



BANK OF ENGLAND



# How do financial vulnerabilities and bank resilience affect medium-term macroeconomic tail risk?

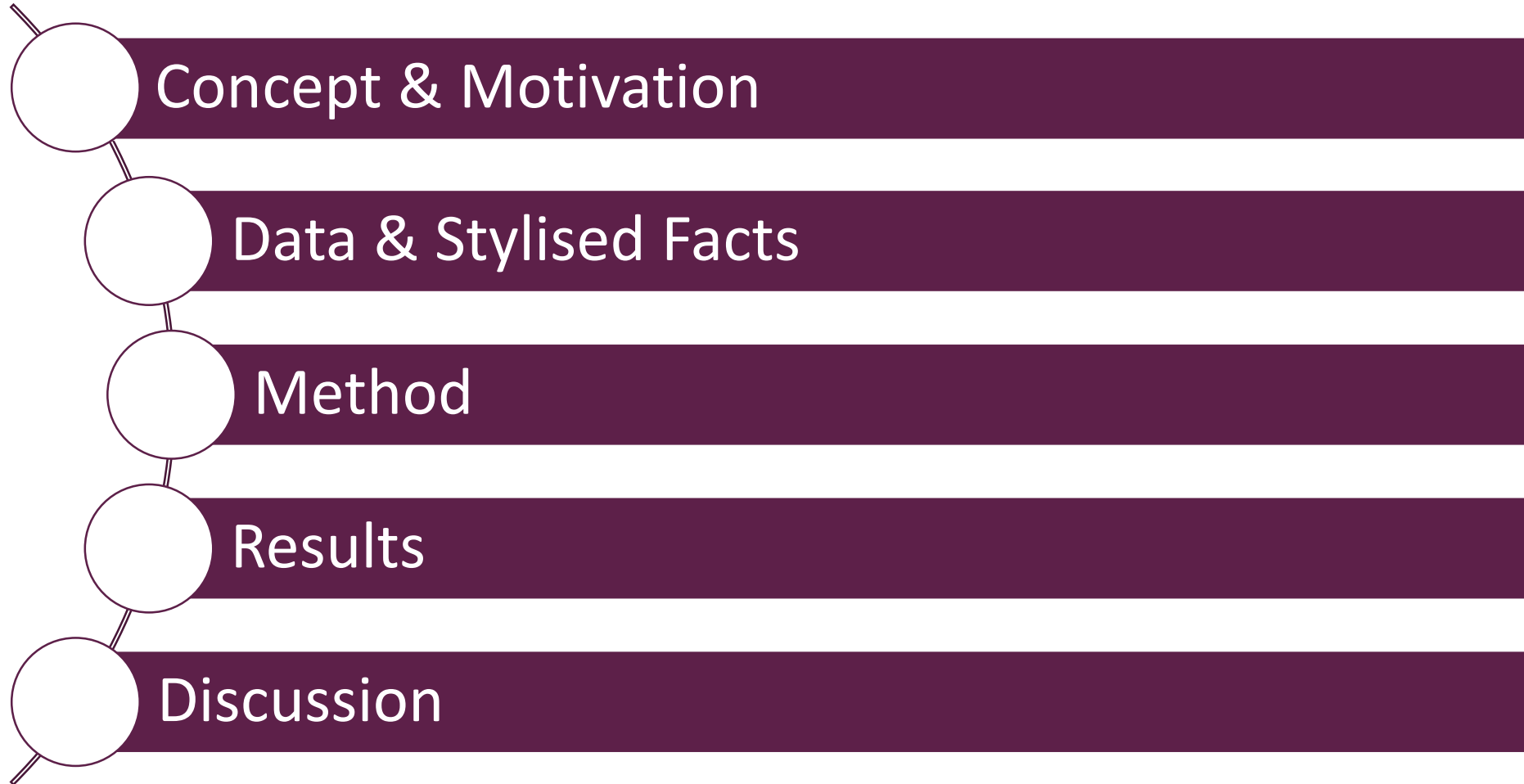
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**4 June 2019**

*This presentation represents the views of the authors and not necessarily those of the Bank of England or its committees*



# Outline



# Motivation

- Clear lessons from financial crises:
  - Systemic risks must be monitored
  - Early warning indicators are needed
  - Resilience needs to be built up during upswing
- Policy committees set up around the world for this purpose
- Operationalising macroprudential regime requires research on two important relationships:
  - a) Impact of vulnerabilities on distribution of future GDP
  - b) Role of macroprudential tools in mitigating tail risks
- Second step is at core of CCyB framework: “primarily viewed as a resilience builder”

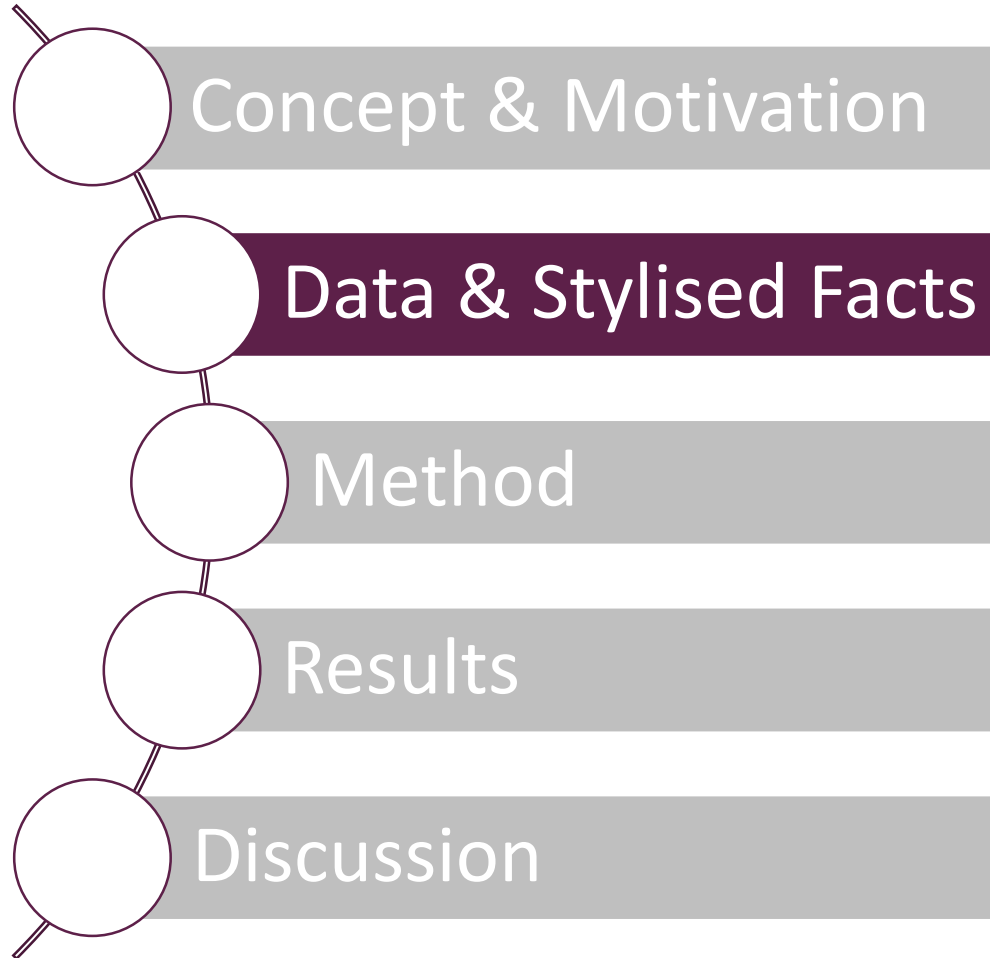
# Related literature and contributions

- Relates most directly with recent work by Adrian *et al.* (2018) & Adrian *et al.* (2019): focuses on relationship between financial conditions and tail risks to GDP growth.
- Cecchetti (2006) and Cecchetti and Li (2008) introduced the application of this technique to study the impact of housing and equity price booms on tail risks.

