Capital regulation and macroeconomic activity

Implications for macroprudential policy

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Disclaimer

The views expressed in this paper are those of the author alone, and not those of the Bank of England or the Monetary Policy Committee.

Outline

The motivating question

How is the macroeconomy affected by shocks to bank capital ratios?

Why ask?

Reasons we might be interested:

- Learn about the transmission channel of shifts in the *supply of intermediated credit*.
- Quantify a potential *source of aggregate fluctuations*, little studied by macroeconomists.
- Simulate *counter-cyclical macroprudential policy*.

Challenges

Identification Most variation in actual bank capital ratios is not exogenous, but a result of *macroeconomic shocks*...

...and macro shocks shift credit demand, as well as credit supply; need *instruments*.

Feedbacks The *partial equilibrium* effect of changes in capital on lending differs from the 'total' or *general equilibrium* effect, to the extent that shifts in loan supply cause shifts in aggregate expenditure...

...so must employ an aggregate approach allowing for feedbacks.

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Identification Use variation in microprudential capital requirements to identify exogenous shifts in capital...

...institutional details of microprudential regime key.

Feedbacks Estimate effects using a Bayesian Vector Autoregression (VAR), capturing dynamic interaction between banks and the macroeconomy...

...but also exploit bank-level data to sharpen inference, a *combined micro-macro approach*.[a]

[a] See Chang, Gomes and Schorfheide (*AER*, 2002) for an application of the micro-macro approach to a DSGE model.

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Literature on credit shocks

Big picture–part of the literature which looks at the macroeconomic consequences of *financial* shocks:

Corporate bond market Gilchrist and Zakrajšek (*JME*, 2009; *AER*, 2012); Meeks (*JEDC*, 2012).

Mortgage bond market Walentin (*JME*, 2014).

Generic 'credit shocks' Finlay and Jääskelä (*J.Mac*, 2014); Barnett and Thomas (*Manch. Sch.*, 2014).

These studies don't look specifically at ***intermediaries***.

This paper looks at shocks that alter the ***mix of financial liabilities*** on bank balance sheets–which may be considered a 'purely financial' shock.

Literature on bank shocks

Aggregate models with banking variables Berrospide and Edge (*IJCB*, 2010), Iacoviello and Minetti (*J.Mac*, 2008), Walentin (*JME*, 2014).

Micro identification of bank credit supply shocks Amiti and Weinstein (*WP*, 2013), Bassett et al. (*JME*, 2014), Mésonnier and Stevanovic (*WP*, 2012).

These studies don't look specifically at shocks to ***regulation***.

Micro models with regulatory capital shocks Aiyar, Calomiris and Wieladek (*WP*, 2012) and Francis and Osborne (*WP*, 2009) for the UK; Labonne and Lamé (*WP*, 2014), for France.

These studies don't take account of ***feedbacks***.

Outline

Data

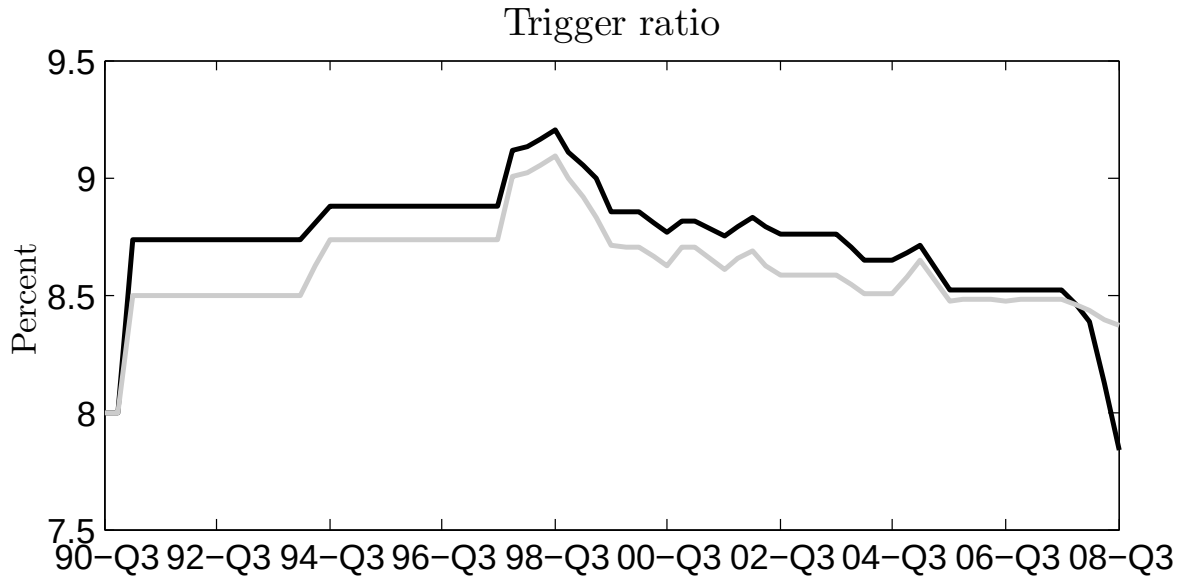
- The period of study is 1989:4 through 2008:3–spanning the Basel I and II regimes...
- ...but excluding the switch to an 'enhanced prudential regime' and the transition to a *permanently higher* level under Basel III.
- In the UK, regulators imposed add-on capital requirements that varied *across time* and *across banks*, in contrast to time-invariant Basel minimums.
- The *aggregate* required capital ratio—summing over the major UK banks—also varies.

