

# Bank Capital Redux: Solvency, Liquidity, and Crisis

Òscar Jordà\*    Björn Richter‡  
Moritz Schularick†    Alan M. Taylor§

\*Federal Reserve Bank of San Francisco; University of California, Davis

‡University of Bonn

†University of Bonn; CEPR

§University of California, Davis; NBER; CEPR

*The views expressed herein are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Federal Reserve Bank of San Francisco or the Board of Governors of the Federal Reserve System.*

*It's not what you don't know that kills you, it's  
what you know for sure that ain't true.*

*— Mark Twain*

*It's not what you don't know that kills you, it's what you know for sure that ain't true.*

— Mark Twain

*A well-run bank needs no capital. No amount of capital will rescue a badly run bank.*

— Walter Bagehot

*It's not what you don't know that kills you, it's what you know for sure that ain't true.*

*— Mark Twain*

*A well-run bank needs no capital. No amount of capital will rescue a badly run bank.*

*— Walter Bagehot*

*The answer is: more capital. —*

*But what was the question?*

*— Overheard at a conference*

# Big picture

- What are the deeper causes of financial crises?

# Big picture

- What are the deeper causes of financial crises?
- What's driving repeated excessive risk-taking in financial markets?

# Big picture

- What are the deeper causes of financial crises?
- What's driving repeated excessive risk-taking in financial markets?
- Incentives or behavioral factors?

# What we ask

- What is the evidence that more capital makes systemic banking crises less *likely*?



# What we ask

- What is the evidence that more capital makes systemic banking crises less *likely*?
- What is the evidence that more capital makes crises less *severe*?

# What we do

- We study these questions empirically with a comprehensive new dataset covering the liability side of banks' balance sheets for 17 advanced economies from 1870-2013.
- Comprehensive picture of funding structure of the banking system: (book) capital, deposits and non-core (wholesale) liabilities.
- This complements the work of Schularick and Taylor (2012) on bank credit as well as Jordà, Schularick and Taylor (2016) on disaggregated credit.

# What we show

- 1 There is no evidence that, *ceteris paribus*, higher capital ratios reduce the likelihood of systemic banking crises.

# What we show

- 1 There is no evidence that, *ceteris paribus*, higher capital ratios reduce the likelihood of systemic banking crises.
  - Result holds across different regulatory regimes, controlling for asset risk, book/market value of capital, macro and micro data.
  - The asset side (loan growth) drives crisis risk, not the funding mix.
  - It's likely causal.

# What we show

- 1 There is no evidence that, *ceteris paribus*, higher capital ratios reduce the likelihood of systemic banking crises.
  - Result holds across different regulatory regimes, controlling for asset risk, book/market value of capital, macro and micro data.
  - The asset side (loan growth) drives crisis risk, not the funding mix.
  - It's likely causal.
- 2 However, there is robust evidence that higher capital ratios make crises less severe.

# What this means

For our understanding of the causes of financial crises:

- More “skin in the game” does not necessarily make financial systems less crisis-prone.
- There is little evidence that excessive risk taking by rational agents is at the heart of crisis dynamics.
- Evidence compatible with the view that crises are driven by spurts of credit-fueled over-optimism (e.g., Gennaioli et al. (2013); Baron and Xiong (2016)).

# Three parts

- 1 New data and stylized facts
- 2 Capital and crisis probability
- 3 Capital and crisis severity

New data and stylized facts



## JORDÀ-SCHULARICK-TAYLOR MACROHISTORY DATABASE

The *Jordà-Schularick-Taylor Macrohistory Database* is the result of an extensive data collection effort over several years. In one place it brings together macroeconomic data that previously had been dispersed across a variety of sources. On this website we provide convenient no-cost open access under a license to the most extensive long-run macro-financial dataset to date. Commercial data providers are strictly forbidden to integrate all or parts of the dataset into their services or sell the data (see [Terms of Use and Licence Terms](#) below).

