

Bank health post-crisis

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Economic growth is persistently low following a financial crisis, possibly because of a continuing weak banking system. In a financial crisis, bank health is significantly damaged. Post-crisis regulatory changes have aimed at restoring bank health, but measuring bank health by Tobin's Q, we find that the ill health of banks in the recent US financial crisis and the Euro crisis has persisted, especially compared to other crises in advanced economies. The low bank Q's cannot be explained by the state of the macroeconomy. The results seem to suggest that bank regulatory changes may be repressive.

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Why does low economic growth persist following a financial crisis?¹ While there are many possible explanations for the persistence of low growth following a financial crisis, one important possibility is that banks do not recover quickly. By definition, a financial crisis involving runs on the banking system is bad for the health of banks. Bank health is clearly important because we know that after a financial crisis unhealthy banks reduce lending. Many studies point to a transmission channel of post-crisis bank distress as causing lower economic growth.² But how bad is a crisis for bank health? And how long are banks ill? We explore these questions across countries and crises using Tobin's Q as a summary measure of bank health. We examine banks' health for five (and ten) years before a financial crisis and five (and ten) years after a financial crisis. In essence, Tobin's Q is a measure of the viability of banks' business models. We find that European and American banks suffered shocks to their health in the financial crises and that this sickness has persisted for five years (and ten years) after the Euro crisis and the US financial crisis, respectively. This pattern of a shock to bank health and the persistence of ill health is not present in other bank crises in advanced economies.

Banks suffer declines in capital during a financial crisis, and after a crisis they must adjust to new bank regulations. After the recent US and Euro financial crises, new international and national bank regulatory reforms have included higher capital requirements, higher liquidity requirements, limitations on leverage ratios, and the introduction of stress tests. In some countries the activities of banks were constrained, e.g. the Volcker Rule. And in the United States, the assessment for deposit insurance was changed so that it was based on total liabilities, regardless of the bank's level of insured deposits. Securitisation became moribund following the recent crises, raising banks' funding costs. Furthermore, in the aftermath of the recent crisis, banks have faced billions

of dollars of fines with legal uncertainty still remaining. And banks have struggled in a low interest rate and low growth environment.

The recent crises in the United States and Europe, significantly worse in terms of output declines, compared to other modern crises in advanced economies, show persistently ill banks compared to the other crises, as measured by Tobin's Q. We also find that the dispersion of bank Q-ratios has declined post-crisis. Low Q banks may have failed, but low Q dispersion seems hard to explain as being due to capital leaving banking (for low Q banks), just when capital ratios have been increased. Another explanation is that low, bunched Q-ratios are due to regulation making all banks essentially the same and inefficient. This persistence suggests that traditional bank business models may no longer be viable. It also suggests that new regulations have not served to revitalise banking, but may have had the opposite effect. As measured by Tobin's Q, the future of US and European banks is not bright.

This paper is related to Sarin and Summers (2016) and Calomiris and Nissim (2014). Sarin and Summers (2016) examine a variety of measures of bank riskiness pre- and post-crisis, e.g. stock price volatility, credit default swaps, option-implied volatility, and find that banks are riskier post-crisis than before the crisis. They write that: "...our findings are most consistent with a dramatic decline in franchise [charter] value of major financial institutions, caused at least in part by new regulations" (abstract). Our findings are consistent with this. We, however, focus on a different issue, namely the pattern of bank health pre- and post-crisis in different crises across countries. Calomiris and Nissim (2014) study the cross section of US banks' Tobin's Q's pre- and post- the recent US financial crisis, relating their panel to measures of banks' activities. They find that low Q's indicate (in cross section) that banks' investments in intangibles (e.g. human capital, information technology) are expected to

1 Low economic growth following financial crises is documented, for example, by Cerra and Saxena (2008) and Reinhart and Rogoff (2014).

2 See, for example, Gibson (1995), Rosengren and Peek (2000), Calomiris and Mason (2003), Dell'Ariccia et al. (2008), Ivashina and Scharfstein (2010), Mladjan (2012), Iyer et al. (2014), Chodorow-Reich (2014), Frydman et al. (2015), Lee and Mezzanotti (2014), Carlson and Rose (2015). These papers show that post-crisis declines in lending are significantly due to bank loan supply rather than to low demand for loans, which may also be present.

generate negative economic profits in the future. This conclusion is also consistent with what we find, although we do not focus on a cross section of banks but on a cross section of countries.

We proceed as follows. In Section 1 we discuss the use and role of Tobin's Q in studying banking. We also discuss our data. Section 2 contains the main results. Final thoughts are contained in Section 3.

11 Measuring bank health

11.1 Tobin's Q

While Tobin's Q is widely used in economics, it plays a particular role in the case of banks because of bank "charter value".³ In general, charter value derives from rents or quasi-rents on assets-in-place and future investment opportunities. Banks make loans, which involves banks in the production of valuable private information about borrowers. This information is valuable for future loans, and the associated bank relationship makes it hard for borrowers to switch banks. See Slovin et al. (1993) and Darmouni (2016). For a bank, rents or quasi-rents accruing from this information production are an intangible asset which the bank loses if it fails. These informational quasi-rents are the bank's private "charter value". In addition, charter value may derive from regulatory barriers to entry or from oligopolistic behaviour that limits entry.⁴ Since banks uniquely produce short-term debt bearing a convenience yield, limitations on entry would also create charter value due to this cheaper source of funding. In oligopolistic industries like banking, the Q's may normally be above one, and can stay that way if there are barriers to entry.

