+1$ bank profits with a lag, then $l>1$.

Sequence of events

Suppose that in period t realized bank profits are non-negative. Banks collect deposits, entrepreneurs demand, and banks supply funds based on $E_t P_{t+1}$. Deposits, bank loans, and investment in bonds are determined for period t. In period $t+1$, P_{t+1} is realized and observed by entrepreneurs and banks. Borrowers pay loans and in turn, banks pay depositors, if possible. If bank profits are non-negative, depositors are paid in full. If profits are negative, depositors cannot be paid in full, and by definition, this is a systemic bank shock. Depositors are paid *pro-rata* by the banks. The government *responds* to the crisis at $t+l$ by issuing bonds and paying depositors any claim unsatisfied by banks.

Equilibrium

We describe the equilibrium at date t by dropping time subscripts from all variables, and define $p \equiv E_t P_{t+1}$.

The bank problem

Let D_i denote total deposits of bank i, $Z \equiv \sum_{i=1}^{N} D_i$ denote total deposits, and $D_{-i} \equiv \sum_{j \neq i} D_j$ denote the sum of deposits chosen by all banks except bank i. Let

$L_{-i} \equiv \sum_{j \neq i} L_j$ denote the sum of loans chosen by all banks except bank i. Each bank chooses deposits, loans, and bond holdings b so as to maximize expected profits, given the choices of other banks. Thus, a bank chooses $(L, b, D) \in R_+^3$ to maximize:

$$pR^L(L_{-i} + L, p)L + rb - R_D(D_{-i} + D)D \qquad (3)$$

subject to $$L + b = D. \qquad (4)$$

The government's policy function

Let $\Pi_t(.)$ denote current *realized* aggregate profits. A government intervention is described by the indicator function: $I^G{}_t(\Pi_{t-l})$ = 1 if $\Pi_{t-l} < 0$, and 0 otherwise. The government supplies bonds in the amount $B_t^S = \overline{B} + B_t(\Pi_{t-l})$, where $B_t(\Pi_{t-l}) = I_t^G(\Pi_{t-l})\Pi_{t-l}$.

Given p, an *equilibrium* is a total amount of loans X, total bonds B, total deposits Z, bond interest rates, loan rates, deposit rates, and government responses such that: a) the banking industry is in a symmetric Nash equilibrium; b) the bond market is in equilibrium; and c) the government meets its commitment to deposit insurance.

Comparative statics

We illustrate the comparative statics of the model using a simple linear specification: the loan supply is given by $R^L(X,p) = Y - p^{-1}X$, and the demand for deposits is given by $R^D(Z) = \alpha Z$.[5] The solutions for all endogenous variables are:

$$X = \frac{N}{N+1}\frac{pY}{1+\alpha} - \frac{\alpha}{1+\alpha}B^S \ ; \qquad Z = \frac{N}{N+1}\frac{pY}{1+\alpha} + \frac{1}{1+\alpha}B^S \ ;$$

$$B = B^S \, ; \qquad r = \frac{\alpha}{1+\alpha}\left(\frac{N+1}{N}B^S + pY\right) \ ;$$

$$R^L = Y\frac{1+\alpha(N+1)}{(N+1)(1+\alpha)} + p^{-1}\frac{\alpha}{1+\alpha}B^S \, ; R^D = \frac{\alpha}{1+\alpha}\left(\frac{N}{N+1}pY + B^S\right)$$

The following table summarizes changes in the endogenous variables in response to an adverse shock.

	Adverse shocks		
Endogenous variables	p ***decreases***	α ***increases***	***Y decreases***
Total Loans	↓	↓	↓
Total Deposits	↓	↓	↓
Bond interest rate	↓	↑	↓
Loan rate	↑	↑	↑
Deposit rate	↓	↑	↑
Realized profits	↓	↓	↓

We can see from this table that a systemic bank shock can be triggered by shocks to the technology (p and Y); to preferences or wealth (α); to a decline in firms' probability

[5] These comparative statics properties hold much more generally. We employ the linear case so that there is no need to discuss a number of technical conditions.

of a good outcome (a decline in p); to a decline in firms' demand for loans due to a decline in Y; or, finally, to a decline in consumers' demand for deposits, represented by a decline in α. Note that these properties hold under any market structure, that is, for any value of *N*.

Such adverse shocks are for the most part unobservable, but their occurrence results in predictable changes in certain variables that are observable. In particular, *independently of the source of the shock*, aggregate loans and deposits will decline, loan rates will increase, and profits will decline. By contrast, the deposit rate and the bond rate will move in a different direction depending on the source of the shock.

Thus, the model allows us to identify a systemic bank shock with a severe decline in loans, deposits, and bank profits, or an increase in loan rates. In our empirical investigation we will use these properties of the model to create empirical measures of systematic banking shocks (SBS) that can be constructed with the two different samples.

We next turn to the banking crisis (BC) indicators.

III. "BANKING CRISIS" INDICATORS AND THEIR DISCREPANCIES

A variety of classifications of systemic banking crises have been used since the mid-1990s by many researchers. Here we consider four comprehensive classifications well known in the literature and widely used in empirical work. These four classifications are all updates, modifications and/or expansions of the classification of banking crises first compiled by Caprio and Kinglebiel (CK) (1996, 1999).

The first classification is due to Demirgüç-Kunt and Detragiache (2002, 2005, hereafter DD), and appears to be the first to have introduced an explicit definition of a systemic banking crisis. The second classification is that compiled by Caprio et al. (2005)

(CEA henceforth). CEA updated and extended the earlier CK classification. The third classification is one recently compiled by Reinhart and Rogoff (2008b) (RR henceforth). The classification criteria used in RR are essentially those used in Kaminsky and Reinhart (1999), whose classification was, in turn, based on CK's classification. Finally, the fourth classification is one recently constructed by Laeven and Valencia (2008) (LV henceforth), which extends previous classifications both in time and country coverage. This classification seems to be considered the most complete to date, and has been used in recent empirical work (see e.g. Cecchetti, Kohler and Upper, 2009).

A. The Crisis Dating Schemes Rely on Government Data Sources and Define Crises in Terms of Government Actions

In BDNL we carry out a detailed review of the criteria used to identify banking crisis dates and duration. That review demonstrates that crisis dating in all these classifications depends on information obtained from bank regulators and/or central banks, and what is recorded is government responses to perceived crises. If such interventions were *contemporaneous* to systemic bank shocks, they could serve as reasonable proxies of these shocks. However, as we show below, these measures of policy responses are *not* contemporaneous to the realization of SBS shocks.

Next, we consider the four series of binary BC indicators that will be used in our empirical work. Each of the four binary BC indicators is set to 1 if a country-year is classified as a crisis year and 0 otherwise. Further, we consider two versions of each indicator. The first *excludes* all country-years classified as crisis after the first crisis year. In practice, this kind of indicator identifies crises' *starting dates.* These starting dates have been used extensively in event-type analyses since IMF (1998) and Kaminsky and Reinhart (1999). The second version includes all crisis country-years beginning with the starting date.