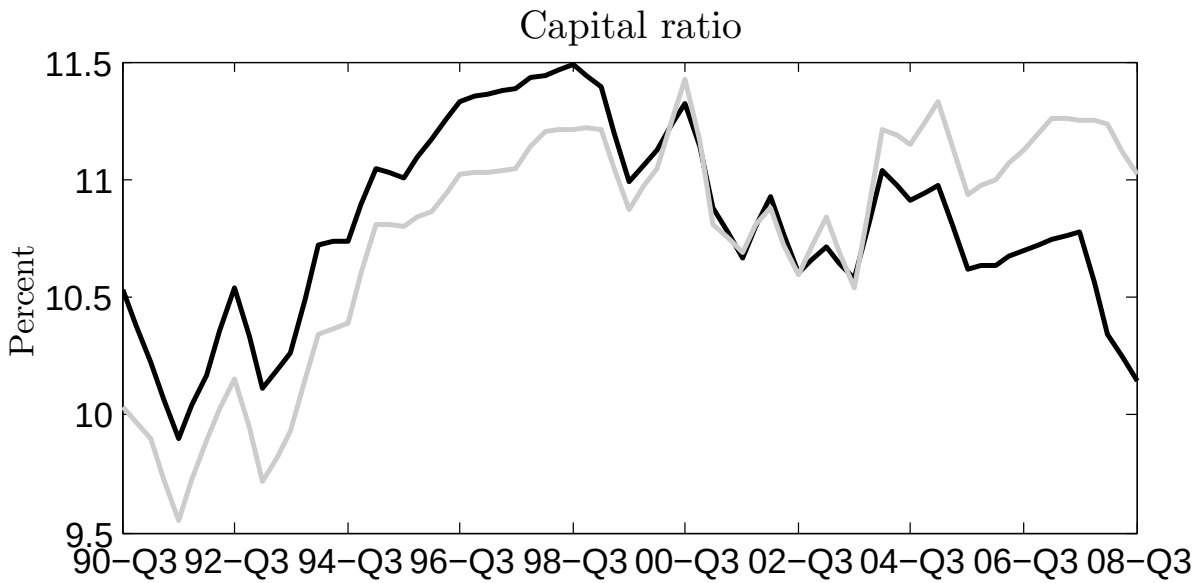
Because breaching minimum Basel plus add-on requirement 'triggered' regulatory action, it is known as the **trigger ratio**.

Aggregate bank capital variables

On average, 15% of the banks in the sample had a change in their capital requirements each period; of these, 8% were increases and 7% were decreases.

Black line – weighted average. Grey line – simple average.





Data

Macro block (M)

- Output, prices, monetary policy interest rate
- House prices, mortgage arrears
- Mortgage and corporate bond spreads

Bank lending block (B)

- Household secured (mortgage) lending growth
- Corporate lending growth

Capital block (K)

- System-wide tier 1 capital ratio

Policy block (P)

- System-wide regulatory minimum capital (trigger) ratio

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Identification: Institutional features of UK system

Confidentiality of changes to trigger implausible that any macro variable responded directly; e.g. no mention of prudential regulation in official record of monetary policy committee meetings (until Jan., 2008).

Timing and scope of reviews supervisory reviews at set two-year intervals, and no clear mandate to respond to business cycle; unlikely that trigger responded to macroeconomic shocks.

Idiosyncratic bank-level shocks led to changes in aggregate capital requirements (and so capital buffers) that acted to shift aggregate loan supply.

Capturing feedbacks: A structural VAR model

$$\mathbf{y}_t^\top \mathbf{A} = \mathbf{x}_t^\top \mathbf{F} + \mathbf{v}_t^\top, \qquad \mathbf{v}_t \sim \mathsf{N}(\mathbf{0}, \mathbf{I})$$

...where $\mathbf{y}_t$ is a vector of 11 aggregate endogenous variables, including macroeconomic aggregates, actual and required capital and bank lending.

The vector $\mathbf{x}_t^\top = (\mathbf{y}_{t-1}^\top, \ldots, \mathbf{y}_{t-p}^\top, 1)$ contains lags of $\mathbf{y}_t$, and $\mathbf{A}$ and $\mathbf{F} = [\mathbf{F}_\ell]$ are coefficient matrices *with equations in columns, variables in rows*.

The VAR allows for complex dynamic interactions between variables in $\mathbf{y}_t$, both contemporaneously and with time lags.

Capturing feedbacks: A structural VAR model

$$\mathbf{y}_t^\top \mathbf{A} = \mathbf{x}_t^\top \mathbf{F} + \mathbf{v}_t^\top, \qquad \mathbf{v}_t \sim \mathrm{N}(\mathbf{0}, \mathbf{I})$$

...impose identifying (exclusion) restrictions on both **A** and **F** matrices:

- macroeconomic variables do not respond *directly* to actual or regulatory minimum capital ratios (but may respond indirectly);
- lending does not adjust immediately to changes in capital;
- banks may adjust actual capital ratios immediately in response to changes in capital requirements.

Capturing feedbacks: A structural VAR model

$$\mathbf{y}_t^\top \mathbf{A} = \mathbf{x}_t^\top \mathbf{F} + \mathbf{v}_t^\top, \qquad \mathbf{v}_t \sim \mathsf{N}(\mathbf{0}, \mathbf{I})$$

Impact matrix $\mathbf{A}$

Variables	M	B	K	P
M	×	×	×	
B		×	×	
K			×	
P			×	×

Lag matrix $\mathbf{F}_\ell$

Variables	M	B	K	P
M	×	×	×	
B	×	×	×	×
K		×	×	×
P		×	×	×

Estimation of the structural VAR model

$$\mathbf{y}_t^\top \mathbf{A} = \mathbf{x}_t^\top \mathbf{F} + \mathbf{v}_t^\top, \qquad \mathbf{v}_t \sim \mathsf{N}(\mathbf{0}, \mathbf{I})$$

...the likelihood function is:

$$p(\mathbf{y}_t|\mathbf{x}_t; \mathbf{A}, \mathbf{F}) \propto |\mathbf{A}| \exp\left\{-\tfrac{1}{2}(\mathbf{y}_t'\mathbf{A} - \mathbf{x}_t'\mathbf{F})(\mathbf{y}_t'\mathbf{A} - \mathbf{x}_t'\mathbf{F})'\right\}$$

The prior distributions are specified following Sims and Zha (*IER*, 1998). Parameterize using a two-part structure for each equation i:

$$\mathbf{a}_i \sim \mathsf{IN}(\mathbf{0}, \underline{\mathbf{S}}_i)$$
$$\mathbf{f}_i|\mathbf{a}_i \sim \mathsf{N}(\underline{\mathbf{B}}\mathbf{a}_i, \underline{\mathbf{H}}_i)$$

where lowercase letters denote columns of the uppercase matrices. Matrix $\underline{\mathbf{B}}$ captures beliefs about reduced form dynamics.

