Macrofinancial Feedback, Bank Stress Testing and Capital Surcharges

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October 19th, 2021

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Overview

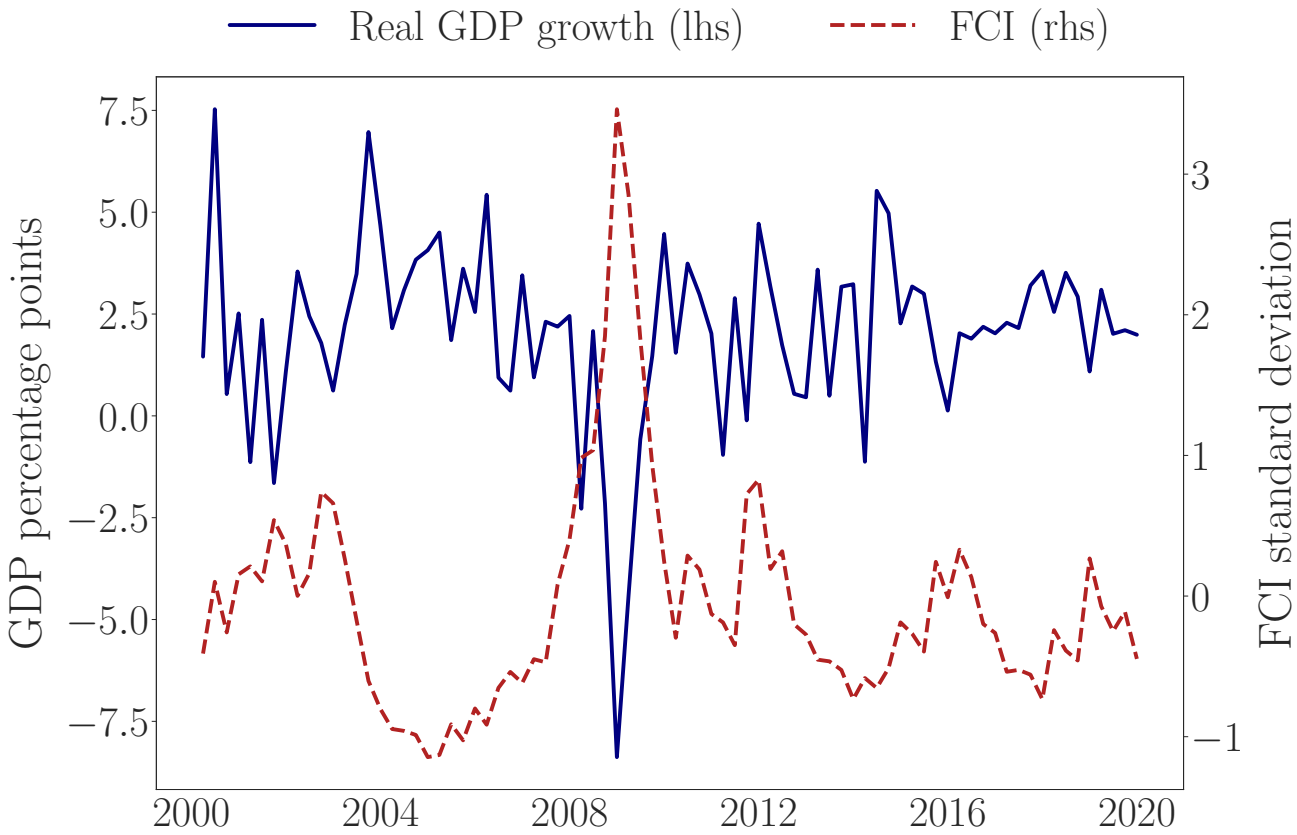
1. Develop a framework to assess vulnerabilities across the business and financial cycles, and calibrate a countercyclical capital buffer (CCyB) in the context of bank stress tests

2. Use a parsimonious model that quantifies the causal impact of bank capital shocks on financial conditions and downside risks to GDP growth:
   - Estimate the **macrofinancial feedback**: banks' amplification of shocks to the economy
   - Calibrate a **bank capital surcharge**: additional bank capital that offsets the macrofinancial feedback

3. Use a **Growth-at-Risk** based metric as a measure of financial stability risks, and calibrate the CCyB as the extra capital needed to offset the macrofinancial feedback across the business cycle

