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# Bank Concentration and Fragility
## Impact and Mechanics

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### 5.1 Purposes and Motivation

Public policy debates and theoretical disputes motivate this paper's examination of the relationship between bank concentration and banking system fragility and the mechanisms underlying this relationship. The rapid consolidation of banks around the world is intensifying concerns among policymakers about bank concentration, as reflected in major reports by the Bank for International Settlements (2001), International Monetary Fund (2001), and the Group of Ten (2001). These reports note that concentration may reduce competition in and access to financial services, increase the market power and political influence of financial conglomerates, and destabilize financial systems as banks become too big to discipline and use their influence to shape banking regulations and policies. These reports also provide countervailing arguments. Consolidation may improve banking system efficiency and enhance stability as the best banks succeed, diversify, and boost franchise value. Further, some may question whether bank concentration is a reliable indicator of competition in the banking industry.

Theoretical disputes parallel these public policy deliberations. Some models yield a "concentration-stability" prediction that banking system concentration reduces fragility (Allen and Gale 2000, 2003). In terms of

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mechanisms, concentration may signal less competition and hence greater market power and profits. Higher profits provide a buffer against adverse shocks and increase the franchise value of the bank, which reduces incentives for bankers to take excessive risk.[1] Also, some hold that it is substantially easier for supervisors to monitor a few banks in a concentrated banking system than it is to monitor lots of banks in a diffuse banking system, so that in equilibrium, concentrated banking systems will suffer fewer banking crises. Some proponents of the "concentration-stability" view note that if (1) concentrated banking systems have larger banks and (2) larger banks hold more diversified portfolios than smaller banks, then concentrated banking systems will tend to be more stable.[2]

In contrast, some models produce a "concentration-fragility" prediction, where concentration increases fragility. Boyd and De Nicoló (2005) stress that banks in less competitive environments charge higher interest rates to firms, which induces firms to assume greater risk. Their model predicts that if concentration is positively associated with banks having market power, then concentration will increase both the expected rate of return on bank assets and the standard deviation of those returns. Also, proponents of the concentration-fragility view disagree with the proposition that a few large banks are easier to monitor than many small banks. If size is positively correlated with complexity, then large banks may be more difficult to monitor than small banks, not less. Finally, some researchers argue that larger banks are protected by implicit "too-big-to-fail" policies that small banks do not enjoy. This protection intensifies risk-taking incentives beyond any diversification advantages enjoyed by large banks (Boyd and Runkle 1993; Mishkin 1999; O'Hara and Shaw 1990).[3] From this perspec-

1. See Boot and Greenbaum (1993), Besanko and Thakor (1993), Hellman, Murdoch, and Stiglitz (2000), and Matutes and Vives (2000). Also, Smith (1984) shows that less competition in banking leads to more stability if information about the probability distribution of depositors' liquidity needs is private and lower competition allows banking relationships to endure for longer periods. Matutes and Vives (1996), however, argue that concentration is not a consistent signal of competition, so that bank illiquidity can arise in any market structure.

2. Each of these conditions is debatable. 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), research finds an inverse relationship between bank size and bank failure in the United States. However, Chong (1991) and Hughes and Mester (1998) indicate that bank consolidation tends to increase the risk of bank portfolios. Moreover, Boyd and Runkle (1993) examine 122 U.S. bank holding companies and find an inverse relationship between size and the volatility of assets returns, but not evidence that large banks fail less frequently than small banks. In contrast, De Nicoló (2000) finds a positive relationship between bank size and the probability that the bank will fail in the United States, Japan, and several European countries. We control for bank size in our regressions, but the focus of our research is on the relationship between the concentration and fragility of national banking systems.

3. A large literature indicates that implicit or explicit deposit insurance creates incentives for banks to increase risk (e.g., Merton 1977, Sharpe 1978, Flannery 1989, Kane 1989, and Chan, Greenbaum, and Thakor 1992). If this insurance were the same for banks of all sizes, these models would predict no relationship between bank size and bank fragility. Since regu-

tive, concentrated banking systems with a few large banks will tend to be more fragile than diffuse banking system with many small banks.

Given these conflicting theoretical predictions and policy disputes, there are surprisingly few cross-country examinations of banking system concentration and fragility.[4] Although there is a growing cross-country empirical literature that uses time series data to examine the determinants of banking crises, this research does not examine concentration (Demirgüç-Kunt and Detragiache 1998, 1999, henceforth DD; Gonzalez-Hermosillo, Pazarbasioglu, and Billings 1997; Kaminsky and Reinhart 1999). Although Barth, Caprio, and Levine (2004) examine the relationship between bank regulations and crises, they do not examine bank concentration, and they use pure cross-country comparisons rather than panel analyses. De Nicoló et al. (2003) find a positive relationship between banking system concentration and the fragility of the largest five banks in a country. They do not, however, examine systemic crises.

This paper (1) assesses the relationship between bank concentration and the probability that a country will suffer a systemic crisis and (2) provides evidence on whether particular hypothesized mechanisms linking concentration and fragility—competition, diversification, and the ease of monitoring—account for the identified relationship between concentration and stability. We focus on these three mechanisms because of their prominence in policy and academic discussions.

To investigate systemic crises, we use annual data on sixty-nine countries over the period 1980–1997. While no single, unambiguous definition of a systemic crisis exists, we use the DD (2002) classification and confirm the results with other definitions. DD (2002) consider a country to be in a systemic crisis if (1) authorities use emergency measures, such as bank holidays, deposit freezes, blanket guarantees, and so forth to assist the banking industry, (2) countries undertake large-scale nationalizations of banks, (3) nonperforming loans top 10 percent of total banking assets, or (4) the fiscal costs of rescue operations exceed two percent of Gross Domestic Product (GDP). Using logit regressions, we analyze the association between banking system concentration and the probability that a country experi-

lators may fear potential macroeconomic consequences of large bank failures, many countries have implicit "too-large-to-fail" policies that protect large banks more than small banks. Thus, the largest banks frequently receive a greater net insurance subsidy from the government. This subsidy may in turn increase the risk-taking incentives of the larger banks more than smaller banks. For an analysis of the corporate governance of banks, see Macey and O'Hara (2003). Note, however, that 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).

4. For the United States, Keeley (1990) provides evidence that increased competition following the relaxation of state branching restrictions in the 1980s increased the risk of large banks. However, Jayaratne and Strahan (1998) find that deregulation in the 1980s lowered loan losses, and Dick (2006) finds higher loan loss provisions following deregulation in the 1990s.

ences a systemic crisis. In the analyses we condition on many country characteristics, including bank supervisory and regulatory practices, institutional development, and macroeconomic controls, such as the level of economic development, economic growth, inflation, interest rates, terms of trade changes, and credit growth.

The results are inconsistent with the concentration-fragility view. We do not find a positive relationship between banking system concentration and the likelihood that the country suffers a systemic crisis. Using different conditioning information sets, different sample periods, different definitions of crises, and different measures of concentration, we never find a significant, positive link between concentration and crises. Thus, our analyses lend no support to the view that concentration increases the fragility of banks.

Rather, the findings are broadly consistent with the concentration-stability view. Concentration enters the crises regressions negatively and significantly across a wide array of specifications. Thus, although we will emphasize numerous qualifications, the data consistently indicate a positive relationship between national bank concentration and banking system stability.

Furthermore, we provide exploratory evidence on the potential mechanisms—competition, diversification, and ease of monitoring—underlying the positive relationship between concentration and stability. First, to assess whether concentration proxies for competition, we include bank regulatory indicators and measures of national institutional development. More specifically, we control for national policies toward bank entry, bank activities, and bank ownership, as well as several indicators of national institutions that affect competition. If (1) these variables measure the competitive environment in banking and (2) concentration proxies for competition, then including these variables should eliminate the significance of concentration in the fragility regressions. Moreover, these assessments provide independently valuable information on the linkages between banking system fragility and bank regulations. Second, to assess whether concentration proxies for diversification or ease of monitoring, we include numerous indicators that attempt to proxy for these mechanisms. For diversification, we control for (a) the size of the economy, which may correlate positively with the ability of banks to diversify domestically, (b) restrictions on making loans abroad, which may correlate negatively with the ability of banks to diversify internationally, and (c) mean bank size, which some argue is positively correlated with diversification. For ease of monitoring, we control for (a) the number of banks, (b) regulatory restrictions on banks' ability to engage in nonlending services, since the complexity of banks may hinder monitoring, (c) mean bank size, since larger banks may be more complex than smaller banks, (d) capital regulatory requirements, deposit insurance, and other prudential regulations, and (e) the average cash flow rights of the controlling owner, if any, of the largest, listed banks

in the country, which may reflect the incentives of the largest owner to govern the bank effectively. Again, if including these variables eliminates the relationship between concentration and fragility, then this provides circumstantial evidence that concentration acts as a proxy for diversification or the cost of monitoring banks.

In terms of regulatory policies and institutional development, we find that (1) fewer regulatory restrictions on banks—lower barriers to bank entry, fewer restrictions on bank activities, and fewer impediments to bank operations in general—reduce banking system fragility, and (2) countries with national institutions that foster competition have lower banking system fragility. Thus, policies and institutions that facilitate competition in banking are associated with less—not *more*—banking system fragility. Furthermore, capital requirements, reserve requirements, and prudential regulations do not affect the results on concentration and, interestingly, do not reduce the likelihood of suffering a systemic crisis. Regarding specific mechanisms associated with the concentration-stability view, the findings that (1) banking system concentration is associated with *lower* fragility and (2) policies that foster competition are associated with *lower* fragility suggest that concentration is proxying for something else besides a lack of competition.

In terms of diversification, we find some support for the view that one of the mechanisms underlying the negative relationship between concentration and banking system fragility is that concentrated banking systems tend to have larger, better-diversified banks. While recognizing that the measures of diversification are both indirect and potentially imprecise, we find that controlling for proxies of diversification substantially reduces the ties between concentration and crises. More specifically, we find that (1) controlling for the size of the domestic economy eliminates the connection between concentration and systemic crises, (2) controlling for the mean size of banks weakens the link between concentration and crises, and (3) controlling for mean bank size and restrictions on foreign loans eliminates the negative relationship between banking system concentration and the probability of suffering a systemic crisis. The results are consistent with arguments that countries with, on average, larger banks tend to have a lower likelihood of suffering a systemic crisis and inconsistent with the view that large banks distort public policies in a manner that increases banking system fragility.

