The Macroeconomic Effects of Bank Capital Regulation

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The Bank Capital Controversy

What are the macro effects of bank capital regulation?

- **regulators vs. industry**
  - BIS on Basel III: "*modest impact on growth (...) followed by a recovery of growth towards baseline*" (Mag, 2010)
  - banking industry: "*The economic impact of these reforms (...) will be significant.*"(Iif, 2011)
- **academics vs. academics**
  - Cochrane (2014): "*zero social costs of lots more equity*"
  - Calomiris (2013): "*banks will face permanently higher funding costs, which in turn will permanently reduce the supply of lending*"

With this paper we try to inform this debate.

The Bank Capital Controversy – Origins (1/2)

Theory is ambiguous:

- More bank capital will reduce lending and growth.
  - capital is costly: asym. information, limited market participation, liquidity provision (Allen et al., 2015 JFE; DeAngelo/Stulz, 2015 JFE; Myers/Majluf, 1984 JFE)
  - GE models: exogenous cost of issuing capital $\rightarrow$ higher requirements reduce lending and output (see e.g., Elenev et al., 2018 NBERWP).
- Higher bank capital will not reduce lending and growth.
  - lower risk decreases funding cost (Admati et al., 2013).
  - "forced safety effect" (Bahaj/Malherbe, 2018 BdFWP)
  - drop in safe/liquid bank debt decreases cost of debt (Begenau, 2019 JFE)

The Bank Capital Controversy – Origins (2/2)

Empirical evidence largely from microeconometric studies.

- partial-equilibrium perspective using bank/loan-level data
- large negative effects of higher capital requirements (Jimenez et al., 2017 JPE)
- high level of econometric credibility

→ not suitable to draw conclusions about the aggregate effects of higher requirements

Our paper is the first to empirically assess the dynamic macro effects of higher aggregate capital requirements.

Our Capital Requirement Indicator (CRI)

- narrative index of US aggregate regulatory capital-requirement changes (all tightenings)
- based on administrative & academic publications, verified by newspaper-based search (Dow Jones Factiva database)
- Cri: we find 6 (8) events in sample from 1979M8-2008M8 (or 2016M12)

Date	Event
Dec. 17, 1981	Regulators set numerical guidelines for Cr
Nov. 30, 1983	International Lending and Supervision Act (Ilsa) passed
Apr. 18, 1985	Common Cr guidelines by regulators for all banks
Dec. 31, 1990	Basel I effective
Dec. 19, 1991	Fdic Improvement Act passed
Dec. 19, 1992	Prompt Corrective Action effective
Jan. 1, 2013	Basel II.5 effective
Jan. 1, 2014	Basel III effective

Notes: Black: events in the baseline Cri. Gray: events included in the robustness analysis.

Events Not Cyclically Motivated (1/2) – Stated Motivation and Institutional Setup

Examples of motives for tighter capital requirements:

- 1981 Event: *"Objectives of the capital adequacy guidelines program are to [...] introduce greater uniformity, objectivity, and consistency ..."*
- 1985 Event: *"Several factors have ... emerged ... accentuating the potential demands on bank capital. The deregulation of interest rates ... competition for financial services ... growing interdependency within the system..."*
- 1990 Event: *"... capital guidelines have a twofold purpose: To make capital requirements more sensitive to differences in risk profiles ... making the definition of bank capital uniform internationally"*
- 2014 Event: *"The final rule addresses several weaknesses which became evident during the financial crisis by helping to ensure a banking and financial system that will be better able to absorb losses and continue to lend in future periods of economic stress."*

Tightening in capital requirements are

- motivated by long-term and structural motives
- permanent in nature and
- the result of slow moving regulatory reforms.

Hence, events are unrelated to the (current) cycle.

Events Not Cyclically Motivated (2/2) – cloglog Regressions

- complementary log-log regressions (same results for simple probit)
- changes in capital requirements on macro and financial variables

Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank capital ratio$_{t-12}$	-0.49						-0.43
	(0.34)						(1.03)
Δ_{t-12}log(Industrial production)		-0.20					-0.11
		(0.27)					(0.72)
Δ_{t-12}log(PCE deflator)			0.11				-0.32
			(0.46)				(2.15)
FFR$_{t-12}$				0.08			0.07
				(0.04)			(0.15)
Δ_{t-12}log(Bank loans)					-0.06		-0.18
					(0.35)		(0.77)
BAA spread$_{t-12}$						0.30	-0.06
						(0.30)	(1.46)

- Capital requirement events are not predictable by current business and financial cycle variables.

Local Projections Model

- local projection regressions without anticipation effects

$$\tilde{y}_{t+h} = c^h + \beta^h(L)\tilde{x}_t + \gamma^h(L)\boldsymbol{CRI_t} + u_{t+h}$$

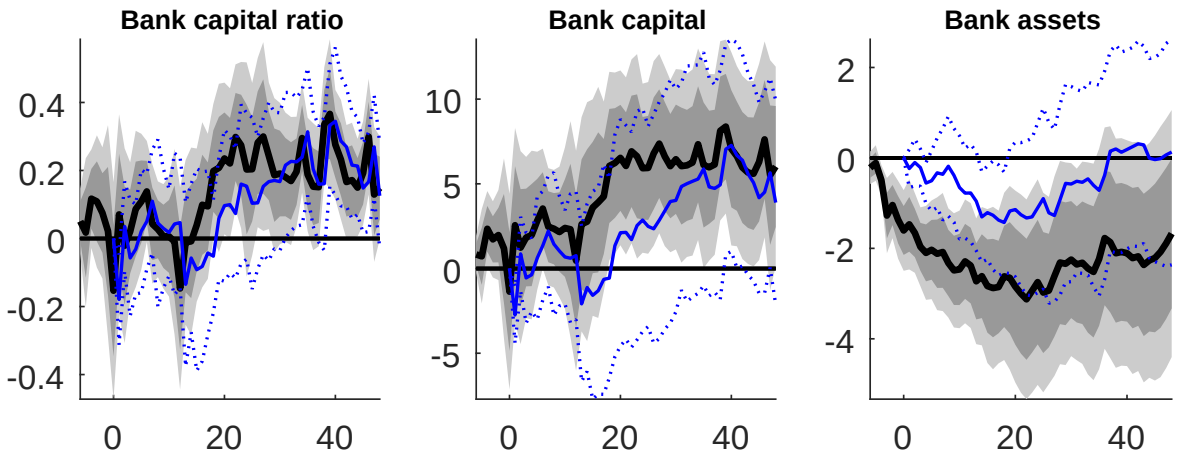
  and with anticipation effects

$$\tilde{y}_{t+h} = c^h + \beta^h(L)\tilde{x}_t + \gamma^h(L)\boldsymbol{CRI_{t+6}} + u_{t+h}$$

  where $\tilde{y}_{t+h} = y_{t+h} - y_t$ and $\tilde{x}_t^i = x_t^i - x_{t-1}^i$ for non-stationary variables and $\tilde{y}_{t+h} = y_{t+h}$ and $\tilde{x}_t = x_t^i$ for stationary variables, see e.g. (Fieldhouse/Mertens/Ravn, 2018 QJE)
- 2 lags of CRI and controls x_t, plus a constant, linear and quadratic trend
- x_t always include industrial production, PCE deflator, bank loan volumes, Federal Funds rate, BAA spread, and left-hand side variables
- $\{\gamma_1^h\}_1^H$ are the impulse response of y_{t+h} to a "typical" bank capital requirement tightening

Banks' Reaction to a CRI Tightening

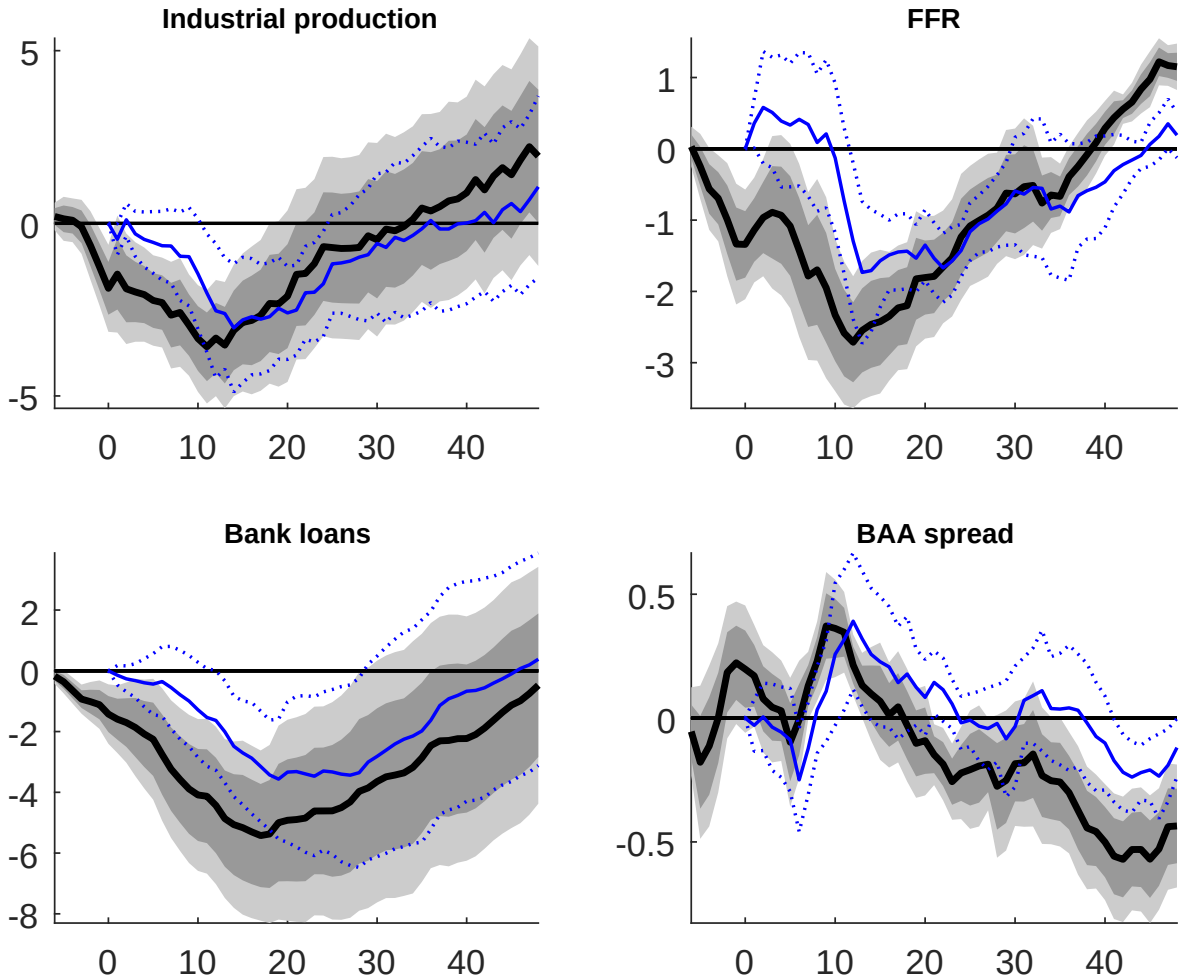
- with anticipation effects (black) and without (blue); banks adjust by first reducing their assets and only later increasing capital
- CRI also gives highly relevant instrument for bank capital ratio (in an alternative IV local projections setup)



Notes: Bank capital ratio in pps, capital and assets in %. Point estimates with 6 months of anticipation (black), plus 68% and 90% confidence bands (dark and light shaded areas), or no anticipation (blue, with 90% confidence bands).