We contribute to the literature in two ways:

1. Novel result linking tail risk to banking system capital: Severity depends on risk and resilience.
2. Jointly estimate the impact of vulnerabilities, so that we can 'add up' contributions of risk and resilience with emphasis on medium term: use results to decompose how tail risks develop over time

# Outline

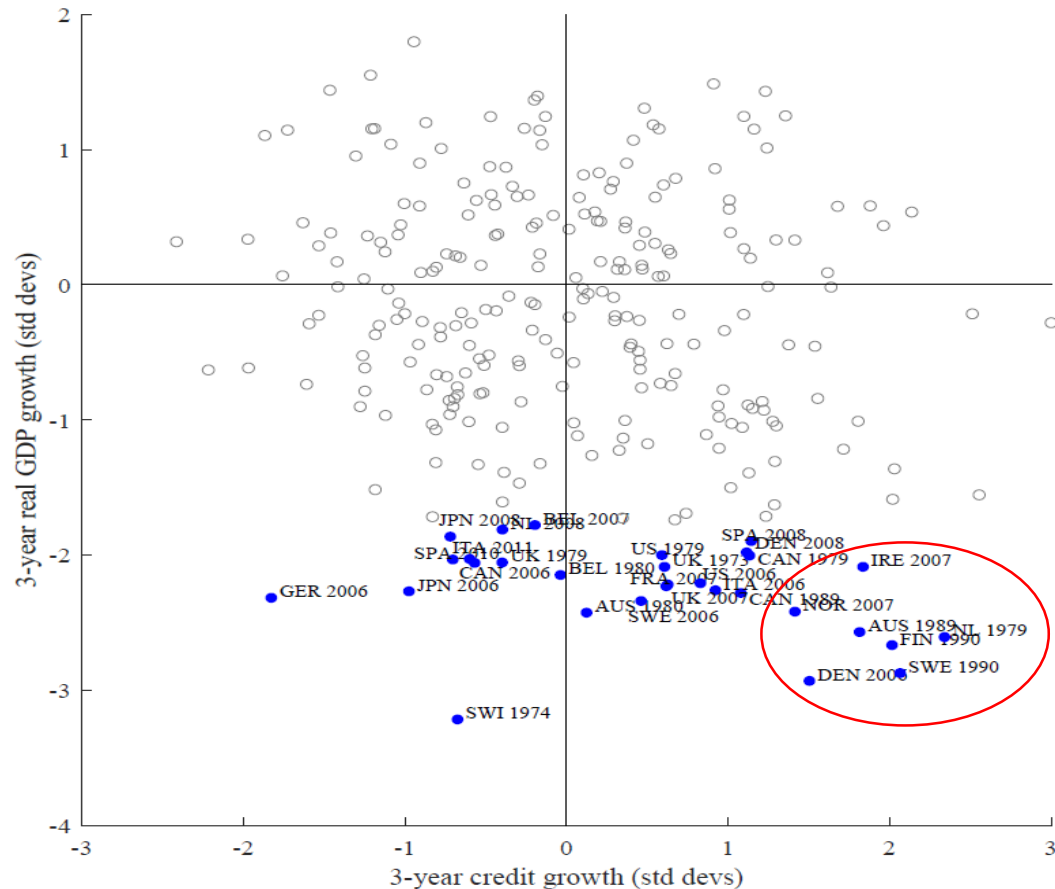


# Data

- Cross-country panel of 16 advanced economy countries over 1980Q4 – 2017Q4
  - Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, UK, USA
- We collect data on five vulnerability measures as explanatory variables:
  - 3 year change in credit-to-GDP
  - 3-year real house price growth
  - Current account deficit
  - Realised equity volatility
  - Banking system capital
- **Capital Ratio:** Measured as tangible common equity over tangible assets
  - Constructed by aggregating bank by bank data into country level measures
  - Use a 'chain weight' approach to account for number of banks changing each period

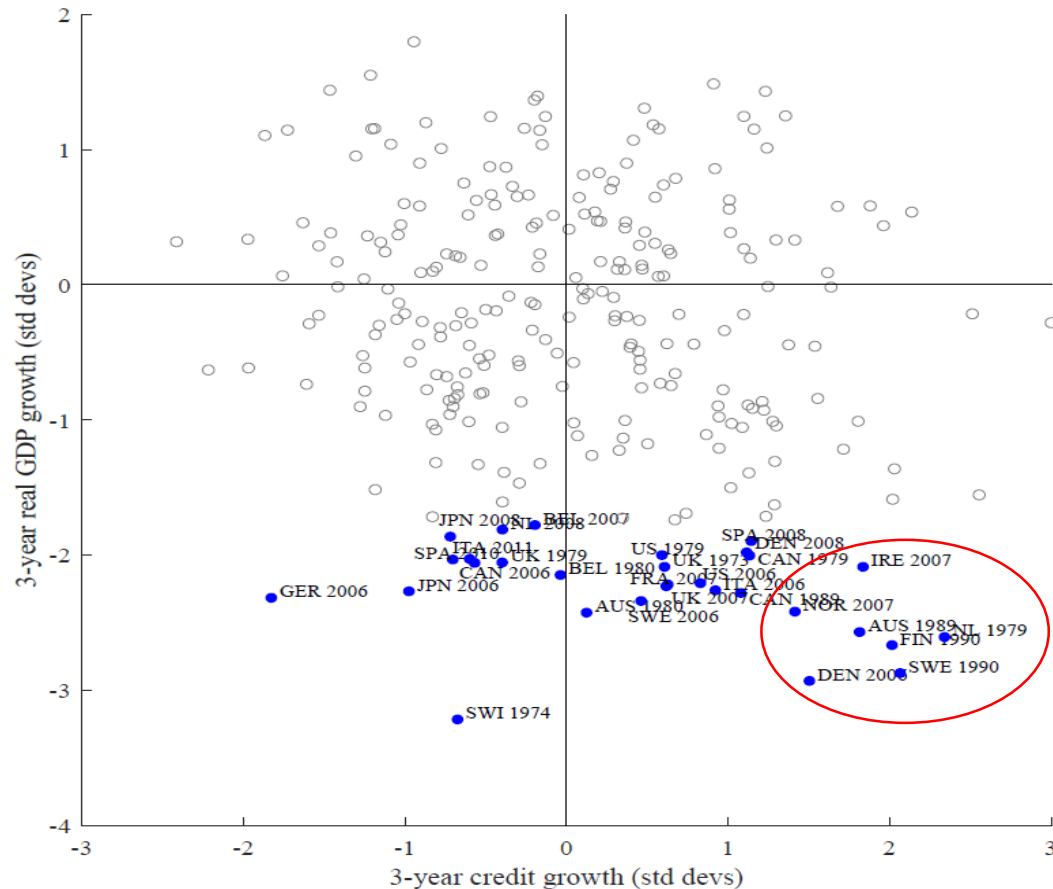
# Correlation of vulnerability indicators with tail events

Credit growth and GDP 'catastrophes'

