

# The Costs of Macroprudential Policy

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*Disclaimer: The views expressed here are those of the authors and do not necessarily reflect those of the Bank for International Settlements.*

# What is new

Q: How do macroprudential policies affect the core objectives of central banks?

- 1 Identification:** we rely on a narrative approach to identify changes in macroprudential regulation that are exogenous wrt output and inflation.
- 2 Measurement:** we quantify the size of these macroprudential policy shocks.
- 3 Effects:** we employ local projections to estimate how these macroprudential shocks affect output and prices.

# Main results

- Mild output effects: A 10pp LTV tightening...
  - ...reduces output by about 1% over a 4-year horizon,
  - ...can be compared to a 25 basis point increase in the policy rate over a two-year horizon.
- These effects are imprecisely estimated and driven by emerging market economies.
- But: Using synthetic re-randomization, we find large effects of LTV changes on credit and house prices.

# Policy shocks

1. Exogenous with respect to current and lagged endogenous variables
2. Uncorrelated with other shocks (e.g., monetary policy acting at the same time)
3. Unanticipated by economic actors

**In existing studies on macroprudential policies these conditions are typically violated.**

# What we do about it

1. Exogeneity

**Narrative identification of exogenous changes (and a battery of tests)**

2. Uncorrelated with other shocks

**Control for monetary policy changes**

3. Unanticipated by economic actors

**Rely on non-systematic nature of LTV actions and intransparent decision procedures**

## How?

- We start from the set of LTV policy actions in the **BIS database** between 1990Q1 to 2012Q2
- We consult official documents on each action and study the motivation (financial vs. real): In the spirit of Romer/Romer (2004, 2010); Cloyne and Huertgen (2016) and others.
- Retain only those actions that are motivated by financial objectives but NOT motivated by concerns over the economic position or outlook.

## Country sample

The sample consists of 56 countries, starting 1990

- **23 advanced economies:** Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States
- **33 emerging market economies:** Argentina, Brazil, Bulgaria, Chile, China, Chinese Taipei, Colombia, Croatia, the Czech Republic, Estonia, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Latvia, Lithuania, Malaysia, Mexico, Peru, the Philippines, Poland, Romania, Russia, Serbia, Singapore, Slovakia, Slovenia, South Africa, Thailand, Turkey and Ukraine

# The LTV measures

- We identify 89 exogenous LTV actions
- Next step: quantify the ratio change
  - When max LTV ratio is tightened from 70% to 60%, LTV variable= 10.
  - When max LTV ratio is loosened from 70% to 80%, LTV variable= - 10.
- Scope-adjustment: adjust change for the types of loans affected by the change
- **Final count: 53 quantified macropru policy shocks**



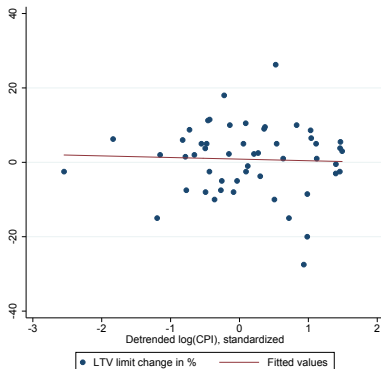
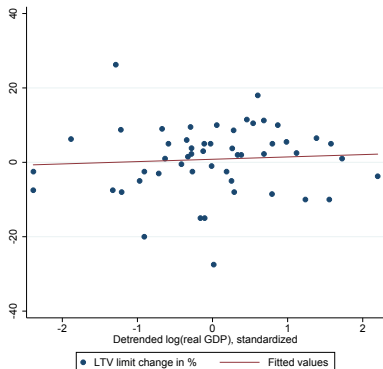
# Are the measures really exogenous to the real cycle?