Macro Reactions to a Cri Tightening

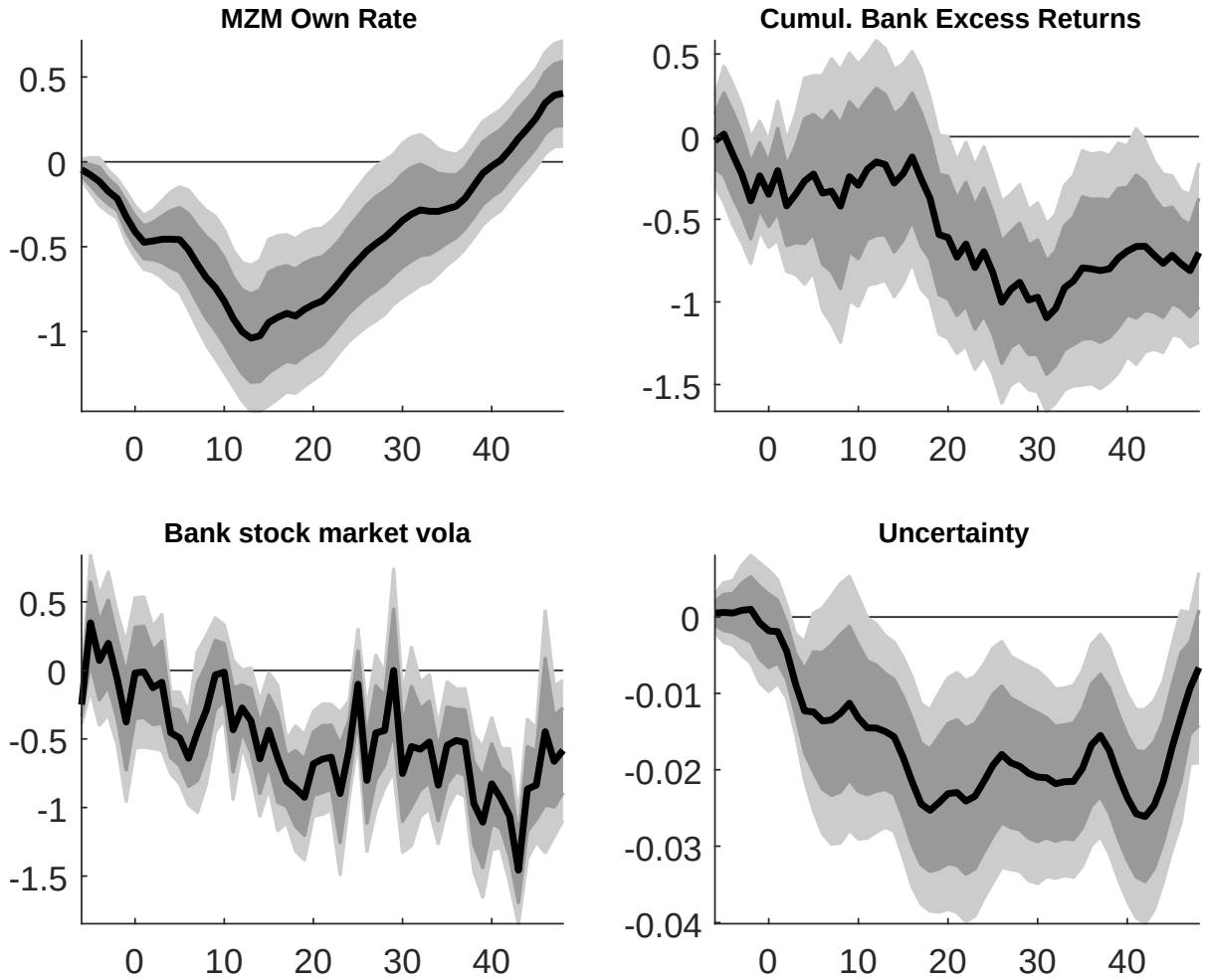
- transitory decline in lending and production, stabilizing monetary policy reaction



Notes: Ffr and Baa spread in pps, production and loans in %. Point estimates with 6 months of anticipation (black), plus 68% and 90% confidence bands (dark and light shaded areas), or no anticipation (blue, with 90% confidence bands).

Transmission to Banks' Funding Costs

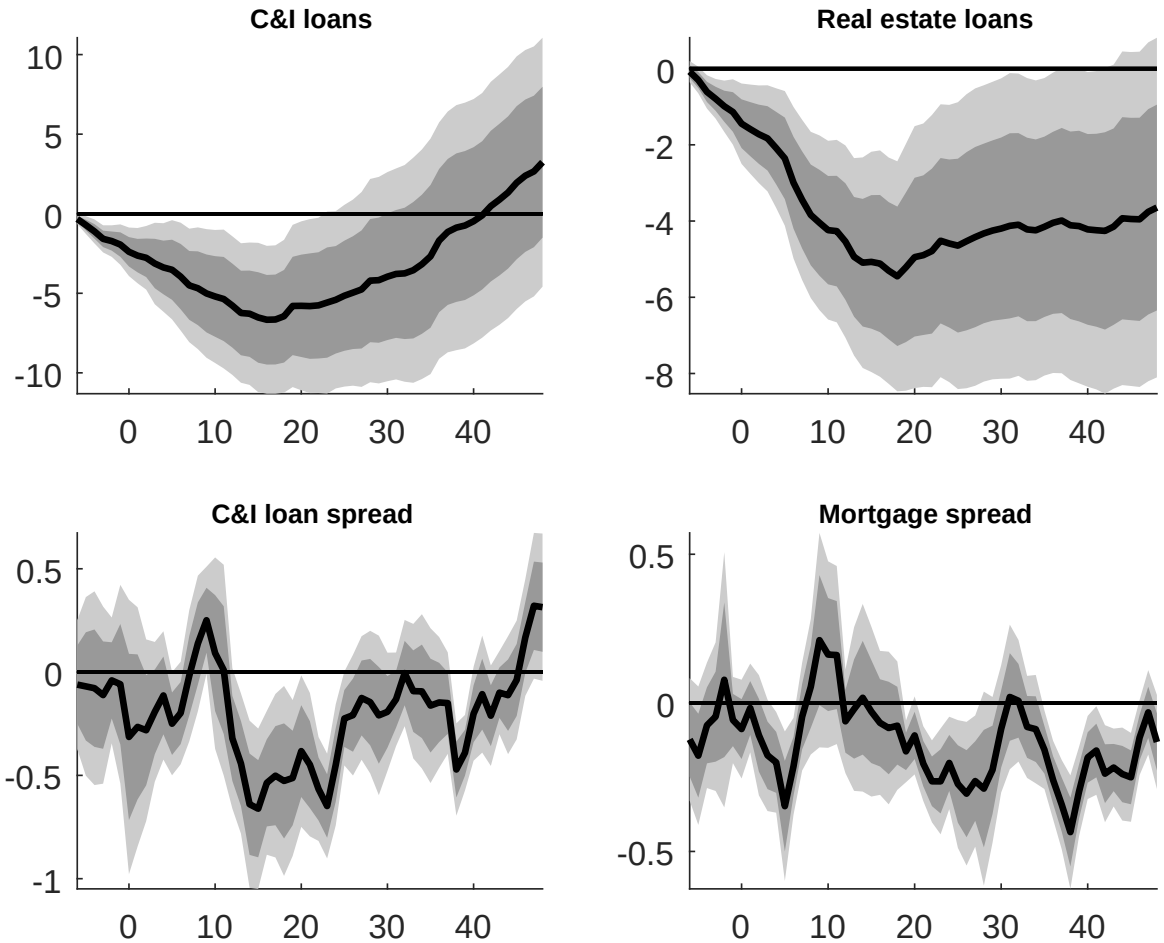
- reduced refinancing costs, risk and uncertainty after CRI tightening



Notes: Excess returns and stock volatility in %, spread in pps. Point estimates, 68% and 90% confidence bands.

Transmission to Loans and Spreads

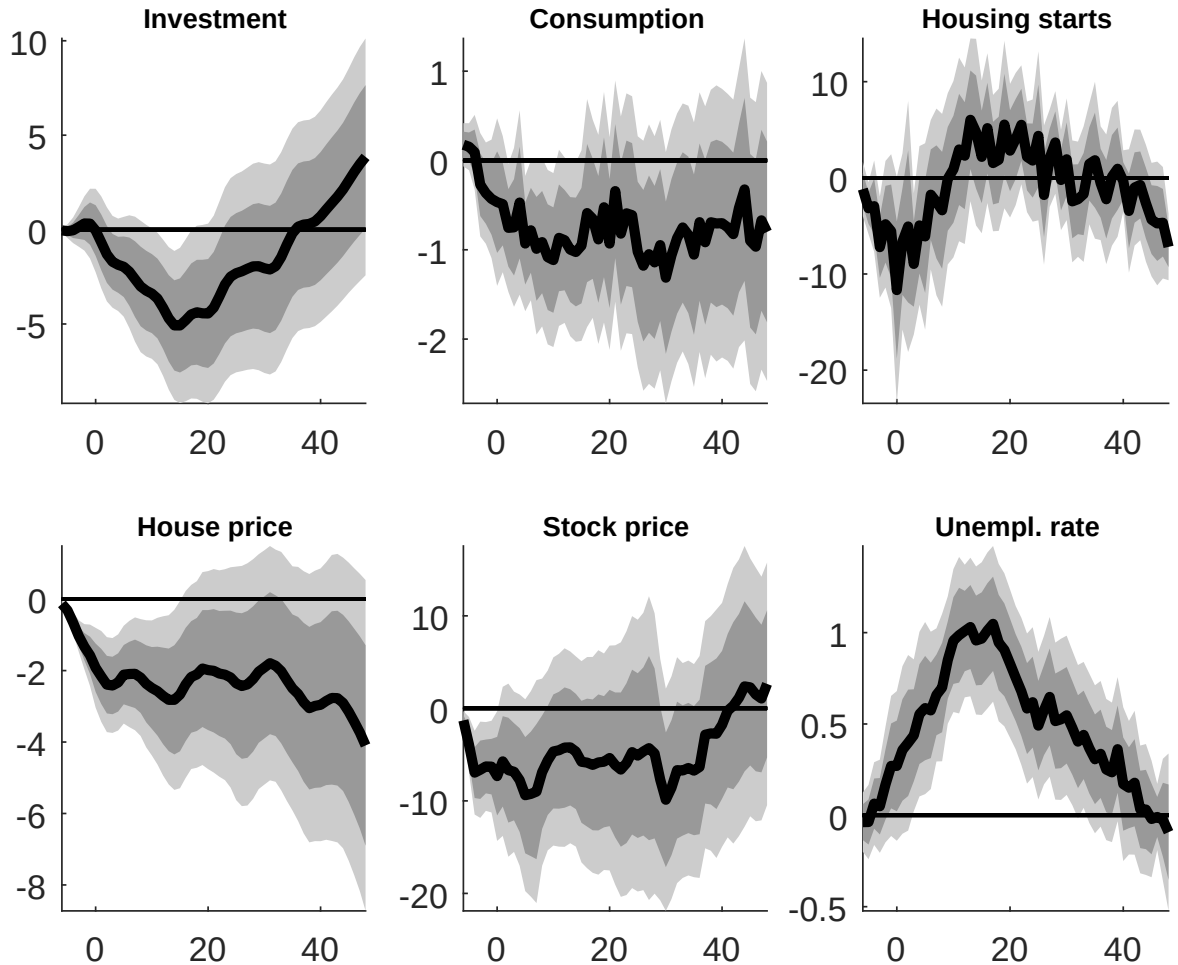
- negative loan supply effects in Commercial&Industrial loans and mortgages



Notes: Loans in %, spreads in pps. 68% and 90% confidence bands.