We use a simple measure of Tobin's Q:

$$Q\text{-ratio} = \frac{\text{market capitalisation}}{\text{book value of equity}} \quad (1)$$

While there are more complicated ways of constructing Tobin's Q, these other methods result

in measures that are very highly correlated with the simple measure. See Chung and Pruitt (1994).

We construct indices of Q for countries experiencing different crises as follows. We first construct an annual Q for each bank in a country. These are then valued-weighted (by total assets) to get a country Q index. For all countries involved in a crisis, e.g. the Euro crisis, we weight countries by real GDP to obtain a Q index for that crisis or set of crises.

11.2 Data

Our data are from WorldScope and the World Development Indicators of the World Bank. The categories of financial institutions used in the analysis are commercial banks, including multi-bank holding companies and single bank holding companies, and savings & loan holding companies.⁵ We also look separately at (what were) the US investment banks. The data are annual and span 1980 until 2015. We merge the real GDP data with the credit-to-the-private-sector data from the World Development Indicators. All variables are winsorised at the 1% level. Table 1 summarises the data, grouping data into all US banks, European banks, and the banks in the other countries that experienced financial crises. This last group will be called "the benchmark".

The variable "Short Yield" is a measure of the yield on short maturity government debt. It is apparent from the table that, even winsorising at 1%, the data appear to be somewhat noisy. This is perhaps due to differences in accounting procedures.

For the benchmark, we use the dates of financial crises (other than the recent crises in the United States and Europe) in other advanced countries from Kaminsky and Reinhart (1999) and Caprio et al. (2005). From these sources we calculate a benchmark for banks' Q's, as described above, before and after financial crises other than the US crisis of 2007-2008 and

³ This is sometimes called "franchise value". See Marcus (1984). High bank charter value (Q greater than one) is viewed as providing an incentive for banks to avoid risk, for fear of losing this intangible asset. There is an empirical literature documenting the decline in US bank charter values in the 1980s. See Keeley (1990), Gorton and Rosen (1995) and Demsetz et al. (1996).

⁴ On oligopolistic bank behaviour see Gorton and He (2008).

⁵ We exclude investment companies, commercial finance companies, insurance companies, land and real estate companies, personal loan companies, real estate investment trusts and business trusts, rental and leasing, savings and loans holding companies, and securities brokerage firms. Results do not change if the savings & loan holding companies are excluded.

T1 Mean, standard deviation, minimum and maximum

	Count	Mean	St.Dev	Min	Max
Qw (US)	11	1.321	0.605	0.606	2.246
Qw (EU)	144	0.986	1.006	0.003	5.995
Qw (ADV)	91	0.850	0.716	0.045	4.333
Assets (US - in bn)	11	9,949.935	2,544.574	5,546.078	12,684.959
Assets (EU - in bn)	148	851.874	351.235	434.993	1,654.476
Assets (ADV - in bn)	94	633.167	685.451	19.024	2,514.260
Δ Assets (US)	10	0.086	0.119	-0.122	0.285
Δ Assets (EU)	132	0.080	0.339	-0.906	1.531
Δ Assets (ADV)	85	0.113	0.256	-0.432	1.394
rGDP (in bn)	865	919.589	2,050.115	6.628	16,800
Δ rGDP	835	0.070	0.122	-0.620	0.481
Credit	926	80.208	47.823	0.186	312.154
Δ Credit	892	0.344	9.350	-0.671	279.229
Short Yield	599	11.918	35.481	0.001	816.100
$\sigma(Q-US)$	11	0.550	0.125	0.391	0.735
$\sigma(Q-EU)$	137	0.583	0.745	0	5.083
$\sigma(Q-ADV)$	89	0.884	0.935	0.005	3.656
No. of banks (US)	11	794.636	89.586	641	921
No. of banks (EU)	148	10.189	11.001	1	44
No. of banks (ADV)	94	36.574	56.377	1	215

Source: Authors' calculations.

Note: *Asset-weighted average Q-ratio, Assets, Δ (Assets), and $\sigma(Qi)$* for the financial sector of each country in our sample, and *rGDP, Δ rGDP, Credit, and Δ Credit* for the economies of the countries in our sample. All variables are winsorised at the 1% level.

the Euro crisis. The benchmark includes the following crises: Australia (1989), Canada (1983), Denmark (1987), France (1994), Germany (1977), Greece (1991), Iceland (1985), Italy (1990), New Zealand (1987), United Kingdom (1974, 1999, 1995), and the United States (1984). Arguably, not all of these crises were systemic, and it seems clear that the crisis of 2007-2008 and the Euro crisis were worse than the sample, so the benchmark seems to concern less significant crises. Still, our view is that it is useful for comparison purposes. Keep in mind that Kaminsky and Reinhart (1999) and Caprio et al. (2005) define these events as systemic banking crises.

