

Bank Capital and Real GDP Growth

Nina Boyarchenko, Domenico Giannone, and Anna Kovner

Federal Reserve Bank of New York, Amazon.com, CEPR and CESifo

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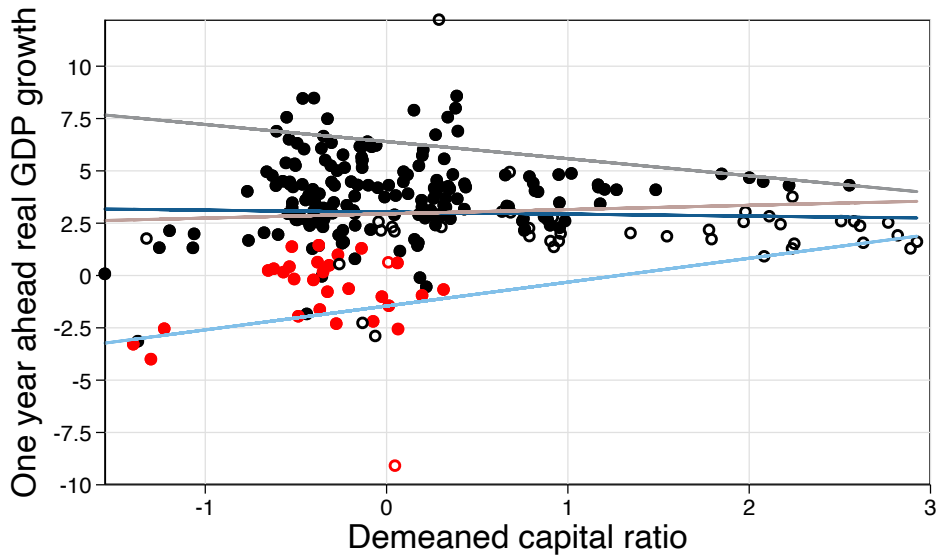
Basic idea

- Theoretical literature: bank capital supports flow of credit to non-financial firms and limits downside risk to growth during downturns
- This paper: study relationship between (aggregate) bank capital ratios and distribution of future real GDP growth

$$Q_{\tau}(\Delta R\text{-GDP}_{t,t+h}) = \alpha_{\tau,h} + \beta_{\tau,h}^g \Delta R\text{-GDP}_{t-4,t} + \beta_{\tau,h}^k \text{capital ratio}_t + \epsilon_{\tau,h,t}$$

- Quantile regressions: characterize entire distribution
- Demeaned capital ratio: captures effects of capital ratios in context of regulatory environment





Results overview

Higher capital ratios:

- Higher Q5 of real GDP growth, lower Q95, no effect on the median

⇒ Trade-off between risk of downturn and risk of exuberant growth

- Predictability at up to 5 years out
- Lower probability of real credit declines
- Lower probability of tight financial conditions
- Helps predict future distribution of real GDP growth over and above information in credit growth and financial conditions



Caveats

- Not causal
- Estimates valid for historically-observed ranges of capital ratios
 - Paper: capital ratios between 5.5 and 12.9 percent
 - Pre-WWII: 20 – 25 percent
- Capital ratios not capital ratio *buffers*
 - ⇒ Cannot evaluate hypothetical effects of imposing/releasing CCyB

But provides useful targets for macro-finance models of financial intermediation



Data



Capital ratio

Trade-off between long history and “right” definition of capital

1. Baseline definition: “regulation” consistent definition

- Y-9C data supplemented with call report data for CB without a top holder/without a Y-9C top holder
- ⇒ Captures non-commercial banking activities of BHCs but not stand-alone dealers
- Numerator: total equity capital pre 1996; Tier 1 RBC 1996 – 2001; approximate CET1 2001 – 2014; CET1 2014 –
- Denominator: total assets pre 1996; RWA 1996 –