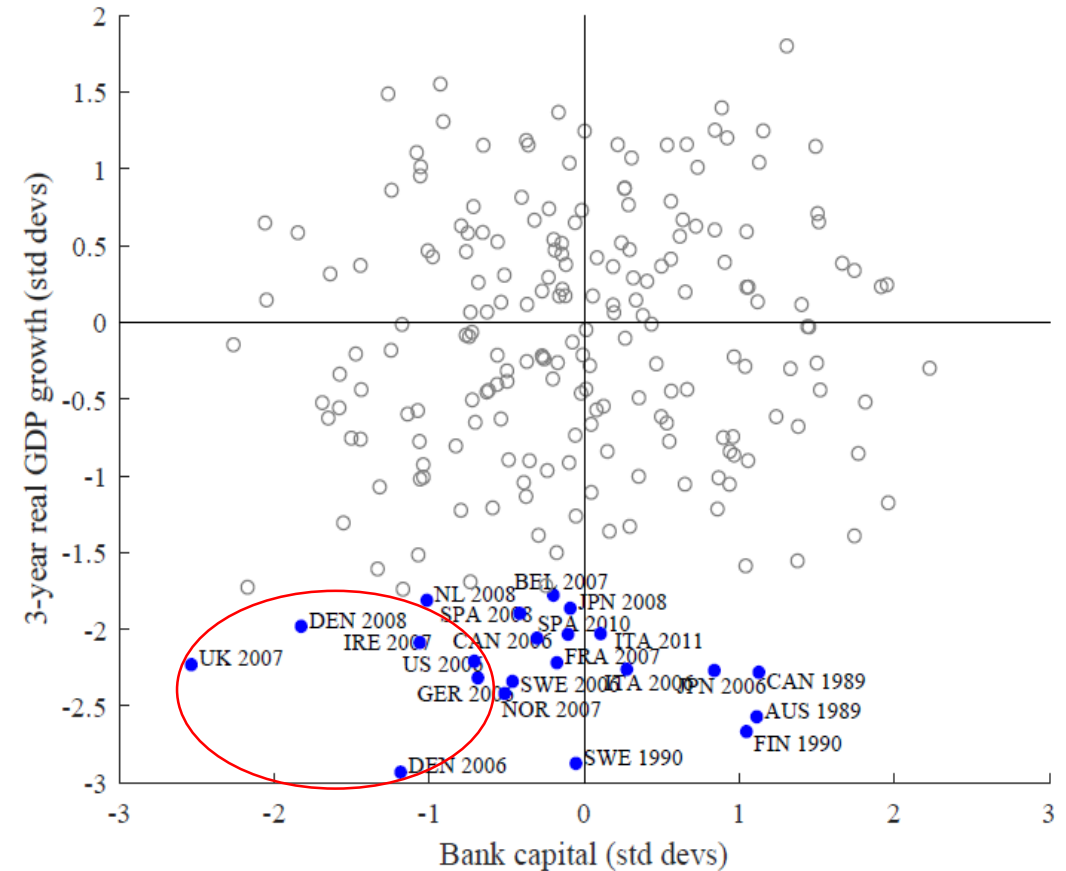


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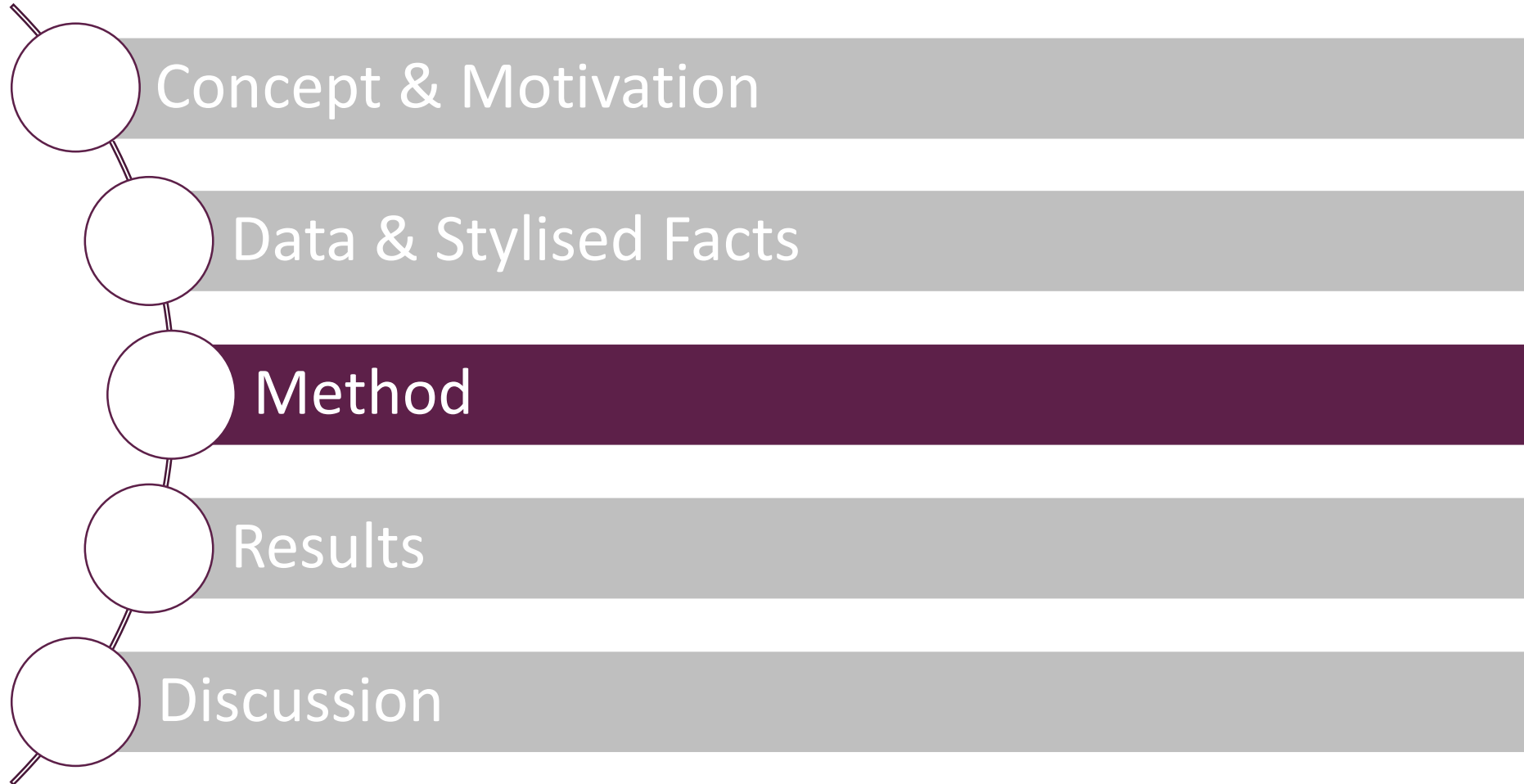
## Credit growth and GDP 'catastrophes'



## Bank capital and GDP 'catastrophes'



# Outline



## Method

- Quantile regressions: assigns more weight to particular parts of distribution
  - We follow Canay (2011): Assumed fixed effects consistent across quantiles, i.e. they affect all of distribution in the same way.
  - Uses a two step process to account for country fixed effects
1. Standard linear panel regression to generate country effects
  2. Quantile regression with the first-stage dependent variable minus the fixed effect on the LHS, and the same independent variables as in the first-stage on the RHS

# Baseline Specification

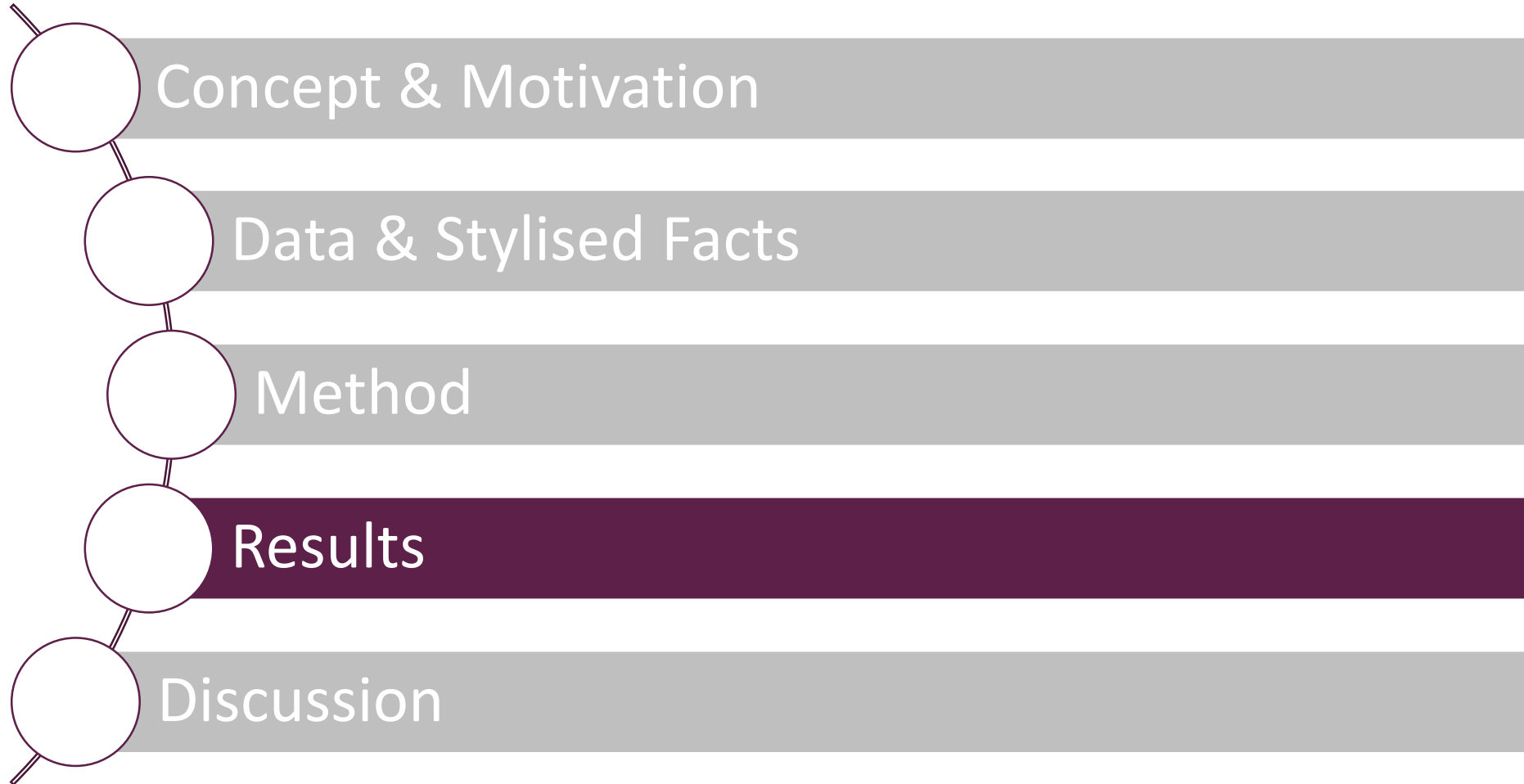
- Estimated from 0 to 20 quarters ahead at different points of distribution
- Baseline results are on 5<sup>th</sup> percentile of GDP growth: we define as ‘GDP-at-Risk’
- At each quarter, GDP growth measured as the average annual growth rate between  $t$  and  $t + h$  for each country  $i$ :

$$\frac{(Y_{i,t+h} - Y_{i,t})}{h/4}$$

- Include 4 risk variables, and the capital ratio to measure resilience. Data standardised by country
- Estimated jointly, so we can ‘add up’ contributions of each