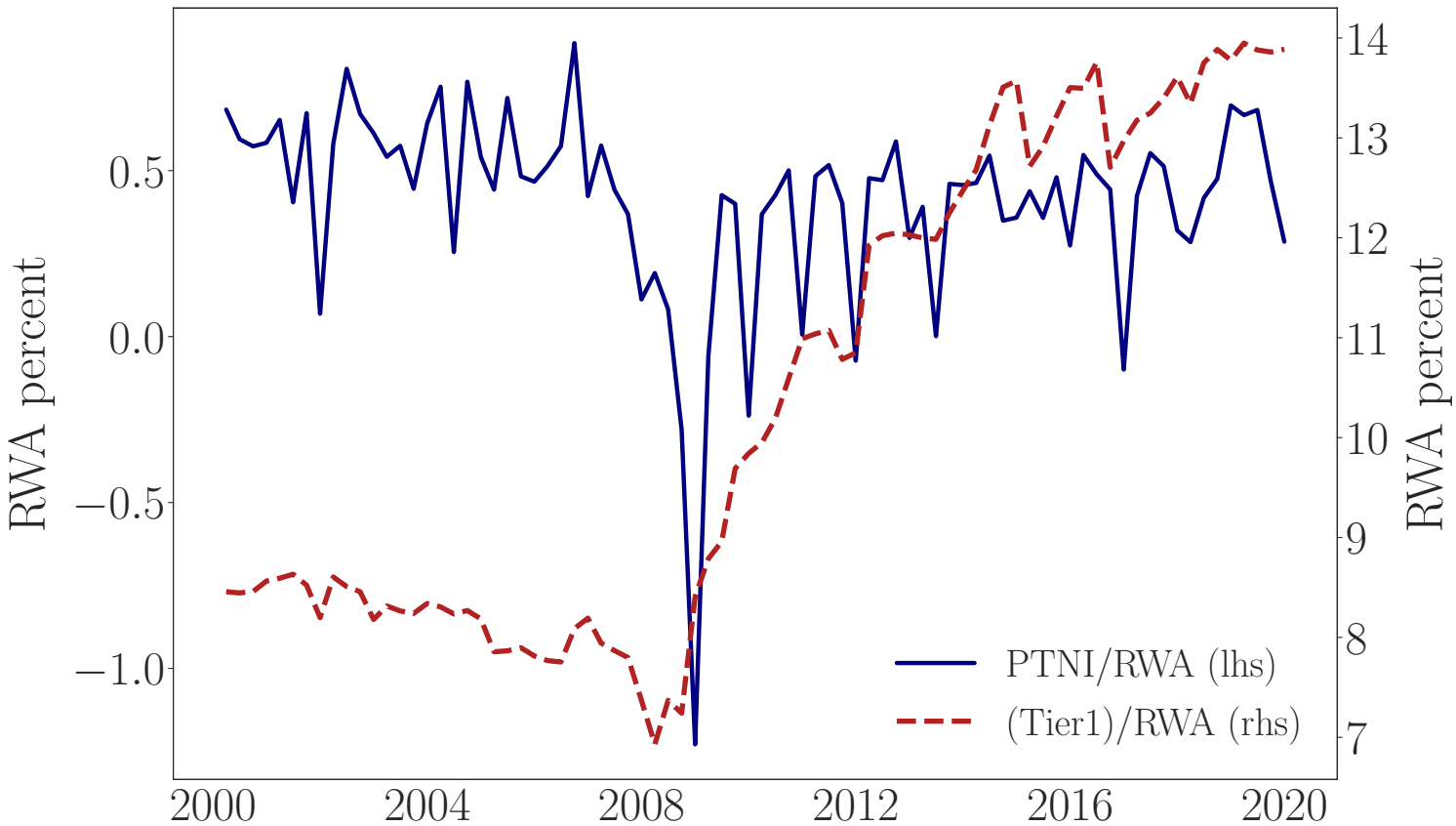
Data

- Quarterly data from 2000 Q1 to 2019 Q4
- Contemporaneous and lagged interactions of GDP growth, changes in bank capital (Δc), and a Financial Condition Index
- FCI uses financial variables in 2020 CCAR scenario, estimated via partial least squares



US banks' average PTNI/RWA and Tier1 Capital/RWA

- $PTNI = PPNR - Net\ Losses$
- Evolution of bank capital ratio (as % RWA) follows:
  $Ratio_{i,t} = Ratio_{i,t-1} + PTNI_{i,t} - Tax_{i,t} - Cap.\ Distribution_{i,t}$



Recursive Quantile Regression Model with Triangular Ordering

$$y_{t+1} = \underbrace{\beta^q_{y,y} y_t + \beta^q_{\Delta,y} \Delta c_t + \beta^q_{f,y} fci_t + \beta^q_{c,y} c_t}_{\Omega_t} + \epsilon^q_y$$

$$\Delta c_{t+1} = \beta^q_{y1,\Delta} y_{t+1} + \underbrace{\beta^q_{y,\Delta} y_t + \beta^q_{\Delta,\Delta} \Delta c_t + \beta^q_{f,\Delta} fci_t + \beta^q_{c,\Delta} c_t}_{\Omega_t} + \epsilon^q_\Delta$$

$$fci_{t+1} = \beta^q_{y1,f} y_{t+1} + \beta^q_{\Delta 1,f} \Delta c_{t+1} + \beta^q_{c,f} c_{t+1} + \beta_{\Omega,f} \Omega_t \; + \; \epsilon^q_f$$

$$\tilde{c}_{t+1} = \tilde{c}_t + \Delta c_{t+1} \quad \text{(Deterministic law of motion)}$$

- y_t : US Real GDP growth; fci_t: US Financial conditions
- Δc_t: PTNI/RWA; c_t: Tier 1 Capital/RWA
- $\tilde{c}_t$: Counterfactual Tier 1 Capital/RWA only changing with the law of motion
- Dynamic simulation via quantile sampling (Schmidt & Zhu 2016)

Endogeneity

- Endogeneity between financial conditions and regulatory capital
- $\Delta c_{t+1} = \beta^q_{y1,\Delta} y_{t+1} + \beta^q_{y,\Delta} y_t + \beta^q_{\Delta,\Delta} \Delta c_t + \beta^q_{f,\Delta} fci_t \; + \; \epsilon^q_\Delta$
- $fci_{t+1} = \beta^q_{y1,f} y_{t+1} + \beta^q_{f,\Delta} \Delta c_{t+1} + \beta^q_{f,c} c_{t+1} + \Omega_t \; + \; \epsilon^q_f$
- Instrumentation via granular instruments (Gabaix and Koijen 2020)
  - Instrument average Δ capital and capital with **bank's granular PTNI/RWA and Tier1 Capital/RWA** data respectively
  - Instrument FCI with **bank's granular EDF** (expected default frequency), **granular CAPM costs** (banks' funding costs) and **US monetary policy shocks** from Cieslak and Schrimpf (JIE 2019)

Granular Instruments (Gabaix and Koijen 2020)

1. **Panel regression** with time and fixed effects at the granular level: $c_{i,t} = \alpha_i + \lambda_t + \epsilon_{i,t}$

2. **Principal component analysis** with K components on the panel residuals: $\epsilon_{i,t} = \sum_{k \in K} \Lambda_k + \nu_{i,t}$

3. The granular instrument is the **average of largest banks' idiosyncratic shocks** $\nu_{i,t}$: $I_t = \sum_{l \in L} w_{l,t} \nu_{l,t}$ where $w_{l,t}$ is the share of bank l assets into the banking system total assets

- The cross-sectional and time orthogonalization of shocks via panel and PCA → **exclusion restriction** with ϵ^q

- The averaging of the largest idiosyncratic shocks → **relevance condition**: the idiosyncratic shocks of largest banks are likely to impact the endogeneous variable.

