CHAPTER 4

CHANGING GLOBAL FINANCIAL STRUCTURES: CAN THEY IMPROVE ECONOMIC OUTCOMES?

Summary

The global financial crisis has required policymakers to reconsider the role that the structure of their financial systems plays in achieving good economic outcomes. A number of forces can be expected to change financial intermediation structures in the period ahead, including crisis intervention measures and an evolving regulatory reform agenda. The changing structures for financial intermediation (through banks or nonbanks, funded by deposits or other sources, interconnected domestically or across borders) can be expected to affect economic growth, its volatility, and financial stability. This chapter investigates these potential relationships from 1998 to 2010 using the measures for financial structures developed in Chapter 3. With this knowledge, the chapter forms ideas about how the evolving financial structures relate to economic outcomes.

It is worth recognizing that forming concrete inferences about the relationship between financial structures and economic growth is difficult—as is most work on the determinants of growth. First, time series of detailed cross-country data on financial structures are short, circumscribing the ability to do long-term analyses. Second, the recent period for which data *is* available included a very severe financial crisis, and while some techniques can control for its influence, the ability to isolate structural effects is difficult. And third, data limitations mean that the series used for the concepts for financial structures are not perfectly aligned—they are proxies—and hence the interpretation of the results needs to factor in this potential imperfection.

Extensive care was taken to account for the limitations. In the end, the empirical results that withstand a battery of methods suggest that some financial intermediation structures are likely to be more closely related to positive economic outcomes than others. On the positive side, protective financial buffers within banks have been associated with better economic outcomes. On the negative side, a domestic financial system that is dominated by some types of nontraditional bank intermediation has in some cases been associated with adverse economic outcomes.

The results also suggest that there may be trade-offs between beneficial effects on growth and stability of some financial structures. For example, the positive association between growth and the size of financial buffers can diminish above a certain, relatively high, threshold—very safe systems may produce less economic growth. Similarly, cross-border connections through foreign banks are beneficial most of the time, but if these banks are not managed well, during a crisis they may import instability or limit growth. Hence, we cannot say that specific characteristics of a financial structure will *always* be associated with better outcomes. The chapter thus suggests where further work could usefully be conducted, particularly since causality between financial structures and economic outcomes cannot be assigned in this framework.

The following tentative policy implications emerge from the analysis:

- While some structures may be associated with both safety and efficiency, policymakers may also face a trade-off between the safety of financial systems and economic growth.
- Regulatory policies that promote financial buffers help economic outcomes, but they need to consist of high-quality capital and truly liquid assets.

In order to reap the benefits of financial globalization and nontraditional bank intermediation, these phenomena need to be well managed. Any measures to enhance growth and stability will only be effective if they are implemented correctly and overseen intensively. The analysis therefore reinforces the lesson from the crisis that high-quality (domestic *and* global) regulation and supervision should be at the forefront of reform efforts.

The global financial crisis has required policymakers to reconsider the role that the structure of their financial systems plays in achieving good economic outcomes. Going forward, a number of forces—including the crisis itself, ongoing adjustments by market participants, crisis management responses by authorities, and an evolving regulatory reform agenda—can be expected to change the structure of the financial intermediation in fundamental ways. Some of the impact of these forces on financial structures is analyzed in Chapter 3 of this report.

The aim of this chapter is to assess how these expected changes in the financial structures across countries will interact with economic outcomes. We will use the measurements of financial structure developed in Chapter 3 and relate them to three indicators of economic outcomes: (1) the growth of real GDP per capita (real growth); (2) the volatility of real growth (which implies periodic economic booms and busts); and (3) financial stress (financial crises lead to economic and social dislocations).

Since the relationship between the *structure* of the financial sector and economic outcomes has not been studied as intensively as the degree of financial *development*, the overall empirical results of this chapter should be viewed as suggestive.[1] First, data available on structural characteristics are only available from the late 1990s, making long-term relationships difficult to verify. Second, the period over which the empirical work can be conducted contains a very severe financial crisis, suggesting that even with good estimation techniques the results should be interpreted cautiously. Third, the proxies for financial structure are just that—proxies of concepts—and the interpretation of the results needs to consider their representativeness. Despite these provisos, the subject fills an important gap given (1) the prominence of innovative structural features in the near collapse of the financial system following Lehman's failure and (2) the prospect of further structural changes (whether intended or not) as regulatory and other policies seek to prevent a replay of that crisis and to improve economic performance by making the financial system safer (see Chapter 3).

Are the structural changes occurring in the financial system making it safer in a way that will promote better economic outcomes? Rather than on the role of financial depth and development, we focus on structural features—such as the extent of unregulated intermediation (banks vs. nonbanks), competition and concentration, and domestic and cross-border interconnectedness. Which of these features matter? How should they be shaped to produce higher real growth, lower volatility of real growth, and a more stable financial system? These are new questions, not taken up before.

Although the results are to be interpreted cautiously, the preliminary evidence from 1998 to 2010 across 58 economies suggests that, indeed, some structures of financial systems are likely to be more closely related to positive economic outcomes than others. On the positive side, protective financial buffers within institutions have been associated with better economic outcomes. On the negative side, a domestic financial system that is dominated by some types of nontraditional bank intermediation or that has a high proportion of foreign banks has in some cases been associated with adverse economic outcomes, especially during the financial crisis.

The results suggest that there may be levels beyond which the beneficial effects on growth and stability of some financial structures diminish. For example, the positive association with growth of financial buffers can diminish above a certain, relatively high, threshold—a too-safe system may limit the available funds for credit and hence growth. Similarly, cross-border connections through foreign banks are beneficial most of the time, but during a crisis may be associated with instability or limit the active participation of these banks in the local economy. Hence, we cannot say that specific characteristics of a financial structure will *always* be associated with better outcomes, since there are cases where these characteristics may in fact have detrimental effects.

Note: This chapter was written by Tao Sun (team leader), Nicolas Arregui, Ken Chikada, Tom Gole, John Kiff, Erik Oppers, and Era Dabla-Norris. Research support was provided by Yoon Sook Kim. Gianni de Nicolò was a consultant.

[1]A rich theoretical and empirical literature has advanced the view that the amount of credit that the financial sector can intermediate is an important determinant of economic performance (see Annex 4.1). This literature generally concludes that a large, well-functioning financial sector with deep and liquid markets can generate the amount of credit needed to support economic growth and reduce the volatility of growth.

The chapter concludes with a few tentative recommendations for regulatory reform and other financial policies to deliver preferred outcomes. These include (1) encouraging sufficient financial buffers (although not so high so as to inhibit banks' intermediation role); (2) ensuring foreign banks can support healthy financial globalization through effective cross-border risk management and supervision, as well as a robust cross-border resolution framework to ensure that financial flows are less volatile; and (3) ensuring a more concrete discussion of how concentration of banking system assets in just a few large banks might hold the economy hostage through large, expensive implicit government guarantees.

The Relationship between Financial Structures and Economic Outcomes

A rich theoretical and empirical literature exists on the relationship between financial development and economic outcomes. It has focused mostly on the relationship between financial development and growth, using proxies for the size of financial systems, and less on the effect of financial structures. Specifically (see also Annex 4.1):

- On financial development and growth, there have long been two schools of thought with sharply differing perspectives on the potential importance of finance. One school sees financial intermediaries playing a key role in economic activity and growth. Another school believes that causality is reversed: economies with good growth prospects develop institutions to provide the funds necessary to support the expected growth—the economy leads, and finance follows.
- On financial development and growth volatility, a large body of theoretical and empirical evidence suggests that larger and deeper financial systems help diversify risk and reduce the vulnerability of the economy to external shocks, thus smoothing output volatility. However, the literature also suggests that financial depth could reduce volatility up to a point, but too much private credit can increase volatility (Box 4.1).
- In considering the importance of financial structure for economic growth, economists have tended to focus on whether bank-based or market-based financial systems are more conducive to growth, with inconclusive results. Empirically, there has been little resounding evidence in favor of either bank-based or market-based systems.
- On financial structure and stability, there are two main dimensions of stability that matter: the volatility of economic growth and financial stability. Some authors investigate the relationship between financial structure and financial stability.

In all, however, conclusions about the relationships between differing financial structures and economic outcomes have been tentative and largely inconclusive. This is an important gap, since the structure of financial intermediation across the globe is changing, especially during the last two decades. It is important to assess how these changes in financial structures may be associated with economic outcomes. If these changes in financial structures are associated with lower growth or increases in economic volatility, there may be a role for government policies to try and "tweak" the changes in financial structures to promote better economic outcomes.

This chapter focuses on the role of financial structure and economic outcomes, taking three approaches to understanding financial structure performance. Throughout, the implications of certain structural features are assessed with our three measures of outcomes—the growth of real GDP per capita, the volatility of real GDP per capita growth, and financial stress.[2] As noted in Chapter 3, the desirable features of a financial system include one that is less complex and more transparent, better capitalized, and that possesses a more sustainable level of maturity mismatch. A safe system would be competitive but without encouraging excessive risk-taking or dependence on implicit government guarantees without paying for them. Finally, a system that allowed a healthy degree of risk diversification with well-managed institutions, both domestically and across borders, would allow economies to benefit from financial globalization.

[2]For the formal definitions of these variables, see Annex 3.1 in Chapter 3. The financial stress index is a monthly indicator of national financial system strain. See Cardarelli, Elekdag, and Lall (2011) for advanced economies and Balakrishnan and others (2009) for emerging market economies. The indicator is used here at an annual frequency.

Box 4.1. Financial Depth and Economic Outcomes[1]

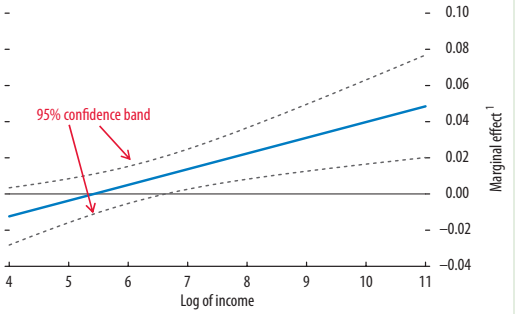
A large body of evidence suggests that as the range and volume of services offered by financial intermediaries and markets expand, countries tend to have stronger and more robust growth, and less pronounced economic fluctuations. However, new empirical analysis indicates that the benefits of increased financial depth do not accrue equally to all countries. This box examines how the above relationships vary across countries.

Financial Depth and Long-Term Growth: Income Level Matters

Financial systems can contribute to higher long-term growth by facilitating trade, mobilizing and allocating funds to productive uses, aiding risk management, and exerting corporate control. Studies find that an increase in financial depth—defined as greater activity by either banks or in capital markets—has a statistically positive and economically meaningful impact on long-term growth.[2] These studies abstract from the specific structure of a countries' financial system (that is, whether they are bank-based or market-based), but they provide a good starting point for an examination of macro-financial interrelations and hence are worthy of review.

Despite the large number of studies linking financial depth to long-term growth, there has been little exploration as to whether this virtuous relationship holds with the same intensity across countries. While the financial depth indicators used in these studies[3] provide a summary measure of the scale of financial sector activities, the degree to which these translate into higher growth could be affected by the institutional environment—the quality of which is closely linked to income level—as well as by how the structure of the *economy* affects incentives and investment. New empirical work revisits the financial depth–growth nexus, examining whether it varies across income levels.[4]

Figure 4.1.1. The Impact of Private Credit on Growth at Different Income Levels



Sources: Dabla-Norris and others (2012); and IMF staff estimates.
[1]Coefficient of ratio of private credit to GDP on growth panel regression.

The analysis suggests that the financial depth–growth nexus in banking is stronger for higher-income countries.[5] Growth regressions reveal that, on average, the coefficient of the private credit-to-GDP ratio is about 40 to 50 percent lower in developing economies[6] than in other countries, and it increases continuously as income per capita rises (Figure 4.1.1).[7] At very low levels of income, the growth impact of financial

Note: This box was prepared by Era Dabla-Norris and Adolfo Barajas.

[1]The analysis was developed as input to the IMF Policy Paper "Enhancing Financial Sector Surveillance in Low-Income Countries: Financial Deepening and Macro-Stability" (Dabla-Norris and others, 2012).

[2]Empirical tests of this relationship have included both cross-country and panel data regressions in which real GDP per capita growth is specified as a function of a set of control variables, augmented by a measure of financial depth. Typically, these include a measure of education attainment, foreign direct investment, the degree of openness, initial GDP per capita to capture convergence effects, and terms of trade, among others. Also, as pointed out by Rousseau and Wachtel (2011), the inclusion of post-1990 data warrants including a dummy variable to account for the disruptive effects of the various financial crises.

[3]Financial depth variables typically used in studies are ratios to GDP of banking sector liquid liabilities, deposits, or credit to the private sector, for banking depth; and of stock market capitalization or value traded (the turnover ratio), for stock market depth.

[4]The regression results reported here rely on a GMM (generalized method of moments) approach within a panel data setting using lags of financial depth and other exogenous variables as instruments.

[5]The panel regressions on the relationship between financial depth and growth consist of 43 high-income, 73 middle-income, and 38 low-income countries—a total of 154 countries.

[6]"Developing economies" refers to low-income countries shown on the IMF's list of countries eligible for the Poverty Reduction and Growth Trust (PRGT) as of May 2012.

[7]This figure shows the marginal effect of the ratio of private sector credit to GDP on growth of real GDP per capita. This effect was obtained from a regression of growth of real GDP per capita on both the level of credit to the private sector and an interaction term of this variable with a proxy for income, the natural logarithm of GDP per capita in 2000 U.S. dollars, and some control variables. This regression thus indicates how the growth implications of credit depend on the level of income. The marginal effect in Figure 4.1.1 traces the predicted growth impact of private credit at various levels of the natural logarithm of GDP per capita, measured using the estimated coefficients of both the level of credit to the private sector and the interaction term. This regression differs from that reported in Table 4.1.1.

Box 4.1 *(continued)*

depth is negligible, and only becomes statistically significant at about the 75th percentile of income in this sample of developing economies.