Dependent Variable	Risk	Resilience	Macro Controls
5 <sup>th</sup> percentile of real GDP growth	Credit-to-GDP changes Real house price growth Current account Financial market Volatility	Capital Ratio	Inflation Policy Rate Lagged GDP

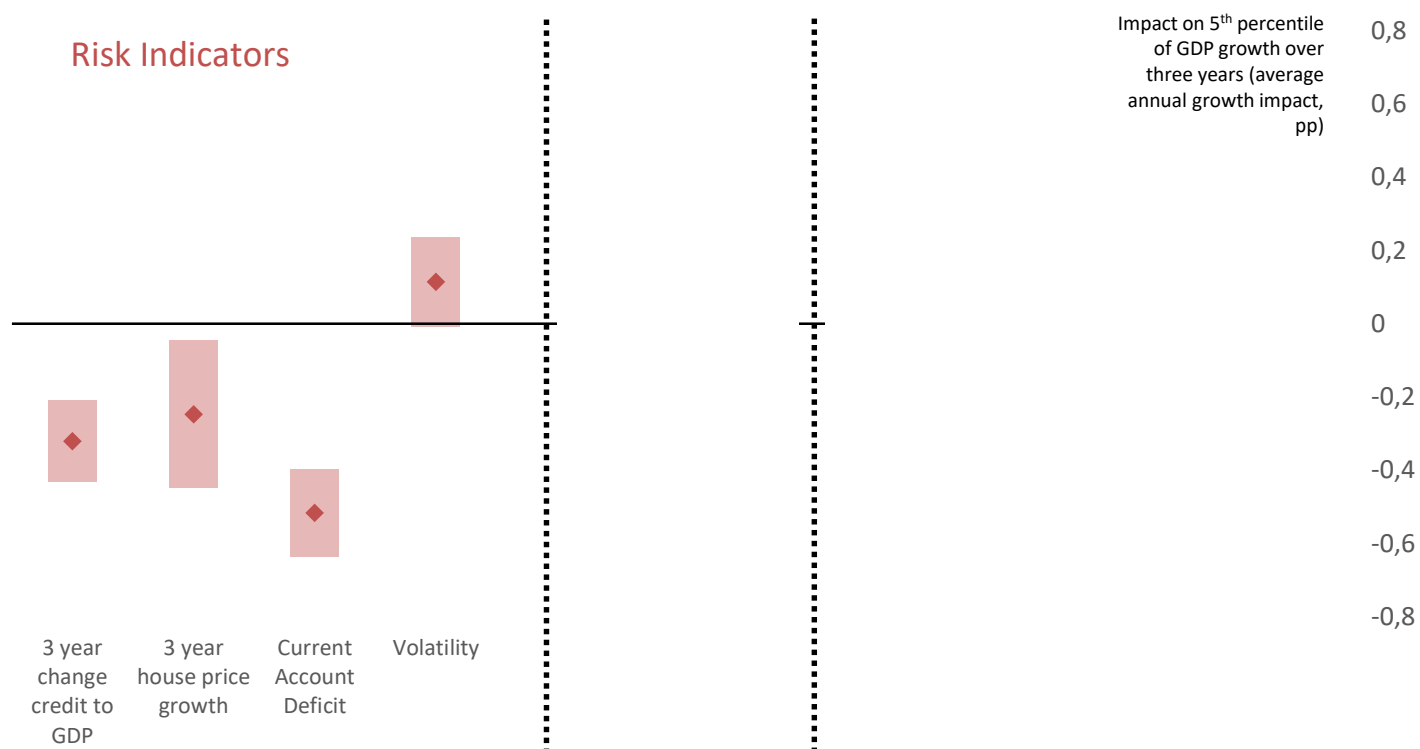
# Outline



# Indicators of downside risks over medium-term

- Focus on medium term: relevant horizon for macroprudential policy
- Credit growth, house price growth and current account deficit all extend tail risk
- No relationship with volatility at this horizon

Impact of each variable on 5th percentile of GDP growth at 3-year horizon

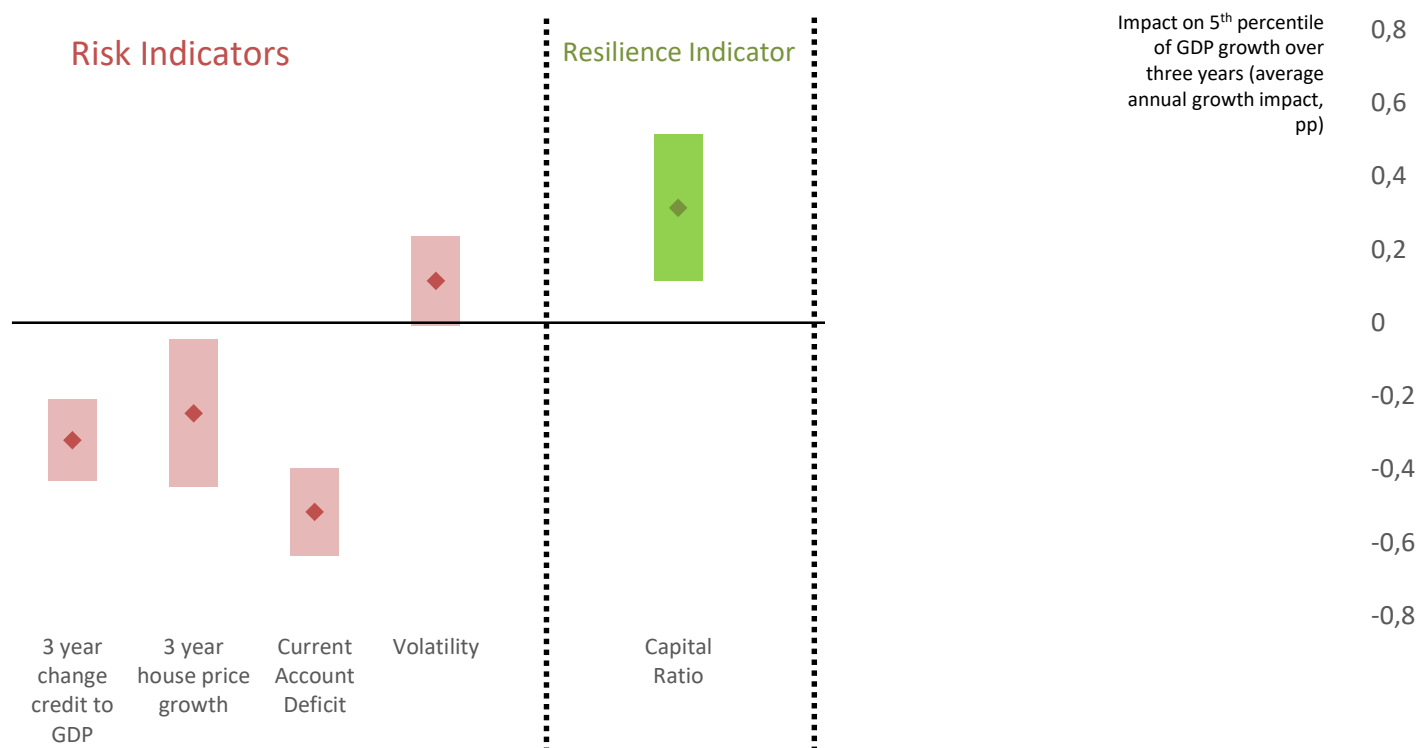


*Note: Chart shows the impact of a one standard deviation change in the indicator at time t on the 5<sup>th</sup> percentile of average annual real GDP growth after 12 quarters. Confidence intervals represent plus and minus 1 standard deviation. Standard errors are generated using block bootstrapping*

