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Bank concentration, competition, and crises: First results

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Abstract

Motivated by public policy debates about bank consolidation and conflicting theoretical predictions about the relationship between bank concentration, bank competition and banking system fragility, this paper studies the impact of national bank concentration, bank regulations, and national institutions on the likelihood of a country suffering a systemic banking crisis. Using data on 69 countries from 1980 to 1997, we find that crises are less likely in economies with more concentrated banking systems even after controlling for differences in commercial bank regulatory policies, national institutions affecting competition, macroeconomic conditions, and shocks to the economy. Furthermore, the data indicate that regulatory policies and institutions that thwart competition are associated with greater banking system fragility.

JEL classification: G21; G28; L16

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1. Introduction

The consolidation of banks around the globe is fueling an active public policy debate on the impact of consolidation on financial stability.[1] Indeed, economic theory provides conflicting predictions about the relationship between the concentration and the competitiveness of the banking industry and banking system fragility. Motivated by public policy debates and ambiguous theoretical predictions, this paper investigates empirically the impact of bank concentration and bank regulations on banking system stability.

Some theoretical arguments and country comparisons suggest that a less concentrated banking sector with many banks is more prone to financial crises than a concentrated banking sector with a few banks (Allen and Gale, 2000, 2004). First, concentrated banking systems may enhance market power and boost bank profits. High profits provide a "buffer" against adverse shocks and increase the charter or franchise value of the bank, reducing incentives for bank owners and managers to take excessive risk and thus reducing the probability of systemic banking distress (Hellman et al., 2000; Besanko and Thakor, 1993; Boot and Greenbaum, 1993; Matutes and Vives, 2000).[2] Second, some hold that it is substantially easier to monitor a few banks in a concentrated banking system than it is to monitor lots of banks in a diffuse banking system. From this perspective, supervision of banks will be more effective and the risks of contagion and thus systemic crisis less pronounced in a concentrated banking system. According to Allen and Gale (2000), the US, with its large number of banks, supports this "concentration–stability" view since it has had a history of much greater financial instability than the UK or Canada, where the banking sector is dominated by fewer larger banks.[3]

[1] See Group of Ten (2001), Bank for International Settlement (2001), International Monetary Fund (2001). See Carletti and Hartmann (2003) and Boyd and De Nicoló (forthcoming) for an overview of the literature.

[2] Rather than focusing on the links between concentration and the portfolio decisions of banks, Smith (1984) holds banks' asset allocation decisions constant and examines the liquidity side of the balance sheet. He shows that less competition can lead to more stability if information about the probability distribution of depositors' liquidity needs is private. Matutes and Vives (1996), however, highlight the complexity of the linkages running from market structure, to competition, to bank stability and show that bank fragility can arise in any market structure.

[3] Some proponents of the "concentration–stability" view argue that—*holding other things constant*—(i) banks in concentrated systems will be larger than banks in more diffuse systems and (ii) larger banks tend to be better diversified than smaller banks. Based on these assumptions, concentrated banking systems with a few large banks will be less fragile than banking systems with many small banks. Models by Diamond (1984), Ramakrishnan and Thakor (1984), Boyd and Prescott (1986), Williamson (1986), Allen (1990), and others predict economies of scale in intermediation. As discussed by Calomiris (2000) and Calomiris and Mason (2000), an extensive literature finds an inverse relationship between bank scale and bank failure in the United States. However, empirical work by Chong (1991) and Hughes and Mester (1998) indicates that bank consolidation tends to increase the riskiness of bank portfolios. Boyd and Runkle (1993), examining 122 US bank holding companies, find that there is an inverse relationship between size and the volatility of asset returns, but no evidence that large banks are less likely to fail. De Nicoló (2000), on the other hand, finds a positive and significant relationship between bank size and the probability of failure for banks in the US, Japan and several European countries. Thus, there are open issues regarding the relationship between bank size and bank risk. Although we explore the sensitivity of our results to controlling for the mean bank size in each country, this paper examines the relationship between bank concentration, bank regulations, and crises, not the relationship between bank size and diversification.

An opposing view is that a more concentrated banking structure enhances bank fragility. First, Boyd and De Nicoló (forthcoming) argue that the standard argument that market power in banking boosts profits and hence bank stability ignores the potential impact of banks' market power on firm behavior. They confirm that concentrated banking systems enhance market power, which allows banks to boost the interest rate they charge to firms. Boyd and De Nicoló's (forthcoming) theoretical model, however, shows that these higher interest rates may induce firms to assume greater risk. Thus, in many parameterizations of the model, Boyd and De Nicoló (forthcoming) find a positive relationship between concentration and bank fragility and thus the probability of systemic distress. Similarly, Caminal and Matutes (2002) show that less competition can lead to less credit rationing, larger loans and higher probability of failure if loans are subject to multiplicative uncertainty. Second, advocates of the "concentration–fragility" view argue that (i) relative to diffuse banking systems, concentrated banking systems generally have fewer banks and (ii) policymakers are more concerned about bank failures when there are only a few banks. Based on these assumptions, banks in concentrated systems will tend to receive larger subsidies through implicit "too important to fail" policies that intensify risk-taking incentives and hence increase banking system fragility (e.g., Mishkin, 1999).[4,5]

Despite conflicting theoretical predictions and policy debates, there is no cross-country empirical evidence on bank concentration, bank competition and the incidence of systemic banking failures. For the US, Keeley (1990) provides evidence that increased competition following relaxation of state branching restrictions in the 1980s resulted in an increase in large banks' risk profiles. Jayaratne and Strahan (1998), on the other hand, find that deregulation in the 1980s resulted in lower loan losses, while Dick (forthcoming) finds higher loan loss provisions following deregulation in the 1990s. On the cross-country level, De Nicoló et al. (2003) relate bank concentration to the fragility of the largest five banks in a country and find a positive

[4] There is a literature that examines deposit insurance and its effect on bank decisions. According to this literature (e.g. Merton, 1977; Sharpe, 1978; Flannery, 1989; Kane, 1989; Keeley, 1990; Chan et al., 1992; Matutes and Vives, 2000; Cordella and Yeyati, 2002)—mis-priced deposit insurance produces an incentive for banks to take risk. If the regulatory treatment were the same for insured banks of all sizes, these models would predict no relationship between bank size and riskiness. Since regulators fear potential macroeconomic consequences of large bank failures, most countries have implicit "too large to fail" policies which protect all liabilities of very large banks whether they are insured or not. Thus, the largest banks frequently receive a greater net subsidy from the government (O'Hara and Shaw, 1990). Even in the absence of deposit insurance, banks are prone to excessive risk-taking due to limited liability for their equity holders and to their high leverage (Stiglitz, 1972). This subsidy may in turn increase the risk-taking incentives of the larger banks. For an analysis of the corporate governance of banks, see Macey and O'Hara (2003).