In contrast, we find no support for any of the views suggesting that concentration is a proxy for the degree of difficulty in monitoring banks. When controlling for the number of banks, or regulatory restrictions on banks, or capital requirements, or prudential regulations, or the cash flow rights of the bank's controlling owner (if any), this does not change the finding of a negative relationship between concentration and crises. In sum, we did not find much support that a distinguishing characteristic of concentrated

banking systems is that they are easier to monitor than more diffuse systems.

The analyses in this paper are subject to considerable qualifications and interpretational limitations.

First, as our own results emphasize, concentration is not necessarily a reliable indicator of competition (Tirole 1988; Sutton 1991, 1998). Mergers and acquisitions that increase concentration could reflect competition, not the absence of competition. A country with a few banks in a contestable market may be more competitive than a country with lots of banks in segmented monopolies. This does not invalidate this paper's usefulness. Around the world, policymakers, in forming bank regulations, and courts, in assessing antitrust challenges to bank consolidation, use banking system concentration as a signal. Toward this end, our work suggests that (1) banking system concentration is not associated with greater bank instability; rather, it is associated with less fragility and (2) policies and regulations that ease competition lower banking system fragility.

Second, although we use different measures of banking system crises, any examination of systemic crises is constrained by the difficulty in defining and dating a "systemic" crisis. Thus, we interpret these results cautiously and trust that this information is one useful input into assessing the linkages between the market structure of the banking industry, bank regulations, and banking system fragility. Future research that examines the interactions between concentration, bank regulations, and bank fragility at the microeconomic level will provide a very valuable addition to the crises analyses that we provide.

Third, the absence of time series data on bank regulations lowers confidence in the finding that regulatory impediments to bank competition increase fragility. The regulatory indicators are measured toward the end of the sample period, so that these indicators are sometimes measured *after* the crisis. This data limitation is difficult to correct because it is only very recently that detailed data have been collected on bank regulations around the world (Barth, Caprio, and Levine 2001a, 2001b, 2004, 2006). More importantly for the purposes of this paper, this timing issue does not affect the core finding supporting the concentration-stability view, as these results hold when including or excluding the regulatory indicators. Furthermore, sensitivity checks suggest that regulatory impediments to competition did not grow after systemic crises, so that reverse causality does not seem to drive the results.

Finally, our exploratory evidence that (1) supports the view that concentrated banking systems tend to have larger, better-diversified banks and (2) contradicts the view that concentrated banking systems with a few large banks are easier to monitor is just that, exploratory. The measures that we use are highly imperfect measures of diversification and the ease of monitoring. Nevertheless, when including imperfect indicators of diversifica-

tion, this reduces the significance of concentration in the fragility regressions, suggesting that concentration may proxy for banking systems with larger, better-diversified banks. Given the natural skepticism about our proxies, however, considerably more evidence is required before one can draw confident conclusions about the mechanisms underlying the negative relationship between concentration and fragility.

The remainder of the paper is organized as follows. Section 5.2 analyzes the relationship between banking system concentration and systemic crises. Section 5.3 provides additional information on the mechanisms explaining the positive relationship between concentration and banking system stability. Section 5.4 briefly lists conclusions.

## 5.2 Does Bank Concentration Enhance the Risk of Systemic Failure?

In this section, we examine the impact of national bank concentration on the likelihood of a country suffering a systemic banking crisis. Using data on sixty-nine countries over the period 1980–1997, we assess the connection between banking system concentration and the incidence of systemic banking failures.[5] To assess the robustness of our analyses, we (1) use a range of different measures of bank concentration and crises, (2) control for an array of country characteristics, (3) use different estimation procedures and samples of countries, and (4) allow for potential nonlinearities in the relationship between concentration and crises. After describing data and methodology in the first two subsections, we present the regression results.

### 5.2.1 Data

*Data: Crises and Concentration*

Following Lindgren, Garcia, and Saal (1996), Caprio and Klingebiel (1999), and Demirgüç-Kunt and Detragiache (2002), we identify and date episodes of banking sector distress by using information on individual bank failures and reports by national supervisory agencies. Then, these episodes of distress are classified as systemic if (1) emergency measures were taken to assist the banking system (such as bank holidays, deposit freezes, blanket guarantees to depositors or other bank creditors), or (2) large-scale nationalizations took place, or (3) nonperforming assets reached at least 10 percent of total assets at the peak of the crisis, or (4) the cost of the rescue operations was at least 2 percent of GDP. In sum, our sample of sixty-nine countries contains forty-seven crisis episodes. Table 5.1 lists this information.

*Crisis* is a dummy variable that equals 1 if the country is going through

5. Demirgüç-Kunt, Laeven, and Levine (2004) investigate the impact of bank concentration on bank net interest margins, but they do not examine bank fragility.

**Table 5.1** **Bank concentration and competition and banking crises**

| Country | GDP per capita | Crisis period | Concentration |
|---|---|---|---|
| Australia | 17,913 | | 0.65 |
| Austria | 25,785 | | 0.75 |
| Bahrain | 9,398 | | 0.93 |
| Belgium | 24,442 | | 0.64 |
| Benin | 362 | (1988–1990) | 1.00 |
| Botswana | 2,781 | | 0.94 |
| Burundi | 186 | | 1.00 |
| Cameroon | 790 | (1987–1993, 1995–1998) | 0.95 |
| Canada | 18,252 | | 0.58 |
| Chile | 3,048 | (1981–1987) | 0.49 |
| Colombia | 1,802 | (1982–1985) | 0.49 |
| Congo | 940 | | 1.00 |
| Côte d'Ivoire | 843 | (1988–1991) | 0.96 |
| Cyprus | 9,267 | | 0.88 |
| Denmark | 31,049 | | 0.78 |
| Dominican Republic | 1,426 | | 0.65 |
| Ecuador | 1,516 | (1995–1997) | 0.40 |
| Egypt | 905 | | 0.67 |
| El Salvador | 1,450 | (1989) | 0.84 |
| Finland | 23,204 | (1991–1994) | 0.85 |
| France | 24,227 | | 0.44 |
| Germany | 27,883 | | 0.48 |
| Ghana | 356 | (1982–1989) | 0.89 |
| Greece | 10,202 | | 0.79 |
| Guatemala | 1,415 | | 0.37 |
| Guyana | 653 | (1993–1995) | 1.00 |
| Honduras | 694 | | 0.44 |
| India | 313 | (1991–1997) | 0.47 |
| Indonesia | 761 | (1992–1997) | 0.44 |
| Ireland | 13,419 | | 0.74 |
| Israel | 13,355 | (1983–1984) | 0.84 |
| Italy | 17,041 | (1990–1995) | 0.35 |
| Jamaica | 1,539 | (1996–1997) | 0.82 |
| Japan | 35,608 | (1992–1997) | 0.24 |
| Jordan | 1,646 | (1989–1990) | 0.92 |
| Kenya | 336 | (1993) | 0.74 |
| Korea | 6,857 | (1997) | 0.31 |
| Lesotho | 356 | | 1.00 |
| Malaysia | 3,197 | (1985–1988, 1997) | 0.54 |
| Mali | 260 | (1987–1989) | 0.91 |
| Mauritius | 2,724 | | 0.94 |
| Mexico | 3,240 | (1982, 1994–1997) | 0.63 |
| Nepal | 179 | (1988–1997) | 0.90 |
| The Netherlands | 22,976 | | 0.76 |
| New Zealand | 15,539 | | 0.77 |
| Nigeria | 251 | (1991–1995) | 0.83 |
| Norway | 28,843 | (1987–1993) | 0.85 |
| Panama | 2,824 | (1988–1989) | 0.42 |
| Papua New Guinea | 1,024 | (1989–1997) | 0.87 |

**Table 5.1** (continued)

| Country | GDP per capita | Crisis period | Concentration |
|---|---|---|---|
| Peru | 2,458 | (1983–1990) | 0.69 |
| Philippines | 1,070 | (1981–1987) | 0.49 |
| Portugal | 8,904 | (1986–1989) | 0.46 |
| Senegal | 562 | (1988–1991) | 0.94 |
| Sierra Leone | 260 | (1990–1997) | 1.00 |
| Singapore | 20,079 | | 0.71 |
| South Africa | 3,680 | (1985) | 0.77 |
| Sri Lanka | 588 | (1989–1993) | 0.86 |
| Swaziland | 1,254 | (1995) | 0.95 |
| Sweden | 24,845 | (1990–1993) | 0.89 |
| Switzerland | 42,658 | | 0.77 |
| Thailand | 1,886 | (1983–1987, 1997) | 0.54 |
| Togo | 366 | | 1.00 |
| Tunisia | 1,831 | | 0.63 |
| Turkey | 2,451 | (1982, 1991, 1994) | 0.45 |
| United Kingdom | 16,883 | | 0.57 |
| United States | 24,459 | (1980–1992) | 0.19 |
| Uruguay | 5,037 | (1981–1985) | 0.87 |
| Venezuela | 3,558 | (1993–1997) | 0.52 |
| Zambia | 464 | | 0.84 |

*Source:* See table 5A.1 for sources.

*Notes:* GDP per capita is in constant dollars, averaged over the entire sample period, 1980–1997. Crisis period denotes the years in which each country experienced a systemic banking crisis and the duration of said crisis. Concentration is a measure of concentration in the banking industry, calculated as the fraction of assets held by the three largest banks in each country, averaged over 1988–1997.

a systemic crisis, and 0 if it is not. We experiment with different ways of dating and defining crises.[6] First, since crises run for multiple years and since crises may influence concentration and other explanatory variables, implying reverse causality, most of the regressions reported in the tables exclude observations classified as crises after the initial year of the crisis. That is, we only include the initial year of a multiyear crisis. We do include the years after a multiyear crisis is over, which are noncrisis observations.[7] If the country suffers a second crisis, this is included as well. Second, we also conducted the analyses when including crisis observations following the initial year of a multiyear banking crisis. The results are robust to including these years and classifying them as either crisis observations or noncrisis observations. Thus, the results are not sensitive to the classification of

6. Clearly, there may be disagreements about the dating of major crises. For example, the database we are using classifies the United States as having a crisis from 1980–1992, and many may dispute this dating. Nevertheless, we use different dating conventions and we use different subsamples to reduce fears that dating problems drive the results.

7. The results also hold when dropping all postcrisis years for each country experiencing a crisis.

the crisis years following the initial year of multiyear crisis. Again, once each crisis is over, we include the noncrisis years that follow a multiyear crisis in all of the specifications. Third, this paper's findings are robust to changing the definition of a crisis to also include borderline crises as defined by Caprio and Klingebiel (1999). Specifically, borderline cases do not meet the definition of a systemic crisis described previously and instead include cases where a large bank fails. We do not believe it is appropriate to include borderline cases because we are assessing the impact of banking system concentration on systemic banking crises, not the failure of a large bank. In sum, while recognizing that there is no single, unanimous definition of a systemic banking crisis, the primary goal of this section is to provide a cross-country, time series assessment of the relationship between national bank concentration and crises. The identified relationship is robust to using these different definitions of a systemic crisis.