Financial Depth and Macroeconomic Volatility: More Depth Is Better, though Not Beyond a Certain Level

Financial depth can help diversify risk, alleviate liquidity constraints, and reduce the vulnerability of enterprises, households, and governments to external shocks, thus lessening macroeconomic volatility. This is particularly important for developing economies, which are more vulnerable to sharp swings in terms of trade and to volatile financing flows. Evidence from the recent global financial crises, however, suggests that while financial depth can help reduce the impact of real sector shocks, it can also propagate financial sector shocks, thus amplifying macroeconomic volatility.

A panel regression of 110 advanced, emerging market, and developing economies over the period 1974–2008 supports the view that deeper financial systems can moderate the amplitude of macroeconomic volatility.[8] The role of financial depth in dampening macroeconomic volatility is shown in Table 4.1.1 (depth is represented by the ratio of private credit issued by banks and nonbank financial institutions to GDP). The analysis indicates that output, consumption, and investment volatility are all negatively related to financial depth. These results are robust to the inclusion of alternative measures of financial depth, controlling for banking crises, institutional quality, and commodity price volatility. They also hold in different subsamples of the data (for example, in a sample of emerging market and developing economies).[9] In addition, the estimates are economically significant, suggesting that financial depth has a particularly pronounced effect in reducing the volatility of consumption and investment.

The analysis also suggests that further increases in financial depth above a certain threshold would increase macroeconomic volatility. To check for the non-monotonic relationship, all regressions include both the level of credit to the private sector and a quadratic term of this variable. While the coefficient associated with the linear term is negative, the quadratic term is positive, indicating a hump-shaped

[8]Panel GMM and simple ordinary least-square regressions were employed to examine the relationship between various proxies of financial system depth and measures of macroeconomic volatility. Macroeconomic volatility is defined as the standard deviation of growth in real GDP per capita, total and private consumption, and investment. For controls, the regressions also incorporate initial real GDP per capita (to control for economic size), growth rates of real GDP per capita, inflation, the central government fiscal balance, financial and trade openness, volatility of the real exchange rate, and time fixed effects. These variables are omitted in Table 4.1.1 and are available upon request. To smooth out cyclical fluctuations, all variables are averaged over consecutive nonoverlapping five-year periods.

[9]Different measures of financial depth include ratios to GDP of bank liquid liabilities, assets, and deposits.

Table 4.1.1. Financial Depth and Macroeconomic Volatility
(Panel GMM regressions, 1974–2008)

	Dependent Variables: Standard Deviation of Growth Rate			
		Consumption		
	GDP	Final	Private	Investment
Private credit to GDP	–0.0397*	–0.0985***	–0.126***	–0.326**
	(0.0214)	(0.0346)	(0.0446)	(0.126)
Square of private credit to GDP	0.000135	0.000371*	0.000529**	0.00154**
	(0.000103)	(0.000198)	(0.000254)	(0.000712)
Threshold value	n.a.	132.9	118.6	106.0
Standard error of threshold value	n.a.	27.78	20.10	11.06
Observations	628	485	506	481
Number of countries	111	110	111	110
Time dummies	Yes	Yes	Yes	Yes
Hansen test *p*-value	0.697	0.712	0.757	0.737
A-B AR(2) test *p*-value	0.750	0.333	0.153	0.783

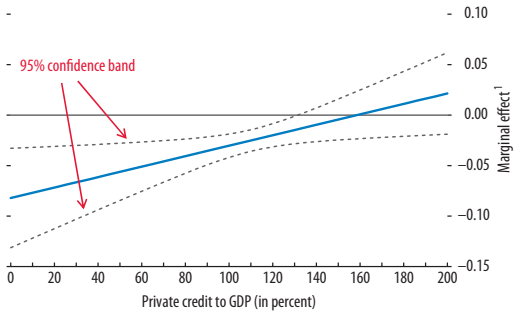
Source: Dabla-Norris and Narapong (forthcoming).

Note: The panel GMM regressions are run on 110 advanced, emerging market, and developing economies over the period 1974–2008.

Shaded cells: If the private credit-to-GDP ratios are higher than the values in the shaded cells, the volatilities of the respective dependent variables increase. Standard errors are shown under the estimated coefficients. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence.

Box 4.1 *(continued)*

Figure 4.1.2. Marginal Effect of Private Credit on Final Consumption Volatility



Source: Dabla-Norris and Narapong (forthcoming).
[1]The projected effect using the coefficients on both the ratio of private credit to GDP and its square in the final consumption volatility regression.

relationship between credit to the private sector and macroeconomic volatility. In particular, the results suggest that finance starts having a negative effect on the volatility of consumption and investment when credit to the private sector exceeds 100 percent of GDP, while the results for GDP volatility are less statistically significant.[10] The level of financial depth in many emerging market and developing economies is lower than these point estimates for the thresholds, suggesting that financial deepening can play a beneficial role in smoothing macroeconomic volatility in these countries (Figure 4.1.2.). At very high levels of private credit, as observed in many advanced economies, finance starts to increase macroeconomic volatility.[11]

[10]The results for GDP volatility are statistically significant if we replace the contemporaneous credit-to-GDP ratio with the lagged one and in the subsample comprising advanced and emerging market economies.

[11]To test for the threshold effects, joint F-tests for the coefficients of the first and second degrees of the financial depth measure and a Wald test for the threshold estimate were conducted. These indicate whether the variable has one effect below the threshold but another effect when above the threshold.

Investigating the relationships between differing financial structures and economic outcomes is not an easy task, with data constraints and econometric issues being the main challenges (Box 4.2). Attempting to overcome these difficulties, this chapter employs the following three approaches:

- *Simple (unconditional) correlations between structure measures and economic outcomes*. We use data for 58 advanced and emerging market economies over the period from 1998 to 2010. The structure measures are mostly from a subset of those analyzed in Chapter 3 (Table 4.1).
- *An assessment of the experiences of five countries with distinctly varying structures*. This assessment considers how ongoing reforms in each country might alter their economic outcomes.
- *A multivariate regression analysis.* The multivariate approach allows for the effects of a change in one variable to be measured while controlling for the effects of other macroeconomic and financial variables, thus isolating the relationship between economic outcomes and specific structural variables. In addition, a model on the probability of banking crises is used to give further insight into the relationship between financial structure and financial stability.

Simple Correlations

With simple correlations across many economies and over time, we get an initial idea of the relationships between financial structures and economic outcomes. We use data for four key concepts: competition, financial buffers, financial globalization, and nontraditional bank intermediation, examining 58 economies in two periods: 1998–2007 and 2008–10. The purpose is to describe the main developments in the data and to motivate certain methodological controls undertaken in the regression analysis, and not to make inferences about causality. Note that there are no statistical confidence bounds provided and the scatter plots mostly suggest relationships to pursue in the later empirical work. To give a broader picture, this section uses the financial

Table 4.1. Financial Structure Measures in This GFSR

Chapter 3	Chapter 4[1]
Market-Based Intermediation	
Nontraditional bank intermediation	Nontraditional bank intermediation
Noninterest income to total income	Noninterest income to total income
Other earning assets to total assets	**Other earning assets to total assets**
Other interest-bearing liabilities to total liabilities	**Other interest bearing liabilities to total liabilities**
Nonbank intermediation	Nonbank intermediation
Loans and bonds held by nonbanks over loans and bonds held by financial sector	Loans and bonds held by nonbanks over loans and bonds held by financial sector
Private bond market capitalization to GDP	
Use of new financial products	
Derivatives turnover to GDP	
Securitization to GDP	
Traditional Bank-Based Intermediation	
Loans and bonds held by banks relative to the overall financial sector	Loans and bonds held by banks relative to the overall financial sector
Net interest margin	Net interest margin
Scale and Scope	
Size	Size
Domestic interconnectedness	Domestic interconnectedness
Wholesale funding ratio	
Interbank assets to total assets	Interbank assets to total assets
Interbank liabilities to total liabilities	Interbank liabilities to total liabilities
Concentration (share of top three banks)	**Concentration (share of top three banks)**
Financial globalization	Financial Globalization
Share of foreign banks in total number of banks	**Share of foreign banks in total number of banks**
Total bank foreign assets to GDP	**Total bank foreign assets to GDP**
Global interconnectedness[2]	
Global interconnectedness on assets	
Global interconnectedness on liabilities	
Financial Buffers	
Liquid assets to deposits and short-term funding	**Liquid assets to deposits and short-term funding**
Equity to total assets	**Equity to total assets**
Competition	
	Lending spread (lending rate minus deposit rate)
	Net interest margin
Transparency/Disclosure of Financial Intermediation	
	Accounting standards: fraction of accounting items reported

Source: IMF staff.

Note: See Annex 3.1. for the description of data and indices.

[1]Variables in bold are those found to be consistently significant in the panel estimation in this chapter.

[2]See Čihák, Muñoz, and Scuzzarella (2012).

structure indices introduced in Chapter 3, and not individual variables as in the regression analysis.

We found that some measures of financial globalization, financial buffers, and nontraditional bank intermediation had no consistent pattern of correlation with economic outcomes over the 13 years studied. (Only those indices and figures that are helpful to motivate methodological controls undertaken in the regression are discussed in this section—others are not discussed or presented.)

- *Financial globalization* had no discernible correlation with growth volatility or the change in financial stress in 1998–2007, but it was positively correlated with these variables in the crisis period 2008–10 (Figure 4.1), suggesting as globalization increases so does financial contagion under adverse circumstances.
- *Financial buffers* also had no definite correlation with the change in financial stress in the precrisis period (before 2008) and a slight negative correla-

Box 4.2. How Robust Are the Econometric Results?

This box summarizes two major challenges—data constraints and econometric issues—associated with the econometric work in this chapter and discusses the attempts to overcome them.

Data Constraints

Both the lack of data and its quality regarding financial structure measures (both indices and variables) constrain the ability to estimate and interpret the results. These are exhibited as follows.

- *The short sample period.* Data on the financial structure measures are only consistently available across a large enough sample of countries to perform meaningful empirical work since 1998. Hence, they are accompanied by a short, and relatively limited, set of macroeconomic circumstances. In particular, the period under study included a very severe financial crisis.
- *Incomplete measures of financial structure*. The correlation and econometric analysis relies on proxies for the concepts of financial structure. For example, to measure the level of financial globalization, the empirical section uses a measure of foreign bank presence (share of foreign banks in total number of banks) and a measure of domestic bank presence overseas (the ratio of total bank foreign assets to GDP). These variables capture important elements of financial globalization, but only imperfectly as they are only measuring globalization from the perspective of the banking sector.
- *Outliers.* Some variables in certain countries exhibit large swings. As a robustness check, the regressions were re-run using a range of methods excluding these outliers.
- *Difficulties in assessing statistical significance*. The initial analysis included a range of structural variables that show no statistically significant relationship (see Annex 4.2). However, this should not be interpreted as evidence of there being no relationship between these other measures and economic outcomes; instead, this statistically insignificant relationship may be the result of insufficient variation in the data to detect a statistical relationship. In the same vein, the results reported in the chapter are the relationships for which the analysis has shown sufficient evidence.

Note: This box was prepared by Tom Gole.

Econometric Issues

The analysis, as in other similar econometric work on economic growth, faces three main econometric challenges:

- *Potential omitted variable bias.* A possible source of error in the empirical results is that both economic outcomes and financial structure might be caused by some third factor, such as the quality of government institutions or movements in the business cycle. To deal with this potential omitted variable bias, the analysis includes a range of control variables, including government debt, the inflation rate, and an IMF estimate of the output gap. The full list of control variables can be found in Annex 4.2.
- *Possibility of a catch-up effect.* The difference in economic development level may affect econometric results. For instance, countries that start at a lower level of economic activity tend to grow faster than those that start at a higher level. There are also other country-specific factors that drive economic outcomes. Therefore, both a specification controlling for the initial level of GDP per capita and a country-level fixed-effects panel specification were employed.[1] In addition, estimation is also done for advanced and emerging market economies separately to broadly reflect the different levels of economic development.
- *Possibility of reverse causality (or endogeneity):* As indicated in some literature, it might be economic outcomes that drive financial structure, rather than the other way around. One approach that can mitigate this problem is the *generalized method of moments* (GMM) approach proposed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). This method is employed in addition to the fixed-effects model with a lagged dependent variable, and provides conclusions that are broadly similar. While the analysis attempts to correct for any reverse causality, the econometric results are presented conservatively as providing information about *associations* between financial structures and economic outcomes, rather than relying on a clear identification of *causal* relationships.

[1]One complication with a country-level fixed-effects approach, combined with the use of a lagged dependent variable, is the possibility of so-called "Nickell bias." See Nickell (1981).

Box 4.2 *(continued)*

In sum, the discussion in the empirical section only presents variables where the estimated coefficients remain statistically significant (or became insignificant and retained the same sign) across various specifications that were used, as well as across time, and across countries (or within subsets of countries), and with or without outliers. The battery of techniques provides some reasonable confidence that the results are "robust" and reflect the "true" association of the variables with economic outcomes.

tion in the crisis period (after 2008), indicating that larger buffers are somewhat helpful in the sense that they were associated with less stress in the crisis. This was true in both advanced and emerging market economies (Figure 4.2).

- *Nontraditional bank intermediation* had a positive correlation with financial stress in the precrisis period, but had a negative correlation during the crisis, suggesting these more nontraditional bank businesses were related to higher stress early on, but then became associated with lower stress later.

These time-varying correlations may signal real changes in the underlying relationships but could also reflect the sharp differences in the economic and financial circumstances. For instance, the period 1998–2007 featured rapid financial and economic expansions, whereas 2008–10 brought economic recession and financial crisis to many countries. Indeed, the relationships between financial globalization and economic outcomes likely reflect the fact that financial systems that were relatively isolated from global financial markets tended to suffer less in the financial crisis. These interplays suggest the need to control for these other features of the macroeconomic environment. Also important is the possibility of nonlinear relationships, in which certain structural measures, such as an increase in capital buffers, can be helpful up to a point but can be counterproductive beyond a certain level. That phenomenon is best examined in the multivariate analysis.