Differing from DD and CEA, the RR and LV classifications do not report crisis durations. For these classifications we have used the duration and country years of the CEA classification, or the DD duration when the CEA duration was not available. In this way, we preserve the starting dates of the original classifications, but we augment them with the applicable duration of either the CEA or DD classifications.[6]

Table 1 reports statistics (Panel A), and pair-wise comparisons of crisis dating (Panel B) across classifications. The most striking fact is that for many crisis episodes the dating classifications differ considerably both in terms of starting date and duration. For example, 15 country years are classified as first crisis years by RR but not by DD, while the reverse is true for 30 country years (Panel B, second line). Panel B shows the ratio of total crisis ranking discrepancies divided by total crisis rankings. For first crisis years, this varies between 23.0% and 49.5%. For the full set of crisis years it varies between 24.5% and 43.4%. In other words, in terms of dating crises (which is the heart of the matter), the different methods are in disagreement roughly between a quarter and a half of the time. All four classifications only agree on 41 start dates.[7]

These widespread discrepancies across banking crisis classifications indicate that there is disagreement among researchers in dating the same modern episodes of financial stress. This makes the robustness of many results obtained in a large empirical literature

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[6] Thus, for two of the four series we have done some between-study data splicing. However, that does not occur when we use the start date only versions of each study. All our important findings hold qualitatively for both methods of dating banking crises.

[7] Some discrepancies for specific countries have been previously noted by Rancière, Tornell and Westermann (2008) and Von Hagen and Ho (2007).

problematic. When we turn to our empirical analysis with the four BC indicators, it is not surprising that they often produce different results. These discrepancies compel us to use all four of them in our empirical analysis.

IV. EVIDENCE FROM CROSS-COUNTRY DATA

We begin our empirical investigation using a country-level dataset that merges and updates the large annual cross-country panel dataset used extensively in DD (2005) and Beck et al. (2006), with data for up to 91 countries for the 1980-2002 period.

We proceed in three steps. First, we describe the benchmark specification of Logit regressions with BC indicators as dependent variables. Second, we construct our theory-based indicators of systemic bank shocks (SBS indicators) for this sample and include *lagged* SBS indicators as additional explanatory variables. This gives an assessment of the extent to which SBS indicators *predict* BC indicators. Third, we re-examine the evidence on the impact of bank market structure, deposit insurance and external shocks on banking fragility, estimating Logit regressions separately with BC and SBS indicators as dependent variables.

A. Benchmark Logit Regressions

In our benchmark Logit regressions, we use the following set of explanatory variables employed by Demirgüç-Kunt and Detragiache (2005) and Beck et al (2006): measures of the macroeconomic environment (real GDP growth, the real interest rate, inflation, changes in the terms of trade, and exchange rate depreciation); a measure of potential vulnerability of a country to a run on its currency (the ratio of M2 to international reserves); a measure of economic development (real GDP per capita); and a measure of financial system development (bank credit to private sector GDP). Finally, we include real bank credit growth lagged twice which has been employed as a proxy measure for credit booms.

Versions of the four BC indicators that exclude all crisis years except the first have been sometimes used as dependent variables in this literature.[8] We will not follow this practice here, since excluding crisis years after the first one seems unwarranted for at least two reasons. First, as we have shown in section II, the BC classifications actually index a variety of government measures to address banking distress. Therefore, deleting observations of years during which a government implements measures in response to continued banking distress significantly reduces the informational content. Second, excluding these observations requires taking a stand on the duration of a crisis. As documented in Table 1 of section III, excluded observations account for a sizeable portion of the sample, ranging from 10 to 15 percent of available country years, inducing sample biases that is difficult to control. As pointed out by Boyd et al. (2005), this procedure can be particularly troublesome for countries where multiple crises have occurred. For these reasons, the empirical analysis in this study uses BC indicators that include all crisis-years observations.[9]

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[8] This exclusion has been made on the ground that "the behavior of some of the explanatory variables is likely to be affected by the crisis itself, and this could cause problems for the estimation" (Demirgüç-Kunt and Detragiache, 2002, p.1381).

[9] However, in BDNL (Table 2) we report results using the version of the four BC indicators that excludes all crisis years except the first. We also employed two different samples to account for differences in results due to either country or crisis coverage. We found that real GDP growth and real interest rates are the only variables that enter significantly (negatively and positively respectively) in all regressions. For all other explanatory variables, there is at least one specification that yields results different from all the others. These differences in results occur not only between specifications within the same sample, but also comparing results of the same regressions between samples.

B. Measures of Systemic Bank Shocks

Our choice of SBS indicators is dictated by data availability. Aggregate bank profits are unavailable in this dataset. Country-average bank loan rates are available in some countries but not in others, and are not consistently measured cross-sectionally. This leaves us with changes in loans and deposits, which were derived theoretically as unambiguous indicators and which are available for almost all nations.

We construct two types of SBS indicators, one based on aggregate bank loans and the other based on aggregate bank deposits. For loans, we construct two indicator variables, SBSL25 and SBSL10, which represent sharp decreases in loan growth. They are equal to one if real domestic lending growth is lower than the 25% and 10%-percentile of the entire distribution of real domestic bank credit growth across countries respectively. The second indicators represent sharp decreases in total bank deposits as a fraction of GDP. Analogously, we construct two indicator variables, SBSD25 and SBSD10, equal to one if the growth rate of the deposit-to-GDP ratio is lower than the 25% and 10% percentile of its distribution across countries respectively.[10]

C. SBS indicators predict BC indicators

If BC indicators are contemporaneous to systemic bank shock realizations, then *SBS indicators should not predict BC indicators.* As shown in Table 2, however, they do. In regressions 1-4, lagged SBS lending indicators predict all BC indicators and this is true using both the 10th percentile cut-off and the 25th percentile cut-off. As shown in regressions 5-8, however, while SBS lagged *deposit* indicators are always positively associated with BC

[10] Our choice of indicator thresholds is also dictated by data availability. We cannot set the thresholds for each country individually, since the time dimension of the sample is not long enough to do that in a meaningful way.

indicators, the relevant coefficients are (weakly) significant in only two specifications. This suggests that depositors may react to a systemic bank shock with a lag due to information asymmetries, or might not react at all if guarantees on deposits are in place. The idea of a lagged depositor response is also supported by our finding, reported in BDNL (table 6), that SBS lending indicators *predict* SBS deposit indicators.

In sum, BC indicators systematically record systemic bank shocks with a lag. Arguably, this is because these indicators index the (lagged) start and duration of *policy responses to banking distress.* This interpretation is buttressed by the fact discussed earlier—that the BC indicator definitions are based almost exclusively on government sources and defined in terms of government actions. We believe that SBS and BC indicators measure different things: a systemic bank shock (SBS indicators) and government responses to bank distress (BC indicators). The economic importance of these differences is illustrated next.[11]

D. Bank Market Structure

In an extensive set of Logit regressions using the DD crisis classification, Beck et al. (2006) conclude that banking crises are less likely in more concentrated banking systems. Table 3 reports the results of our baseline Logit specifications with BC and SBS indicators as dependent variables, where we have added a bank concentration measure identical to the one used by Beck et.al (2006). This is denoted by *avgherf,* which is an inter-temporal average of the Hirschman-Herfindhal index for each country.