*Concentration* equals the share of total banking system assets held by the three largest banks. The data are from the Bankscope database. 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. As reported in tables 5.1 and 5.2, most countries have concentrated banking systems with a sample mean of 72 percent. Still, there is wide cross-country variation in the sample, with concentration levels ranging from less than 20 percent for the United States to 100 percent for many African countries. Simple correlations show a significant negative relationship between the crisis dummy and bank concentration.

In robustness tests, we consider a number of different concentration measures. This paper's results hold when using (1) annual concentration values, (2) concentration from Bankscope measured at the beginning of the sample period (1988), and (3) a measure of concentration based on the Barth, Caprio, and Levine (2004) survey of bank supervisory agencies regarding deposits in banks.[8] Moreover, by confirming our results using the initial level of concentration at the start of the sample period, we reduce reverse causality concerns. Unfortunately, using initial values cuts the number of observations in half. Thus, we focus on the data averaged over the entire period.

*Data: Core Control Variables*

To investigate the relationship between systemic banking crises and banking system concentration, we condition on an assortment of macro-

8. This alternative measure of concentration is from the Barth, Caprio, and Levine (2004) survey 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, Caprio, and Levine is 52 percent, and is significant at the 1 percent level.

economic and regulatory factors that may also influence banking system fragility.

We start with the explanatory variables from DD's (2002) examination of the determinants of banking system crises. DD (2002) include four contemporary explanatory variables to control for macroeconomic factors that may affect the quality of bank assets and bank profitability: (1) national economic growth (*real GDP growth*), (2) changes in the external terms of trade (*terms of trade change*), (3) the rate of inflation (*inflation*), and (4) the short-term real interest rate (*real interest rate*). DD (2002) include two variables to control for international forces influencing bank vulnerability: (1) the rate of exchange rate depreciation (*depreciation*) and (2) the ratio of M2 to foreign exchange reserves (*M2/reserves*). Since rapid credit growth may signal an asset price bubble, DD (2002) include lagged credit growth (*credit growth*$_{t-2}$). To condition on the overall level of economic development, DD (2002) also include the level of real per capita GDP (*GDP per capita*). In robustness tests, we also include DD's (2002) measure of deposit insurance generosity (*moral hazard*). 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, which 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.

Simple correlations in table 5.2 suggest that banking crises are more likely in countries with less concentrated banking systems, higher levels of inflation and exchange rate depreciation, and less likely in growing countries with higher GDP per capita and higher real interest rates. Crises are more likely in countries with more generous deposit insurance.

*Data: Bank Regulation and Supervision Control Variables*

We augment the benchmark specification from DD (2002) by including measures of bank regulation and supervision from Barth, Caprio, and Levine (2001a, 2001b, 2004). These data on bank supervision and regulation around the world were collected through surveys of government officials from over 100 countries in 1999. This is a problem, because the crises regressions are run over the period 1980–1997. Thus, the regulatory indicators are measured *after* the dependent variable. Besides the fact that no other dataset has the level of cross-country detail on bank regulations, we offer three additional defenses for using these data in the crisis regressions (despite the timing problem). First, Barth, Caprio, and Levine (2001b) show that the regulatory restrictions on bank activities did not change much following systemic crises. Moreover, in the few cases when they did change,

**Table 5.2** **Summary statistics and correlations**

| | Mean | Median | Standard deviation | Maximum | Minimum | Observations |
|---|---|---|---|---|---|---|
| | | | *A. Summary statistics* | | | |
| Banking crisis | 0.04 | 0.00 | 0.20 | 1.00 | 0.00 | 1,230 |
| Real GDP growth | 3.41 | 3.45 | 4.25 | 23.60 | –17.15 | 1,216 |
| Terms of trade change | 0.15 | 0.01 | 10.30 | 63.24 | –51.45 | 1,191 |
| Real interest rate | 1.58 | 2.68 | 19.34 | 151.21 | –283.00 | 1,160 |
| Inflation | 14.07 | 7.75 | 23.42 | 350.56 | –29.17 | 1,220 |
| M2/reserves | 19.87 | 6.56 | 68.86 | 1,289.31 | 0.19 | 1,222 |
| Depreciation | 0.10 | 0.04 | 0.22 | 2.62 | –0.35 | 1,238 |
| Credit growth$_{t-2}$ | 6.01 | 5.09 | 15.84 | 115.42 | –54.62 | 1,203 |
| Real GDP per capita | 7,813.94 | 2,302.37 | 10,299.92 | 45,950.46 | 134.54 | 1,222 |
| Moral hazard | –1.09 | –2.49 | 2.24 | 3.98 | –2.49 | 1,238 |
| Concentration | 0.72 | 0.77 | 0.21 | 1.00 | 0.19 | 1,106 |
| Banking freedom | 3.36 | 3.00 | 0.88 | 5.00 | 1.00 | 1,184 |

| | Banking crisis | Real GDP growth | Terms of trade change | Real interest rate | Inflation | M2/reserves | Depreciation | Credit growth$_{t-2}$ | Real GDP per capita | Moral hazard | Concentration |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *B. Correlations: Banking crisis, concentration, macro indicators, and institutions* | | | | | | | |
| Real GDP growth | 0.158*** | 1.000 | | | | | | | | | |
| Terms of trade change | –0.032 | 0.029 | 1.000 | | | | | | | | |
| Real interest rate | 0.079*** | 0.093*** | –0.053* | 1.000 | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inflation | 0.103*** | –0.117*** | 0.043 | –0.980*** | 1.000 | | | | | | |
| M2/reserves | 0.094*** | –0.117*** | 0.015 | 0.011 | –0.017 | 1.000 | | | | | |
| Depreciation | 0.171*** | –0.194*** | 0.002 | –0.561*** | 0.642*** | –0.035 | 1.000 | | | | |
| Credit growth$_{t-2}$ | –0.023 | 0.040 | 0.008 | 0.004 | –0.015 | –0.097*** | –0.103*** | 1.000 | | | |
| Real GDP per capita | 0.090*** | –0.084*** | 0.015 | 0.029 | –0.051* | –0.053* | –0.226*** | –0.014 | 1.000 | | |
| Moral hazard | 0.078*** | –0.004 | 0.030 | 0.028 | –0.037 | –0.058** | –0.096*** | –0.015 | 0.459*** | 1.000 | |
| Concentration | –0.062** | –0.061** | –0.004 | 0.004 | –0.002 | 0.093*** | 0.040 | –0.054* | 0.263*** | –0.399*** | 1.000 |
| Banking freedom | 0.183*** | 0.019 | –0.012 | 0.018 | –0.022 | 0.098*** | 0.070** | –0.020 | 0.456*** | –0.142*** | 0.257*** |

*Source:* See table 5A.1 for sources.

*Notes:* Summary statistics are presented in Panel A and correlations in Panel B. Banking crisis is a crisis dummy, which takes on the value of 1 if there is a systemic crisis and the value of zero otherwise. Growth is the rate of growth of real GDP. 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 a measure of concentration in the banking industry, calculated as the fraction of assets held by the three largest banks in each country, averaged over the sample period. Banking freedom is an indicator of the relative openness of the banking system.

***Indicates significance at the 1 percent level.

**Indicates significance at the 5 percent level.

*Indicates significance at the 10 percent level.

there was a change toward fewer regulatory restrictions. Thus, the timing of the Barth, Caprio, and Levine (2001b) data actually biases the results against finding a positive relationship between regulatory restrictions on bank activities and the likelihood of suffering a systemic crisis. Second, Carkovic and Levine (2002) show that the bank regulations that compose the Barth, Caprio, and Levine (2001b) survey have remained virtually unchanged in Chile during the decade of the 1990s. Third, Barth, Caprio, and Levine's (2006) follow-up survey indicates that there have been remarkably few substantive changes in bank regulatory regimes since the initial survey in 1999, which advertises the stability of bank supervisory and regulatory policies. Nevertheless, timing issues are an important constraint on our ability to draw confident conclusions on the market power, diversification, and easier monitoring explanations of why concentration is associated with more stable banking systems.

We include bank regulation indicators to accomplish three objectives. 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. Finally, examining the relationship between bank regulations and banking system stability is independently valuable, since countries may implement regulations to promote banking system stability. The timing problem primarily, though not necessarily exclusively, affects this last motivation for including the regulatory controls: the fact that regulations are measured after crises reduces the confidence we have in the results on regulations.

*Fraction of entry denied* equals the number of entry applications denied as a fraction of the number of applications received from domestic and foreign entities, which is a measure of entry restrictions in banking and thus the contestability of the market. If entry restrictions only increase bank profits, this would be associated with a lower rate of fragility. If, however, entry restrictions induce inefficiencies in the banking market, then they could lead to greater fragility.

*Activity restrictions* is an index of regulatory restrictions on bank activities. This includes information on regulations regarding bank activities in the securities, insurance, real estate markets, and banks owning nonfinancial firms. For each of these four categories of bank activities each country is given a score of 1 through 4, depending on the degree to which regulations restrict bank activity in each area: (1) unrestricted, (2) permitted, (3) restricted, or (4) prohibited. The aggregate indicator has therefore a range from 4 to 16, with higher numbers indicating more restrictions on bank activities. If these activity restrictions keep banks from entering risky lines of

business, then Activity Restrictions will tend to reduce the probability of crises. If, however, regulatory restrictions on bank activities prevent firms from diversifying risks, then higher values of Activity Restrictions will tend to increase the probability of suffering a systemic crisis.

*Required reserves* equals the ratio of bank deposits 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 each country's capital stringency requirements, taken from Barth, Caprio, and Levine (2004). To the extent that book capital is an accurate measure of bank solvency we expect better-capitalized banks to be less fragile. Also, capital regulations are a focus of Basel agreements to reduce systemic risk. Thus, including an index of national capital regulations will provide information on whether cross-country differences in one of the three pillars of the Basel II Accord on prudential bank supervision and regulation actually explain differences in banking system fragility. Problematically, however, Barth, Caprio, and Levine (2006) stress that Basel's success and the lack of historical data on capital regulations makes it difficult to assess the impact of capital regulations. Specifically, because Basel has successfully harmonized capital regulations over the past decade, there may be insufficient cross-country variation in the Capital Regulatory Index to explain systemic crises.