**Table:** Balance of treated and control sub-populations

	Difference: Tightening-Control	
Smoothed 4-quarter GDP growth, demeaned	-0.26	(0.22)
Smoothed 4-quarter CPI growth, demeaned	-0.49	(0.84)
Detrended log real GDP	-0.04	(0.18)
Detrended price level	-0.09	(0.18)
Observations	3721	
	Difference: Loosening-Control	
Smoothed 4-quarter GDP growth, demeaned	0.44	(0.27)
Smoothed 4-quarter CPI growth, demeaned	-0.27	(1.03)
Detrended log real GDP	0.21	(0.22)
Detrended price level	-0.24	(0.21)
Observations	3710	

# Predictable LTV changes?

**Figure:** LTV shocks and output/price deviation from trend



# Estimating the effects: local projections

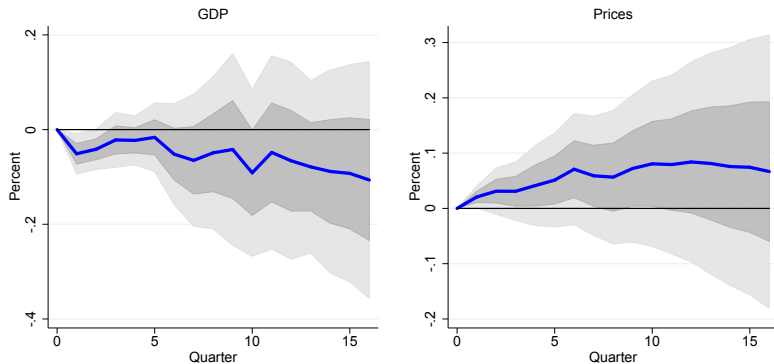
Determine the dynamic propagation of macroprudential shock on output and inflation:

$$\Delta_h y_{i,t} = \alpha_i^h + \gamma_t^h + \beta^h \Delta MaPP_{i,t} + \sum_{k=0}^4 \phi_k^h \Delta X_{i,t-k} + \epsilon_{i,t+h},$$

- $\Delta_h y_{i,t}$ : change in output / price level between quarter  $t$  and  $t + h$ , for  $h = 1, \dots, 16$ .
- $\Delta MaPP_{i,t}$ : change in LTV limit in country  $i$  and quarter  $t$
- $\Delta X_{i,t}$ : vector of controls, incl. policy rate, and lagged response variables
- $\alpha_i^h$ : country dummy for country-specific growth rates
- $\gamma_t^h$ : time dummy for global trends

# Baseline results

**Figure:** Impulse responses to a 1pp change in LTV limits



# Baseline results

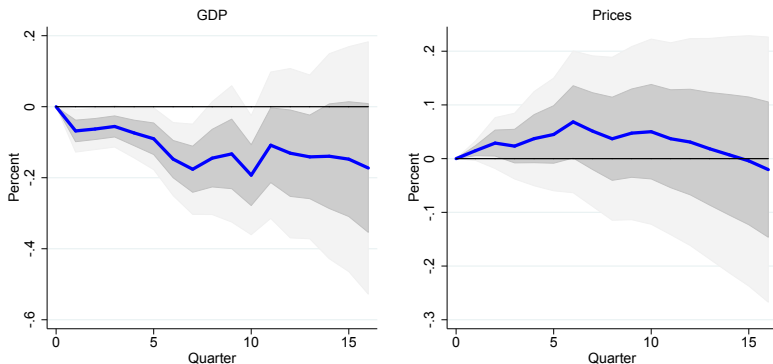
**Table:** Responses of real GDP and prices to a 1pp change in maximum loan-to-value ratios

	$h = 1$	$h = 4$	$h = 8$	$h = 12$	$h = 16$
<b>Dep. Var.: <math>100 \times \log</math> real GDP</b>					
LTV change	-0.05** (0.02)	-0.02 (0.03)	-0.05 (0.08)	-0.07 (0.11)	-0.11 (0.13)
Observations	3171	3171	3171	3171	3171
<b>Dep. Var.: <math>100 \times \log</math> CPI</b>					
LTV change	0.02** (0.01)	0.04 (0.04)	0.06 (0.06)	0.08 (0.09)	0.07 (0.13)
Observations	3171	3171	3171	3171	3171

*Notes:* Clustered (by country) standard errors in parentheses. Control vector includes the current value and four lags of GDP growth, CPI-inflation, and policy rate changes. Specifications include country-fixed-effects and quarter-fixed-effects.

