Is a macroprudential reaction function emerging and is it sensible?

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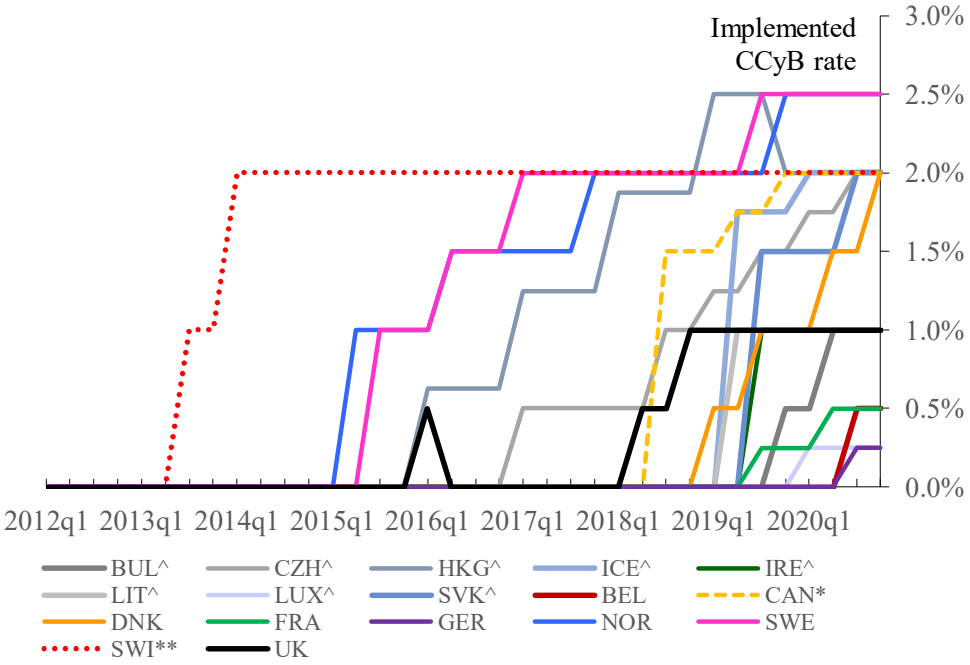
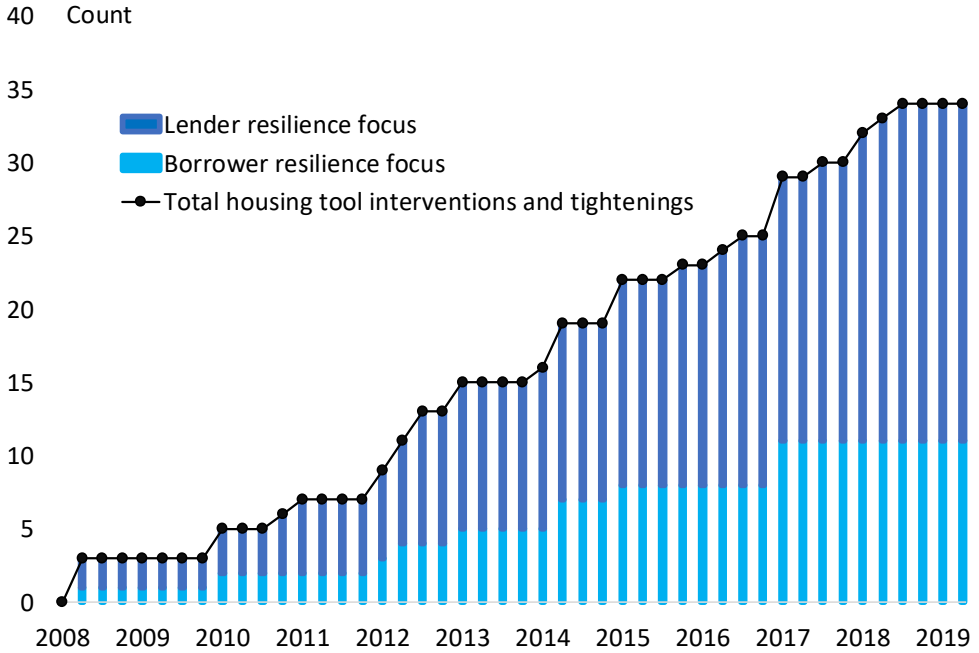
The macroprudential response to two key fault lines

Build Bank Capital: Worldwide use of the countercyclical capital buffer (CCyB)



- 17 countries worldwide have now set a positive CCyB.
- In our sample of 15 advanced economies, 9 have "switched on".

Limit Household Debt: Instances of housing tools being introduced or tightened



- 10 of our 15 AEs have used a housing tool.
- 34 instances of housing tools being either introduced or meaningfully tightened.

Q1: is there an emerging reaction function from this growing tool use?

- Are tools systematically responding to the risk environment? 3 tests:

1. $\Pr\{H_{i,t} = 1 | \boldsymbol{X}_{i,t-1}\} = \varphi(c + \beta \boldsymbol{X}_{i,t-1})$
2. $\Pr\{C_{i,t} = 1 | \boldsymbol{X}_{i,t-1}\} = \varphi(c + \beta \boldsymbol{X}_{i,t-1})$
3. $CCyB_{i,t} = c + \beta \boldsymbol{X}_{i,t-1}$

- **X:** a set of risk indicators, drawn from early warning literature;
- **t**: year within 2012-2019;
- **i**: country within 15 advanced economies

→ N = 120

- Models 1 & 2 are Probit models where H and C are indicator variables for housing and CCyB tool use respectively. Tool use includes switch on and tightening.
- Model 3 is continuous: $CCyB_{i,t}$ is the CCyB rate in country i at time t.
- In all cases, tool use a function of risk environment in previous year.

Univariate case:

What are policymakers responding to in practice…

	Total credit growth	NFC credit growth	HH credit growth	HH DSR	Real house price	Current Account	Volatility (inverted)
	Housing probit: probability of tool tightening next year:						
Coeff†	0.5***	0.36**	0.39**	0.17	0.00	0.06	-0.08
Marginal effect p(tigthen)^	15%	11%	12%	4%	0%	2%	-2%
Pseudo R^2	0.12	0.06	0.06	0.01	0.00	0.00	0.00

† All coefficients show impact of a 1SD increase in the risk indicator labelled. Indicators standardised at country level using 1980-2018 distribution. Growth rates 3yr averages.
^ Impact of 1SD increase in risk indicator on probability tool is tightened next year. Marginal effect shown is from the unconditional probability of tightening (13% for housing tools, 17% for CCyB).

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CCyB probit: probability of CCyB increase next year:							
Coeff†	0.16	-0.07	0.51***	0.03	0.48**	0.16	0.42**
Marginal effect p(tigthen)^	4%	-1%	14%	1%	13%	4%	13%
Pseudo R^2	0.01	0.00	0.09	0.00	0.06	0.01	0.06
CCyB Linear: explanatory variable for CCyB setting:							
Coeff†	0.15***	0.03	0.3***	0.02	0.22***	0.01	0.15***
Marginal effect (CCyB rate)	15bps	3bps	30bps	2bps	22bps	1bp	15bps
Pseudo R^2	0.06	0.00	0.17	0.00	0.06	0.00	0.05

- Both tools: respond to rapid household credit growth.
- The CCyB also responds to rapid house price growth and low volatility.

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Q2: If a reaction function is emerging, is it sensible?