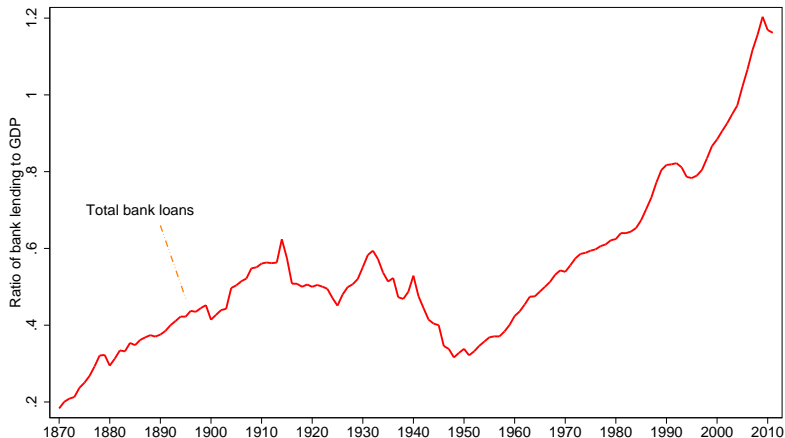
The database covers 17 advanced economies since 1870 on an annual basis. It comprises 25 real and nominal variables. Among these, there are time series that had been hitherto unavailable to researchers, among them financial variables such as bank credit to the non-financial private sector, mortgage lending and long-term house prices. The database captures the near-universe of advanced-country macroeconomic and asset price dynamics, covering on average over 90 percent of advanced-economy output and over 50 percent of world output.

Assembling the database, we relied on the input from colleagues, coauthors and doctoral students in many countries, and consulted a broad range of historical sources and various publications of statistical offices and central banks. For some countries we extended existing data series, for others we relied on recent data collection efforts by others. Yet in a non-negligible number of cases we had to go back to archival sources including documents from governments, central banks, and private banks. Typically, we combined information from various sources and spliced series to create long-run datasets spanning the entire 1870–2014 period for the first time. The table below lists the available series.

[Download Data ▾](#)[Documentation ▾](#)[How to Cite ▾](#)[Research ▾](#)

# The financial hockey stick

Total bank credit to the non-financial private sector, 17 countries, 1870-2010



Source: Schularick, Moritz and Alan M. Taylor, Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises 1870-2012, American Economic Review, 2012.

# The liability side

**Banks:** Monetary financial institutions (MFIs), including commercial banks, savings banks, postal banks, building societies

**Capital:** Shareholders funds that allow to absorb losses:

- Common stock (paid-up capital), including the share premium
- Retained earnings
- Disclosed reserves
- No adjustment for double liability

**Deposits:** Term and sight deposits, checking and saving accounts by non-financial residents

**Non-core:** Other liabilities such as bonds, repo and interbank funding

# Balance sheet ratios

An unweighted capital ratio (in the spirit of the Basel III leverage ratio):

$$\text{Capital Ratio} = \frac{\text{Capital}}{\text{Total Assets}}$$

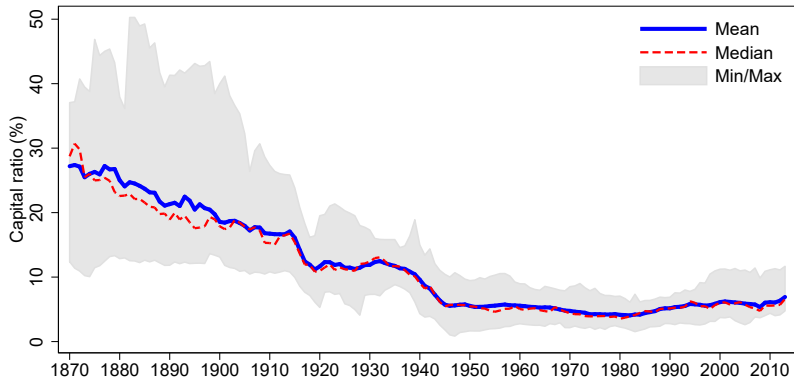
The loan-to-deposit ratio as an illiquidity measure:

$$\text{LtD Ratio} = \frac{\text{Loans}}{\text{Deposits}}$$

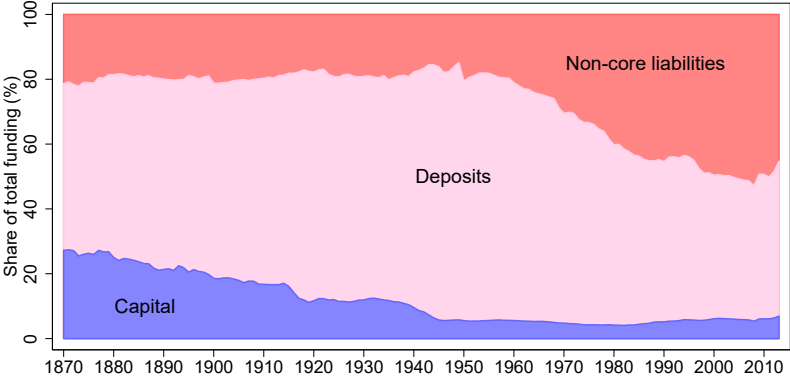
The reliance on non-core debt funding:

$$\text{Noncore Share} = \frac{\text{Noncore liabilities}}{\text{Deposits} + \text{Noncore Liabilities}}$$

# Aggregate capital ratio from 1870 to 2015



# Composition of funding



## FUNDING STRUCTURE AND FINANCIAL INSTABILITY

# Two views on the origins of financial crisis

## The capital view

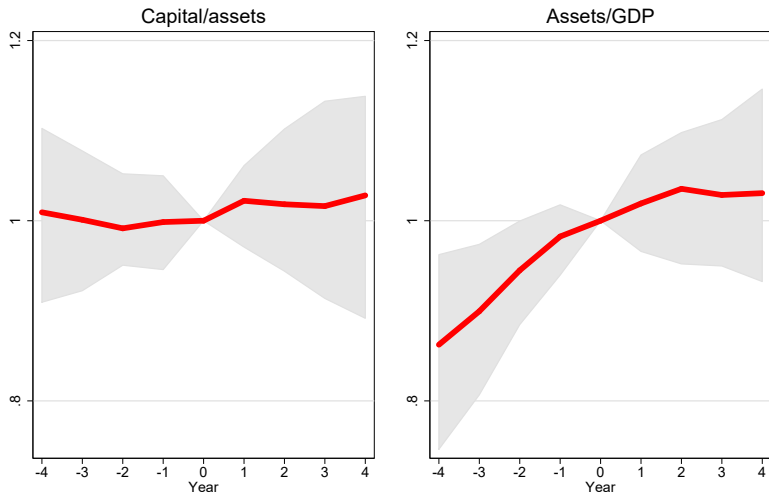
- Large role for incentive and agency problems leading to excessive risk-taking of rational agents
- Close correlation between “skin in the game” and financial riskiness

## The Minsky/Kindleberger view (updated)

- Crises are caused by spurts of credit-fueled over-optimism and then sudden collapses of mispriced assets (e.g., Gennaioli, Shleifer, Vishny (2013); Baron and Xiong (2016))
- Repricing triggers bank runs, liquidity matters (e.g., Bernanke 2015)
- Crises are orthogonal to bank capital. Everyone is caught in the same heuristic bubble. If anything, liquidity matters.



# Balance sheet ratios around financial crises



*Notes:* This figure presents the path of balance sheet variables around financial crises (Jordà et al. 2016). The values of the respective variable are scaled to equal 1 in year 0. The solid line corresponds to the mean and the grey bands to the interquartile range.

## Binary classification model

The log-odds ratio of a crisis in country  $i$  at time  $t$  conditional on observables:

$$\log \left( \frac{\Pr[S_{i,t} = 1|X_{i,t}]}{\Pr[S_{i,t} = 0|X_{i,t}]} \right) = \alpha_i + \beta X_{i,t}, \quad (1)$$

where:

$S_{i,t}$  is a financial crisis dummy (Jordà et al. (2016)).