Regressions 1-4 indicate that there is no evidence of a significant relationship between bank concentration and the probability of a government response to banking distress

[11] It is interesting to observe in Table 2 that very few of the right-hand side control variables are statistically significant and consistent across the different dependent variables. The only control variable that is significant in all specifications is *rgrpgr,* which is the growth rate in real GDP.

as represented by these BC indicators.[12] Thus, the Beck et al (2006) result is clearly not robust. It depends on the definition of a BC event, sample composition, the choice of control variables, or some combination of these factors.[13] By contrast, in all specifications with the SBS indicators as dependent variables (regressions 5-8), systemic bank shocks are *more* likely to occur in more concentrated banking systems. These findings with SBS indicators dependent are consistent with some earlier theory work by Boyd and De Nicolò (2005) and De Nicolò and Lucchetta (2009) and empirical results reported in Boyd, De Nicolò and Jalal (2006 and 2009) and De Nicolò and Loukoianova (2007).

E. Deposit Insurance

In Logit regressions of the type illustrated so far, Demirgüç-Kunt and Detragiache (2002) find—and Barth, Caprio and Levine (2004, 2006) and Beck et al. (2006) confirm—that banking crises are more likely in countries with deposit insurance systems in place. These findings have been interpreted as consistent with the moral hazard incentives created by deposit insurance and other government guarantees.[14] Table 4 reports the results of Logit regressions with the BC and SBS indicators as dependant variables, in which we retain the

[12] Our baseline specification differs slightly from the one used by Beck et al (2006). However, we have been able to essentially replicate their results using their identical specification and sample. Moreover, in BDNL (Table 7) we present Logit regressions with the average C3 concentration ratio as an alternative measure of bank concentration, obtaining identical results

[13] In tests to be presented later (Table 7) we employ an individual bank dataset that we shall argue is more powerful than the country panel dataset. With those data, for all four BC indicators we find a positive and significant relationship between banking concentration and the probability of a BC event. Thus, with the arguably better data, we find the opposite relationship as that reported by Beck et al. (2006). We believe this is simply due to a lack of robustness in their original findings.

[14] Yet, this argument is valid only in a partial equilibrium context *and* absent sufficiently strong countervailing regulations limiting banks' risk-taking, such as capital requirements. In a general equilibrium context, and allowing contracts in nominal terms because of a non-trivial role for money, this simple moral hazard argument does not necessarily hold (e.g. Boyd, Chang and Smith 2002 and 2004).

Herfindhal index as a control and add the indicator variable *di*. The variable *di* takes on the value 1 if a government deposit insurance system is in place, and zero otherwise. This variable is obtained from Demirgüç-Kunt and Detragiache (2002).

As shown in regressions 1-4, in three of four specifications there is evidence of a positive and significant relationship between the BC indicators and the deposit insurance variable. However, if we interpret the BC indicators as government policy response indicators, this finding seems hardly surprising. It simply suggests that *policy responses to systemic bank shocks are more likely if a deposit insurance system is in place.* And with this interpretation, this empirical finding sheds little light on the moral hazard effects of deposit insurance. Results are different when we use SBS indicators as dependent variables. As shown in regressions 5-8, in none of the specifications does the probability of a systemic bank shock significantly depend on the presence of a deposit insurance system[15] . In sum, our results suggest that the presence of deposit insurance has no effect on the probability of a systemic bank shock. However, they suggest that deposit insurance makes a government response to systemic bank shocks more likely, a finding that seems hardly remarkable.

F. Currency Crises, Financial Openness and Exchange Rate Arrangements

There is a substantial literature on external shocks to an economy and their effects on the incidence of banking crises. But, empirical results often diverge in important dimensions. In a seminal empirical study on the subject, Kaminsky and Reinhart (1999) found that the

[15] To explore this issue further, in BDNL (Table 10) we report Logit regressions where we have added an index of "moral hazard" associated with design features of deposit insurance systems (used in Beck et al (2006)). In those tests we find no evidence that more generous deposit insurance systems result in a higher probability of a banking crisis (SBS indicator).

occurrence of a banking crisis is a predictor for the occurrence of a currency crisis, and that indicators of real activity predict the occurrence of both kinds of crises. Yet, Demirgüç-Kunt and Detragiache (2005) observed that Kaminsky and Reihnart's study was based on a relatively small sample of 20 countries, that they investigated mostly fixed exchange rate arrangements, and that the impact of several potential determinants of crises was not examined jointly.

Specifically, two factors have been pointed out in the literature as potential sources of banking system fragility: financial openness and exchange rate rigidity. Many have argued that financial openness, in exposing countries to volatile capital flows, may make domestic banking systems more vulnerable to runs. However, in their extensive survey of the literature, Kose, Prasad, Rogoff and Wei (2009) conclude that "*there is little formal empirical evidence to support the oft-cited claim that financial globalization in and of itself is responsible for the spate of financial crises that the world has seen over the last three decades*" (op. cit., 2009, p.28). In light of the recent financial crisis, a debate on the potential value of limiting financial openness (see e.g. Ostry et al, 2010) is back in the headlines.

The lack of sufficient exchange rate flexibility has also been pointed out as a potential source of bank instability, as it might give incentives to banks to take on currency mismatches that can endanger their solvency. In examining the impact of "external" shocks on banking crises, Eichengreen and Rose (1998) and Arteta and Eichengreeen (2002) found that exchange rate arrangements do not appear to have a significant impact on the likelihood of banking "crises", as measured by BC indicators. By contrast, Domac and Martinez-Peira (2003) find that in developing economies, banking crises, as measured by BC indicators, are less likely in countries with fixed exchange rate systems.

Here we re-examine the role of these "external" factors in determining the four measures of government responses to banking distress (BC) as well as of our two measures of systemic bank shocks (SBS). Our focus is both on illustrating the differences in the results obtained with BC and SBS indicators, and on providing novel evidence on the relationship between external shocks and bank fragility.

We refine the specification of the Logit regressions used in the previous sections, which was employed to facilitate comparison with the previously cited literature. First, for present purposes we use lagged values of all explanatory variables. This specification is more satisfactory than using contemporaneous variables, since it delivers an interpretation of these regressions as "forecasting" equations, where both simultaneity biases and endogeneity issues are less relevant. Second, we replace the measures of exchange rate depreciation (*depr*), of potential vulnerability of a country to a run of the currency (*m2res*), and of terms of trade shocks (*totch*), with a direct indicator of a currency crisis (*crisis25*). This indicator is constructed using monthly data employing the algorithm implemented in Frankel and Wei (2004). It equals 1 if the sum of exchange rate depreciation and loss of international reserves is lower than the 25^{th} percentile of the entire cross country distribution.

Financial openness and exchange rate flexibility are captured by two previously unexploited measures of bank fragility. The financial openness measure (*finopen*) is given by the sum of countries' external assets and liabilities over GDP as estimated by Lane and Milesi-Ferretti (2005). Exchange rate flexibility is measured by an index of the degree of flexibility of exchange rate arrangements (*erclassrr)* constructed by Reinhart and Rogoff (2004), which classifies their degree of flexibility in increasing order.