Macrofinancial Feedback Loop

- The direct effect is defined as the real or financial impact from GDP or from FCI to the banks (standard stress-tests)
- The macrofinancial feedback loop is the second-round impact of shocked bank capital on the economy and the financial sector (deleveraging, increased risk premium, etc.)
- In other words, it reflects how banks amplify the economic/financial crisis at different points of the distribution of GDP and FCI.
- **Macrofinancial feedback**: calculated as the difference in projected path of GDP growth in the unrestricted model and a restricted model that shuts down responses of GDP growth and FCI to the change in capital.

Restricted Model

We consider the model where we shut down the impact of capital on GDP and FCI:

$$y_{t+1} = \beta^q_{y,y} y_t + \beta^q_{\Delta c,y} \overline{\Delta c}_{t0} + \beta^q_{c,y} \bar{c}_{t0} + \beta^q_{f,y} fci_t \ + \ \epsilon^q_y$$

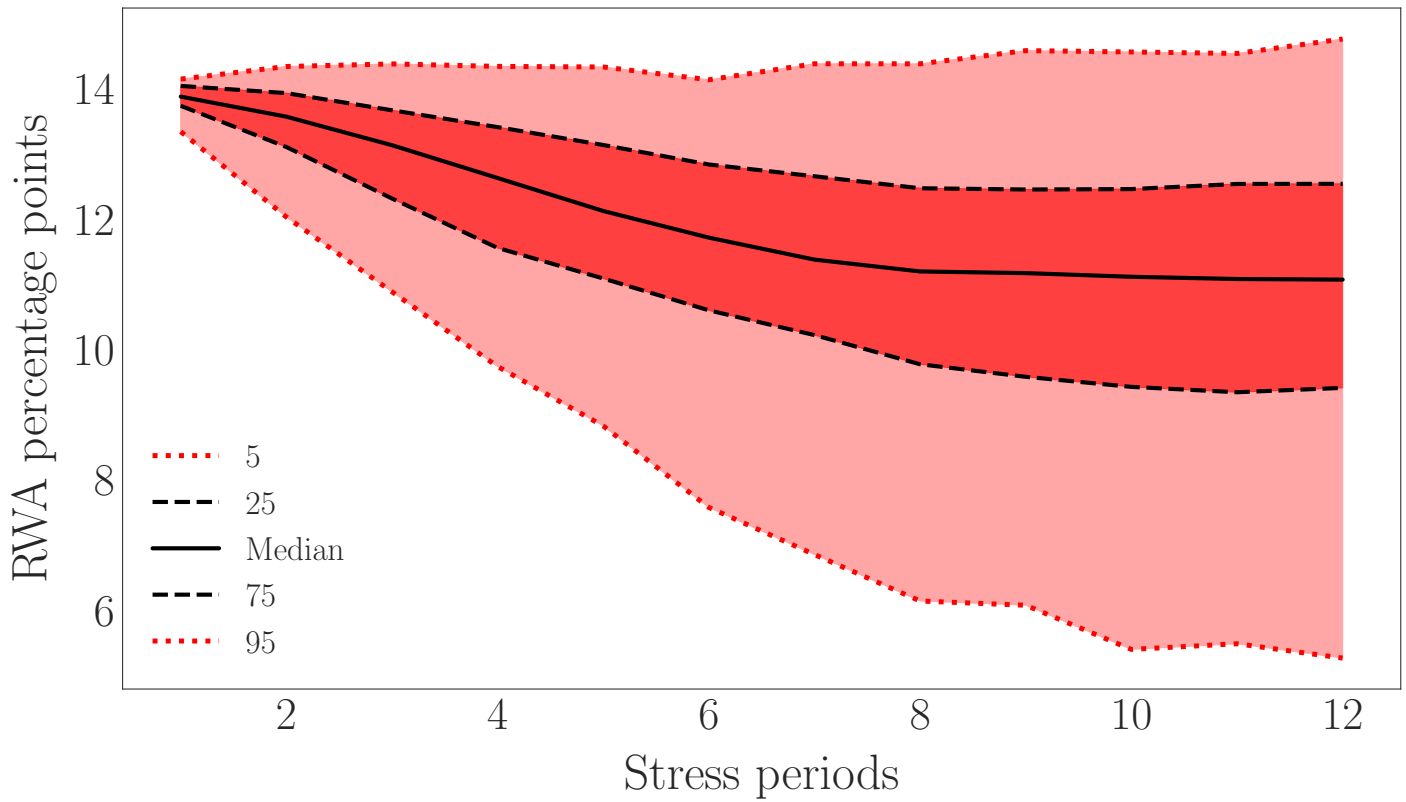
$$\Delta c_{t+1} = \beta^q_{y1,\Delta} y_{t+1} + \beta^q_{y,\Delta} y_t + \beta^q_{\Delta,\Delta} \Delta c_t + \beta^q_{c,\Delta} c_t + \beta^q_{f,\Delta} fci_t \ + \ \epsilon^q_\Delta$$

$$fci_{t+1} = \beta^q_{y1,f} y_{t+1} + \beta^q_{\Delta c,f} \overline{\Delta c}_{t0} + \beta^q_{c,f} \bar{c}_{t0} + \beta^q_{y,f} y_t + \beta^q_{f,f} fci_t \ + \ \epsilon^q_f$$