Transmission to Firms and Households

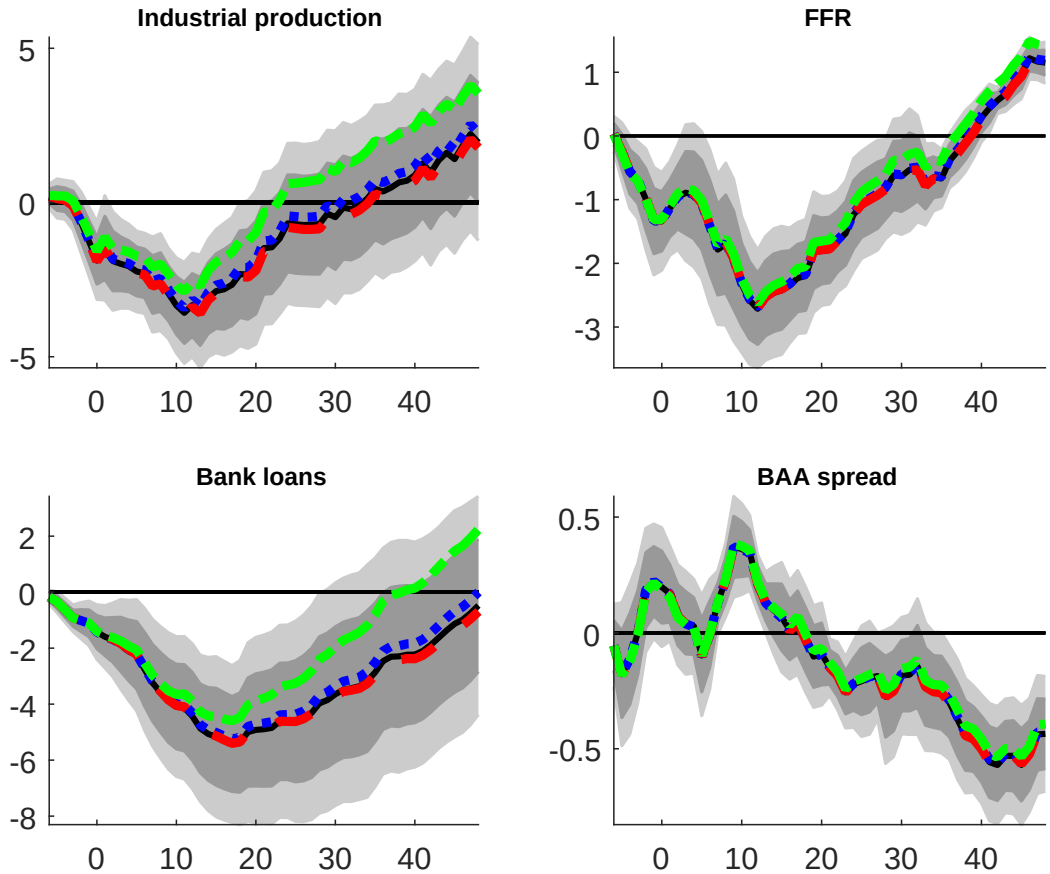
- decline in investment and consumption, drop in housing activity



Notes: Unempl. rate in pps, others in %. Point estimates, 68% and 90% confidence bands.

Robustness: Info. Sufficiency of Controls (1/2)

- add other candidates for controls: credit-to-GDP gap, S&L crisis dummy, # bank failures

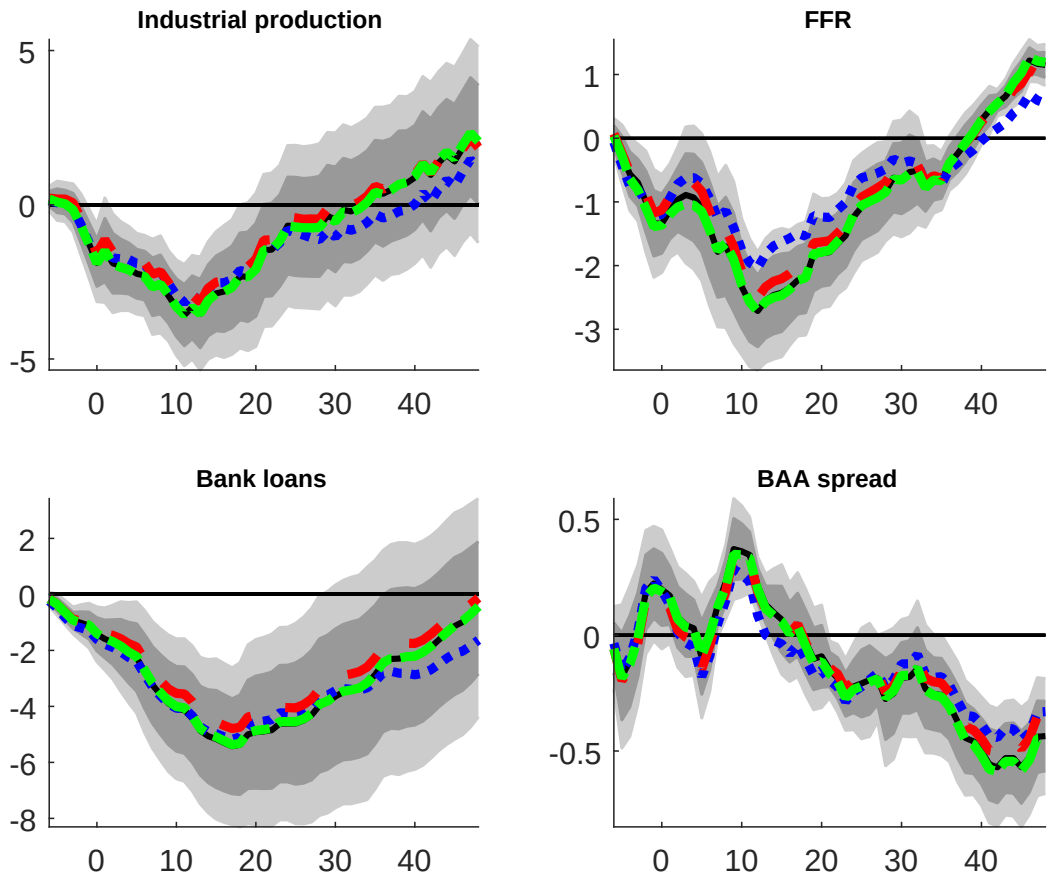


Notes: Black: baseline model (with confidence bands). Blue dotted: add credit-to-GDP gap. Red dashed: add S&L crisis dummy. Green dash-dots: add number of bank failures.

- virtually no difference in responses, so initial set of control seems sufficient

Robustness: Info. Sufficiency of Controls (2/2)

- add yet other controls: Ted spread, Excess Bond Premium, Sloos lending standards



Notes: Black: baseline model (with confidence bands). Blue dotted: add Ted spread. Red dashed: add Excess Bond Premium (Gilchrist/Zakrajšek, 2012 Aer). Green dash-dots: add lending standards from Senior Loan Officer Opinion Survey.

Other Robustness Checks

- additional controls: oil price, Nber recessions, Romer Romer (2004) monetary policy shocks, Fernald utilization-adjusted Tfp growth, Romer Romer (2010) tax changes, Ramey (2011) military spending news
- Cri:
  - anticipation horizon of 4, 8 or 10 months,
  - remove events one by one,
  - add 1983 and 1997 events,
  - cumulate Cri,
  - narrative weighting of events
- vary lag length of controls and Cri
- vary sample (1983-2008; 1979-2016; 1979-2016 w/ Basel II.5 and Basel III)

Additional Analyses

- counterfactual with no monetary-policy easing after the events: stronger and more persistent crisis
- comparison to Gilchrist/Zakrajšek (2012 AER) Excess Bond Premium shock: significantly different, intuitive distinctions
- in a companion paper, we look at the effects on inequality (which generally declines), see Eickmeier, Kolb and Prieto (2018, BbkDP 54)

Conclusion

How large and long-lasting are effects of changes in bank capital requirements?

- We propose a narrative identification strategy to analyze the macro effect of bank capital requirement tightenings in the US.
- Regulatory changes in capital requirements are not taken to offset cyclical factors affecting the economy.
- A regulatory tightening causes **permanent** increases in the bank capital ratio and a **significant but temporary** reduction in lending and economic activity.
- Negative effects are cushioned by positive medium-term effects on uncertainty and volatility and considerable monetary policy stabilization.

Back-up slides

Literature (1/2)

Allen, F., Carletti, E., and Marquez, R. (2015). Deposits and bank capital structure. Journal of Financial Economics, 118(3):601–619.
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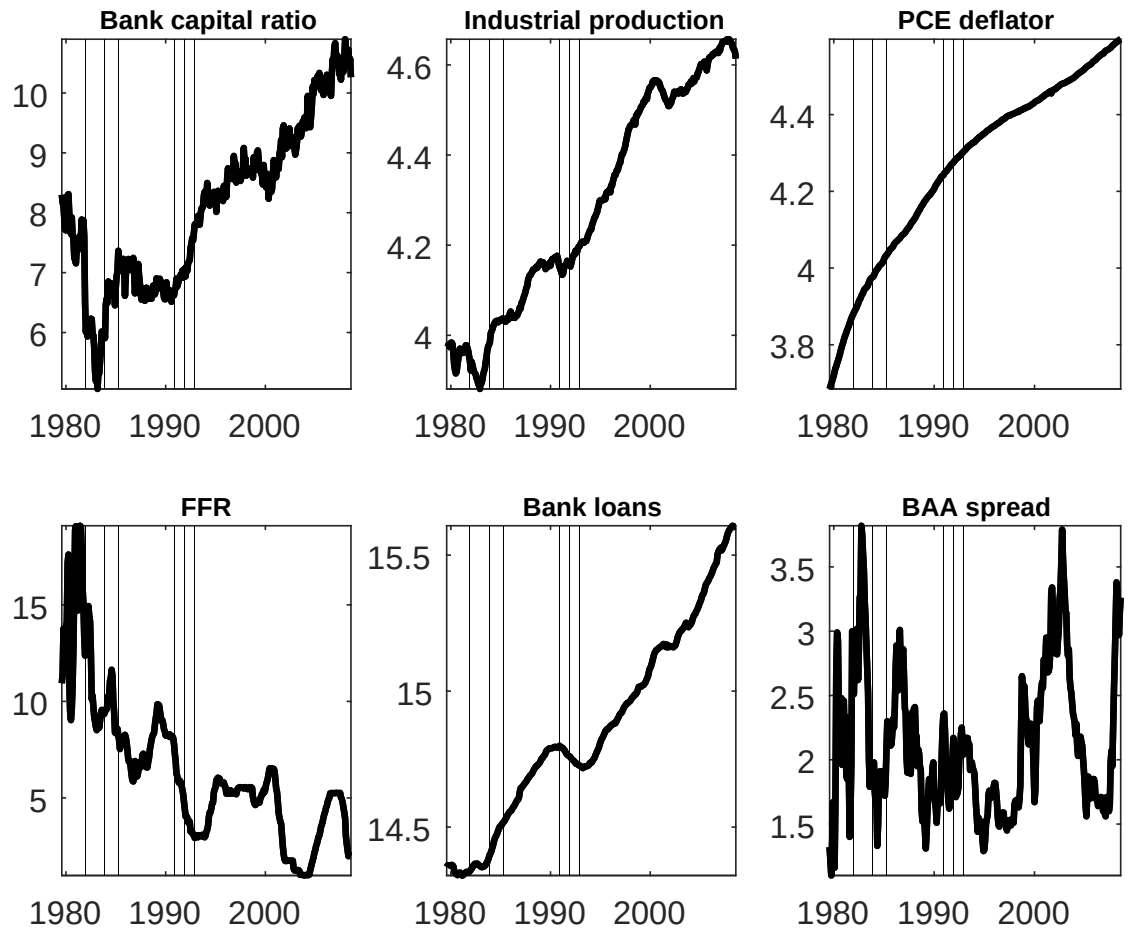
Literature (2/2)

Gilchrist, S. and Zakrajšek, E. (2012). Credit spreads and business cycle fluctuations. American Economic Review, 102(4):1692–1720.
Jiménez, G., Ongena, S., Peydró, J.-L., and Saurina, J. (2017). Macroprudential Policy, Countercyclical Bank Capital Buffers, and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments. Journal of Political Economy, 125(6):2126–2177.
Jordà, O. (2005). Estimation and inference of impulse responses by local projections. American Economic Review, 95(1):161–182.
Myers, S. C. and Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. Journal of Financial Economics, 13(2):187–221.
Ramey, V. A. (2011). Identifying Government Spending Shocks: It's all in the Timing. The Quarterly Journal of Economics, 126(1):1–50.
Romer, C. D. and Romer, D. H. (2004). A New Measure of Monetary Shocks: Derivation and Implications. American Economic Review, 94(4):1055–1084.
Romer, C. D. and Romer, D. H. (2010). The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks. American Economic Review, 100(3):763–801.