- Macroprudential tools seek to build resilience to – or to lean against – tail risks to the macroeconomy emanating from the financial sector.
- **"GDP-at-risk"**: the 5th percentile of the forecasted GDP growth distribution is one measure of such tail risks. Quantile regressions (following Aikman et al (2019b)):

$$\hat{\beta}_{\tau}^{h} = argmin_{\beta^h} \sum_{i,t} \rho_{\tau}\left(y_{i,t+h} - X_{i,t}\beta_{\tau}^{h}\right)$$

Where τ is the quantile under consideration (5th), h is the horizon (3 years), ρ_{τ} is the standard asymmetric absolute loss function, $y_{i,t+h}$ is average annual GDP growth in country i over the next h periods and X is a vector of risk indicators X^F and macro controls X^M.

- A sensible macroprudential reaction function might therefore respond to the overall contribution of financial indicators to GDP-at-risk: $X_{i,t}^{F}.\beta_{\tau}^{h}$
- In particular, policy should respond most aggressively to indicators which have the largest impact on GDP-a-risk (ie large β's). Assuming the tools can affect these risks.

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What "should" policymakers respond to, given the impact on GDP-at-risk…

Impact on tail risk†‡	0.6	0.6	0.6	1.0	0.3	0.6	-0.2

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DSR and current account matter for tail risks but are not part of the reaction function.

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Multivariate case – using GDP-at-risk to "add-up" risks:

- Policymakers respond to HH credit, NFC credit, house prices and volatility.
- Multivariate GDP-at-risk model can be used to weight together these four indicators according to their impact on GDP tail risks. This results in:
- Total contribution to **GDP-at-risk** =

  *0.39 * HH credit growth*

  *+ 0.35 * NFC credit growth*

  *+ 0.06 * Real House price growth*

  *– 0.02 * Equity Volatility*

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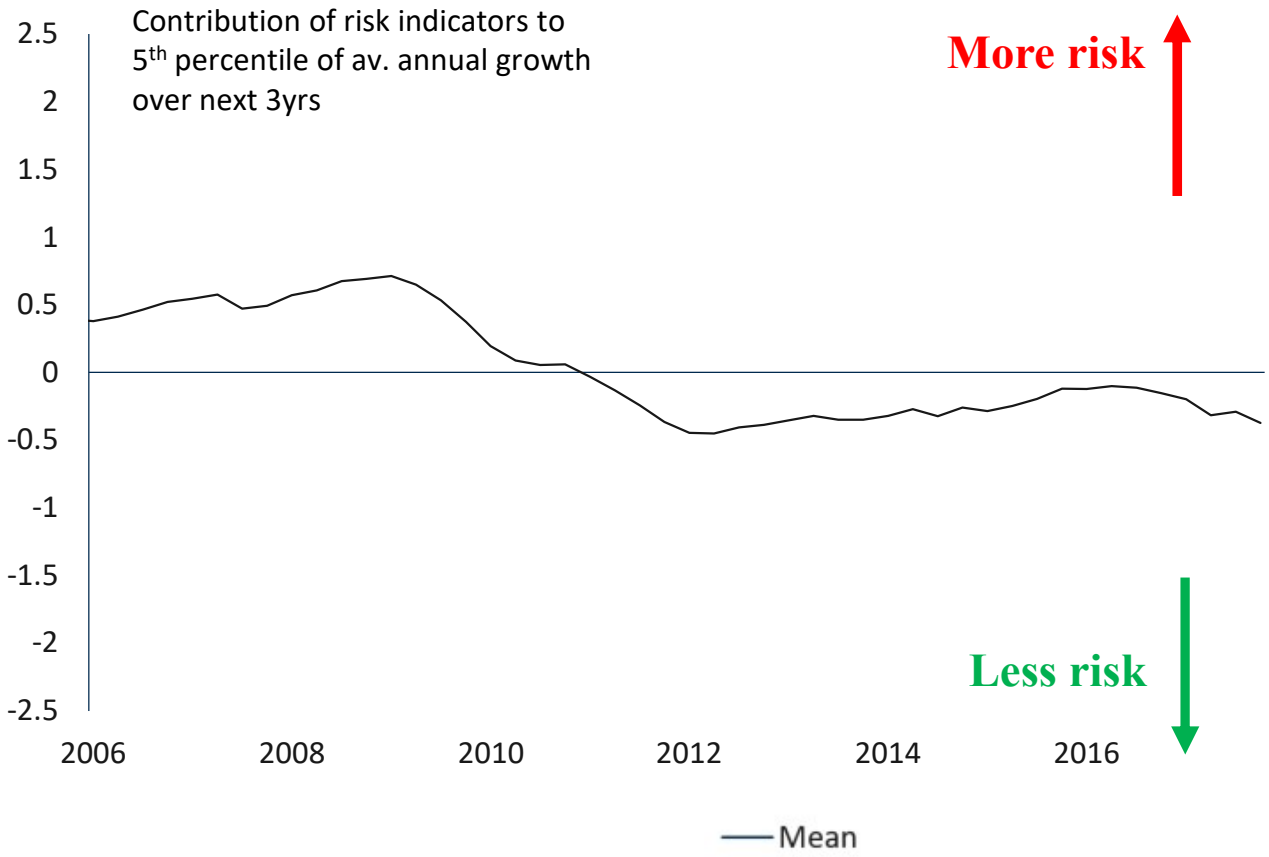

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- Chart shows average contribution of the resulting **aggregate indicator** to GDP-at-risk across our 15 countries.
- **On average**: elevated pre-crisis risks followed by subdued period of repair. Risks then return towards standard by 2016.

Note: GDP-at-risk coefficients estimated from 16 advanced economy panel 1980-2018: based on Aikman et al (2019b).

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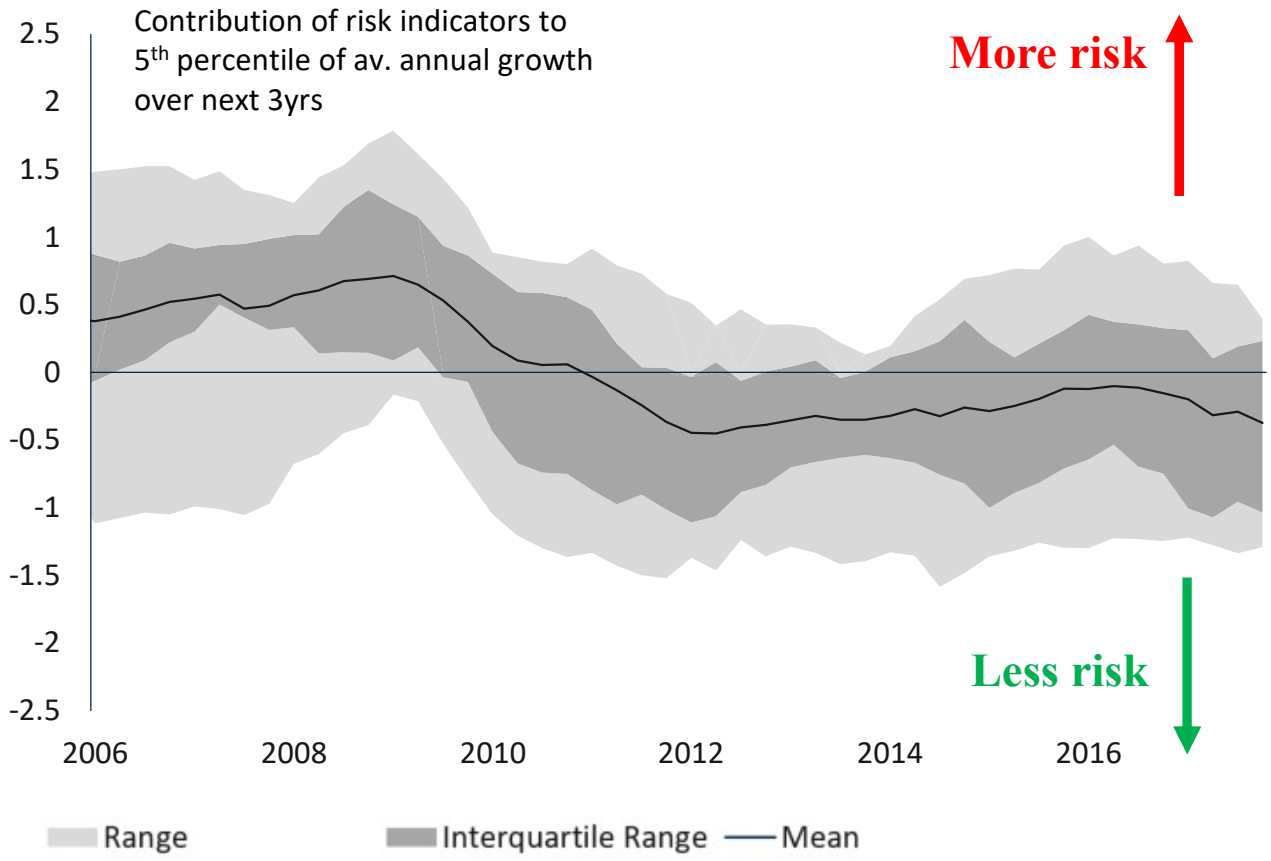