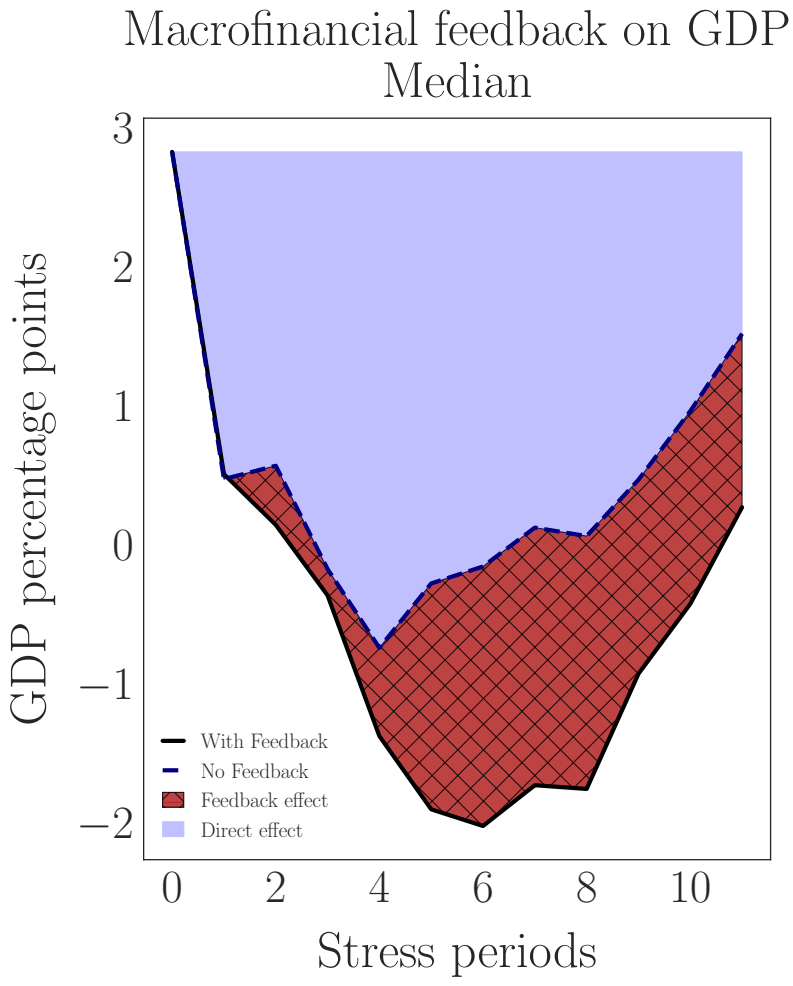
- To avoid inducing intercept-driven shocks, we keep both banks' capital/RWA and PTNI/RWA constant at their initial level
- The macrofinancial feedback is therefore shutdown in the restricted model

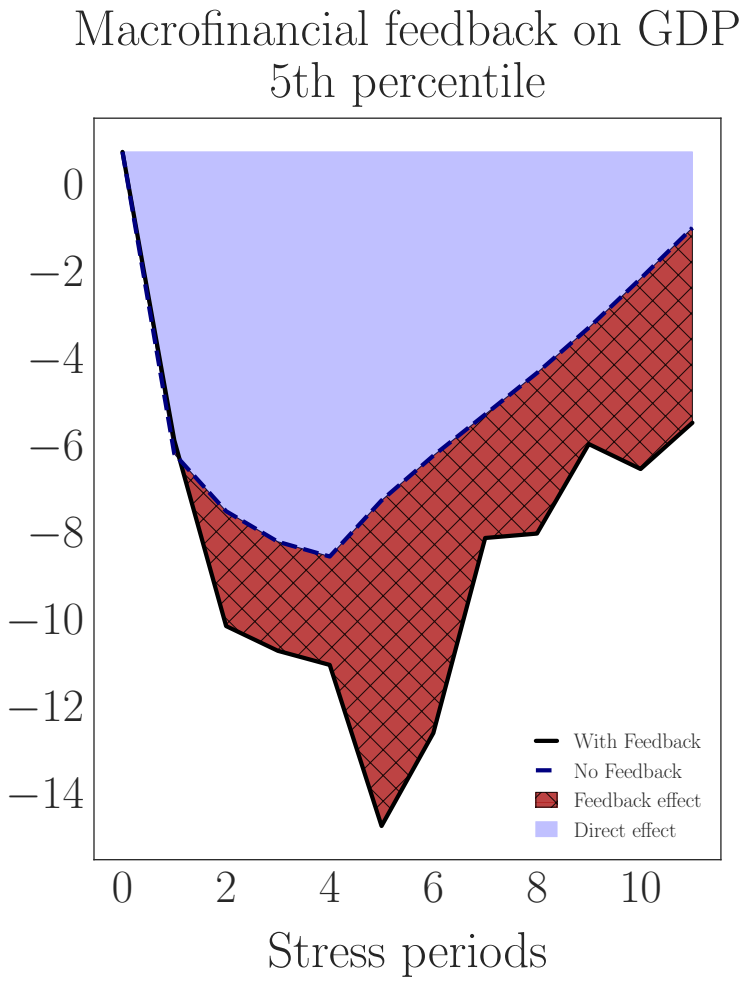
Our Empirical Model and CCAR Results

- Our simple framework replicates the aggregate path of bank capital (Tier 1 Capital/RWA) over a 3-year horizon under the CCAR severely adverse scenario: about 3 p.p. median decline from start to minimum.