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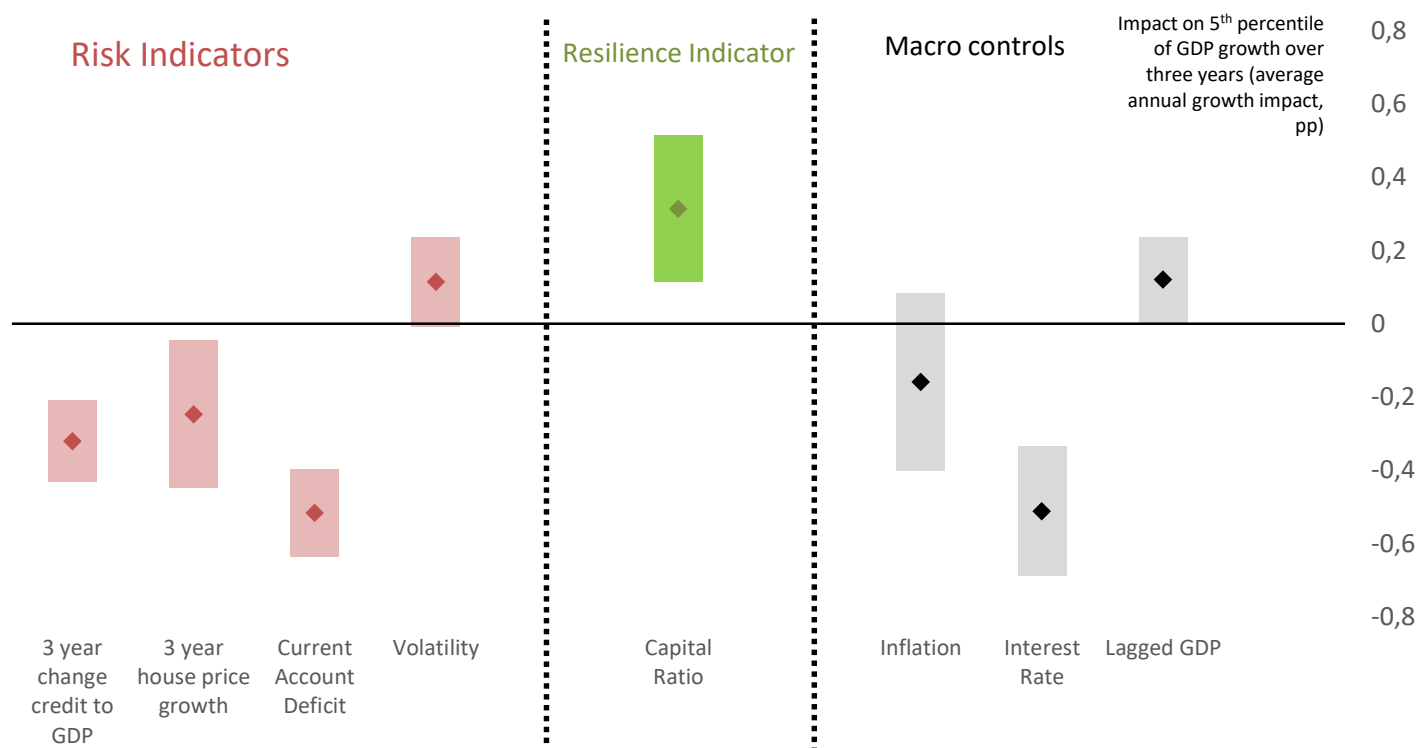


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- Changes in Central Bank policy rate also important

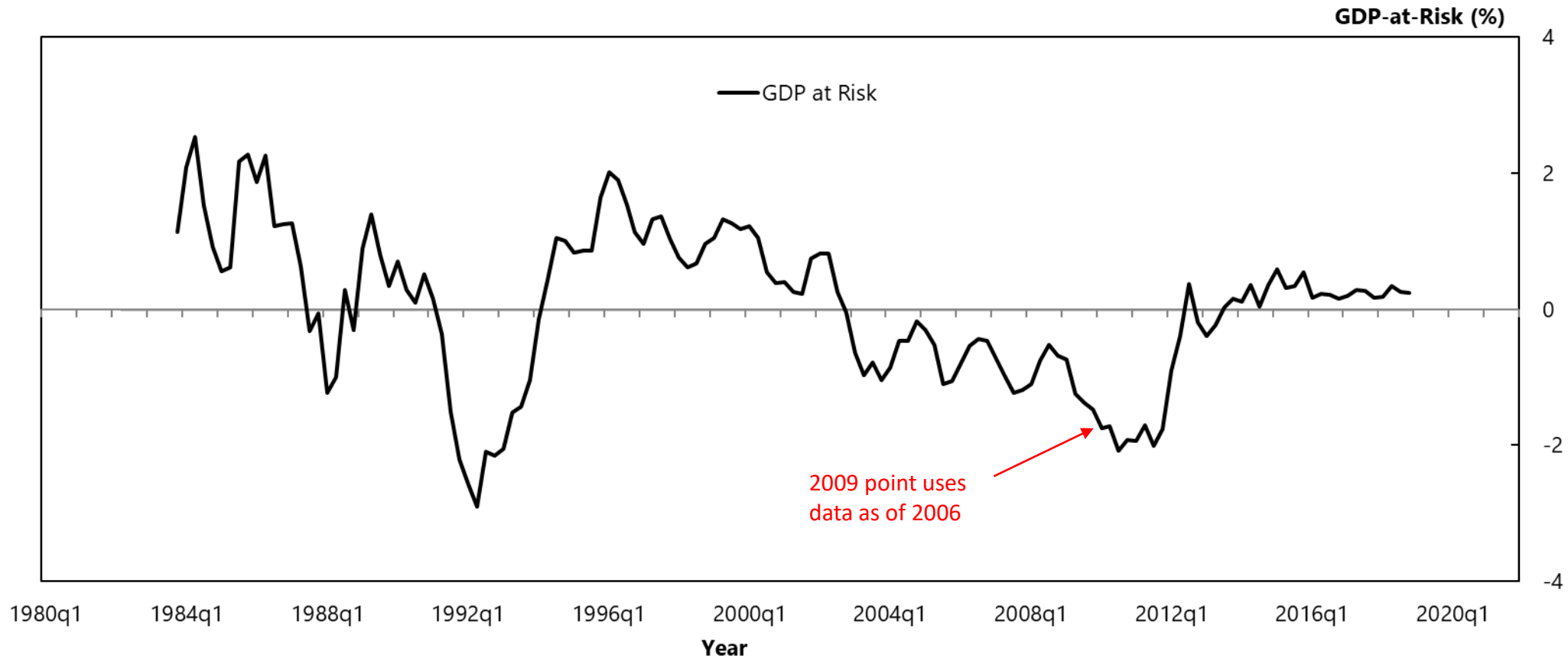
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# Decomposing GDP-at-Risk

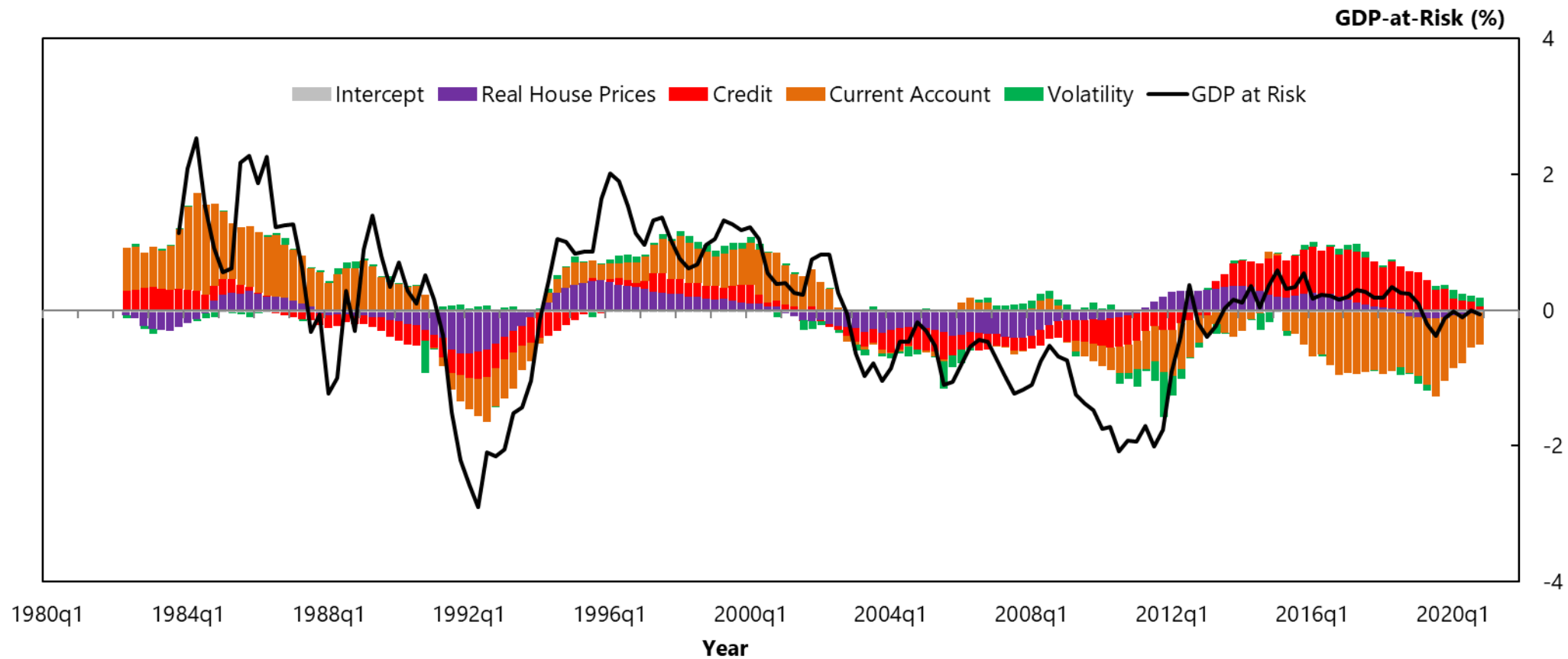
UK GDP-at-Risk (5<sup>th</sup> percentile): 12 quarters ahead