Nevertheless, the correlation between a few financial structure measures and economic outcomes appears to be relatively stable across the periods:

- *Financial buffers* show a positive correlation with growth in the pre- and postcrisis periods, for both advanced and emerging market economies, suggesting higher buffers are related to higher growth (Figure 4.2).
- *Competition* was slightly negatively correlated with growth throughout the entire period 1998–2010 meaning higher competition (at least with this measure) was associated with lower growth (Figure 4.3).[3]

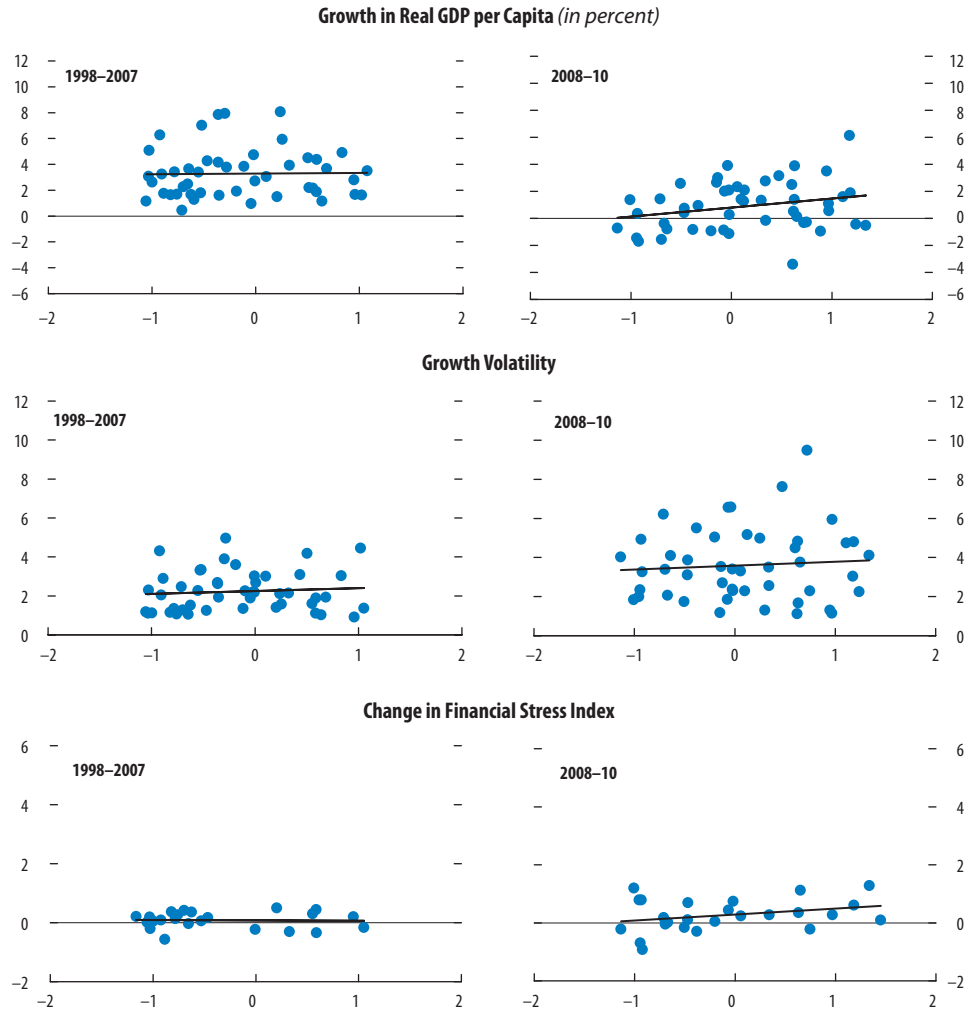
Country Case Studies

Another way to assess the relationship between financial structures and economic outcomes is to look at country case studies. For this purpose, five countries were chosen (Australia, China, Germany, Japan, and the United States) that offer a contrast in their financial structures (Boxes 4.3 to 4.7 and Table 4.2). The main points of contrast are:

- The importance of nonbank financial sectors—the United States versus countries that depend primarily on banking sectors for financial intermediation.
- The depth, resilience, and dynamism of the financial sector—the United States versus countries that are less integrated into globalized financial asset markets or face less intense competition, such as Australia and China.
- The severity of financial distress in the recent crisis—the United States and Germany versus countries that largely avoided it, such as Australia, China, and Japan.

[3]Note that the measures of competition used here are commonly used by researchers evaluating the traditional banking business—making loans and taking deposits. This measure is most applicable to those more traditional banking systems, that is, most economies with the exception of a number of advanced ones, during normal times. Its representativeness could be questioned during a crisis period, when the underlying interest rates are subject to crisis management policies or other distressed conditions.

Figure 4.1. Time Varying Correlations: Financial Globalization Index



Source: IMF staff calculations.

Note: For explanation of the financial structure indices, see Table 4.1. This figure shows the relationship between the financial globalization index from Chapter 3 and economic outcomes for advanced and emerging market economies. The index is constructed so that higher values are associated with higher levels of financial globalization. Each index is constructed by standardizing the values, using the mean and standard deviation across all economies and the entire sample period. Not all economies have a value for the financial globalization index.

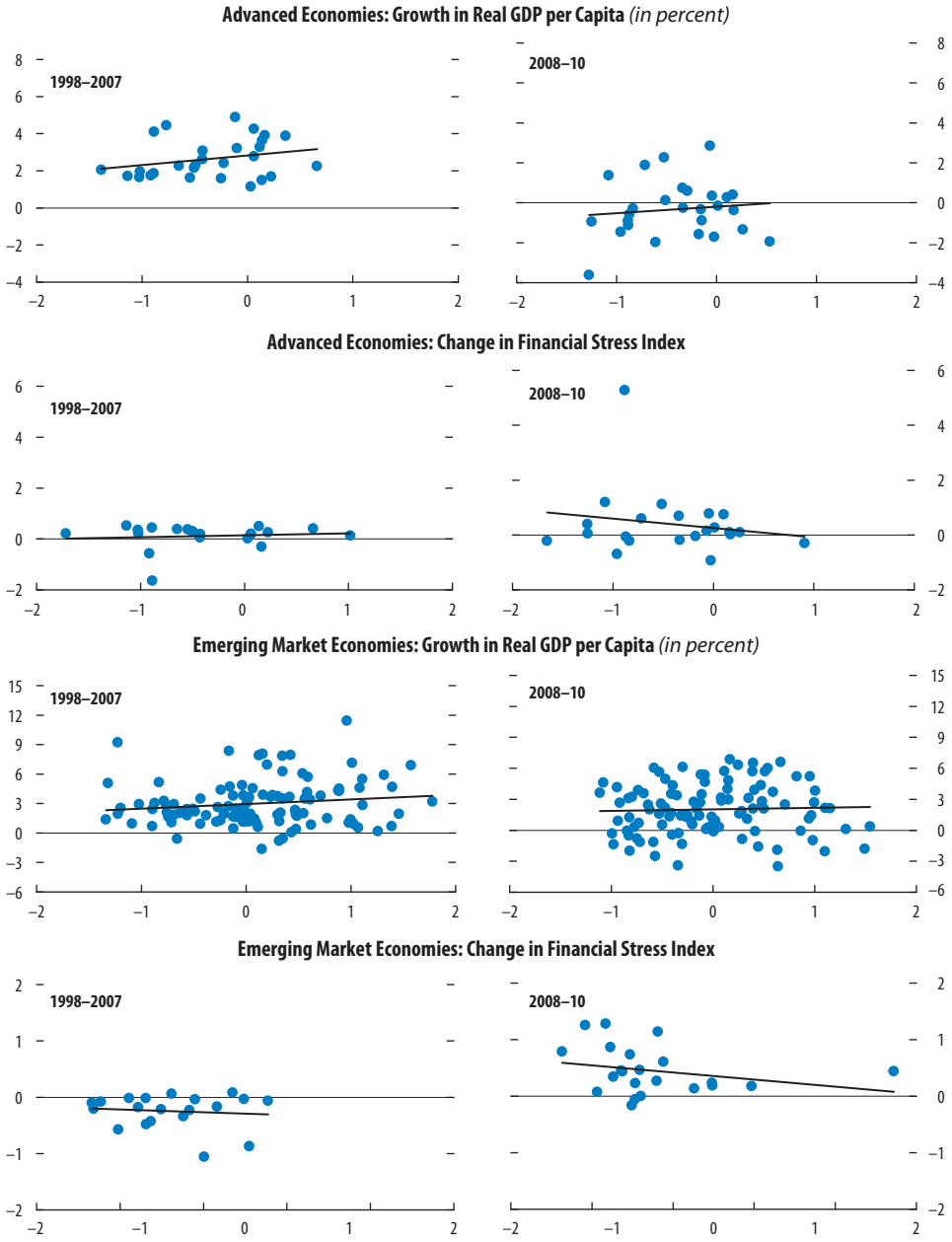
The case studies address a common set of issues for each country:

- The characteristics of the country's financial structure.
- The association, if any, between financial structure and economic outcomes.
- The implications of the ongoing regulatory reforms for the current financial structure and for growth and volatility.

The five case studies suggest the following general conclusions:

- No particular financial structure can ensure best economic outcomes under all circumstances. In other words, there exists no optimal (or one-size-fits-all) structure to generate growth and maintain financial stability. What appeared to give good results on both counts during a certain period may not work in a different period. Japan's "main bank system" and the United States' capital markets are examples of structures that worked well for growth for a while (before the 1980s and 2000s, respectively) but then caused major

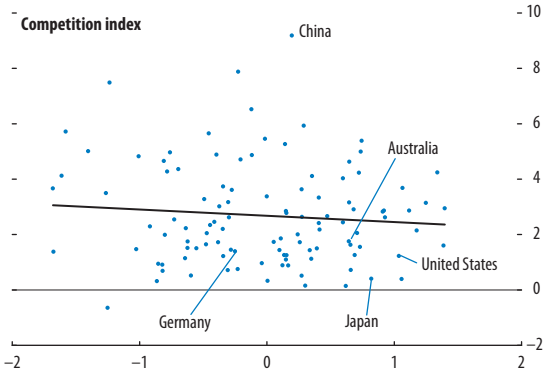
Figure 4.2. Time Varying Correlations: Financial Buffers



Source: IMF staff calculations.

Note: For explanation of the financial structure indices, see Table 4.1. This figure shows the relationship between the financial buffers index from Chapter 3 and economic outcomes for advanced and emerging market economies. The index is constructed so that higher values are associated with higher levels of financial buffers. Each index is constructed by standardizing the values, using the mean and standard deviation across all economies and the entire sample period. Not all economies have a value for the financial buffers index.

Figure 4.3. Financial Structure and Economic Growth, 1998–2010
(Growth in real GDP per capita, in percent)



Source: IMF staff calculations.
Note: For explanation of the financial structure indices, see Table 4.1. This figure shows the relationship between the competition index from Chapter 3 and economic outcomes for advanced and emerging market economies. The index is constructed so that higher values are associated with higher levels of competition. Each index is constructed by standardizing the values, using the mean and standard deviation across all economies and the entire sample period. Not all economies have a value for the competition index.

financial disruptions. China, with the smallest financial sector and highest share of financial sector assets held in banks among the case study countries, showed the best economic performance (higher GDP per capita growth and less growth volatility than in other countries) over the last decade. However, this may well be the result of other factors (healthy export markets) and its relatively low level of economic development when economic reforms were initiated in 1978. Moreover, the dominance of large banks in financial intermediation has contributed to inefficiencies in credit allocation and the potential buildup of vulnerabilities. These vulnerabilities are heightened by a relatively low cost of capital as a result of incomplete financial deregulation. Similarly, although Australia showed solid economic performance over the last decade and resilience to the recent financial crisis, it is not clear whether the role of its highly concentrated banking sector was key in this regard as many attribute its success to supervisors' ability to influence the largest banks' behavior alongside the economic support of a substantial commodity boom.[4]

[4]A concentrated banking sector has its risks as well as advantages. On the one hand, monopoly power could lower borrowing firm profitability and incentivizes firms to take excessive risk

- Some features of the financial structure could make a financial system more susceptible to contagion and thereby undermine economic performance. The case of Germany, with high reliance of part of its banking system on noncustomer deposit funding, and of the United States, with its high domestic and global interconnectedness, make them prone to contagion.
- A financial structure that shields the sector from certain risks may not be sufficient to ensure better economic performance because of other economic linkages. For example, the Japanese financial system showed resilience during the recent crisis partly as a result of its limited reliance on foreign-currency-based wholesale funding. However, the country is reliant on trade, and it could not avert one of the most severe output contractions among advanced economies as global trade plummeted.
- The ongoing global regulatory initiatives are not likely to change the basic financial structures in Australia and Japan much, but they are likely to have effects in China and the United States, where domestic financial reforms are expected to play a large role as well. However, the extent to which these initiatives could ensure better economic outcomes depends equally on (1) how financial structures would change and (2) how the financial structures are related to financial stability. These issues are discussed in Chapter 3, and we explore them more analytically in the next section.

Multivariate Regressions

The earlier basic correlation and case study analyses provide a starting point for a more formal and broader approach to study the interplay between financial structures and economic outcomes. Both multivariate regressions and a probability model of banking crisis are used to investigate the possible relationship between financial structures and

(Boyd and De Nicolò, 2005). On the other hand, large banks have economies of scale and less concentrated portfolios, which tend to result in higher profits and less risk. A small number of large banks are also easier to supervise than a large number of small banks.

Box 4.3. Australia

Australia's bank-based financial sector is large and mature. Authorized deposit-taking institutions, mostly banks, are the dominant group of financial institutions accounting for more than 50 percent of financial assets (about 200 percent of GDP). Superannuation funds account for 20 percent of financial assets and are the fastest growing group.[1] The insurance sector has 7 percent of financial assets, and non-superannuation managed funds have another 6 percent. Most of the financial sector assets are domestic.