Feedback Loop impact on the GDP Path from 2019 Q4

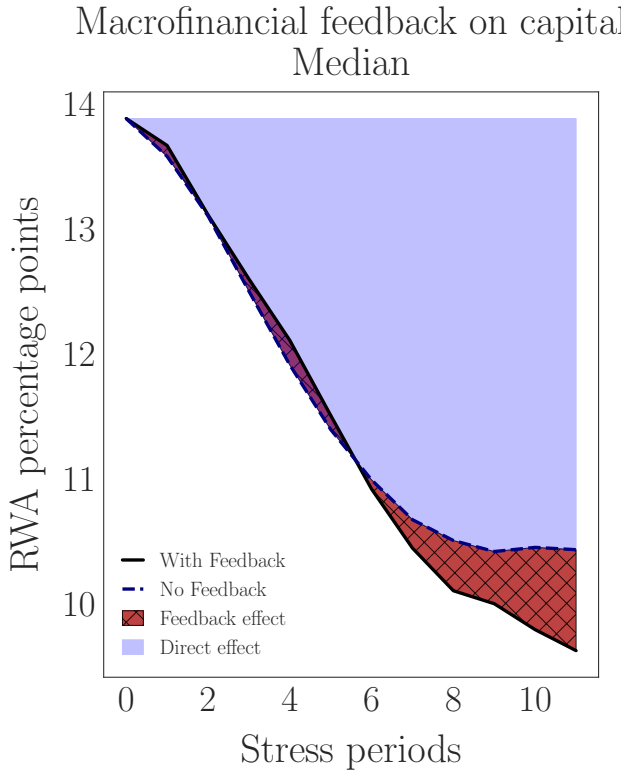


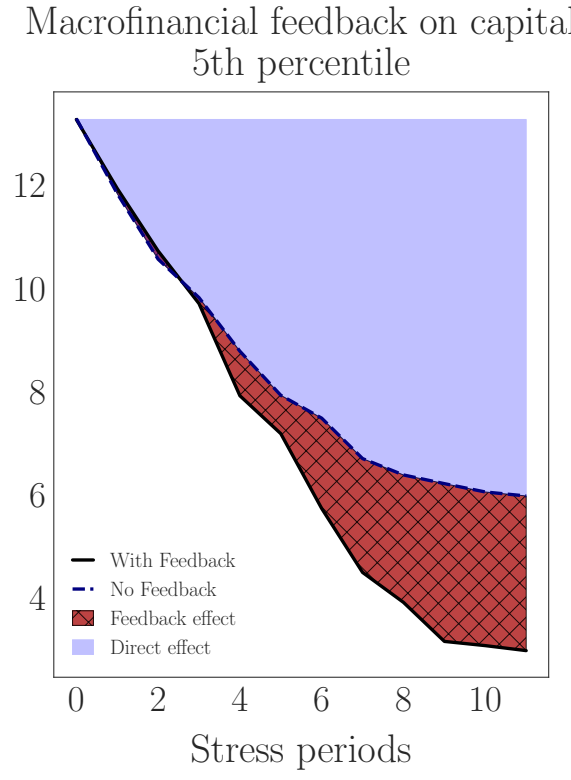


Feedback Loop Impact on Capital Path from 2019 Q4

Capital surcharge: additional capital needed to offset banks' macrofinancial feedback:

- In 2019, **A capital surcharge of 1.5 p.p. for the median** will be needed to offset a macrofinancial feedback impact on GDP of around 2 p.p. for the median.





Growth-at-Risk Gap as Vulnerabilities Metric and the Capital Surcharge

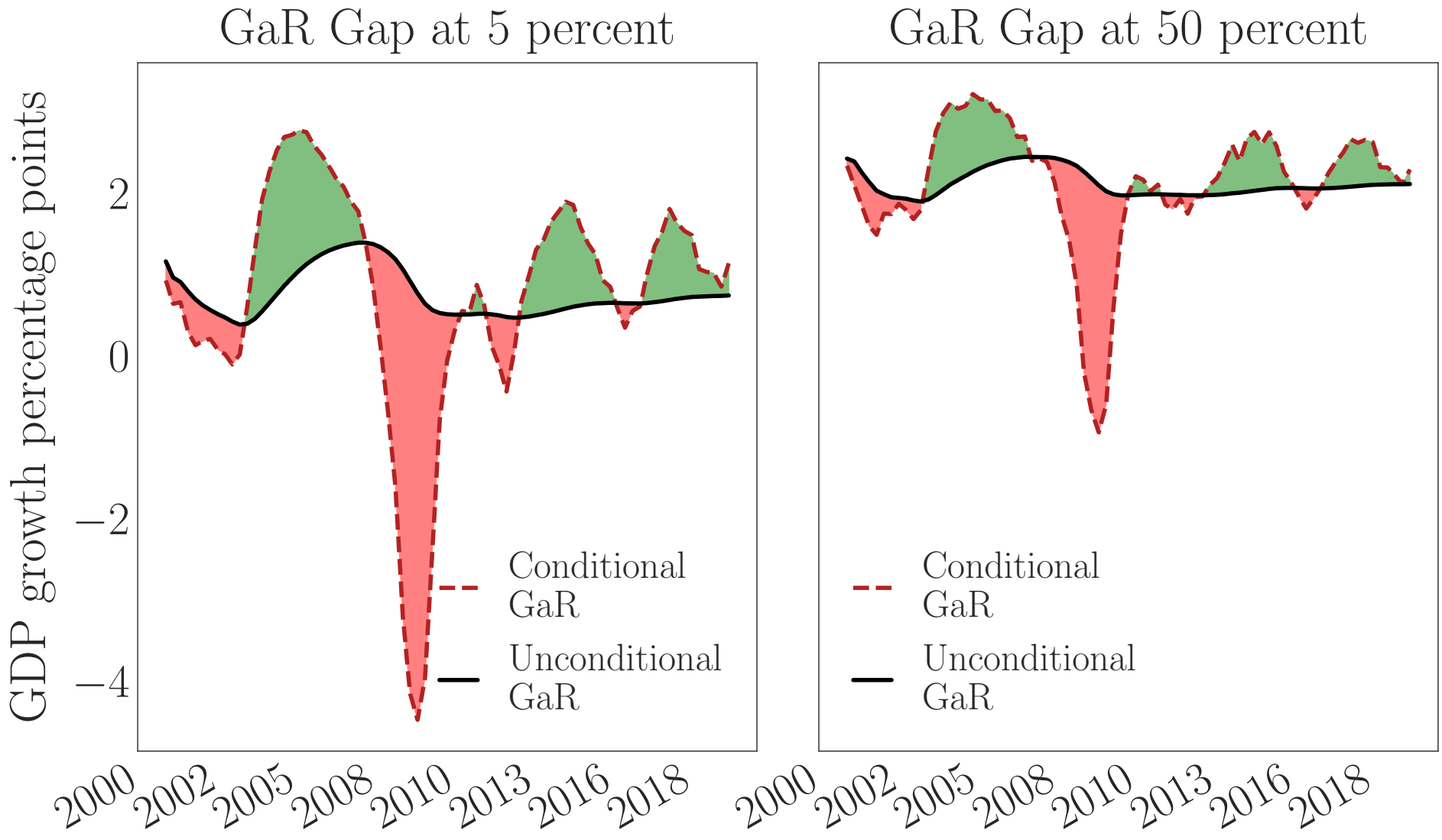
- GaR estimates downside risks to GDP:
  - It is a forward-looking, time-varying metric that depends on the state of the economy (conditional distribution)
  - Natural anchor: unconditional Growth at Risk, updated with historic sample and incorporating structural changes