[5] Proponents of the concentration–fragility view would also disagree with the proposition that a concentrated banking system characterized by a few banks is easier to monitor than a less concentrated banking system with many banks. The countervailing argument is as follows. Bank size is positively correlated with complexity so that large banks are harder to monitor than small banks. Holding all other features of the economy constant, concentrated banking systems tend to have larger banks. Thus, this argument predicts a positive relationship between concentration and fragility. Again, this paper focuses on the aggregate relationship between bank concentration and crises. Although we control for bank size in our regressions, we do not examine the linkages between bank size and the ease of monitoring.

relationship, suggesting that bank concentration leads to more bank fragility. They do not consider the incidence of systemic banking distress.

Using data on 69 countries over the period 1980–1997, this paper provides the first cross-country assessment of the impact of national bank concentration, bank regulations, and national institutions on the likelihood of a country suffering a systemic banking crisis.[6] While defined more rigorously below, a systemic banking crisis refers to an episode when the entire national banking system has suffered sufficient losses such that non-performing loans exceed 10% of total banking system assets, or when the government has taken extraordinary steps, such as declaring a bank holiday or nationalizing much of the banking system. Besides the relationship between systemic banking crises and concentration, we also examine international differences in bank capital regulations, rules restricting bank entry, regulatory restrictions on bank activities, and the overall institutional environment. While we use cross-country differences in these bank regulations and institutions to assess the robustness of the relationship between concentration and crises, the results on regulations and institutions are independently valuable. Specifically, we provide empirical evidence on which regulations and institutions are associated with bank stability.

The bulk of the evidence indicates that crises are less likely in more concentrated banking systems, which supports the concentration–stability view. The negative relationship between concentration and crises holds when conditioning on macroeconomic, financial, regulatory, institutional, and cultural characteristics and is robust to an array of sensitivity checks. The data never support the concentration–fragility view. Furthermore, our analyses suggest that the relationship between concentration and crises is not driven by reverse causality.

The data also indicate that (i) fewer regulatory restrictions on banks—lower barriers to bank entry and fewer restrictions on bank activities—reduce banking system fragility, and (ii) countries with national institutions that facilitate competition in general have a lower likelihood of suffering a systemic banking crisis. Thus, more competitive banking systems are associated with less banking system fragility. In terms of linking the results back to specific parts of the concentration–stability view, the finding that competition reduces fragility when controlling for concentration suggests that something else besides a positive relationship between bank concentration and bank profits drives the negative relationship between bank concentration and banking system fragility. Our results also suggest that concentration might be an insufficient measure of the competitiveness of the banking system.[7]

[6] Demirgüç-Kunt et al. (2004) investigate the impact of bank concentration and regulations on bank net interest margins, but they do not examine bank fragility. Earlier work on systemic banking instability has mostly focused on identifying (i) the macroeconomic determinants of banking crises (Gonzalez-Hermosillo et al., 1997; Demirgüç-Kunt and Detragiache, 1998, henceforth DD), (ii) the relationship between banking and currency crises (Kaminsky and Reinhart, 1999), (iii) the impact of financial liberalization on bank stability (DD, 1999), and (iv) the impact of deposit insurance design on bank fragility (DD, 2002). Barth et al. (2004) examine the relationship between bank regulations and crises, but they do not examine bank concentration.

[7] See also Claessens and Laeven (2004) who do not find any evidence for a negative relationship between bank concentration and a measure of bank competitiveness calculated from marginal bank behavior.

Given that this is an initial study of bank concentration and crises, these results must be qualified along a number of dimensions. First, we investigate systemic banking crises, which are very difficult to define and date. Consequently, we use different definitions of and dates for crises and obtain robust results. Nevertheless, future work that assesses the impact of the market structure of the banking industry and bank regulations on individual bank fragility will provide a valuable complement to and extension of our research. Second, in some specifications, we examine cross-country differences in bank regulatory policies and national institutions to (i) assess the robustness of the concentration–fragility relationship and (ii) provide information on the links between bank regulations, national institutions, and banking system crises. We are cautious about these results, however, because the regulatory and institutional indicators are measured toward the end of the sample period. Thus, the regulatory and institutional variables are measured after some of the crises. This timing problem does not affect our primary results on bank concentration because the same results hold when these regulatory variables are excluded. Furthermore, some existing research that we review below finds that, except in a few countries, regulatory policies and national institutions have, in general, changed little over the last couple of decades. Nevertheless, future work that focuses on bank-level fragility while using detailed data on bank regulations and institutions will further contribute to our understanding of the determinants of banking crises. Third, this paper provides evidence that is consistent with concentration–stability theories, but inconsistent with models that emphasize the concentration–fragility view. Nonetheless, the empirical work does not explain exactly why concentration increases banking system stability. Future work needs to more fully dissect the channels through which concentration influences bank stability. Finally, while policy-relevant, this research provides an initial assessment of whether concentration is positively or negatively associated with crises and should not be taken as a recommendation for greater bank concentration.

The rest of the paper is organized as follows. Section 2 describes the data set and presents summary statistics. Section 3 explains the methodology used in empirical tests. Section 4 contains the main results and Section 5 concludes.

2. Data and summary statistics

Our sample covers the period 1980–1997.[8] Table 1 presents descriptive statistics for the whole sample.[9]

Crisis is a dummy variable that equals one if the country is going through a systemic crisis and zero if it is not. We use the DD (2002) dating of systemic banking

[8] The data include the East Asian crises, but are robust to their exclusion.

[9] Appendix Tables 1 and 3 (i) provide data sources, (ii) present country data on GDP per capita, concentration, crisis periods, and (iii) define the rationale for classifying each crisis as a systemic banking crisis. Appendix Table 2 presents separate statistics for crisis- and non-crisis observations. These tables are available on request.

Table 1
Summary statistics

Variable	Obs.	Mean	St. Dev.	Maximum	Minimum
Banking crisis	1138	0.05	0.21	0	1
Growth	1138	3.30	4.24	−16.40	23.60
Terms of trade change	1138	0.17	10.03	−51.45	63.24
Real interest rate	1138	−5.39	185.00	−5845.19	192.90
Inflation	1138	23.37	203.18	−29.17	6134.79
M2/reserves	1138	23.51	81.30	0.19	1372.94
Depreciation	1138	0.11	0.27	−0.35	4.26
Credit growth$_{t-2}$	1138	6.12	15.66	−54.62	115.42
Real GDP per capita	1138	8282.29	10638.37	148.18	45950.46
Moral hazard	1138	−0.87	2.36	−2.49	3.98
Concentration	69	0.71	0.22	0.19	1
Fraction of entry applications denied	41	0.20	0.28	0	1
Activity restrictions	53	9.38	2.55	4	14
Required reserves	41	11.81	11.67	0	43
Capital regulatory index	52	5.52	1.69	2	8
Banking freedom	67	3.37	0.85	2	5
Economic freedom	67	3.21	0.61	1.9	4.5
KKZ_composite	69	0.32	0.81	−1.03	1.72
British legal origin	69	0.39	0.49	0	1
French legal origin	69	0.48	0.50	0	1
German legal origin	69	0.07	0.26	0	1
Latitude	69	0.29	0.20	0.01	0.71
Catholic	69	36.08	36.88	0	96.60
Muslim	69	15.00	28.27	0	99.40
Protestant	69	16.36	24.00	−1.53E−06	97.80
Ethnic fractionalization	68	0.32	0.30	0	0.86