Swathe shows the significant cross country variation in GDP-at-risk across our advanced economy sample

Note: GDP-at-risk coefficients estimated from 16 advanced economy panel 1980-2018 to best explain movements in 5th percentile of GDP at risk over cumulative 12quarter horizon.

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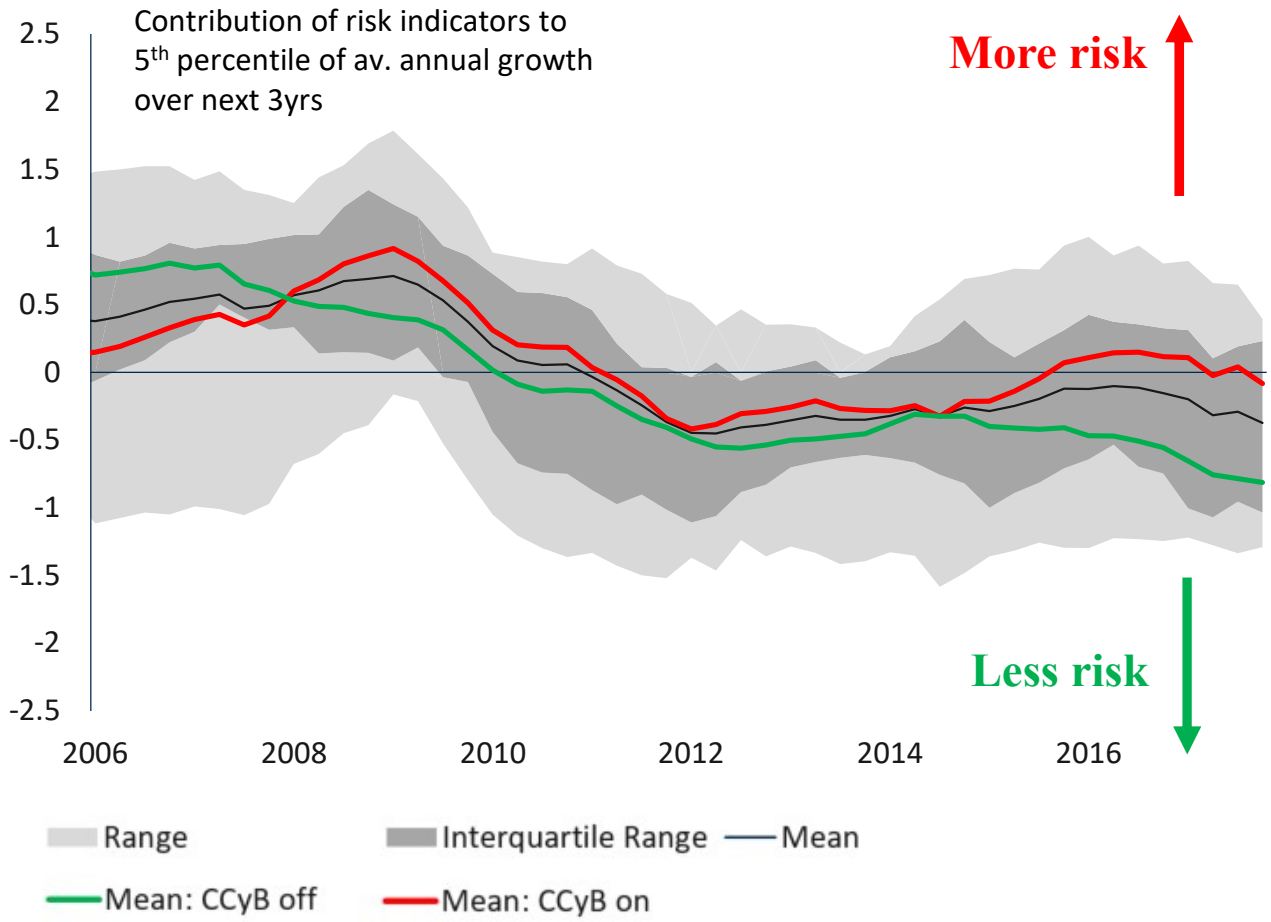

Since 2014, countries which have activated the CCyB have, on average, had higher GDP-at-risk than those who have not.