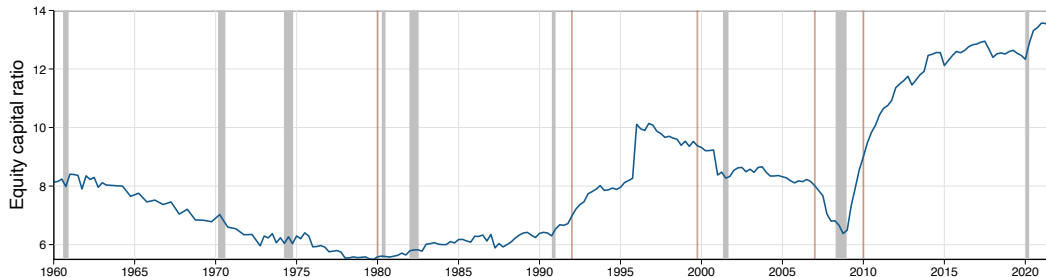
2. Robustness (paper appendix): time-consistent definition

- Commercial banks only
- Numerator: total equity
- Denominator: total assets

Higher capital ratio \Longleftrightarrow better capitalized system



Raw equity capital ratio



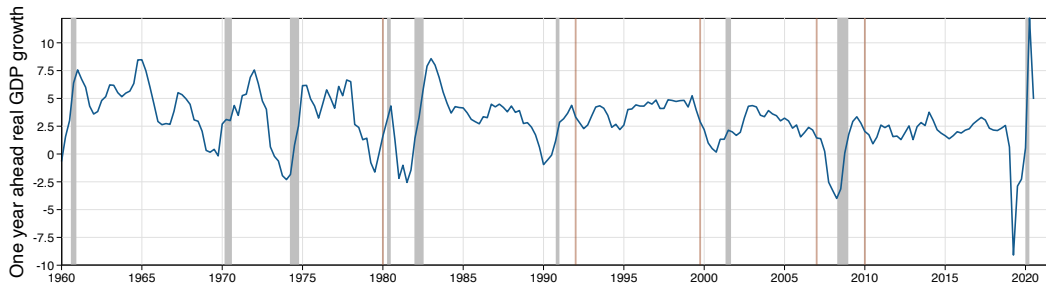
Event lines at: Q1 1970 (Depository Institutions Deregulation and Monetary Control Act); Q1 1992 (Basel I); Q4 1999 (Graham-Leach-Bliley); Q1 2010 (Dodd-Frank Act)



Standardizing variables

Real GDP growth: annualized change in GDP over H quarters

$$\Delta \text{R-GDP}_{t,t+h} = 100 \left(\left(\frac{\text{R-GDP}_{t+h}}{\text{R-GDP}_t} \right)^{\frac{4}{h}} - 1 \right)$$

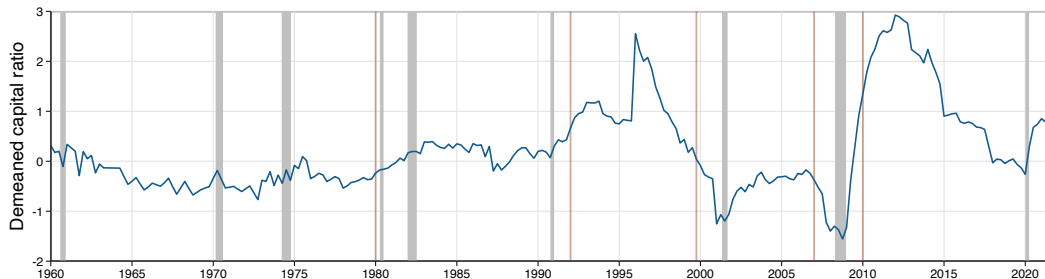


► Alternative capital ratio

Standardizing variables

Demeaned capital ratio: capital ratio relative to trailing 5Y average

$$\text{Demeaned capital ratio}_t = \text{capital ratio}_t - \frac{1}{20} \sum_{l=1}^{20} \text{capital ratio}_{t-l}$$