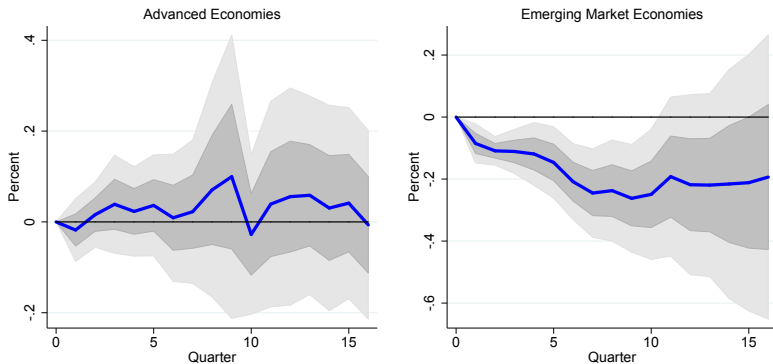
# Additional controls

**Figure:** Local projection: Responses of real GDP and the price level to a change in maximum loan-to-value ratios, quantified measure, additional controls.



# GDP responses: AE vs. EM

**Figure:** Responses of real GDP in advanced and emerging market economies.



## Asymmetry: tightening vs loosening

Define two separate variables for tightening and loosening

$$\Delta^{>0}MaPP_{i,t} = \begin{cases} \Delta MaPP_{i,t} & \text{if } \Delta MaPP_{i,t} > 0 \\ 0 & \text{if } \Delta MaPP_{i,t} \leq 0 \end{cases}$$

$$\Delta^{<0}MaPP_{i,t} = \begin{cases} \Delta MaPP_{i,t} & \text{if } \Delta MaPP_{i,t} < 0 \\ 0 & \text{if } \Delta MaPP_{i,t} \geq 0 \end{cases}$$

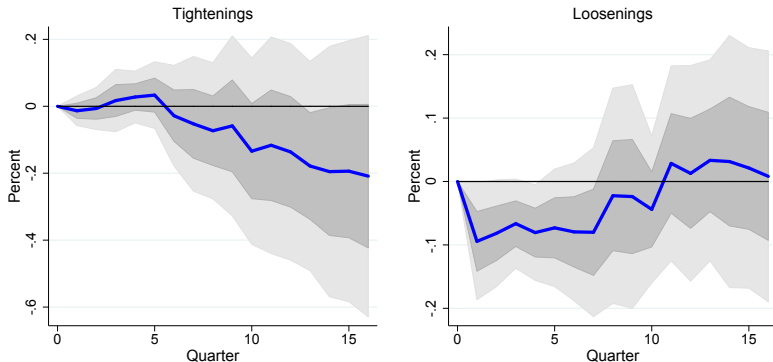
We can add these two variables to the baseline specification:

$$\Delta_h y_{i,t} = \alpha_i^h + \gamma_t^h + \beta^h \Delta MaPP_{i,t}^{>0} + \kappa^h \Delta MaPP_{i,t}^{<0} + \sum_{k=0}^4 \phi_k^h \Delta X_{i,t-k} + \epsilon_{i,t+h}$$



# GDP responses – tightening and loosening

**Figure:** Responses of real GDP to intensity adjusted  $\Delta^{>0}MaPP_{i,t}$  and  $\Delta^{<0}MaPP_{i,t}$



*Notes:* The blue lines display the coefficients of cumulative responses of real GDP over the 16 quarters following 1pp higher  $\Delta^{>0}MaPP_{i,t}$  or  $\Delta^{<0}MaPP_{i,t}$ . Shaded areas refer to 1 standard deviation (dark) and 1.96 standard deviations (light).