Key variables and events



Notes: Industrial production, PCE deflator and bank loans in logs, other variables in percent. Vertical bars represent our Cri events.

Events NOT in Our Indicator

- **Basel II, 2008**: literature is ambiguous as to whether Basel II was binding for US banks' capital ratios (Gehrig/Iannino, CEPR WP 2017; Cerruti/Correa/Fiorentino/Segalla, IJCB 2017)
- **Capital easings for agricultural banks, 1986**: clearly cyclically motivated; only for subset of banks; temporary

Capital requirements non cyclically motivated

More examples of motivation for changes in regulatory capital requirements:

- 1985 Event: "Several factors have (...) emerged (...) accentuating the potential demands on bank capital. The deregulation of interest rates, (...) competition for financial services (...) growing interdependency within the system (...)"
- 1990 Event: "(...) capital guidelines have a twofold purpose: To make capital requirements more sensitive to differences in risk profiles (...) making the definition of bank capital uniform internationally"
- 2014 Event: "The final rule addresses several weaknesses which became evident during the financial crisis by helping to ensure a banking and financial system that will be better able to absorb losses and continue to lend in future periods of economic stress."

$\Rightarrow$ Tightening in capital requirements were motivated by long-term and structural motives.

Probit regressions

Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank capital ratio$_{t-1}$	-0.33						-0.48
	(0.30)						(0.53)
Δ_{t-1}log(Industrial production)		-0.43					-0.60
		(0.27)					(0.63)
Δ_{t-1}log(PCE deflator)			0.22				0.37
			(1.62)				(2.46)
FFR$_{t-1}$				0.04			-0.08
				(0.05)			(0.30)
Δ_{t-1}log(Bank loans)					-0.15		0.08
					(0.35)		(1.42)
BAA spread$_{t-1}$						0.08	-0.20
						(0.43)	(1.55)

Notes: Dependent variable is CRI$_t$. A constant enters the regression, as well as month-on-month differences in %. Robust standard errors in parentheses. ** $p < 0.01$, * $p < 0.05$.

- similar results for 12 and 24 lags of m-o-m diffs and 1 and 12 lags of y-o-y diffs

One Example Event (Dec. 1981)

- In 1981, regulators for the first time introduced numerical capital adequacy guidelines (between 5 and 6% of primary capital to assets).
- **Motivation**: "*Objectives of the capital adequacy guidelines program are to*
  - *address the long-term decline in capital ratios (...);*
  - *introduce greater uniformity, objectivity, and consistency into the supervisory approach for assessing capital adequacy;*
  - *provide direction for capital and strategic planning to banks (...);*
  - *and permit some reduction of existing disparities in capital ratios between banking organizations of different size.*"
    (Federal Reserve Bulletin 68(1), Jan. 1982, p. 33)
- **Relevance**: Keeley (1988) and Wall and Peterson (1987, 1988) find that the newly introduced capital ratios were largely binding for banks.

Data Sources and Treatment (1/3)

Variable	Details	Type	Source
Baseline model variables			
Industrial production	Index 2012=100	d	FRED
Total bank loans, real	Sum of real estate, C&I, consumer bank loans	d, n	Fed H8
Core PCE deflator	PCE excluding food and energy (chain-type price index 2009=100)	d	FRED
Federal funds rate		l	FRED
Baa spread	Moody's seasoned Baa corporate bond yield - 10y Treasury constant maturity rate	l	FRED
Bank variables & spreads			
Bank capital ratio	(Bank assets - bank liabilities)/bank assets	l	Fed H8
Bank assets, real		d, n	Fed H8
Bank capital, real	Bank assets-bank liabilities	d, n	Fed H8
C&I loans, real		d, n	Fed H8
Consumer loans, real		d, n	Fed H8
Real estate loans, real		d, n	Fed H8
Commercial paper spread	3m nonfinancial commercial paper rate - 3m Tbill rate	l	FRED
C&I loan spread	Bank prime rate - 2y Tbill rate	l	FRED
Personal loan spread	Finance rate on personal loans at comm. banks, 24m loan - 2y Tbill rate	l	FRED
Mortgage spread	30y fixed rate mortgage average in the US - 10y Treasury constant maturity rate	l	FRED

Notes: We take logarithms for all series but rates or ratios. "Type" specifies the data transformation: Most series are in differences (d), some are in levels (l). Whenever the original frequency is quarterly (q), the series has been converted to monthly using the cubic spline (last) method. Series are converted from nominal (n) to real by dividing them with the core PCE deflator.

Data Sources and Treatment (2/3)

Variable	Details	Type	Source
Investm., Consumpt., Assets			
Non-residential private fixed investment, real		d, q	BEA NIPA
Commercial paper, real	Nonfinancial corporate business sector	d, n, q	Financial Accounts
Corporate bonds, real	Nonfinancial corporate business sector	d, n, q	Financial Accounts
Personal consumption expenditure (PCE), real		d, n	FRED
Housing starts	New privately owned housing units started	l	FRED
House price, real	All transactions house price index for the US, 1980:Q1=100	d, n, q	FRED, FHFA
S&P 500, real		d, n	Robert Shiller's webpage
Unemployment rate	Civilian Unemployment Rate, seasonally adj.	l	FRED
GDP, real	billions of chained 2009 Dollars	d, q	BEA NIPA
New car loan rate spread	Finance rate on consumer installment loans at commercial banks, new autos 48m loan - 3y Tbill rate	l	FRED

Notes: We take logarithms for all series but rates or ratios. "Type" specifies the data transformation: Most series are in differences (d), some are in levels (l). Whenever the original frequency is quarterly (q), the series has been converted to monthly using the cubic spline (last) method. Series are converted from nominal (n) to real by dividing them with the core PCE deflator.

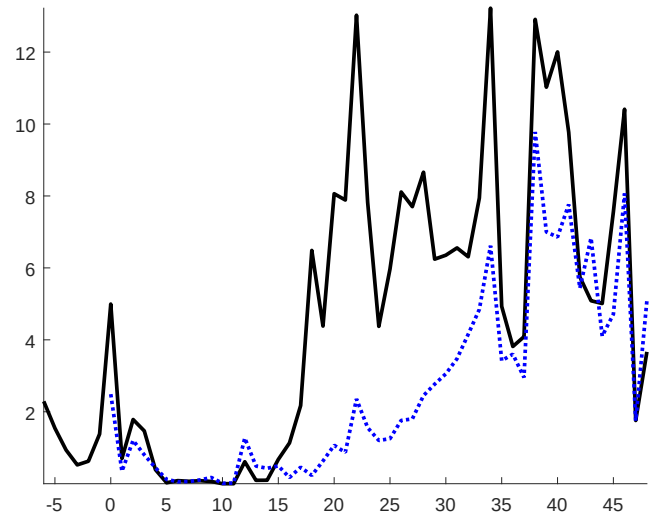
Data Sources and Treatment (3/3)

Variable	Details	Type	Source
Other variables			
Shadow short rate	Leo Krippner's SSR measure	l	RBNZ webpage
Excess Bond Premium (EBP)	see ?	d	Simon Gilchrist's webpage
TED spread	3m Eurodollar Deposit Rate - 3m Tbill rate	l	Mark Watson's webpage
Romer Romer mon. pol. shock	see ?,	d	Yuri Gorodnichenko's
	?	d	webpage
Fernald TFP series	see ?	l, q	FRBSF webpage
WTI oil price	Spot crude oil price: West Texas Intermediate (WTI), dollars per barrel	d, n	FRED
Romer Romer tax shock	see ?	l, q	AER webpage
Ramey military news fiscal shock	see ?	l, q	Valery Ramey's webpage
US recession dates	binary series indicating months in recession	l	NBER

Notes: We take logarithms for all series but rates or ratios. "Type" specifies the data transformation: Most series are in differences (d), some are in levels (l). Whenever the original frequency is quarterly (q), the series has been converted to monthly using the cubic spline (last) method. Series are converted from nominal (n) to real by dividing them with the core PCE deflator.

Relevance for IV-Local Projections

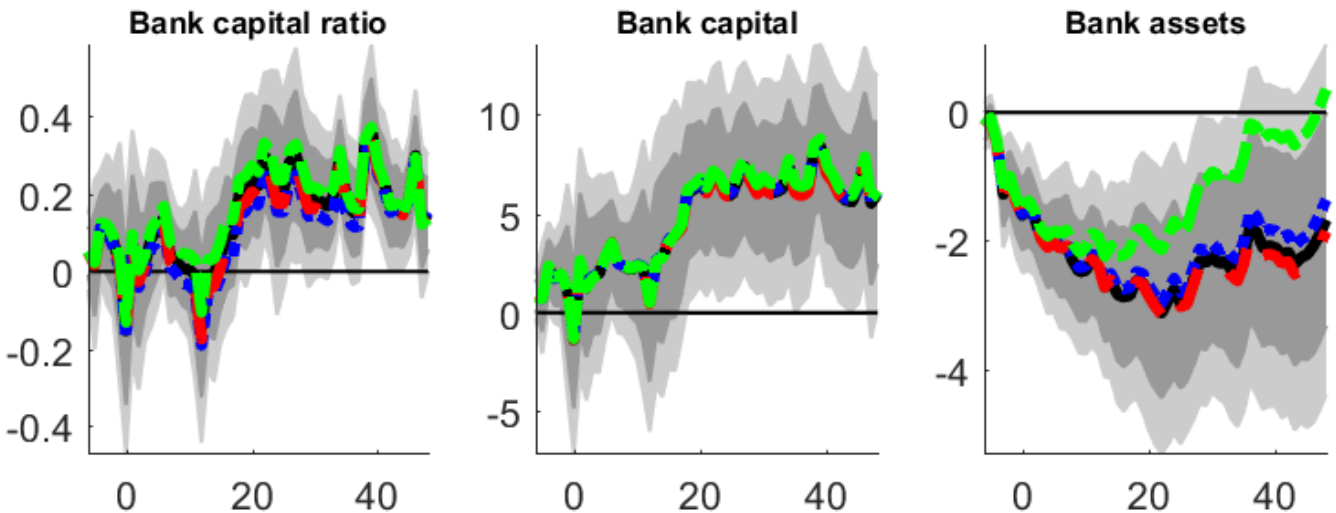
- **Relevance**:



  - IV-LP
  - first stage regression: future bank capital ratio
  - but: no regulatory bank capital available

Robustness: Informational Sufficiency of our Controls, bank variables (1/2)

