How Effective are Macroprudential Policies? An Empirical Investigation

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The views expressed in this presentation are our own and do not necessarily reflect those of the Board of Governors of the Federal Reserve System.

Motivation

- Several countries in recent decade have experienced boom-bust cycles in credit and asset prices, some of which resulted in severe financial crises.

- In response, a number of countries have used a variety of cyclical macroprudential policy (MAPP) tools.
  - Monetary policy viewed as last line of defense for financial instability risks.

- Our understanding of MAPP measures and their effectiveness is limited.

Objective

- Document the use of various MAPP measures across the emerging and advanced economies.
  - A novel *quarterly* index of MAPP measures (domestic, FX-related and capital controls).

- Provide new empirical evidence about the impact of various MAPP measures on credit and asset price cycles.
  - Concentrate on *bank credit, housing credit and house prices* because of their link to boom-bust financial cycles.

Related Literature

- Single country case studies
  - Saurina (2009), Igan and Kang (2011), Fischer (2014)

- Cross country studies
  - Lim and others (2011), Craig and Hua (2011), Kuttner and Shim (2013), Zhang and Zoli (2014), Claessens and others (2014), Cerutti, Claessens, Laeven (2015)

Outline

1. Macroprudential Policy Measures
   - Data and Construction of MAPP index
   - Usage of MAPP measures

2. Empirical Evidence
   - Event Study: The Case of Korea
   - The Empirical Model
   - Capital controls and FX-related prudential policies

Macroprudential Policy Measures

- *Housing related measures (MAPPH):*
  - Time-varying loan-to-value (LTV) caps
  - Time-varying debt-to-income (DTI) caps
  - "Other housing measures" such as, quantitative limits on mortgage lending, risk weights on housing loans, housing tax, etc.

- *Nonhousing related measures (MAPPNH):*
  - Countercyclical capital requirements
  - Dynamic loan loss provisioning
  - Credit growth ceilings
  - Consumer loan limits

Outline

Data

- 57 Countries: **Asia** (China, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand); **Latin America** (Argentina, Brazil, Chile, Colombia, Mexico, Peru, Uruguay); **CEE** (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Serbia, Turkey, Ukraine); **AFEs** (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK); **Others** (Israel, South Africa).

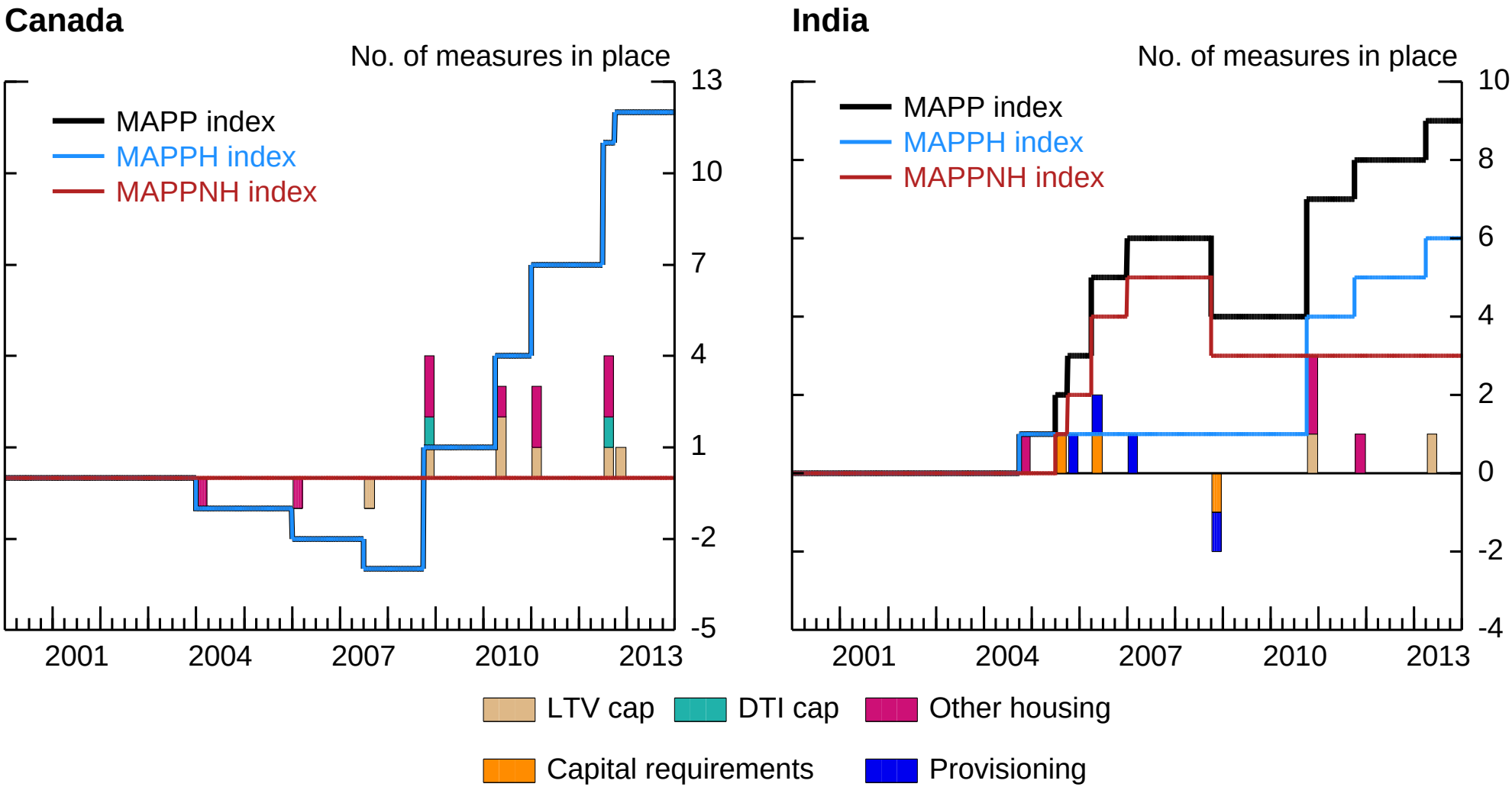
- Time Span: 2000Q1-2013Q4.

- *Data Source*: IMF survey data (2011 and 2013) and BIS database on macroprudential tools, various country documents and national sources, and feedback from national authorities.

Construction of MAPP index

- For each measure, created monthly variables that take on three discrete values:
  - 1 for tightening actions.
  - -1 for easing actions.
  - 0 for no change.
- Monthly observations are summed to create quarterly time series.
- Create subindex for housing (MAPPH), nonhousing (MAPPNH) components.

