Online Annex 2.1. Analysis of Selected Banking Sector Indicators

Sampling Approach

The sampling approach for regressions using banks' financial statements sought to achieve representativeness at the country and global level, by assuring that there would be a sufficient number of banks to represent each country, and that both global systematically important banks (G-SIBs) and domestic systematically important banks (D-SIBs) would be included. The procedure is summarized below:

- A sample of 80 countries was chosen, in line with that of previous GFSR chapters, such as Chapter 2 of the October 2017 GFSR. The sample contains 35 advanced countries and 45 emerging economies.

- Using Fitch Connect, for each of the 80 countries, annual balance sheet and income statement information for banks from 2000 to 2017, or the latest available year, was collected on both a consolidated and unconsolidated basis. In general, the preference was for the unconsolidated information, or for the basis that would provide the largest number of time observations.[1]

- Once an initial "full sample" was collected, it was reduced to the largest banks, those that collectively accounted for at least 70 percent of a given country's total banking assets in the Fitch Connect dataset, or had at least US$5 billion in assets in 2016 (or the most recent observation), whichever constraint was least binding.[2] That is, a country with small banks would have at least 70 percent of its banking system represented, while a country with larger banks would have all its banks with at least US$5 billion in assets included.

- Further manual inclusions and exclusions were introduced to ensure that:

  a) All 266 D-SIBs for 42 countries were included. Depending on the case, the D-SIB could be either a bank holding company or a subsidiary.

  b) Nonbank subsidiaries were removed from the sample.

  c) For banks that are neither G-SIBs nor D-SIBs, if both a bank subsidiary and its holding company were in the sample, the former was retained and the latter discarded. This was done to eliminate double counting.

The country coverage and number of banks in the sample are reported in Annex Table 2.1.1.

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[1] In countries where unconsolidated data are generally unavailable, such as the United States and Canada, financial statistics were collected on a consolidated basis. For bank holding companies, the data were collected on a consolidated basis, so some double counting may have occurred in the domicile country where the bank holding company resides.

[2] The full sample consisted of all banks available from Fitch Connect.

Annex Table 2.1.1. Sample of Countries for the Regression Analysis Using Financial Statements

Advanced Economies (AEs)	Emerging Markets Economies (EMEs)
Australia	Argentina
Austria	Bangladesh
Belgium	Bolivia
Canada	Botswana
Cyprus	Brazil
Czech Republic	Bulgaria
Denmark	Chile
Estonia	China
Finland	Colombia
France	Costa Rica
Germany	Croatia
Greece	Egypt
Hong Kong SAR	FYR Macedonia
Iceland	Georgia
Ireland	Ghana
Israel	Hungary
Italy	India
Japan	Indonesia
Korea	Jordan
Latvia	Kazakhstan
Lithuania	Kenya
Luxembourg	Kuwait
Malta	Malaysia
Netherlands	Mauritius
New Zealand	Mexico
Norway	Mongolia
Portugal	Montenegro
Singapore	Morocco
Slovak Republic	Namibia
Slovenia	Nigeria
Spain	Pakistan
Sweden	Panama
Switzerland	Paraguay
United Kingdom	Philippines
United States	Poland
	Romania
	Russia
	Saudi Arabia
	Serbia
	South Africa
	Thailand
	Turkey
	Ukraine
	Uruguay
	Venezuela

Number of Banks	
Emerging Market Economies	992
Advanced Economies	1,582
All countries	2,574

Sources: IMF staff.

Means Tests Approach

The analytical approach is to run regressions to test whether there have been significant changes in each indicator over time (particularly, after the crisis compared to before the crisis); across countries; and across groups of banks.

For each indicator Y, the regression is (i = bank, j = country, t = time):[3]

$$Y_{i,j,t} = \beta_0 + \beta_1 GFC_t + \beta_2 PostGFC_t + \beta_3 FE + \beta_4 BANK_i + \beta_5 COUNTRY_j * GFC_t \\ + \beta_6 COUNTRY_j * PostGFC_t + \beta_7 BANK_i * GFC_t + \beta_8 BANK_i * PostGFC_t \\ + \varepsilon_{it}$$

(A.2.1.1)

in which *GFC* and *PostGFC* are dummies for the global financial crisis (GFC) and postcrisis periods—that is, all observations are compared to the precrisis period; *FE* is the bank or country fixed effect, while *COUNTRY* is a dummy for a group of countries; and *BANK* is a set of bank-specific and time-invariant characteristics. Error terms are clustered at the bank level.