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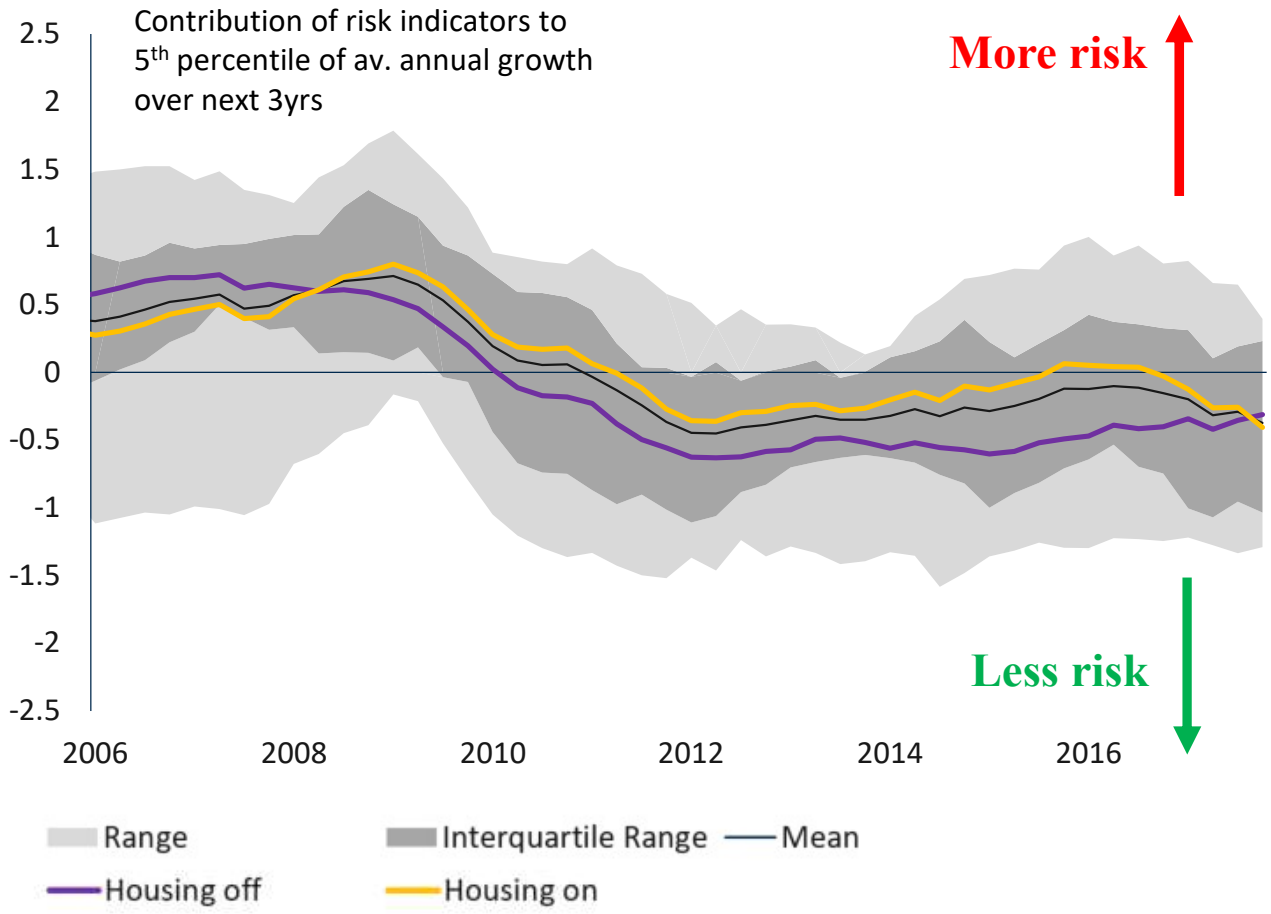

Until late-2017, countries which had activated housing tools had, on average, somewhat higher GDP-at-risk than those who had not.

Since then, the gap has closed.

But tool use may lean on risk indicators (eg credit growth) and have caused some of this convergence.

➔ Look at GDP-at-risk in year preceding each tool change.

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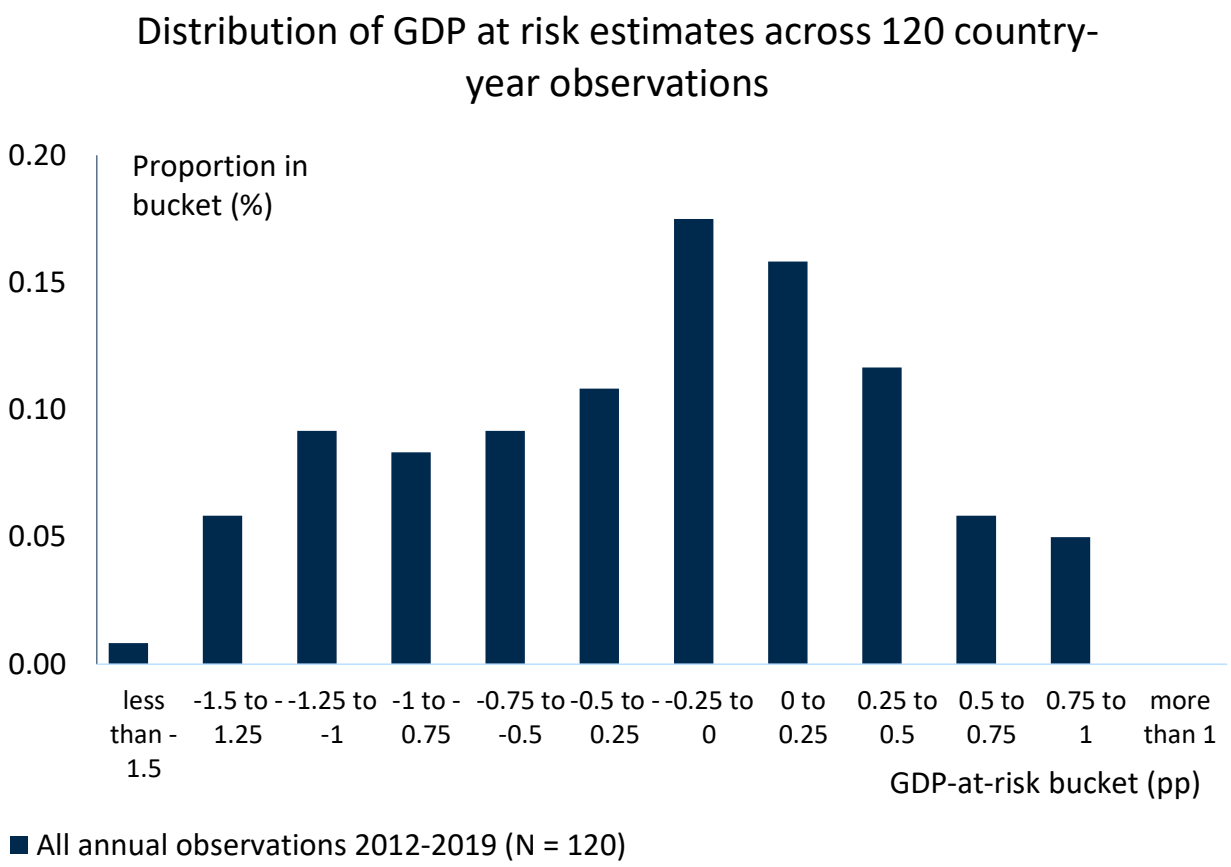
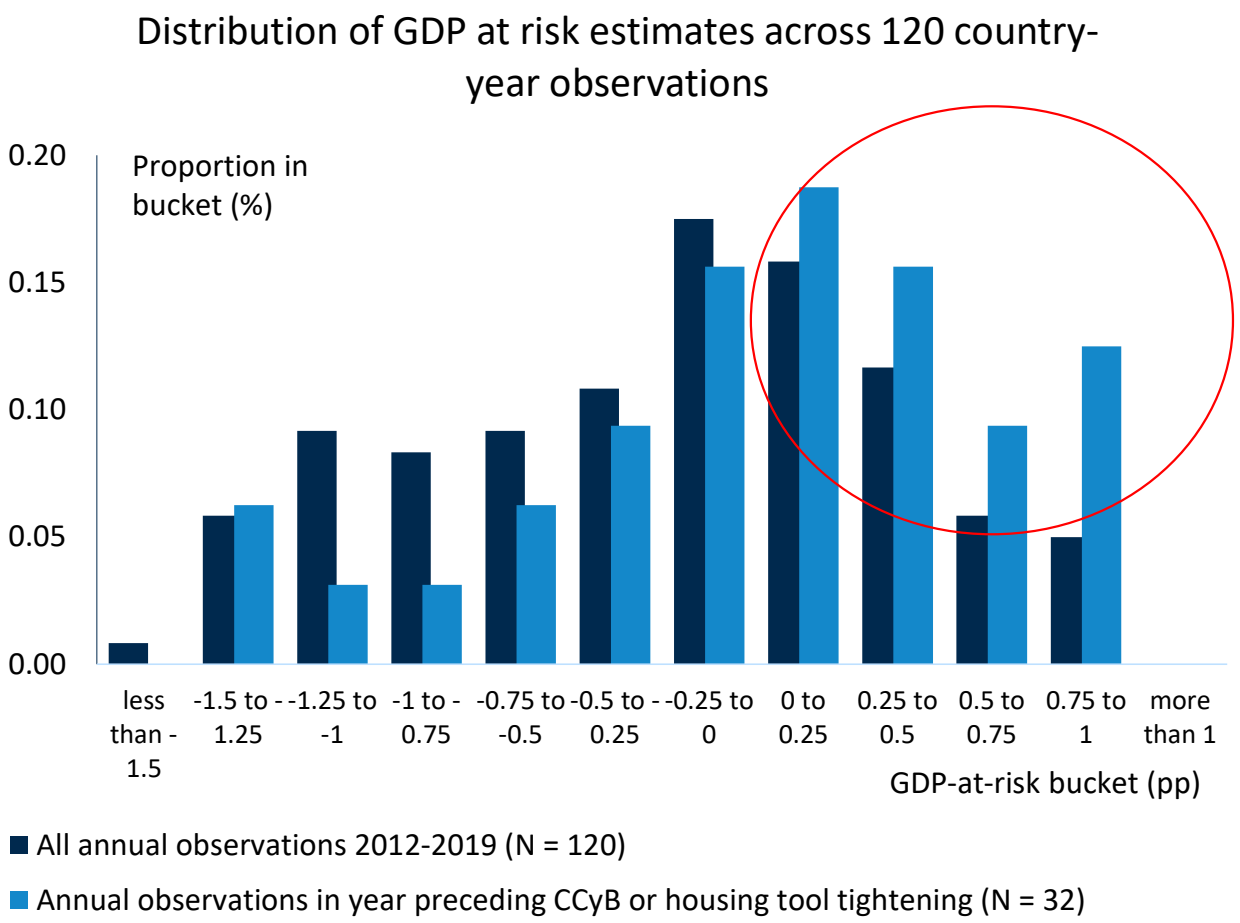
GDP-at-risk