*Note: GDP-at-Risk measured as 5<sup>th</sup> percentile of projected 3-year average annual growth rate of real GDP at each point in time*

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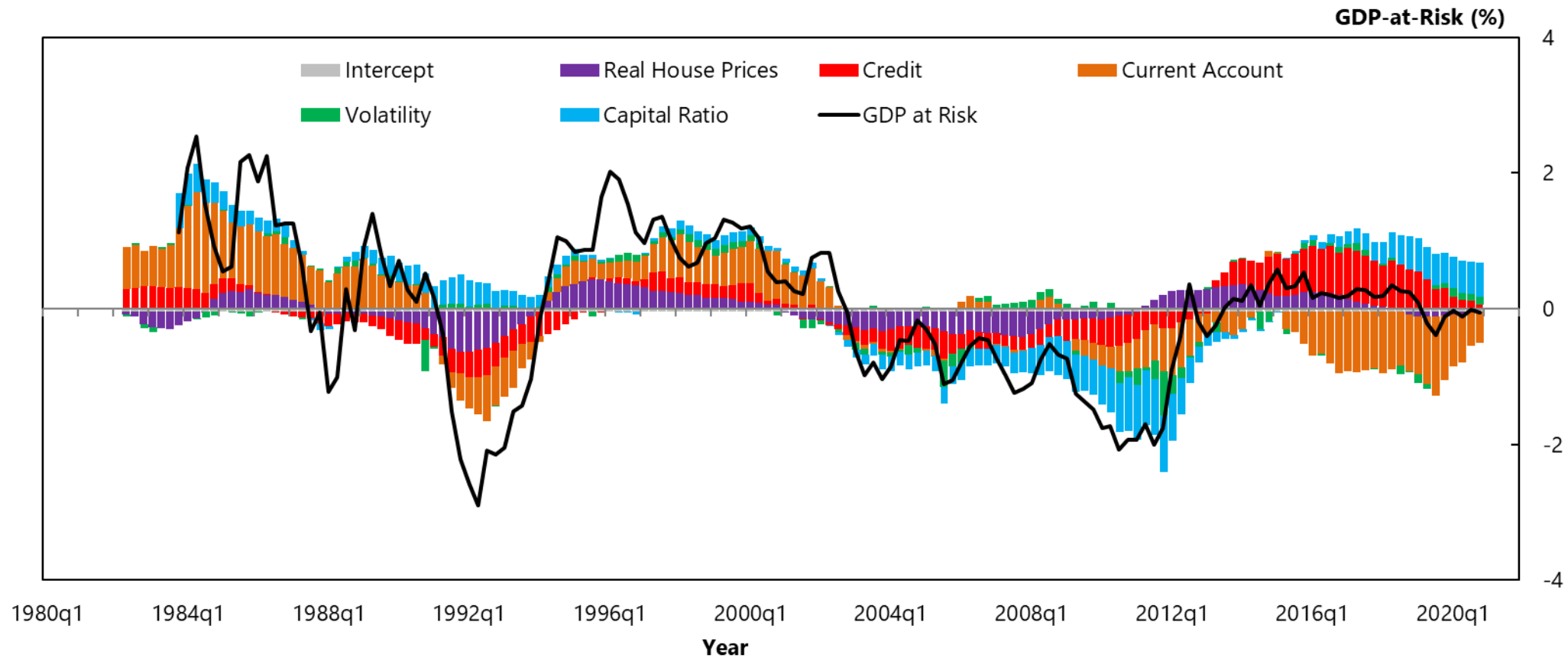
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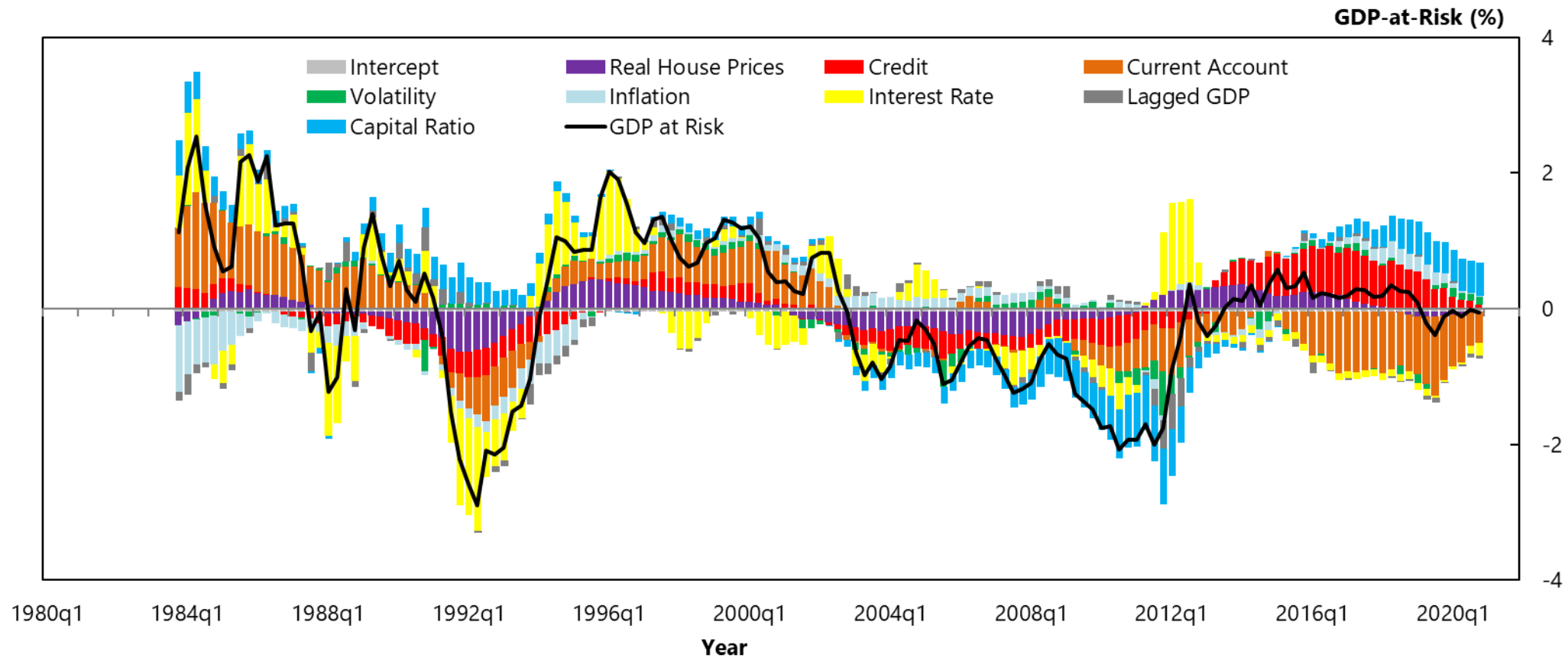
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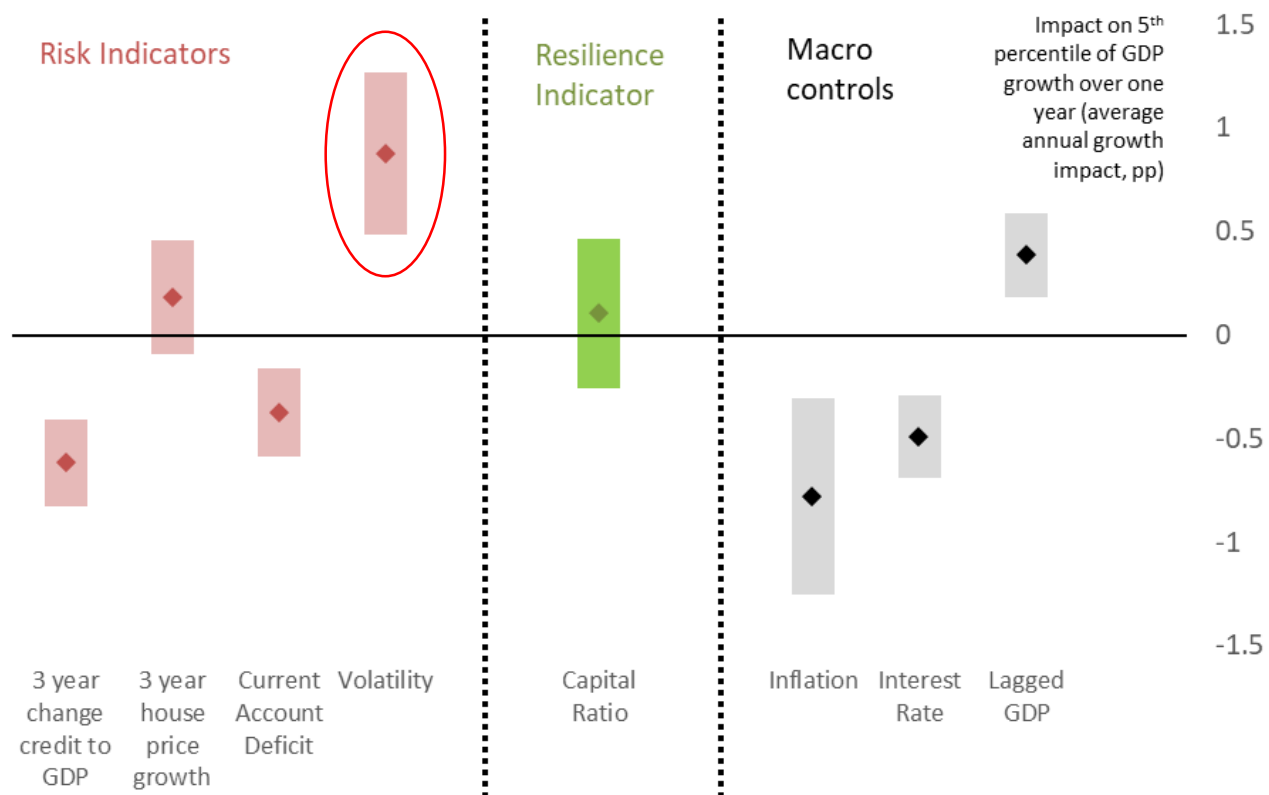
# Indicators of downside risks over medium-term