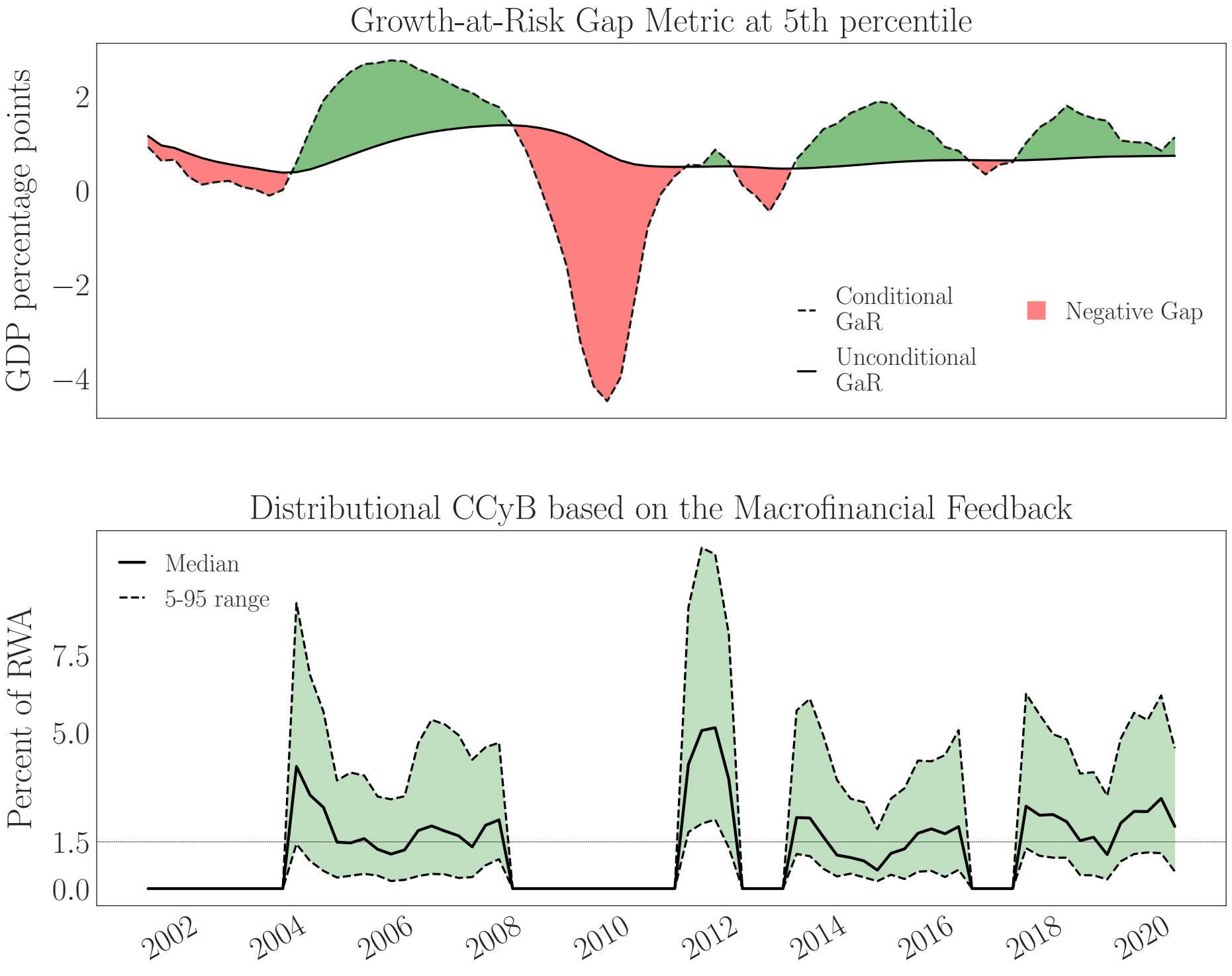
- Difference between conditional and unconditional GaR: **cyclical versus structural vulnerabilities**.