- 120 annual GDP-at-risk observations 2012-2019 across 15 advanced economies **(Dark Blue distribution).**

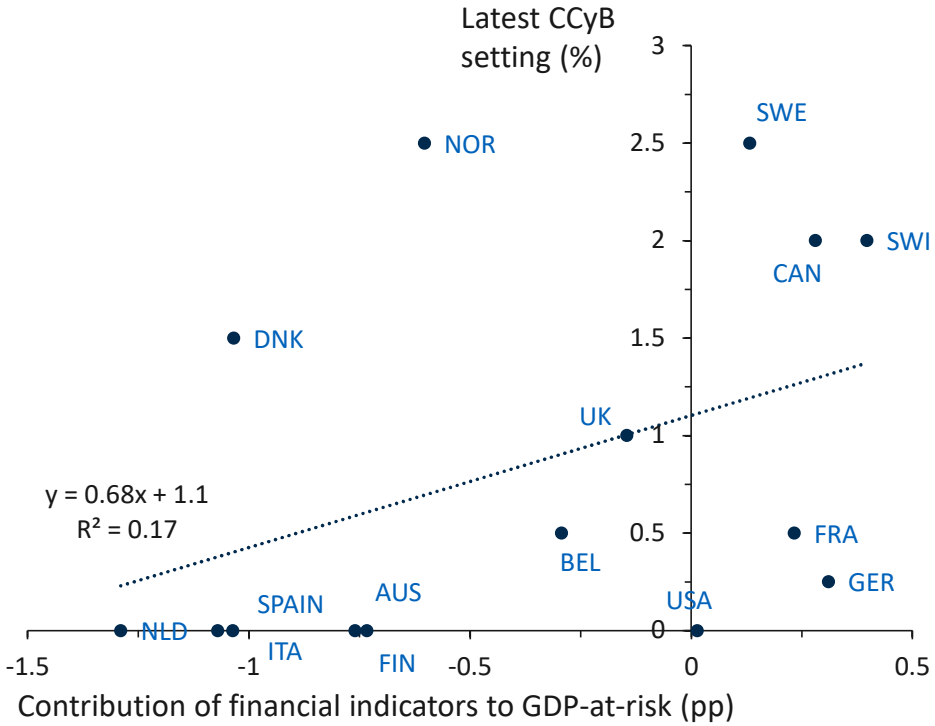
GDP-at-risk is higher in the years preceding tool tightening:



- 120 annual GDP-at-risk observations 2012-2019 across 15 advanced economies **(Dark Blue distribution).**
- Within that, 32 observations are followed by a CCyB tightening and/or housing tool tightening the next year.
- GDP-at-risk heavily skewed to right of the overall distribution in year preceding tool use **(Light Blue distribution).**
- ➔ GDP-at-risk indicator strongly significant in housing tool probit model and in explaining CCyB setting…

GDP-at-risk and current CCyB setting:

Higher GDP-at-risk associated with higher CCyB…



- Simple correlation suggests countries have typically set a CCyB of around 1% when risk indicators are around their historical average. And have increased the CCyB by 70bps for each 1pp increase in GDP-at-risk.

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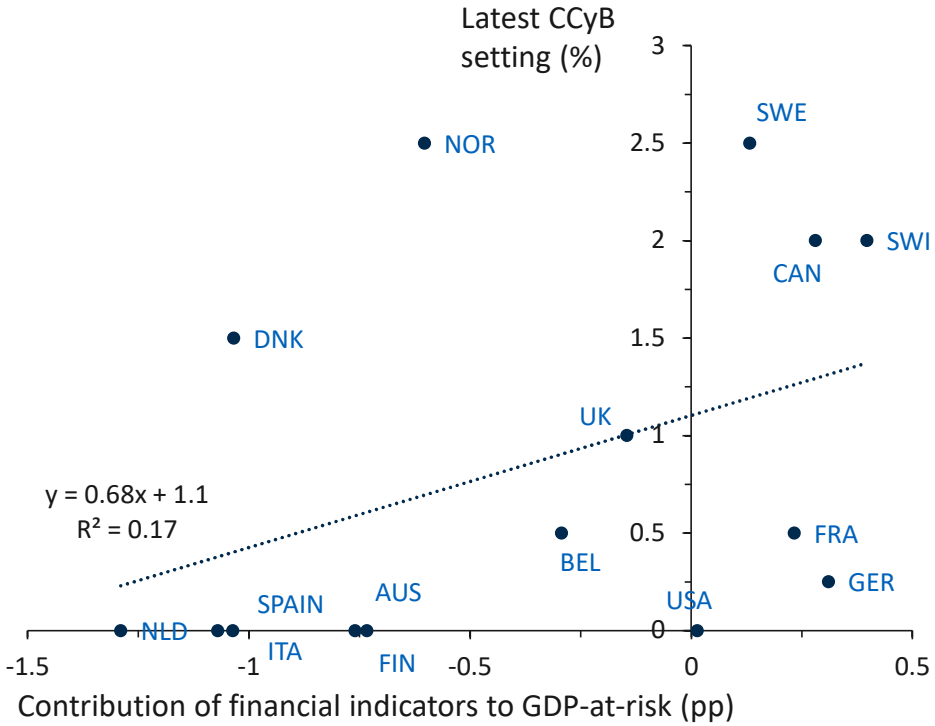
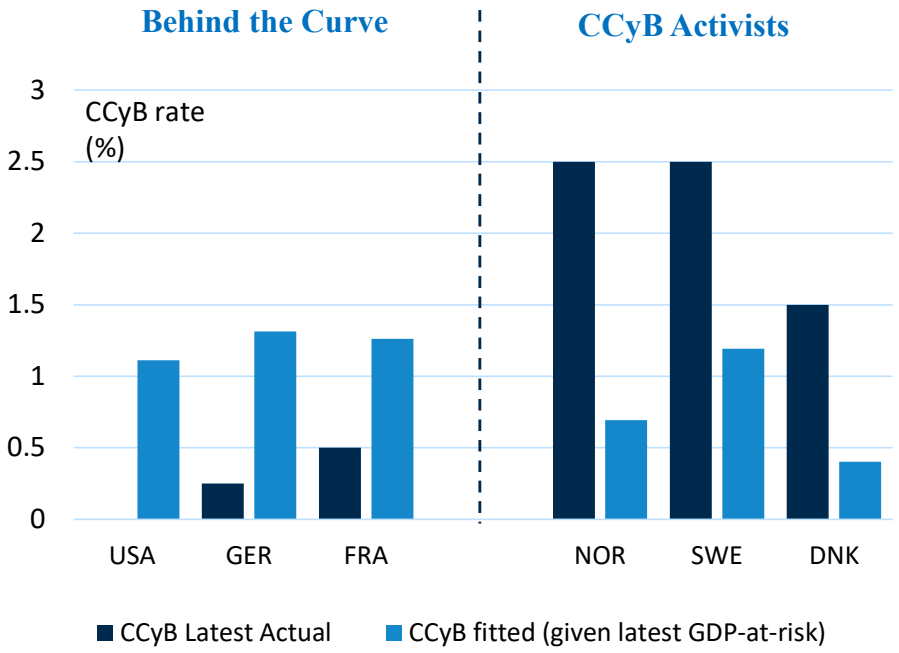