## Comparison to monetary policy

- How does a 10pp LTV tightening compare to a contractionary monetary policy shock?
- Comparing to estimates from the monetary policy literature
  - We find a two-year GDP response of -0.5% to a 10pp tightening
  - Jordà et al. (2017) find a two-year GDP response of -1.9% to a 100 basis points tightening
  - A 10pp tightening in LTV ratios roughly corresponds to a  $\frac{0.5}{1.9} \times 100 = 26$  basis points tightening.

# Robustness and further checks

- Index specification [▶ Go](#)
- Pre-2007 sample [▶ Go](#)
- Announcement vs implementation dates [▶ Go](#)
- Results driven by one country?  
Exclude: [▶ China](#) [▶ Hong Kong SAR](#) [▶ Iceland](#)
- No adjustment for scope [▶ Go](#)
- Boom vs. slump [▶ Boom](#) [▶ Slump](#)

## Intermediate summary

- Changes in LTV limits have small, mostly insignificant output effects.
- A 10pp tightening in LTV ratios is associated with a 1.1% reduction in output after 16 quarters.
- This effect is entirely driven by EMEs.
- Question: Do policies achieve their targets?

## How do financial variables respond?

- Previous identification approach does not work here, as policies typically target the credit cycle.
- Use 2-stage inverse propensity weighting procedure:
  - Stage 1: determine the probability of an LTV tightening. Propensity score is estimated using logit, based on extended set of controls.
  - Stage 2: run local projections using inverse of propensity score as weights and put greater weight on hard-to-predict LTV tightenings.

# Strategy

- First Stage: we construct a model for the probability of a tightening conditional on observables  $p(d_{i,t} = 1|X_{i,t-1})$  and denote the estimate by  $\hat{p}_{i,t}$
- Second stage: using weighted least squares (WLS) with weights:  $w_{i,t} = d_{i,t}/\hat{p}_{i,t} + (1 - d_{i,t})/(1 - \hat{p}_{i,t})$ :

$$\Delta_h y_{i,t} = \alpha_i^h + \gamma_t^h + \beta^h d_{i,t} + \sum_{k=0}^4 \phi_k^h \Delta X_{i,t-k} + \epsilon_{i,t+h}.$$

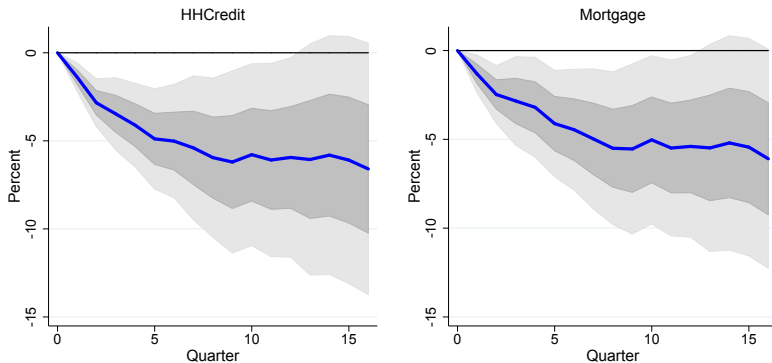
# 1st stage

**Table:** Predicting LTV tightening

	Tightening Dummy
$\Delta_4$ Output gap	0.72 (1.20)
$\Delta_4$ CPI gap	-0.89 (1.02)
$\Delta_4$ Real private credit	0.28* (0.16)
$\Delta_4$ Real mortgage credit	0.11 (0.21)
$\Delta_4$ Real household credit	-0.16 (0.18)
$\Delta_4$ Real stock price index	2.40 (2.68)
Pseudo $R^2$	0.133
AUC	0.77 (0.05)
Observations	455