The banking sector is highly concentrated, and dominated by four large Australian-owned banks, whose combined assets account for almost 80 percent of total banking assets. Their share in banking sector assets has risen more than 10 percentage points since mid-2008 largely as a result of the acquisition of smaller banks and the withdrawal of some foreign-owned banks during the crisis. The government has a "four pillars" policy that prohibits mergers among the four major banks but does not automatically object to acquisitions of smaller banks by major banks, which are subject to approval by the competition authority. The Australian banking system is open, with no policy or regulation discriminating against foreign banks. Foreign banks account for 12 percent of total banking assets.

The financial sector grew rapidly over much of the past two decades, but growth has since slowed to a sustainable pace in line with income growth. Financial deregulation in the 1980s and disinflation in the 1990s permitted a strong expansion of the financial sector with little output volatility. The stable expansion of the financial sector has supported two decades of uninterrupted output growth. While some of this financial expansion was enabled by offshore wholesale funding, use of this funding source has been on the decline since the global financial crisis began. The growth in home mortgages, the fastest growing type of banking asset in the past two decades, was for a time accompanied by rapid increases in household debt and house prices, although both household debt and house prices have gradually adjusted downward over the past two years.

Any risks arising from these developments are being managed and there is no plan to change regulation in order to prospectively change the bank-based financial structure to a capital-market-based one. Australia has a well-functioning model of financial regulation, with separate regulatory agencies responsible for prudential regulation and conduct of business. The Australian Prudential Regulation Authority (APRA) takes pride in its "intrusive" approach to financial supervision, which is forward looking and risk based. APRA is preparing to implement Basel III standards in 2013, well ahead of schedule, although the reform is not intended to change the current structure of the financial system. The intense supervisory approach has been broadly effective for Australia as evidenced by the high-quality capital and the strong emphasis on loan serviceability in granting credit. That said, considering the diversity of country circumstances, what is successful in Australia may not necessarily be so elsewhere.

Note: This box was prepared by Xiaoyong Wu.

[1]The program is funded by mandatory contributions by employers and voluntary and tax-privileged contributions by employees.

economic outcomes (Annex 4.2 and Annex 4.3). For the multivariate regression exercise we again use a sample consisting of 58 economies during the 1998–2010 period, separated into advanced and emerging market, and the same three outcomes as before—the growth of real GDP per capita (real growth), the volatility of real growth, and a financial stress index. The tables only report relationships that are robust across several panel data specifications, meaning the coefficients were statistically significant using one of the techniques and did not change sign in the other techniques, and as well, did not change substantively if outliers were removed or other controls were introduced.

The results are as follows. In regressions that relate real GDP per capita growth, growth volatility, and change in financial stress to measures of financial structure, the variables proxying for competition,

Table 4.2. Financial Sector Size, Structure, and Economic Performance in Case Study Countries
(In percent)

	Australia			China			Germany			Japan			United States		
	1998–2002	2003–07	2008–10	1998–2002	2003–07	2008–10	1998–2002	2003–07	2008–10	1998–2002	2003–07	2008–10	1998–2002	2003–07	2008–10
Financial sector size															
Total financial sector asset (relative to GDP)	286	360	382	n.a.	219	252	334	365	377	479	497	508	358	414	430
Financial sector asset share															
Banks (depository institutions)	48	47	52	n.a.	90	87	73	69	66	63	60	61	24	24	27
Insurance and pensions	34	33	29	n.a.	5	6	15	17	18	18	20	20	32	29	25
Other financial institutions	18	21	20	n.a.	5	7	12	14	16	19	20	19	45	47	47
Financial structure variables															
Bank noninterest income[1]	43	36	27	14	20	14	46	51	45	22	29	25	42	42	39
Interbank assets to total assets	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	28	25	24	15	15	16	11	12	12
Bank asset concentration[2]	68	72	65	71	64	55	67	71	75	34	38	45	22	29	35
Net interest margin	1.7	2.2	2.0	2.2	2.3	2.7	1.2	1.0	1.0	1.3	1.3	1.2	3.9	3.4	3.4
Economic performance															
GDP per capita growth (x)	2.5	2.0	0.3	7.4	11.0	9.2	1.6	1.7	–0.1	–0.1	1.8	–0.8	2.1	1.8	–1.1
GDP per capita volatility (y)	1.0	0.8	0.8	0.7	1.8	0.6	1.2	1.9	4.3	1.5	0.4	4.9	1.6	0.6	3.3
Growth-volatility ratio (x/y)	2.5	2.7	0.4	11.2	6.1	14.7	1.3	0.9	0.0	–0.1	4.2	–0.2	1.3	2.9	–0.3

Sources: National flow of funds; national accounts; World Bank, Global Financial Development database; and IMF staff estimates.

Note: All figures are period averages. Financial sector excludes central banks. For Japan, financial sector excludes Fiscal Loan Program; for China, the earliest financial sector data are as of 2005.

[1]Ratio of banks' noninterest income to total income.

[2]Ratio of assets held by the three largest banks to those held by banks.

financial buffers, financial globalization, and nontraditional bank intermediation have some statistical significance over the full period 1998–2010. However, for the proxies for financial globalization, the results seem to be driven mainly by the developments since the crisis as re-estimating the regressions using data through 2007 results in some of the relationships losing statistical significance.[5]

Concentration and Lending Spreads

- Higher concentration and lending spreads are statistically significantly associated with higher growth and less growth volatility. While there are varying possible explanations for this, the result is puzzling and warrants further investigation.[6]

- Similarly, higher concentration (proxied by three banks' concentration ratio—the proportion of assets attributable to the largest three banks compared to their banking system) is associated with higher growth in "good times" and higher financial stress during a banking crisis[7] (Table 4.3, and Table 4.5 in Annex 4.2).

While the panel technique is not able to definitively identify causal relationships, it still suggests that banks in less competitive systems are able to earn more during "good times," easing economic volatility. However, their ability to earn higher profits on their banking business is hindered during a banking crisis.

Liquidity and Capital Buffers

- Higher liquidity buffers (as measured by the ratios of liquid assets to deposits and to short-term

[5]The short period—we have annual data only for 1998–2010—means that the interpretation is based on one business cycle, and hence should not be interpreted as accounting for long-run growth relationships.

[6]Higher lending spreads traditionally signal lower competition, although more recent economic models of competition show how this may not be the case (Annex 4.1). The notion is that higher spreads enable banks to earn higher profits, and as a result they are less motivated to take excessive risk and thus less likely to cause or contribute to economic fluctuations. This result could as easily, however, reflect a reverse causality: during periods of high growth, banks are able to charge higher lending spreads.

[7]This specification controls for the ratio of government debt to GDP and so the result suggests that concentration matters even after accounting for the impact of government debt on financial stress.

Box 4.4. The United States

The U.S. financial system is large and highly diversified, but what sets it apart from that of other countries is the 80 percent share of credit market assets held outside of depository institutions. Depository institutions hold only about 20 percent, largely because only about 10 percent of credit to the corporate sector comes from banks. Insurers and pension funds hold about 12 percent of credit market assets, which is roughly similar to this subsector's share in other countries. "Households" are a large factor (9 percent), comprised mostly of hedge funds, private equity, and personal trusts, as are foreign investors (16 percent).

The remainder of credit market assets is held in a number of subsectors that have become characterized as significant contributors to the crisis. These include government-sponsored enterprises (GSEs), which account for about 14 percent of total credit market assets, mostly concentrated in residential mortgage markets.[1] Their implicit guarantees and social policy mandates contributed to a softening in credit discipline and a buildup of systemic risk. Other large subsectors include investment funds (10 percent), including money market mutual funds (3 percent), and private-label securitization vehicles (4 percent).

The U.S. financial system structure is well suited to fueling credit growth in good times, but it is prone to exacerbating downdrafts (Bhatia and Bayoumi, 2012). For example, dependence on capital-markets-based funding, with much of that foreign and buoyed by securitization, has been associated with greater volatility in the availability of credit (Dagher and Kazimov, 2012). Also, various forms of secured funding increased the amount of interconnectedness and effective leverage in the system (Bhatia and Bayoumi, 2012; and Singh, 2012). In addition, much financial intermediation takes place in the largely unregulated "shadow banking" subsector.

U.S. bank supervision is fragmented and the diffusion of powers across agencies undermines its efficiency, effectiveness, transparency, and accountability (IMF, 2010c). The Dodd-Frank Act has resulted in some streamlining, but the number of U.S. agencies responsible for financial sector oversight has been increased rather than reduced. That said, the new Financial Stability Oversight Council should help coordinate regulatory actions that have a macroprudential objective. Various proposals on the future of the GSEs are being examined, but little action on this agenda is expected soon.

However, authorities are committed to reregulate the banking sector, money market mutual funds, securitization, and over-the-counter (OTC) derivatives. Because many of the new rules remain under development, predicting their impact on the structure of the financial sector is difficult. Nevertheless, profound changes are likely, as investment banking becomes less profitable, and the costs of running OTC derivative and securitization businesses rise.

Note: This box was prepared by John Kiff.

[1]GSE assets here consist of loans held on their balance sheets plus those held in agency- and GSE-backed mortgage pools.

funding) were associated with higher growth for the entire sample and the subsample of emerging market economies. Higher capital buffers (as measured by the ratio of equity to total assets) are negatively related to growth volatility in the full sample and are also negatively related to financial stress in advanced economies (Table 4.3, and Table 4.5 in Annex 4.2).[8]

Share of Foreign Banks in the Total Number of Banks

- The share of foreign banks in the total number of banks in a country (as one possible proxy for financial globalization) is associated with lower growth and higher volatility in the full sample during 1998–2010, but the result appears to be driven mainly by developments since the crisis, as this negative relationship diminishes when a sample before the 2007 crisis is used (Table 4.3, and

[8]This chapter uses the ratio of equity to total assets as a proxy for capital buffers, rather than a measure of risk-weighted capital adequacy. This approach has been used by various studies in the literature (Barrell and others 2010a, 2010b; Kato, Kobayashi, and Saita, 2010; Demirgüç-Kunt, Detragiache, and Merrouche, 2010). Moreover, during the crisis, market participants focused on this measure of capital adequacy over those using risk-weighted assets since it appeared to them to be less subject to accounting and risk-management manipulation.

Box 4.5. Germany

The German financial sector is dominated by banks, which account for about 65 percent of financial sector assets. German industry is highly reliant on bank financing and households borrow almost exclusively from domestic banks. The banking system is based on a "three pillar" system (private banks, savings banks and the associated Landesbanken, and networks of cooperative banks). The savings bank and cooperative pillars are each bound together through mutual guarantees, vertical ownership ties, and the so-called regional principle whereby members do not compete with each other.

The large commercial banks (accounting for 25 percent of banking sector assets) are major participants in international financial markets. They compete across the full spectrum of products, including over-the-counter (OTC) derivatives and structured finance products. They are now recalibrating business models around the new regulatory environment. Some of the Landesbanken (17 percent of banking sector assets) were heavily involved in highly speculative markets, fueled until 2005 by cheap and abundant government-guaranteed funding. When those investments turned sour, some of them required extensive public financial support. In addition, the Landesbanken and big private banks are highly dependent on wholesale and capital-market-based funding, which proved to be problematic to some, particularly in 2007–08.

The cooperative and savings banks, which comprise about 25 percent of banking sector assets, have proven to be the most resilient subsector. A focus on retail deposit funding has insulated them to a large degree from the crisis, and they have remained steady providers of credit to the domestic economy while the other banks were scaling back. However, according to the September 2011 Monthly Report of the Deutsche Bundesbank, the postcrisis downturn in lending never approached credit-crunch conditions. In fact, much of the contraction came from reduced loan demand, which in turn was largely due to firms' ability to self-fund out of retained earnings.

The big two commercial banks will be particularly challenged by financial sector reregulation, because of their extensive investment banking activities, high leverage, and capitalization that is not as robust as that of their foreign peers. All the large commercial banks are still bolstering capitalization and refocusing on core banking activities, including competing more aggressively for domestic retail deposits. Six large banks that were called upon to strengthen their capital position as a result of the late-2011 European Banking Authority stress test are well on their way to complying.

Note: This box was prepared by John Kiff.

Table 4.5 in Annex 4.2).[9] Similarly, larger foreign bank share during a banking crisis is associated with lower growth in advanced economies. Hence it appears that most of the detrimental relationship takes place in times of distress.[10]

Previous empirical work on the influence of foreign banks shows that it depends on their business model in the host country. Based on more granular balance sheet and bank ownership data for 137 countries over 1995–2009, Claessens and van Horen (2012) found that foreign banks reduced credit more compared to domestic banks during the crisis but this was limited to those countries where they had a small role in financial intermediation. Detragiache, Tressel and Gupta (2008), using a sample of low-income countries, argue that the foreign banks that are more reliant on "hard information," such as collateral values, are less able to manage their lending relationships compared with those that rely on "soft information," such as entrepreneurial ability, and so they tend to lend less, and to lend predominantly

[9]Being a crude proxy for financial globalization, the share of foreign banks in the total number of banks may capture only a limited dimension of financial globalization.

[10]Earlier work on the costs and benefits of interconnectedness shows how this can be the case. It notes that cross-border connections are helpful in distributing (mitigating) risk in normal times, but can also be mechanisms for the transmission of shocks. Shocks in one part of the system can be amplified and transmitted if globally connected financial institutions pursue similar investment strategies and become collectively overexposed to risk in the upswing of a credit cycle and collectively risk averse in a downswing (IMF, 2010a, 2010b).

Box 4.6. Japan

Relative to its GDP, Japan has one of the largest financial sectors in the world. The sector is predominately bank based, but Japan also has large insurance and pension subsectors (see Table 4.2). Banks (deposit-taking institutions) hold roughly 60 percent of total financial sector assets. There are three major banking groups ("megabanks"), but concentration is relatively low (see Chapter 3), as the banking sector also comprises nearly 400 regional banks and Shinkin banks (cooperative regional financial institutions) and the Japan Post Bank. Foreign banks have traditionally played a minor role in the domestic loan and deposit markets, but they have a significant presence in investment banking and derivatives trading.