Banking crisis is a crisis dummy, which takes on the value of one if there is a systemic and the value of zero otherwise. Growth is the rate of growth of real GDP. Terms of trade equals the change in the terms of trade of goods and services. Real interest rate is the nominal interest rate minus the contemporaneous rate of inflation. Inflation is the rate of change of the GDP deflator. M2/reserves is the ratio of M2 to international reserves. Credit growth is the real growth of domestic credit, lagged two periods. Depreciation is the rate of change of the exchange rate. Moral hazard is an aggregate index of moral hazard associated with varying deposit insurance schemes. Concentration is calculated as the fraction of assets held by the three largest banks in each country, averaged over the sample period. Fraction of entry applications denied is the number of entry applications denied as a fraction of the number of applications received from domestic and foreign entities. Activity restrictions measures the degree to which a bank is restricted from engaging in business of securities underwriting, insurance underwriting and selling, and from real estate investment, management, and development. Required reserves is the percentage of reserves regulators require banks to hold. Capital regulatory index measures capital stringency in the banking system. Banking freedom is an indicator of the relative openness of the banking system. Economic freedom is a composite measure of institutional factors determining economic freedom. KKZ_composite is a composite measure of governance indicators. Legal origin includes the three dummies UK, France and Germany, which take the value 1 for each legal origin respectively. Latitude is the absolute value of the latitude of each country normalized to lie between zero and one. Religion includes three variables, Catholic, Muslim, Protestant, which indicate the percentage of the population that follows a particular religion. Ethnic fractionalization is the probability that two randomly selected individuals in a country will not speak the same language. Detailed variable definitions and sources are given in the data appendix, available on request.

crises, referring to periods where the national banking system is in such distress that it is not capable of fulfilling any meaningful intermediation role for the economy. Using country-specific data on individual bank failures and reports by national supervisory agencies, along with data collected by Lindgren et al. (1996) and Caprio and Klingebiel (1999); DD (2002) define systemic banking crises as occurring when emergency measures were taken to assist the banking system (such as bank holidays, deposit freezes, blanket guarantees to depositors or other bank creditors), or if large-scale nationalizations took place. DD (2002) also classify a country as experiencing a systemic banking crisis if non-performing assets reached at least 10% of total assets at the peak of the crisis, or if the fiscal cost of the rescue operations was at least 2% of GDP. Many crises run for multiple years. Following DD (2002), we exclude years classified as crisis years after the initial year of the crisis because during a crisis, the behavior of some of the explanatory variables is likely to be affected by the crisis itself. Note, however, that including all of the crisis years does not change the conclusions, as we demonstrate in the tables below. For the period 1980–1997, our sample includes 69 countries and 47 crisis episodes. Besides using this definition of systemic crises, which has been employed by recently published papers (DD, 1998, 2002; Barth et al., 2004, forthcoming), we provide robustness tests using alternative definitions of "systemic crises."[10]

Concentration equals the share of assets of the three largest banks in total banking system assets.[11] We compute a measure of bank concentration using the Bankscope database compiled by Fitch-IBCA, which reports bank balance sheet data in a large cross-section of countries beginning in 1988. Since the sample of banks covered in Bankscope increased over the sample period, changes in the concentration measure could reflect changes in coverage. To reduce biases stemming from the coverage problem, we average the concentration measure over the period 1988–1997. Moreover, other information suggests that changes in Bankscope coverage do not influence our results because we obtain the same results using (i) annual concentration values, (ii) concentration from Bankscope measured at the beginning of the sample period, and (iii) different measures of concentration. Furthermore, by confirming our results using the initial level of concentration at the start of the sample period, we reduce reverse causality concerns.

As reported in Table 1, there is wide cross-country variation in the sample, with concentration levels ranging from less than 20% for the US to 100% for many African countries, with a sample mean of 71%.

We control for many factors. Specifically, we begin with the econometric specification in DD (2002) and include the same regressors. Thus, we include the rate of

[10] While recognizing that there is no single, unanimous definition of a systemic banking crisis, the primary goal of this paper is to provide the first cross-country assessment of the relationship between bank concentration and crises. Thus, we assess this link using different definitions of both crises and concentration.

[11] Defining the economy as the relevant banking market abstracts from the fact that in some developed countries, such as the United States, the relevant banking market is sub-national. Below, we control for this fact by testing the robustness of our results to dropping developed economies.

growth of real GDP, the change in the external terms of trade, and the rate of inflation, to capture macroeconomic developments that are likely to affect the quality of bank assets. The short-term real interest rate is included to capture the banks' cost of funds. Also, higher real interest rates may affect bank profitability increasing default rates. The vulnerability of the banking system to sudden capital outflows triggered by foreign exchange risk is measured by the rate of exchange rate depreciation and by the ratio of M2 to foreign exchange reserves. Lagged credit growth is also a control since high rates of credit expansion may finance an asset price bubble that may cause a crisis when it bursts. We also include DD's (2002) index of moral hazard caused by deposit insurance generosity since they find that it contributes significantly to financial fragility.[12] Finally, GDP per capita is used to control for the level of development of the country. Table 1 shows a wide variation in the control variables across countries and over time. Our preliminary analyses show that countries in crisis grow more slowly, experience negative terms of trade shocks, and have both higher inflation and deprecation rates than countries not in crisis.[13]

We also augment the benchmark specification in DD by using measures of bank regulation, the competitiveness of the banking system and the economy in general, and a summary institutional index. Measures of bank regulation come from Barth et al. (2001, 2004, forthcoming). The data set is collected through surveys of government officials in the late 1990s. There is some evidence, however, that regulatory policies have not changed much in most countries. For instance, Barth et al. (2001) show that the regulatory restrictions on bank activities did not change much following systemic crises. Moreover, in the few cases when they did change, there was a change toward fewer regulatory restrictions. Thus, the timing of the Barth et al. (2001) data actually biases the results against finding a positive relationship between regulatory restrictions on bank activities and the likelihood of suffering a systemic crisis.[14]

We use four measures of bank regulation.

Fraction of entry denied is the number of entry applications denied as a fraction of the number of applications received from domestic and foreign entities. This is a measure of entry restrictions in banking and thus the contestability of the market. To the extent restricted entry increases bank profits, this variable would be associated with less fragility. If however, restricted entry induces inefficiencies in the banking market, it could also lead to greater fragility.

Activity restrictions aggregates measures that indicate whether bank activities in the securities, insurance, and real estate markets and ownership and control of nonfinancial firms are (1) unrestricted, (2) permitted, (3) restricted, or (4) prohibited.