► Alternative capital ratio

Baseline results



Predicting growth one-year-ahead

Q5

	(1)	(2)
Constant	-2.95***	-2.31***
Lagged one year real GDP growth	0.47***	0.40***
Demeaned capital ratio		0.99***
Pseudo R^2	0.06	0.16
N. obs	243	243

Q50

	(1)	(2)
Constant	2.44***	2.51***
Lagged one year real GDP growth	0.21***	0.20**
Demeaned capital ratio		-0.04
Pseudo R^2	0.02	0.02
N. obs	243	243

Q95

	(1)	(2)
Constant	7.56***	7.66***
Lagged one year real GDP growth	-0.24	-0.27
Demeaned capital ratio		-0.95***
Pseudo R^2	0.02	0.07
N. obs	243	243

- Higher capital ratios \Rightarrow smaller left tail of GDP growth (more positive Q5) and smaller right tail of GDP growth (less positive Q95)

\Rightarrow Compressed distribution around the median

Trade-off lower risk of downturns with lower risk of exuberant growth



Predicting growth one-year-ahead

Q5		
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Magnitudes: 1 p.p. \uparrow in capital ratio

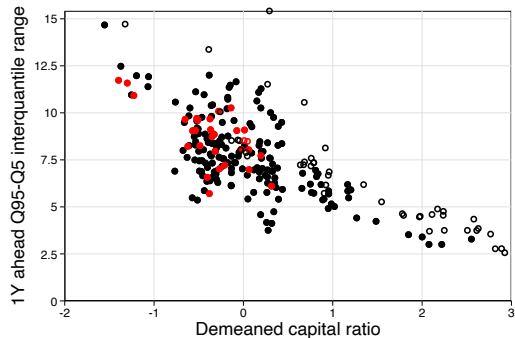
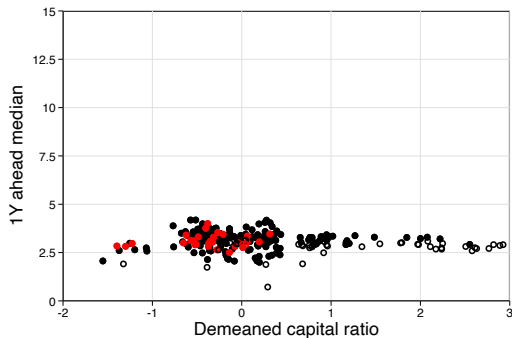
\Rightarrow 0.99 p.p. increase in Q5 of real GDP growth (rel. to -1.6% unconditional)

\Rightarrow 0.04 p.p. decrease in Q50 of real GDP growth (rel. to 3% unconditional)

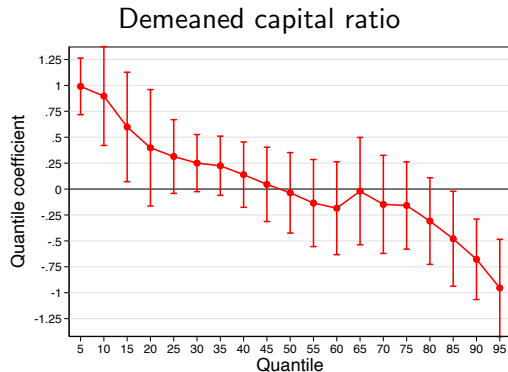
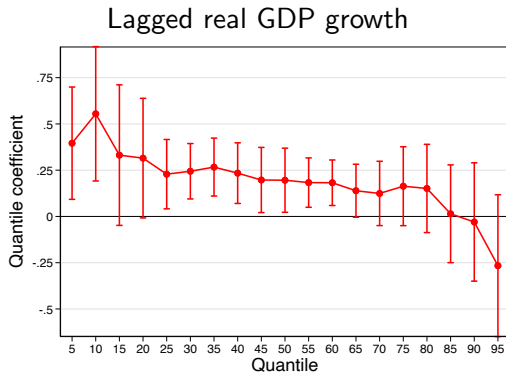
\Rightarrow 0.95 p.p. decrease in Q95 of real GDP growth (rel. to 6.7% unconditional)