The $\underline{\mathbf{S}}_i$ and $\underline{\mathbf{H}}_i$ matrices are identical for equations in the M, and {B,K,P} blocks.

Priors estimated from micro data

The prior distribution of coefficients in the {B,K,P} blocks

$$\mathbf{f}_i|\mathbf{a}_i \sim \mathsf{N}(\underline{\mathbf{B}}\mathbf{a}_i, \underline{\mathbf{H}}_i), \quad i = \text{lending/capital variables}$$

is centered on *panel estimates* of the lending-capital relationship on bank-level data:

$$\mathbf{y}_{jt}^{(i)} = \mathbf{B}^{(i)}\mathbf{y}_{j,t-1}^{(i)} + \mathbf{C}\mathbf{z}_{j,t-1} + \psi_j + \lambda_t + \boldsymbol{\varepsilon}_{jt}$$

with $\mathbf{B}^{(i)}$ is the sub-matrix corresponding to $\mathbf{y}^{(i)}$ in $\underline{\mathbf{B}}$.

Reduced form matrix **B**

Variables	M	B	K	P
M	×	×	×	×
B	×	×	×	×
K		×	×	×
P		×	×	×

Priors estimated from pre-sample data

Important to capture the 'medium run' nature of the financial cycle (early 1990s housing bust in particular).

Run an auxiliary VAR on the {M,B} blocks using data 1975-1989, center the macro and bank lending priors on resulting estimates.

Reduced form matrix **B**

Variables	M	B	K	P
M	×	×	×	×
B	×	×	×	×
K		×	×	×
P		×	×	×

Key point

Posterior estimates of model quantities combine 'prior' information from micro data with sample information on aggregate quantities.

Intuitively, micro-level variation sharpens macro-level inference by exploiting multiple instances of changes in capital requirements and changes in lending.[a]

A long run of data is used to estimate the relationship between bank lending and macroeconomic aggregates.

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[a] The posterior distributions of the parameters are obtained via Gibbs sampling (Waggoner and Zha, *JEDC*, 2003).

Outline

Main messages

Changes in financial structure have real effects

Supervisory actions to alter funding mix of banks reduce lending growth and have spill-overs to asset prices and real expenditure; comparable to bank credit supply shock in Bassett et al. (*JME*, 2014). Consistent with other empirical findings on 'financial shocks'.

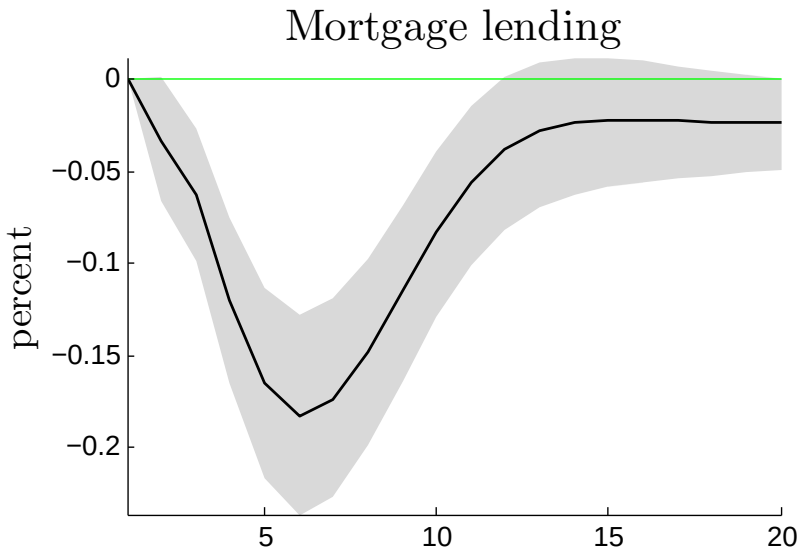
Financial accelerator mechanism amplifies shock

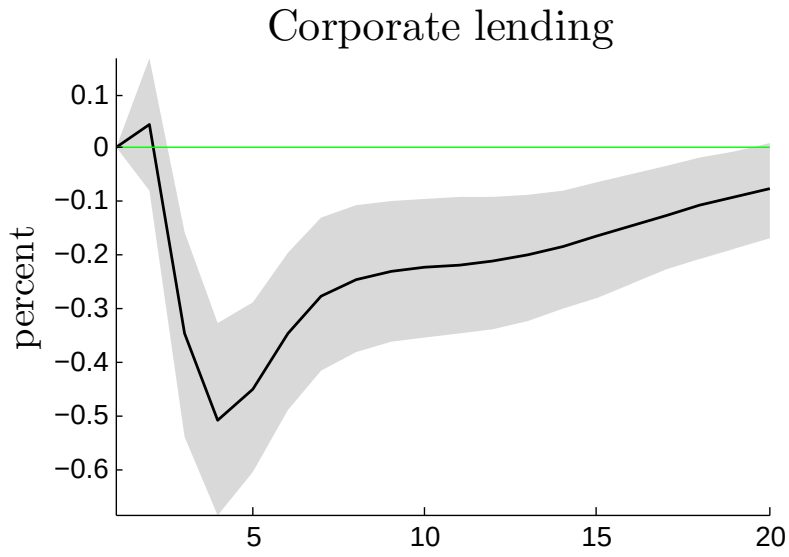
Increases in credit spreads on both mortgage and corporate lending amplify regulatory disturbances (Iacoviello, *AER*, 2005). Feedbacks strongest within the banking system.