While the megabanks and some other large financial institutions have a sizable international presence, the Japanese financial system is very much domestically oriented and has a strong linkage to the sovereign thanks to significant and growing holdings of government securities.[1] The main factors behind this strong link to the sovereign are (1) Japanese households' continued preference for allocating the majority of their assets to bank deposits—despite the prolonged near-zero interest rate environment; (2) a rise in deposits from the corporate sector; and (3) banks' cautious risk-taking strategies following the financial crisis of the late 1990s to early 2000s. The Japanese banking sector's profitability remains very low compared to that in other advanced economies, partly as a result of fierce competition among banks in the face of subdued demand for credit from the corporate and household sectors.[2]

The assessment of the Japanese financial system's effect on economic growth and its stability is mixed. Until the burst of its asset price bubble in the early 1990s, Japanese economic success was often attributed to Japanese banks' close ties with their corporate customers (relationship-based banking, or the so-called "main bank system"). However, since that time these close ties have worked adversely and, at least partially, have encouraged forbearance and ever-greening of credit extended to nonviable companies. Aggravated by banks' thin buffers of capital that can absorb losses, this in turn has prolonged the necessary deleveraging and restructuring process of the financial system and economy, resulting in Japan's so-called "lost decade." However, at the same time, the main bank system has probably contributed to averting severe financial disintermediation and mitigated an acute economic downturn, at the cost of a prolonged period of low growth (which can also be seen in its low growth and low volatility performance in the 1998–2002 period shown in Table 4.2).[3,4]

The Japanese financial system has performed relatively well since the mid-2000s. Financial developments improved in the mid-2000s, reflecting in part an acceleration in balance sheet repair in the early 2000s. During the global financial crisis, the Japanese financial system as a whole was relatively less affected than those in other advanced economies, in part because of its relatively limited exposure to securitized products and foreign claims and limited reliance on foreign-currency-based wholesale funding. However, as global trade plummeted, the resilience of the financial sector could not avert one of the most severe contractions in output experienced among the advanced economies.[5]

Looking ahead, it seems unlikely that the ongoing regulatory changes will alter the structure of the financial system dramatically. Major Japanese banks seem well positioned to meet the new capital requirements, thanks in part to substantial holdings of low-risk-weighted "safe" assets. Also,

Note: This box was prepared by Ken Chikada.

[1]Banks (including the Japan Post Bank) hold about 40 percent of the outstanding amount of Japanese government securities issued; insurance companies and pension funds hold about 20 percent. See IMF (2012a) for cross-country comparison.

[2]Profitability is a challenge for regional banks, which are predominantly involved in domestic lending and have relatively thin capital buffers.

[3]For discussions on the main bank model, see Aoki and Patrick (1995) for example; for the prolonged adjustment, see Caballero, Hoshi, and Kashyap (2008); for somewhat different perspectives on Japan's lost decade, see Shirakawa (2012).

[4]It is noteworthy that banks held sizable equity exposures to their large corporate clients, which in turn exposed banks' capital to volatile and downward-trending stock market prices. Although banks' stock holdings declined substantially in the last decade, they remain a large risk factor for the major banks (Bank of Japan, 2012).

[5]During the fourth quarter of 2008 and the first quarter of 2009, Japan's real GDP shrank by nearly seven percent.

Box 4.6 *(continued)*

their abundant holdings of Japanese government securities should make it easier to meet the Liquidity Coverage Ratio. However, it would also imply that the Japanese financial system remains exposed to a potential spike in yields, perhaps associated with risks to longer-term fiscal sustainability. And the challenge remains for the Japanese financial system to contribute to a still-needed revival of economic dynamism and higher potential growth in the Japanese economy, which is under considerable downward pressure because of a rapidly aging population.[6]

[6]See IMF (2012b, 2012c) for more details.

to governments and large corporations. Yet another study examining crisis periods, Detragiache and Gupta (2004), shows that the most relevant differences in performance during the Asian crisis are not based on the differences between foreign and domestic banks, but between subsidiaries of foreign banks whose operations were not concentrated in Asia and other banks, suggesting that foreign banks that are more "embedded" in a region are likely to help the economy perform better than others. Overall, the more committed foreign banks are to the host country the better is economic performance.

Ratio of Other Interest-Bearing Liabilities to Total Liabilities

- The ratio of other interest-bearing liabilities to total liabilities (as a proxy for nontraditional bank intermediation) is positively associated with financial stress in emerging market economies (Table 4.3, and Table 4.5 in Annex 4.2).
- This ratio is negatively (positively) associated with economic growth (growth volatility) in the full sample and in advanced economies (Table 4.3, and Table 4.6 in Annex 4.2).

These results suggest that nontraditional funding structures that depend on other interest-bearing liabilities may be unfavorable to economic outcomes.

Further analysis also shows that the effects of the buffer variables are nonlinear (Table 4.3, and Table 4.6 in Annex 4.2). For instance, up to a certain threshold, higher capital buffers tend to be related to higher economic growth, but beyond that threshold they can be associated with lower growth. The threshold in this exercise should not be viewed as a prudential maximum since what may be an appropriate set of buffers for a specific country will depend on the ability of its financial institutions to manage risk properly and the incidence and size of shocks to which it is subject. In any event, the thresholds for the capital buffers are in all cases above 25 percent and most of the countries that exceed the thresholds were low-income or emerging market economies.

Applying the multivariate regression exercise to advanced and emerging market economies separately shows some differences between the two groups (see Table 4.3, and Tables 4.5 and 4.6 in Annex 4.2). For emerging market economies, liquidity buffers play an important role, with the nonlinear relationship to growth (and to growth volatility) confirmed for this subset. Those results were absent for advanced economies. There is also a nonlinear relationship for emerging market economies as regards one of the financial globalization variables: at lower levels, the ratio of foreign banks to all banks is associated with higher financial stress, but it is associated with lower stress when it exceeds a certain level in emerging market economies.

The model on the probability of banking crises indicates that a more highly concentrated system is associated with a lower probability of banking crises (Table 4.7 in Annex 4.3).[11] This result may be related to the issue of too-important-to-fail: If there is high concentration with only a few important banks, then authorities will be more likely to take action to prevent a banking crisis. It is also consistent with the work that shows that excessive

[11]The measure of a banking crisis is taken from Laeven and Valencia (2010).

Box 4.7. China

China's financial structure has undergone rapid changes as the country moves toward a more commercially oriented financial system, supported by rapid financial development. The current financial structure is still predominantly bank based, with bank assets and private credit accounting for 240 percent of GDP and 140 percent of GDP in 2011, respectively. Though having declined in the last decade, the degree of concentration in the banking sector remains large: The large commercial banks, which are mostly state owned, make up almost half of commercial bank assets, and the assets of each of the four largest banks exceed 20 percent of GDP. The fixed-income market has grown as an alternative funding channel (with total debt securities outstanding amounting to 56 percent of GDP in 2011), but it remains heavily concentrated in public sector securities. The equity market remains relatively small (stock market capitalization amounted to only 46 percent of GDP in 2011), and mainly meets the needs of large enterprises in spite of recent initiatives to encourage securities financing for small and medium-sized enterprises. A notable recent development is the increasing importance of the nonbank financial sector, such as wealth management products, private equity, trust products, and private lending. Though no official estimates exist on the size of the nonbank financial sector, its linkages to the traditional banking system and the real estate sector have been growing.

The rapid financial development and structural changes have been largely supportive of China's rapid growth of GDP through at least two channels. One channel is the increasing number of financial institutions, which make it easier for people to save. The high saving rate supports a high level of investment, which boosts economic growth. Indeed, during the period 2000–11, private saving and investment reached average levels of 41 percent and 42 percent of GDP, respectively. The other channel is a reduction in information asymmetries between savers and investors, which lowers intermediation costs and thus promotes investment. To the extent that the ongoing financial reforms help reduce intermediation costs, this second channel will become increasingly important in sustaining the rapid economic growth.

However, the current financial structure and the governments' role in shaping it may affect the volatility of growth going forward. The dominance of large banks in financial intermediation, against the backdrop of the macroeconomic and institutional environment, has contributed to inefficiencies in credit allocation and a buildup of vulnerabilities. First, the relatively low cost of capital (partly as a result of incomplete interest rate deregulation) spurs excessive investment. Second, underdeveloped capital markets limit the alternatives for corporate funding and placement of household savings. Third, owing to incomplete interest rate deregulation and limited exchange rate flexibility, banks and other market participants lack sufficient incentives to improve their assessment, management, and pricing of risks. This managed approach to deregulation has generated significant downside risks in the form of overcapacity, a capital-intensive means of production, a tendency for asset bubbles, and a periodic need for publicly funded bank recapitalizations—although these have yet to be manifested in large downswings in output.

Going forward, the ongoing international regulatory reforms together with China's domestic financial reforms are expected to reshape China's financial structure. Specifically, the securities markets are expected to play a larger role in financial intermediation, and the banking sector will see more competition with the share of four large commercial banks declining. The Basel III rules will be phased in from 2013, and the capital and liquidity requirements are expected to be fully implemented. Whether these changes will underpin a healthier and more efficient financial system remains to be seen, as vulnerabilities from imbalances remain.

Note: This box was prepared by Tao Sun.

Table 4.3. Summary of Fixed-Effects Panel Estimation Results on Economic Outcomes, 1998–2010

Category of Financial Structure	Financial Structure Variable	Term	Dependent Variable: Growth — Full Sample	Growth — Advanced Economies	Growth — Emerging Market Economies	Volatility — Full Sample	Volatility — Advanced Economies	Volatility — Emerging Market Economies	Change in Financial Stress — Full Sample	Change in Financial Stress — Advanced Economies	Change in Financial Stress — Emerging Market Economies
Financial globalization	Share of foreign banks in total number of banks	Linear	−***	−**	−***	+**	+**		+*		+**
		Interaction with crisis	−*	−**	−*	−**	−***				+*
		Linear	−***	−***			+*		+**		+***
		Quadratic[1]									−**
	Ratio of total bank foreign assets to GDP	Linear			−*						
		Interaction with crisis	−**	−**		−**					+***
		Linear	−*	−**		+***	+***		−**		
		Quadratic[1]	+***	+***		−***	−***		+***		
Competition	Lending spread	Linear	+***		+**	−***		−***			
		Interaction with crisis				+**				−**	
		Linear	+*		+*	−***		−**			
		Quadratic[1]				+*					
	Concentration	Linear	+***	+***	+***	−***	−**	−*			
		Interaction with crisis					+**		+***	+**	
		Linear									
		Quadratic[1]									
Financial buffers	Liquid assets/ deposits and short-term funding	Linear	+***		+**						
		Interaction with crisis						−***	+***	+***	
		Linear			+***	−**		−**	−**		−***
		Quadratic[1]			−***	+**		+***	+**		+***
	Equity to total assets	Linear				−**				−***	
		Interaction with crisis				+*			−***	−***	
		Linear	+***					−**			
		Quadratic[1]	−***					+**			
Nontraditional bank intermediation	Ratio of other earning assets to total assets	Linear	+***								
		Interaction with crisis			−**			+***	+*	+*	
		Linear					+*				
		Qudratic[1]					−*				
	Ratio of other interest-bearing liabilities to total liabilities	Linear							+*		+**
		Interaction with crisis			+**			−***			
		Linear	−**	−**		+***	+***	+*	+*	+*	+***
		Qudratic[1]	+*	+**		−***	−***				−***

Source: IMF staff estimates.

Note: This table summarizes the results of the fixed-effects panel estimation on growth, growth volatility, and financial stress. For each variable, the first two rows represent the coefficients in the interaction specification (see Table 4.5) while the third and fourth rows represent the coefficients in the quadratic specification (see Table 4.6). +/- indicate the sign of estimated coefficients. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence based on robust standard errors. For the definition of dependent variables and independent variables, see Tables 4.1 and 4.4, respectively. For sample countries, see Annex 4.2.

[1]Square of financial structure measures.

competition can lead to excessive risk-taking by institutions that aim to maintain a high return on equity or profitability.

Policy Implications

This chapter has tried to bring empirical methods to bear to investigate the relationship between financial structures and economic outcomes. It has found some relationships that are statistically significant, but before summarizing these findings and attempting to draw some general policy implications, it is useful to remind ourselves of the limitations of the investigation.

First, the period under study was relatively short. Detailed data on many measures of financial structures has been available only since the late 1990s, limiting the time series substantially; for example, it did not include a number of business cycles, which would be desirable to make inferences about the long-term relationship between financial structures and economic activity. As we go forward and longer data series become available, additional analysis may make it possible to draw more definite conclusions.

Second, the period under study was exceptional in that it included a very severe financial crisis. While the empirical setup attempted to take account of its effects, the crisis and the policy measures taken to combat it probably affect the results. In some cases, the sequence of events is crucial and may distort apparent causality. For example, during the upswing, growth accelerated and financial institutions facing high demand for credit were able to expand lending spreads. Even though these events happened simultaneously, there may be no contemporaneous causality that would suggest that a more lucrative banking sector leads to better growth performance. This shows that the interpretation of the results needs to carefully take into account the specific economic and financial context, as is done below.

Third, there are important data gaps that hamper the analysis. As discussed in Chapter 3, the available measures are incomplete and can only proxy for the true financial structure. It is therefore important to consider exactly for which relationship the proxy data are being used and we need to keep asking ourselves whether it is telling the whole story. Also in this case, more extensive, timely, and accurate data would allow more definite conclusions to be drawn on the relationship between financial structures and economic outcomes.

Extensive care was taken in the empirical analysis to take account of these limitations. In the end, the following sets of results appear robust—across various specifications that were used, as well as across time, and across countries (or within subsets of countries), and with or without outliers:

- Some features can enhance the effectiveness and resilience of a financial system and thus contribute to better economic outcomes. The main features that have these beneficial effects are capital and liquidity buffers. The analysis showed this most clearly for emerging market economies; the effect was not significant for advanced economies. This is not as surprising as it may seem: it became clear in the financial crisis that the measured capital and liquidity buffers that we thought were in place in advanced economies were not large enough nor of sufficiently high quality, did not offer the liquidity and solvency protection they were supposed to provide, and had to be raised in the subsequent period of economic downturn.[12] Buffers in emerging market economies were larger and were consistently of higher quality and protected these financial systems more effectively from instability.
- Some features that improve the resilience of a financial system can adversely interact with economic outcomes once they exceed a certain threshold. Capital and liquidity buffers are a case in point. While these financial buffers generally tend to help economic outcomes, the analysis found that beyond certain (fairly high) levels in low-income and emerging market economies, they may be associated with lower economic growth, higher volatility of economic growth, and higher financial stress. This result is generally in line with findings of the Basel Committee on Banking Supervision (BCBS, 2010) on the diminishing benefits of buffers. A similar result has also been found in other studies for the influence of

[12]Alternatively, the insignificant relationship could reflect the notion that crisis intervention measures substitute for the use of the buffers in past advanced economy crises, serving to cushion economic growth and its volatility.

credit-to-GDP ratio on economic volatility (see Box 4.1).