Table 5 illustrates the new Logit regressions with BC and SBS indicators as dependent variables. Here, we have retained bank concentration and deposit insurance variables as controls. Note that with the new specification all results previously established for these variables (Table 4) continue to hold qualitatively.

In the regressions with BC indicators as dependent variables (regressions 1-4), two results stand out. First, in all specifications BC indicators are positively associated with the occurrence of a currency crisis, and significantly so in three of four. Thus, the government seems more likely to intervene in a banking crisis when it is preceded by a currency crisis. Second, financial openness (*finopen)* and the flexibility of exchange rate arrangements *(erclassrr)* enter significantly in only one BC specification (column (1)). Although these factors have been mentioned in the literature as important determinants of banking fragility, they do not appear to be significant determinants of policy (BC) responses.

Quite different results are obtained with the SBS indicators as dependent variables (regressions 5-8). There is evidence that both financial openness (*finopen),* and the flexibility of exchange rate arrangements (*erclassrr)* increase the probability of a systemic bank shock, (although the relevant coefficients are not always statistically significant).

In sum, in these tests there is a positive and significant impact of currency crises on both the probability of a government response, (BC), and on the probability of systemic bank shocks (SBS). However, financial openness and exchange rate arrangements appear to affect only the probability of a systemic bank shock, not the probability of a government response. These differences in findings are interesting and undoubtedly deserve more analysis in future research. For present purposes, however, they primarily serve to emphasize the importance of separating the BC and SBS indicators, and correctly interpreting what they represent.[16]

V. Evidence from bank-level data

In this section we replicate the previous analysis using a bank level panel dataset. This analysis is not strictly comparable to any of the studies reviewed thus far. We shall argue, however, that the cost of losing direct comparability is offset by the advantage of better measurement and more powerful tests. In fact, the evidence obtained with this bank-level dataset supports the main finding regarding the key differences between BC and SBS indicators. It also provides evidence that the use of bank-level data may be more informative in assessing the determinants of bank fragility.

We use a bank-level dataset employed in Boyd, De Nicolò and Jalal (2006, 2009) and De Nicolò and Loukoianova (2007). These data include accounting information for about 3,000 banks in a large sample of emerging and developing countries over the period 1993 to 2004, which is from the *Bankscope* (Fitch-IBCA) database. Specifically, they include all commercial banks (unconsolidated accounts) for which data are available. The sample comprises all banks operating in each period, including those which exited either because they were absorbed by other banks or because they were closed.[17]

[16] Similar results emerge from the analysis of the impact of bank dollarization on bank fragility. De Nicolò, Honohan and Ize (2005) find that dollarization is positively associated with bank fragility using a theory-based indicator of systemic bank shock, the Z-score of large banks, as well as measures of aggregate non-performing loans. By contrast, Arteta (2003) finds no effects using a version of BC indicators.

[17] Coverage of the Bankscope database is incomplete in some countries for the earlier years (1993 and 1994), but from 1995 coverage in almost all countries is about 95 percent of all banking systems' assets.

Using a firm-level dataset has two key advantages. First, it allows us to construct our theory-based SBS indicators based on severe declines in profits. As noted earlier, using this direct measure of systemic bank shocks was not feasible with the country dataset. Second, individual bank data and the almost universal coverage of banks allow us to conduct more powerful tests. Banking systems heterogeneity and, specifically, the fact that bank systemic shock may affect banks differently, are taken into account. This means that the data determine whether a bank shock is "systemic" in nature, or only affects a portion of the banking system; and similarly, whether government actions are truly responding to a systemic bank shock or only to distress affecting a portion of the banking system. In addition, we can construct better measures of some determinants of bank fragility such as bank market structure, since these variables can be constructed as time-series and not as period averages.

As noted, the comparison with the previous work is not perfect, as the period covered by the bank-level dataset is shorter than the previous one, and includes only emerging and developing economies, whereas the country datasets also include advanced economies. Yet, a comparison of the qualitative results is still appropriate, as we retain about two thirds of the observations classified by BC indicators as "crisis" years for about 60 countries.

A. Measures of Systemic Bank Shocks and Government Responses

As observed in Boyd, De Nicolò and Jalal (2009), the best empirical measure of actual failure in banking is arguably a binary indicator indicating whether a sample bank "survived" or "failed." Unfortunately, such data are difficult to obtain since actual bank failures are uncommon occurrences and failing banks are often rescued by government.

However, consistent with the implications of our model we can define two measures capturing extreme adverse realizations of bank profits. We construct two firm-level SBS indicators based on the overall distribution of the sum of profits and equity capital divided by assets: FAIL5 and FAIL10. These variables correspond to the 5th and 10th percentile of the entire distribution of this sum across time and countries. Thus, these measures can capture a systemic bank shock through a sharp drop in the sum of a bank's profits plus capital.[18]

With the individual bank dataset, we must re-define the indicator of a government response to a systemic bank shock, e.g a BC indicator. For this purpose we use the cross product of a country BC indicator, and a bank profit shock indicator. For example, in Table 6 "DD5" is defined as the product of the DD indicator for a country-year, and the 5th percentile profit indicator for a bank-year. Other variables are defined similarly. These transformations yield modified BC indicators naturally interepreted as the *joint occurrence* that a bank is distressed and is in a country in which the government is responding to a banking crisis. The interpretation of an SBS indicator as a dependent variable is straightforward: it is the realization that a bank suffers an extremely bad profit outcome.

To account for bank heterogeneity across countries, we estimate random coefficient Logit regressions. Standard likelihood ratio tests confirmed the superiority of this specification over a pooled specification, indicating the importance of taking bank heterogeneity into account. In the Logit regressions presented in Tables 6 and 7, all explanatory variables are lagged one period as in section IV.

[18] Our theoretical model did not include banks' equity capital. However, for the empirical implementation we recognize that when the sum of profits plus equity becomes negative, a firm is "bankrupt."

Our baseline specification includes as controls standard macroeconomic variables available for all countries in the sample: GDP growth (*growth*), the inflation rate (*infl*), and GDP per capita (*gdppc*). In addition, we control for bank size with the log of assets (*lasset*).

B. SBS indicators predict BC indicators

As shown in Table 6, in all specifications the SBS indicators predict the BC indicators with high significance, suggesting again that the BC indicators capture lagged government responses. GDP growth predicts BC indicators with significance levels much higher than those obtained with the country data. In addition, bank size has a positive and significant impact on the joint probability of a bank in distress being in a country with crisis intervention. This could be the result of too-big-to-fail policies; that is, when large banks are failing the authorities are more likely to intervene.

In sum, the ability of SBS indicators to predict BC indicators found in country data is even stronger when using bank-level data.

C. Bank Concentration, Deposit Insurance and External Shocks

Mirroring what was done previously, the last set of regressions in Table 7 compares Logit estimates with BC and SBS indicators as dependent variables. We focus on the impact of: i. bank concentration, ii. deposit insurance, iii. currency crises, iv. financial openness and v. flexibility of exchange rate arrangements. Table 7 reports the relevant regressions, with BC indicators as dependent variables (1-4), and with SBS indicators as dependent variables (5 and 6).