2I Post-crisis bank health: results

In this section we look at the evolution of bank health around financial crises.

Table 2 shows mean values for Tobin's Q, Total Assets, the cross-sectional dispersion of Q-ratios, and macroeconomic variables over the course of the five years prior to and five years after a financial crisis for four sets of banks: all US commercial banks and the US investment banks in the recent US financial crisis, European banks during the Euro crisis of 2008, and banks in advanced economies that experienced financial crises, as discussed above. Tobin's Q-ratios, the number of financial institutions, and the change in real GDP and Credit are, on average, lower post-crisis in the US and EU banks. However, we observe no significant differences in the Q-ratios of commercial banks in advanced economies' crises. Note that the policy rate, represented by "Short Yield", is lower post-crisis in all cases, but it is significantly different only in the cases of EU banks and the banks in the benchmark, but not for the US banks.

T2 Summary statistics

a) US banks (all)				b) US banks (specific)			
	Prior	Post	Mean Diff.		Prior	Post	Mean Diff.
Qw	1.921	0.820	1.101*** (9.10)	Qw	2.021	0.836	1.186*** (7.24)
Assets (in bn)	7,711.798	11,815.049	-4,103.252** (-4.68)	Assets (in bn)	5,320.737	8,982.943	-3,662.206*** (-6.13)
Δ Assets	0.184	0.021	0.163* (2.81)	Δ Assets	0.177	0.051	0.127* (2.64)
rGDP (in bn)	12,344.540	15,059.200	-2,714.660** (-4.78)	rGDP (in bn)	12,344.540	15,059.200	-2,714.660** (-4.78)
Δ rGDP	0.055	0.027	0.028+ (2.14)	Δ rGDP	0.055	0.027	0.028+ (2.14)
Credit	181.549	188.431	-6.882 (-0.96)	Credit	181.549	188.431	-6.882 (-0.96)
Δ Credit	0.031	-0.015	0.047 (1.54)	Δ Credit	0.031	-0.015	0.047 (1.54)
Short Yield	2.638	0.895	1.743 (1.55)	Short Yield	2.638	0.895	1.743 (1.55)
$\sigma(Q)$	0.665	0.455	0.210*** (5.47)	$\sigma(Q)$	0.447	0.297	0.149*** (5.49)
No. of banks	829.200	765.833	63.367 (1.19)	No. of banks	6	6	0

c) EU banks				d) Advanced banks			
	Prior	Post	Mean Diff.		Prior	Post	Mean Diff.
Qw	1.403	0.632	0.771*** (4.94)	Qw	0.880	0.828	0.052 (0.34)
Assets (in bn)	627.206	1042.842	-415.636*** (-8.87)	Assets (in bn)	519.395	725.060	-205.664 (-1.45)
Δ Assets	0.241	-0.031	0.272*** (4.91)	Δ Assets	0.187	0.066	0.121* (2.16)
rGDP (in bn)	582.430	744.729	-162.299 (-1.32)	rGDP (in bn)	702.098	1,041.596	-339.498 (-1.30)
Δ rGDP	0.140	0.001	0.139*** (10.42)	Δ rGDP	0.105	0.064	0.041+ (1.82)
Credit	95.328	112.516	-17.188** (-2.80)	Credit	58.546	69.638	-11.092* (-2.01)
Δ Credit	4.168	0.001	4.166 (1.10)	Δ Credit	0.060	0.037	0.023 (0.61)
Short Yield	2.907	1.834	1.073** (2.82)	Short Yield	13.503	10.003	3.500*** (3.55)
$\sigma(Q)$	0.655	0.527	0.127 (0.99)	$\sigma(Q)$	0.903	0.871	0.032 (0.16)
No. of banks	10.824	9.650	1.174 (0.65)	No. of banks	33	39.462	-6.462 (-0.55)

Source: Authors' calculations.

Note: The Table summarises the mean values of asset-weighted average Q-ratio, Assets, Δ (Assets), and $\sigma(Q)$ for (i) US banks (all) prior to vs. after the 2007 crisis, (ii) EU banks (all) prior to vs. after the 2008 crisis, (iii) specific US banks (Bank of America, Citigroup, Goldman Sachs, JP Morgan, Morgan Stanley, and Wells Fargo) prior to vs. after the 2007 crisis, and (iv) advanced countries' banks prior to and after major financial crises.

The third column reports the difference in means and the t-statistic of the difference.

t-statistics in parentheses: + p < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001.

Table 2 also shows that Tobin's Q was above one prior to the crises in the United States and Europe and then fell below one, with the change being statistically significant.⁶ In contrast, in the other financial crises, Tobin's Q was just

below one in the five years prior to the crises (on average) and is about the same in the five years afterward. Also, real GDP dropped significantly in the United States but not in Europe or in the other crises.

⁶ This is consistent with the findings of Calomiris and Nissim (2014) for the United States.