- Some features of a financial system appear to make it more susceptible to financial instability and to poor economic outcomes. These features include a higher level of nontraditional bank intermediation and a high share of foreign banks in the financial sector. This is where a careful interpretation of the results is important: they do *not* imply that nontraditional bank intermediation and financial globalization are not beneficial. Instead, they suggest that there are some costs to foreign bank presence—particularly in a period leading up to and including severe financial distress. Some previous empirical work suggests that foreign banks' positive role is most likely when those banks are well managed, know their local customer base, and have a commitment to the economy or region.

Keeping in mind the caveats mentioned above, the following tentative policy conclusions emerge:

- *Regulatory policies that promote financial buffers help economic outcomes, but they need to consist of high-quality capital and truly liquid assets.* The regulatory initiatives to enhance liquidity management and capital requirements as encompassed in Basel III go in the right direction. That said, buffers beyond certain high levels may hurt growth by limiting credit intermediation, although the number of countries in the sample that exceeded the thresholds were small and typically were low-income countries with traditionally high capital buffers and a large proportion of liquid assets in the form of government debt. The thresholds implied by the models here should not be interpreted as prudential maximums as they will vary according to the strength of the financial system, the type of economy, and the nature and size of typical shocks.
- *In order to reap the benefits of financial globalization and nontraditional bank intermediation, these phenomena need to be well managed.* Global regulations should avoid incentives that may exacerbate the volatility of cross-border flows. Supervisory colleges or other means of discussing the cross-border business activities of financial institutions could go some way to ensuring foreign banks play a positive role in host countries even in times of stress. And a robust cross-border resolution regime could help relieve disruptive unwinding of global institutions. At a minimum, oversight arrangements should be put in place that allow for a more careful monitoring of these aspects of financial structures. Additional information about cross-border relationships within and between financial institutions as well as monitoring exercises such as those performed by the Financial Stability Board on shadow banking is welcome. Further work could usefully explore in more detail how financial globalization and nontraditional bank intermediation (such as non-deposit funding structures of banks) may influence economic outcomes.
- *Competition and concentration measures are often too influenced by regulatory, supervisory, and macroeconomic policies to use them to assess their direct relationship with economic outcomes.* Some of the results suggest bank concentration is associated with higher economic activity and lower financial stress, but this could be consistent with policies that in effect permit banks to become too-big-to-fail, allowing them to grow large alongside the economy and with sufficient profits to keep financial stress at bay. It is also possible that too much competition (the "opposite" of concentration) is damaging to growth and financial stability if it encourages (and if supervisors allow) excessive risk-taking behavior. In either case, policymakers should be aware that there are potential trade-offs between growth and stability that depend on competition in the banking sector in perhaps complicated ways. Hence, to evaluate the longer-run prospects for both a healthy financial system and economic stability a broader discussion about the role played by financial sector concentration is in order.
- *No particular financial system model can ensure the best economic outcomes under all circumstances.* In other words, there exists no optimal (or one-size-fits-all) recipe for the structural make-up of the financial sector to generate growth and maintain financial and economic stability. What appears to work well in one period or circumstance may not do so during different times. Indeed, complacency

and over-confidence regarding a particular type of financial structure may well plant the seeds for future financial instability—a lesson to be learned from past experience.

- *The policy implications may depend on countries' preferences regarding the trade-off between the safety of financial systems and economic growth.* For instance, our case study of China suggests that a preference for remaining somewhat isolated in terms of foreign-bank presence may have helped to protect the domestic economy from volatility, at least so far.

Finally, whatever financial regulatory measures are adopted to enhance growth and stability, they are likely to be effective only if they are implemented correctly—the quality of (domestic *and* global) regulation and supervision is essential. Hence, this chapter should be interpreted as a first, tentative step in showing that some elements of financial structure do indeed have an effect on economic activity, its volatility, and financial stress—some positive and some negative. A deeper understanding of these relationships will allow policy responses to help improve economic outcomes.

Annex 4.1. What Does the Literature Say About the Relationship between Financial Structures and Economic Outcomes?

A rich theoretical and empirical literature exists on the relationship between financial and economic outcomes. It has focused mostly on financial development—using proxies of size of financial systems—and less on financial structures. This annex reviews what the literature tells us about these various relationships.

Financial Development and Growth

There have long been two schools of thought with sharply differing perspectives on the potential importance of finance. On the one hand, economists such as Schumpeter (1911), Goldsmith (1969), and McKinnon and Shaw (1973) saw financial intermediaries and markets as playing a key role in economic activity and growth. A battery of models articulates the mechanisms through which the financial system may affect long-term growth, stressing that financial markets enable small savers to pool funds, that these markets allocate investment to the use with the highest return, and that financial intermediaries partially overcome problems of adverse selection in credit markets. Empirically, researchers have shown that a range of financial indicators for size, depth, and functioning are robustly positively correlated with economic growth. For instance, Levine (2005) showed that deep and well-functioning financial systems are associated with higher long-term growth. On the other hand, Robinson (1952) believed that the causality was reversed. Economies with good growth prospects develop institutions to provide the funds necessary to support those good prospects. In other words, in this view, the economy leads, and finance follows. Lucas (1988) also dismissed the finance–economic growth relationship, stating that economists "badly over-stress" the role that financial factors play in economic growth.

Financial Development and Growth Volatility

A large body of theoretical and empirical evidence suggests that larger and deeper financial systems help diversify risk and reduce the vulnerability of the economy to external shocks, thus smoothing output volatility. Easterly, Islam, and Stiglitz (2000) suggest that financial depth (as measured by the ratio of private credit to GDP) reduces volatility up to a point, but too much private credit can increase volatility. Rancière, Tornell, and Westermann (2008) argue that countries with large financial sectors feature both higher growth and higher volatility. Moreover, Dabla-Norris and Narapong (forthcoming) summarize the theoretical literature that outlines various mechanisms through which financial development can affect macroeconomic volatility. Aghion, Banerjee, and Piketty (1999) develop a theoretical model that combines financial market imperfections and unequal access to investment opportunities. They show that economies with poorly developed financial systems tend to be more volatile, as the demand for and supply conditions for credit tend to be more deeply cyclical. Empirically, Aghion and others (2010) find that deep financial systems can alleviate liquidity constraints on firms and facilitate long-term investment, reducing the volatility of investment and growth. In the same vein, Raddatz (2006) finds that in countries with underdeveloped financial systems, sectors with larger liquidity needs are more volatile and their economies experience deeper crises. Similarly, access to bank finance dampens the volatility of output at the industrial level owing to countercyclical borrowing by financially constrained sectors (Larrain, 2006). Evidence at the household level suggests that access to financial services allows for greater risk smoothing (i.e., lessening the deviations of realized income from mean income). Dabla-Norris and Narapong (forthcoming) also investigate the relationship between volatility and financial development in both advanced and developing economies (see Box 4.1).

Financial Structure and Growth

In considering the importance of financial structure for economic growth, economists have tended to focus on whether bank-based or market-based financial systems are more conducive to growth, with inconclusive results. Those who argue for the superiority of bank-based systems emphasize the advantages that banks and other intermediaries have

in information acquisition and relationship formation (Grossman and Hart, 1980; Stiglitz, 1985; Bhide, 1993; Allen and Gale, 2000). However, proponents of market-based systems argue that bank-based systems tend to include intermediaries with monopoly power, and that bank-based systems tend to be more conservative and less flexible in nature (see Rajan, 1992). Still others argue that neither type is more effective than the other at promoting growth; what matters is the financial system's overall level of development (see for example, Rajan and Zingales, 1998).

Empirically, there has been little resounding evidence in favor of either bank-based or market-based systems. Beck and Levine (2004), Demirgüç-Kunt and Maksimovic (2002), and Levine (2003) all suggest that financial structure does not play a decisive role in growth. Others, however, find that after controlling for the effect of overall financial development on growth, the structure of the financial system can still matter. When countries have inflexible judicial systems so that they are less able to adapt laws to changing economic conditions, the degree of bank orientation is positively correlated with long-term economic growth (Ergungor, 2008).

Some in the literature have considered in some depth whether a competitive or monopolistic banking structure is better for promoting growth. Some authors find support for high levels of competition (Jayaratne and Strahan, 1996; Cetorelli and Strahan, 2006; World Bank, 2007), whereas others find that a more oligopolistic system better promotes growth (Jackson and Thomas, 1995; Petersen and Rajan, 1995). As for financial stability, Allen and Gale (2004) argue that excessive risk taking is contained when banks enjoy monopoly power, while Boyd and De Nicolò (2005) argue that monopoly power lowers borrowing firm profitability and incentivizes firms to take excessive risk. Borrowing firm profitability may depend on industrial development stage. In early stages, firm profitability can be higher with larger investments of other firms (e.g., nineteenth century railroads and, more recently, the dot-com boom). In such cases, financial intermediaries compete (if allowed) to facilitate investments, resulting in higher growth and more stability (Ueda, forthcoming).

Financial Structure and Stability

There are two main dimensions of stability that matter: the volatility of economic growth and financial stability. Most research has been concerned with the volatility of economic growth, that is, the effect of financial structure on the occurrence of booms and recessions. Two papers analyze the role of the relative importance of equity and debt financing in macroeconomic volatility. Denizer, Iyigun, and Owen (2000) find that a higher share of equity financing leads to greater macroeconomic volatility; Huizinga and Zhu (2006) reach the opposite conclusion. There has been some research related to financial structure and financial stability. For instance, Rajan (2005) posits that the increasing complexity of the modern financial system may create more financial-sector-induced procyclicality than in the past, and create a great probability of a catastrophic meltdown.

Some authors investigate the relationship between financial structure and financial stability. Barrell and others (2010a, 2010b) and Kato, Kobayashi, and Saita (2010) expand existing work on early warning systems for banking crises to include buffer measures like capital and liquidity. They find that higher buffers markedly reduce the probability of a banking crisis. Lund-Jensen (2012) finds that financial interconnectedness, proxied by ratio of noncore to core bank liabilities, has a positive significant impact on the probability of a systemic banking crisis. Additionally, the BCBS (2010) report on the long-term economic impact of stronger capital and liquidity requirements studies how higher buffers may reduce the amplitude of normal business cycles. In another study, Rosengren (2012) finds that certain financial structures (taking the presence of money market mutual funds and broker-dealers as aspects of structure) can make the financial system vulnerable to stresses.

The aim of this chapter differs from seemingly similar work (IMF, 2006), which focused on comparing the economic cycle dynamics associated with "arms-length" versus "relationship-based" financial systems. Still, the work reported in the September 2006 *World Economic Outlook* (IMF, 2006) was influential regarding the choice of variables used in this chapter. That work also abstracts from the detailed financial and regulatory factors considered here.

Annex 4.2. Econometric Study on Financial Structures and Economic Outcomes: Data, Methodology, and Detailed Results

Cross-country panel regression models were used to relate economic outcomes (real GDP per capita growth, volatility of real GDP per capita growth, and financial stress) to financial structures and a set of controls, country fixed effects, and common time effects.

Data and Methodology

Panel fixed-effects data models are employed to examine the relationships between financial structures and economic outcomes, using annual data during 1998–2010.

A "baseline" regression relates economic outcomes to financial structures and a set of controls. In addition, we include an interaction term between the financial structure variable being examined and a crisis dummy indicating whether a given country is undergoing a banking crisis. The purpose is to explore the possible differences in their relationships between good times and crisis periods.

The baseline regression is then augmented to investigate the presence of nonlinearities in the relationship between financial structures and economic outcomes. We allow for these nonlinear effects by including a second-degree polynomial specification for the financial structure variables.

The fixed-effects panel regressions are run on available data in a sample of 58 economies during the 1998–2010 period:[13]

- *Advanced economies*: Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong SAR, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Malta, the Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, the United Kingdom, and the United States
- *Emerging market economies*: Brazil, Bulgaria, China, Colombia, Costa Rica, Croatia, Guyana, Hungary, India, Indonesia, Lithuania, Malaysia, Mexico, Moldova, Nicaragua, Peru, Philippines, Poland, Romania, Russia, South Africa, Suriname, Thailand, Turkey, and Ukraine

To determine whether the relationship between financial structures and economic outcomes differs depending on different levels of economic development, the analysis is also conducted separately for each group of economies. Also, to control for the level of development the GDP per capita level was introduced, but it did not gain significance, as the fixed effect captured this concept in the cross-section of countries.

The dependent variables and "control" independent variables in the regressions are shown in Table 4.4. The independent variables related to financial structure measures are listed in Table 4.1.

Most of the variables related to financial structure and analyzed in Chapter 3 were included in the regressions, but many of these variables were not consistently statistically significant. Insignificant variables included the ratios of noninterest income to total income, interbank assets to total assets, interbank liabilities to total liabilities, loans and bonds held by nonbanks to loans and bonds held by the financial sector, and loans and bonds held by banks to the overall financial sector. Net interest margin and the transparency (disclosure) of financial information had inconsistent results, which may be due to limitations in the data.

In addition, we used the indices developed in Chapter 3 in the regressions. However, the results were not as statistically significant as the individual variables. This may reflect the potential loss of information in such aggregated indexes.

Finally, panel GMM (generalized method of moments) regressions are employed to further examine the relationships between financial structures and economic outcomes, using annual data during 1998–2010. The results are broadly in line with those in fixed-effects models presented below.

Note: Prepared by Ken Chikada, Tom Gole, and Tao Sun.