With regard to bank concentration, we find a positive and significant impact of bank concentration (*hhib*) on the probability of a government response. This result is consistent with those obtained in several studies in the literature using SBS-type indicators mentioned previously. However, it conflicts with what has been reported in the literature using BC indicators (e.g a negative relationship), and with what we obtained earlier with the country level data (e.g. no robust relationship). Assessing whether these differences are due to differences in sample composition or to other factors is left to future research. At the same time, we find a positive and significant relationship between bank concentration and the probability of a systemic bank shock (SBS) just as we found with the country level data.

With regard to deposit insurance, the results with bank-level data are somewhat different than those obtained with the country sample. With the individual bank data, the probability of a government response to bank distress (BC) is *not* significantly higher when an explicit deposit insurance system is in place. This finding conflicts with all results previously reported in the literature. Similar to what we found with the country sample, an explicit deposit insurance system does not have a significant impact on the probability of a systemic bank shock (SBS). Again, assessing whether these differences are due to sample composition or to other factors is worth investigating further but left for future research.

The impact of variables related to the external shocks is stronger and slightly different from that obtained using country-level data. First, currency crises appear to have a positive and significant impact on *both* the joint probability that a distressed bank is located in a country where a policy (BC) response occurs, as well as on the probability of a bank systemic shock (SBS). This is consistent with the previous findings based on country-level data, but the significance of coefficients is stronger in all cases.

Second, financial openness is associated with a lower probability of a distressed bank being in a country in which there was a policy response to bank distress, but statistical significance is weak. Importantly, financial openness has no effect on the probability of an adverse bank shock (SBS).

Finally, more flexible exchange rate arrangements are not significantly associated associated with the probability that a distressed bank is in a country where a policy response occurred. However, more flexible exchange rate arrangements are associated with a lower probability of an adverse bank shock (SBS). This evidence supports some of the arguments made in the literature about the comparatively stronger resilience to external shocks of countries with more flexible exchange rate arrangements.

All in all, the evidence obtained with this bank-level dataset supports the main finding regarding the differences between BC and SBS indicators. It also provides evidence that bank-level data may be more informative in assessing the determinants of bank fragility.

VI. Policy implications and Future Research Directions

There are important policy implications here. As we have documented elsewhere (Boyd and De Nicolo, 2005), policy-makers have long believed that there exists an unfortunate trade-off between competition and stability in banking. However, our previous research on that topic (Boyd and De Nicolò 2005, Boyd, De Nicolò and Jalal 2009, and De Nicolò and Lucchetta, 2009) has challenged the conventional wisdom. It has also produced a substantial new debate on this issue. One seemingly important piece of evidence in the debate has been the empirical finding that more competition leads to a higher probability of banking crises. Results in the current paper suggest that this finding is incorrect and that the relationship is actually of opposite sign. To be sure, this is an on-going debate and more work is needed. But this is an extremely important policy issue.

Previous research has concluded that the presence of deposit insurance worsens moral hazard problems and increases the likelihood of banking crises (Demirgüç-Kunt and Detragiache, 2002, and Beck et al. 2006). We find that this is not so, but when deposit insurance is present the authorities may be more likely to intervene when the banking system suffers an adverse shock. With the BC indicators employed in previous research, the two separate effects—crisis occurrence and policy response—are co-mingled and their effects appear to have been misinterpreted. From a policy perspective, therefore, the moral hazard problems created by deposit insurance may be smaller than thought or may not even exist. If true, policy makers have less reason to be concerned about this "side effect" of deposit insurance. Again, this topic is important and simply needs more research.

Lastly, previous research has obtained different results with regard to the impact of financial openness and the flexibility of exchange arrangements on bank fragility. Using individual bank data, we found that financial openness does not necessarily adversely impact banking systems solvency, and that flexibility of exchange rate arrangements may be associated with a lower probability of bank insolvency. These results are highly relevant for policy and more research is needed as well. Moreover, in some of our specifications, our results contrast with results using country-data. This suggests the potential value of extracting information from disaggregated data.

The results of this study suggest two priorities for future research. First, the most obvious need is to develop richer theory capable of delivering SBS indicators more refined than the simple ones employed in this study. The main concern is to be sure that candidate SBS indicators truly reflect bad shocks to banks and not government responses. In this regard, there is no substitute for richer theory guiding measurement. Second, individual bank panel datasets are likely to be more useful than the country panels usually employed. The individual firm data are more informative and allow better measurement of systemic bank shocks as well as some determinants of bank fragility.

In sum, much work remains to be done. We believe the results of a large literature on the determinants of bank fragility need to be reassessed and/or reinterpreted.

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Table 1. Statistics of BC Indicators

DD: Demirgüç-Kunt and Detragiache (2005); CEA: Caprio et al. (2005); RR: Reinhart and Rogoff (2008b); LV: Laeven and Valencia (2008)

Panel A : Summary Statistics of Classifications of Systemic Banking Crises

	Total country years	Total country years excluding crisis years after the first	Total country years excluding crisis years after the first as % of total country years	Total crisis country years	Total crisis country years as % of total country years	Total number of systemic crises	Average crisis duration in years
DD	2350	2070	88.1	363	15.4	83	4.4
CEA	2143	1833	85.5	382	17.8	78	4.9
RR	2375	2171	91.4	300	12.6	69	4.3
LV	2275	2021	88.8	339	14.9	84	4.0

Panel B : Pairwise Comparisons

Classifications A	B	Total country years in common	Number of country years A = NO crisis B= crisis	Number of country years A = crisis B=NO crisis	Total country years discrepancies	Total agreed country years	Total discrepancies as % of common country years	Total discrepancies as % of agreed crisis country years + discrepancies
Only first crisis country year								
DD	CEA	1720	14	20	34	55	2.0	38.2
DD	RR	1986	15	30	45	46	2.3	49.5
DD	LV	1920	15	21	36	57	1.9	38.7
CEA	RR	1777	7	18	25	55	1.4	31.3
CEA	LV	1769	10	10	20	67	1.1	23.0
LV	RR	1976	22	12	34	55	1.7	38.2
All crisis country years								
DD	CEA	2118	109	93	202	263	9.5	43.4
DD	RR	2187	48	115	163	248	7.5	39.7
DD	LV	2090	65	95	160	264	7.7	37.7
CEA	RR	1979	41	123	164	259	8.3	38.8
CEA	LV	2089	19	65	84	259	4.0	24.5
RR	LV	2275	99	60	159	240	7.0	39.8