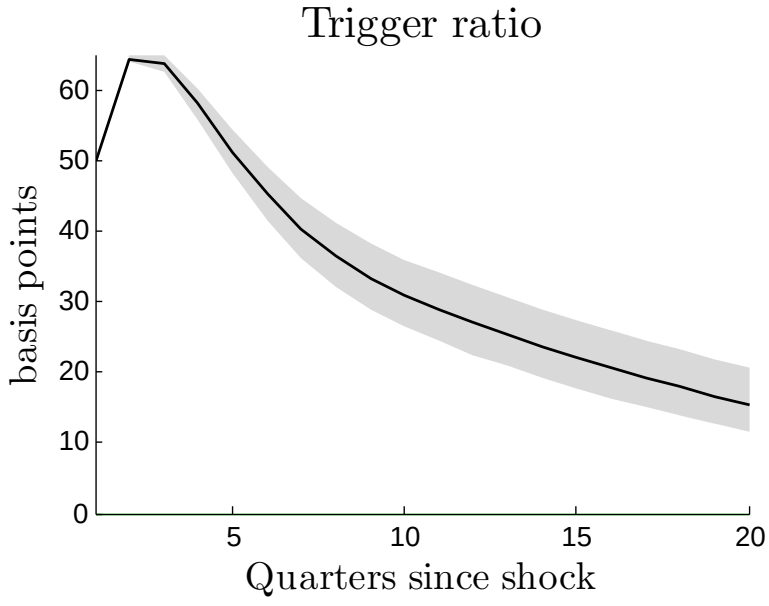
Regulation had modest effects on asset prices and lending growth over the period of study

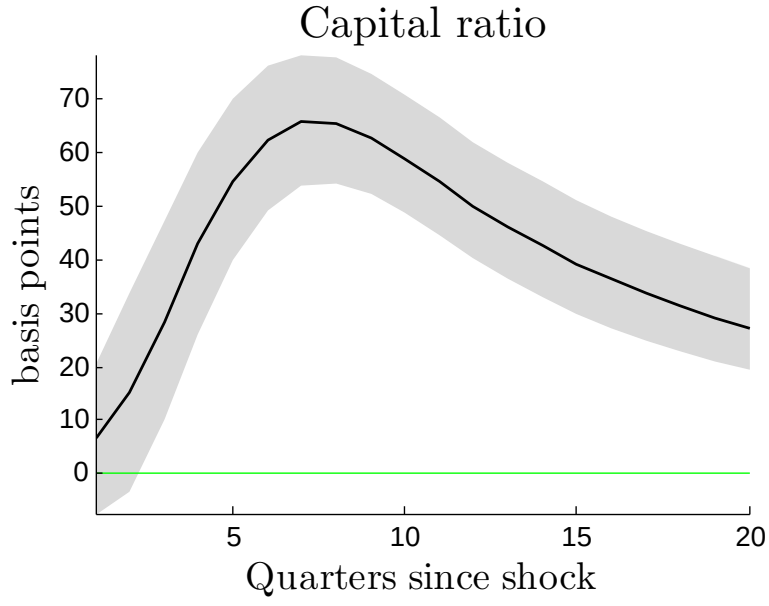
Large regulatory shocks were infrequent; thus variation in microprudential capital requirements not, on average, a source of macro fluctuations.