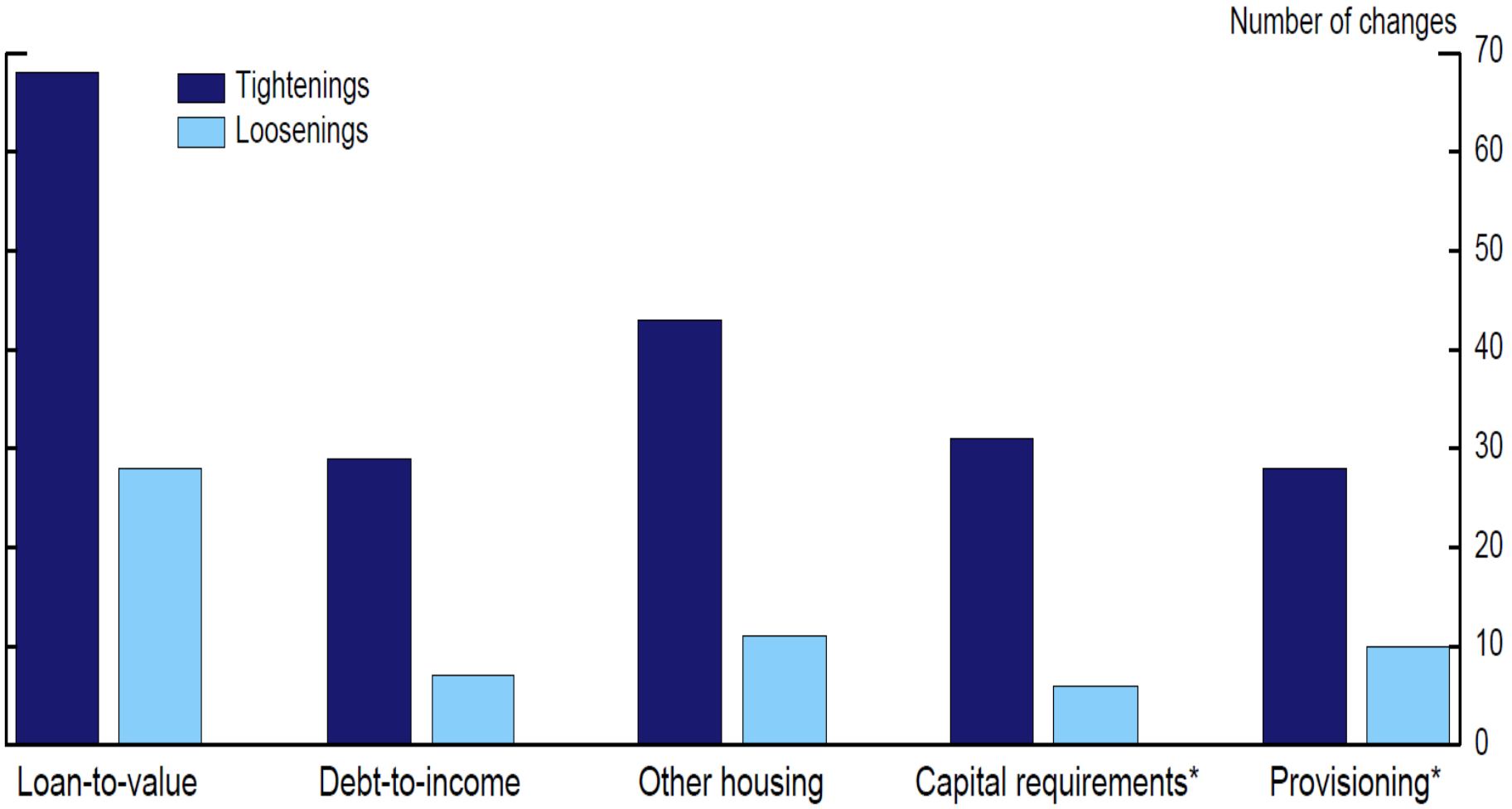
New and Cumulative MAPP Tools in Selected Countries



Note: Capital requirements and provisioning exclude housing-related measures.