- Robustness checks produce similar findings:
  - Replacing volatility with a Financial Conditions Index (cuts sample to 1991)
  - Adding a global factor of risky asset prices (Agrippino and Rey (2018))
  - Using annual observations of data
  - Splitting credit into household and corporate
  - Running specification using 1-year instead of 3-year growth rates of credit and house prices

# Indicators of downside risks in near-term

- **Short term:** relevant for loosening macroprudential policy
- Equity market volatility is a key determinant
- Credit growth and current account also important
- House price growth not significant (but positive effect up to 2-quarter horizon)
- Bank capital has no impact on tail risks at this horizon

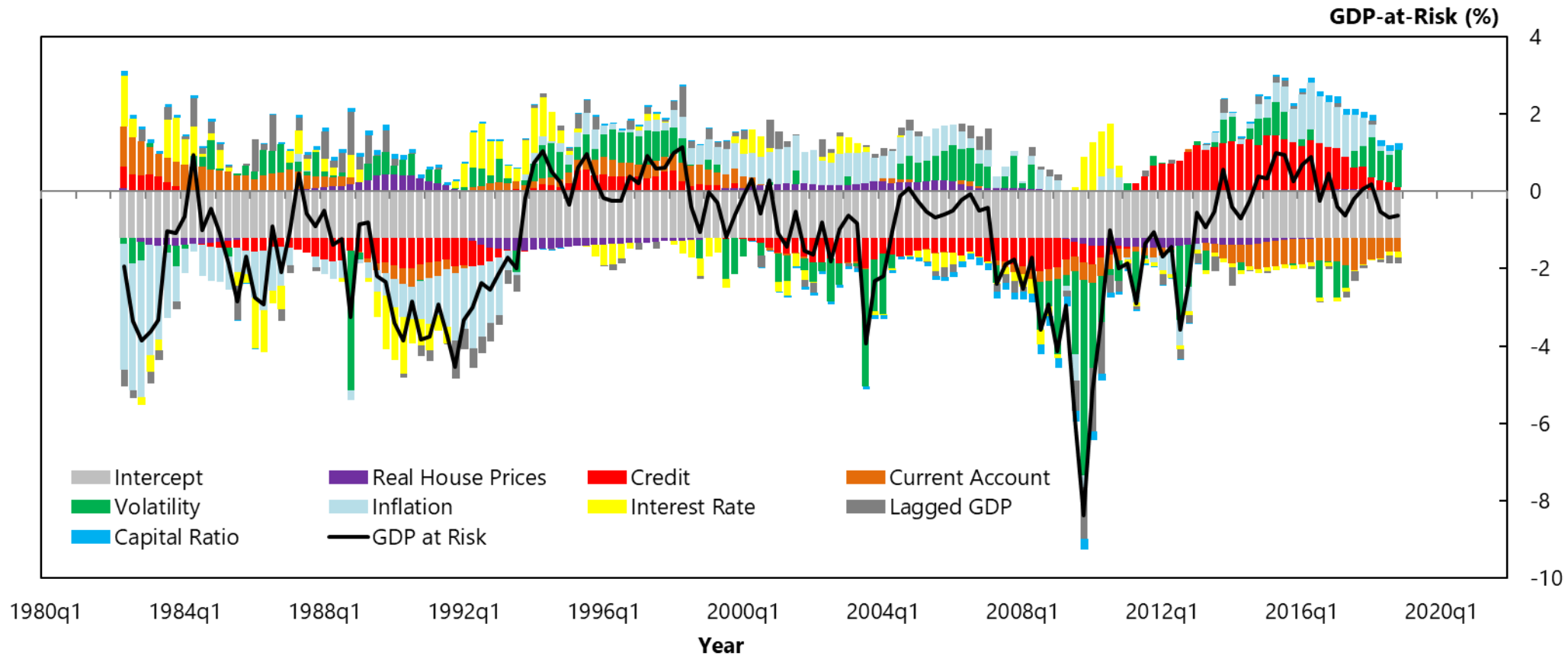
Impact of each variable on 5th percentile of GDP growth at 1-year horizon



*Note: Chart shows the impact of a one standard deviation change in the indicator at time t on the 5<sup>th</sup> percentile of annual real GDP growth after 4 quarters. Confidence intervals represent plus and minus 1 standard deviation. Standard errors are generated using block bootstrapping*

# Decomposing GDP-at-Risk

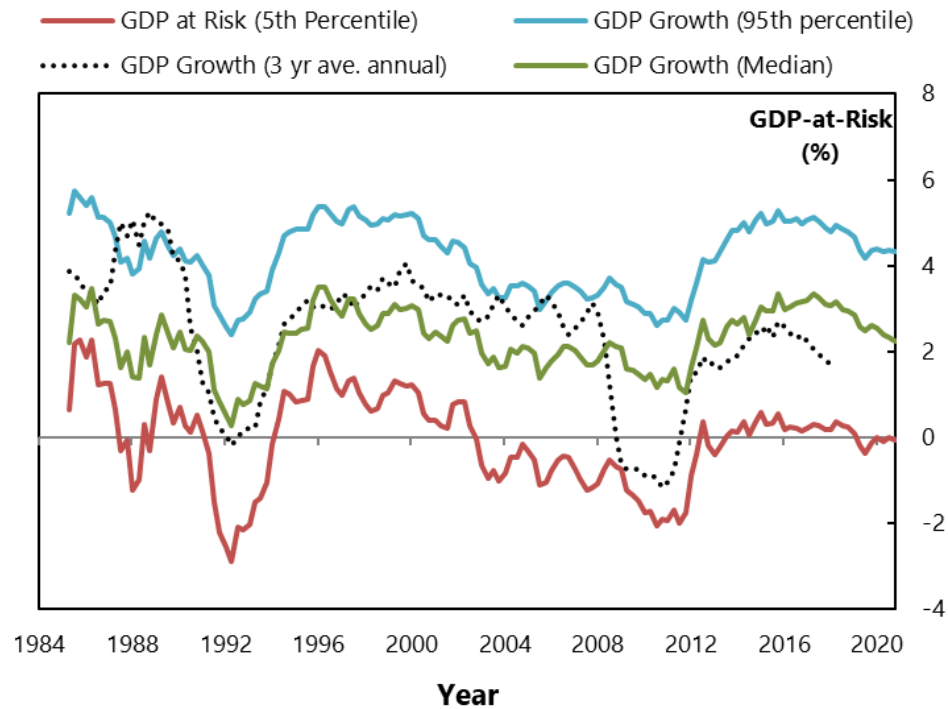
UK GDP-at-Risk (5<sup>th</sup> percentile): 4 quarters ahead