Response to regulation shock









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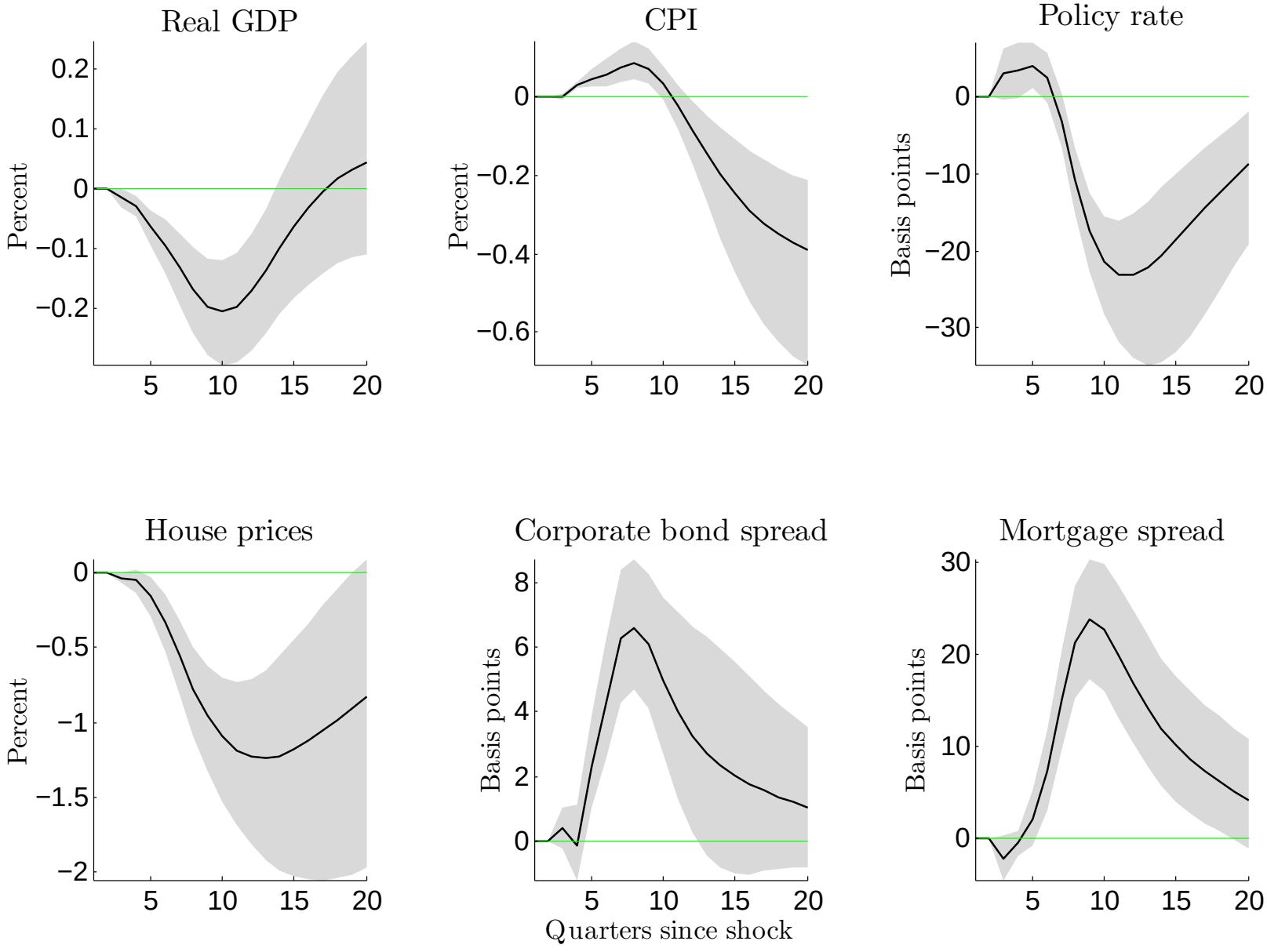
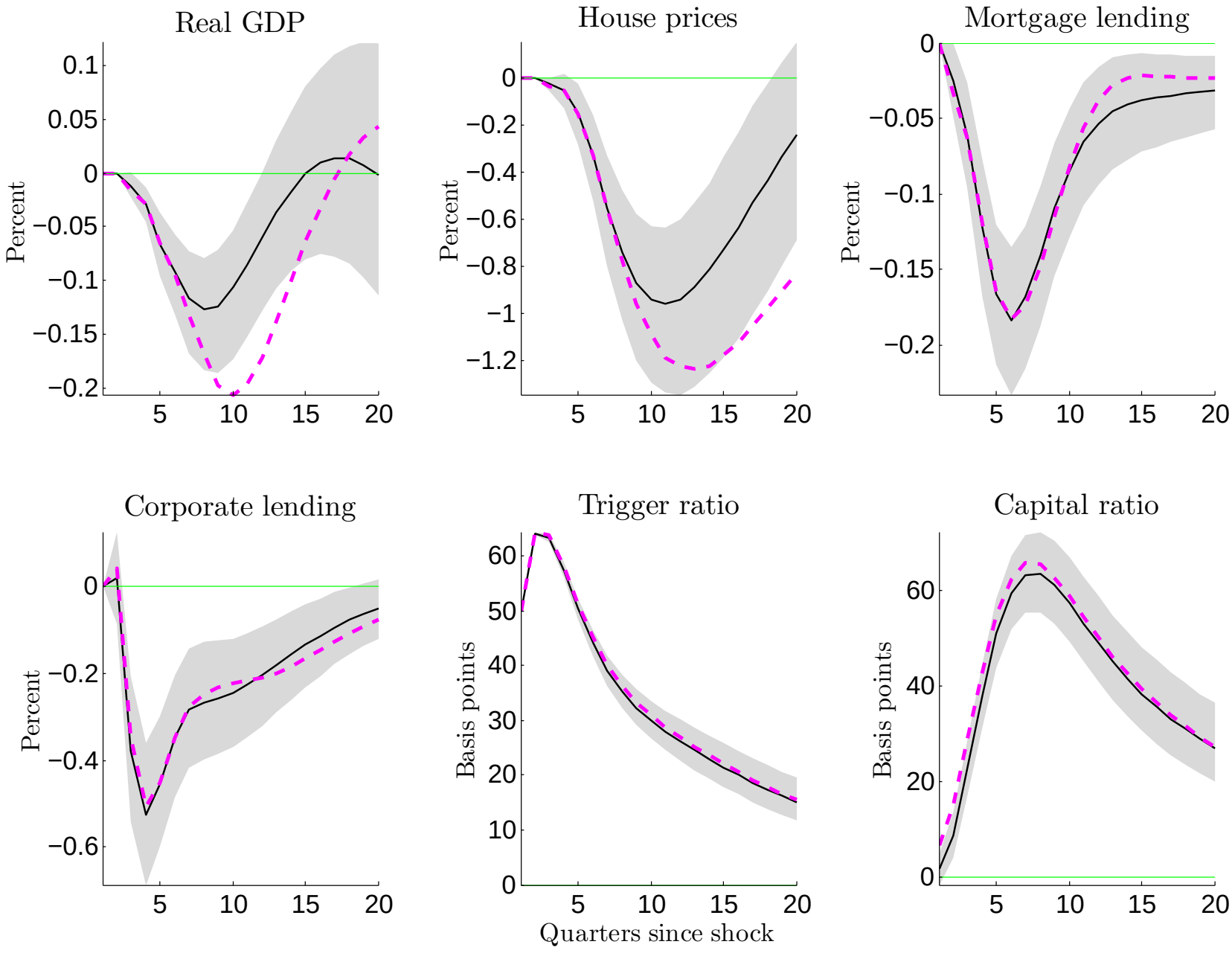
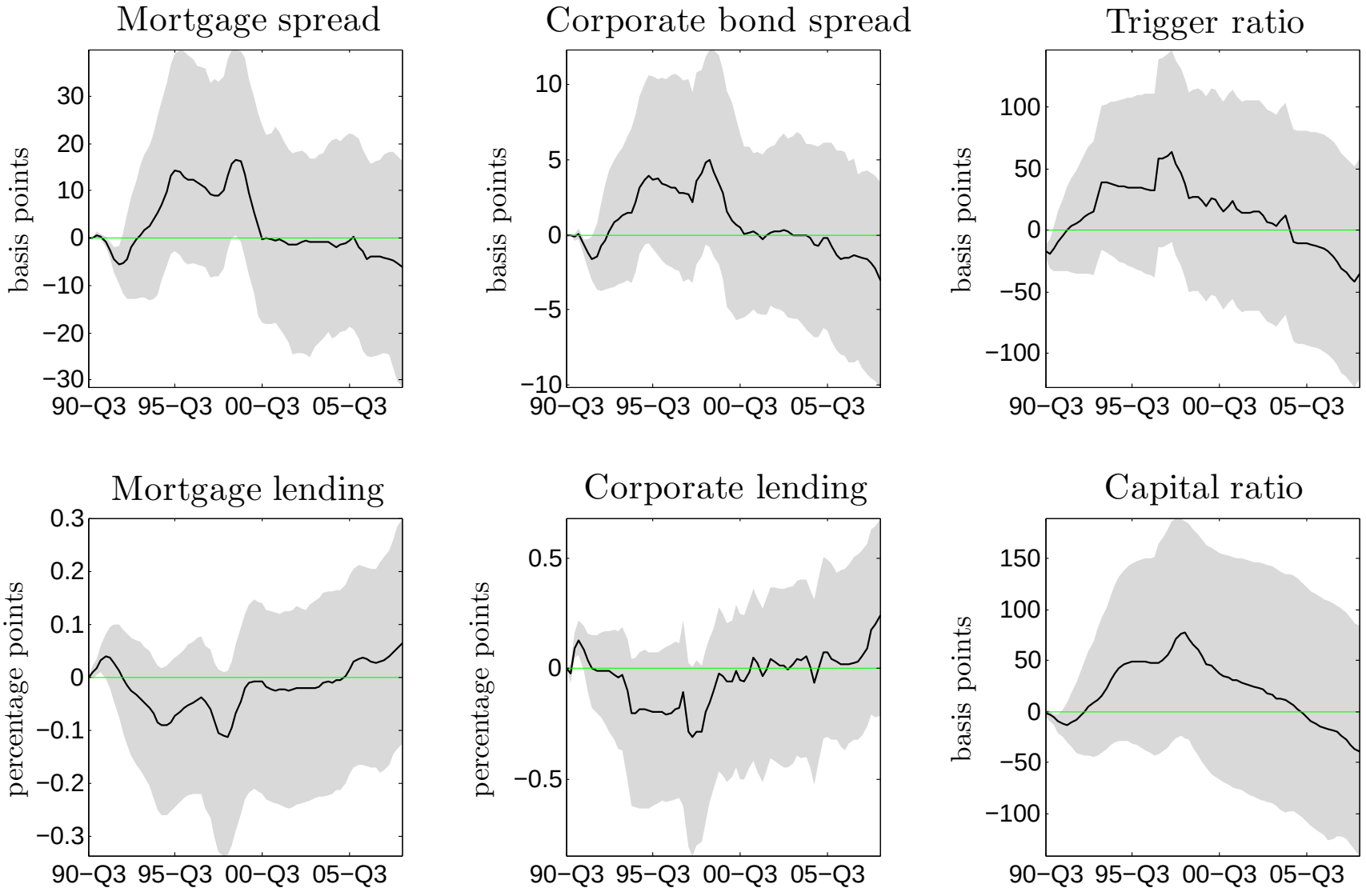