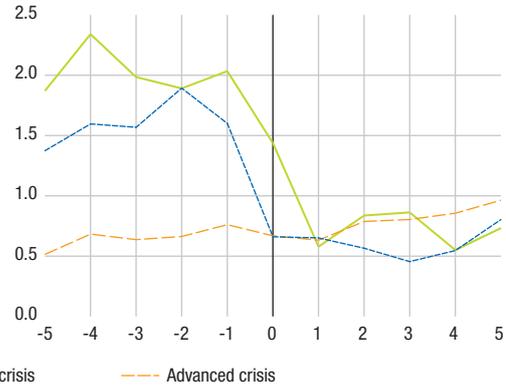
C1 Evolution of Q-ratios – Five years prior to and after the crisis

(X axis: time from crisis; Y axis: Q-ratio)

a) US banks (all)



b) US banks (specific)



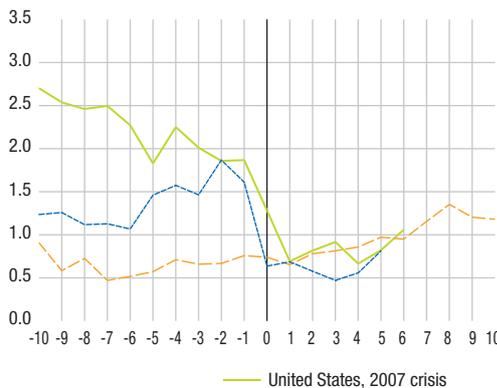
Source: Authors' calculations.

Note: In Chart a) the US, 2007 crisis line is the average Q-ratio for US banks five years prior to and after the 2007 crisis. In Chart b) the US, 2007 crisis line is the average Q-ratio for specific US banks (Bank of America, Citigroup, Goldman Sachs, JP Morgan, Morgan Stanley, and Wells Fargo) five years prior to and after the 2007 crisis. The advanced, crises line is the average Q-ratio five years prior to and after the following crises: Australia (1989), Canada (1983), Denmark (1987), France (1994), Germany (1977), Greece (1991), Iceland (1985), and Italy (1990), and New Zealand (1987), United Kingdom (1974, 1991, 1995), and United States (1984). The Euro, 2008 crisis line is the average Q-ratio five years prior to and after the following 2008 crises: Austria, Belgium, Denmark, France, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Portugal, Slovenia, Spain, Netherlands, and Sweden.

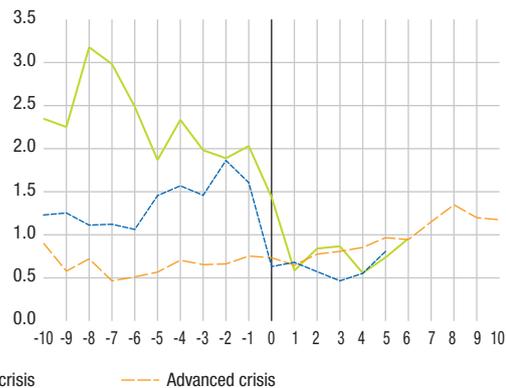
C2 Evolution of Q-ratios – Ten years prior to and after the crisis

(X axis: time from crisis; Y axis: Q-ratio)

a) US banks (all)



b) US banks (specific)



Source: Authors' calculations.

Note: In Chart a) the US, 2007 crisis line is the average Q-ratio for US banks ten years prior to and after the 2007 crisis. In Chart b) the US, 2007 crisis line is the average Q-ratio for specific US banks (Bank of America, Citigroup, Goldman Sachs, JP Morgan, Morgan Stanley, and Wells Fargo) ten years prior to and after the 2007 crisis. The advanced, crises line is the average Q-ratio ten years prior to and after the following crises: Australia (1989), Canada (1983), Denmark (1987), France (1994), Germany (1977), Greece (1991), Iceland (1985), and Italy (1990), and New Zealand (1987), United Kingdom (1974, 1991, 1995), and United States (1984). The Euro, 2008 crisis line is the average Q-ratio ten years prior to and after the following 2008 crises: Austria, Belgium, Denmark, France, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Portugal, Slovenia, Spain, Netherlands, and Sweden.

Chart 1a shows the evolution of Q-ratio indices for the above-mentioned different sets of banks. Chart 1a shows that, prior to the US financial crisis and the Euro crisis, banks were healthy with high Tobin's Q's, consistent with high charter value. The Q's plummet during the respective crises and do not recover during the subsequent five years. On the other hand, the banks in countries involved in the benchmark crises show a low Q prior to the crisis, on average, and after the crisis; the Q for this group does not move. It is flat. The figure is substantially the same if we look at the median Q instead of the average Q.

We interpret the high Q's for American and European banks prior to the crisis as evidence of oligopolistic banking systems – systems dominated by a few large banks. In addition, charter value could reflect implicit too-big-to-fail insurance. In any case, in the crises and their aftermaths, this charter value is significantly destroyed, resulting in Q ratios falling well below one. And this persists.

Chart 1b looks at the Q's for only the US banks that were at the centre of the financial crisis, i.e. the investment banks.⁷ These firms show a very high charter value prior to the crisis and a huge drop during the crisis. These are the banks for which the Volcker Rule is binding. And this is the set of banks that face the most legal action.