[12] To build an aggregate index of moral hazard, DD (2002) estimate the first principal component of various deposit insurance design features. Specifically, they use coinsurance, coverage of foreign currency and interbank deposits, type of funding, source of funding, management, membership, and the level of explicit coverage to create this aggregate index that increases with the generosity of the deposit insurance regime. The index varies over time since different countries adopted deposit insurance or revised its design features at different points in time.

[13] See Appendix Table 2, available on request.

[14] Carkovic and Levine (2002) show that the bank regulations in Chile changed very little in the 1990s.

The aggregate indicator has therefore a possible maximum variation between four and 16, with higher numbers indicating more restrictions on bank activities and non-financial ownership and control. If these restrictions keep banks from entering excessively risky lines of business, then they may foster banking system stability. If however, restrictions prevent firms from diversifying outside their traditional lines of business, they may increase the fragility of the system.

Required reserves is the ratio of bank assets that regulators require banks to hold as reserves. Banking systems with higher ratios of required reserves may be more stable since they would have a greater buffer to absorb liquidity shocks. However, greater required reserves are also a tax on the banking system, which may lower profits and raise fragility.

Capital regulatory index is a summary measure of capital stringency and is given by the sum of initial capital stringency and overall capital requirements. To the extent that book capital is an accurate measure of bank solvency we expect better capitalized banks to be less fragile.

We also use three additional variables to capture the extent of banking freedom and general economic freedom and the institutional environment.

Banking freedom is an indicator of the openness of the banking system. It is a composite index of whether foreign banks are able to operate freely, how difficult it is to open domestic banks, how degree of regulation of financial market activities, the presence of state-owned banks, whether the government influences allocation of credit, and whether banks are free to provide customers with insurance products and invest in securities. Higher values indicate fewer restrictions on banking freedoms. On the one hand, fewer official impediments to bank operations and entry could stimulate efficiency and diversification that promotes stability. On the other hand, greater banking freedom could induce destabilizing competition.

Economic freedom is an indicator of how a country's policies rank in terms of providing economic freedoms. It is a composite of ten indicators ranking policies in the areas of trade, government finances, government interventions, monetary policy, capital flows and foreign investment, banking and finance, wages and prices, property rights, regulation, and black market activity. Higher scores indicate polices more conducive to competition and economic freedom. To the extent freedoms allow banks to improve efficiency and to engage in different activities and diversify their risks, we expect increased level of freedoms to reduce fragility. However, greater freedoms also allow banks to undertake greater risks, particularly if existing regulations distort risk-taking incentives. Thus, overall greater freedom may also lead to greater bank fragility. Both *Banking* and *Economic Freedom* are available from the Heritage Foundation, are built on expert opinions, and are average values for the period 1995–1997.

KKZ_composite is an index of the overall level of institutional development constructed by Kaufman et al. (1999). The underlying indicators are voice and accountability, government effectiveness, political stability, regulatory quality, rule of law, and control of corruption. This index is available for 1998. We expect better institutions to lead to reduced bank fragility, controlling for all other factors.

Finally, we control for other national characteristics that the literature has identified as being closely linked to financial sector development. Specifically, we control

for whether the country has a *British*, *French German*, *or Scandinavian legal origin* because La Porta et al. (1997, 1999), Beck et al. (2003), and others find that legal origin explains cross-country differences in financial development. We control for legal origin by including dummy variables that take on the value one for the respective legal tradition. We capture the Scandinavian legal origin in the constant. *Catholic, Protestant* and *Muslim* are the shares of the respective religion in each country, with the constant capturing other religions. Stulz and Williamson (2003) find that Protestant countries have stronger creditor right protection. We also use the absolute value of a country's *Latitude*, since Easterly and Levine (2003), and Beck et al. (2003) show that endowments influence institutional and financial development. Finally, we control for *Ethnic Fractionalization*, since Easterly and Levine (1997) show that ethnic diversity tends to reduce the provision of public goods, including the institutions that support the contracting environment.

3. Methodology

To test whether bank concentration and competition affect banking system fragility, we follow DD (1998, 2002) and use a logit probability model that is robust to heteroskedasticity.[15] We estimate the probability that a systemic crisis will occur at a particular time in a particular country, assuming that this probability is a function of the explanatory variables ($X(i,t)$). Let $P(i,t)$ denote a dummy variable that takes the value of one when a banking crisis occurs in country i and time t and a value of zero otherwise. β is a vector of n unknown coefficients and $F(\beta' X(i,t))$ is the cumulative probability distribution function evaluated at $\beta' X(i,t)$.[16] Then, the log-likelihood function of the model is

$$\text{Ln } L = \sum_{t=1,\ldots,T} \sum_{i=1,\ldots,n} \{P(i,t) \ln[F(\beta' X(i,t))] + (1 - P(i,t)) \ln[1 - F(\beta' X(i,t))]\}.$$

While the sign of the estimated coefficient for each explanatory variable indicates whether an increase of that explanatory variable increases or decreases the probability of a crisis, the estimated coefficients do not indicate the magnitude of the impact of a marginal change in the explanatory variable on the probability of a crisis. Instead, the coefficients reflect the effect of a change in an explanatory variable on $\ln(P(i,t)/(1 - P(i,t)))$, so that the magnitude of the impact on the probability of a crisis depends on the slope of the cumulative distribution function at $\beta' X(i,t)$. Therefore, the magnitude of the change in the probability of a crisis depends on the initial values of all the independent variables and their coefficients. Thus, in the analyses below, we present marginal coefficient estimates that are computed at the sample mean. These estimates illustrate the economic magnitudes of the relationship between each explanatory variable and the probability of a systemic banking crisis evaluated at the sample mean.

[15] Also see Cole and Gunther (1993), Gonzalez-Hermosillo et al. (1997), and Demirgüç-Kunt (1989).

[16] Since observations within each country group may also be correlated, we relax the assumption that errors are independent within country observations. We present these robustness tests below.

4. Results

4.1. Main findings

In Table 2, banking system concentration enters all of the regressions negatively and significantly. Regression (1) presents the results when including the standard explanatory variables; regression (2) adds concentration.[17] Concentration enters with a significant negative coefficient throughout. In columns (3) and (4), we test the sensitivity of our findings to the treatment of crisis observations after the initial year of the crisis. In column (3), we include all the crisis period observations.[18] In column (4), we weight the crisis observations by the length of the crisis. In both cases, our finding of a negative and significant relationship between bank concentration and crisis probability is confirmed. These analyses lend no support to the view that concentration induces banking system instability. Rather, the results suggest that concentrated banking systems are less vulnerable to banking crises.

Table 2 estimates also suggest that the economic impact is large. Regression (2) indicates that a one standard deviation increase in concentration (0.2) leads to a decrease in the probability of a crisis of 1% ($-0.01 = 0.2^{*}-0.05$). Since crisis probabilities at any point in time are quite low (5%), this is a substantial reduction. When including the subsequent crisis years in the analyses, the estimated effect of a one standard deviation in bank concentration leads to a reduction in the predicted probability of a crisis of 3.5%, compared to a sample mean of 18% for the sample that includes the years of the crisis. This result is supportive of the concentration–stability view that concentration fosters a more stable banking system.