*Official supervisory power* is an index of the power of the commercial bank supervisory agency to monitor and discipline banks (Barth, Caprio, and Levine 2004). It includes information on the legal power of the supervisory authority to (1) meet with, demand information from, and impose penalties on auditors, (2) force a bank to change its internal organizational structure, managers, directors, and so on, (3) oblige the bank to provision against potential bad loans, suspend dividends, bonuses, management fees, and to supersede the rights of shareholders, and (4) intervene a bank and/or declare a bank insolvent. The appendix provides a more detailed definition of Official Supervisory Power. An emphasis of the Basel II accord on prudential supervision and regulation is to strengthen official monitoring of banks. We use this indicator of the power of the supervisory authority to assess the robustness of the results on concentration and to examine the relationship between Official Supervisory Power and the probability that a country suffers a systemic crisis.

*Data: Bank Ownership Control Variables*

Next, we also control for ownership.

*State ownership* equals the percentage of banking system assets controlled by banks that are 50 percent or more government owned, which is

taken from the Barth, Caprio, and Levine (2001a, 2001b) database.[9] If government-owned banks enjoy greater government support than private banks, then banking systems with a larger share of public banks may experience fewer banks runs and fewer (overt) banking crises. However, inefficiencies in public banks may also make them more fragile, as argued by Caprio and Martinez-Peria (2000). While providing evidence on the relationship between ownership and crises, we use State Ownership as a control variable to test the robustness of the results between concentration and crises. There is not a significant correlation between State Ownership and crises.

*Foreign ownership* equals the percentage of the banking system's assets in banks that are 50 percent or more foreign owned, which is also taken from the Barth, Caprio, and Levine (2001a, 2001b) database. Foreign banks may bring better banking practices that improve the operation and safety of the banking system (Claessens, Demirgüç-Kunt, and Huizinga 2001). On the other hand, greater openness to foreign banks could intensify competition, reduce profits, and hurt stability. Thus, it is an empirical question as to whether, on net, foreign bank ownership stabilizes or destabilizes a banking system. Again, our goal is to assess the robustness of the relationship between concentration and crises, not to fully explore the impact of foreign banks on the operation of a domestic financial system. The simple correlation between Foreign Ownership and crises is insignificant.

*Data: Openness, Competition, Institutional Control Variables*

Finally, we include additional control variables for the general openness, competitiveness, and institutional development of the banking sector in particular and the economy more generally. There is overlap between some of these general indexes and the individual regulatory and ownership variables defined earlier. Also, there is overlap between these general indicators. Thus, we note these overlaps in defining the variables and do not include them simultaneously in the regressions that follow.

*Banking freedom* is an indicator of the relative openness of the banking system. We obtain these data from the Heritage Foundation and use an average over the period 1995–1997. It is a composite index of the barriers foreign banks and financial services firms face in conducting banking operations, how difficult it is to open domestic banks and other financial services firms, how heavily regulated the financial system is, the presence of state-owned banks, whether the government influences allocation of credit, and

9. As a robustness check, we employ a different measure of state ownership than La Porta, Lopez-de-Silanes, and Shleifer (2002), which equals the percentage of government ownership (voting rights) of the assets of the ten largest banks in each country where ownership of each bank is weighted by the assets of that bank. Thus, the La Porta, Lopez-de-Silanes, and Shleifer (2002) measure does not define bank ownership in terms of voting rights greater than 50 percent. We get the same results with both measures.

whether banks are restricted from providing insurance and securities market services to clients. Higher values indicate fewer restrictions on banking freedoms. This aggregate Banking Freedom indicator also uses information from the regulatory restrictions, entry restrictions, and ownership indicators discussed previously. We include this for two reasons. First, debate exists on the impact of official restrictions on bank operations. On the one hand, fewer official impediments to bank operations and entry could stimulate efficiency and diversification, which promotes stability. On the other hand, greater banking freedom could induce destabilizing competition. We provide information on this debate. Second, official impediments to banking freedom could influence both concentration and fragility. Since our goal is to assess the independent link between concentration and crises, we test the robustness of the findings to controlling for banking freedom.

*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. We obtain these data from the Heritage Foundation and use an average over the period 1995–1997. Higher scores indicate policies more conducive to competition and economic freedom. Also, Banking Freedom is a subcomponent of Economic Freedom, which includes information on economic freedom beyond the banking industry. To the extent that freedoms allow banks to improve efficiency and to engage in different activities and diversify their risks, we expect an increased level of freedoms to reduce fragility. However, it is also true that greater freedoms allow banks to undertake greater risks, particularly if the underlying institutional environment and existing regulations and supervision distort risk-taking incentives. Thus, overall greater freedom may also lead to greater bank fragility. Thus, we (1) examine the relationship between economic freedom and crises and (2) assess the strength of the relationship between concentration and crises conditional on overall economic freedom.

*KKZ composite* is an index of the overall level of institutional development constructed by Kaufman, Kraay, and Zoido-Lobaton (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. Simple correlations indicate that the crisis dummy is negatively and significantly correlated with the two freedom indicators and the institutions variable. Countries with better institutions also tend to have more competitive banking systems with fewer regulatory restrictions. Thus, it is independently valuable to examine the relationship between institutional development and banking system stability. At the same time, we use KKZ Com-

posite to gauge the strength of the independent relationship between concentration and crises.

### 5.2.2 Methodology

Methodologically, to estimate the crisis model we follow Cole and Gunther (1995), Gonzalez-Hermosillo, Pazarbasioglu, and Billings (1997), Demirgüç-Kunt (1989), and DD (1998, 2002) and use a logit probability model with standard errors that are robust to heteroskedasticity. Specifically, 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 explanatory variables ($X[i, t]$). Let $P(i, t)$ denote a dummy variable that takes the value of 1 when a banking crisis occurs in country $i$ and time $t$ and a value of zero otherwise. $\beta$ is a vector of $n$ unknown coefficients and $F(\beta' X[i, t])$ is the cumulative probability distribution function evaluated at $\beta' X(i, t)$. Then, the log-likelihood function of the model is

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

We also conducted robustness tests using alternative estimation procedures. First, this core specification allows for heteroskedasticity but assumes that the errors are independent. We confirm the results, however, when allowing for clustering of the errors within countries, which requires that the error terms are independent across countries but not within countries. Second, the results hold when estimating a logit model with random country effects.

### 5.2.3 Results

The paper finds that crises are less likely in more concentrated banking systems using different measures of concentration and conditioning on different country characteristics. As shown in table 5.3, concentration always enters with a negative and significant coefficient. Regression 1 presents our baseline specification, where we exclude observations classified as crises after the first year of a multiyear banking crisis. Regressions 2 and 3 include crisis observations after the initial crisis year. In column 2, crisis observations following the initial year of a multiyear crisis are classified as crises.[10] In column 3, crisis observations after the initial year of a multiyear crisis are classified as noncrisis observations.[11] In all three regressions, concentration enters negatively and significantly.

The negative relationship between concentration and crises is robust to

10. This explains the entry of 202 crises in column 2 of table 5.3. When we include all of the years of each multiyear banking crisis, this adds an additional 155 crisis observations to the number reported in regressions 1 and 3.

11. In all three specifications, we include observations after the crisis is over. Thus, we include the switch from crisis to the noncrisis state.

**Table 5.3 Banking crisis and concentration**

| | Specification | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Real GDP growth | –0.163*** | –0.088*** | –0.136*** | –0.306*** | –0.164*** | –0.164*** |
| | (0.035) | (0.020) | (0.030) | (0.074) | (0.035) | (0.033) |
| Terms of trade change | –0.013 | –0.008 | –0.011 | –0.034 | –0.015 | –0.012 |
| | (0.012) | (0.007) | (0.012) | (0.024) | (0.013) | (0.012) |
| Real interest rate | 0.010*** | 0.006** | 0.002 | 0.009 | 0.010*** | 0.010*** |
| | (0.004) | (0.003) | (0.004) | (0.009) | (0.004) | (0.004) |
| Inflation | 0.009 | 0.006** | –0.002 | –0.016 | 0.009 | 0.008 |
| | (0.009) | (0.003) | (0.005) | (0.024) | (0.008) | (0.009) |
| M2/reserves | 0.002* | 0.002** | 0.001 | 0.001 | 0.002* | 0.002 |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) |
| Depreciation | 0.453 | 0.624 | 0.706 | 1.802 | 0.777 | 0.491 |
| | (1.142) | (0.425) | (0.991) | (2.696) | (1.133) | (1.151) |
| Credit growth$_{t-2}$ | 0.014* | –0.001 | 0.012 | 0.028*** | 0.015* | 0.014 |
| | (0.009) | (0.005) | (0.009) | (0.012) | (0.009) | (0.009) |
| Real GDP per capita | –0.004* | –0.000*** | –0.000* | –0.006* | | –0.002 |
| | (0.002) | (0.000) | (0.000) | (0.004) | | (0.002) |
| Concentration | –1.946*** | –1.479*** | –1.696** | –3.744*** | –1.607** | –1.845*** |
| | (0.797) | (0.415) | (0.747) | (1.430) | (0.805) | (0.797) |
| G10 countries | | | | | | 1.011 |
| | | | | | | (2.332) |
| G10 countries × concentration | | | | | | –3.287 |
| | | | | | | (5.091) |
| No. of crises | 47 | 202 | 47 | 20 | 47 | 47 |
| No. of observations | 989 | 1,144 | 1,144 | 410 | 989 | 989 |
| Percent crises correct | 68 | 57 | 64 | 70 | 68 | 70 |
| Percent correct | 73 | 66 | 67 | 76 | 72 | 72 |
| Model $\chi^2$ | 47.83*** | 75*** | 37.37*** | 40.34*** | 38.19*** | 46.38*** |

*Sources:* See table 5A.1 for sources.

*Notes:* 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$_{j,t} + \beta_9$ Average concentration$_{j,t} + \beta_{10}$ G10 countries$_{j,t} + \varepsilon_{j,t}$. The dependent variable is a crisis dummy that takes on the value of one if there is a systemic crisis and the value of zero otherwise. Growth is the rate of growth of real GDP. 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. G10 country is a dummy variable that takes the value 1 for G10 countries and zero otherwise. Concentration is a measure of concentration in the banking industry, calculated as the fraction of assets held by the three largest banks in each country, averaged over the sample period. Banking freedom measures the relative openness of the banking and financial system. The sample period is 1980–1997. Specification (1) excludes all crisis observations after the initial year of crisis. Specification (2) includes the crisis periods (after the initial crisis year) as crisis observations. Specification (3) includes the crisis periods (after the initial crisis year) as non-crisis observations. In specification (4) Average Concentration is replaced by the Initial Concentration, and is restricted to the actual starting date and years following that date. Specification (5) omits real GDP per capita. Specification (6) includes G10 country dummy and its interaction with concentration. White's heteroskedasticity consistent standard errors are given in parentheses. See table 5A.1 for detailed variable definitions.