Chart 2 shows the same figures as above but over a decade pre- and post-crisis. Over a ten-year period some data are lost so coverage of banks is not as complete as over the five-year horizon. Nevertheless, the figures show that the ill health of US and European banks persists beyond five years. This is consistent with Cerra and Saxena (2008) who document output losses from financial crises persisting even at a ten-year horizon. Reinhart and Rogoff (2014), in a study of 100 crisis episodes, find that it takes about eight years to reach the pre-crisis level of income.

Table 3 confirms that the difference between the US crisis and the Euro crisis and the benchmark

T3 Difference-in-differences regression over the course of a crisis
Five years prior to and after the beginning of a financial crisis

	(1) $\log(Qw)_t$	(2) $\log(Qw)_t$	(3) $\log(Qw)_t$	(4) $\Delta\log(Qw)_t$	(5) $\Delta\log(Qw)_t$
$\mathbb{1}(\text{US \& EU Banks})_t$	1.232** (3.33)	2.047* (1.82)	0.000 (.)	0.823*** (11.94)	1.188*** (4.99)
$\mathbb{1}(\text{Post Crisis})_t$	-0.300 (-1.39)	-0.282 (-1.37)	-0.108 (-0.56)	-0.219 (-1.49)	-0.208 (-1.30)
$\mathbb{1}(\text{US \& EU Banks})_t \times \mathbb{1}(\text{Post Crisis})_t$	-0.529** (-3.68)	-0.594*** (-4.41)	-0.615** (-3.29)	-0.301* (-2.51)	-0.383** (-3.35)
$\log(\text{rGDP})_t$		-0.351 (-0.69)	-0.895+ (-2.15)		
$\log(\text{Credit})_t$		-0.115 (-0.34)	0.286 (1.43)		
$\log(\text{Short Yield})_t$			-0.053 (-0.39)		
$\Delta\log(\text{rGDP})_t$				1.062+ (1.80)	0.632 (0.88)
$\Delta\log(\text{Credit})_t$				-1.295*** (-4.77)	-0.979*** (-4.71)
$\log(Qw)_{t-1}$				-0.398*** (-5.59)	-0.437* (-2.95)
$\Delta\log(\text{Short Yield})_t$					-0.092 (-1.30)
Constant	-1.044*** (-7.38)	1.124 (0.41)	2.647 (1.09)	21.366+ (1.74)	12.527 (0.84)
N	245	244	150	220	133
R ²	0.51	0.51	0.58	0.54	0.61
FE (Year)	YES	YES	YES	YES	YES
FE (Country)	YES	YES	YES	YES	YES

Source: Authors' calculations.

Note: The table summarises the effect of the 2007 US financial crisis and 2008 Euro financial crisis on asset-weighted average Q-ratios of the financial sector of each country. The panel of countries in the regressions includes all countries in the sample. All regression specifications take into account country and year fixed effects, and standard errors are clustered by country. The specification is: $\log(Qw)_{n,t} = \alpha_n + a_t + \beta\mathbb{1}(\text{US \& EU Banks})_{n,t} + \gamma\mathbb{1}(\text{Post Crisis})_{n,t} + \delta\mathbb{1}(\text{US \& EU Banks})_{n,t} \times \mathbb{1}(\text{Post Crisis})_{n,t} + \zeta'X_{n,t} + \epsilon_{n,t}$, where $X_{n,t} = (\log(\text{rGDP})_t, \Delta\log(\text{rGDP})_t, \log(\text{Credit})_t, \Delta\log(\text{Credit})_t, \log(Qw)_{t-1})'$.

t-statistics in parentheses: + p < 0.10; * p < 0.05; ** p < 0.01; *** p < 0.001.

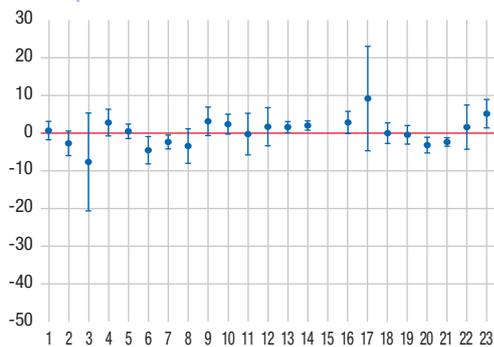
is indeed significant. In a difference-in-differences context, a dummy variable for US and EU banks interacted with a dummy for the post-crisis period is highly significant. The table highlights another point, namely that the level and change in Q indices are not associated with measures of the macroeconomy, as measured by real GDP

7 These banks are excluded from "all US commercial banks" prior to 2009. The investment banks became commercial banks at the end of 2008 and are subsequently included in "all US commercial banks".