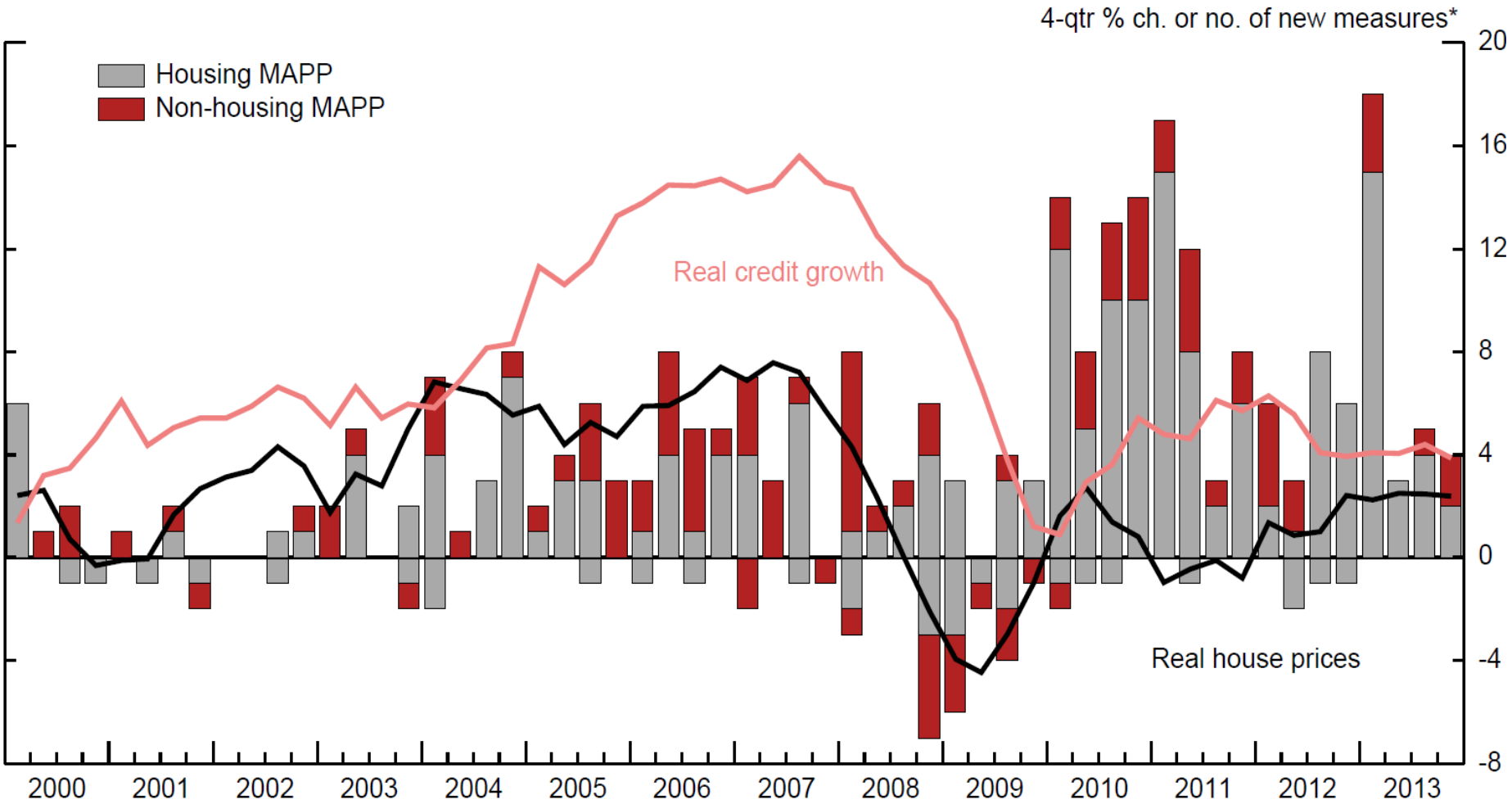
Outline

Use of Various MAPP Tools, 2000Q1-2013Q4



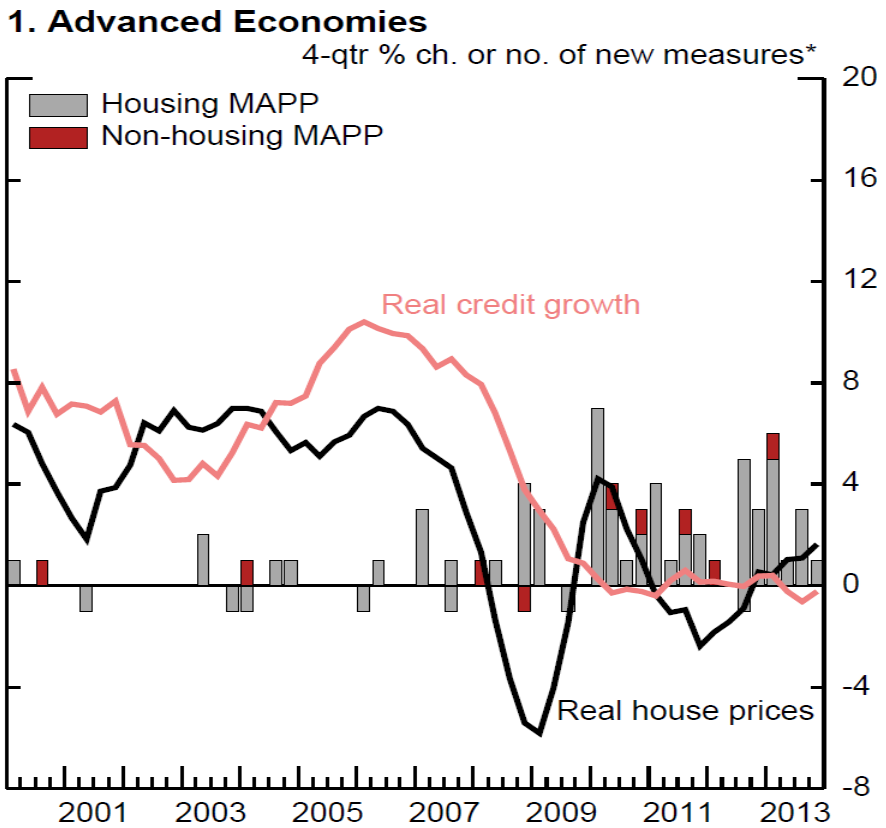
* Excludes housing measures.

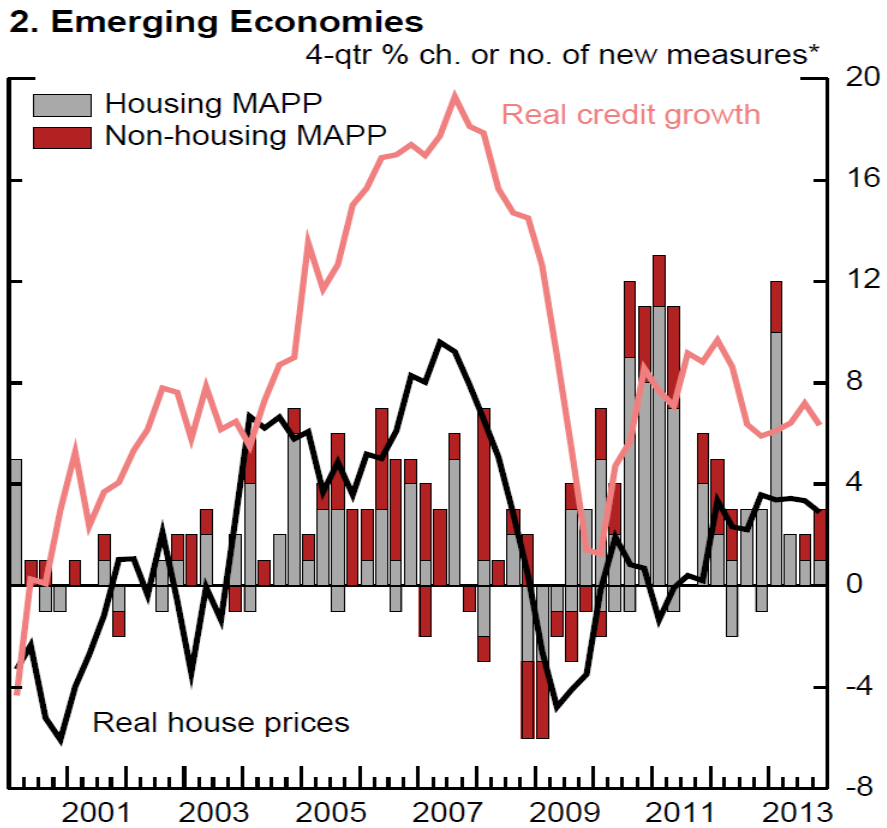
Evolution of MAPP Use, 2000Q1-2013Q4



Note: Average for real credit growth and real house price inflation and sum for MAPP measures across all countries.
* 4-qtr % ch. is for credit and house prices; no. of new measures is for MAPP.