Table 2. Logit Regressions: SBS indicators Predict BC Indicators

Dependent variables are the BC indicators with all crisis dates: DD, CEA, RR and LVE. All regressions include all available observations for each classification. Explanatory variables: *rgdpgr* is the GDP growth rate; rint is the real interest rate; *infl* is the percentage change in the GDP deflator; *totch* is the change in the terms of trade; *depr* is the exchange rate depreciation vs. the US$; *m2res* is the ratio of M2 to foreign exchange reserves; *rgdpcp* is real GDP per-capita; *privcrd_gdp* is bank credit to the private sector to GDP; *L2.domcredgr* is real domestic bank credit growth to the private sector lagged twice. *L.SBSL10* and L.SBSL25 are lagged SBS lending indicators; *L.SBSD10* and L.SBSD25 are lagged SBS deposit indicators. Standard errors are clustered by country. Robust p-values are reported in brackets, with *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	DD	CEA	RR	LV	DD	CEA	RR	LV
rgdpgr	-0.0672***	-0.0869***	-0.0840***	-0.0767***	-0.0674***	-0.0872***	-0.0840***	-0.0771***
	[0.000437]	[1.90e-05]	[3.25e-06]	[0.000272]	[0.000430]	[1.68e-05]	[2.34e-06]	[0.000249]
rint	0.000177	0.000174	0.000345**	0.000140	0.000151	0.000122	0.000293*	9.83e-05
	[0.119]	[0.109]	[0.0490]	[0.202]	[0.155]	[0.229]	[0.0674]	[0.340]
infl	0.000161	0.000163	-0.000906	0.000108	0.000130	9.97e-05	-0.000912	5.70e-05
	[0.405]	[0.289]	[0.122]	[0.507]	[0.477]	[0.506]	[0.113]	[0.720]
totch	-0.00102	-0.00169	-0.00179	-0.00257	-0.00104	-0.00150	-0.00201	-0.00259
	[0.803]	[0.618]	[0.673]	[0.471]	[0.794]	[0.638]	[0.622]	[0.449]
depr	0.341	0.298	0.706*	0.430	0.388	0.393	0.767**	0.508*
	[0.273]	[0.327]	[0.0565]	[0.165]	[0.197]	[0.195]	[0.0394]	[0.0977]
m2res	0.00204*	0.00114	0.00187**	0.00147	0.00202**	0.00113	0.00187**	0.00144*
	[0.0540]	[0.220]	[0.0464]	[0.109]	[0.0453]	[0.174]	[0.0335]	[0.0799]
rgdpcp	-1.30e-05	-1.74e-05	-1.49e-05	-2.12e-05	-1.40e-05	-1.95e-05	-1.79e-05	-2.32e-05
	[0.529]	[0.573]	[0.640]	[0.323]	[0.499]	[0.533]	[0.580]	[0.287]
privcrd_gdp	0.00113***	-0.164	-0.0884	-0.129	0.00111***	-0.179	-0.0991	-0.138
	[0.000497]	[0.239]	[0.414]	[0.269]	[0.000759]	[0.242]	[0.402]	[0.271]
L2.rdomcredgr	0.00218	-0.00209	-0.00274	-0.00130	0.00261	-0.00143	-0.00254	-0.000574
	[0.560]	[0.502]	[0.413]	[0.733]	[0.496]	[0.654]	[0.451]	[0.881]
L.SBSL10	**0.365****	**0.785*****	**0.771*****	**0.664*****				
	[0.0469]	[2.72e-05]	[2.61e-05]	[0.000482]				
L.SBSD10					**0.212**	**0.340***	**0.182**	**0.336***
					[0.343]	[0.0922]	[0.482]	[0.0971]
Constant	-1.402***	-1.104***	-1.603***	-1.306***	-1.381***	-1.035***	-1.505***	-1.252***
	[0]	[8.47e-07]	[0]	[0]	[0]	[3.55e-06]	[0]	[2.40e-10]
Observations	1707	1529	1707	1633	1707	1529	1707	1633
# of countries	91	81	91	87	91	81	91	87
Pseudo-R2	0.0420	0.0825	0.0802	0.0807	0.0405	0.0734	0.0704	0.0746
L.SBSL25	**0.412*****	**0.576*****	**0.519*****	**0.448*****				
	[0.00388]	[0.000126]	[0.000126]	[0.00541]				
L.SBSD25					**0.152**	**0.143**	**0.0542**	**0.127**
					[0.415]	[0.425]	[0.763]	[0.487]

Table 3. Logit Regressions: BC Indicators, SBS Indicators and Bank Concentration

Dependent variables are the BC indicators with all crisis dates: DD, CE
A, RR and LV. All regressions are full sample regressions including all available observations for each classification. Explanatory variables*: rgdpgr* is the GDP growth rate; *rint* is the real interest rate; *infl* is the percentage change in the GDP deflator; *totch* is the change in the terms of trade; *depr* is the exchange rate depreciation vs. the US$; *m2res* is the ratio of M2 to foreign exchange reserves; *rgdpcp* is real GDP per-capita; *privcrd_gdp* is bank credit to the private sector to GDP; *L2.domcredgr* is real domestic bank credit growth to the private sector lagged twice; *avgherf* is the average Herfindhal index. Standard errors are clustered by country. Robust p-values are reported in brackets, with *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	DD	CEA	RR	LV	SBSL25	SBSL10	SBSD25	SBSD10
rgdpgr	-0.0850***	-0.109***	-0.0954***	-0.105***	-0.120***	-0.109***	0.0545***	0.0355
	[0.000134]	[2.92e-06]	[6.34e-05]	[8.00e-06]	[1.31e-05]	[0.000916]	[0.00172]	[0.131]
rint	0.00501	0.00503	0.00490	0.00167	-0.00921*	-0.00670*	-0.00103	-0.00299
	[0.160]	[0.367]	[0.166]	[0.596]	[0.0692]	[0.0513]	[0.726]	[0.112]
infl	0.00527	0.00518	0.00338	0.00210	-0.00180	-0.00663**	-0.00235	-0.00461**
	[0.161]	[0.343]	[0.260]	[0.524]	[0.790]	[0.0348]	[0.386]	[0.0279]
totch	0.00254	4.05e-05	-0.000178	0.000225	0.0181***	0.0136**	0.0158*	0.0268***
	[0.575]	[0.992]	[0.969]	[0.955]	[0.00142]	[0.0260]	[0.0935]	[0.00756]
depr	0.534	0.740	0.807	0.583	2.446***	3.305***	1.633***	2.576***
	[0.319]	[0.199]	[0.159]	[0.280]	[0.000275]	[6.14e-08]	[0.000618]	[8.84e-07]
m2res	0.00188*	0.000912	0.00182**	0.00103	0.00181**	-0.000329	0.00165***	0.00168
	[0.0682]	[0.250]	[0.0302]	[0.220]	[0.0257]	[0.668]	[0.00924]	[0.137]
rgdpcp	-2.12e-05	-9.21e-06	-3.80e-05	-4.09e-05	-1.81e-05	5.03e-05**	-1.42e-05	-5.68e-05***
	[0.362]	[0.779]	[0.352]	[0.129]	[0.222]	[0.0392]	[0.269]	[0.00770]
privcrd_gdp	0.00117***	-0.180	-0.0871	-0.131	-0.000645**	-5.794***	0.000835***	-0.00125
	[0.00123]	[0.297]	[0.511]	[0.418]	[0.0238]	[1.01e-05]	[6.19e-05]	[0.276]
L2.rdomcredgr	0.00287	-0.00165	-0.00224	-0.00187	-0.0134**	0.00231	-0.0142***	-0.00600
	[0.583]	[0.728]	[0.657]	[0.734]	[0.0114]	[0.646]	[0.00755]	[0.314]
avgherf	**-0.118**	**1.114**	**-0.375**	**0.255**	**1.460*****	**1.562*****	**0.866****	**1.587*****
	[0.848]	[0.221]	[0.635]	[0.767]	[4.75e-05]	[0.00135]	[0.0250]	[0.00121]
Constant	-1.335***	-1.605***	-1.433***	-1.180***	-1.539***	-1.936***	-1.705***	-3.120***
	[1.03e-05]	[0.000747]	[0.000790]	[0.00282]	[0]	[1.05e-05]	[0]	[0]
Observations	1205	1057	1205	1143	1205	1205	1205	1205
# of countries	79	69	79	75	79	79	79	79
Pseudo-R2	0.0600	0.120	0.0986	0.112	0.178	0.313	0.0672	0.157