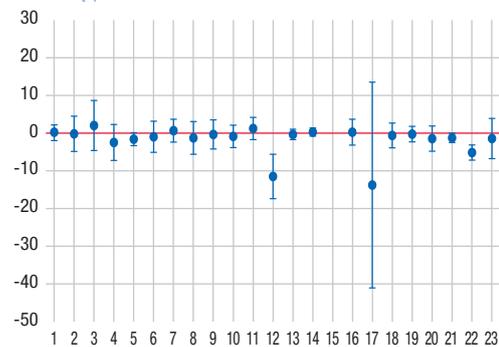
C3 Explanatory/predictive regression over the course of a crisis
Five years prior to and after the beginning of a financial crisis – country/crisis level

(X axis: country; Y axis: coefficient)

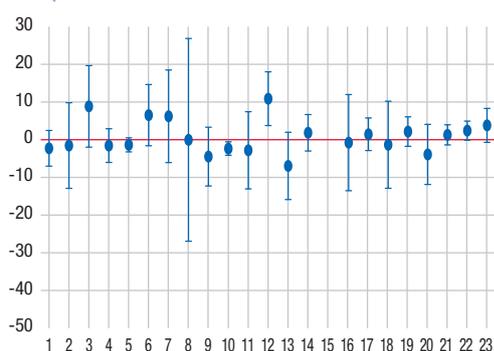
a) $\Delta \text{real GDP}_t$



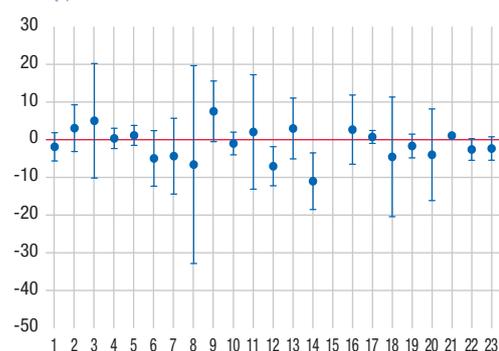
b) $\Delta \text{real GDP}_{t-1}$



c) ΔCredit_t



d) $\Delta \text{Credit}_{t-1}$



- | | | | | | |
|-------------|-----------------|----------------|----------------|----------------|------------------------|
| 1 Australia | 5 Denmark (Adv) | 9 Greece (Adv) | 13 Italy (Adv) | 17 New Zealand | 21 United Kingdom |
| 2 Austria | 6 Denmark (EU) | 10 Greece (EU) | 14 Italy (EU) | 18 Portugal | 22 United States (US) |
| 3 Belgium | 7 France (Adv) | 11 Hungary | 15 Luxembourg | 19 Spain | 23 United States (Adv) |
| 4 Canada | 8 France (EU) | 12 Ireland | 16 Netherlands | 20 Sweden | |

Source: Authors' calculations.

Note: Figures a) through d) summarise the predictive power of changes in real GDP, and credit to private sector, and their first-year lags on the change in Q-ratios.

All regressions are performed at the country level (countries with multiple crises are treated as separate time series) and standard errors are corrected using Newey-West (1987) with one lag.

The regression specification is: $\Delta Qw_{n,t} = \alpha_n + a_t + \beta X_{n,t} + \epsilon + n, t$, where $X_{n,t} = (\Delta \text{real GDP}_{n,t}, \Delta \text{real GDP}_{n,t-1}, \Delta \text{Credit}_t, \Delta \text{Credit}_{t-1})'$.

or credit-to-the-private sector. This is surprising because we would expect these variables to be significant if low bank Q's were due to the continuing recession (real GDP) or the credit boom prior to the crisis and the subsequent deleveraging in the economy. The regression also includes a measure of a short interest rate for each country (Short Yield) intended to capture

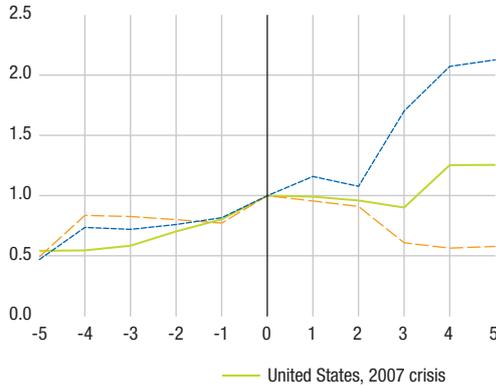
the effects of the zero lower bound in recent crises.⁸ Neither the level nor the change in this variable are significant. Thus the table suggests the presence of other factors explaining the low Q's. We further look into the relationship between Q-ratios and real GDP and Credit in Chart 3. We find that macroeconomic measures have little or no explanatory power over Tobin's Q measure.

⁸ These data are from Global Financial Data. The data are not available for our full sample of countries. Excluding the short yield, however, does not alter the results.

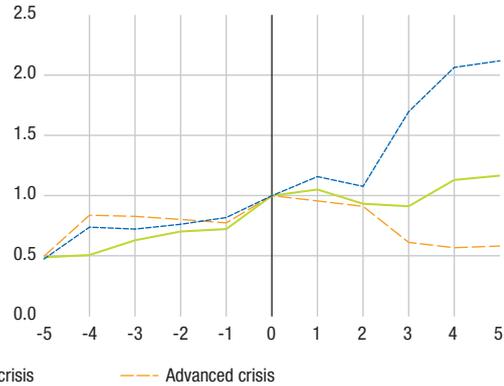
C4 Total cumulative cash growth – Five years prior to and after the crisis

(X axis: time from crisis; Y axis: cash growth)

a) US banks (all)



b) US banks (specific)



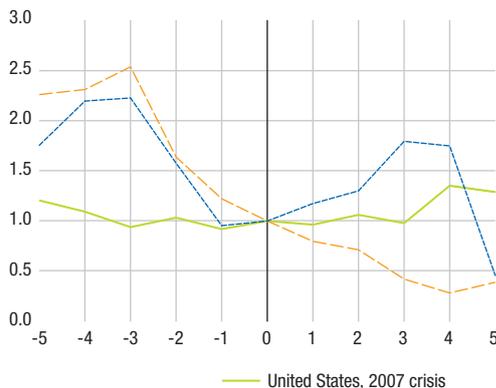
Source: Authors' calculations.