Among the control variables, GDP growth and per capita GDP enter negatively, while the real interest rates enter positively, as suggested by economic theory and earlier empirical studies. While moral hazard enters positively and significantly in column (1), indicating that deposit insurance design influences banking system stability, it loses significance in some specifications when controlling for bank concentration. A strong negative correlation between concentration and moral hazard might explain the loss of significance of moral hazard. We view the fit of the model as satisfactory given the difficulty in modeling systemic crises. The benchmark specification with concentration classifies 66% of all observations and 73% of crisis observations accurately (column 2).[19] Pseudo R^2 range from 6% to 11% depending on the specification. The mean predicted probability for crisis observations is 12%, whereas it is 4% for non-crisis observations. The estimated crisis probability increases prior to the crisis, and the mean for three years prior to crisis is 5%.

[17] We also ran the column (2) regression without GDP per capita and obtain very similar results on concentration.

[18] When we included subsequent crisis years as non-crisis observations, the results on concentration are similar.

[19] In classifying observations, predicted probabilities significantly higher than 5% (number of crisis observations divided by total number of observations which equals the sample mean of the crisis dummy) are classified as crisis observations and those below 5% are classified as no crisis.

Table 2
Banking crisis and concentration

	(1)	(2)	(3)	(4)	(5)
Real GDP growth	−0.0052***	−0.0053***	−0.0121***	−0.0201***	−0.0048***
	(0.0011)	(0.0011)	(0.0026)	(0.0025)	(0.0010)
Terms of trade change	−0.0005	−0.0004	−0.0011	−0.0027***	−0.0003
	(0.0004)	(0.0004)	(0.0010)	(0.0010)	(0.0003)
Real interest rate	0.0003**	0.0003**	0.0007**	0.0013***	0.0005***
	(0.0001)	(0.0001)	(0.0003)	(0.0005)	(0.0001)
Inflation	0.0003	0.0003	0.0007**	0.0022***	0.0003
	(0.0003)	(0.0003)	(0.0003)	(0.0007)	(0.0003)
M2/reserves	0.0000	0.0001	0.0003**	0.0003**	0.0000
	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0000)
Depreciation	0.0191	0.0138	0.0832	−0.1537*	0.0200
	(0.0368)	(0.0362)	(0.0570)	(0.0810)	(0.0320)
Credit growth$_{t-2}$	0.0004	0.0004	0.0001	0.0024***	0.0004
	(0.0003)	(0.0003)	(0.0007)	(0.0006)	(0.0003)
Real GDP per capita	−1.39e−06**	−1.45e−06**	−4.87e−06***	−4.85e−06***	−1.60e−06**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Moral hazard index	0.0050**	0.0032	0.0166***	0.0156***	0.0040*
	(−0.0022)	(0.0023)	(0.0048)	(0.0047)	(0.0022)
Concentration		−0.0517**	−0.1591***	−0.1527***	
		(0.0251)	(0.0562)	(0.0500)	
Concentration*Quint1					−0.2432
					(0.1541)
Concentration*Quint2					−0.2427**
					(0.0983)
Concentration*Quint3					−0.1929***
					(0.0674)
Concentration*Quint4					−0.1776***
					(0.0551)
Concentration*Quint5					−0.1170***
					(0.0447)
No. of crises	47	47	196	200	47
No. of observations	989	989	1138	1142	989
% Crises correct	61	66	61	65	66
% Correct	73	73	65	69	73
Pseudo R^2	0.0942	0.1135	0.0856	0.0622	0.1474

The logit probability model estimated is Banking Crisis$_{[\text{Country}=j,\text{Time}=t]} = \alpha + \beta_1$ Real GDP growth$_{j,t} + \beta_2$ Terms of trade change$_{j,t} + \beta_3$ Real interest rate$_{j,t} + \beta_4$ Inflation$_{j,t} + \beta_5$ M2/reserves$_{j,t} + \beta_6$ Depreciation$_{j,t} + \beta_7$ Credit growth$_{j,t-2} + \beta_8$ Real GDP per capita$_{j,t} + \beta_9$ Moral hazard index$_{j,t} + \beta_{10}$ Concentration$_{j,t} + \varepsilon_{j,t}$. The dependent variable is a crisis dummy that takes on the value of one if there is a systemic and the value of zero otherwise. Growth is the rate of growth of real GDP. Terms of trade equals the changes in the terms of trade of goods and services. Real interest rate is the nominal interest rate minus the contemporaneous rate of inflation. Inflation is the rate of change of the GDP deflator. M2/reserves is the ratio of M2 to international reserves. Credit growth is the real growth of domestic credit, lagged two periods. Depreciation is the rate of change of the exchange rate. Moral hazard is an aggregate index of moral hazard associated with varying deposit insurance schemes. Concentration is calculated as the fraction of assets held by the three largest banks in each country, averaged over the sample period. Bank data are from the Bankscope database of Fitch IBCA. Specifications (1) and (2) exclude crisis observations after the initial crisis year. Specification (3) includes the crisis period as crisis observations. Specification (4) weights crisis years by duration of crisis. In specification (5), we run piecewise regressions where concentration is split into quintiles and entered 5 times, each time multiplied by a dummy that takes the value 1 for each quintile. We present the marginal effects (dy/dx) of the logit regressions. White's heteroskedasticity consistent standard errors are given in parentheses. Detailed variable definitions and sources are given in the data appendix, available on request.

* Indicate statistical significance at 10%.

** Indicate statistical significance at 5%.

*** Indicate statistical significance at 1%.

To check for a non-linear relationship between concentration and crises, we run a piecewise regression, where concentration is broken into quintiles (Table 2, column 5). We create five concentration quintile dummies that equal one if the value of concentration falls within that quintile and zero otherwise. Thus, each observation in the regression has five concentration variables. We multiply the concentration variable by each of the concentration quintile dummy variables, so that four of these equal zero for each observation. The results indicate that the stabilizing effect of concentration is significant for all but the lowest concentration quintile. The coefficient size decreases at higher levels of concentration, but remains negative. The regression (5) results indicate that there is a statistically significant, negative relationship between concentration and banking system fragility for levels of concentration above 35%.