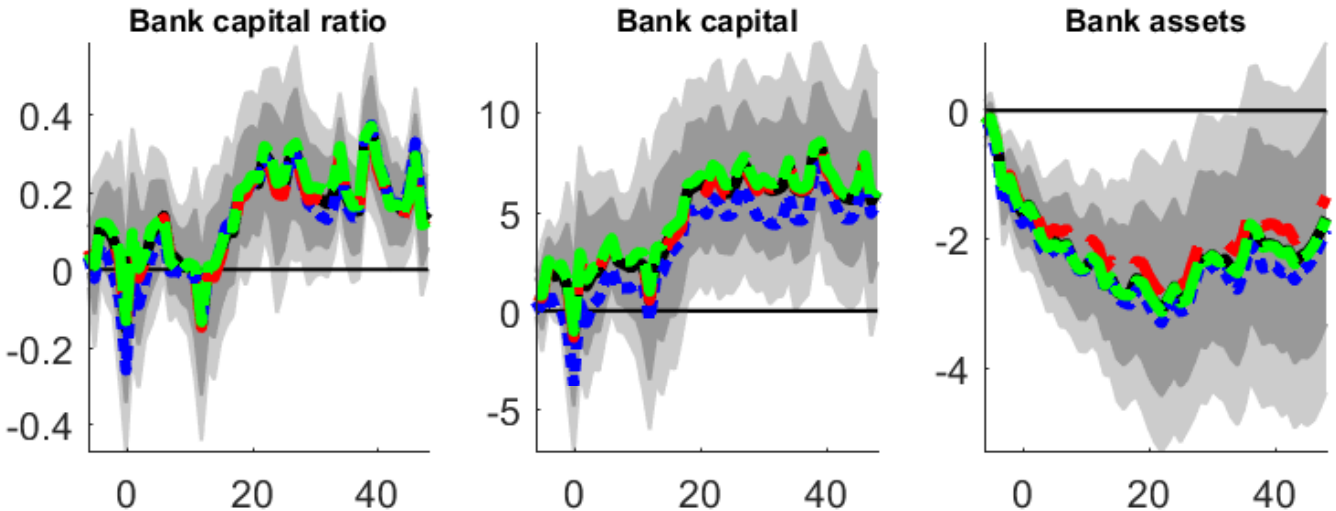
- slow-moving additional controls (credit-to-GDP gap, S&L crisis dummy, number of bank failures) on bank variables



Notes: Black solid line: baseline model (with confidence bands). Blue dotted: add credit-to-GDP gap. Red dashed: add S&L crisis dummy. Green dash-dots: add number of bank failures.

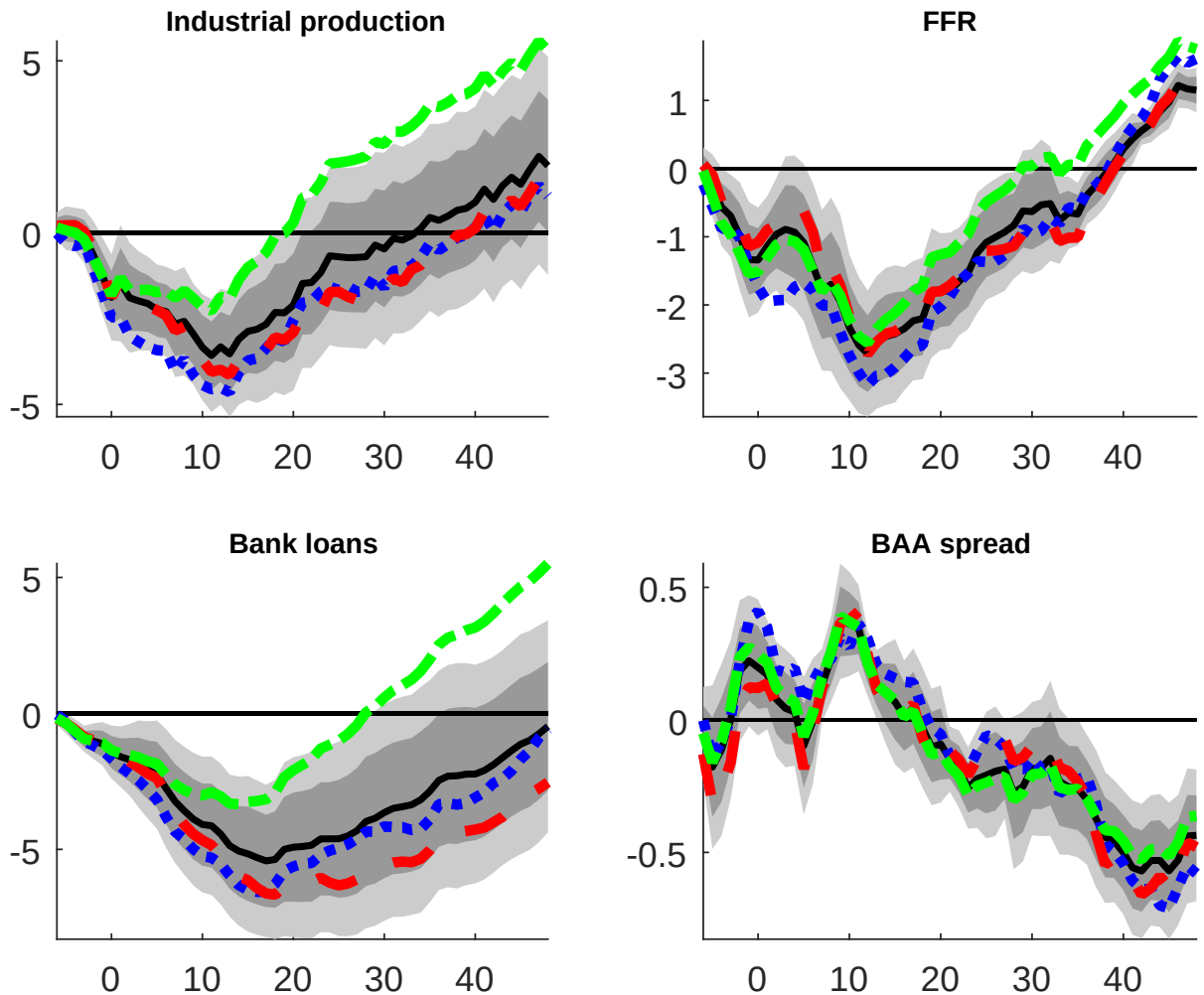
Robustness: Informational Sufficiency of our Controls, bank variables (2/2)

- fast-moving additional controls (Ted spread, Excess Bond Premium, SLOOS lending standards) on bank variables



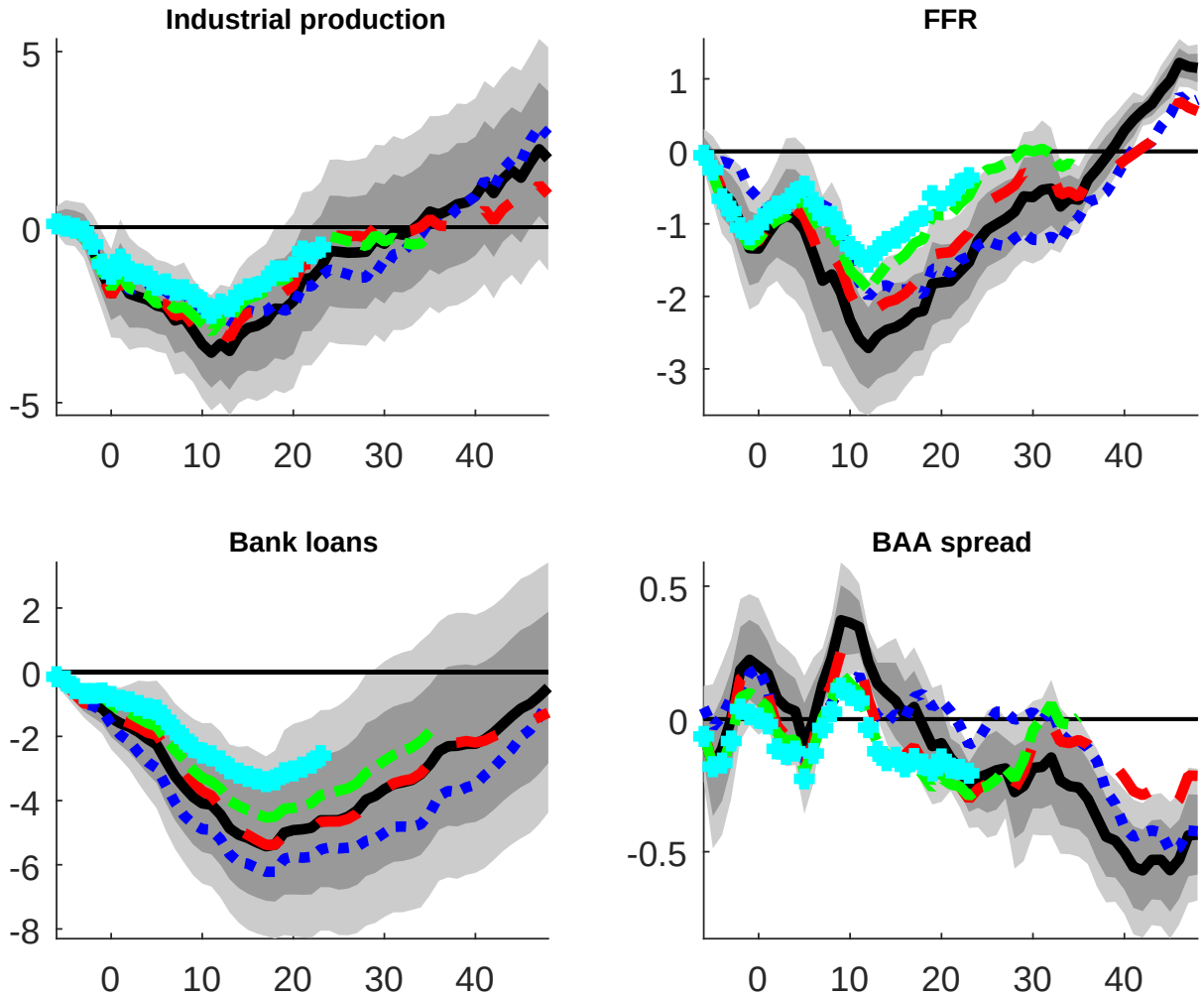
Notes: Black solid line: baseline model (with confidence bands). Blue dotted: add Ted spread. Red dashed: add Excess Bond Premium (Gilchrist/Zakrajšek, 2012). Green dash-dots: add lending standards from Senior Loan Officer Opinion Survey ("net percentange of domestic banks reporting increased willingess to make cunsumer installment loans").