[13]The group of advanced and emerging market economies is defined in the *World Economic Outlook*. The 1998 starting date is chosen as this is the year in which there are enough data available regarding most of the structural variables to allow panel estimation.

Table 4.4. List of Variables Used in Regression Analysis

Concept	Variables	Source
	Dependent Variables	
Output growth	Growth rate of real GDP per capita	IMF, World Economic Outlook database
Growth volatility	Standard deviation of real GDP per capita growth, computed on a backward-looking five-year rolling window	IMF, World Economic Outlook database
Financial stress	Financial stress index (FSI) built using market-based indicators in real time and at high frequency. The FSI for each country is constructed as an average of three banking-related variables, three securities-market-related variables, and one foreign exchange variable.[1]	IMF staff estimates
	Macroeconomic and Institutional Control Variables	
Lagged value of the dependent variable	Lagged value of the dependent variable (see above)	See above
Inflation	CPI inflation rate	IMF, World Economic Outlook database
Government debt	Government debt-to-GDP ratio	IMF, World Economic Outlook database
Government consumption	Government consumption-to-GDP ratio	IMF, World Economic Outlook database
Trade openness	Sum of imports and exports-to-GDP ratio	IMF, World Economic Outlook database
Institutional quality (government stability)	Composite index of individual country risk guide	The PRS Group, ICRG database
Output gap	Difference between nominal GDP and potential GDP relative to potential GDP (scaled by 100)	IMF, World Economic Outlook database

Source: IMF staff.

[1]See Cardarelli, Elekdag, and Lall (2011); and Balakrishnan and others (2009).

Results

Fixed-Effects Panel Regressions with Interaction Terms

To investigate the possible differences between financial structures and economic outcomes during both good times and crisis periods, we run fixed-effects panel regressions with interaction terms (Table 4.5).

Results for Growth

- A larger share of foreign banks in the domestic banking sector is associated with lower economic growth. This result is robust in the full sample as well as separately for advanced and emerging market economies. However, these relationships weaken when regressions are run using a sample that includes only data prior to 2007. Similarly, the interaction terms with crises are also significant in advanced economies, suggesting that having a banking sector with a high share of foreign banks is associated with poor outcomes during crisis periods. This difference between precrisis and crisis periods indicates a potentially destabilizing role played by foreign banks during the crisis as they could—and were sometimes forced to—deleverage and retrench relatively quickly.
- The ratio of liquid assets to deposits and short-term funding is positively associated with economic growth in the full sample and in emerging market economies, suggesting a positive role for liquidity buffers, possibly driven by the relatively larger emphasis on emerging market economies.
- The lending spreads are positively related to growth in the full sample and in emerging market economies, which suggests that good growth and profitable commercial lending go together.
- The bank concentration ratio is positively associated with economic growth in the full sample and separately in each economy group. This result could have several interpretations, including that positive growth allows the already dominant banks to remain so and even become more dominant.

Results for Volatility

- The share of foreign banks in the domestic banking sector is positively associated with volatility, in the full sample and in advanced economies. The interaction term with crises is negative in the

Table 4.5. Fixed-Effects Panel Estimation with Interaction Term, 1998–2010

Category	Variable	Growth			Volatility			Change in Financial Stress		
		Full Sample	Advanced Economies	Emerging Market Economies	Full Sample	Advanced Economies	Emerging Market Economies	Full Sample	Advanced Economies	Emerging Market Economies
Financial globalization	Share of foreign banks in total number of banks (percent)	–0.212***	–0.181**	–0.229***	0.0322**	0.0350**	0.0174	0.0584*	–0.0165	0.0995**
		(0.0605)	(0.0679)	(0.0648)	(0.0129)	(0.0149)	(0.0267)	(0.0343)	(0.0470)	(0.0343)
	Interaction of banking crisis dummy and share of foreign banks in total number of banks	–0.0326*	–0.0387**	–0.0497*	–0.00633**	–0.00956***	0.000918	–0.0222	–0.0202	0.0244*
		(0.0172)	(0.0176)	(0.0245)	(0.00257)	(0.00230)	(0.00715)	(0.0143)	(0.0315)	(0.0119)
	Number of observations	559	346	213	510	317	193	354	210	144
	R^2	0.483	0.506	0.557	0.621	0.669	0.599	0.373	0.466	0.402
	Ratio of total bank foreign assets to GDP (percent)	–0.00506	–0.00459	–0.403*	0.000244	0.000934	–0.00184	0.00102	0.00344	–0.202
		(0.00557)	(0.00550)	(0.213)	(0.00157)	(0.00169)	(0.0481)	(0.00883)	(0.00955)	(0.140)
	Interaction of banking crisis dummy and ratio of total bank foreign assets to GDP	–0.00211**	–0.00187**	–0.0213	–0.000460**	–0.000320	–0.0200	0.0106	0.00220	1.307***
		(0.000947)	(0.000897)	(0.296)	(0.000212)	(0.000218)	(0.103)	(0.0143)	(0.0131)	(0.232)
	Number of observations	429	277	152	389	252	137	256	169	87
	R^2	0.412	0.465	0.551	0.631	0.669	0.611	0.439	0.519	0.524
Competition	Lending spread (lending rate minus deposit rate, percentage points)	0.198***	0.258	0.178**	–0.0813***	–0.0453	–0.0766***	–0.119	–0.242	–0.0874
		(0.0720)	(0.293)	(0.0659)	(0.0177)	(0.106)	(0.0164)	(0.135)	(0.434)	(0.128)
	Interaction of banking crisis dummy and lending spread	–0.285	–0.553	–0.140	0.171**	0.0617	0.0996	–0.197	–1.854**	–0.0915
		(0.204)	(0.517)	(0.173)	(0.0650)	(0.0887)	(0.0734)	(0.212)	(0.821)	(0.120)
	Number of observations	426	219	207	397	208	189	256	130	126
	R^2	0.396	0.436	0.444	0.586	0.636	0.582	0.335	0.419	0.384
	Asset concentration for top three banks (percent)	0.0822***	0.0752***	0.0952***	–0.0135***	–0.0142**	–0.0129*	–0.00653	0.000984	–0.0118
		(0.0193)	(0.0204)	(0.0291)	(0.00411)	(0.00619)	(0.00717)	(0.0105)	(0.0160)	(0.0185)
	Interaction of banking crisis dummy and asset concentration for top three banks	0.0150	0.00553	0.0602	–0.000763	0.00915**	0.00507	0.0647***	0.0657**	–0.0164
		(0.0197)	(0.0301)	(0.0614)	(0.00520)	(0.00416)	(0.0100)	(0.0171)	(0.0248)	(0.0220)
	Number of observations	548	328	220	500	300	200	350	207	143
	R^2	0.423	0.462	0.470	0.609	0.666	0.586	0.379	0.474	0.380
Financial buffers	Liquid assets/deposits and short-term funding (percent)	0.0406***	0.0218	0.0870**	0.000865	–0.000661	0.00402	0.00495	0.00943	–0.00302
		(0.0141)	(0.0149)	(0.0318)	(0.00587)	(0.00597)	(0.0136)	(0.0142)	(0.0164)	(0.0249)
	Interaction of banking crisis dummy and liquid assets/deposits and short-term funding	0.0100	0.0108	0.0811	–0.00175	0.00783	–0.0318***	0.0696***	0.0706***	0.0309
		(0.0222)	(0.0222)	(0.0546)	(0.00669)	(0.00657)	(0.0112)	(0.0207)	(0.0216)	(0.0245)
	Number of observations	572	342	230	522	313	209	353	210	143
	R^2	0.393	0.432	0.480	0.590	0.657	0.558	0.384	0.489	0.377
	Ratio of equity to total assets (percent)	0.0506	0.0305	0.0494	–0.0129**	–0.00396	–0.0349	–0.0166	–0.0268***	–0.00907
		(0.0345)	(0.0265)	(0.0424)	(0.00630)	(0.00700)	(0.0232)	(0.0129)	(0.00619)	(0.0271)
	Interaction of banking crisis dummy and ratio of equity to total assets	–0.0575	–0.120	–0.133	0.0304*	–0.00287	0.0430	–0.463***	–1.306***	–0.0857
		(0.0512)	(0.0839)	(0.270)	(0.0175)	(0.0162)	(0.0536)	(0.150)	(0.178)	(0.149)
	Number of observations	577	346	231	527	317	210	354	210	144
	R^2	0.378	0.429	0.417	0.594	0.655	0.565	0.386	0.506	0.377
Nontraditional bank intermediation	Ratio of other earning assets to total assets (percent)	0.0569***	0.0459	0.0557	–0.00917	–0.000762	–0.0221	0.0256	0.0282	–0.00426
		(0.0210)	(0.0278)	(0.0356)	(0.00654)	(0.00680)	(0.0149)	(0.0161)	(0.0260)	(0.0227)
	Interaction of banking crisis dummy and ratio of other earning assets to total assets	0.0331	0.0342	–0.305**	0.00282	0.000476	0.169***	0.0549*	0.0594*	—0.0466
		(0.0313)	(0.0326)	(0.114)	(0.00838)	(0.00927)	(0.0596)	(0.0299)	(0.0329)	(0.0653)
	Number of observations	462	269	193	415	242	173	305	174	131
	R^2	0.454	0.490	0.499	0.580	0.670	0.513	0.421	0.492	0.398
	Ratio of other interest-bearing liabilities to total liabilities (percent)	–0.0145	–0.0188	–0.0124	0.0116	0.00700	0.0342	0.0377*	0.0275	0.0973**
		(0.0212)	(0.0219)	(0.0385)	(0.00772)	(0.00744)	(0.0240)	(0.0190)	(0.0179)	(0.0434)
	Interaction of banking crisis dummy and ratio of other interest-bearing liabilities to total liabilities	0.0314	–0.0139	0.117**	–0.000111	0.0141	–0.0792***	0.0196	0.0273	–0.0311
		(0.0405)	(0.0376)	(0.0515)	(0.0107)	(0.0102)	(0.0149)	(0.0242)	(0.0384)	(0.0368)
	Number of observations	442	266	176	396	239	157	302	173	129
	R^2	0.450	0.479	0.539	0.597	0.672	0.523	0.425	0.488	0.442

Source: IMF staff estimates.

Note: This table summarizes the results of fixed-effects panel estimation of growth, growth volatility, and financial stress. Standard errors are shown under the estimated coefficients. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence based on robust standard errors, with 5 percent and 1 percent levels shown in shaded cells. For the definition of dependent variables and independent variables, see Tables 4.1 and 4.4, respectively. For sample countries, see Annex 4.2.

full sample and advanced economies, suggesting that this positive relationship turns negative if a country is in a banking crisis.
- The relationship between the foreign assets of domestic banks and volatility is not statistically significant in any of the samples. However, the interaction term with crises is significant and negative for the full sample. This may suggest that in times of crisis having large overseas assets could help reduce growth volatility, but the effect is negligible as the coefficient is not economically significant.
- The ratio of liquid assets to deposits has a largely insignificant relationship with economic volatility. For emerging market economies, however, the interaction term for liquid assets ratio is significant and negative, suggesting that in times of crisis liquid assets may lower volatility. In the full sample, a higher ratio of equity to total assets is associated with lower volatility.
- The lending spreads have a relationship with volatility that depends on the state of the economy. In noncrisis periods, a higher spread is associated with lower volatility, which may reflect the potentially stabilizing effects of limited competition in the banking sector. However, during crisis periods the higher spread is associated with higher volatility.
- Higher concentration in the banking sector is associated with lower economic volatility in the full sample and in advanced economies.

Results for Financial Stress

- The share of foreign banks in the total number of banks is significant and positive for emerging market economies. This indicates that emerging market economies are more susceptible to stress related to foreign banks.
- Concentration in the banking sector is insignificant in the full sample, suggesting a limited role for concentration in reducing financial stress. However, the interaction terms are significant and positive in the full sample and advanced economies. This suggests that concentration does not matter much under normal circumstances but increases financial stress in times of banking crisis.

Fixed-Effects Panel Estimation with Quadratic Term

To investigate the possibility of a nonlinear relationship among some variables, we use a second-degree polynomial (quadratic) approximation for the relations, using fixed-effects panel regressions (Table 4.6).

Results for Growth

- The ratio of liquid assets to deposits and short-term funding is associated with higher growth in emerging market economies, and the ratio of equity to total assets is associated with higher growth in the full sample. However, the quadratic term is of the opposite sign, suggesting that the link between the level of financial buffers and positive economic outcomes weakens as buffers accumulate. The thresholds are quite high, approximately 74 percent for liquidity buffers and 45 percent for capital buffers, suggesting any dampening economic effect occurs only after these buffers are more than high enough to act as prudential buffers and begin to constrict a bank's normal intermediation activities.[14]
- The ratio of other interest-bearing liabilities to total liabilities is negatively associated with economic growth in the full sample and in advanced economies. This may suggest that a funding structure that depends on other interest-bearing liabilities is unfavorable to economic growth.
- The share of foreign banks in the domestic banking system is negatively related to growth in the full sample and in advanced economies. This is in line with the results in the panel regressions with interaction terms.

Results for Growth Volatility

- In the full sample and advanced economies, greater foreign asset holdings by domestic banks is associated with higher economic volatility, but is associated with lower volatility beyond a certain point.
- A higher level of liquid assets is associated with lower economic volatility in the full sample and in emerging market economies. However, beyond a certain point, higher liquidity buffers could increase the volatility, reflecting the possible

[14]The lowest threshold across all three dependent variables was approximately 25 percent.