$\alpha_i$  is a country fixed effect.

$X_{i,t}$  includes either the lag or the average 5-year change ( $\Delta$ ) of the respective balance sheet ratio and in some specifications additionally the 5-year change in private credit relative to GDP (Schularick and Taylor (2012)).

# Motivating logit regressions

Full sample

Dependent variable: binary for financial crisis

---

Capital ratio	0.15***		
LtD ratio		0.06***	
Non-core ratio			0.01
AUC	0.67	0.68	0.62
Observations	2017	1975	1922

---

Note: marginal effects reported.

Benchmark AUC: 0.62 (full sample), 0.60 post-WW2

# Including loans to GDP growth

Full and post-WW2 samples

Dependent variable: binary for financial crisis

	Full	Post	Full	Post	Full	Post
Loans	0.74***	0.54***	0.50***	0.23***	0.75***	0.15*
Cap Ratio	0.15***	0.05				
LtD Ratio			0.04***	0.04***		
Noncore					-0.01	0.08***
AUC	0.71	0.74	0.72	0.79	0.71	0.84
Observations	1720	998	1713	1004	1671	1004

Note: marginal effects reported

Benchmark AUC: 0.62 (full sample), 0.60 post-WW2

# Asset risk

We add controls for asset risks:

- 1 Market perception of bank risk: excess returns on the banking sector stock index from Baron and Xiong (2017).
- 2 Macro risks: 5-year/10-year moving standard deviations of gdp, inflation, and interest rates. (NB: Also tried forward looking: no effect.)
- 3 House price booms: run-up in real house prices over 5-year period.

# Controlling for asset risk

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta$ Loans	31.66*** (6.11)	32.38*** (7.15)	33.14*** (11.32)	30.31*** (5.08)	30.45*** (6.09)	32.62*** (10.97)
Capital ratio	5.75*** (1.51)	7.61*** (2.51)	16.25 (11.93)			
$\Delta$ Capital ratio				16.40 (54.78)	20.75 (55.43)	-73.22 (91.15)
Macro-risks	Yes	Yes	Yes	Yes	Yes	Yes
House prices	No	Yes	Yes	No	Yes	Yes
Excess returns	No	No	Yes	No	No	Yes
Pseudo $R^2$	0.079	0.110	0.143	0.065	0.094	0.140
AUC	0.73 0.04	0.76 0.04	0.76 0.06	0.70 0.04	0.73 0.04	0.77 0.05
Observations	1432	1262	720	1419	1259	720

Notes: The table shows logit classification models where the dependent variable is the financial crisis dummy and the regressors are in lagged levels or lagged average 5-year changes. All models include country fixed effects. Robust standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## Market value of capital (post-1973 only)

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta$ Loans change		21.13** (9.33)	20.74** (9.45)		22.25** (9.03)	21.96** (8.98)
Market Leverage Ratio	-0.04 (3.53)	1.66 (3.30)	3.59 (3.55)			
$\Delta$ Market Leverage Ratio				0.23 (15.26)	12.70 (15.95)	19.71 (16.20)
Excess returns	No	No	Yes	No	No	Yes
Pseudo $R^2$	0.014	0.047	0.054	0.014	0.049	0.057
AUC	0.58 0.08	0.66 0.07	0.67 0.07	0.60 0.07	0.66 0.07	0.67 0.07
Observations	321	321	321	321	321	321

Notes: The table shows logit classification models where the dependent variable is the financial crisis dummy and the regressors are in lagged levels or in lagged 5-year average changes. All models include country fixed effects. Robust standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## More checks

- Cross-country differences in capital ratios may be the reason why some countries experience more banking crises than others: pooled regressions.
- Controls for GDP growth, inflation, investment, short- and long-term interest rates, and the current account do not change the results.
- We might miss leverage in the shadow banking sector: excluding US and UK does not change results.
- Including decade fixed effects or monetary regime dummies does not affect the results.