Higher bank capital \Rightarrow narrower distribution of real GDP growth

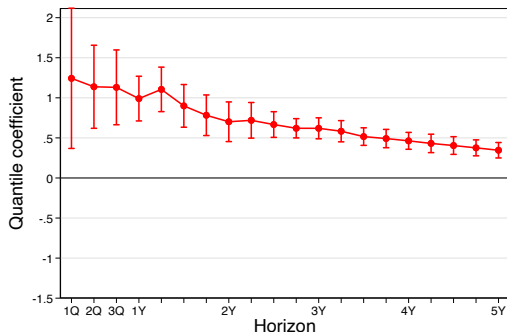


Higher bank capital \Rightarrow narrower distribution of real GDP growth

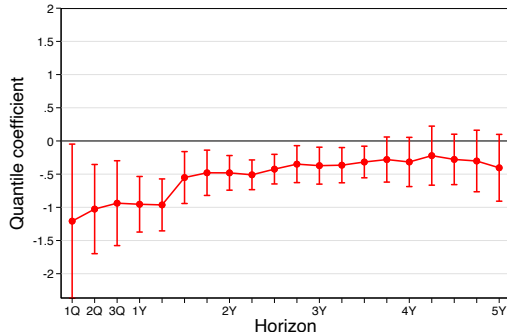


Persistent relationship between capital and downside risk

Q5



Q95



- Shorter-lived effect on upside risk
- **Magnitudes:** 1 p.p. \uparrow in capital ratio
 - \Rightarrow 0.35 p.p. increase in Q5 of real GDP growth (rel. to 0.9% unconditional)
 - \Rightarrow 0.14 p.p. decrease in Q50 of real GDP growth (rel. to 2.9% unconditional)
 - \Rightarrow 0.40 p.p. decrease in Q95 of real GDP growth (rel. to 5.1% unconditional)



Baseline results robust:

- Out-of-sample
- To alternative sample cut-offs [▶ Go](#)
- To alternative capital normalizations [▶ Go](#)
- To using time-consistent measure of capital growth
- To using alternative econometric methods [▶ Go](#)



Potential mechanisms



Recap

Recap: Higher capital ratios trim the tails of the distribution of future real GDP growth without changing the median

But micro banking literature: higher capital \Rightarrow lower loan provision on average



Recap

Recap: Higher capital ratios trim the tails of the distribution of future real GDP growth without changing the median

But micro banking literature: higher capital \Rightarrow lower loan provision on average

Potential channels:

1. Substitution from provision of credit by banks to non-banks \Rightarrow no effect on total quantity of credit
2. Banks reduce credit provision to less productive borrowers \Rightarrow less total credit but no effect on aggregate growth

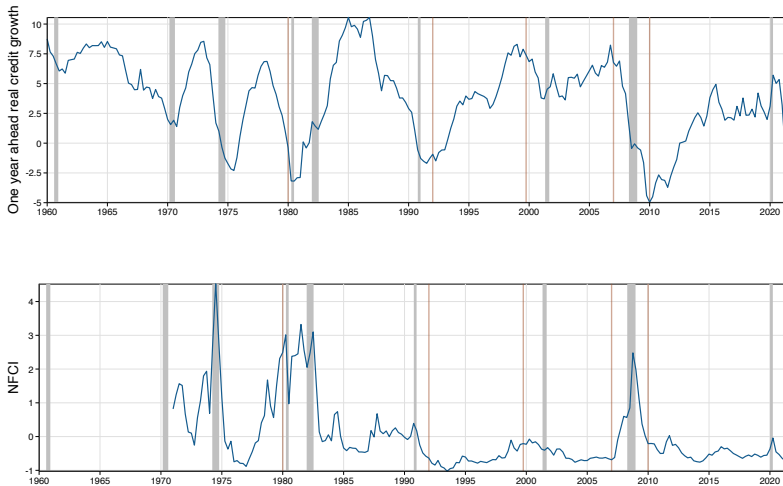


Approach

1. Does bank capital predict future credit growth? Future financial conditions?
 - “Bank capital reduces downside risk to growth by supporting future credit provision”
2. Does bank capital predict future real GDP growth over and above credit and financial conditions?
 - “Bank capital predicts downside risk to growth because it predicts downside risk to credit provision”
 - Credit growth: annualized growth rate of total credit in real terms borrowed by U.S. non-financial corporations and households
 - Financial conditions: NFCI (\uparrow NFCI \Rightarrow tighter financial conditions)