## 2nd stage: Inverse propensity weighted LP

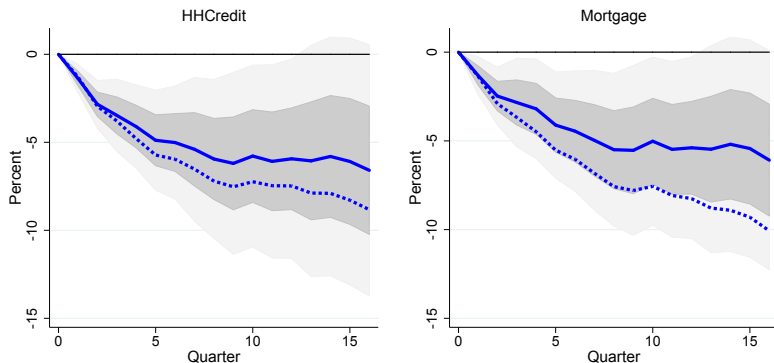
Figure: Responses of household and mortgage credit





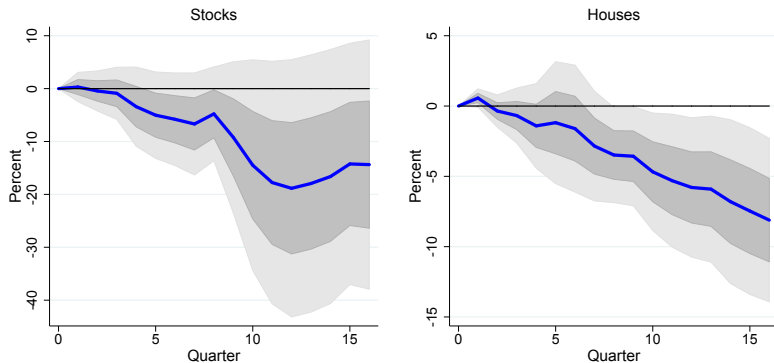
# Comparison: non-weighted

**Figure:** Local projection: Responses of real household and mortgage credit to a change in maximum loan-to-value ratios, tightening dummy



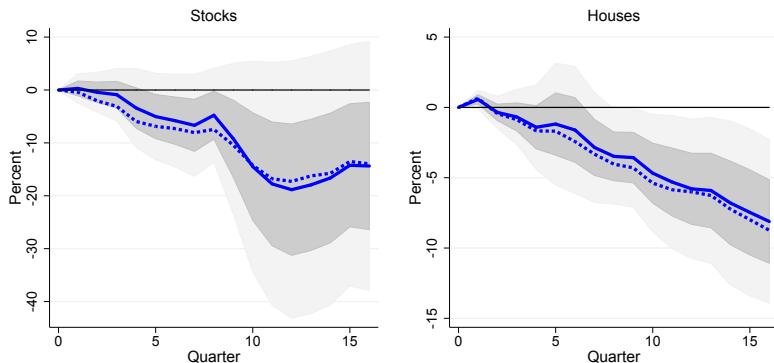
## 2nd stage: Inverse propensity weighted LPs

Figure: Responses of stock and house prices



# Comparison: non-weighted

**Figure:** Local projection: Responses of real stock and house prices to a change in maximum loan-to-value ratios, tightening dummy



# Summary

- We study the causal effects of macroprudential shocks on output and prices
- A 10pp tightening of LTV ratios reduces output by about 1% after 4 years
- However, the effects are imprecisely estimated and mostly driven by EMEs
- We also present evidence that LTV changes affect the credit cycle and asset prices

Good news for central banks: macroprudential policies as a complementary policy tool that does not interfere with core objectives in a major way