The simplest specification of A.2.1.1 would include only the two time-period dummies plus the country *FE*. This regression would therefore ask the following question: Across all countries, did the given indicator change during the global financial crisis and afterward? (Notice that the *FE* would control for common economic factors that are bank- or country-specific but time-invariant, and help explain why the indicator has a different value for bank i in country j before the global financial crisis).

An alternative specification tests whether there are significant differences in a postcrisis period that excludes the most recent year, and in that most recent year. For example, if the most recent year is 2016, then the regression equation is shown below (excluding bank- and country-specific interactions for simplicity). Thus, although Y during most of the postcrisis period (from 2010 to 2015) may not be significantly different from its precrisis level ($\beta_2 = 0$), it could have increased throughout the period to reach a significantly higher level in the final year ($\beta_3 > 0$). A third specification isolates the postcrisis period to test whether there is a significant time trend during that period.

$$Y_{i,j,t} = \beta_0 + \beta_1 GFC_t + \beta_2 PostGFC1015_t + \beta_3 YEAR\_2016 + \beta_4 FE + \varepsilon_{it}$$

(A.2.1.2)

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[3] Some indicators are only available at the country level, in which case the bank dimension of this equation drops out. However, even if some variables are available at the bank level, we run the country-level regressions in addition to the bank-level regressions as a robustness check.

$$Y_{i,j,t} = \beta_0 + \beta_1 TIME + \beta_2 FE + \varepsilon_{it}, t = 2010\text{–most recent year}$$

<div align="right">(A.2.1.3)</div>

As in equation A.2.1.1, these specifications would then be expanded to include interactions between the *COUNTRY/BANK* characteristics and the *GFC* and *PostGFC* dummies to see if changes in time were greater for certain groups of countries or types of banks. Possible country characteristics that could be added include:

Basel Committee on Banking Supervision (BCBS) members; and

Countries experiencing a banking crisis at any time during 2007–09 according to the classification in Laeven and Valencia (2012). This variable takes a value of 1 for the entire sample period, not only during the crisis years.

Bank-specific characteristics that were added: a G-SIB dummy variable, equal to 1 for a bank that had been designated as a G-SIB at any time during the sample period.

Robustness Checks

In addition to means tests using the full sample of bank-level data, and the definition of the global financial crisis period as 2008–09, alternative tests were run: (1) using country-level data, when available; (2) limiting the sample to banks with at least US$50 billion in assets; (3) redefining the GFC period as 2008–12; (4) using weighted least squares in which each bank observation was weighted by ($\frac{1}{N_j}$), in which N_j is the number of banks in country j in the sample;[4] (5) using weighted least squares in which the weight for each observations is total assets, either at the bank or country level; and (7) incorporating macroeconomic controls: country-level real GDP growth, country-level financial conditions index (FCI), or the global FCI.

Annex Table 2.1.2 compares the alternative tests with the initial, full sample tests, which are labeled the "baseline test." The specification used is the simplest version of equation (A.2.1.1), which includes a dummy variable for the global financial crisis and another for the postcrisis periods, without distinguishing between groups of countries or banks (Annex 2.1.2). Annex Table 2.1.3 also compares baseline to alternative tests, but uses Specification (2.1.2), with a dummy variable for the GFC period, another for a partial post-GFC period—which excludes the most recent year—and a third dummy for the most recent year.[5] Annex Table 2.1.3 reports only the third coefficient.

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[4] The purpose of this weighing was to give each country equal weight in the regression, regardless of the number of banks represented.

[5] Both tables contain areas that have been shaded gray, which indicates that the robustness check is not feasible or meaningful. For example, some indicators such as ratings are available only at the bank level, while others, are available only at the country level.

In general, the means tests are quite robust to the alternative assumptions, with a few qualifications. Means tests on capital buffers tend to reveal a stronger postcrisis buildup in the country-level regressions or when limiting the sample to larger banks. In general, changing the definition of the GFC period has little impact on the results. The weighing scheme occasionally leads to a different outcome: for example, the reduction in banking concentration ceases to be statistically significant when each country is weighed by the size of its banking system. Thus, in larger banking systems, the decline in concentration is not as clear. Introducing macroeconomic controls does not alter the main results of the mains tests, that is, changes in the indicator across periods. Finally, it is also important to note that restricting to banks with over US$50 billion in assets reduces the sample notably; in the case of the test for equity-to-assets, the number of banks falls from 2,511 to 502, and the number of countries goes from 80 to 43.