- This provides a **counter-cyclical, state-dependent and risk-based capital surcharge**

- The capital surcharge is defined as the additional bank capital needed to offset the macrofinancial feedback across the business cycle, at a given risk level (CCyB)

Counter-cyclical Growth-at-Risk Gap Metric



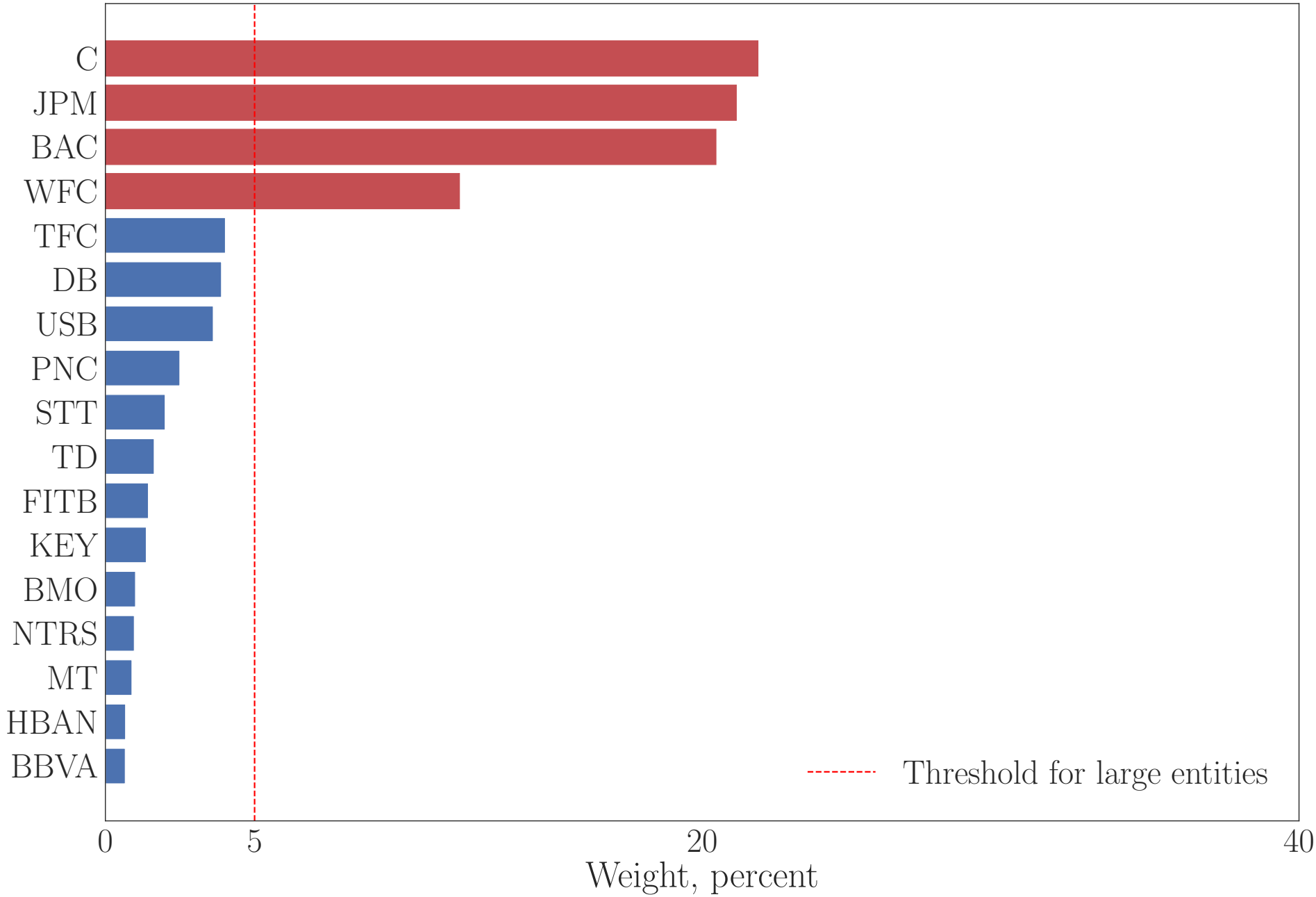

Growth-at-Risk Gap Metric at 5th percentile
GDP percentage points
2
0
−2
−4
Conditional GaR
Unconditional GaR
Negative Gap
Distributional CCyB based on the Macrofinancial Feedback
Percent of RWA
Median
5-95 range
7.5
5.0
1.5
0.0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