More on results

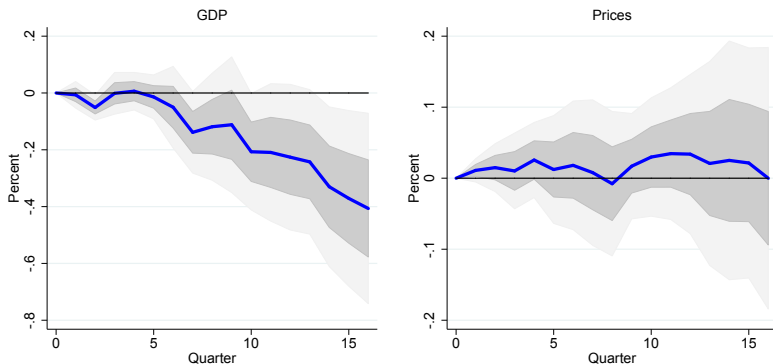
## State dependence: boom vs slump

Do the responses of output and prices depend on the macroeconomic environment?

- We use the Hamilton (2017) detrended real GDP in order to define boom and slump periods.
- We consider the economy to be in a boom (slump) if GDP is above (below) trend.
- We run the local projections separately for the sample of boom and slump observations.

# Booms

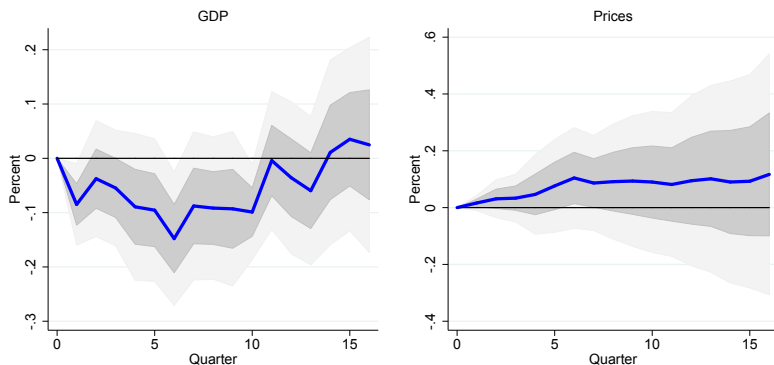
**Figure:** Responses of real GDP and prices to a change in maximum loan-to-value ratios in a boom



*Notes:* The blue lines display the coefficients of cumulative responses of real GDP and price level over the 16 quarters following a change in maximum LTV ratios. Shaded areas refer to 1 standard deviation (dark) and 1.96 standard deviations (light).

# Slumps

**Figure:** Responses of real GDP and prices to a change in maximum loan-to-value ratios in a slump period



*Notes:* The blue lines display the coefficients of cumulative responses of real GDP and price level over the 16 quarters following a change in maximum LTV ratios. Shaded areas refer to 1 standard deviation (dark) and 1.96 standard deviations (light).



# Robustness: index specification

- We replace the intensity-adjusted measure by an index variable:

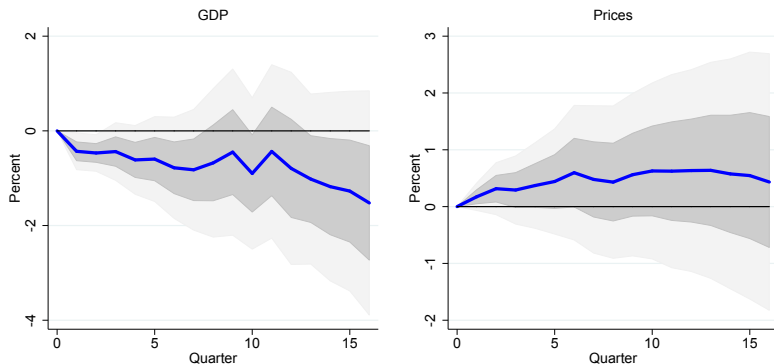
$$\Delta MaPP_{i,t}^{Index} = \begin{cases} 1 & \text{if } \Delta MaPP_{i,t} > 0 \\ 0 & \text{if } \Delta MaPP_{i,t} = 0 \\ -1 & \text{if } \Delta MaPP_{i,t} < 0. \end{cases}$$