4.2. Sensitivity analyses

In Table 3, we investigate the sensitivity of the results to using different definitions of a systemic crisis, controlling for reverse causation, employing alternative definitions of banking system concentration, estimating alternative econometric specifications and using alternative samples. In column (1), we change the crisis definition to the one used by Caprio and Klingebiel (1999).[20] This crisis definition blurs the distinctions between crisis and non-crisis observations, as it includes borderline crises. Nevertheless, we use this alternative definition as a robustness check. The concentration result remains essentially unchanged, negative and significant at 10%. In column (2) we report results with a different crisis definition where systemic crisis definition excludes the NPL criteria (NPL > 10%) and reclassifies these "former" crisis countries as non-crisis countries. This change leaves the results unchanged. In unreported regressions, we also tried excluding these countries from the estimation, which does not affect the significance level of the concentration variable.[21]

Robustness tests indicate that the results are not driven by reverse causality. Reverse causality could arise if systemic crises led to lower levels of concentration in the banking system through greater entry or changes in general competition policies. Although we check the robustness of the results, it is important to reiterate why we use average concentration over the period 1988–1997 for the bulk of the analyses rather than using annual observations. The sample of banks covered by Bankscope changes over the sample period. Thus, measured changes in concentration when using annual data may reflect changes in coverage, not changes in actual concentration. Therefore, using annual data will induce an errors in variables problem that

[20] Portugal and Guyana are re-defined as non-crisis countries and the following crises are added to the sample: Burundi (1994–1997), Canada (1983–1985), Congo (1992–1997), Denmark (1987–1992), and France (1994–1995).

[21] In unreported regressions, we also excluded from the systemic crisis definition NPL as well crisis cost criteria (crisis costs >2% of GDP) and re-classified all these observations as non-crisis observations; the coefficient on concentration is still negative and significant at the 6% level.

Table 3
Banking crisis and concentration: alternative crisis and concentration measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Concentration	−0.0448*	−0.0488**	−0.0531*	−0.0536*	−0.0517**	−0.2182***	−0.0494*	−0.0465*
	(0.0261)	(0.0228)	(0.0256)	(0.0325)	(0.0236)	(0.0737)	(0.0280)	(0.0246)
No. of crises	50	42	47	47	47	20	43	47
N	980	989	989	989	989	270	829	988
% Crises correct	68	67	66	66	66	75	67	68
% Correct	71	77	74	72	73	76	69	73
Pseudo R^2	0.1180	0.1175	0.1139	0.1108	0.1135	0.2520	0.1146	0.1152

The logit probability model estimated is Banking $\text{Crisis}_{[\text{Country}=j,\,\text{Time}=t]} = \alpha + \beta_1$ Real GDP $\text{growth}_{j,t} + \beta_2$ Terms of trade $\text{change}_{j,t} + \beta_3$ Real interest $\text{rate}_{j,t} + \beta_4$ $\text{Inflation}_{j,t} + \beta_5$ $\text{M2/reserves}_{j,t} + \beta_6$ $\text{Depreciation}_{j,t} + \beta_7$ Credit $\text{growth}_{j,t-2} + \beta_8$ Real GDP per $\text{capita}_{j,t} + \beta_9$ Moral hazard $\text{index}_{j,t} + \beta_{10}$ $\text{Concentration}_{j,t} + \varepsilon_{j,t}$. The dependent variable is a crisis dummy that takes on the value of one if there is a systemic and the value of zero otherwise. Growth is the rate of growth of real GDP. Terms of trade equals the change in the terms of trade of goods and services. Real interest rate is the nominal interest rate minus the contemporaneous rate of inflation. Inflation is the rate of change of the GDP deflator. M2/reserves is the ratio of M2 to international reserves. Credit growth is the real growth of domestic credit, lagged two periods. Depreciation is the rate of change of the exchange rate. Moral hazard is an aggregate index of moral hazard associated with varying deposit insurance schemes. The aforementioned variables are used in analysis but not shown for the sake of brevity. Concentration is calculated as the fraction of assets held by the three largest banks in each country, averaged over the sample period. Bank data are from the Bankscope database of Fitch IBCA. Specification (1) uses an alternative definition of crisis, based on Caprio and Klingebiel (1999). In specification (2), we reclassify those countries whose only criteria for crisis classification is non-performing loans >10%. In specification (3), Average concentration is replaced by Initial concentration, for the entire sample period. In specification (4) the concentration measure used is the Herfindahl index. Specification (5) relaxes the assumption of independent error terms within countries (clustering). In specification (6) the sample excludes all countries with populations less than 20 million. In specification (7) the sample excludes G-10 countries. In specification (8), we control for mean bank size, which is given in billions of US$. White's heteroskedasticity consistent standard errors are given in parentheses. Detailed variable definitions and sources are given in the data appendix, available on request.

* Indicate statistical significance at 10%.

** Indicate statistical significance at 5%.

*** Indicate statistical significance at 1%.

biases the results toward finding an insignificant relationship. Nevertheless, we undertake the following sensitivity analyses. First, we inspect individual crisis cases in our sample. We do not see a significant pattern of reduced concentration after crisis episodes, and indeed the data suggest that concentration generally varies little over time. Second, we estimate a specification using the initial level of concentration (1988 or the first available year in the data) instead of the 1988–1997 average. Table 3 regression (3) shows that this does not change our results significantly: concentration is negatively associated with the likelihood of suffering a crisis.[22]

As additional robustness checks, we use the Herfindahl index of concentration, which is the sum of the squared market shares. Given that our sample size changes over the sample period, including banks beyond the top three might introduce mea-

[22] Since some of the crisis episodes occur before the date beginning date of data on concentration, we reran the regression without those crisis episodes that precede the initial concentration date. This leaves us with only 20 crisis episodes and less than half of the total number of observations, yet the concentration variable still remains negative and significant. We also confirm our results using annual data.

surement bias. For this reasons, we favor the three-bank concentration indicator, which equals the share of assets of the three largest banks relative to total banking system assets. Nevertheless, the result using the Herfindahl index for all available banks indicates a negative and significant (at the 10% level) relationship between concentration and crises (column 4).[23]

Thus far, we have allowed for heteroskedasticity of errors and corrected for it, but assumed that the errors are independent. Given that we use a panel data set, the error terms within individual countries may be correlated with each other. To control for the fact that omitted country-level characteristics might cause correlation of the error terms within countries, Table 3, column (5) reports results that allow for clustering within countries. Specifically, we require that error terms are independent across countries but not necessarily within countries. Concentration still enters with a negative and significant coefficient.[24]

We also investigate the sensitivity of our results to using alternative samples. In column (6) of Table 3, we exclude all countries with populations of less than 20 million.[25] In column (7), we exclude G-10 countries. In both cases, we continue to find a negative relationship between crises and concentration.[26,27]

Finally, we control for Bank Size, which equals total banking system assets divided by the number of banks in billions of US$. If concentration is simply proxying for the average size of banks in a country, then including Bank Size will drive out the significance of concentration. Regression (8), however, indicates that concentration continues to enter negatively and significantly when controlling for Bank Size, but Bank Size does not enter significantly.

[23] We also use a survey-based measure of concentration from the Barth et al. (2004) database, which defines bank concentration as the share of deposits of the largest five banks. The correlation between the concentration measures calculated from Bankscope data and from Barth et al. is 52%, significant at the 1%-level. Using this measure reduces our sample greatly, but still yields a negative coefficient, significant at the 13% level.

[24] We also estimated a logit model with random country effects. Again, the results are not significantly different and we cannot reject the Hausman null hypothesis that the differences in coefficients estimated using random country errors and those using fixed effects estimations are not systematic.