Biggest CCyB "gaps", given current GDP-at-risk…



- Simple correlation suggests countries have typically set a CCyB of around 1% when risk indicators are around their historical average. And have increased the CCyB by 70bps for each 1pp increase in GDP-at-risk.
- But correlation is not tight. There is considerable heterogeneity in CCyB activism wrt GDP-at-risk.

Do indicator weightings in practice reflect GDP-at-risk weights?

	Memo: GDP-at-risk coeffs (impact on GDP tails)
Coeffs:	
HH credit growth (3yr)	0.39
NFC credit growth (3yr)	0.35
Real house price growth (3yr)	0.06
Volatility	-0.02
Constant	
R-squared	
Number of obs	
Coeffs (share of total):	
HH credit growth (3yr)	49%
NFC credit growth (3yr)	45%
Real house price growth (3yr)	8%
Volatility	-2%
	100%

Do indicator weightings in practice reflect GDP-at-risk weights?

	Housing (Probit)	CCyB (Probit)	CCyB (Linear)	Memo: GDP-at-risk coeffs (impact on GDP tails)
Coeffs:				
HH credit growth (3yr)	0.30	1.02***	0.38***	0.39
NFC credit growth (3yr)	0.25	-0.7***	-0.14**	0.35
Real house price growth (3yr)	-0.10	0.55*	0.09	0.06
Volatility	0.00	0.56**	0.19***	-0.02
Constant	-0.88***	-1.37***	0.43***	
R-squared	0.09	0.29	0.30	
Number of obs	120	120	120	
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- **Housing tools:** Even in multivariate setting, weak explanatory power for housing tool interventions.
- Consistent with housing tools being used structurally rather than cyclically and/or other factors determining macroprudential activism (eg institutional setup?).
- **CCyB:** Multivariate models explain around 30% of variation in CCyB.

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NFC credit growth (3yr)	0.25	-0.7***	-0.14**	0.35
Real house price growth (3yr)	-0.10	0.55*	0.09	0.06
Volatility	0.00	0.56**	0.19***	-0.02
Constant	-0.88***	-1.37***	0.43***	
R-squared	0.09	0.29	0.30	
Number of obs	120	120	120	
Coeffs (share of total):				
HH credit growth (3yr)	67%	72%	73%	49%
NFC credit growth (3yr)	56%	-49%	-26%	45%
Real house price growth (3yr)	-23%	38%	17%	8%
Volatility	0%	39%	36%	-2%
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- Relative weights put on different indicators differs from GDP-at-risk weights, eg household credit over-weighted and corporate credit underweighted.

Is a macroprudential reaction function emerging and is it sensible?

Elements of a common reaction function emerging:

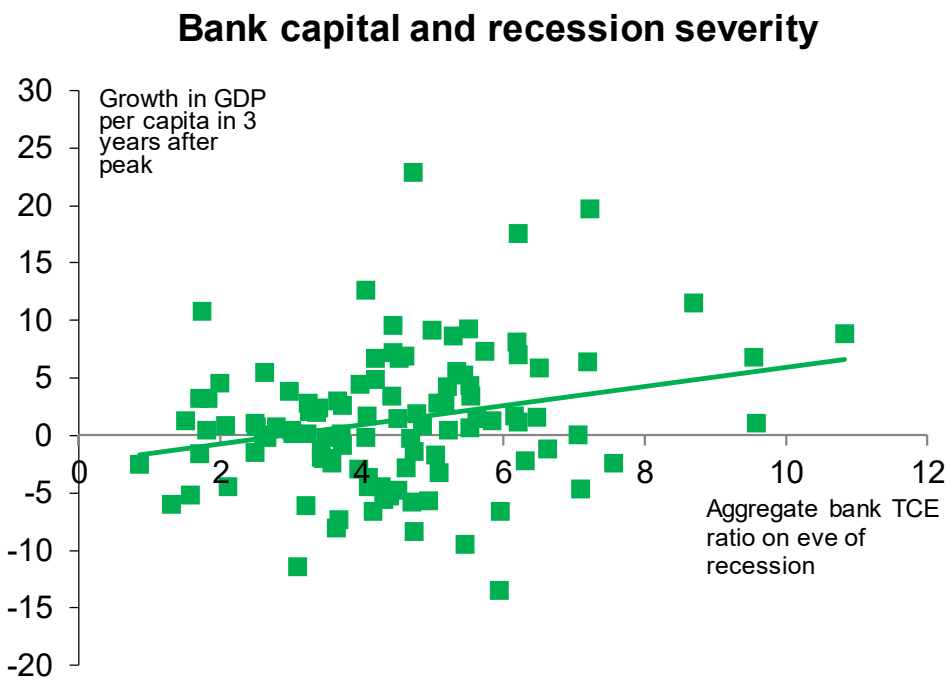
- CCyB and housing tools tighten when credit growth is high, particularly in HH sector:
- CCyB also responds when house price growth is rapid and volatility is low.
- CCyB and housing tools are on in countries where GDP-at-risk (GaR) is highest and high GaR precedes tool tightening.
- An emerging CCyB reaction function is: ≈1% when GaR is at its historical average and raise it 70bps for each 1pp deterioration in GaR.
- Around 30% of variation in CCyB use can be explained by headline risk indicators.