# Going micro

What if the dispersion matters and a few under-capitalized banks drive crisis risk?

- We use a micro-level dataset from Italy (Historical Archive of Credit in Italy) covering the universe of Italian banks from 1890 to 1970.
- Study effects for different percentiles of the capital ratio distribution.

# Logit with Italian dispersion measures

	(1)	(2)	(3)	(4)
	5th pctile	10th pctile	25th pctile	Aggregate
Capital ratio	33.07* (18.59)	18.57 (13.35)	11.93 (9.75)	11.51* (6.27)
Pseudo $R^2$	0.036	0.024	0.020	0.061
AUC	0.68 (0.09)	0.65 (0.09)	0.64 (0.09)	0.71 (0.11)
Observations	81	81	81	81

Notes: The table shows logit classification models where the dependent variable is the financial crisis dummy. Regressors are in one-period lagged levels.

Robust standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

# Do a few large banks predict instability?

Do the capital ratios of the largest banks drive financial instability?

- We use micro data kindly shared by Mazbouri et al. (2017) for the largest banks in Belgium, France, Germany, Italy, Switzerland and the UK for the period 1890 to 1970.
- We extended the coverage of the data series using data for the same set of banks in France, Germany, Italy, Switzerland and the UK to 2015.
- We then test the capital-instability nexus for the largest banks in each country in the subsample.

# Logit with largest banks

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta$ Loans		39.81*** (9.86)	44.69*** (14.37)		32.74*** (5.96)	42.71*** (16.01)
Capital ratio	4.20** (2.03)	5.41* (3.04)	6.78** (2.99)			
$\Delta$ Capital ratio				-16.92 (56.92)	-13.11 (59.69)	-35.20 (35.52)
Macro-risk	No	No	Yes	No	No	Yes
Deposit Insurance	No	No	Yes	No	No	Yes
Pseudo $R^2$	0.031	0.097	0.166	0.008	0.063	0.140
AUC	0.63 0.08	0.77 0.07	0.80 0.06	0.61 0.08	0.72 0.07	0.79 0.06
Observations	349	349	349	349	349	349

*Notes:* The table shows logit classification models where the dependent variable is the financial crisis dummy. Regressors are in one-period lagged levels or in lagged 5-year average changes. Macro-risk includes 5-year moving standard deviations of GDP growth, inflation and short-term interest rates. All specifications include country fixed effects. Robust standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

# Is this causal?

- We instrument changes in bank capital with lagged changes in profits
  - **Relevance:** retained earnings are a major source of bank capital given equity issuance frictions
  - **Exclusion restriction:** High profitability not correlated with future crisis risk
  - **Fundamental improvements** in productivity should lower crisis risk

# Two-stage control function approach

- **First stage OLS:** Instrument changes in capital with lagged profits.

$$\Delta_5 \text{Capital Ratio}_{i,t-1} = \alpha_i + \sum_{j=1}^5 \Delta \text{Profits}_{i,t-j} + \Delta_5 \text{Loans/GDP}_{i,t-1} \\ + \text{ReturnPremium}_{i,t-1} + \epsilon_{i,t-1}$$

- Take residuals of this regression: potentially endogenous variation in capital.
- **Second stage probit:** include  $\text{Residual}_{i,t-1}$  as an additional control:

$$\Phi^{-1}(\text{Crisis}_{i,t}) = \alpha_i + \Delta_5 \text{Capital Ratio}_{i,t-1} + \text{Residual}_{i,t-1} \\ + \Delta_5 \text{Loans/GDP} + \text{ReturnPremium}_{i,t-1} + \epsilon_{i,t}$$

## Second stage probit

	Full sample	Post WW2
Capital ratio 5-year change $_{i,t-1}$	0.27* (0.14)	0.15* (0.09)
Residual $_{i,t-1}$	-0.26* (0.14)	-0.14 (0.09)
5-year ReturnPremium $_{i,t-1}$	-0.06 (0.05)	-0.04 (0.04)
Loans-to-GDP 5-year change $_{i,t-1}$	1.12*** (0.24)	0.83*** (0.23)
Observations	1232	850