Real credit growth and financial conditions



Higher bank capital \Rightarrow lower downside risk to credit growth

	(1)	(2)	(3)
Constant	-3.60***	-3.65***	-2.99***
Lagged one year real GDP growth	0.31**	0.10	0.22*
Lagged one year real credit growth	0.35**	0.62***	0.57***
Demeaned capital ratio		1.18***	0.26
NFCI			-1.29*
Pseudo R^2	0.24	0.32	0.37
N. obs	199	199	199

- Reduced statistical significance at 1Y horizon once control for financial conditions



Higher bank capital \Rightarrow lower downside risk to credit growth

	1Q	1Y	3Y	5Y
Constant	-4.33***	-2.99***	-2.37***	-1.75***
Lagged one year real GDP growth	0.35	0.22*	0.00	0.17
Lagged one year real credit growth	0.51**	0.57***	0.38***	0.23***
NFCI	-1.43**	-1.29*	0.18	1.14***
Demeaned capital ratio	0.24	0.26	1.54***	1.48***
Pseudo R^2	0.32	0.37	0.31	0.29
N. obs	202	199	191	183

- But still significant at longer horizons



Higher bank capital \Rightarrow lower risk of financial conditions tightening

	(1)	(2)	(3)
Constant	0.82*	1.50***	1.48***
Lagged one year real GDP growth	0.16*	-0.00	-0.01
NFCI	1.64***	1.64***	1.66***
Demeaned capital ratio		-0.36***	-0.35*
Lagged one year real credit growth			0.01
Pseudo R^2	0.39	0.45	0.45
N. obs	199	199	199

- Statistically significance at 1Y horizon even after controlling for credit growth



Higher bank capital \Rightarrow lower risk of financial conditions tightening

	1Q	1Y	3Y	5Y
Constant	0.65***	1.48***	0.98***	2.53***
Lagged one year real GDP growth	0.02	-0.01	0.34***	0.13
Lagged one year real credit growth	-0.01	0.01	-0.00	-0.27***
NFCI	1.39***	1.66***	0.41	-0.27
Demeaned capital ratio	-0.17**	-0.35*	-0.72***	-1.16***
Pseudo R^2	0.69	0.45	0.28	0.28
N. obs	202	199	191	183

- And significant at longer horizons



Predictability of real GDP growth over and above credit, financial conditions

Q5

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-2.47***	-2.65***	-2.38***	-1.56	-2.57***	-2.03***
Lagged one year real GDP growth	0.42**	-0.16	0.49***	0.53*	-0.05	-0.08
Demeaned capital ratio	1.02***	1.83***	0.86***		1.60***	1.35***
Lagged one year real credit growth		0.56***		-0.07	0.52***	0.52**
Financial conditions			-0.72	-2.08**	-0.33	0.93*
Future one year real credit growth						-0.02
Future financial conditions						-1.23**
Pseudo R^2	0.17	0.29	0.22	0.14	0.29	0.35
N. obs	199	199	199	199	199	199

Q95

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	7.62***	6.22***	7.11***	6.26***	6.17***	5.50***
Lagged one year real GDP growth	-0.29	-0.43**	-0.22	-0.41*	-0.43*	-0.60***
Demeaned capital ratio	-0.89***	-0.46**	-0.64**		-0.47**	-0.36*
Lagged one year real credit growth		0.39***		0.39**	0.40**	-0.09
Financial conditions			0.36	0.21	-0.04	-0.68
Future one year real credit growth						0.58***
Future financial conditions						0.52
Pseudo R^2	0.07	0.17	0.08	0.15	0.17	0.35
N. obs	199	199	199	199	199	199