Note: In Chart a) the US, 2007 crisis line is the total cumulative cash growth for US banks five years prior to and after the 2007 crisis. In Chart b) the US, 2007 crisis line is the total cumulative cash growth for specific US banks (Bank of America, Citigroup, Goldman Sachs, JP Morgan, Morgan Stanley, and Wells Fargo) five years prior to and after the 2007 crisis. The advanced, crises line is the average cumulative cash growth five years prior to and after the following crises: Australia (1989), Canada (1983), Denmark (1987), France (1994), Germany (1977), Greece (1991), Iceland (1985), and Italy (1990), and New Zealand (1987), United Kingdom (1974, 1991, 1995), and United States (1984). The Euro, 2008 crisis line is the average cumulative assets growth five years prior to and after the following 2008 crises: Austria, Belgium, Denmark, France, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Portugal, Slovenia, Spain, Netherlands, and Sweden.

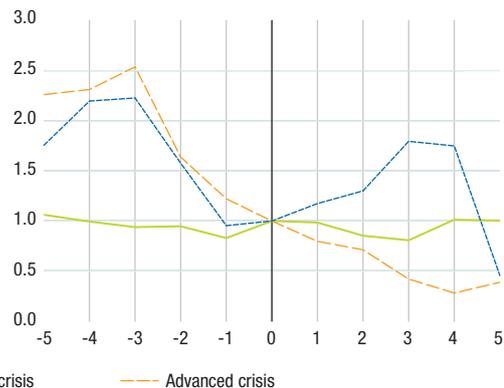
C5 Total cumulative cash/assets growth – Five years prior to and after the crisis

(X axis: time from crisis; Y axis: cash/assets)

a) US banks (all)



b) US banks (specific)



Source: Authors' calculations.

Note: In Chart a) the US, 2007 crisis line is the total cumulative cash/assets growth for US banks five years prior to and after the 2007 crisis. In Chart b) the US, 2007 crisis line is the total cumulative cash/assets growth for specific US banks (Bank of America, Citigroup, Goldman Sachs, JP Morgan, Morgan Stanley, and Wells Fargo) five years prior to and after the 2007 crisis. The advanced, crises line is the average cumulative cash/assets growth five years prior to and after the following crises: Australia (1989), Canada (1983), Denmark (1987), France (1994), Germany (1977), Greece (1991), Iceland (1985), and Italy (1990), and New Zealand (1987), United Kingdom (1974, 1991, 1995), and United States (1984). The Euro, 2008 crisis line is the average cumulative assets growth five years prior to and after the following 2008 crises: Austria, Belgium, Denmark, France, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Portugal, Slovenia, Spain, Netherlands, and Sweden.

211 Bank growth

We mentioned above the large literature that documents a decline in the supply of loans by banks following a financial crisis. If banks are seriously harmed in a crisis, and quite ill afterwards, we should see a decline in loan growth. Our data are not fine enough to examine loans specifically, but we can examine the growth of cash holdings and cash holdings as a percentage of total assets. Higher cash holdings and higher cash-to-assets ratios imply lower loan growth since the bank holds on to its cash. In Chart 4 above we look at the same three categories of crises as above. In Chart 4a, the cumulative growth of cash holdings starting five years before the crisis (normalised to one at the beginning of the crisis) is significantly higher for banks that experienced the US financial crisis or the Euro crisis compared to the benchmark. Chart 4b shows that the (old) US investment banks perform

similarly in terms of cash growth. The patterns in Chart 4 are consistent with low Q's and ill health.

Chart 5 above confirms the above findings for the case of the cash-to-assets ratio.

212 The dispersion of bank Q-ratios

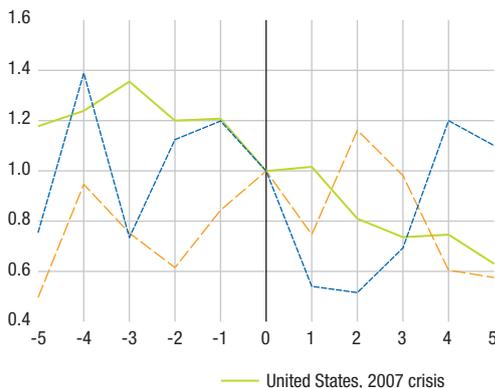
We next examine the dispersion of bank Q-ratios. In theory, as capital is reallocated, efficiency would result in all firms having a Q of one. Capital should flow from firms with low Q's to firms with high Q's. For example, if there is a financial liberalisation, giving non-financial firms equal access to credit, then the dispersion of Q for the non-financial firms should go down. Indeed, it does. See, for example, Abiad et al. (2008).⁹ However, in a financial crisis banks are not functioning well, and the dispersion of Q's for non-financial firms does not go down; see Chousakos et al. (2016). Post-crisis there are

⁹ The dispersion of Q is often used as a measure of capital reallocation. For example, Eisfeldt and Rampini (2006) use the dispersion of Q for this purpose.