Robustness: lags and cumulating Cri



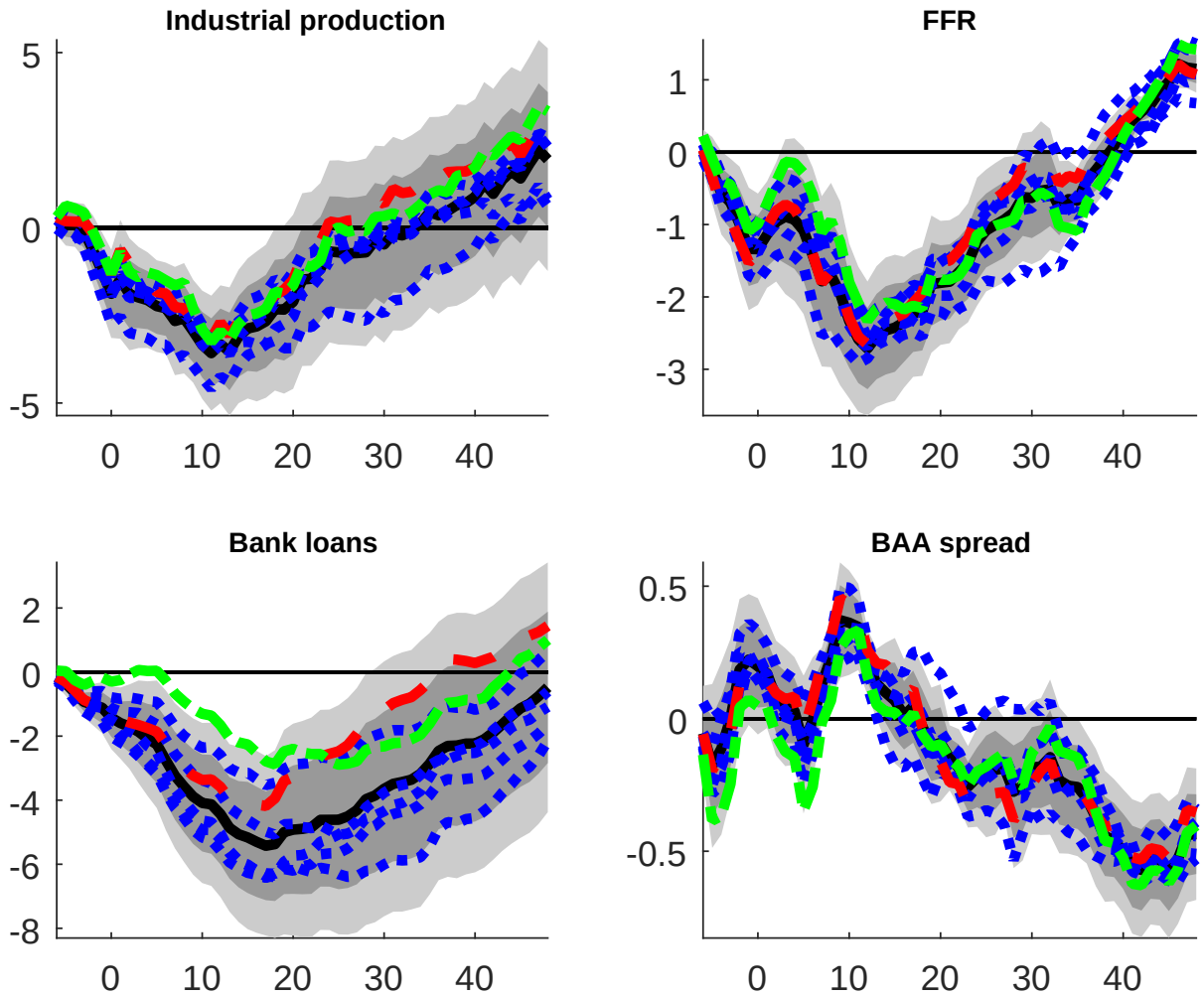
Notes: Black solid line: baseline model (with confidence bands). Blue dotted: 12 lags of controls. Red dashed: 12 lags of Cri. Green dash-dots: cumulated Cri

Robustness: sample



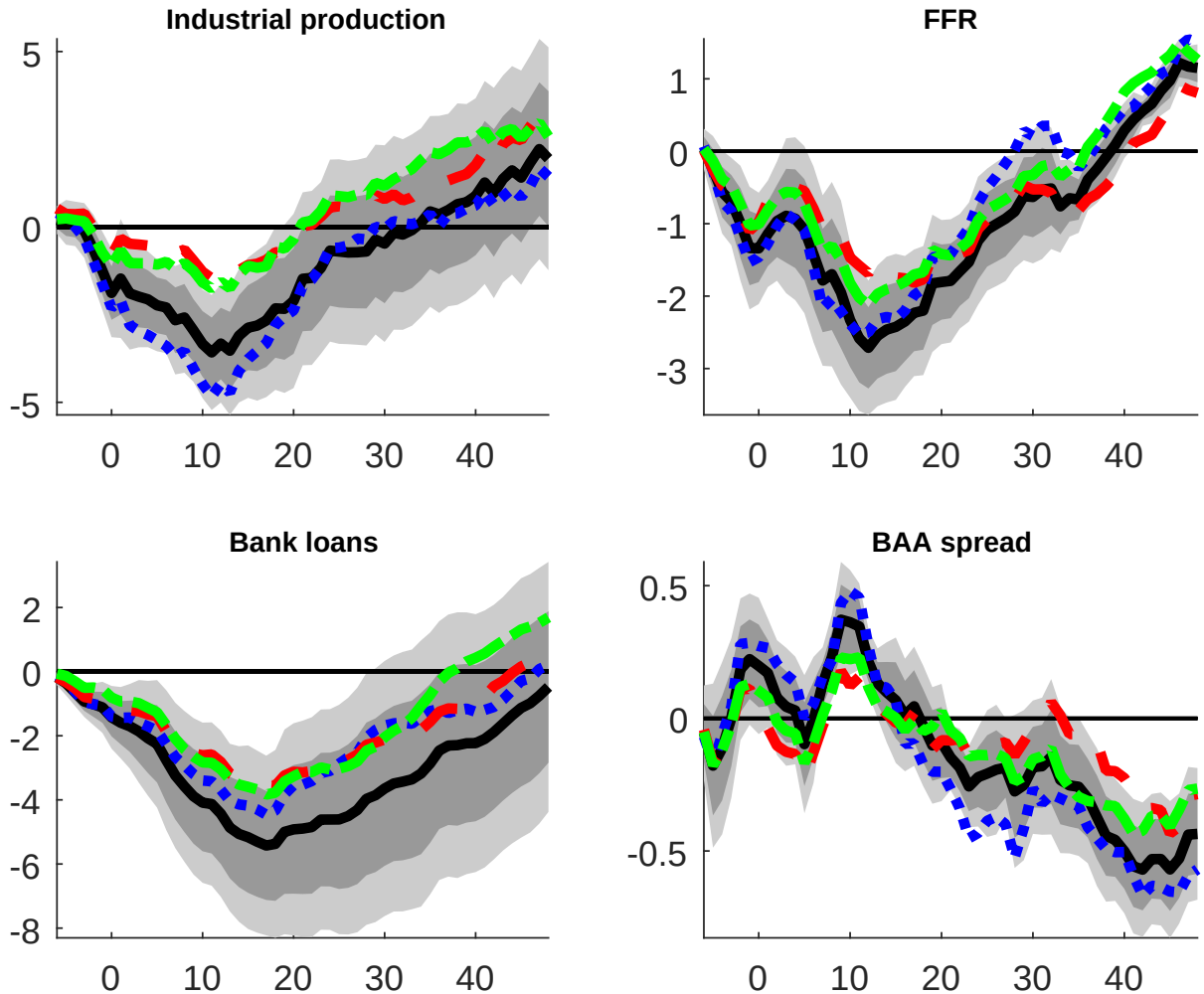
Notes: Black solid line: baseline model (with confidence bands). Blue dotted: 1983-2008. Red dashed: 1979-2016. Green dash-dots: 1979-2016 (incl. Basel II.5, forecast horizon 36 months). Cyan with crosses: 1979-2016 (incl. Basel II.5 and Basel III, forecast horizon 24 months). After 2008, FFR = Leo Krippner's Shadow Short Rate.

Robustness CRI (1/2): remove events



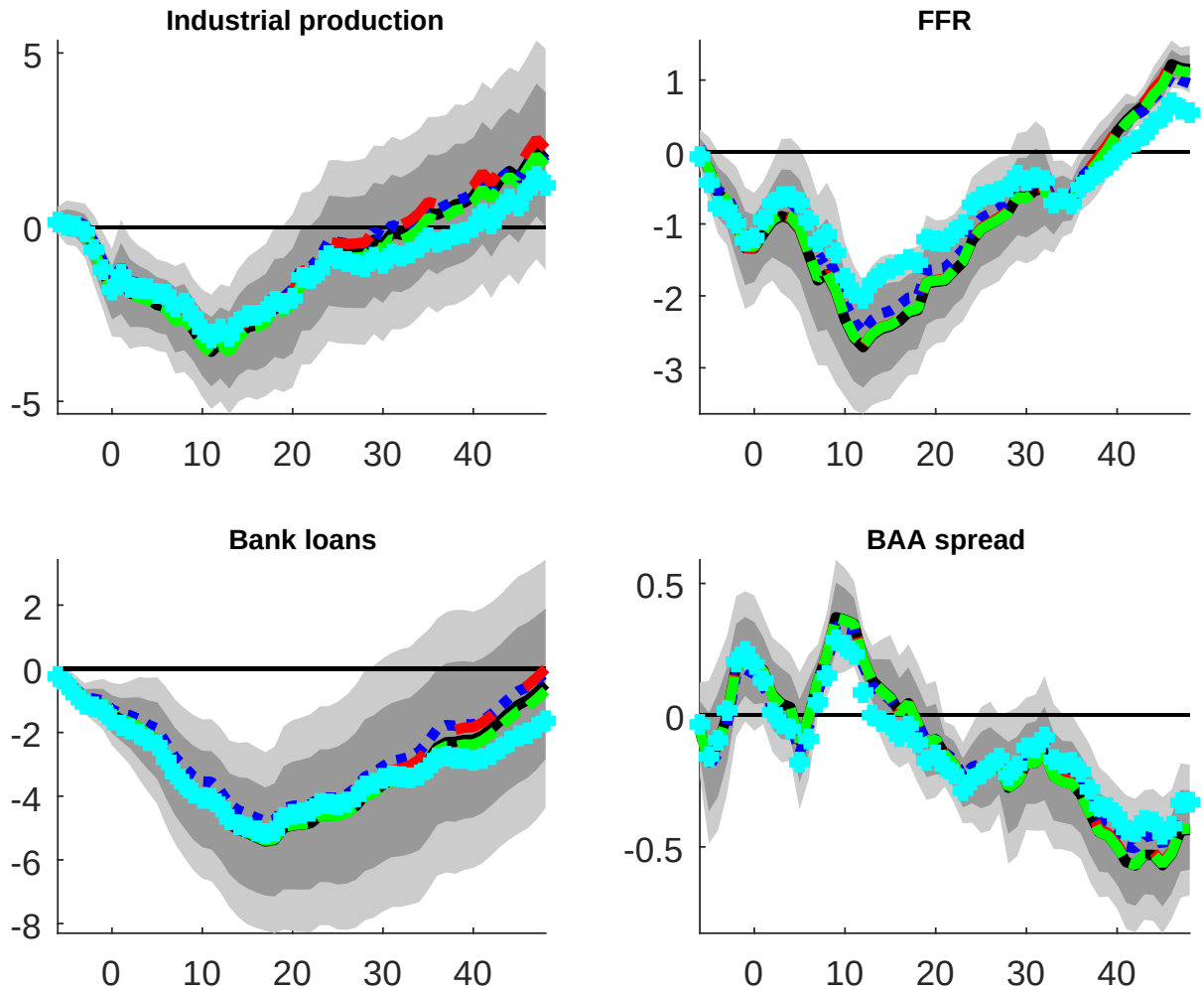
Notes: Black solid line: baseline model (with confidence bands). Red dashed line: remove Basel I (the only international event). Blue dotted: remove other events one by one. Green dash-dots: remove 1991 and 1992 events when the Fed did not act as a regulator.