***Indicates significance at the 1 percent level.

**Indicates significance at the 5 percent level.

*Indicates significance at the 10 percent level.

alternative specifications and to controlling for reverse causality. If systemic crises reduce concentration, then it would be inappropriate to interpret our early results as implying that concentration reduces banking system fragility. Thus, in regression 4, we use the value of banking system concentration measured at the beginning of the sample period instead of concentration averaged over the period. Even when using initial concentration, however, we continue to find a negative relationship between concentration and crises. Regression 5 shows that the results do not depend on including or excluding real GDP per capita. Regression 6 assesses whether the results change if the country is a Group of Ten (G10) country. We see that country membership in the G10 does not alter the results on concentration. Further, the insignificant interaction between concentration and membership in G10 indicates that the relationship between concentration and systemic banking fragility does not vary between the G10 countries and the remainder of the sample.

Among the control variables in table 5.3, annual real GDP growth enters negatively and significantly throughout. This suggests that macroeconomic success reduces the likelihood of suffering a crisis. Or, to phrase this differently, recessions increase banking system fragility. The estimates also indicate that real interest rate enters positively, which confirms earlier research (DD 1999).

Furthermore, the economic impact of banking system concentration on the likelihood of a country suffering a systemic crisis is large. We evaluate the marginal impact of concentration on the probability of crisis at the mean values for all variables using regression 1 from table 5.3. The estimates indicate that a 1 standard deviation increase in concentration leads to a decrease in crisis probability of 1 percent. Since crisis probabilities at any point in time are quite low, with a mean value of 4 percent, this is a substantial reduction. We have recalculated the economic impact of a marginal increase in bank concentration when using a sample that includes the year after the initial year of the crisis. Using this larger sample, we find an even larger economic impact of concentration on crises than in the core regression presented in table 5.3.

This paper's findings hold when allowing for a potential nonlinear relationship between concentration and crises. First, we added a simple quadratic term and found no evidence of a nonlinear relationship. Next, we estimated piecewise regressions, where concentration was broken into (a) quintiles and then (b) deciles. The results indicate that the stabilizing effect of concentration becomes significant after the first quintile (second decile), where the quintile and decile analyses identify consistent cutoffs. The data indicate that there is a statistically significant, negative relationship between concentration and banking system fragility for levels of concentration above 35 percent, and the marginal impact of a change in concentration does not vary significantly beyond this 35 percent cutoff. This cutoff

is low, considering that the sample mean value of national banking system concentration is 72 percent. There is never a positive relationship between concentration and fragility. Third, we examine whether concentration has different effects in different institutional settings by interacting concentration and our measures of institutional development (Economic Freedom and KKZ composite). Again, this did not change the result of a negative relationship between bank concentration and the probability of suffering a systemic crisis.

The negative relationship between crises and concentration also holds when using different samples of countries. Specifically, we excluded all countries with populations less than 1 million, less than 10 million, and less than 20 million, respectively. The coefficient on concentration remains negative and significant across these three different samples of countries. Next, we excluded all sub-Saharan African countries, since they tend to have very high bank concentration ratios, and we eliminated the G10 countries because their high level of institutional development may not be captured appropriately with the control variables. Again, these two different samples yield the same results. Finally, we excluded a few country-year data points where the data seem to be mismeasured, because the values are extraordinarily different from the country's average value over the sample.[12] The results do not change.

In sum, these results are consistent with the concentration-stability theory's argument that banking systems characterized by a few large banks are more stable than less concentrated banking markets. There is certainly no evidence that banking system concentration increases banking sector fragility. Furthermore, the inverse relationship between banking system concentration and the likelihood of suffering a systemic crisis holds when allowing for possible nonlinear links between concentration and fragility and when using different samples of countries. Next, we assess the robustness of these results to conditioning on additional country-specific traits.

### 5.2.4 Additional Sensitivity Tests and Discussion

*Additional Country Level Controls*

In table 5.4, we confirm the findings on the relationship between banking sector concentration and systemic crises when controlling for (1) moral hazard associated with deposit insurance, (2) different bank regulations, (3) the ownership of banks, and (4) general indicators of banking freedom, economic freedom, and institutional development. The results hold when controlling for moral hazard, fraction of entry applications denied, activity

12. Specifically, we eliminate Côte d'Ivoire (1993) because their M2/reserves values are very different for that year. Similarly, in these outlier tests, we exclude Peru (1991) because its inflation and real interest rate values are so different from other years.

**Table 5.4** **Banking crisis, regulation, and concentration**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Concentration | –1.467** | –2.556* | –2.285*** | –2.472*** | –2.847*** | –2.533** | –2.796*** | –2.524*** | –1.953*** | –1.930*** | –1.881*** |
| | (0.565) | (1.552) | (0.939) | (1.060) | (1.142) | (1.096) | (1.091) | (1.083) | (0.806) | (0.809) | (0.769) |
| Moral hazard | 0.037 | | | | | | | | | | |
| | (0.075) | | | | | | | | | | |
| Fraction of entry denied | | 1.885*** | | | | | | | | | |
| | | (0.737) | | | | | | | | | |
| Activity restrictions | | | 0.166** | | | | | | | | |
| | | | (0.072) | | | | | | | | |
| Official Supervisory Power | | | | –0.021 | | | | | | | |
| | | | | (0.166) | | | | | | | |
| Required reserves | | | | | 0.016 | | | | | | |
| | | | | | (0.016) | | | | | | |
| Capital regulatory index | | | | | | –0.079 | | | | | |
| | | | | | | (0.129) | | | | | |
| State ownership | | | | | | | 0.015* | | | | |
| | | | | | | | (0.008) | | | | |
| Foreign ownership | | | | | | | | –0.005 | | | |
| | | | | | | | | (0.008) | | | |
| Banking freedom | | | | | | | | | –0.506*** | | |
| | | | | | | | | | (0.165) | | |
| Economic freedom | | | | | | | | | | –0.513*** | |
| | | | | | | | | | | (0.225) | |
| KKZ_composite | | | | | | | | | | | –0.439** |
| | | | | | | | | | | | (0.201) |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of crises | 47 | 21 | 34 | 34 | 27 | 33 | 32 | 31 | 47 | 47 | 47 |
| No. of observations | 989 | 583 | 767 | 767 | 572 | 755 | 686 | 609 | 955 | 955 | 989 |
| Percent crises correct | 66 | 62 | 68 | 62 | 63 | 61 | 66 | 68 | 68 | 66 | 68 |
| Percent correct | 71 | 81 | 79 | 78 | 77 | 79 | 74 | 73 | 70 | 70 | 72 |
| Model [2] | 37.93*** | 29.34*** | 38.21*** | 38*** | 30.46*** | 37.62*** | 30.97*** | 34.15*** | 52.41*** | 47.58*** | 49.59*** |

*Source:* See table 5A.1 for sources.

*Notes:* 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 $\text{rate}_{j,t} + \beta_4$ $\text{Inflation}_{j,t} + \beta_5$M2/reserves$_{j,t} + \beta_6$Depreciation$_{j,t} + \beta_7$ Credit $\text{growth}_{j,t-2} + \beta_8$ $\text{Concentration}_{j,t} + \beta_9$ Regulatory $\text{measure}_{j,t} + \varepsilon_{j,t}$. 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 growth rate of real GDP. Real interest rate is the nominal interest rate minus the inflation rate. 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. Concentration equals the fraction of assets held by the three largest banks in each country, averaged over the sample period. Moral Hazard is an aggregate index of moral hazard associated with variations in deposit insurance design features. Fraction of entry denied measures the number of entry applications denied as a fraction of the total received. Activity restrictions captures bank's ability to engage in business of securities underwriting, insurance underwriting and selling, and in real estate investment, management, and development. Official Supervisory Power is an index of the power of supervisory agency to enforce prudential regulations on banks. Required reserves is the percentage of deposits regulators require banks to hold as reserves. Capital regulatory index is a summary measure of capital stringency. State ownership is the percentage of banking system's assets in banks that are 50 percent or more government owned. Foreign ownership is the percentage of banking system's assets in banks that are 50 percent or more foreign owned. Banking freedom is an indicator of relative openness of banking and financial system, while economic freedom is a composite of ten institutional factors determining economic freedom, KKZ composite is an aggregate measure of six governance indicators. White's heteroskedasticity consistent standard errors are given in parentheses. The sample period is 1980–1997. See table 5A.1 for detailed variable definitions

***Indicates significance at the 1 percent level.

**Indicates significance at the 5 percent level.

*Indicates significance at the 10 percent level.

restrictions, official supervisory power, required reserves, and the capital regulatory index (regressions 1–6). The significance level on concentration falls to a 10 percent level when including fraction of entry applications denied, but data limitations on fraction of entry applications denied cuts the sample from 989 to 583 observations. Furthermore, concentration remains negatively associated with crises at the 1 percent significance level when controlling for state or foreign ownership of banks (regressions 7 and 8). In terms of broad measures such as banking freedom or general indicators of economic freedom and institutional development (KKZ composite), concentration continues to enter the crisis regressions negatively and significantly at the 1 percent level (regression 9–11). The regressions in table 5.4 do not include GDP per capita because (1) the regulatory/institutional variables are highly correlated with the level of development and (2) GDP per capita is often used to proxy for institutional development. However, including GDP per capita in table 5.4 does not change the conclusions on concentration.

Beyond concentration, the table 5.4 results 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, Caprio, and Levine (2004), who examine the impact of entry restrictions and regulatory restrictions on bank activities 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 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.

Overall, the results do not provide support for Basel II's emphasis on capital regulations and more stringent regulations. We do not find that stricter capital regulations or greater official supervisory power lowers the probability that a country will suffer a systemic crisis. While it is natural and appropriate to question these results because of the timing issues emphasized earlier, we are unaware of cross-country research that finds that banking system stability is enhanced by countries adopting official supervisory and regulatory regimes that impose stricter capital regulations or more stringent prudential regulations. Indeed, a growing body of evidence suggests that strengthening official supervisory power can actually increase corruption in lending and reduce banking system efficiency (Barth, Caprio, and Levine 2006; Beck, Demirgüç-Kunt, and Levine 2006; Demirgüç-Kunt, Laeven, and Levine 2004). Finally, confirming earlier research, we also see that state ownership is associated with greater fragility, albeit significant only at 10 percent (Caprio and Martinez-Peria 2000).