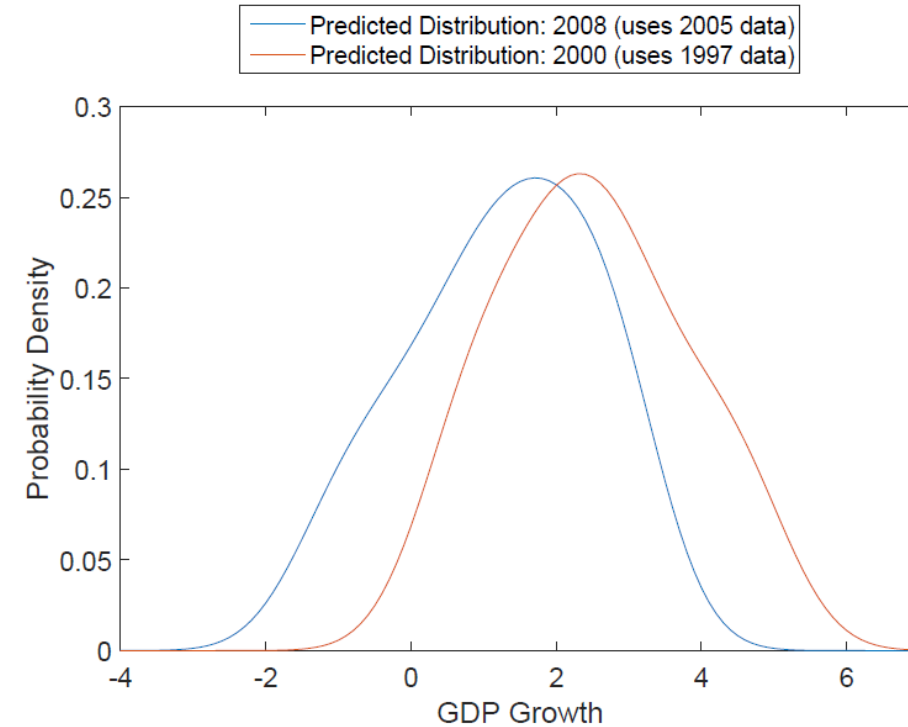
*Note: GDP-at-Risk measured as 5<sup>th</sup> percentile of projected annual growth rate of real GDP at each point in time*

# Full distribution – 3 years ahead

5<sup>th</sup>, 50<sup>th</sup> and 95<sup>th</sup> percentile

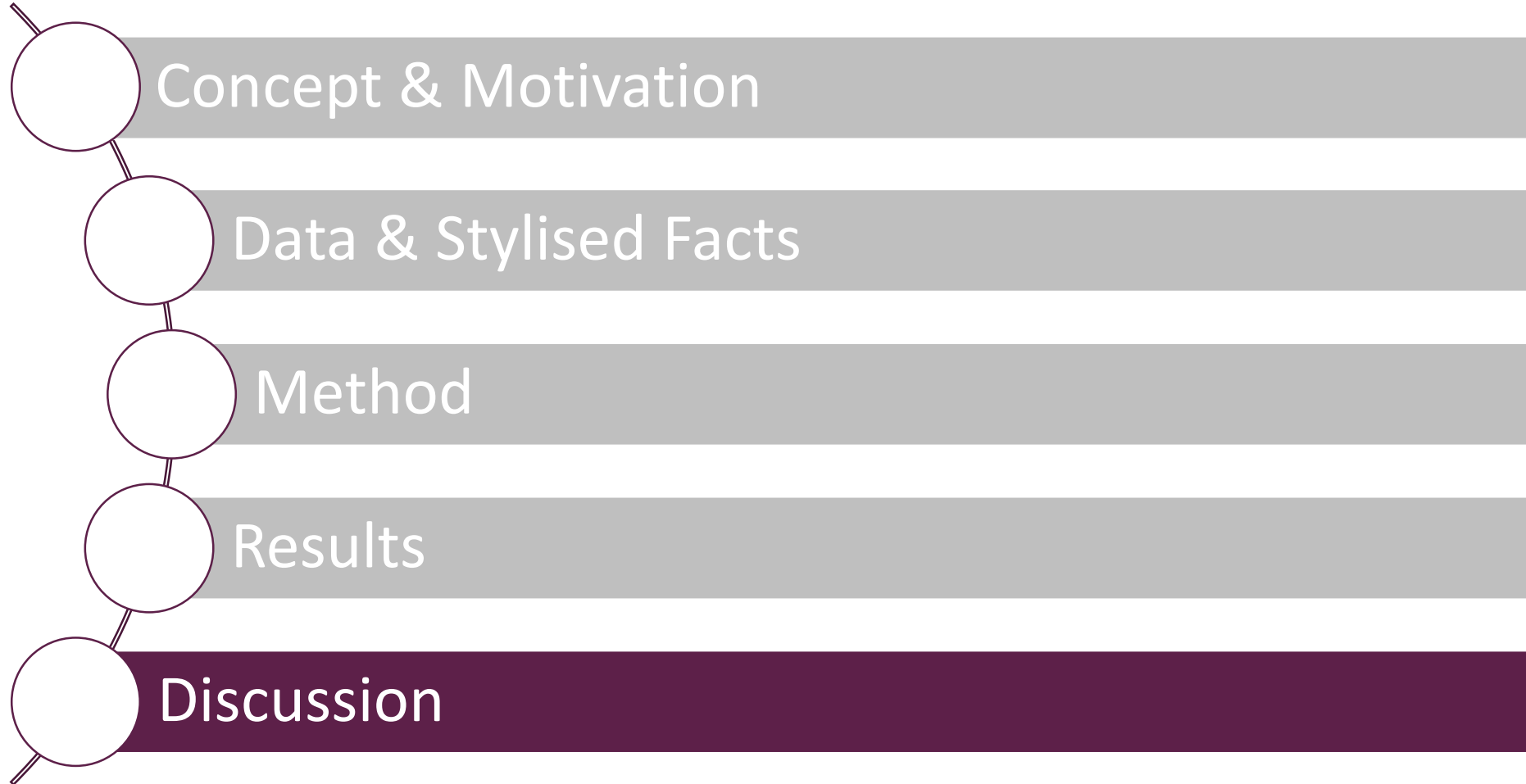


Fitted distribution



*Note: The left panel shows the predicted 5th, 50th and 95th percentiles of GDP growth using data 12 quarters ahead of each point in time as well as the realised observation at each point. The right panel shows the full predicted distribution of GDP growth in 2008 and 2000, using data from 2005 and 1997*

# Outline



# CCyB and tail risks

- How much difference might raising the CCyB above its neutral setting make to GDP-at-Risk?
- Counterfactual where CCyB was in active use before crisis

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- How much difference might raising the CCyB above its neutral setting make to GDP-at-Risk?
- Counterfactual where CCyB was in active use before crisis
- CCyB of 5% (2.5%) would have offset a half (quarter) of the build-up in tail risks pre-crisis

Illustration of the potential offsetting effect of raising the CCyB in response to growing GDP-at-risk from 2002 to 2007

Estimated 5% GDP-at-risk (ave. annual GDP growth over next three years)			Estimated impact of CCyB on GDP-at-risk*		Proportion of deterioration in GDP-at-risk from 2002 to 2007 offset by CCyB				
2002 Q4	2007 Q4	Change 2002 to 2007	CCyB set at 2.5% by end- 2007	CCyB set at 5% by end- 2007	CCyB set at 2.5% by end- 2007	CCyB set at 5% by end- 2007			
Average across all countries			-0.3	-1.0	-0.8	0.2	0.5	23%	46%

\*assumes an average risk weight of 50% and a 50% domestic CCyB pass-through rate (also abstracts from reciprocation of any foreign CCyBs). A 1pp domestic CCyB increase is therefore assumed to be associated with a 0.25pp in the TCE to total assets ratio.

# Summary

Two key results in paper:

1. Novel result linking tail risk to banking system capital: Severity depends on risk and resilience.
2. Jointly estimate the impact of vulnerabilities, so that we can 'add up' contributions of risk and resilience with emphasis on medium term: use results to decompose how tail risks develop over time