Bootstrapped standard errors in parentheses \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## CAPITAL AND THE COST OF CRISES



# Do capital ratios impact the cost of crises?

- Consider a country  $i$  coming out of a business cycle expansion  $p$  and entering a recession at time  $t(p)$
- ... when there was a financial crisis in a window  $\pm 2$  years
- ... hitting an economy with a banking sector that had a capital ratio lower than the average capital ratio at the start of all such recessions
- ... how does this change the expected path of the economy through recession and recovery  $(y_{t(p)}, \dots, y_{t(p)+h})$ ?

# Model specification

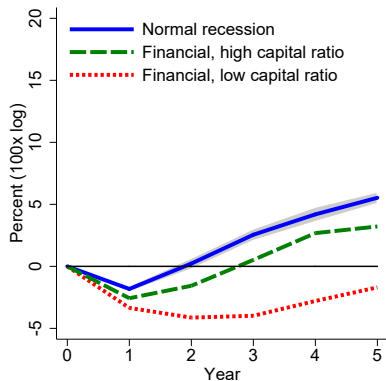
$$\Delta_h y_{i,t(p)} = \underbrace{\sum_{i=1}^I \alpha_{i,h} D_{i,t(p)}}_{\text{country-indicators}} + \underbrace{\mu_h}_{\text{avg. path}} + \gamma_h^{HI} d_{i,t(p)} \times \delta_{i,t(p)} \\ + \gamma_h^{LO} d_{i,t(p)} \times (1 - \delta_{i,t(p)}) + X_{i,t(p)} \Psi + \epsilon_{i,t(p)} \quad \text{for } h = 1, \dots, 5$$

Controls  $X$  at time  $h = 0, -1$ :

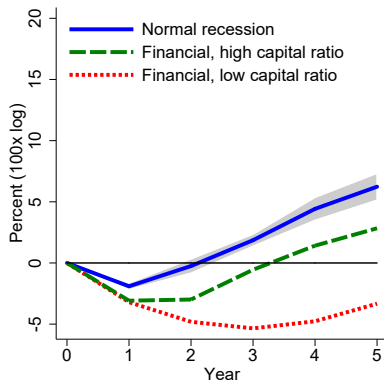
- 1 real GDP per capita growth rate
- 2 real investment per capita growth rate
- 3 CPI inflation rate
- 4 short-term interest rate
- 5 long-term interest rate
- 6 current account to GDP ratio

# Slower recovery with low capital

(a) No controls

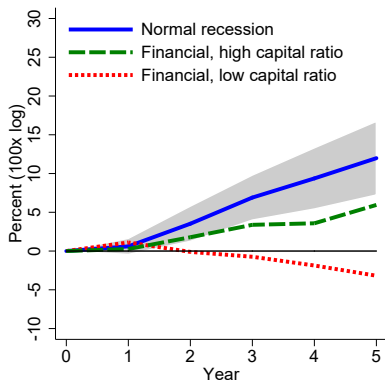


(b) With controls

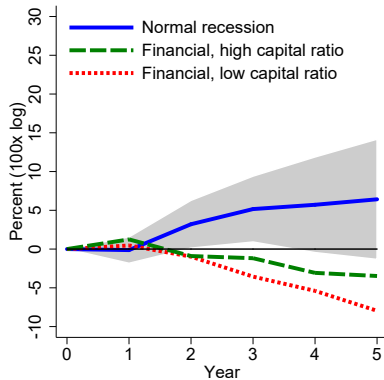


# Slower credit growth with low capital

(a) Full sample



(b) Post-WW2



# Conclusions

- The balance sheet structure of banks changed substantially between 1870 and today, but the large decline in capital occurred before WW2, not afterwards.
- Capital ratios are a poor indicator of financial vulnerability.
- Capital matters, however. Financial crises are less costly when capital ratios are high.