Furthermore, the results in table 5.4 suggest that openness, competition, and institutional development foster greater banking system stability. Countries with greater freedoms in banking (banking freedom) and generally more competitive economic systems (economic freedom) are less likely to experience banking crises (regressions 9 and 10). This finding suggests that concentration is not simply proxying for the degree of competition in the banking industry. Better institutional environment is also associated with a lower probability of systemic crisis (regression 11). The evidence is consistent with theories that emphasize the stabilizing effects of openness and competition, but inconsistent with the many models that stress the destabilizing effects from competition.[13]

*Costs of Banking Crises*

We also assessed whether countries with concentrated banking systems have bigger, more costly banking crises. If (1) concentrated banking systems are more likely to have too-big-to-fail policies and (2) too-big-to-fail policies induce greater risk-taking and (3) too-big-too fail policies can operate for only some fixed period of time, then this suggests that crises will be larger, though less frequent, in concentrated banking systems. If this were the case, then our findings that concentration is associated with a lower probability of suffering a systemic crisis may provide a misleading impression of the concentration-stability relationship.

Thus, in table 5.5, we examine the relationship between banking system concentration and the costs of banking crises. To include countries that suffered no crises in the sample, we use a Tobit model, where zero implies that the country did not experience a banking crisis. We use three different measures of banking crisis costs.

As shown in table 5.5, we find no evidence for the contention that more concentrated banking systems have more costly crises. Concentration does not enter significantly at the 5 percent level in any of the regressions. It enters with a negative coefficient across the different cost measures. Given the lack of a robust relationship, however, we do not draw the conclusion that concentration reduces both the likelihood and the size of crises.

## 5.3 Why Is Concentration Stabilizing? Additional Evidence from Crisis Data

Although the finding of a negative relationship between banking system concentration and the likelihood of suffering a systemic crisis is consistent

13. Boyd and De Nicoló (2005) stress that competition exerts a stabilizing impact on banks because more competitive banks charge lower interest rates to firms and these lower rates reduce the likelihood of default. This prediction is consistent with our results. However, Boyd and De Nicoló (2005) use bank concentration as an indicator of bank competition. Thus, they stress that concentration will exert a destabilizing impact on banks, which is inconsistent with our results.

**Table 5.5 Banking crisis and concentration: Cost of crises**

| | Specification | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Real GDP growth | 3.821*** | 3.614*** | 1.553** |
| | (0.811) | (0.857) | (0.814) |
| Terms of trade change | –0.929* | –0.832 | 0.047 |
| | (0.489) | (0.593) | (0.444) |
| Real interest rate | 0.235 | 0.591** | –0.139 |
| | (0.191) | (0.291) | (0.257) |
| Inflation | 1.050*** | 1.198*** | 0.316 |
| | (0.196) | (0.272) | (0.225) |
| M2/reserves | 0.144*** | 0.080** | 0.126*** |
| | (0.029) | (0.036) | (0.029) |
| Depreciation | –57.818*** | –141.172*** | –26.592 |
| | (16.742) | (32.809) | (21.046) |
| Credit growth$_{t-2}$ | 0.217 | 0.185 | 0.087 |
| | (0.141) | (0.155) | (0.178) |
| Real GDP per capita | 0.000** | 0.000 | –0.000 |
| | (0.000) | (0.000) | (0.000) |
| Moral hazard index | 0.408 | 0.764 | 1.343* |
| | (0.887) | (0.912) | (0.820) |
| Concentration | –8.261 | –15.006* | –2.269 |
| | (7.499) | (9.207) | (9.355) |
| No. of observations | 47 | 49 | 69 |

*Notes:* The Tobit model estimated takes the form: Cost of crisis$_{[Country=j]}$ = $\alpha + \beta_1$ Real GDP growth$_j$ + $\beta_2$ Terms of trade change$_j$ + $\beta_3$ Real interest rate$_j$ + $\beta_4$ Inflation$_j$ + $\beta_5$M2/reserves$_j$ + $\beta_6$Depreciation$_j$ + $\beta_7$ Credit growth$_j$ + $\beta_8$ Moral hazard index$_j$ + $\beta_9$ Concentration$_j$ + $\varepsilon_j$. The dependent variables capture the fiscal cost of crisis. In specification (1) we focus on one variation of the Klingebiel-Honohan fiscal cost measure, while in specifications (2) focus is on the second variation of the Klingebiel-Honohan fiscal cost measure. Specification (3) examines the Boyd and Smith measure of cost of crisis. Growth is the rate of growth of real GDP. 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. Depreciation is the rate of change of the exchange rate. Credit growth is the real growth of domestic credit, lagged two periods. Moral hazard is an aggregate index of moral hazard associated with varying deposit insurance schemes. Concentration is a measure of concentration in the banking industry, calculated as the fraction of assets held by the three largest banks in each country, averaged over the sample period. White's heteroskedasticity-consistent standard errors are given in parentheses. Detailed variable definitions and sources are given in the data appendix.

***Indicates significance at the 1 percent level.

**Indicates significance at the 5 percent level.

*Indicates significance at the 10 percent level.

with the concentration-stability view (tables 5.3 and 5.4), the results do not distinguish among possible explanations of this finding. Why is concentration stabilizing? This section explores the validity of different explanations for why bank concentration lowers banking system fragility.

### 5.3.1 Is It Market Power and Bank Profits?

One possible argument is that the level of bank concentration proxies for the degree of competition in the banking industry. According to this market power view, powerful banks (either directly or through policymakers) restrict competition, which boosts bank profits, lowers incentives for risk taking, and thus reduces systemic risk. Thus, the finding of a negative relationship between banking system concentration and systemic crises is consistent with the view that banking sector concentration increases banking system stability by reducing the openness and competitiveness of the banking industry.

In contrast to this market power explanation of how concentration promotes banking system stability, however, note that concentration remains negatively associated with crises even when controlling for regulatory restrictions on bank activities and measures of the openness and competitiveness of the banking industry and the economy more generally. Thus, to the extent that these variables adequately control for competition, the findings suggest that something else besides market power is driving the negative relationship between bank concentration and bank fragility.

The findings on bank regulations, banking freedom, economic freedom, and institutional development also run counter to the view that competition intensifies fragility. Restrictions on competition and openness—such as regulatory impediments to the entry of new banks, or regulatory barriers to banks engaging in nonlending services, or general indicators of the openness of the banking industry or the overall economy—do not reduce the probability of suffering a systemic banking crisis (table 5.4). Thus, the findings that (1) concentration lowers banking system fragility and (2) low competition raises banking system fragility imply that concentration is not proxying for the degree of competition in the banking industry.

However, the measures of bank regulation, bank freedom, economic freedom, and institutional development may not sufficiently control for competition in banking. Thus, given the difficulty in adequately controlling for the competitive environment using regulatory indicators, some may view the table 5.4 results as too weak to discard the market power explanation of why concentration is stabilizing.

### 5.3.2 Is It Diversification?

Next, consider the argument that banks in more concentrated banking systems are more diversified than banking systems composed of many small banks. If this argument is correct and if we include good measures of

bank diversification in the systemic crises regressions, then this should drive out the significance of bank concentration.

To proxy for the diversification channel, we use three measures. First, we use *mean bank size,* which equals total bank assets divided by the number of banks.[14] The presumption is that larger banks tend to be more diversified. While clearly problematic, bank-level data on each bank's asset holdings are impossible to obtain. So, we use mean bank size in trying to assess why concentration is associated with lower levels of banking system fragility. If mean bank size does not drive out the significance of concentration, this weakens the argument that concentrated banking systems have larger, better-diversified banks than less concentrated banking systems with smaller banks. However, since bank size does not directly measure diversification, finding that mean bank size drives out concentration provides only suggestive support for the diversification argument.

Second, we include an indicator of regulatory restrictions on banks' ability to diversify risk abroad. Specifically, *no foreign loans* equals 1 if banks are prohibited from making foreign loans, and 0 otherwise. In many countries, it may be impossible for banks to sufficiently diversify their asset holding domestically. Thus, restrictions on investing abroad may doom domestic banks to holding excessively risky assets. Indeed, countries with both small banks and regulatory restrictions on those banks' lending abroad may have especially unstable banks. Again, if we control for these measures of diversification and they drive out the significance of concentration in the systemic crisis regressions, then this provides smoking gun evidence that concentration is associated with banking system stability because concentration is associated with more diversified banks.

A third potential indicator of bank diversification is the size of the economy. The presumption, albeit questionable, is that larger economies are more diversified and therefore offer banks easier means to hold diversified loan portfolios. Thus, we include the level of GDP in attempting to dissect the negative relationship between concentration and crises.[15]

The results in table 5.6 provide suggestive support for the view that concentrated banking systems are composed of bigger, more diversified banks that are hence less prone to systemic failure. As the results in table 5.6 show, the significance of the concentration coefficient drops to 10 percent when we control for bank size and completely disappears when we control for the size of the economy (regressions 1 and 2). These findings are consistent with the view that part of the reason that concentration enhances stability is that concentrated systems are composed of bigger, better-diversified banks. Regression 3 indicates that including no foreign loans does not al-

14. Using the mean bank size of the largest three banks does not change our results.

15. Replacing GDP by M2 to control for the size of the financial system does not change our results.

**Table 5.6 Banking crisis and concentration: Diversification versus ease of supervision**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Concentration | –1.511* | –1.379 | –2.381** | –1.653 | –2.234* | –2.111** | –3.576** |
| | (0.854) | (0.860) | (1.095) | (1.119) | (1.162) | (1.061) | (1.651) |
| Mean bank size | 0.004 | | | 0.007 | | | |
| | (0.005) | | | (0.005) | | | |
| No foreign loans | | | 0.153 | –0.350 | | | |
| | | | (0.635) | (0.617) | | | |
| No foreign loans × bank size | | | | 0.184*** | | | |
| | | | | (0.068) | | | |
| GDP ($) | | 0.0003 | | | | | |
| | | (0.0002) | | | | | |
| No. of banks | | | | | 0.008 | 0.003 | |
| | | | | | (0.014) | (0.013) | |
| Activity Restrictions | | | | | | 0.141 | |
| | | | | | | (0.103) | |
| Cashflow | | | | | | | 0.030** |
| | | | | | | | (0.014) |
| No. of crises | 47 | 47 | 34 | 34 | 34 | 34 | 29 |
| No. of observations | 988 | 989 | 767 | 767 | 767 | 767 | 527 |
| Percent of crises correct | 68 | 72 | 65 | 62 | 62 | 68 | 72 |
| Percent correct | 73 | 73 | 79 | 79 | 79 | 79 | 78 |
| Model $\chi^2$ | 48.36*** | 48.79*** | 49.43*** | 43.90*** | 43.90*** | 43.43*** | 48.31*** |

*Source:* See table 5A.1 for sources.