[25] Eliminating countries with less than 1 million or less than 10 million inhabitants yielded similar results. Excluding African countries, which tend to have very high bank concentration ratios, does not change our results either.

[26] Running the regression with only G-10 or high-income countries yields a negative but insignificant relationship between concentration and crisis, which can be explained by (i) the low number of crises in developed countries over the sample period, and (ii) the fact that the rich country sample is much smaller. While some may argue that this implies that our results are developing country results, it should be remembered that the results hold when controlling for GDP per capita and other institutional measures of economic development.

[27] We also tested the sensitivity of our findings to outliers. Specifically, we excluded Cote d'Ivoire (1993) because their M2/reserves values are outliers and Peru (1991) because its inflation and real interest rate values are outliers. Our findings are confirmed. Further, when we lag all observations by one period, our results are again confirmed.

4.3. Concentration, regulations, institutions, and crises

In Table 4, we control for different bank regulations and the institutional environment.[28] We include indicators of bank regulations for three reasons. First, controlling for differences in national policies provides a simple robustness test of the relationship between concentration and crises. Second, controlling for regulations provides additional information on the concentration–fragility relationship. If concentration is proxying for regulations that impede competition, then controlling for the regulatory environment will drive out the significance of concentration in the crisis regression and therefore explain why we find a significant, negative coefficient on concentration. Finally, examining the relationship between bank regulations and banking system stability is independently valuable. Countries implement regulations to promote banking system stability. This research provides some information about which policies work.[29]

Table 4 results indicate that the negative relationship between banking system concentration and the probability of suffering a systemic banking crisis holds even when including measures of the regulatory environment, the general openness of the banking industry, the degree of economic freedom in the economy, and a general index of institutional development.[30] When controlling for capital regulations, reserve requirements, banking freedom, economic freedom and a summary measure of institutional development, concentration enters negative and significantly at the 5% level. When controlling for the fraction of entry applications denied and regulatory restrictions on the activities of banks, concentration enters negatively and significantly at the 10% level.[31]

Table 4 results also indicate that tighter entry restrictions and more severe regulatory restrictions on bank activities boost bank fragility. These are consistent with the results obtained by Barth et al. (2004), who examine the impact of entry restrictions on crises in a purely cross-country investigation that does not control for bank concentration. A higher fraction of entry applications denied—a proxy for tighter entry regulations—leads to higher levels of fragility in the banking system. This is consistent with the argument that restricted entry reduces the efficiency of the banking system, also making it more vulnerable to external shocks. Similarly, we find that

[28] We also controlled for public and foreign ownership. While we cannot find a robust relationship between the ownership structure and banking system stability, controlling for the ownership structure does not affect our main finding of a negative relationship between concentration and crisis probability.

[29] These specifications exclude GDP per capita since it is also a proxy for the overall institutional environment, including bank regulations. We have also estimated specifications where we have left out the concentration variable and included only the regulation. The results are virtually unchanged.

[30] Bank concentration remains significantly, negatively associated with bank fragility even when simultaneously controlling for the regulatory variables and the institutional development indicators, but the intersection of these regulatory and institutional variables cuts the number of observations virtually in half.

[31] In unreported regressions we have also explored specifications where we have interacted the concentration variable with these regulatory and institutional variables, but the interaction terms did not enter significantly.

Table 4
Banking crisis, regulations, institutions, and concentration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Concentration	−0.0402*	−0.0388*	−0.0492**	−0.0483**	−0.0568**	−0.0584**	−0.0523**	−0.0564**
	(0.0211)	(0.0211)	(0.0246)	(0.0224)	(0.0253)	(0.0267)	(0.0243)	(0.0249)
Fraction of entry applications	0.0345***							
	(0.0127)							
Activity restrictions		0.0037**						
		(0.0014)						
Required reserves			0.0003					
			(0.0003)					
Capital regulatory index				−0.0016				
				(0.0027)				
Banking freedom					−0.0164***			−0.0121*
					(0.0058)			(0.0071)
Economic freedom						−0.0185**		
						(0.0081)		
KKZ_composite							−0.0153**	−0.0100
							(0.0067)	(0.0084)
No. of crises	21	34	27	33	47	47	47	47
No. of observations	583	767	572	755	955	955	989	955
% Crises correct	67	74	67	70	68	66	68	70
% Correct	77	75	78	73	69	70	72	69
Pseudo R^2	0.1854	0.2105	0.2477	0.2031	0.1145	0.1058	0.1106	0.1186

The logit probability model estimated is Banking $\text{Crisis}_{[\text{Country}=j,\,\text{Time}=t]} = \alpha + \beta_1$ Real GDP $\text{growth}_{j,t} + \beta_2$ Terms of trade $\text{change}_{j,t} + \beta_3$ Real interest $\text{rate}_{j,t} + \beta_4$ $\text{Inflation}_{j,t} + \beta_5$ $\text{M2/reserves}_{j,t} + \beta_6$ $\text{Depreciation}_{j,t} + \beta_7$ Credit $\text{growth}_{j,t-2} + \beta_8$ Moral hazard $\text{index}_{j,t} + \beta_9$ $\text{Concentration}_{j,t} + \beta_{10}$ Regulatory $\text{measures}_{j,t} + \varepsilon_{j,t}$. The dependent variable is a crisis dummy that takes on the value of one if there is a systemic and the value of zero otherwise. Growth is the rate of growth of real GDP. Terms of trade equals the change in the terms of trade of goods and services. Real interest rate is the nominal interest rate minus the contemporaneous rate of inflation. Inflation is the rate of change of the GDP deflator. M2/reserves is the ratio of M2 to international reserves. Credit growth is the real growth of domestic credit, lagged two periods. Depreciation is the rate of change of the exchange rate. Moral hazard is an aggregate index of moral hazard associated with varying deposit insurance schemes. The aforementioned variables are used in analysis but not shown for the sake of brevity. Concentration is calculated as the fraction of assets held by the three largest banks in each country, averaged over the sample period. Bank data are from the Bankscope database of Fitch IBCA. Fraction of entry applications denied measures the number of entry applications denied as a fraction of the total applications received. Activity restrictions measures the degree to which banks are restricted from engaging in business of securities underwriting, insurance underwriting and selling, and from real estate investment, management, and development. Required reserves is the percentage of reserves regulators require banks to hold. Capital regulatory index is a summary measure of capital stringency. Banking freedom is an indicator of the relative openness of the banking system. Economic freedom is a composite measure of institutional factors determining economic freedom. KKZ_composite is a composite measure of governance indicators. White's heteroskedasticity consistent standard errors are given in parentheses. Detailed variable definitions and sources are given in the data appendix, available on request.

* Indicates statistical significance at 10%.