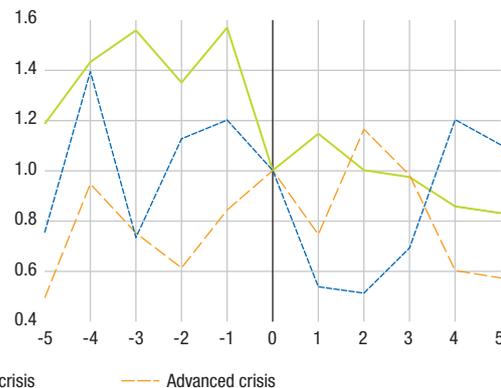
C6 Average standard deviation of cross-sectional Q-ratios
Five years prior to and after the crisis, standardised to begin at 1 for all three categories

(X axis: time from crisis; Y axis: $\sigma(Q_t)$)

a) US banks (all)



b) US banks (specific)



Source: Authors' calculations.

Note: In Chart a) the US, 2007 crisis line is the average standard deviation of cross-sectional Q-ratios for US banks five years prior to and after the 2007 crisis. In Chart b) the US, 2007 crisis line is the average standard deviation of cross-sectional Q-ratios for specific US banks (Bank of America, Citigroup, Goldman Sachs, JP Morgan, Morgan Stanley, and Wells Fargo) five years prior to and after the 2007 crisis. The advanced, crises line is the average standard deviation of cross-sectional Q-ratios five years prior to and after the following crises: Australia (1989), Canada (1983), Denmark (1987), France (1994), Germany (1977), Greece (1991), Iceland (1985), and Italy (1990), and New Zealand (1987), United Kingdom (1974, 1991, 1995), and United States (1984). The Euro, 2008 crisis line is the average standard deviation of cross-sectional Q-ratios five years prior to and after the following 2008 crises: Austria, Belgium, Denmark, France, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Portugal, Slovenia, Spain, Netherlands, and Sweden.

impediments to the reallocation of capital, because of the damage to the banking sector. What should we expect of the dispersion of banks' Q 's during and after a crisis? If less efficient, low Q , banks fail and investment flows to higher Q banks, then dispersion should be reduced. But if this does not happen for non-financial firms post-crisis, it is hard to understand how it could happen for banks.

Chart 6 above shows the average standard deviation of cross-sectional bank Q -ratios for five years prior to and five years after the financial crisis (normalised to one five years prior to the crises). It is striking that the average standard deviation is declining post-crisis, and especially so for the six former US investment banks. For US commercial banks, the trend is upwards until the crisis and then downwards. The decline in the dispersion of bank Q 's is paradoxical. It seems unlikely that the reason for the decline in the dispersion of Q is that capital is being reallocated in the banking sector at the very time when the banking sector is weak. We saw in Charts 1 and 2 that bank Q 's are below one following the crisis, meaning that capital should be flowing out of this sector. Can this happen when banks are being required to hold more capital? Another possible explanation is that the raft of new regulations is essentially homogenising banks at low Q 's.

3I Conclusion

US banks since the financial crisis of 2007-2008 and European banks following the Euro crisis have been persistently unhealthy as measured by Tobin's Q . Of course, there can be many, non-mutually exclusive, reasons for this continuing ill health. However, the state of the macroeconomy does not seem to explain low bank Q 's. The zero lower bound of interest

rates also does not seem to explain the low Q 's. So what does explain the low Q 's? An important remaining possibility is whether post-crisis bank regulation has been repressive, so much so that it accounts for the low Q 's. And regulation could account for a decline in the dispersion of bank Q -ratios. If banks' business models are permanently damaged due to regulation, then their long-run survival is in question (at least in their current form). Post-crisis heightened survival risk is consistent with the results of Sarin and Summers (2016) who show that banks are riskier. New regulations may have made banks "safer" in that they are less likely to be subject to bank runs. But that may have come at a very high cost.

To be clear, we have not shown any direct evidence on whether or not the cumulative effects of new bank regulations are repressive or not. We have just summarised data. But some recent trends also seem to suggest this. Lux and Greene (2015), for example, point out that in 2014 nonbanks accounted for over 40 per cent of mortgage originations while in 2010 this number was 12 per cent. And according to Nash and Beardsley (2015), peer-to-peer lending grew from USD 26 million in 2009 to USD 1.7 billion in 2014. They argue that: "Regulation will continue to shift activities from banks to nonbanks" (p. 1). Academic research is also emerging that is consistent with this view. Morris-Levenson et al. (2017) study cross-sectional heterogeneity in the regulatory exposure of different types of mortgage originators in the US. They find that less regulated banks and non-bank firms have a larger share of the mortgage origination market post-crisis. Is this the start of a new shadow banking system due to post-crisis constraining bank regulations? Not clear. But still, the question is very important and the evidence we have produced is (to us) striking and suggestive.

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