Annex Table 2.1.2. Summary of the Results of Means Tests under Alternative Assumptions

	Baseline test - Bank Level				Country Level			Banks > $50 Billion in assets				GFC = 2008-2012		Weighted Least Squares, wij = 1/Nj		Weighted Least Squares, wij = TAij		Including Macro Controls					
																		Real GDP Growth		Country-specific FCI		Global FCI	
	GFC (2008-09)	Post-GFC (2010-17)	No. of banks	No. of countries	GFC (2008-09)	Post-GFC (2010-17)	No. of countries	GFC (2008-09)	Post-GFC (2010-17)	No. of banks	No. of countries	GFC (2008-12)	Post-GFC (2013-17)	GFC (2008-09)	Post-GFC (2010-17)	GFC (2008-09)	Post-GFC (2010-17)	GFC (2008-09)	Post-GFC (2010-17)	GFC (2008-09)	Post-GFC (2010-17)	GFC (2008-09)	Post-GFC (2010-17)
Regulatory capital to RWA	-0.476	0.642	1952	80	-0.448	1.449***	69	1.964***	4.397***	137	26	0.149	0.676	-1.402**	0.0761	-1.039	0.815	-0.322	0.855*	0.251	1.164*	-0.185	0.619
Tier 1 regulatory capital to RWA	0.0119	1.511***	1671	79	-0.47	1.867***	69	1.877***	4.888***	584	43	0.749**	1.697**	-0.286	1.525**	-2.350***	-0.727	0.203	1.716***	0.622	1.748**	0.477	1.481**
Common equity to total assets	-0.187	0.413*	2511	80				0.248*	1.176***	502	43	0.103	0.490*	-0.151	0.452	-0.442	0.459	0.239	0.676***	-0.113	0.393*	0.0542	0.393*
Mandatory reserves	0.0474	0.303	679	66				0.329	0.632***	439	42	0.279	0.15	0.356	0.669	-0.754	0.596**	0.0975	0.275	0.0922	0.502	-0.111	0.298
Cash and due from banks	0.918***	2.640***	2446	80				0.804***	3.584***	421	41	1.537***	3.123***	1.345***	2.902***	0.271	3.273***	0.689**	2.540***	1.194***	2.519***	1.456***	2.593***
Government securities	-0.616	1.154	2114	80				-0.0699	1.189*	598	43	0.304	1.320*	-1.548**	0.303	-3.328***	-0.361	-0.749	1.018	0.438	1.15	-0.0118	1.11
RWA to total assets	-1.111	-2.763	1552	79				-5.963***	-8.330***	377	42	-2.833	-1.841	1.699	-0.861	3.041	0.473	-0.612	-2.462	-2.517	-3.829	-1.559	-2.745
Gross loans to total assets	1.187	0.895	2470	80				-1.938***	-1.867	591	43	0.874	1.065	3.481***	3.914***	9.526***	7.423***	0.955	0.777	0.0325	-0.184	1.359	0.88
Three-bank asset share					-3.179***	-5.623***	80					-4.612***	-5.684***			-2.975	-3.751	-3.660**	-5.657***	-3.315	-4.972***	-4.242***	-5.553***
Five-bank asset share					-1.044	-2.799***	79					-2.063**	-2.858***			-1.276	-1.882	-1.175	-2.933***	-0.43	-0.737	-1.468	-2.774**
Lerner index					0.00497	-0.105	79					0.0257**	-0.285			-0.0336**	0.0522***	0.139	-0.0624	0.0346	0.0476**	0.0124	-0.106
Boone index					-0.0115	0.0389*	80					0.00436	0.0633**			0.0597***	0.0506***	-0.0255	0.0303	-0.00735	0.025	-0.00653	0.0385*
Support rating (stand-alone banks)	0.283***	-0.220***	652	70				0.457***	0.173	135	36	0.457***	0.173	0.214**	-0.427**	0.235***	-1.251***	0.334***	-0.196**	0.401***	-0.112**	0.389***	-0.107**
Wholesale funding ratio	1.373*	-1.652	2461	80	2.807***	-0.051	68	1.798	-1.019	585	43	0.268	-2.477*	2.087***	-1.899**	7.056***	-1.808*	0.0503	-2.062*	0.477	-1.47	0.705	-1.598

Sources: Fitch Connect; Fitch Ratings; IMF, Financial Soundness Indicators; IMF, Monetary and Fiscal Statistics database; World Bank, Global Financial Development Database; and IMF staff calculations.