Robustness CRI (2/2): more events



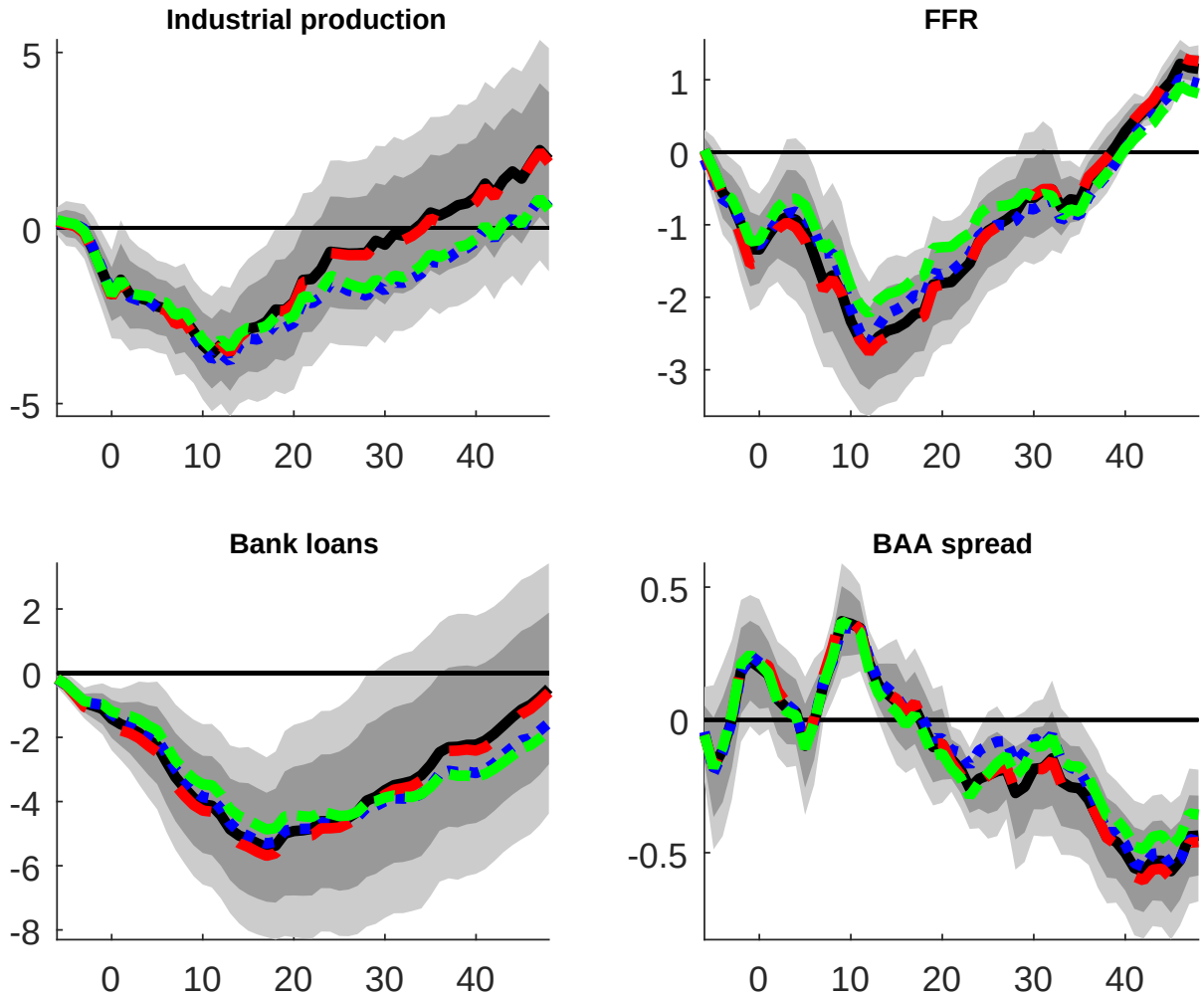
Notes: Black solid line: baseline model (with confidence bands). Blue dotted: only effective dates (no Congress acts). Red dashed: include Jun. 1983 event. Green dash-dots: include Jan. 1997 event.

Robustness: additional controls (1/3)



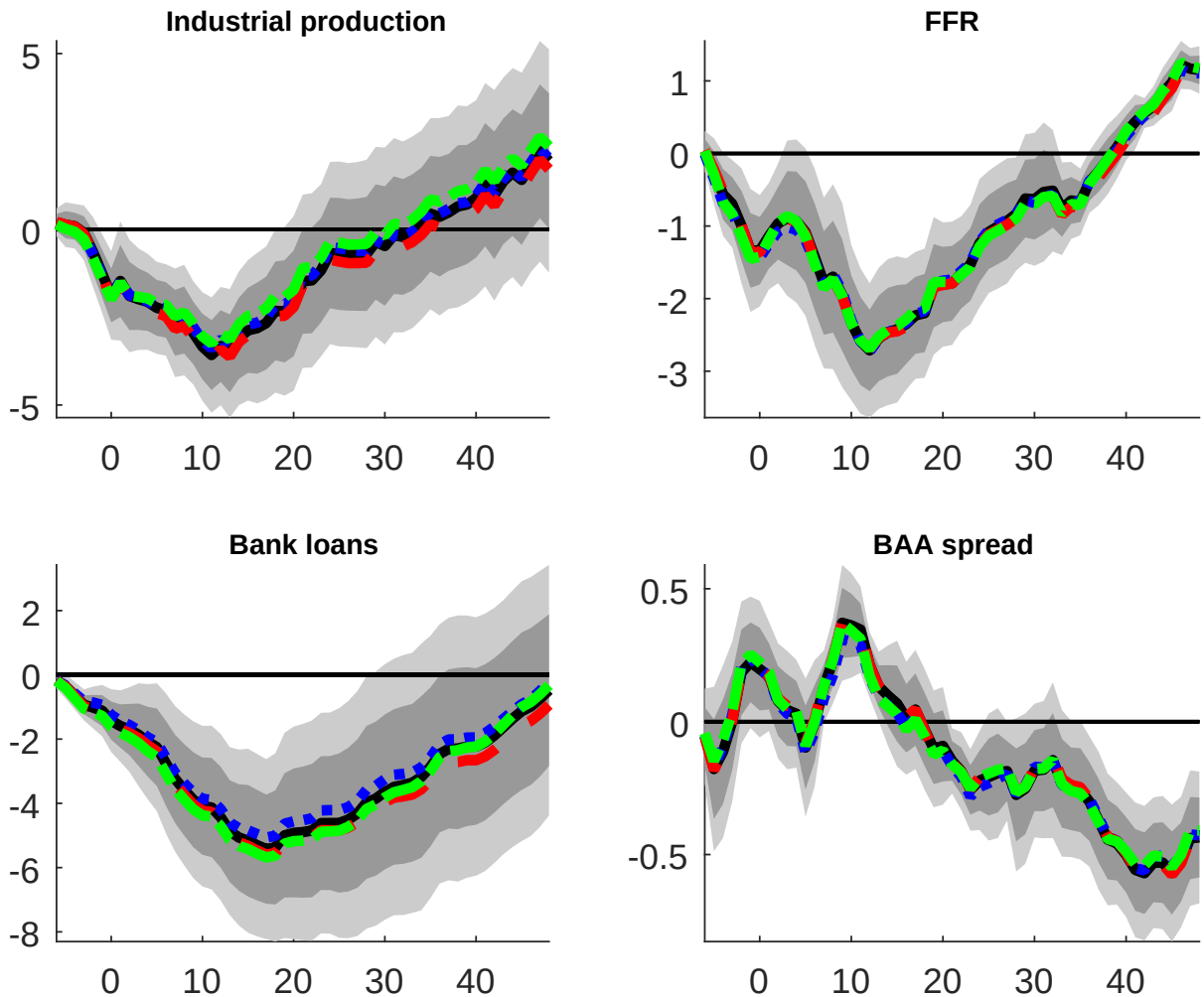
Notes: Black solid line: baseline model (with confidence bands). Blue dotted: add excess bond premium. Red dashed: add Basel credit-to-GDP gap. Green dash-dots: add Savings and Loan crisis dummy. Cyan with crosses: add TED spread.

Robustness: additional controls (2/3)



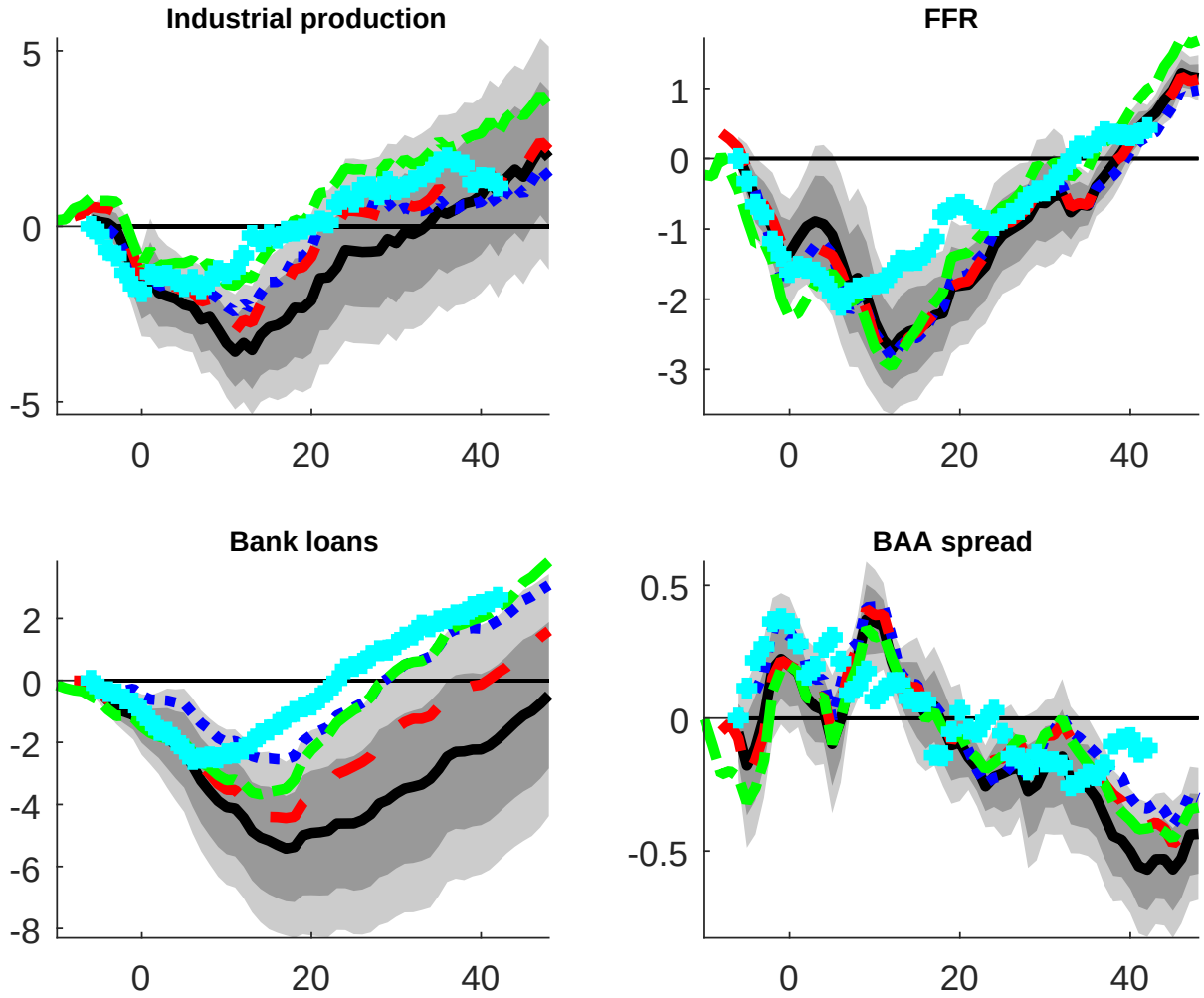
Notes: Black solid line: baseline model (with confidence bands). Black solid line: baseline model (with confidence bands). Blue dotted: add Romer-Romer monetary policy shock measure. Red dashed: add Fernald utilization-adjusted TFP growth. Green dash-dots: add oil price.