Advanced and Emerging Economies, 2000Q1-2013Q4





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   - The Empirical Model
   - Capital controls and FX-related prudential policies

Empirical Evidence

- Analyze the impact of various MAPP measures on credit and asset prices.
  - Concentrate on *bank credit, housing credit and house prices* because of their link to boom-bust financial cycles.
  - Schularick and Taylor (2012), Gourinchas and Obstfeld (2012), and Mendoza and Terrones (2012).

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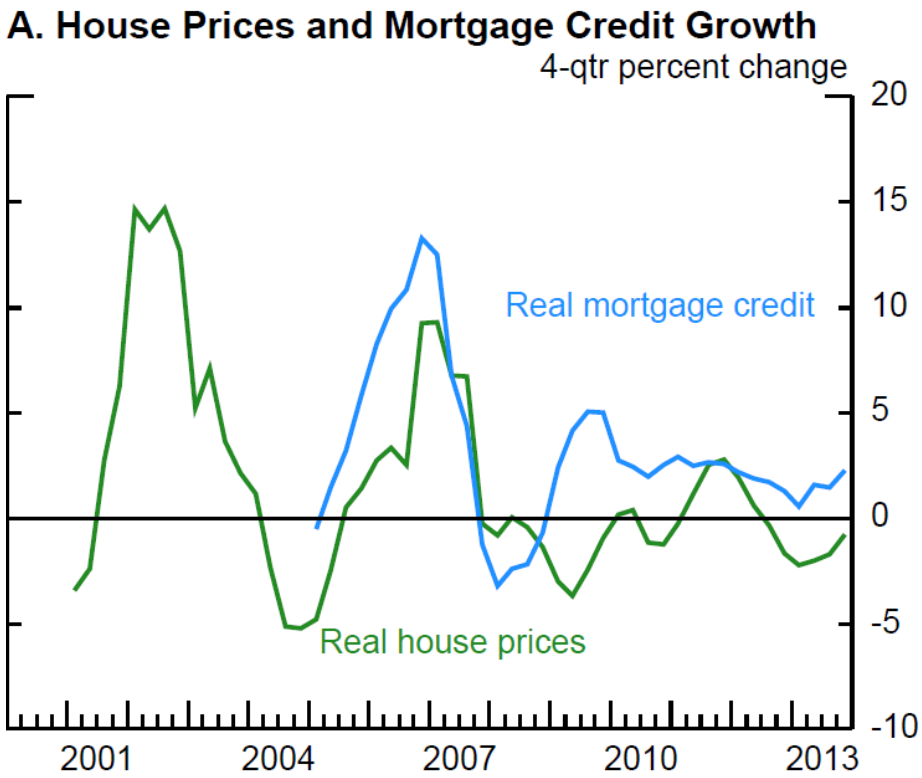
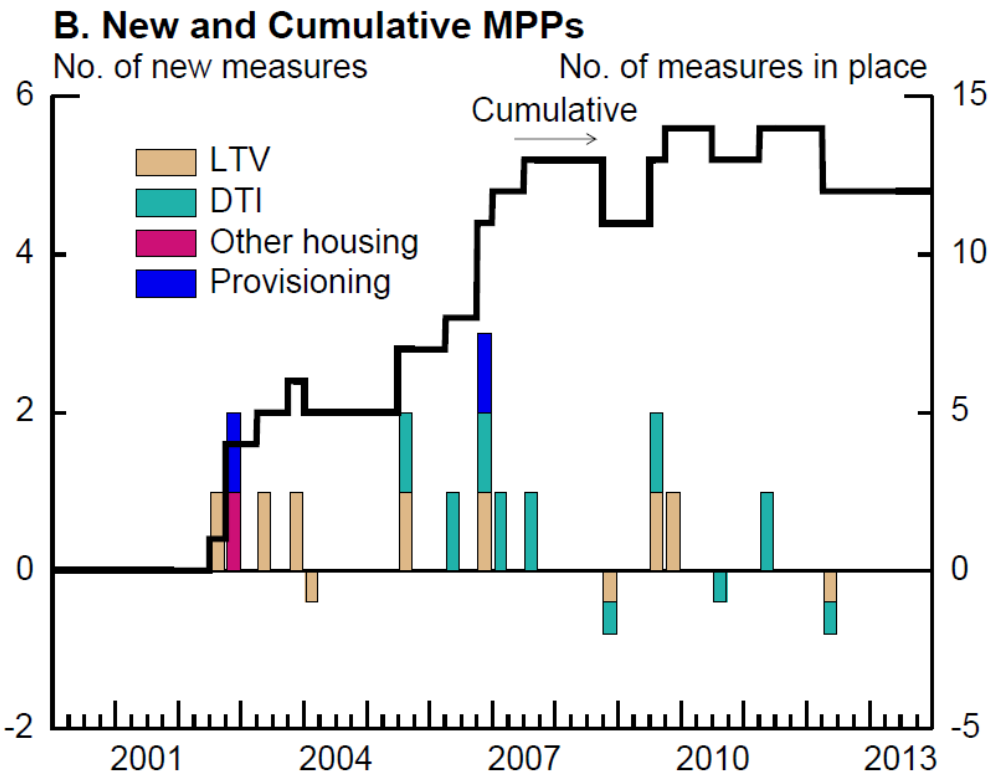
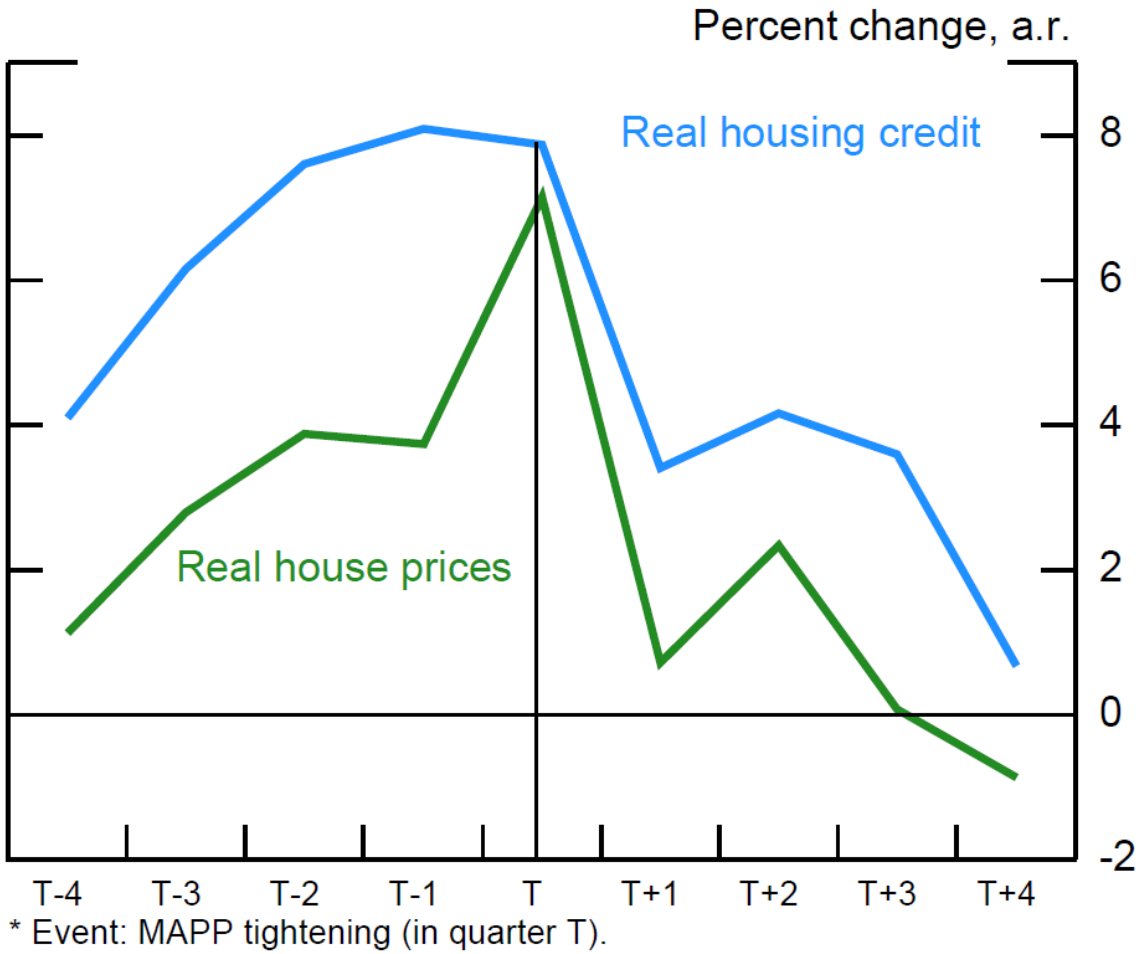
Korea: Housing Market Developments and MAPP