- Using this measure, we estimate

$$\Delta_h y_{i,t} = \alpha_i^h + \gamma_t^h + \beta^h \Delta MaPP_{i,t}^{Index} + \sum_{k=0}^4 \phi_k^h \Delta X_{i,t-k} + \epsilon_{i,t+h},$$

# Index specification

**Figure:** Impulse responses to a one unit increase in the LTV index



*Notes:* The blue lines display the coefficients of cumulative responses of real GDP and price level over the 16 quarters following a one unit increase in the LTV index. Shaded areas refer to 1 standard deviation (dark) and 1.96 standard deviations (light).

# Index specification

**Table:** Responses of real GDP and prices to a 1 unit increase in the LTV index variable

	$h = 1$	$h = 4$	$h = 8$	$h = 12$	$h = 16$
<b>Dep. Var.: <math>100 \times \log</math> real GDP</b>					
LTV Index	-0.432** (0.198)	-0.614 (0.370)	-0.677 (0.800)	-0.793 (1.036)	-1.522 (1.208)
$R^2$	0.257	0.362	0.360	0.358	0.368
Observations	3171	3171	3171	3171	3171

**Dep. Var.:  $100 \times \log$  CPI**

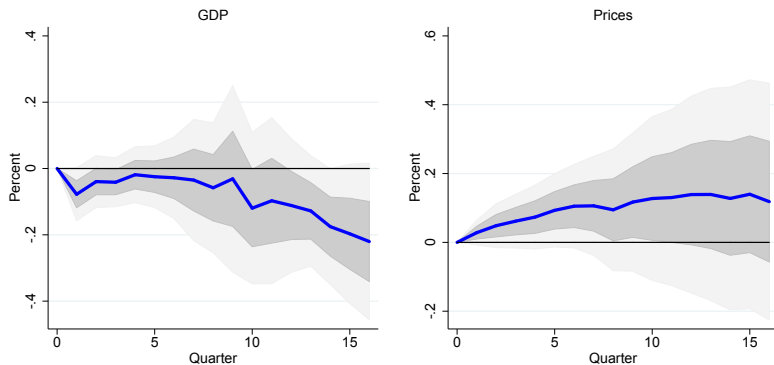
LTV Index	0.173 (0.123)	0.371 (0.385)	0.431 (0.684)	0.634 (0.906)	0.433 (1.152)
$R^2$	0.523	0.497	0.526	0.525	0.532
Observations	3171	3171	3171	3171	3171

Notes: Clustered (by country) standard errors in parentheses. Control vector includes the current value and four lags of GDP growth, CPI-inflation, and policy rate changes.

Specifications include country-fixed-effects and quarter-fixed-effects.