** Indicates statistical significance at 5%.

*** Indicates statistical significance at 1%.

restrictions on bank activities increase crisis probabilities. This result indicates that overall these restrictions prevent banks from diversifying outside their traditional business, reducing their ability to reduce the riskiness of their portfolios. The required reserves and capital regulatory index do not enter with significant coefficients.[32]

The variables that capture the general openness and competitiveness of the banking system and the economy enter with negative and very significant coefficients

[32] Including all the regulatory variables simultaneously (i) does not change the results on concentration and (ii) does not yield significant coefficients on the regulatory variables because they are highly correlated with each other.

(Table 4 regressions 5–7). Thus countries with greater freedoms in banking and generally more competitive economic policies are less likely to experience banking crises.

Table 5
Banking crisis, national characteristics, and concentration

	(1)	(2)	(3)	(4)	(5)
Concentration	−0.0737***	−0.0523**	−0.0789***	−0.0579**	−0.0845***
	(0.0257)	(0.0242)	(0.0248)	(0.0270)	(0.0246)
Common legal origin	−0.0504**				−0.0643*
	(0.0211)				(0.0384)
French legal origin	−0.0811**				−0.0854
	(0.0338)				(0.0722)
German legal origin	−0.0289***				−0.0318***
	(0.0084)				(0.0086)
Latitude		−0.0444			−0.0831**
		(0.0350)			(0.0332)
Catholic			−0.0004**		−0.000*
			(0.0002)		(0.0002)
Muslim			−0.0001		0.0000
			(0.0002)		(0.0002)
Protestant			0.0001		−0.0002
			(0.0003)		(0.0004)
Ethnic fractionalization				0.0184	−0.0036
				(0.0197)	(0.0181)
No. of crises	47	47	47	47	47
No. of observations	989	989	989	974	974
% Crises correct	64	70	68	68	72
% Correct	71	74	72	73	71
Pseudo R^2	0.1318	0.1174	0.1339	0.1147	0.1583

The logit probability model estimated is Banking $\text{Crisis}_{[\text{Country}=j,\,\text{Time}=t]} = \alpha + \beta_1$ Real GDP $\text{growth}_{j,t} + \beta_2$ Terms of trade $\text{change}_{j,t} + \beta_3$ Real interest $\text{rate}_{j,t} + \beta_4$ $\text{Inflation}_{j,t} + \beta_5$ $\text{M2/reserves}_{j,t} + \beta_6$ $\text{Depreciation}_{j,t} + \beta_7$ Credit $\text{growth}_{j,t-2} + \beta_8$ Moral hazard $\text{index}_{j,t} + \beta_9$ $\text{Concentration}_{j,t} + \beta_{10}$ Historical $\text{determinants}_{j,t} + \varepsilon_{j,t}$. The dependent variable is a crisis dummy that takes on the value of one if there is a systemic and the value of zero otherwise. Growth is the rate of growth of real GDP. Terms of trade equals the change in the terms of trade of goods and services. Real interest rate is the nominal interest rate minus the contemporaneous rate of inflation. Inflation is the rate of change of the GDP deflator. M2/reserves is the ratio of M2 to international reserves. Credit growth is the real growth of domestic credit, lagged two periods. Depreciation is the rate of change of the exchange rate. Moral hazard is an aggregate index of moral hazard associated with varying deposit insurance schemes. The aforementioned variables are used in analysis but not shown for the sake of brevity. Concentration is calculated as the fraction of assets held by the three largest banks in each country, averaged over the sample period. Bank data are from the Bankscope database of Fitch IBCA. Legal origin includes the three dummies UK, France and Germany, which take the value 1 for each legal origin respectively. Latitude is the absolute value of the latitude of each country normalized to lie between zero and one. Religion includes three variables, Catholic, Muslim, Protestant which indicate the percentage of the population that follows a particular religion. Ethnic fractionalization is the probability that two randomly selected individuals in a country will not speak the same language. White's heteroskedasticity consistent standard errors are given in parentheses. Detailed variable definitions and sources are given in the data appendix, available on request.

* Indicate statistical significance at 10%.

** Indicate statistical significance at 5%.

*** Indicate statistical significance at 1%.

This is the case despite the fact that these policies also tend to reduce entry barriers and are correlated with reduced levels of bank concentration. A better institutional environment is also associated with a lower probability of systemic crisis, as expected. In regression (8), we include two of the institutional indicators simultaneously. As shown, there is multicollinearity across the different institutional variables (though they jointly enter significantly). Even when simultaneously including these controls, however, concentration enters negatively and significantly. The evidence is consistent with theories that emphasize the stabilizing effects of competition, but inconsistent with the many models that stress the destabilizing effects from competition.

In Table 5, we explore the linkages between systemic banking crises and concentration while controlling for other national characteristics that may explain institutional development, such as legal origin, religious composition, geography, and ethnic diversity. The negative relationship between banking system concentration and systemic crises remains negative and significant even when controlling for these other factors.

The findings that (i) concentration lowers banking system fragility and (ii) low competition raises banking system fragility imply that future research needs to move beyond a simple "concentration–stability" versus "concentration–fragility" debate where concentration is viewed as a simple proxy for market power. More specifically, one standard view holds that concentrated banking systems reduce banking system fragility by boosting the profits of banks. Recall, however, that this paper finds that (i) concentration remains negatively associated with banking system fragility when controlling for regulations and institutions associated with competition and (ii) these indicators of competition are associated with greater banking system stability. If our regulatory and institutional indicators do a reasonably good job of measuring the competitiveness of the banking industry, then these results (i) are inconsistent with the argument that concentration enhances stability by boosting the market power of banks and (ii) indicate that concentration is measuring "something else" besides market power. We hope that future studies at the individual bank-level can identify why bank concentration is negatively correlated with bank fragility even after controlling for the degree of competition in the banking industry.

5. Conclusions

This paper investigates the impact of bank concentration on banking system fragility. We use cross-country data on 69 countries and 47 crisis episodes. The paper conducts an array of sensitivity analyses that extend the core results.

The results are consistent with concentration–stability theories but are inconsistent with the concentration–fragility views. These initial analyses indicate that national bank concentration tends to reduce the likelihood that a country will suffer a systemic banking crisis. The results hold when controlling for a wide array of macroeconomic, regulatory and institutional factors, when using different definitions of crises and concentration, and after examining different sub-samples of countries.

In terms of regulations and institutions, the data do not support the view that more competition increases fragility. Quite to the contrary, the results indicate that banking systems where a larger fraction of entry applications are denied, and those where regulations restrict banks from engaging in non-loan making activities have a greater likelihood of experiencing a systemic crisis. Similarly, in terms of national institutions, the regressions indicate that countries with better-developed institutions that foster competition are less likely to suffer systemic banking crises. The finding that both concentration and competitiveness of the banking system is positively related to banking stability suggests that bank concentration is an insufficient measure of bank competitiveness.

While our paper shows that more concentrated banking systems are less likely to suffer systemic crises, we do not explore the mechanisms. While policy-relevant, our findings should therefore not be seen as a recommendation for policymakers to foster bank concentration. Future research has to examine the channels through which concentration and the competitiveness of the financial system impact stability.

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