Higher capital ratio \Rightarrow narrower distribution of real GDP growth even after

- Controlling for real credit growth, financial conditions
- Controlling for **future** real credit growth, financial conditions



Predictability of real GDP growth across horizons

Q5

	1Q	1Y	3Y	5Y
Constant	-4.18***	-2.57***	0.24	1.07***
Lagged one year real GDP growth	0.25	-0.05	0.07	0.07
Demeaned capital ratio	1.40**	1.60***	0.59***	0.33***
Lagged one year real credit growth	0.44***	0.52***	-0.03	-0.02
Financial conditions	-1.48**	-0.33	-0.06	0.51***
Pseudo R^2	0.25	0.29	0.13	0.20
N. obs	202	199	191	183

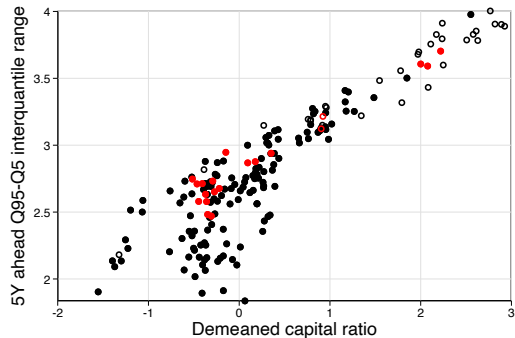
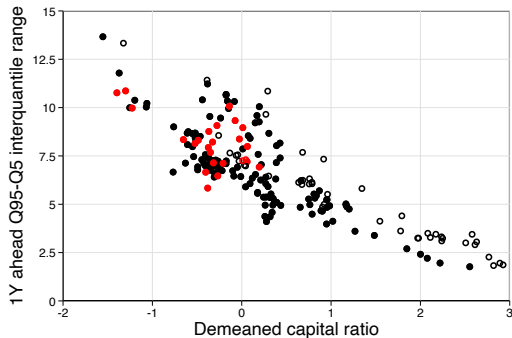
Q95

	1Q	1Y	3Y	5Y
Constant	7.94***	6.17***	5.16***	3.95***
Lagged one year real GDP growth	-0.37	-0.43*	-0.03	-0.02
Demeaned capital ratio	-0.44	-0.47**	0.16	0.75***
Lagged one year real credit growth	0.48	0.40**	-0.12***	0.00
Financial conditions	0.62	-0.04	0.16	0.30**
Pseudo R^2	0.06	0.17	0.13	0.09
N. obs	202	199	191	183

- Financial conditions predict downside risk in the short-run
- Real credit growth predicts downside risk in the short-to-medium run
- Bank capital ratios predict downside risk across horizons
- Potential intertemporal trade-off in upside risk: bank capital ratio loosening predicts greater upside to growth in the short run but smaller upside in the long run



Intertemporal trade-off in upside risk



Conclusion

- Activation of CCyB \Rightarrow higher capital ratio \Rightarrow smaller left tail of future real GDP growth



Conclusion

- Activation of CCyB \Rightarrow higher capital ratio \Rightarrow smaller left tail of future real GDP growth ✓
- Release of CCyB $\stackrel{?}{\Rightarrow}$ lower capital ratio