Table 4.6. Fixed-Effects Panel Estimation with Quadratic Term, 1998–2010

Category	Variable	Growth			Volatility			Change in Financial Stress		
		Full Sample	Advanced Economies	Emerging Market Economies	Full Sample	Advanced Economies	Emerging Market Economies	Full Sample	Advanced Economies	Emerging Market Economies
Financial globalization	Share of foreign banks in total number of banks (percent)	–0.291***	–0.281***	–0.119	0.0301	0.0348*	–0.0219	0.109**	–0.0395	0.180***
		(0.0766)	(0.0886)	(0.0810)	(0.0233)	(0.0181)	(0.0420)	(0.0513)	(0.0891)	(0.0390)
	Square of share of foreign banks in total number of banks	0.000832	0.00100	–0.00144	1.67e–05	3.41e–06	0.000486	–0.000898	–5.48e–05	–0.00107**
		(0.00121)	(0.00119)	(0.00103)	(0.000202)	(0.000238)	(0.000303)	(0.000674)	(0.00159)	(0.000503)
	Number of observations	559	346	213	510	317	193	354	210	144
	R^2	0.457	0.481	0.552	0.620	0.667	0.599	0.307	0.412	0.403
	Ratio of total bank foreign assets to GDP (percent)	–0.0147*	–0.0154**	–0.897	0.00312***	0.00427***	0.152	–0.0291**	–0.0205	–0.185
		(0.00791)	(0.00647)	(0.546)	(0.000934)	(0.000920)	(0.107)	(0.0132)	(0.0179)	(0.592)
	Square of ratio of total bank foreign assets to GDP	4.43e–06***	4.53e–06***	0.0281	–8.57e–07***	–1.00e–06***	–0.00808	0.000129***	8.46e–05	–0.000187
		(1.56e–06)	(1.25e–06)	(0.0220)	(1.85e–07)	(1.75e–07)	(0.00575)	(4.33e–05)	(5.72e–05)	(0.0385)
	Number of observations	429	277	152	389	252	137	256	169	87
	R^2	0.396	0.454	0.554	0.633	0.674	0.612	0.353	0.450	0.476
Competition	Lending spread (lending rate minus deposit rate, percentage points)	0.456*	0.293	0.461*	–0.139***	–0.205	–0.126**	–0.106	–0.284	–0.0841
		(0.236)	(0.494)	(0.256)	(0.0476)	(0.181)	(0.0475)	(0.209)	(0.815)	(0.193)
	Square of lending spread	–0.00808	–0.00215	–0.00841	0.00190*	0.0236	0.00155	0.000364	–0.00770	0.000657
		(0.00505)	(0.0681)	(0.00534)	(0.00102)	(0.0218)	(0.000941)	(0.00215)	(0.167)	(0.00206)
	Number of observations	426	219	207	397	208	189	256	130	126
	R^2	0.384	0.426	0.438	0.585	0.636	0.579	0.277	0.350	0.365
	Asset concentration for top three banks (percent)	0.0767	0.0792	0.0874	–0.0264	0.0156	–0.0685	0.0408	0.0992	0.0310
		(0.0806)	(0.131)	(0.119)	(0.0287)	(0.0365)	(0.0409)	(0.0700)	(0.107)	(0.0937)
	Square of asset concentration for top three banks	4.23e–05	–1.83e–05	4.69e–05	9.46e–05	–0.000202	0.000429	–0.000314	–0.000645	–0.000316
		(0.000578)	(0.000872)	(0.000904)	(0.000203)	(0.000253)	(0.000275)	(0.000500)	(0.000756)	(0.000668)
	Number of observations	548	328	220	500	300	200	350	207	143
	R^2	0.397	0.436	0.454	0.609	0.665	0.586	0.296	0.408	0.377
Financial buffers	Liquid assets/deposits and short-term funding (percent)	0.106	0.0573	0.291***	–0.0353**	–0.00295	–0.0828**	–0.0777**	–0.00953	–0.149***
		(0.0697)	(0.0720)	(0.0605)	(0.0153)	(0.0141)	(0.0297)	(0.0381)	(0.0716)	(0.0325)
	Square of liquid assets/deposits and short-term funding	–0.000667	–0.000355	–0.00196***	0.000356**	2.96e–05	0.000781***	0.000828**	0.000283	0.00131***
		(0.000589)	(0.000643)	(0.000466)	(0.000146)	(0.000153)	(0.000232)	(0.000319)	(0.000680)	(0.000241)
	Number of observations	572	342	230	522	313	209	353	210	143
	R^2	0.373	0.407	0.516	0.597	0.656	0.586	0.318	0.417	0.447
	Ratio of equity to total assets (percent)	0.121***	0.0657	0.0538	–0.0160	0.00645	–0.149**	–0.0338	–0.0927	–0.132
		(0.0423)	(0.0444)	(0.201)	(0.0185)	(0.0225)	(0.0551)	(0.0464)	(0.0603)	(0.112)
	Square of ratio of equity to total assets	–0.00136***	–0.000683	–0.000351	8.20e–05	–0.000150	0.00249**	0.000172	0.000728	0.00251
		(0.000429)	(0.000405)	(0.00345)	(0.000206)	(0.000234)	(0.000988)	(0.000511)	(0.000666)	(0.00201)
	Number of observations	577	346	231	527	317	210	354	210	144
	R^2	0.360	0.404	0.405	0.593	0.655	0.570	0.302	0.418	0.379
Nontraditional bank intermediation	Ratio of other earning assets to total assets (percent)	0.111	0.0391	0.180	0.0241	0.0732*	–0.0193	0.0124	0.0235	0.0357
		(0.101)	(0.150)	(0.148)	(0.0238)	(0.0406)	(0.0259)	(0.0777)	(0.140)	(0.0827)
	Square of ratio of other earning assets to total assets	–0.000583	0.000102	–0.00150	–0.000367	–0.000775*	–2.85e–05	0.000198	6.66e–05	–0.000542
		(0.00100)	(0.00145)	(0.00163)	(0.000243)	(0.000404)	(0.000339)	(0.000927)	(0.00158)	(0.000821)
	Number of observations	462	269	193	415	242	173	305	174	131
	R^2	0.427	0.463	0.483	0.582	0.683	0.503	0.331	0.415	0.384
	Ratio of other interest-bearing liabilities to total liabilities (percent)	–0.0873**	–0.117**	0.000233	0.0442***	0.0456***	0.0994*	0.0673*	0.0736*	0.264***
		(0.0332)	(0.0447)	(0.121)	(0.0113)	(0.0105)	(0.0539)	(0.0362)	(0.0359)	(0.0809)
	Square of ratio of other interest-bearing liabilities to total liabilities	0.00112*	0.00132**	–0.000236	–0.000513***	–0.000548***	–0.00244	–0.000361	–0.000586	–0.00572***
		(0.000587)	(0.000556)	(0.00352)	(0.000116)	(0.000114)	(0.00160)	(0.000446)	(0.000406)	(0.00188)
	Number of observations	442	266	176	396	239	157	302	173	129
	R^2	0.430	0.476	0.513	0.608	0.687	0.520	0.345	0.429	0.448

Source: IMF staff estimates.

Note: This table summarizes the results of fixed-effects panel estimation of growth, growth volatility, and financial stress. Standard errors are shown under the estimated coefficients. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence based on robust standard errors, with 5 percent and 1 percent levels shown in shaded cells. For the definition of dependent variables and independent variables, see Tables 4.1 and 4.4, respectively. For sample countries, see Annex 4.2.

adverse impact of excess requirements on holdings of liquid assets. A similar pattern exists for the ratio of equity to total assets in emerging market economies.

Results for Financial Stress

- The share of foreign banks is positively associated with changes in financial stress in the full sample and in emerging market economies. The ratio of total bank foreign assets to GDP is negatively associated with changes in the financial stress in the full sample, suggesting a role for bank foreign assets in smoothing financial stress.
- A higher ratio of liquid assets to deposits and short-term funding is associated with lower financial stress in the full sample and in emerging market economies. But this relationship may reverse beyond a certain point in line with its relationship with volatility.
- The ratio of other interest-bearing liabilities to total liabilities is positively associated with financial stress in emerging market economies.

For the two models, these results represent those for which the results were either statistically significant across a number of specifications of both the fixed-effects model and the GMM estimation technique or, in some instances, maintained constant signs across specifications. Further, the regressions were also run with a range of approaches to removing outliers, with little change in the results.

Annex 4.3. Financial Structure Variables and the Probability of Banking Crises: Data, Methodology, and Detailed Results

This Annex draws on the methodology in the September 2011 GFSR to study the relationship between financial structure variables and the probability of banking crises.

Data and Methodology

The probability of a banking crisis is estimated with a probit panel data model with country fixed effects:[15]

$$Pr(y_{i,t} = 1|x_{i,t-h}) = \Phi(\alpha_i + x_{i,t-h}\theta)$$

where $y_{i,t}$ denotes a binary banking crisis variable; $x_{i,t-h}$ is a row vector of indicator variables; α_i denotes the fixed effect for country i; Φ is the cumulative distribution function of a standard normal distribution; and θ is a column vector of unknown parameters to be estimated. Note that all the indicator variables are known at time $t - h$. This analysis considers forecast horizons at one, two, and three years.

We adopt the Laeven and Valencia (2010) definition under which a banking crisis is systemic if two conditions are present: (1) significant signs of distress in the banking system (as indicated by significant bank runs, losses in the banking system, and bank liquidations); and (2) significant banking policy interventions in response to significant losses in the banking system.

The basic specification above, in which the growth in equity prices and the change in the ratio of credit to GDP are explanatory variables, is expanded to include two additional sets of variables: macroeconomic controls and financial structure variables.[16] The macroeconomic controls include the change in the real effective exchange rate, the growth rate of real GDP, and the ratio of the current account balance to GDP.[17]

The financial structure variables are (1) bank interconnectedness, measured as the ratio of interbank deposit assets to total assets; (2) the net interest margin; and (3) bank concentration, measured as the three-bank asset concentration ratio. The main challenge is that the time coverage of these three financial structure variables is rather limited, which reduces the number of crises covered in the sample.

Results

The results on the extended specification with financial structure variables (Table 4.7) show that the coefficients on "equity growth" and "change in credit to GDP" are mostly significant and roughly stable. The growth rate of real GDP and the ratio of current account balance to GDP are significant at some lag specification. Specifically:

- The coefficient on the net interest margin is negative and significant at one lag, suggesting that a higher interest rate margin (less competition) is associated with a lower probability of banking crises.
- The coefficient on concentration is negative and significant at two lags, suggesting that a higher concentration (possibly related to "too important to fail" or to excessive risk taking that may be associated with high competition) is associated with a lower probability of banking crises.
- The coefficient on interconnectedness is positive and significant at one and three lags, suggesting that a higher degree of interconnectedness is associated with a higher probability of banking crises.

As a robustness check, a logit model with fixed effects was also estimated. In such a model, the bank concentration ratio has a negative and significant association with the probability of a banking crisis. The estimated coefficients for net interest margin and interconnectedness are insignificant.

Note: Prepared by Nicolas Arregui.

[15]Probit models with fixed effects are subject to the incidental parameters problem (Neyman and Scott, 1984; Lancaster, 2000). Heckman and MaCurdy (1980) found that, for $N = 100$ and $T = 8$, the bias appeared to be on the order of 10 percent. We restrict our database to countries with at least eight years of data. A logit fixed-effect model was also estimated as a robustness check. Results are presented only for the probit model, as it allows for comparability with previous GFSR work.

[16]See the September 2011 GFSR, Chapter 3, Annex 3.2, Table 3.5.

[17]The ratio of the fiscal surplus to GDP was considered but appeared not to be significant at any lag specification, so the results are not included in this Annex.

Table 4.7. Systemic Banking Crises and Financial Structure Variables: Probit Model

	Lag Length (h)														
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Equity growth	–0.000	0.007***	–0.002	–0.001	0.019***	–0.005	–0.009**	0.025***	0.001	0.000	0.007**	–0.004	0.003	0.005	–0.005
	0.488	0.009	0.213	0.352	0.003	0.147	0.042	0.004	0.454	0.456	0.020	0.172	0.154	0.104	0.107
Change in credit to GDP	0.053***	0.036**	0.047***	0.058**	0.050*	0.033*	0.051	0.042	0.100**	0.071**	0.028	0.072***	0.077***	0.031	0.098***
	0.005	0.028	0.010	0.028	0.054	0.075	0.121	0.122	0.011	0.013	0.134	0.009	0.01	0.118	0.004
REER growth				0.020	–0.006	0.008	–0.002	–0.047*	–0.031	0.037	0.006	0.024	0.025	0.013	0.046*
				0.247	0.429	0.378	0.482	0.069	0.171	0.105	0.410	0.185	0.185	0.323	0.061
Real GDP growth				0.195**	0.063	0.038	0.373***	0.184**	0.110*	0.148**	0.083	0.098	–0.028	0.077	0.199**
				0.014	0.238	0.301	0.004	0.016	0.097	0.015	0.113	0.102	0.329	0.126	0.029
Current account to GDP				–0.133*	–0.080	–0.027	–0.260**	–0.091	–0.029	–0.340***	–0.092*	–0.014	–0.227***	–0.075	–0.012
				0.051	0.122	0.475	0.015	0.121	0.339	0.000	0.068	0.411	0.004	0.115	0.429
Fiscal surplus to GDP				0.001	0.034	–0.004									
				0.494	0.356	0.282									
Interconnectedness							0.212**	0.092	0.184**						
							0.044	0.196	0.05						
Net interest margin										31.9391***	14.956	3.538			
										0.009	0.129	0.389			
Concentration													–2.039	–3.392**	–2.952*
													0.163	0.040	0.076
Number of observations	457	457	457	333	333	333	180	180	180	360	360	360	335	335	335
Number of countries	36	36	36	33	33	33	17	17	17	35	35	35	32	32	32
R^2 McFadden	0.15	0.17	0.15	0.30	0.32	0.20	0.30	0.26	0.25	0.33	0.23	0.21	0.28	0.22	0.28
Number of crises	27	27	27	20	20	20	15	15	15	24	24	24	22	22	22

Source: IMF staff calculations.

Model specification: $Pr(y_{i,t} = 1|x_{i,t-h}) = \Phi(\alpha_i + x_{i,t-h}\theta)$

Note: The dependent variable is a binary systemic banking crises variable from Laeven and Valencia (2010). Interconnectedness is computed as the ratio of interbank deposit assets to total assets from the OECD Bank Income Statement and Balance Sheet database. Net interest margin and concentration (asset concentration for top three banks) are from World Bank, Global Foundation for Democracy and Development database. The model parameters are estimated using country fixed effects. The *p*-values are shown under the estimated coefficients. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence based on robust standard errors, respectively.

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