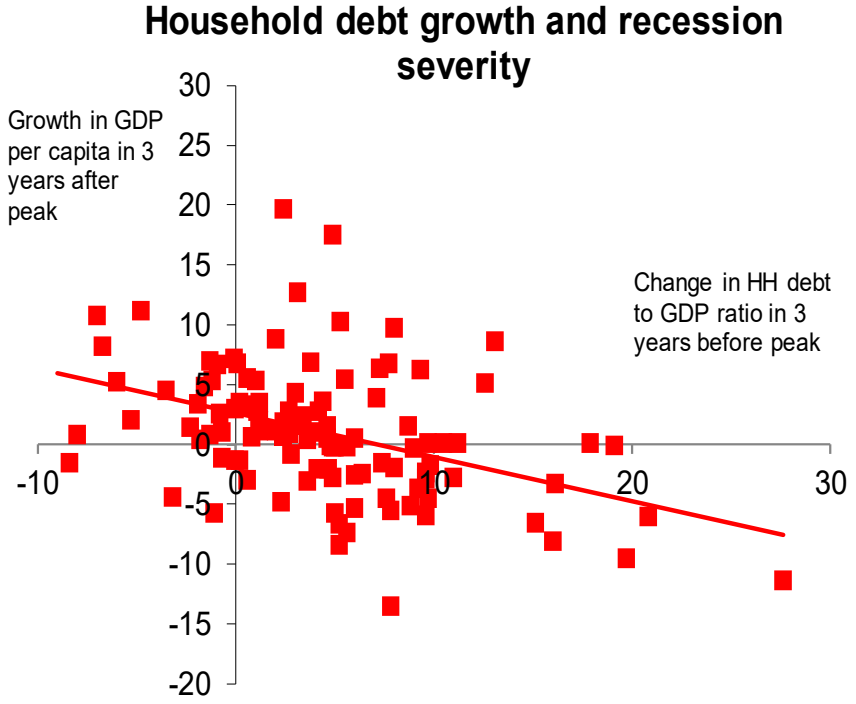
Challenges:

- Neither tool responds to the household DSR, which affects GDP tail risks more than any other indicator.
- Significant heterogeneity in macroprudential activism for a given level of GDP-at-risk.
- Overall, housing tool use is not well explained by variation in risk indicators: may reflect structural use or institutional constraints.
- Salient indicators (household credit and house prices) are over-weighted in CCyB reaction function relative to corporate credit.

Spares

GFC Diagnosis: two key fault lines explain its severity…



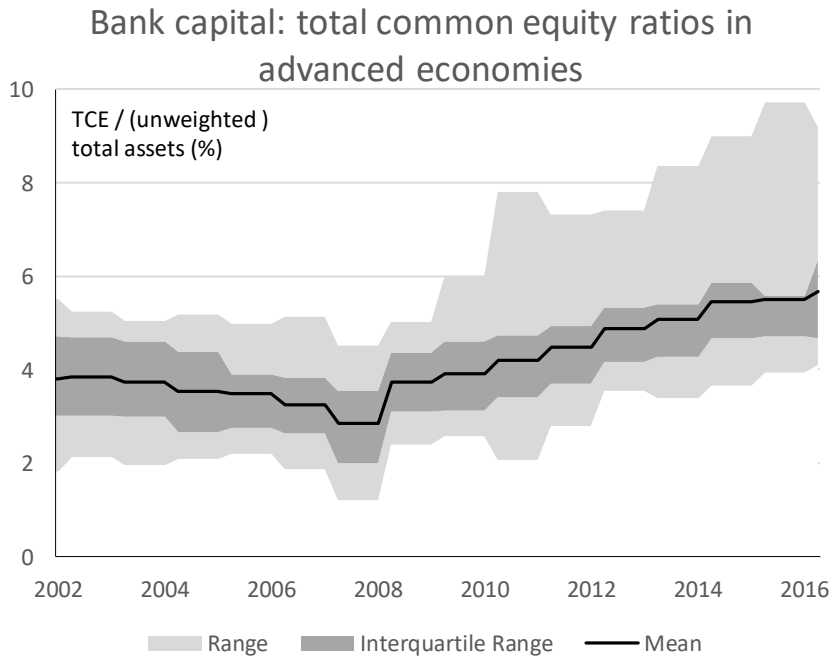


- Aikman et al (2019a) find that credit crunch (associated with low bank capital) and household debt deleveraging (associated with preceding credit boom) can account for up to ¾ of the output loss in the US between 2007 and 2010.

Note: charts based on sample of 110 recessions across 26 advanced economies since the 1970s, drawing on data of Bridges et al (2017).

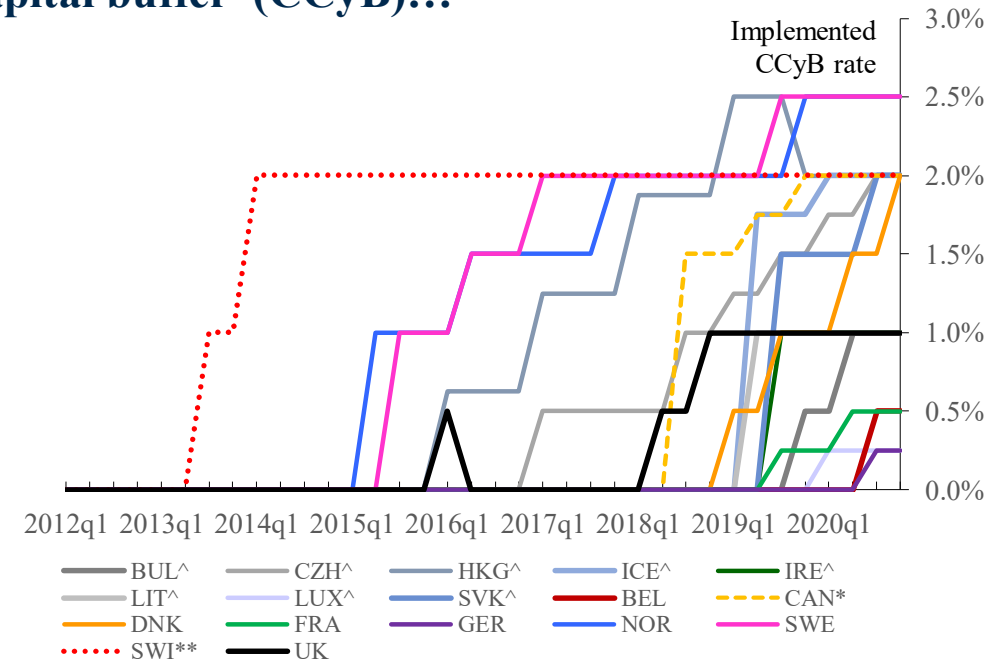
Response: #1 Build Bank Capital:

Structural reforms…



- Capital ratios have doubled since the financial crisis. They are now levelling off.