Conclusion

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Conclusion

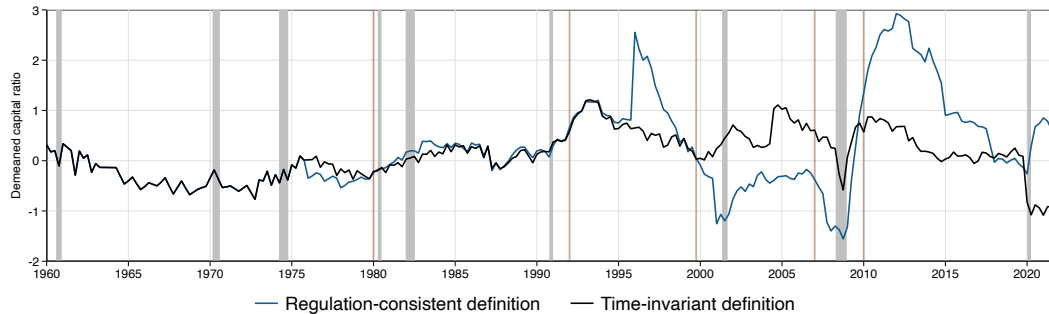
- Activation of CCyB \Rightarrow higher capital ratio \Rightarrow smaller left tail of future real GDP growth ✓
- Release of CCyB $\stackrel{?}{\Rightarrow}$ lower capital ratio \Rightarrow bigger right tail of future real GDP growth but no effect on median ✗
- More broadly:
 - Complex interactions between bank capital ratios and policies to support credit growth
 - Support for credit growth today may increase risks in the future if not supported by capital ratios



Reference Slides



Demeaned capital ratio



◀ Back



Robustness



Alternative sample cutoffs

Q5

	Full sample	Pre-COVID	Pre-crisis	Pre 1996
Constant	-2.31 (0.50)***	-2.21 (0.44)***	-1.99 (0.49)***	-1.97 (0.65)***
Lagged one year real GDP growth	0.40 (0.15)**	0.38 (0.15)**	0.41 (0.16)**	0.38 (0.19)*
Demeaned capital ratio	0.99 (0.14)***	0.97 (0.14)***	2.05 (0.28)***	2.32 (1.01)**
Pseudo R^2	0.16	0.19	0.22	0.10
N. obs	243	236	196	144

Q95

	Full sample	Pre-COVID	Pre-crisis	Pre 1996
Constant	7.66 (0.88)***	6.50 (0.70)***	7.62 (0.67)***	7.66 (0.72)***
Lagged one year real GDP growth	-0.27 (0.19)	-0.03 (0.16)	-0.23 (0.16)	-0.10 (0.17)
Demeaned capital ratio	-0.95 (0.24)***	-0.83 (0.22)***	-0.61 (0.80)	-0.46 (1.20)
Pseudo R^2	0.07	0.05	0.01	0.02
N. obs	243	236	196	144



Alternative capital normalization

Q5

	Baseline	10Y demeaned	Raw
Constant	-2.31 (0.49)***	-2.40 (0.49)***	-4.92 (2.28)**
Lagged one year real GDP growth	0.40 (0.16)**	0.47 (0.15)***	0.40 (0.17)**
Capital ratio	0.99 (0.14)***	0.86 (0.11)***	0.37 (0.34)
Pseudo R^2	0.16	0.17	0.06
N. obs	243	243	243

Q95

	Baseline	10Y demeaned	Raw
Constant	7.66 (0.92)***	7.50 (0.99)***	12.76 (1.44)***
Lagged one year real GDP growth	-0.27 (0.20)	-0.24 (0.21)	-0.30 (0.18)*
Capital ratio	-0.95 (0.25)***	-0.65 (0.15)***	-0.65 (0.18)***
Pseudo R^2	0.07	0.09	0.09
N. obs	243	243	243



Alternative econometric approach: threshold regressions

$$\mathbb{P}_t(\Delta GDP_{t,t+h} \leq \kappa) = \text{Logistic}(\Delta GDP_{t-4,t}, \text{Demeaned capital ratio}_t)$$

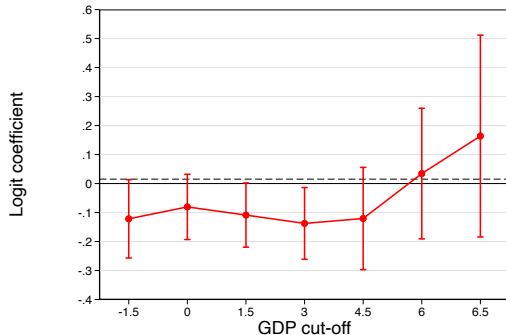
- Quantile regressions: trace out inverse CDF by varying quantile τ
- Threshold regressions: trace out CDF by varying cut-off κ