Table 4. Logit Regressions: BC Indicators, SBS Indicators and Deposit Insurance

Dependent variables are: the BC indicators with all crisis dates (DD, CEA, RR and LV); the SBS lending indicators, *SBL25* and *.SBSL10*, and the SBS deposit indicators, *SBSD25* and *SBSD10*. Explanatory variables: *rgdpgr* is the GDP growth rate; *rint* is the real interest rate; *infl* is the percentage change in the GDP deflator; *totch* is the change in the terms of trade; *depr* is the exchange rate depreciation vs. the US$; *m2res* is the ratio of M2 to foreign exchange reserves; *rgdpcp* is real GDP per-capita; *privcrd_gdp* is bank credit to the private sector to GDP; *L2.domcredgr* is real domestic bank credit growth to the private sector lagged twice; *avgherf* is the average Herfindhal index; *di* is the binary indicator of deposit insurance. Standard errors are clustered by country. Robust p-values are reported in brackets, with *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	DD	CEA	RR	LV	SBSL25	SBSL10	SBSD25	SBSD10
rgdpgr	-0.0871***	-0.118***	-0.0980***	-0.113***	-0.119***	-0.110***	0.0546***	0.0360
	[0.000148]	[2.76e-06]	[5.69e-05]	[9.05e-06]	[1.56e-05]	[0.00107]	[0.00169]	[0.134]
rint	0.00546	0.00597	0.00537	0.00223	-0.00936*	-0.00662*	-0.000987	-0.00277
	[0.128]	[0.256]	[0.129]	[0.458]	[0.0679]	[0.0572]	[0.739]	[0.154]
infl	0.00568	0.00601	0.00374	0.00254	-0.00165	-0.00665**	-0.00231	-0.00440**
	[0.132]	[0.250]	[0.210]	[0.420]	[0.811]	[0.0276]	[0.395]	[0.0408]
totch	0.00219	-0.000736	-0.000612	-0.000527	0.0182***	0.0133**	0.0158*	0.0264***
	[0.624]	[0.867]	[0.895]	[0.897]	[0.00144]	[0.0291]	[0.0938]	[0.00697]
depr	0.523	0.762	0.801	0.596	2.434***	3.327***	1.631***	2.603***
	[0.338]	[0.223]	[0.177]	[0.294]	[0.000319]	[4.63e-08]	[0.000587]	[1.16e-06]
m2res	0.00197*	0.00116	0.00191**	0.00123	0.00179**	-0.000283	0.00167***	0.00179
	[0.0554]	[0.125]	[0.0212]	[0.123]	[0.0271]	[0.712]	[0.00880]	[0.110]
rgdpcp	-3.06e-05	-2.52e-05	-4.51e-05	-5.63e-05**	-1.63e-05	4.67e-05**	-1.55e-05	-6.43e-05***
	[0.172]	[0.438]	[0.278]	[0.0411]	[0.300]	[0.0469]	[0.285]	[0.00253]
privcrd_gdp	0.00114***	-0.219	-0.102	-0.157	-0.000647**	-5.741***	0.000831***	-0.00119
	[0.00127]	[0.195]	[0.465]	[0.332]	[0.0229]	[1.75e-05]	[4.96e-05]	[0.290]
L2.rdomcredgr	0.00295	-0.000858	-0.00196	-0.00145	-0.0134**	0.00242	-0.0142***	-0.00556
	[0.568]	[0.855]	[0.687]	[0.791]	[0.0114]	[0.628]	[0.00785]	[0.342]
avgherf	**0.189**	**1.898****	**-0.0661**	**0.878**	**1.416*****	**1.731*****	**0.904****	**1.893*****
	[0.766]	[0.0298]	[0.933]	[0.299]	[0.000249]	[0.000589]	[0.0273]	[3.49e-05]
di	**0.568***	**1.325*****	**0.549**	**1.099*****	**-0.101**	**0.334**	**0.0775**	**0.584**
	[0.0719]	[0.00185]	[0.203]	[0.00432]	[0.685]	[0.275]	[0.789]	[0.164]
Constant	-1.552***	-2.188***	-1.651***	-1.636***	-1.509***	-2.079***	-1.732***	-3.364***
	[4.84e-06]	[1.65e-06]	[9.59e-05]	[3.01e-05]	[0]	[8.52e-06]	[0]	[0]
Observations	1205	1057	1205	1143	1205	1205	1205	1205
# of countries	79	69	79	75	79	79	79	79
Pseudo-R2	0.0668	0.152	0.104	0.136	0.178	0.314	0.0673	0.162