Expanding the Current Stress Testing Framework

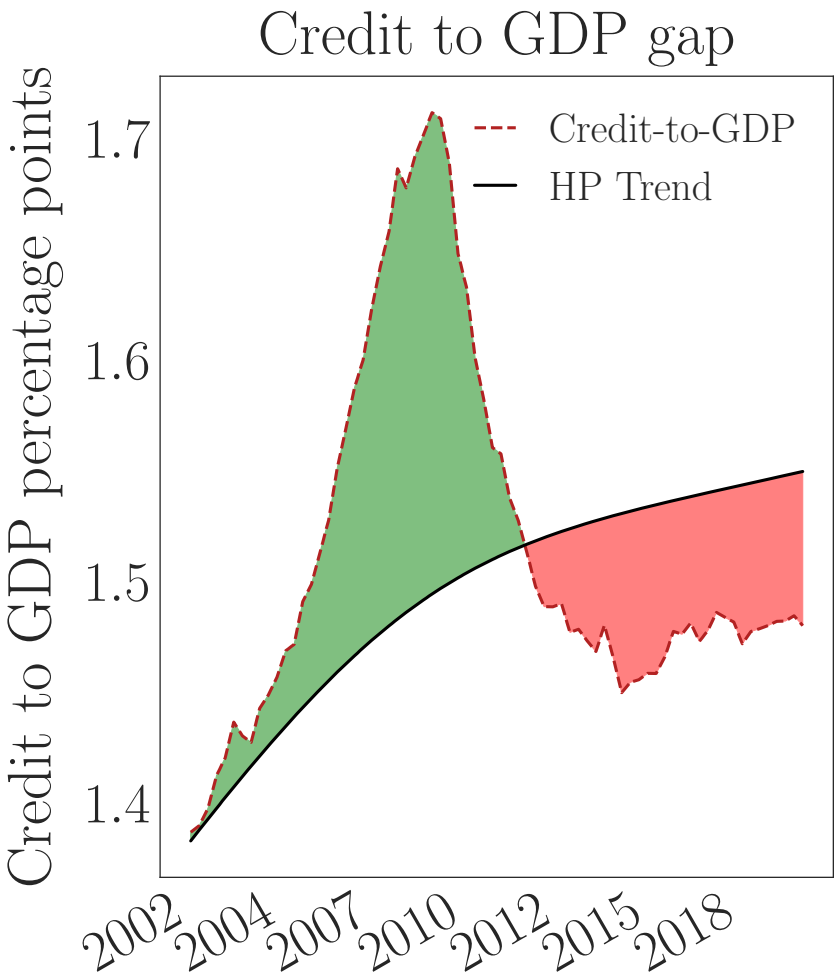
- Traditional stress tests overlook macrofinancial feedback effects
- Our methodology can easily augment the current stress testing machinery to include the calculation of the **macrofinancial feedback** and **the capital surcharge**:
  - Quick implementation using simple auxiliary equations relative to models currently estimated
- Our framework provides simple guidelines that use stress tests to inform the setting of the **countercyclical capital buffer**
- It is applicable to any stress testing approach (e.g., macro scenarios of different severity, different planning horizons) and thus can be easily adopted by supervisors

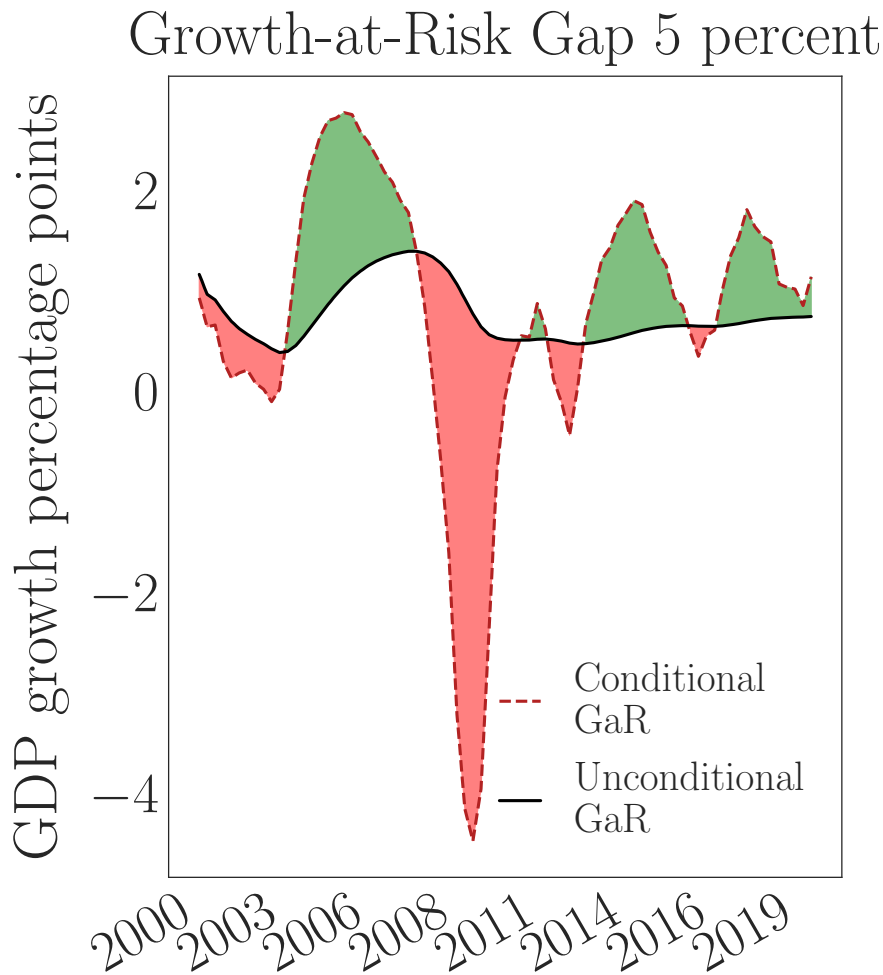
Appendix Slides

Market Share by Banks and Selection Threshold



Credit to GDP Gap vs. Growth-at-Risk Gap Metric





Growth-at-Risk Gap vs Credit-to-GDP gap

- Our GaR Gap measure improves upon alternative measures of financial vulnerabilities, such as the Credit-to-GDP Gap:
  - Credit-to-GDP gap measures one potential source of vulnerabilities (e.g., excessive credit relative to GDP), whereas the **GaR Gap summarizes different vulnerabilities into one consistent metric**
  - Credit-to-GDP gap reacts slowly to the cycle: empirical evidence suggests it is a poor counter-cyclical indicator
  - Credit-to-GDP gap is not risk-based, does not capture amplification in the tails
  - HP filter suffers from many statistical shortcomings (end-point problem, choice of lambda, over-persistent trend, etc.), which makes it difficult for policy use