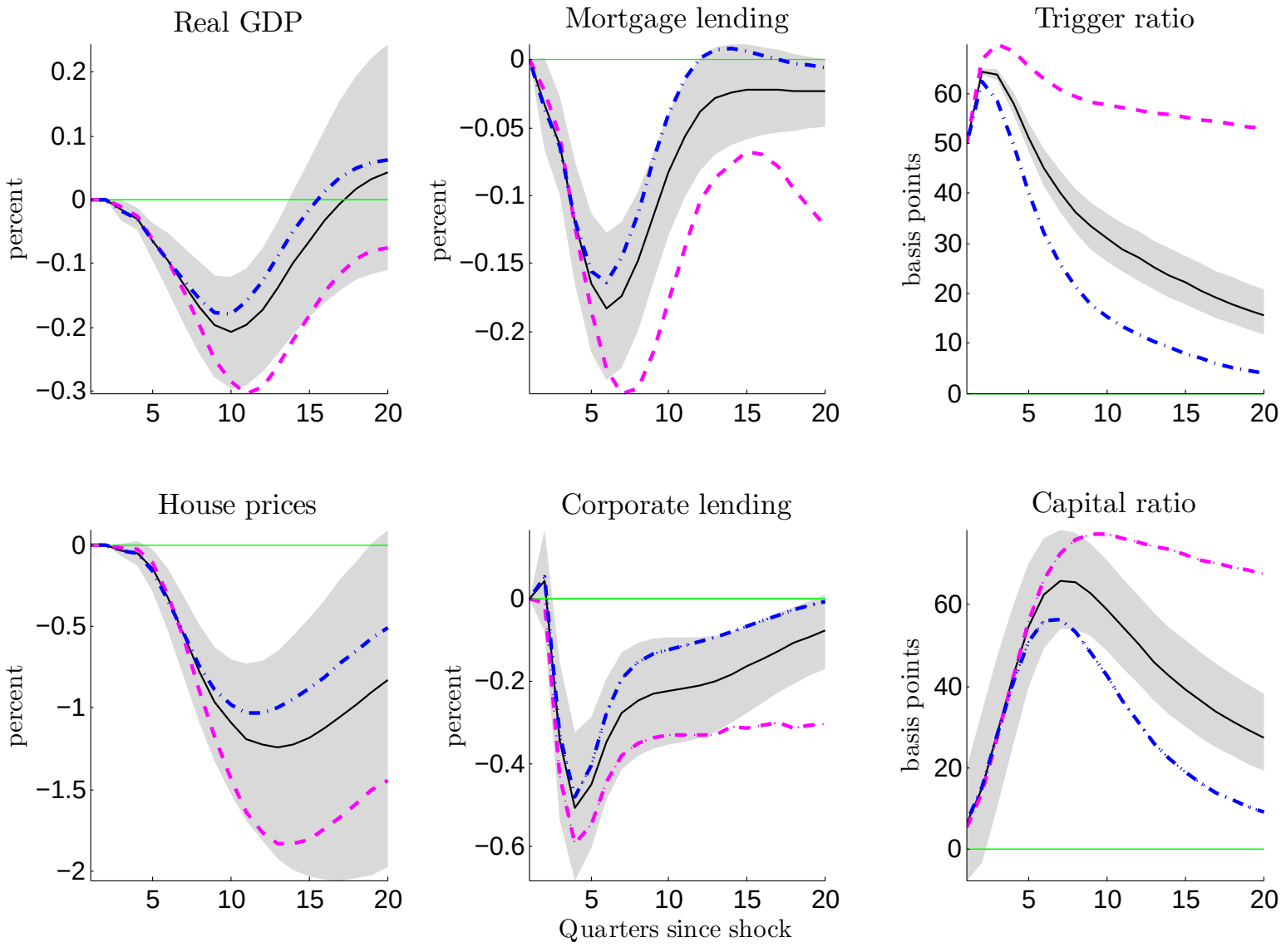
Response to regulation shock, credit spreads fixed



Historical contribution of shocks to trigger ratio



Effects of prior bank-level information



–– baseline prior; –– a ‘loose’ prior; – · – a ‘tight’ prior.

Outline

A macroprudential counterfactual

Extrapolate from the 1989-2008 regime to learn something about the Basel III macroprudential regime:

- Replay history, with the same exogenous shocks but a *different* policy equation.
- Restrict attention to linear feedback rules (no threshold effects, no contingency on stress test results etc.).