Note: This table shows the results of means tests for a number of banking sector indicators, namely the coefficients on GFC and post-GFC dummy variables. The first set of columns shows the baseline specification, the simplest form of equation A.2.1.1, consisting of an intercept, the two dummy variables, and bank fixed effects, estimated using bank-level data. The second set of results runs the same specification using country-level data, and therefore omits the bank fixed effect. The third set limits the sample to banks with more than US$50 billion in assets, and the fourth set redefines the GFC period as 2008–12, thereby also redefining the post-GFC period accordingly. The fifth and sixth sets use a weighted least squares method, first weighing each bank by the number of banks in the country (thereby giving each country equal weight), then weighing each bank by its size in total assets. The last three sets of results include macroeconomic controls as additional explanatory variables, first GDP growth, then country-specific financial conditions indices (FCI), and finally, the global FCI. Gray areas indicate that the means test was not possible, for example, because country or bank-level data were not available for the given indicator.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Annex Table 2.1.3. Summary of the Results of Means Tests under Alternative Assumptions

	Last observation vs PreGFC				
	Baseline test - Bank Level	Country Level	Banks > $50 Billion in assets	Weighted Least Squares, wij = 1/Nj	Weighted Least Squares, wij = TAij
Regulatory capital to RWA	1.473**	2.812***	5.245***	2.038*	2.623
Tier 1 regulatory capital to RWA	2.555**	3.369***	6.436***	3.056***	0.0699
Common equity to total assets	0.890***		1.592***	0.882*	-0.128
Mandatory reserves	0.301		0.622*	0.523	1.766**
Cash and due from banks	4.114***		6.265***	4.023***	6.668***
Government securities	0.186		0.534	-0.181	-1.872*
RWA to total assets	-1.969		-9.624***	-1.126	0.778
Gross loans to total assets	0.744		-1.646	3.849***	6.328***
Three-bank asset share		-5.091***			-2.291
Five-bank asset share		-2.068			-0.628
Lerner index		-0.0214			0.166***
Boone index		0.0733**			0.109***
Support rating (stand-alone banks)	-0.630***		-0.593*	-0.942***	-0.359*
Wholesale funding ratio	-2.981**	-1.92		-2.968***	-6.298***

Sources: Fitch Connect; Fitch Ratings; IMF, Financial Soundness Indicators; IMF, Monetary and Fiscal Statistics database; World Bank, Global Financial Development Database; and IMF staff calculations.

Note: This table shows the results of means tests for a number of banking sector indicators, focusing on the coefficient on the last year available in comparison to the precrisis mean. The first set of columns shows the baseline specification, the simplest form of equation A.2.1.2, consisting of an intercept, the dummy variable for the last year available, and bank fixed effects, estimated using bank-level data. The second set of results runs the same specification using country-level data, and therefore omits the bank fixed effect. The third set limits the sample to banks with more than US$50 billion in assets. The fourth and fifth sets use a weighted least squares method, first weighing each bank by the number of banks in the country (thereby giving each country equal weight), then weighing each bank by its size in total assets. Gray areas indicate that the means test was not possible, for example, because country- or bank-level data were not available for the given indicator.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Annex Table 2.1.4. Data Sources