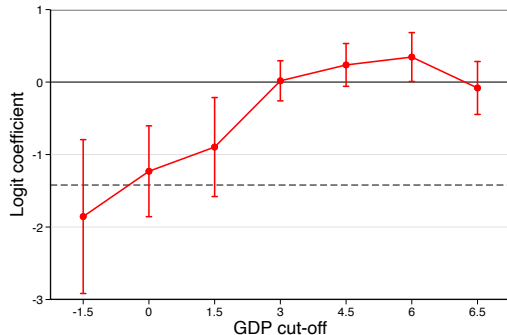
Alternative econometric approach: threshold regressions

$$\mathbb{P}_t(\Delta GDP_{t,t+h} \leq \kappa) = \text{Logistic}(\Delta GDP_{t-4,t}, \text{Demeaned capital ratio}_t)$$

Lagged GDP growth



Demeaned capital ratio



- Higher capital ratio \Rightarrow lower probability of lower realizations and extremely high realizations



Alternative: linear models

Recession probability

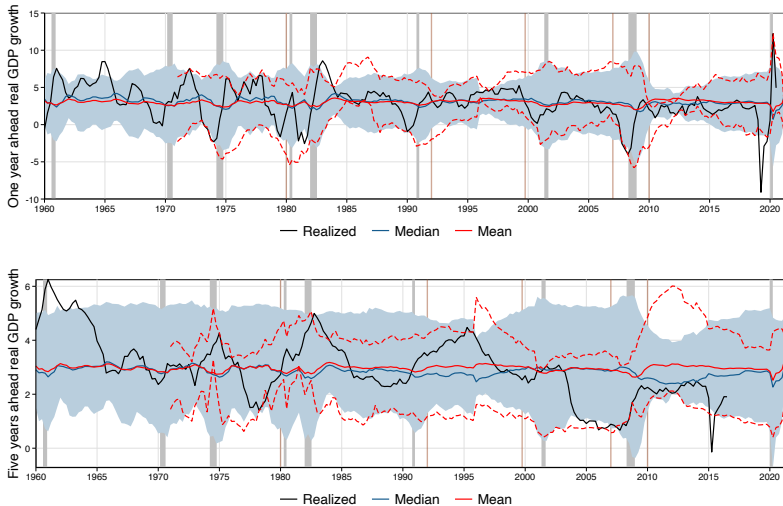
	(1)	(2)	(3)	(4)	(5)
Constant	-2.58***	-2.02***	-2.14***	-3.36***	-3.82***
L.Y1 real credit growth	-0.01			0.35***	0.40***
L.Y5-Y1 real credit growth	0.15**			-0.09	-0.05
L.Y1 average NFCI		0.72***		1.60***	1.78***
L.Y5-Y1 average NFCI		-0.90**		-1.67***	-1.72***
L.Demeaned capital ratio			-1.44***	-1.23***	-1.19***
AIC	179.96	146.66	162.45	130.70	117.95
Pseudo R^2	0.02	0.06	0.11	0.21	0.18
N. obs	242	197	242	197	154

Average growth

	(1)	(2)	(3)	(4)	(5)
Constant	2.79***	3.14***	2.83***	2.49***	3.62***
L.Y1 real credit growth	0.22***			0.18***	0.14**
L.Y5-Y1 real credit growth	-0.07			0.02	-0.07
L.Y1 average NFCI		-0.62**		-0.21	-0.54*
L.Y5-Y1 average NFCI		1.44***		1.23***	1.42***
L.Demeaned capital ratio			0.17	0.62**	1.36***
AIC	1117.42	895.33	1128.24	891.44	647.25
Adj. R^2	0.04	0.10	-0.00	0.13	0.28
N. obs	242	197	242	197	151

- Capital ratios better predictor of recessions than credit growth but does not help predict the mean
- Column (4): excluding post-2008 observations

Predicted distributions of real GDP growth



Red: model including credit, financial conditions