Event Study Analysis: Korea



Outline

The Empirical Model

- Panel regression, quarterly data for 57 countries over 2000:Q1-2013:Q4.

$$C_{i,t} = \eta_i + \rho\, C_{i,t-1} + \beta\, VIX_t + \sum_{k=1}^{p} \theta_k X_{i,t-k} + \delta\, MAPP_{i,t-1} + \varepsilon_{i,t}$$

- C : Growth rate of *real domestic bank credit* or *real housing credit* or *real house prices* (q/q, annualized).
- VIX : Log of VIX global risk aversion index.
- X: Change in policy rates, growth rate (q/q, annualized) of *real GDP*.
- $MAPP$: Macroprudential policy measures.

Panel Estimation Results: Bank Credit Growth

VARIABLES	(1) Baseline Model	(2) Model with MPP	(3) Model with MPPH	(4) Model with MPPNH
Lagged dependent variable	0.32***	0.32***	0.32***	0.32***
	(0.051)	(0.051)	(0.051)	(0.051)
VIX index	-2.61***	-2.78***	-2.74***	-2.65***
	(0.76)	(0.77)	(0.77)	(0.76)
GDP growth, 1st lag	0.25***	0.24***	0.24***	0.24***
	(0.071)	(0.071)	(0.071)	(0.071)
GDP growth, 2nd lag	0.27***	0.25***	0.26***	0.26***
	(0.055)	(0.055)	(0.055)	(0.055)
Change in policy rate, 1st lag	-1.10**	-1.01*	-1.07*	-0.97*
	(0.55)	(0.55)	(0.55)	(0.55)
MPP index, 1st lag		**-0.32*** **		
		(0.11)		
Housing MPP index, 1st lag			**-0.27****	
			(0.12)	
Nonhousing MPP index, 1st lag				**-0.78*** **
				(0.29)
Observations	2,689	2,689	2,689	2,689
R-squared	0.311	0.313	0.312	0.313

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel Estimation Results: Housing Credit Growth

VARIABLES	(1) Baseline Model	(2) Model with MPP	(3) Model with MPPH	(4) Model with MPPNH
Lagged dependent variable	0.42***	0.42***	0.41***	0.42***
	(0.069)	(0.068)	(0.068)	(0.069)
VIX index	-2.64**	-2.94***	-3.06***	-2.60**
	(1.02)	(1.03)	(1.03)	(1.03)
GDP growth, 1st lag	0.31***	0.29***	0.29***	0.31***
	(0.096)	(0.094)	(0.093)	(0.096)
GDP growth, 2nd lag	0.22***	0.21***	0.21***	0.22***
	(0.071)	(0.070)	(0.069)	(0.071)
Change in policy rate, 1st lag	-0.19	-0.066	-0.068	-0.24
	(0.79)	(0.79)	(0.78)	(0.79)
MPP index, 1st lag		**-0.64*** **		
		(0.16)		
Housing MPP index, 1st lag			**-1.09*** **	
			(0.19)	
Nonhousing MPP index, 1st lag				0.51
				(0.48)
Observations	2,453	2,453	2,453	2,453
R-squared	0.432	0.435	0.438	0.432