Lucas critique If private agents form plans based on expectations of future regulatory policy, altering the policy rule while leaving other relations unchanged may result in error. Two rebuttals:

- Risk-based capital regulation a novel tool circa 1990, therefore unlikely agents could form a realistic assessment of its impact.
- Lack a widely agreed-upon fully structural alternative.

Counterfactual policy rules

Credit gap rule

Raise requirements when the ratio of credit to GDP is high relative to trend:

$$\text{trig}_t = \theta^{\text{gap}} \frac{1}{3}(\text{credgap}_t + \text{credgap}_{t-1} + \text{credgap}_{t-2}) + \hat{\boldsymbol{\beta}}' \mathbf{w}_t + \nu_t^{\text{trig}}$$

Set $\theta^{\text{gap}} = 1/8$ in simulations.

House price/mortgage spread rule

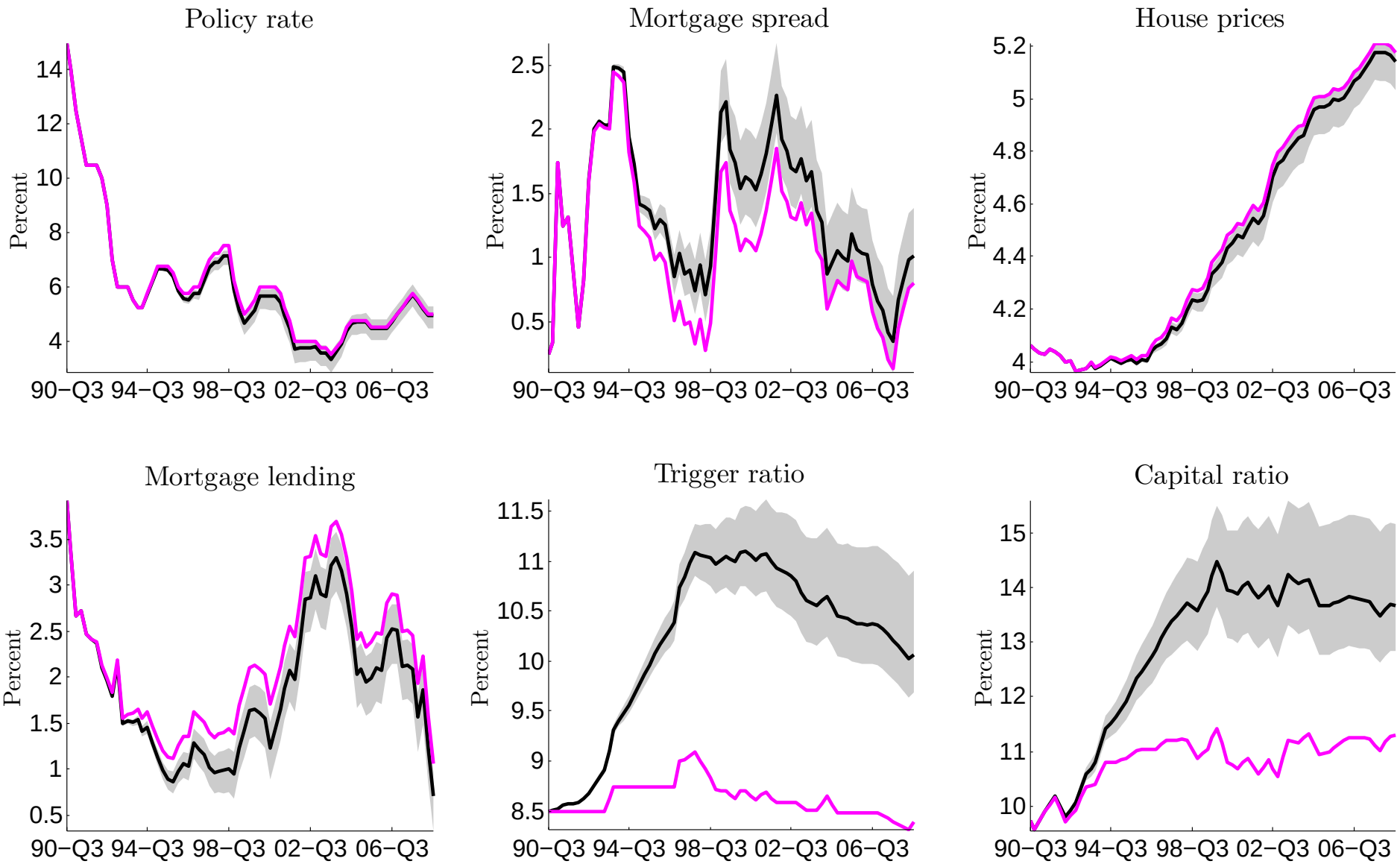
Raise capital requirements when house prices accelerate, or spreads fall:

$$\text{trig}_t = \theta^{\text{hp}} \Delta^2 \ln \text{housep}_t - \theta^{\text{spr}} \left(\text{spr}_t - \frac{1}{2} [\text{spr}_{t-1} + \text{spr}_{t-2}] \right) + \hat{\boldsymbol{\beta}}' \mathbf{w}_t + \nu_t^{\text{trig}}$$

Set $\theta^{\text{hp}} = 3/4, \theta^{\text{spr}} = 1/5$ in simulations.

Note: when $\theta^{\text{gap}} = 0$ or $\theta^{\text{hp}} = \theta^{\text{spr}} = 0$, every simulated path coincides precisely with the data.