Variables	Description	Source
Bank-level Variables		
Regulatory capital to RWA	Ratio of total regulatory capital to risk-weighted assets	Fitch Connect
Tier 1 regulatory capital to RWA	Ratio of Tier 1 regulatory capital to risk-weighted assets	Fitch Connect
Common equity to total assets	Ratio of common equity to total assets	Fitch Connect
RWA to total assets	Ratio of risk-weighted assets to total assets	Fitch Connect
Gross loans to total assets	Ratio of gross loans to total assets. Gross loans is calculated as follows: residential mortgage loans + other mortgage loans + other consumer/ retail Loans + corporate anc commercial loans + other loans.	Fitch Connect
Mandatory reserves	Amount that is specifically required to be held for regulatory purposes, in US dollars	Fitch Connect
Cash and due from banks	Cash including any balances disclosed under "Cash and Due from Banks" in the financial report, in US dollars	Fitch Connect
Government securities	Securities issued by central or local/municipal government, in US dollars	Fitch Connect
Liquidity coverage ratio	Ratio of stock of high-quality liquid assets to total net cash outflows over the next 30 calendar days	Fitch Connect
Wholesale funding ratio	Ratio of wholesale funding to total funding and capital. Wholesale funding is calculated as follows: other deposits and short-term borrowings + total long-term funding + trading Lliabilities + preferred shares and hybrid capital accounted for as debt + preferred shares and hybrid capital accounted for as equity.	Fitch Connect
Support rating	Support rating reflects the agency's view on the likelihood that a financial institution will receive extraordinary support, in case of need, to prevent it defaulting on its senior obligations. Converted into numerical scale for the purpose of the analysis.	Fitch Ratings
Country-level Variables		
House price index	House price index deflated by consumer price index	IMF, Research Department house price data set
Mortgage debt growth	Growth rate of outstanding mortgage debt, year on year	Haver Analytics
Asset-backed commercial paper	Issuance of private-label asset-backed commercial paper, in US dollars	Association for Financial Markets in Europe; CRE Finance Council; Fitch Ratings; JPMorgan Chase & Co.; Merrill Lynch
Mortgage-backed securities	Issuance of private-label mortgage-backed securities, in US dollars	Association for Financial Markets in Europe; CRE Finance Council; Fitch Ratings; JPMorgan Chase & Co.; Merrill Lynch
Regulatory capital to RWA	Ratio of total regulatory capital to risk-weighted assets	IMF, Financial Soundness Indicators
Tier 1 regulatory capital to RWA	Ratio of Tier 1 regulatory capital to risk-weighted assets	IMF, Financial Soundness Indicators
Real GDP	Gross domestic product, constant prices, in national currency	IMF, World Economic Outlook database
Credit to private sector	Credit provided to the private sector by deposit money banks, in national currency	IMF, Monetary and Financial Statistics database
Three-bank concentration ratio	Assets of three largest commercial banks as a share of total commercial banking assets. Total assets include total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax assets, discontinued operations and other assets.	World Bank, Global Financial Development Database
Five-bank asset share	Assets of five largest banks as a share of total commercial banking assets. Total assets include total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax, discontinued operations and other assets.	World Bank, Global Financial Development Database
Lerner Index	A measure of market power in the banking market. It compares output pricing and marginal costs (that is, markup). An increase in the Lerner index indicates a deterioration of the competitive conduct of financial intermediaries.	World Bank, Global Financial Development Database
Boone Index	A measure of degree of competition based on profit-efficiency in the banking market. It is calculated as the elasticity of profits to marginal costs. An increase in the Boone indicator implies a deterioration of the competitive conduct of financial intermediaries.	World Bank, Global Financial Development Database
Wholesale funding ratio	Ratio of total liabilities minus retail funding to total liabilities	IMF, Monetary and Fiscal Statistics database
Assets of OFI	Assets of financial intermediaries other than central banks, banks, public financial institutions, insurance corporations and pension funds, in US dollars.	Financial Stability Board
Assets of Narrow shadow banking	Assets of narrow measure of shadow banking, in US dollars. This narrow measure is based on the FSB Policy Framework (FSB (2013)), in which non-bank financial entities are classified with reference to five economic functions, each of which involves non-bank credit intermediation that may pose risks to financial stability.	Financial Stability Board
Assets of banks	Assets of banks, in US dollars. Banks refer to the broader category of deposit-taking corporations.	Financial Stability Board
Bank exposures to shadow banks	Banks' claims on OFIs as a share of bank assets	Financial Stability Board
Bank use of funding from shadow banks	Banks' liabilities to OFIs as a share of bank assets	Financial Stability Board
Domestic bank holdings of general government debt securities	Share of domestic bank holdings to total investor holdings of general government debt securities	Arslanalp and Tsuda (2014, updated)
Share of different counterparties in derivatives clearing	Share of different counterparties to notional amounts outstanding at end of period in derivatives clearing	Bank for International Settlements
VC-backed global fintech financing	Annual venture capital-backed global fintech financing, in US dollars	CB Insights
VC-backed global fintech deals	Number of annual venture capital-backed global fintech deals	CB Insights
Unique vulnerabilities	Number of uniquely identified vulnerabilities	Protiviti
Critical and high unique vulnerabilities	Number of critical and high unique vulnerabilities. Vulnerabilities are labeled "Critical" severity if they have a Common Vulnerability Scoring System (CVSS) base score of 9.0-10.0.	Protiviti

Source: IMF staff.

Reference

Arslanalp, Serkan, and Takahira Tsuda. 2014. "Tracking Global Demand for Advanced Economy Sovereign Debt." IMF Economic Review 62 (3): 430–64.

Laeven, Luc and Fabian Valencia. 2012. "Systemic Banking Crises Database: An Update." IMF Working Paper 12/163, International Monetary Fund, Washington, DC.