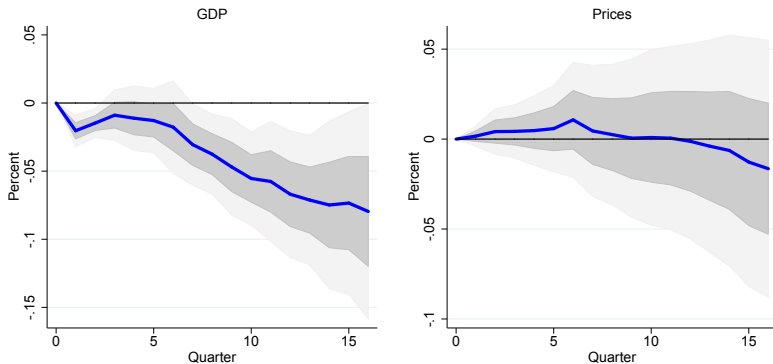
# Pre-2007 sample

Figure: Responses of real GDP and the price level, pre-2007



# No adjustment for scope

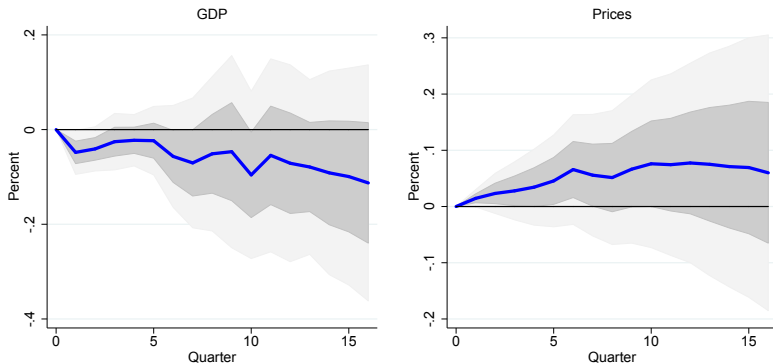
Figure: Response of real GDP and the price level



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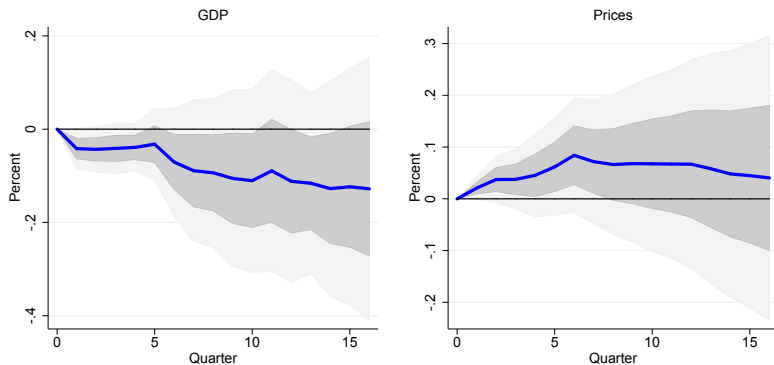
# Announcement instead of implementation dates

Figure: Response of real GDP and the price level



# Excluding Iceland

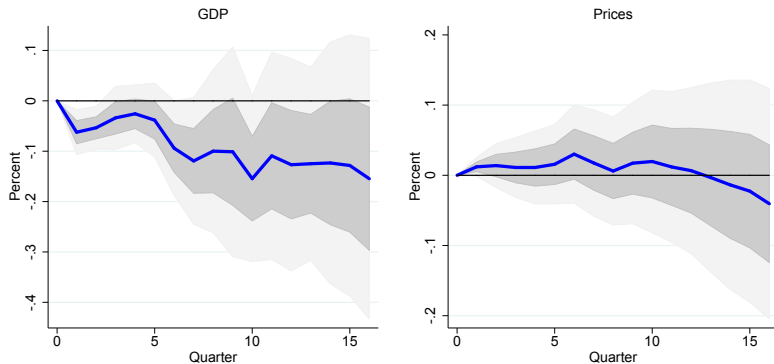
Figure: Response of real GDP and the price level



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# Excluding Hong Kong SAR

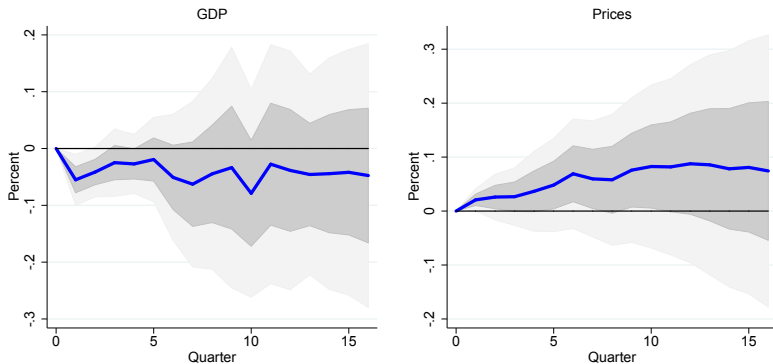
Figure: Response of real GDP and the price level





# Excluding China

Figure: Response of real GDP and the price level



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