*Notes:* 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$_{j,t} + \beta_{11}$ Mean Bank Size$_{j,t} + \beta_{12}$ No foreign loans$_{j,t} + \beta_{13}$ GDP$_{j,t} + \beta_{14}$ No. of Banks$_{j,t} + \beta_{15}$ Activity Restrictions$_{j,t} + \beta_{16}$ Cashflow rights$_{j,t} + \varepsilon_{j,t}$. The dependent variable is a crisis dummy that takes on the value of one if there is a systemic crisis and the value of zero otherwise. Growth is the rate of growth of real GDP. 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 a measure of concentration in the banking industry, calculated as the fraction of assets held by the three largest banks in each country, averaged over the sample period. The sample period is 1980–1997. Mean bank size is given by average bank asset size (in billions of U.S. dollars). No foreign loans takes the value one if banks are prohibited from investing abroad and 0 otherwise. GDP is real GDP in billions of US$. Number of banks is given in hundreds and activity restrictions captures bank's ability to engage in business of securities underwriting, insurance underwriting and selling, and in real estate investment, management, and development. Both are from Barth, Caprio, and Levine (2001a, 2001b) database. Cashflow is the fraction of a bank's total cash-flow rights held by each bank's main owner, averaged across each country's banks (Caprio, Laeven, and Levine 2003). White's heteroskedasticity consistent standard errors are given in parentheses. See table 5A.1 for detailed variable definitions.

***Indicates significance at the 1 percent level.

**Indicates significance at the 5 percent level.

*Indicates significance at the 10 percent level.

ter the findings on banking system concentration. In regression 4, the concentration effect becomes completely insignificant when including the (1) mean bank size, (2) no foreign loans, and (3) the interaction term between bank size and no foreign loans. The result in column 4 indicates that countries with larger banks become significantly more prone to systemic crises

if they prohibit their banks from investing abroad. This finding on the interaction between bank size and regulatory restrictions on foreign loans runs counter to our prediction that restrictions on foreign lending would be particularly destabilizing for small (presumably less diversified) banks. Nevertheless, while these measures of diversification are highly imperfect, including these proxies for diversification drives out the significance of banking system concentration and suggests that the diversification explanation has some merit.

### 5.3.3 Is It Easier Monitoring?

A third argument for why concentration is stabilizing is that (1) concentrated banking systems tend to have a few large banks and (2) a few large banks are easier to monitor than many small ones. As earlier, if this easier monitoring argument is correct and if we include good measures of monitoring in the crisis regressions, then this should drive out the significance of bank concentration. Of course, there are countervailing views. Large banks may be substantially more complex than small banks. So, supervision may be more difficult with a few complex banks than with a higher number of simple banks.[16]

We use three measures to attempt to capture empirically the ease of monitoring banks. First, we use the *number of banks,* which equals the number of banks in the economy. The easier monitoring argument relies on the presumption that concentrated banking systems have a few large banks, and this is crucial in explaining better monitoring and greater banking system stability. Second, *activity restrictions* equals regulatory restrictions on the ability of banks to engage in securities market, insurance, and real estate activities as well as restrictions on banks owning nonfinancial firms. The presumption is that greater regulatory restrictions will make it easier to monitor banks. So, to the extent that regulatory restrictions are correlated with bank concentration, this would help account for the negative relationship between concentration and systemic crises. Third, *cash-flow* is the fraction of a bank's total cash-flow rights held by each bank's main owner, averaged across each country's banks. As suggested by La Porta et al. (1999) and La Porta, Lopez-de-Silanes, and Shleifer (2002), countries where laws and regulations are ineffective at protecting the rights of small shareholders will tend to have corporations that do not rely on small shareholders to exert corporate control, and instead have concentrated cash-flow rights to induce the main owner to exert sound corporate governance. In terms of banks, Caprio, Laeven, and Levine (2003) show

16. As pointed out to us by Mark Carey and René Stulz, there is another dimension to this monitoring argument. If monitoring skills are scarce and there are economies of scope in monitoring, then concentrated banking systems may facilitate monitoring. However, the scarcity of monitoring skills, and hence the benefits of concentration, may be different across countries.

that a bank's major owner tends to have higher cash-flow rights in countries where the institutions underlying monitoring of banks are weak, such as weak shareholder protection laws or ineffective bank supervision and regulation. These weak institutions discourage diffuse ownership and produce concentrated ownership of banks. Thus, we use each country's average cash-flow rights across banks as an additional proxy of each country's monitoring regime. If including cash-flow rights eliminates the significance of concentration, concerns would naturally arise about the endogeneity of cash-flow rights. But if including cash-flow rights does not alter the results on concentration, then this simply represents an additional, if flawed, robustness check.

The results presented in table 5.6 do not provide support for the easier monitoring view of why concentration reduces the likelihood of suffering a systemic crisis. Including the number of banks reduces the significance of concentration to 10 percent, but the significance level is restored once we also control for activity restrictions. Including cash-flows does not alter the findings on concentration either. Number of banks and activity restrictions do not enter the crises regressions significantly. Cash-flow enters positively, which is consistent with the view that in countries with weak legal and corporate governance institutions and ineffective bank supervision and regulation the ownership structure adjusts such that cash-flow becomes concentrated in order to boost monitoring incentives. However, the resultant outcome is still associated with a higher likelihood of suffering a crisis. For the purposes of this paper, the point is that including proxies for the monitoring regime does not alter the results on concentration significantly. This suggests, to the extent that these are reasonable proxies, that concentration is not a simple proxy for easier monitoring.

## 5.4 Conclusions

To summarize, using a cross-country, time series panel of data on systemic banking crises, we find that greater bank concentration is associated with a lower likelihood of suffering a crisis. We never find that concentration increases fragility. While subject to the qualifications stressed in the introduction and throughout the paper, the negative relationship between concentration and crises is robust to including various control variables, including indicators of the macroeconomic environment, the international environment, the domestic banking environment, bank supervisory and regulatory policies, and indexes of overall economic freedom and institutional development. Furthermore, reverse causality does not seem to be driving the concentration-stability findings. Thus, the data on systemic crises are more consistent with the concentration-stability view than with the concentration-fragility view.

In searching for the mechanisms underlying the concentration-stability

result, we find no support for the view that banking system concentration is a proxy for a less competitive banking environment. We draw this conclusion for two reasons. First, when we include regulatory and institutional measures of the degree of competition in banking and the overall economy, we find that crises are less—not more—likely in competitive regulatory and institutional environments. Second, even when we control for these regulatory and institutional measures of the degree of competition, we continue to find that concentration is negatively associated with systemic crises. To the extent that we have good measures of the competitive environment, these findings suggest that banking system concentration is a proxy for something else besides banking industry competition.

Furthermore, we find suggestive support that concentrated banking systems have more diversified banks, but not evidence that concentrated banking systems with a few large banks are easier to monitor and hence more stable than less concentrated banking systems. On ease of monitoring, none of our measures of the ease of monitoring enters significantly, and including them in the analyses did not alter the coefficient on bank concentration. On diversification, the data indicate that part of the reason concentrated banking systems lower the probability of suffering a systemic crisis is that concentrated banking systems tend to have larger, better-diversified banks with a correspondingly lower probability of failure. We draw this tentative conclusion because the concentration-crisis link weakens appreciably when we include proxies for diversification. We emphasize, however, that these proxies are aggregate indicators and do not directly measure individual bank asset diversification, and hence we view these results as suggestive and hope that they stimulate cross-country, bank-level research into this important policy issue.

# Appendix

**Table 5A.1**

| Variable | Definition | Source |
|---|---|---|
| Banking crisis | Dummy takes on value of 1 during episodes identified as a systematic banking crises | Demirgüç-Kunt and Detragiache (2001) |
| Real GDP growth | Rate of growth of real GDP | WDI (World Bank) |
| Terms of trade change | Change in the terms of trade | WDI (World Bank) |
| Real interest rate | Nominal interest rate minus the contemporaneous rate of inflation | IFS (IMF) |
| Inflation | Rate of change of GDP deflator | IFS (IMF) |
| M2/reserves | Ratio of M2 to international reserves | IFS (IMF) |
| Depreciation | Rate of depreciation | IFS (IMF) |
| Credit growth | Rate of growth of real domestic credit to the private sector | IFS line 32d divided by GDP deflator |
| GDP/CAP | Real GDP per capita | WDI (World Bank) |
| GDP | Real GDP in billions of U.S. dollars | WDI (World Bank) |
| Moral hazard index | Principal component indicator measuring the generosity of deposit insurance, based on coinsurance, coverage of foreign currency and interbank deposits, type and source of funding, management, membership, and level of explicit coverage | DD (2002) |
| Concentration | Degree of concentration in the banking industry, calculated as the fraction of assets held by the three largest banks. Averaged over the 1988–1997 period. | Beck, Demirgüç-Kunt, and Levine (2000)—Financial Structures Database |
| Initial Concentration | Initial degree of concentration in the banking industry | BankScope database |
| Mean Bank Size | Total banking assets divided by number of banks | BankScope database |