Macroprudential add on: Countercyclical capital buffer (CCyB)…

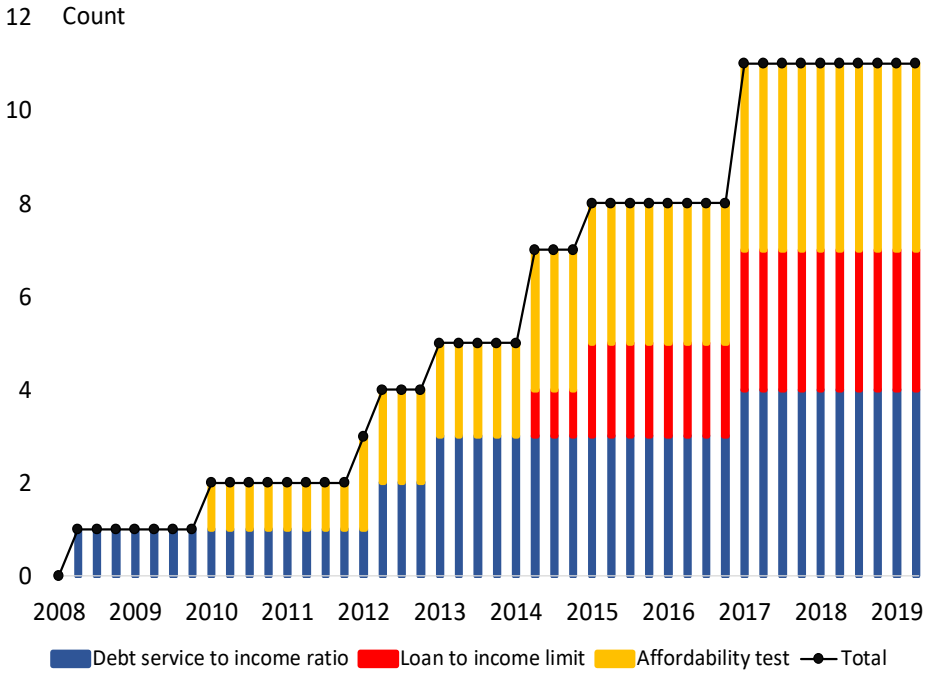


- 17 countries worldwide have now set a positive CCyB.
- In our sample of 15 advanced economies, 9 have "switched on".

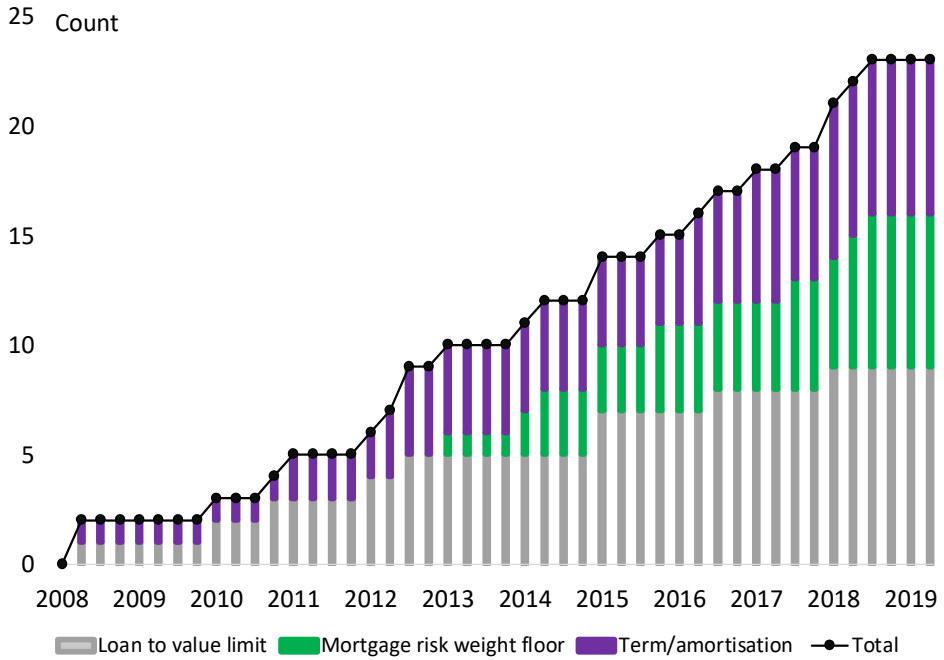
^ Denotes CCyB user not in our sample. * Canada uses a "Domestic Stability Buffer" (akin to a CCyB). ** Switzerland uses a sectoral CCyB for housing.

Response: #2 Limit Household Debt:

Borrower-based measures…



Lender-based measures…



- Detailed data collection based on national *Financial Stability Reports.*
- Across our sample of 15 advanced economies, 10 have used some form of housing tool.
- In total, there have been 34 instances of housing being either introduced or meaningfully tightened.
- Within that, 11 moves have targeted borrower resilience; 23 lender resilience.

Univariate case:

What are policymakers responding to in practice…

	Total credit growth	NFC credit growth	HH credit growth	HH DSR	Real house price	Current Account	Volatility (inverted)
Housing probit: probability of tool tightening next year:							
Coeff†	0.5***	0.36**	0.39**	0.17	0.00	0.06	-0.08
Marginal effect p(tigthen)^	15%	11%	12%	4%	0%	2%	-2%
Pseudo R^2	0.12	0.06	0.06	0.01	0.00	0.00	0.00
CCyB probit: probability of CCyB increase next year:							
Coeff†	0.16	-0.07	0.51***	0.03	0.48**	0.16	0.42**
Marginal effect p(tigthen)^	4%	-1%	14%	1%	13%	4%	13%
Pseudo R^2	0.01	0.00	0.09	0.00	0.06	0.01	0.06
CCyB Linear: explanatory variable for CCyB setting:							
Coeff†	0.15***	0.03	0.3***	0.02	0.22***	0.01	0.15***
Marginal effect (CCyB rate)	15bps	3bps	30bps	2bps	22bps	1bp	15bps
Pseudo R^2	0.06	0.00	0.17	0.00	0.06	0.00	0.05

- Both tools: respond to rapid household credit growth.
- The CCyB: also responds to rapid house price growth and low volatility.
- Some evidence the housing tools also respond to rapid corporate credit growth (surprising).

† All coefficients show impact of a 1SD increase in the risk indicator labelled. Indicators standardised at country level using 1980-2018 distribution. Growth rates 3yr averages.
^ Impact of 1SD increase in risk indicator on probability tool is tightened next year. Marginal effect shown is from the unconditional probability of tightening (13% for housing tools, 17% for CCyB).

Is a macroprudential reaction function emerging and is it sensible?

Sensible features emerging:

- Clear evidence that both CCyB and housing tools tighten when credit growth is high, particularly in household sector:
  - A 1SD increase in HH credit growth ≈ doubles the probability of a tool tightening next year and, on average, leads to a 30bp CCyB hike.
- CCyB also responds when house price growth is rapid (higher risk) and when volatility is low (less costly CCyB adjustment).

Challenges:

- CCyB does not respond to corporate credit growth, despite being a broad-based tool. May reflect role of market-based finance?
- Neither tool responds to the household DSR or the current account deficit, both of which affect GDP tail risks. The lack of housing tool response to the DSR is surprising, but may reflect the tools being structural in nature.

Is a macroprudential reaction function emerging and is it sensible?

Sensible features emerging:

- CCyB and housing tools tighten when credit growth is high, particularly in HH sector:
  - A 1SD increase in HH credit growth ≈ doubles the p(tool tightening) next year and leads to a 30bp CCyB hike.
- CCyB also responds when house price growth is rapid and volatility is low.
- GDP-at-risk (GaR) coefficients, which weight indicators according to their impact on tail risks, do a good job at explaining tool use: CCyB and housing tools are on in countries where GaR is highest and high GaR precedes tool tightening.
- An emerging CCyB reaction function is: ≈1% when GDP-at-risk is at its historical average and raise it 70bps for each 1pp deterioration in GDP-at-risk.

Challenges:

- CCyB does not respond to NFC credit growth, perhaps reflecting market-based finance?
- Neither tool responds to the household DSR or the current account deficit, both of which affect GDP tail risks.
- There remains significant heterogeneity in the degree of macroprudential activism internationally, for a given level of GDP-at-risk.

Next steps

- Look at more granular risk indicator information set, perhaps drawing on the sentiment in national *Financial Stability Reports*.

- Investigate the link between governance structure and macroprudential activism. Are independent Financial Stability Committees more activist, for a given level of GDP-at-risk?