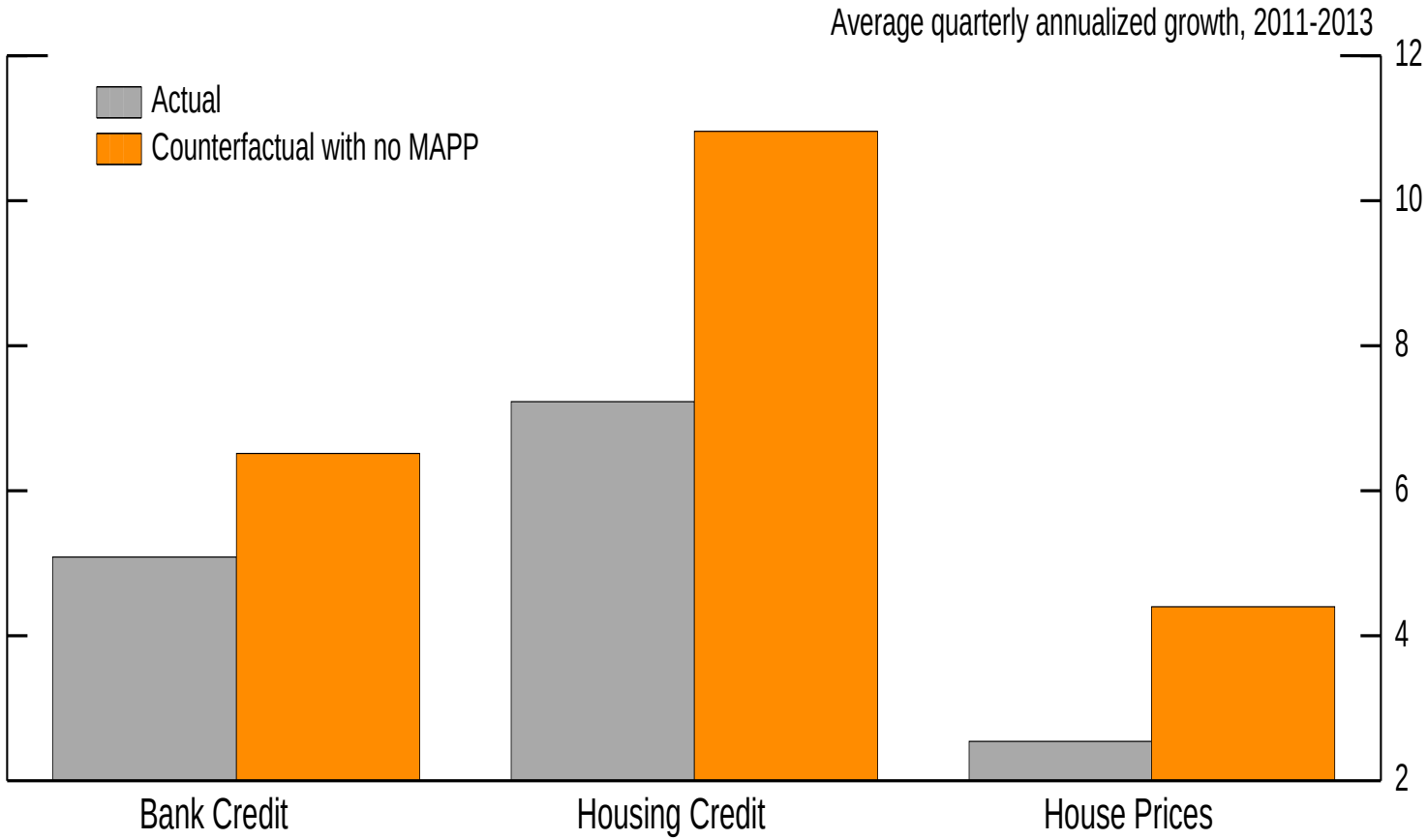
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel Estimation Results: House Price Inflation

VARIABLES	(1) Baseline Model	(2) Model with MPP	(3) Model with MPPH	(4) Model with MPPNH
Lagged dependent variable	0.20***	0.20***	0.20***	0.20***
	(0.038)	(0.038)	(0.038)	(0.038)
VIX index	-4.05***	-4.25***	-4.28***	-4.06***
	(0.72)	(0.73)	(0.73)	(0.73)
GDP growth, 1st lag	0.27***	0.26***	0.26***	0.27***
	(0.060)	(0.060)	(0.060)	(0.060)
GDP growth, 2nd lag	0.21***	0.21***	0.21***	0.21***
	(0.056)	(0.056)	(0.055)	(0.056)
Change in policy rate, 1st lag	-1.42***	-1.36***	-1.37***	-1.42***
	(0.48)	(0.49)	(0.48)	(0.49)
MPP index, 1st lag		**-0.32*** **		
		(0.12)		
Housing MPP index, 1st lag			**-0.45*** **	
			(0.13)	
Nonhousing MPP index, 1st lag				-0.028
				(0.41)
Observations	2,406	2,406	2,406	2,406
R-squared	0.173	0.175	0.176	0.173

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Counterfactual Analysis 2011-2013



- Bank credit; counterfactual is MPP = 0 and averages include countries with at least 1 MPP measure.
- Housing credit and house prices; counterfactual is MPPH = 0 and averages include countries with at least 1 MPPH measure.

Panel Estimates for Individual Measures: Bank Credit

VARIABLES	(1) Model with LTV	(2) Model with DTI	(3) Model with Other Housing	(4) Model with CCR	(5) Model with Provisioning
Lagged dependent variable	0.32***	0.32***	0.32***	0.32***	0.32***
	(0.051)	(0.051)	(0.051)	(0.051)	(0.051)
VIX index	-2.75***	-2.62***	-2.70***	-2.67***	-2.61***
	(0.77)	(0.76)	(0.77)	(0.77)	(0.76)
GDP growth, 1st lag	0.25***	0.25***	0.25***	0.24***	0.25***
	(0.071)	(0.071)	(0.071)	(0.071)	(0.071)
GDP growth, 2nd lag	0.26***	0.26***	0.26***	0.26***	0.26***
	(0.055)	(0.055)	(0.055)	(0.055)	(0.054)
Change in policy rate, 1st lag	-1.07*	-1.09**	-1.08*	-1.00*	-1.02*
	(0.55)	(0.55)	(0.55)	(0.55)	(0.55)
LTV index, 1st lag	**-0.52***				
	(0.30)				
DTI index, 1st lag		-0.39			
		(0.42)			
Other Housing index, 1st lag			**-0.55****		
			(0.22)		
Capital Requirements index, 1st lag				**-0.96****	
				(0.38)	
Provisioning index, 1st lag					**-1.76*****
					(0.66)
Observations	2,689	2,689	2,689	2,689	2,689
R-squared	0.312	0.312	0.312	0.313	0.314

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel Estimates for Individual Measures: Housing Credit