Robustness: additional controls (3/3)



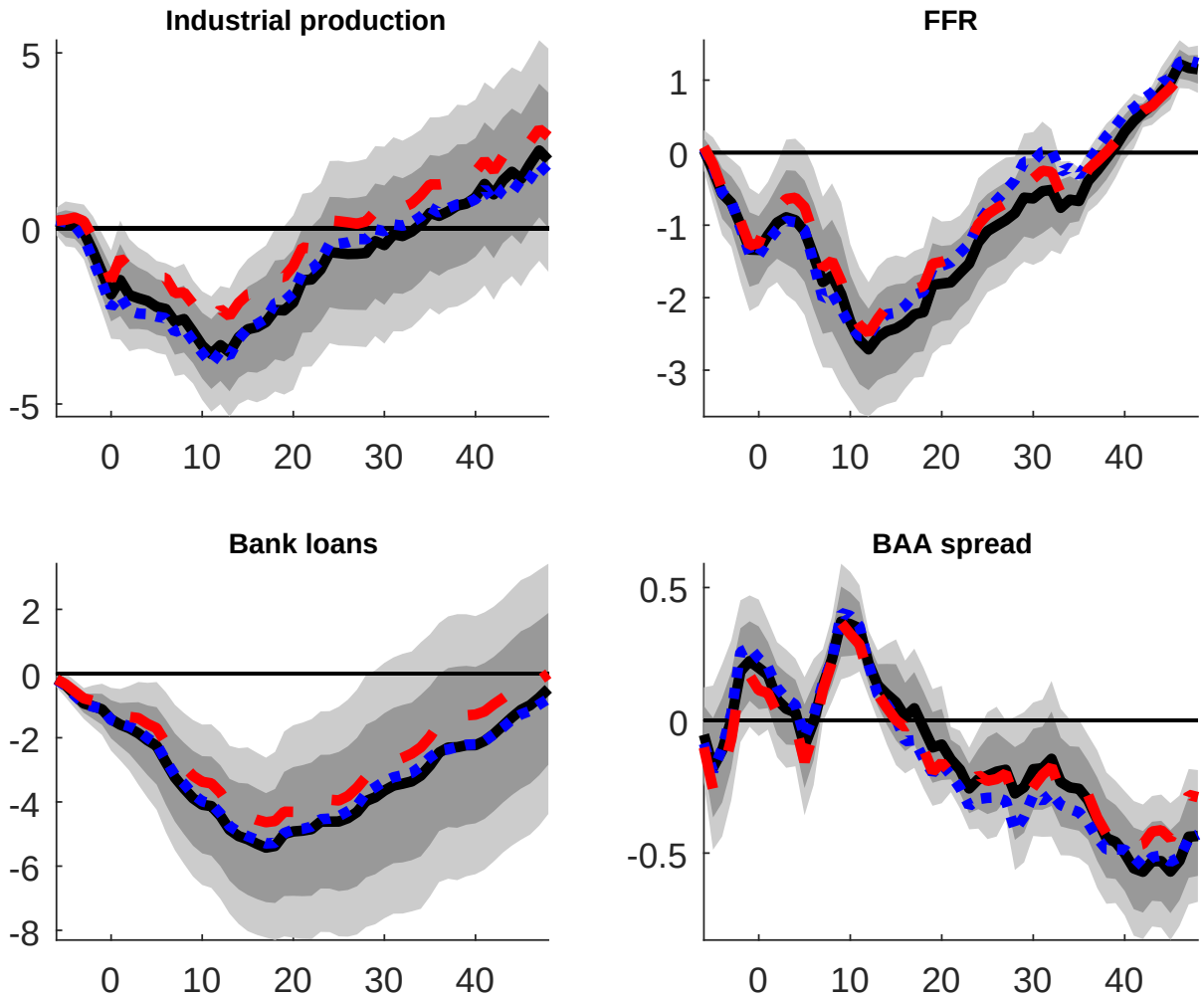
Notes: Black solid line: baseline model (with confidence bands). Blue dotted: add Romer-Romer tax changes. Red dashed: add Ramey military spending news. Green dash-dots: add NBER recession dummy.

Robustness: Anticipation horizon



Notes: Black solid line: baseline model with a 6-month average anticipation horizon (with confidence bands). Blue dotted: average anticipation horizon of 4 months. Red dashed: average anticipation horizon of 8 months. Green dash-dots: anticipation horizon of 10 months. Cyan with crosses: individual anticipation horizons

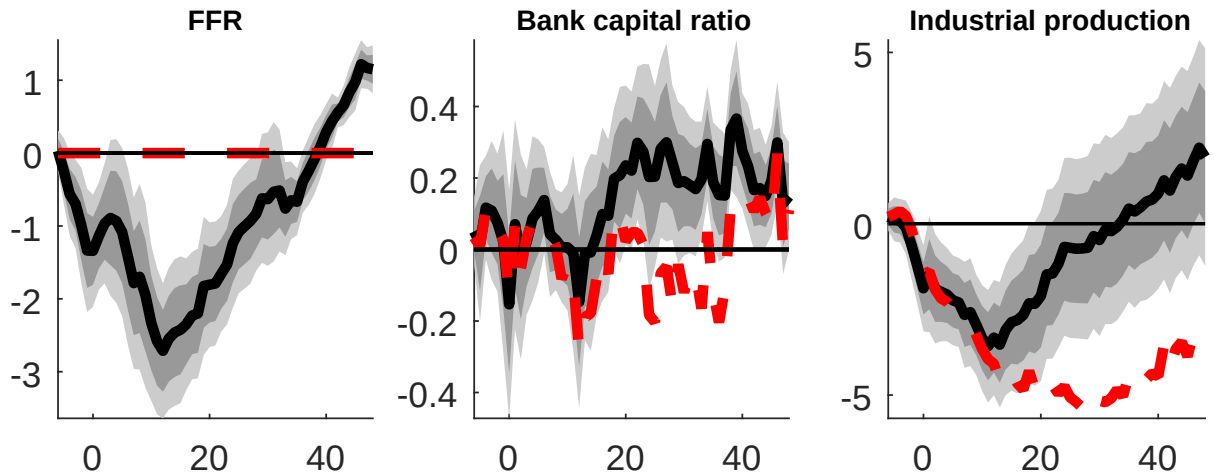
Robustness: Narrative weighting scheme



Notes: Black solid line: baseline model (with confidence bands). Blue dotted: narrative "intensity" measure of events. Red dashed: narrative "extent" measure of events.

Counterfactual: No Monetary Policy

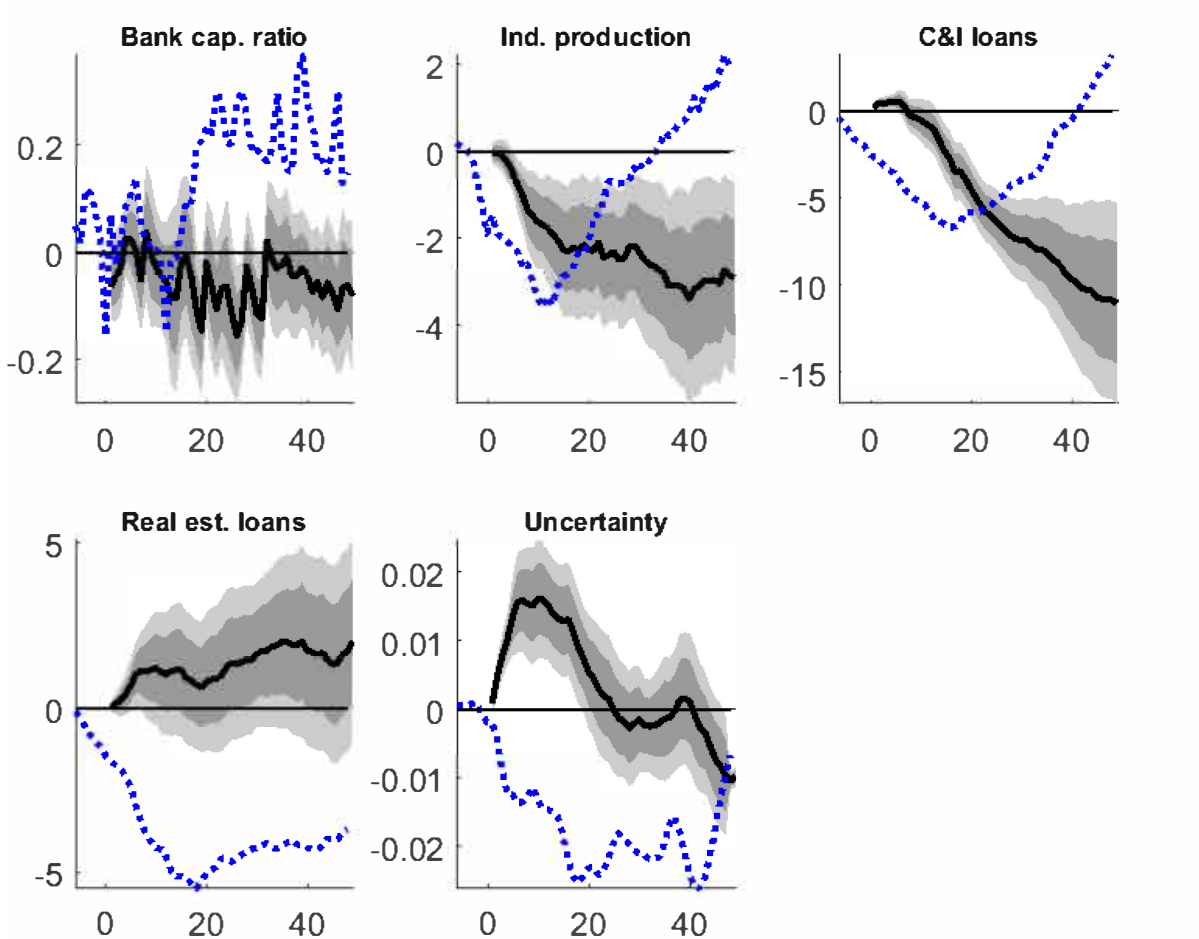
- stronger and more persistent recession without MP stabilization



Notes: In percentage points (FFR and spread) and percent (others). Black: baseline model (with confidence bands). Red dashed: counterfactual impulse responses (no policy interest rate reaction).

Comparison to an Ebp shock

- Excess Bond Premium shock (black; Gilchrist/Zakrajšek, 2012 Aer) causes no increase in bank capital and more persistent recession than our Cri shock (blue)



Notes: Rates, ratios and spreads in percentage points, others in percent. Black: responses to Ebp shock (with confidence bands). Blue dashed: our baseline model.

CR changes overview

CR change	rules for comment	final rules published	effective date
num. CAR	Jun. 23, 1981 (FR46/32498)	Jun. 23, 1981 (FR46/32498)	Dec. 17, 1981 (FR46/62693)
ILSA	Jul. 20, 1984 (FR49/29400)	Apr. 18, 1985 (FR50/11128)	Apr. 18, 1985 (FR50/11128)
Basel I	Mar. 27, 1986 (FR51/10602)	Jan. 18, 1989 (FR54/4186)	Dec. 31, 1990 (FR54/4186)
FDICIA/PCA	Jul. 1, 1992 (FR57/29226)	Sep. 29, 1992 (FR57/44866)	Dec. 19, 1992 (FR57/44866)
MRA	Jul. 25, 1995 (FR61/47358)	Sep. 6, 1996 (FR61/47358)	Jan. 1, 1997 (FR61/47358)
Basel II	Sep. 6, 2006 (FR71/55830)	Dec. 7, 2007 (FR72/69288)	Apr. 1, 2008 (FR72/69288)
Basel II.5	Jan. 11, 2011 (FR77/53061)	Aug. 30, 2012 (FR77/53060)	Jan. 1, 2013 (FR77/53060)
Basel III	Aug. 30, 2012 (FR78/62020)	Oct. 11, 2013 (FR78/62018)	Jan. 1, 2014 (FR78/62018)