Table 5. Logit Regressions: BC Indicators, SBS Indicators and Currency Crises

Dependent variables are the BC indicators with all crisis dates: DD, CEA, RR and LV. Explanatory variables: *rgdpgr* is the GDP growth rate; *rint* is the real interest rate; *infl* is the percentage change in the GDP deflator; *rgdpcp* is real GDP per-capita; *privcrd_gdp* is bank credit to the private sector to GDP; *avgherf* is the average Herfindhal index.; *di* is the binary indicator of deposit insurance *; crisis 25* is the indicator of currency crisis; *finopen* is financial openness; *erclassrr* is the index of flexibility of exchange rate arrangements Standard errors are clustered by country. Robust p-values are reported in brackets, with *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	DD	CEA	RR	LV	SBSL25	SBSL10	SBSD25	SBSD10
L.rgdpgr	-0.088***	-0.134***	-0.127***	-0.128***	-0.118***	-0.112***	-0.065***	-0.078**
	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.027]
L.rint	0.005*	0.005	0.006*	0.005	0.008**	0.009***	0.002	0.000
	[0.079]	[0.203]	[0.065]	[0.118]	[0.039]	[0.000]	[0.584]	[0.800]
L.infl	0.005*	0.004	0.003	0.005	0.010***	0.009***	0.001	0.000
	[0.084]	[0.223]	[0.201]	[0.136]	[0.000]	[0.000]	[0.734]	[0.983]
L.rgdpcp	-0.000	-0.000	-0.000	-0.000*	-0.000	-0.000	-0.000	-0.000***
	[0.319]	[0.583]	[0.504]	[0.058]	[0.233]	[0.789]	[0.123]	[0.000]
L.privcrd_gdp	0.001***	-0.251	-0.128	-0.155	-0.000	-2.528***	0.001***	-0.000
	[0.003]	[0.144]	[0.391]	[0.350]	[0.863]	[0.003]	[0.000]	[0.909]
L2.rdomcredgr	0.005	0.000	-0.002	0.003	-0.012**	-0.001	-0.018**	-0.009
	[0.389]	[0.990]	[0.774]	[0.714]	[0.031]	[0.836]	[0.016]	[0.137]
avgherf	**0.511**	**2.491****	**0.246**	**0.895**	**2.074*****	**1.733*****	**1.541*****	**2.878*****
	[0.487]	[0.020]	[0.783]	[0.413]	[0.000]	[0.000]	[0.000]	[0.000]
di	**0.428**	**1.502*****	**0.559**	**1.251*****	**0.069**	**0.313**	**-0.097**	**0.221**
	[0.241]	[0.003]	[0.268]	[0.007]	[0.788]	[0.283]	[0.732]	[0.614]
L.crisis25	**0.299**	**0.532****	**0.441***	**0.449***	**1.061*****	**0.734*****	**0.193**	**0.526***
	[0.242]	[0.046]	[0.094]	[0.065]	[0.000]	[0.008]	[0.340]	[0.054]
L.finopen	**-0.501***	**-0.348**	**-0.527**	**-0.458**	**0.046**	**0.253*****	**0.129**	**0.357*****
	[0.097]	[0.329]	[0.144]	[0.163]	[0.519]	[0.002]	[0.281]	[0.003]
L.erclassrr	**0.014**	**0.014**	**-0.037**	**-0.034**	**0.000**	**0.018**	**0.044***	**0.093*****
	[0.720]	[0.775]	[0.472]	[0.408]	[0.988]	[0.482]	[0.070]	[0.002]
Constant	-1.127**	-2.026**	-0.740	-0.897	-2.015***	-2.884***	-1.782***	-4.225***
	[0.046]	[0.014]	[0.255]	[0.158]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	935	823	935	903	935	935	935	935
# of countries	61	54	61	59	61	61	61	61
Pseudo-R2	0.0788	0.186	0.129	0.171	0.195	0.223	0.0835	0.192

Table 6. Evidence from bank-level data: SBS Indicators Predict BC Indicators

Dependent variables are the BC indicators DD(x), CEA(x), RR(x) and LV(x) interacted with the proxy measures of bank failure probabilities at the fifth percentile (x=5) and the 10^{th} percentile (x=10). All explanatory variables are lagged one year (prefix L.): *growth* is the GDP growth rate; *infl* is CPI inflation; *gdppc* is real GDP per capita; *lasset* is banks' log of total assets. *FAIL5* and *FAIL10* are two proxy measures of bank failures according to the overall distribution of the sum of profits and equity capital standardized by assets, corresponding to the 5^{th} and 10^{th} percentile of the entire distribution of this sum across time and countries. The statistical model is a random effect logit model, with standard errors clustered by country. Robust p-values are reported in brackets, with *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	DD5	DD10	CEA5	CEA10	RR5	RR10	LV5	LV10
L.growth	-0.074***	-0.055***	-0.072***	-0.045***	-0.086***	-0.053***	-0.071***	-0.048***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
L.infl	0.002	0.001	0.001	-0.003	0.001	-0.002	0.001	0.001
	[0.432]	[0.773]	[0.548]	[0.966]	[0.533]	[0.997]	[0.449]	[0.898]
L.gdppc	0.0003***	0.0006***	0.0004***	0.0009***	0.0008***	0.0002***	0.0004***	0.0003***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
L.lasset	0.396***	0.499***	0.411***	0.521***	0.428***	0.521***	0.398***	0.505***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
L.FAIL5	**1.476*** **		**1.307*** **		**1.275*** **		**1.456*** **	
	[0.000]		**[0.000]**		**[0.000]**		**[0.000]**	
L.FAIL10		**1.370*** **		**1.299*** **		**1.303*** **		**1.348*** **
		[0.000]		**[0.000]**		**[0.000]**		**[0.000]**
Constant	-10.263***	-11.883***	-10.480***	-12.151***	-11.333***	-12.887***	-10.444***	-12.198***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	13828	13828	13475	13475	13828	13828	13774	13774
Number of banks	3172	3172	3082	3082	3172	3172	3163	3163

Table 7. Evidence from bank-level data: Determinants of BC and SBS Indicators

Dependent variables are the BC indicators DD5, CEA5, RR5 and LV5 described in table 6, and the two SBS indicators that proxy measures of bank failures according to the overall distribution of the sum of profits and equity capital standardized by assets, corresponding to the 5^{th} and 10^{th} percentile of the entire distribution of this sum across time and countries, called *FAIL5* and *FAIL10* respectively. All explanatory variables are lagged one year (prefix L.): *growth* is the GDP growth rate; *infl* is CPI inflation; *gdppc* is real GDP per capita; *lasset* is banks' log of total assets; *crisis 25* is the indicator of currency crisis; *finopen* is financial openness; *erclassrr* is the index of flexibility of exchange rate arrangements. The statistical model is a random effect logit model, with standard errors clustered by country. Robust p-values are reported in brackets, with *** p<0.01, ** p<0.05, * p<0.1.

	BC Indicators					SBS Indicators	
	(1)	(2)	(3)	(4)		(5)	(6)
VARIABLES	DD5	CEA5	RR5	LV5		FAIL5	FAIL10
L.growth	-0.101***	-0.090***	-0.103***	-0.089***		-0.042***	-0.004
	[0.000]	[0.000]	[0.000]	[0.000]		[0.010]	[0.783]
L.infl	0.001	0.001	0.001	0.001		0.000	0.000
	[0.218]	[0.196]	[0.196]	[0.181]		[0.324]	[0.683]
L.gdppc	0.000***	0.000***	0.000***	0.000***		0.000	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]		[0.114]	[0.241]
L.lasset	0.542***	0.548***	0.596***	0.529***		0.520***	0.682***
	[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]
L.hhib	**2.420*** **	**2.287*** **	**2.021** **	**2.452*** **		**2.415*** **	**2.300*** **
	[0.002]	[0.004]	[0.022]	[0.002]		[0.000]	[0.000]
L.di	**-0.012**	**-0.018**	**-0.233**	**0.041**		**0.142**	**0.269**
	[0.962]	[0.944]	[0.378]	[0.871]		[0.455]	[0.116]
L.crisis25	**0.455** **	**0.618*** **	**0.613*** **	**0.537** **		**0.523*** **	**0.451*** **
	[0.032]	[0.003]	[0.006]	[0.012]		[0.002]	[0.003]
L.finopen	**-0.440** **	**-0.252**	**-0.271**	**-0.380* **		**0.059**	**0.101**
	[0.027]	[0.171]	[0.169]	[0.056]		[0.600]	[0.340]
L.erclassrr	**-0.023**	**-0.023**	**-0.037**	**-0.022**		**-0.058*** **	**-0.047** **
	[0.363]	[0.368]	[0.180]	[0.392]		[0.005]	[0.015]
Constant	-12.675***	-13.072***	-13.919***	-12.860***		-11.705***	-13.202***
	[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]
Observations	8630	8494	8630	8630		8630	8630
Number of banks	1855	1821	1855	1855		1855	1855

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