VARIABLES	(1) Model with LTV	(2) Model with DTI	(3) Model with Other Housing	(4) Model with CCR	(5) Model with Provisioning
Lagged dependent variable	0.41***	0.40***	0.42***	0.42***	0.42***
	(0.067)	(0.067)	(0.069)	(0.069)	(0.069)
VIX index	-3.21***	-2.67***	-2.73***	-2.55**	-2.64***
	(1.03)	(1.01)	(1.03)	(1.02)	(1.03)
GDP growth, 1st lag	0.28***	0.29***	0.30***	0.31***	0.31***
	(0.092)	(0.091)	(0.096)	(0.096)	(0.096)
GDP growth, 2nd lag	0.21***	0.20***	0.22***	0.22***	0.22***
	(0.069)	(0.068)	(0.071)	(0.071)	(0.071)
Change in policy rate, 1st lag	-0.074	-0.10	-0.17	-0.26	-0.22
	(0.77)	(0.78)	(0.79)	(0.78)	(0.79)
LTV index, 1st lag	**-2.60*** **				
	(0.46)				
DTI index, 1st lag		**-5.06*** **			
		(0.88)			
Other Housing index, 1st lag			**-0.55***		
			(0.33)		
Capital Requirements index, 1st lag				0.92	
				(0.64)	
Provisioning index, 1st lag					0.98
					(1.06)
Observations	2,453	2,453	2,453	2,453	2,453
R-squared	0.439	0.442	0.432	0.432	0.432

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel Estimates for Individual Measures: House Prices

VARIABLES	(1) Model with LTV	(2) Model with DTI	(3) Model with Other Housing	(4) Model with CCR	(5) Model with Provisioning
Lagged dependent variable	0.20***	0.20***	0.20***	0.20***	0.20***
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)
VIX index	-4.29***	-4.11***	-4.19***	-4.18***	-4.04***
	(0.73)	(0.72)	(0.73)	(0.73)	(0.73)
GDP growth, 1st lag	0.26***	0.27***	0.27***	0.26***	0.28***
	(0.060)	(0.060)	(0.059)	(0.060)	(0.060)
GDP growth, 2nd lag	0.21***	0.21***	0.21***	0.20***	0.21***
	(0.056)	(0.055)	(0.056)	(0.056)	(0.056)
Change in policy rate, 1st lag	-1.37***	-1.40***	-1.40***	-1.36***	-1.44***
	(0.48)	(0.48)	(0.48)	(0.49)	(0.48)
LTV index, 1st lag	**-0.87*** **				
	(0.28)				
DTI index, 1st lag		**-1.29*** **			
		(0.50)			
Other Housing index, 1st lag			**-0.69*** **		
			(0.25)		
Capital Requirements index, 1st lag				**-1.13** **	
				(0.46)	
Provisioning index, 1st lag					0.96
					(0.88)
Observations	2,406	2,406	2,406	2,406	2,406
R-squared	0.175	0.175	0.175	0.175	0.174

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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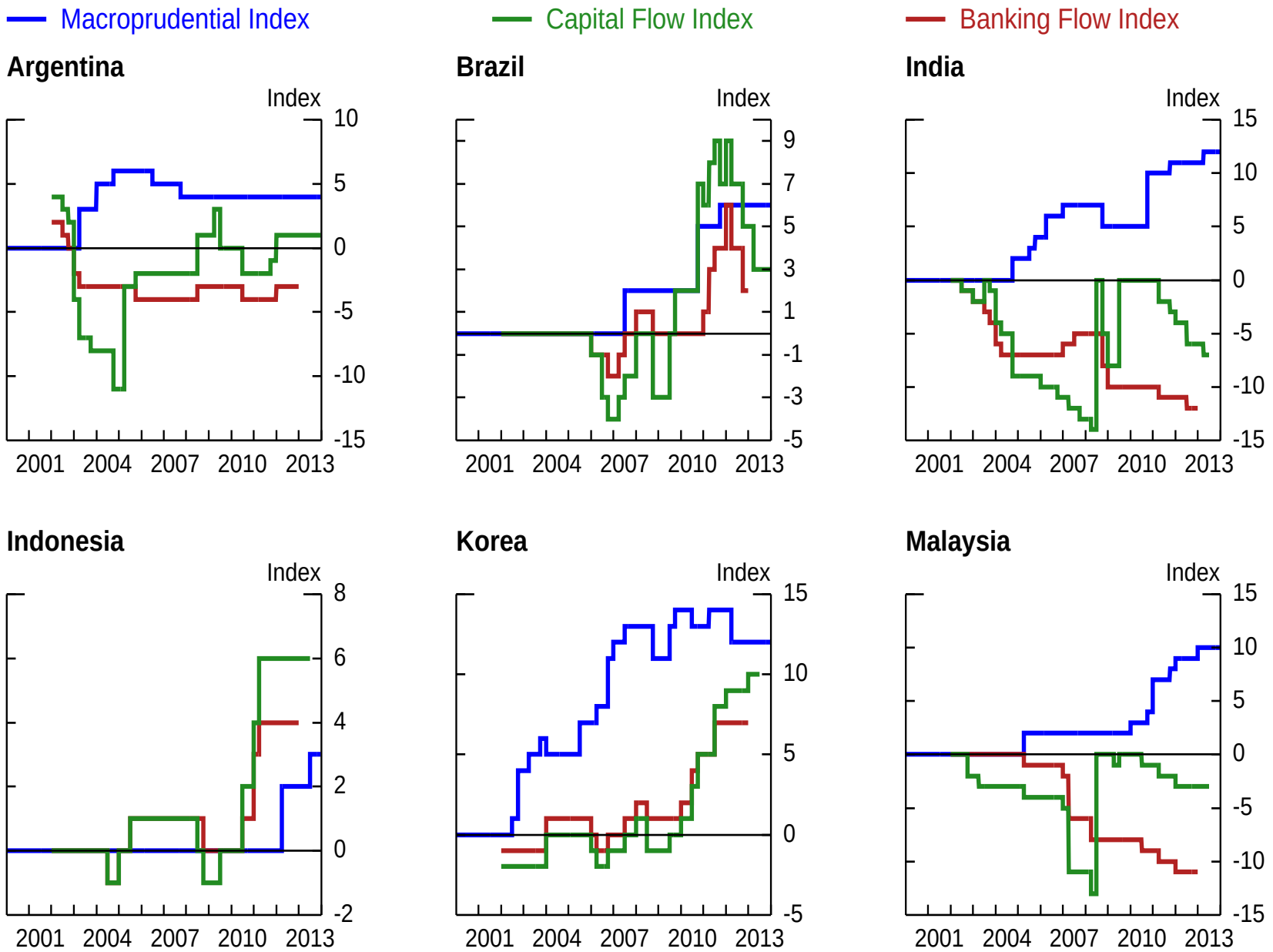
Capital controls, FX-related Macroprudential Policies

- Several countries used capital controls and FX-related MAPP.
- Extension of the model to include *quarterly* "Capital Control Index".
  - Covers 2002Q1-2012Q4 period for 19 emerging market economies.
  - Subindices for FDI, portfolio, and banking inflow restrictions.
  - Examples: taxes on investment by foreigners, taxes on short-term external borrowing, limits on exposure to FX securities, and reserve requirements on FX deposits.