Macroprudential policy – credit gap



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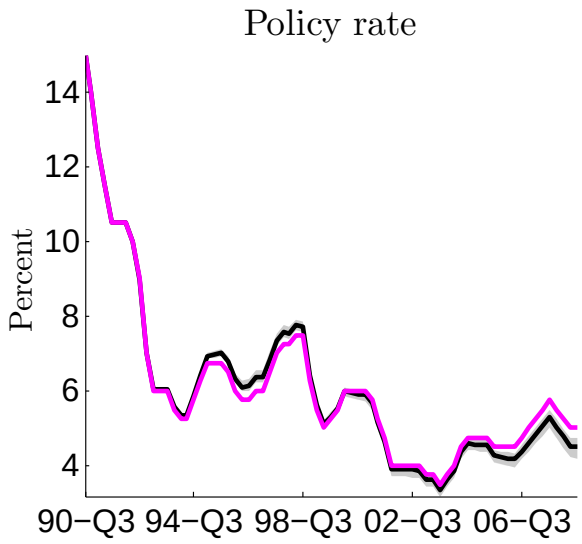

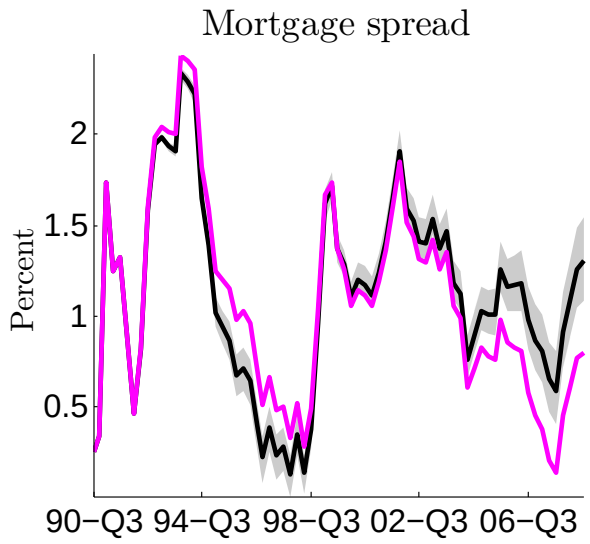

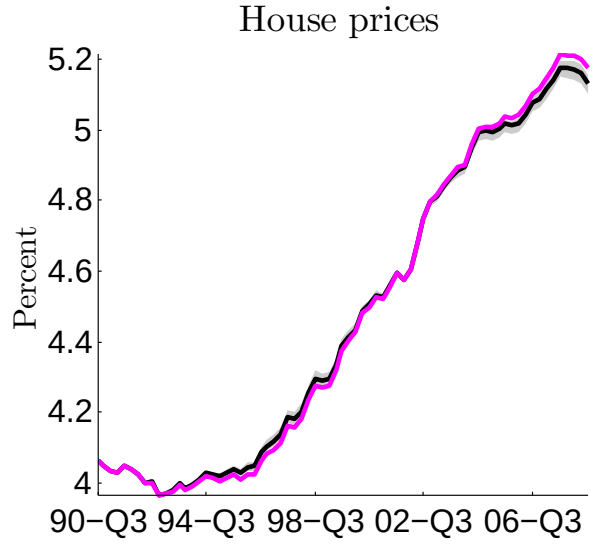

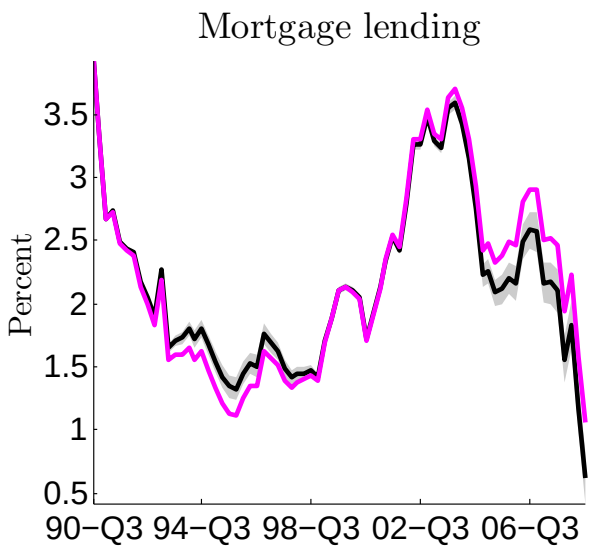

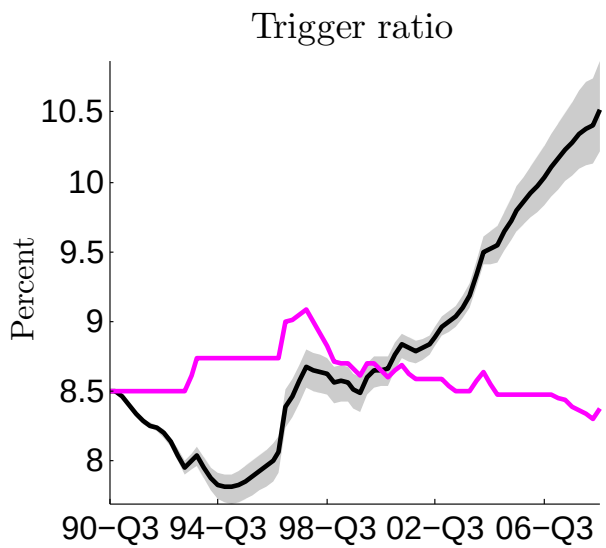

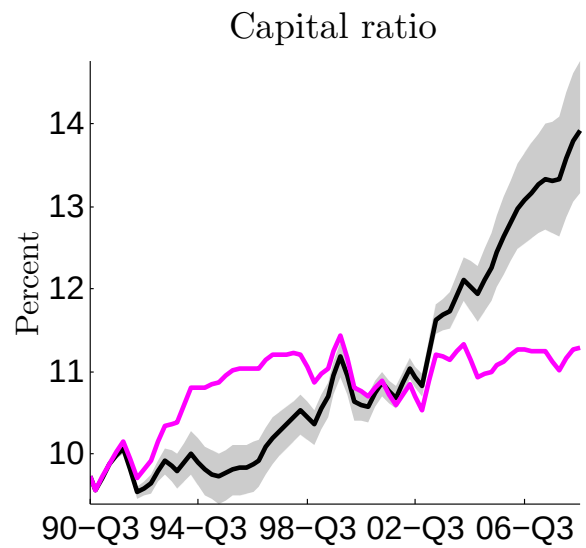

Outline

Summary: what this paper does

- Identifies exogenous changes in bank loan supply through regulation-induced changes in bank capital ratios.
- Estimates a VAR using both micro and macro data, to produce sharper estimates of IRFs while capturing system-level feedbacks.
- Demonstrates that changes in banks' liability structures can produce macroeconomic effects, that are amplified by a financial accelerator mechanism.
- Presents simulations demonstrating that a counter cyclical macroprudential policy can stabilize credit with little impact on aggregate expenditure.