*continued*

**Table 5A.1** (continued)

| Variable | Definition | Source |
|---|---|---|
| No Foreign Loans | Survey question 7.2 asks if banks are prohibited from making loans abroad (yes = 1, no = 0) | Barth, Caprio, and Levine (2001a, 2001b)—Survey of Bank Regulation and Supervision |
| No. of Banks | Number of banks (in hundreds) | Barth, Caprio, and Levine (2001a, 2001b)—Survey of Bank Regulation and Supervision |
| Banking Freedom | Indicator of relative openness of banking and financial system: specifically, whether the foreign banks and financial services firms are able to operate freely, how difficult it is to open domestic banks and other financial services firms, how heavily regulated the financial system is, the presence of state-owned banks, whether the government influences allocation of credit, and whether banks are free to provide customers with insurance and invest in securities (and vice versa). The index ranges in value from 1 (very low—banks are primitive) to 5 (very high—few restrictions). Averaged over 1995–1997 period. | Index of Economic Freedom (Heritage Foundation) |
| Fraction of entry denied | Number of entry applications denied as a fraction of the number of applications received from domestic and foreign entities | Barth, Caprio, and Levine (2001a, 2001b)—Survey of Bank Regulation and Supervision |
| Activity restrictions | Indicator of bank's ability to engage in business of securities underwriting, insurance underwriting and selling, and in real estate investment, management, and development | Barth, Caprio, and Levine (2001a, 2001b)—Survey of Bank Regulation and Supervision |
| Required reserves | Ratio of reserves required to be held by banks | Barth, Caprio, and Levine (2001a, 2001b)—Survey of Bank Regulation and Supervision |
| Capital regulatory index | Summary measure of capital stringency: sum of overall and initial capital stringency. Higher values indicate greater stringency | Barth, Caprio, and Levine (2001a, 2001b)—Survey of Bank Regulation and Supervision |
| Official Supervisory Power | Principal component indicator of fourteen dummy variables: 1. Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? 2. Are auditors required by | Barth, Caprio, and Levine (2001a, 2001b)—Survey of Bank Regulation and Supervision |

| | | |
|---|---|---|
| | law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in elicit activities, fraud, or insider abuse? 3. Can supervisors take legal action against external auditors for negligence? 4. Can the supervisory authority force a bank to change its internal organizational structure? 5. Are off–balance sheet items disclosed to supervisors? 6. Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? 7. Can the supervisory agency suspend the directors' decision to distribute: (a) dividends? (b) bonuses? (c) management fees? 8. Can the supervisory agency legally declare—such that this declaration supersedes the rights of bank shareholders—that a bank is insolvent? 9. Does the banking law give authority to the supervisory agency to intervene; that is, suspend some or all ownership rights—in a problem bank? 10. Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency do the following: (a) supersede shareholder rights? (b) remove and replace management? (c) remove and replace directors? | |
| State ownership | Percentage of banking system's assets in banks that are 50% or more government owned | Barth, Caprio, and Levine (2001a, 2001b)—Survey of Bank Regulation and Supervision |
| Foreign ownership | Percentage of banking system's assets in banks that are 50% or more foreign owned | Barth, Caprio, and Levine (2001a, 2001b)—Survey of Bank Regulation and Supervision |
| Economic freedom | Composite of ten institutional factors determining economic freedom: trade policy, fiscal burden of government, government intervention in the economy, monetary policy, capital flows and foreign investment, banking and finance, wages and prices, property rights, regulation, and black market activity. Individual factors are weighted equally to determine overall score of economic freedom. A high score signifies an institutional or consistent set of policies that are most conducive to economic freedom, while a score close to 1 signifies a set of policies that are least conducive. Averaged over 1995–1997 period. | Index of Economic Freedom (Heritage Foundation) |

*continued*

**Table 5A.1** (continued)

| Variable | Definition | Source |
|---|---|---|
| KKZ composite | Composite of six governance indicators (1998 data): voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and corruption. Individual factors are weighted equally to determine overall score of economic freedom. Higher values correspond to better governance outcomes. | Kaufman and Kray (1999) |
| G10 countries | Dummy accounting for G10 country | |
| Concentration | Degree of concentration in the banking industry, calculated as the fraction of assets held by the three largest banks. Averaged over the 1994–2001 period. | Bankscope database |
| Banking Freedom | Indicator of relative openness of banking and financial system: specifically, whether the foreign banks and financial services firms are able to operate freely, how difficult it is to open domestic banks and other financial services firms, how heavily regulated the financial system is, the presence of state-owned banks, whether the government influences allocation of credit, and whether banks are free to provide customers with insurance and invest in securities (and vice versa). The index ranges in value from 1 (very low—banks are primitive) to 5 (very high—few restrictions). Averaged over 1994–2001 period. | Index of Economic Freedom (Heritage Foundation), 2003 |
| Cashflow | Fraction of a bank's total cash-flow rights held by each bank's main owner, averaged across each country's banks | Caprio, Laeven, and Levine (2004) |

*Source:* Kaufman, Kraay, and Zoido-Lobaton (1999).

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## Comment René M. Stulz

Kwast and De Nicolo (2001) and Hartmann, Straetmans, and de Vries (chapter 4, this volume) find that interdependencies among large banks increased in the 1990s for, respectively, the United States, and the United

Kingdom and the eurozone. A plausible explanation for these findings is that bank consolidation led to an increase in systemic risk. While some observers are concerned that increases in bank concentration have led to increases in systemic risk, this belief is not universally shared. For instance, the recent Counterparty Risk Management Policy Group report concludes that systemic risk has decreased in the banking system in recent years.

The paper by Beck, Demirgüç-Kunt, and Levine makes an important contribution to this debate. They look across countries to find whether there is a relation between bank concentration and the extent to which a country spends its time in banking crises. They find that bank concentrations is associated with fewer crises across the globe. As is typical of the papers by these authors, it is hard to think of a robustness check that they have not already attempted. Consequently, it would be a waste of my time to try to argue that maybe after all there is a positive relation between banking concentration and banking crises. After reading the paper, one has to conclude that, across the world, countries with higher bank concentration have not been more likely to experience banking crises.

The strength of the paper is that it allows us to dismiss the simple argument that concentration creates systemic risk. In my discussion, I focus on three issues that the paper raises. First, it seems that welfare is lower in the high banking concentration countries, so that the frequency of banking crises may not be a good indicator of welfare. Second, it is hard to evaluate the extent to which the paper can be used to argue that concentration in the United States does not create systemic risk. Third, while it is clear that concentration does not increase the risk of crises, one has to be cautious about concluding that it decreases them.

The sample includes sixty-nine countries. A large number of countries in the sample are small and financially underdeveloped. The authors measure concentration by the fraction of assets held by the three largest banks in the country. In the sample, there is a strong negative correlation between real GDP per capita and banking concentration. The highest value of the concentration index is 1. The sample has seven countries with a concentration index of 1. They are all African countries. From 1980 through 1997, these countries spend a total of eleven years in the banking crisis state. In contrast, the United States has a concentration index of 0.19 and spends twelve years in the banking crisis state. The authors show that there results hold without the African countries and without the United States. However, the comparison points to important issues when one attempts to evaluate the results of the paper. First, though banking concentration is not associated with banking crises, it seems associated with financial underdevelopment. Perhaps most of these countries would happily trade their banking system for the U.S. banking system if the cost were to have a savings and loans crisis. Second, not all crises are alike. The U.S. savings and loans crisis was assuredly expensive. However, did it really endanger the U.S. banking system? Probably not.

There are not many banks in the world that come close to being similar to the largest U.S. banks. These banks have activities throughout the world. Their activities are quite diversified. They have extremely sophisticated risk measurement and management organizations. Increasing concentration in the United States might just bring assets under the control of the most efficient banks. However, at the same time, one has to wonder about whether such incredibly complex organizations are not more fragile than simpler and more straightforward organizations. The Challenger shuttle was brought down by an O-ring. Do we really have a good sense of what the O-rings of a major bank are? The sample the authors consider does not really help in answering that question. This it not a criticism of the paper. It is just that this type of study is well suited at answering the question of whether concentration leads to greater systemic risk for the median country in the sample but not for countries where banks are fundamentally different from typical banks in the sample.

Most banks do not use derivatives. However, in the United States, most of the notional amount of derivatives contracts held by banks is held by a handful of banks. Specifically, at the end of the third quarter of 2005, the notional amount of derivatives held by banks was $96.2 trillion, but 95 percent of that amount was held by five U.S. banks.[1] JP Morgan Chase alone accounts for close to half the notional amount of derivatives held by U.S. banks. There are good reasons why this concentration of derivatives holdings could substantially worsen the impact of losses at major banks. Suppose that JP Morgan Chase suffers a one-year-in-fifty loss on its loan portfolio. Would the problems posed by that loss be smaller or greater if it held one fourth of its derivatives? There are reasons why the problems would be smaller with a smaller portfolio of derivatives. One would expect the bank's dealings with its counterparties in the derivatives market to become substantially more complicated after such a large loss. Contracts wherein JP Morgan has to put up additional collateral would impose demands on the bank's liquidity. More importantly, its ability to trade derivatives would be impaired, which would adversely affect its ability to hedge and to generate income. All of these developments would substantially worsen the impact of the loss on its loss portfolio. Obviously, a crisis at JP Morgan Chase that prevents it from functioning normally as a bank would have far-reaching implications compared to the S&L crisis. However, whether banking concentration makes such a crisis more likely and whether it worsens its impact cannot be learned from international comparisons—very few other countries have the equivalent of JP Morgan Chase.

The authors attempt to understand why it is that concentration reduces the risk of crises. I have two reservations with that exercise. First, while it is clear that concentration does not worsen the risk of crises, it is less clear that it reduces it. The authors use a dataset of yearly observations. The ob-

1. See Comptroller of the Currency (OCC), Bank derivatives report, third quarter of 2005.

vious difficulty with such a sample is that concentration is highly autocorrelated. It seems likely that this autocorrelation leads to an overstatement of the significance of the coefficient on concentration in the logistic regressions that predict whether a country is in the crisis state or not. Second, the authors consider the impact on the coefficient on concentration of adding explanatory variables to the logistic regression. They find that concentration ceases to be significant when they add a variable corresponding to the mean bank size of a country times an interactive variable that takes value 1 if the banks in the country cannot make foreign loans. In other words, crises are more likely in countries where the banking system seems closed and where banks are large. While the authors would like to interpret this result as explaining the role of concentration, I am not convinced with that view. All they seem to show is that they added an omitted variable in the regression.

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## Discussion Summary

Much of the general discussion was focused on alternative stories. *Philipp Hartmann* suggested an alternative to a market-power story: Concentration increases the chance that a material portion of a nation's banking sector will be treated as too-big-to-fail, and given the definition of the crisis measure, this will reduce the measured likelihood of a crisis. *Jan Krahnen* wondered whether measured concentration may be a proxy for country size and about other measurement error, noting that the German banking system is functionally highly concentrated even though it would not be measured as such by the authors. *Patricia Jackson* observed that United Kingdom experience has taught that, at the individual bank level, concentration in the sense of a bank being locked into a single funding source, into lending to a single industry, or into operating in a small geographic area is a major factor in bank failure, but the paper does not include these types of concentration.

*Hashim Pesaran* and *Darrell Duffie* expressed concern about the use of a logit model in a setting where dynamic relationships within the sample may be material. Duffie suggested use of a Cox proportional hazard model for the probability of moving into a crisis as a way of dealing with such concerns. He also suggested examining the probability of moving out of a crisis.