Capital Controls and Macroprudential Policy



The Extended Empirical Model

- Panel regression, quarterly data for 19 countries over 2002:Q1-2012:Q4.

$$C_{i,t} = \eta_i + \rho\, C_{i,t-1} + \beta\, VIX_t + \sum_{k=1}^{p} \theta_k X_{i,t-k} + \delta\, MAPP_{i,t-1} + \alpha\, CCI_{i,t-1} + \varepsilon_{i,t}$$

- $CCI_{i,t-1}$: Capital control index or banking inflow subcomponent.

- Also tested interaction terms for capital control indexes and macroprudential index but got no significant results and estimation of other coefficients unchanged.

Baseline for Capital Control Countries: Bank Credit

VARIABLES	(1) Model with MPP	(2) Model with MPPH	(3) Model with MPPNH
Lagged dependent variable	0.24*** (0.060)	0.24*** (0.060)	0.24*** (0.061)
VIX index	-4.31*** (1.42)	-4.46*** (1.41)	-4.25*** (1.42)
GDP growth, 1st lag	0.20** (0.095)	0.21** (0.094)	0.20** (0.094)
GDP growth, 2nd lag	0.34*** (0.077)	0.34*** (0.077)	0.34*** (0.078)
Change in policy rate, 1st lag	-0.70 (0.76)	-0.77 (0.77)	-0.70 (0.76)
MPP index, 1st lag	**-0.45**** (0.19)		
Housing MPP index, 1st lag		**-0.46**** (0.23)	
Nonhousing MPP index, 1st lag			**-0.74*** (0.42)
Observations	799	799	799
R-squared	0.254	0.252	0.253

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Estimation with Capital Controls: Bank Credit

VARIABLES	Model with MPP	Model with MPPH	Model with MPPNH
Lagged dependent variable	0.24***	0.25***	0.25***
	(0.058)	(0.058)	(0.058)
VIX index	-4.24***	-4.35***	-4.18***
	(1.39)	(1.39)	(1.39)
GDP growth, 1st lag	0.22**	0.22**	0.22**
	(0.095)	(0.095)	(0.095)
GDP growth, 2nd lag	0.34***	0.35***	0.34***
	(0.077)	(0.076)	(0.077)
Change in policy rate, 1st lag	-0.68	-0.75	-0.70
	(0.73)	(0.73)	(0.73)
Capital control index, 1st lag	0.21	0.21	0.16
	(0.15)	(0.15)	(0.14)
MPP index, 1st lag	**-0.45****		
	(0.18)		
Housing MPP index, 1st lag		**-0.59****	
		(0.24)	
Nonhousing MPP index, 1st lag			-0.56
			(0.37)
Observations	805	805	805
R-squared	0.286	0.285	0.284

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Estimation with Banking Flow Restrictions: Bank Credit

VARIABLES	Model with MPP	Model with MPPH	Model with MPPNH
Lagged dependent variable	0.25***	0.25***	0.25***
	(0.058)	(0.058)	(0.058)
VIX index	-4.19***	-4.29***	-4.15***
	(1.39)	(1.39)	(1.39)
GDP growth, 1st lag	0.22**	0.22**	0.22**
	(0.095)	(0.095)	(0.095)
GDP growth, 2nd lag	0.34***	0.34***	0.34***
	(0.076)	(0.076)	(0.077)
Change in policy rate, 1st lag	-0.67	-0.73	-0.69
	(0.74)	(0.73)	(0.73)
Banking control index, 1st lag	-0.19	-0.22	-0.18
	(0.17)	(0.17)	(0.17)
MPP index, 1st lag	**-0.39****		
	(0.18)		
Housing MPP index, 1st lag		**-0.49****	
		(0.22)	
Nonhousing MPP index, 1st lag			-0.50
			(0.37)
Observations	805	805	805
R-squared	0.285	0.284	0.283

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusion

- A novel index on housing and nonhousing macroprudential policy measures.
- MAPPs have been used far more actively after the crises, and these policies have primarily targeted the housing sector.
- Both housing and nonhousing measures seem to restrain credit growth.
- The evidence suggests that only housing measures, such as caps on LTV and DTI, can restrain housing credit growth and house price inflation.
- Banking flow restrictions are also associated with lower bank credit growth, while general capital controls are not.
- Robust to several extensions, including to other estimation techniques (such as Arrelano and Bond (1991)).

EXTRA SLIDES

Selected MAPP measures: 2000Q1-2013Q4.

	Macroprudential Measures					
	LTV	**DTI**	**Other Housing**	**Capital Req. (Risk Weights)**	**Provisioning Req.**	**Consumer Loan & Credit Limit**
EMEs	**68** (57, 11)	**30** (24, 6)	**37** (35, 2)	**69** (59, 10)	**30** (24, 6)	**27** (18, 9)
Asia	**50** (43, 7)	**17** (14, 3)	**23** (23, 0)	**18** (16, 2)	**10** (8, 2)	**6** (5, 1)
LatAm	**3** (1, 2)	**1** (1, 0)	**2** (2, 0)	**17** (14, 3)	**6** (6, 0)	**0** (0, 0)
CEEs	**15** (13, 2)	**12** (9, 3)	**12** (10, 2)	**34** (29, 5)	**14** (10, 4)	**21** (13, 8)
AFEs	**13** (12, 1)	**3** (3, 0)	**31** (29, 2)	**14** (14, 0)	**3** (3, 0)	**1** (1, 0)
TOTAL	**81**	**33**	**68**	**83**	**33**	**28**

Descriptive Statistics

Variable	Observations	Mean	Std. Dev.	Min.	Max.
Real bank credit growth, annualized rate	2880	7.4	14.3	-79.5	162.9
Real housing credit growth, annualized rate	2502	10.6	19.5	-96.7	172.9
Real house price growth, annualized rate	2562	2.9	13.9	-73.6	133.9