Macroprudential Policies and Housing Prices
–
A new Database and Empirical Evidence for Central, Eastern, and South-Eastern Europe

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Outline

- motivation & existing literature
- housing price and credit developments in CESEE
- macroprudential policy measures dataset
  - policy measures
  - data collection
  - measuring the relative strength of measures
- econometric analysis
  - core variables & baseline regression
  - endogeneity
- conclusions

Motivation

- emerging consensus: need to incorporate macroprudential dimension to macroeconomic frameworks
- limited evidence & doubts about effectiveness with respect to management of financial cycle
- mostly country-level studies, few cross-country studies (lack of good quality cross-country datasets)
- CESEE gained experience during last decade's boom/bust cycle

→ were MPPs a significant determinant of housing price inflation in CESEE?

Preview of results

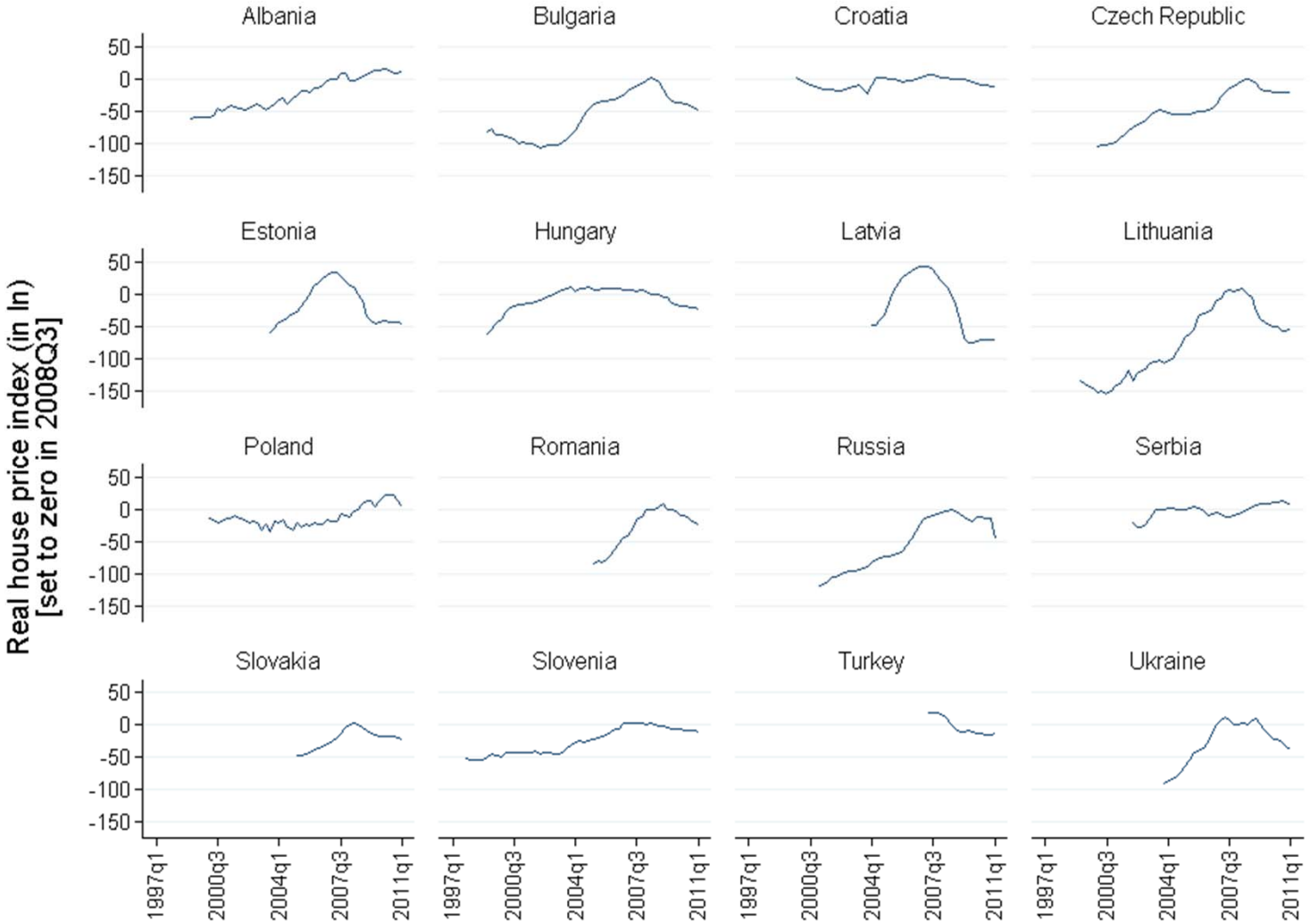
- for four instruments we find evidence of significant impact on housing prices:

1. minimum capital adequacy ratio
2. maximum sectoral leverage ratio (for loans to households)
3. marginal reserve requirements related to credit growth (credit ceilings)
4. marginal reserve requirements on foreign borrowing

Existing empirical literature

- MPPs and housing prices
  - Korea: Igan and Kang 2011; Hong Kong: Craig and Hua 2011; panel of 55 countries: Kuttner and Shim 2012; cross-section of 36 countries: IMF 2013
- MPPs and credit growth
  - UK: Aiyar, Calomiris and Wieladek 2012; Spain: Jimenez et al. 2013; Croatia: Galac 2010, 5 Latin American countries: Tovar et al. 2012; panel of 55 countries: Kuttner and Shim 2012
- MPPs and procyclicality of credit
  - panel of 48 countries: Lim et al. 2011
- MPPs and banks' balance sheets
  - panel of 48 countries: Claessens, Ghosh and Mihet 2013
- studies differ in regional scope (mostly country studies) as well as with respect to the instruments covered

Different patterns of housing price development across countries



Housing booms were credit funded

	Loans to households (share of total loans, in percent, 2007)	Foreign currency loans to households (share of total loans to households, in percent, 2007)	Housing loans (share of total loans to households, in percent, 2007)	Housing loans growth rate (annual average, in percent, 2002–07)
Albania	35.8	56.8	64.0	n.a.
Bulgaria	37.7	20.1	40.7	88.9
Czech Republic	48.8	0.1	47.2	45.6
Croatia	56.7	68.4	n.a.	n.a.
Estonia	49.7	77.4	80.9	46.6
Hungary	44.8	55.0	53.2	32.1
Latvia[a]	50.0	85.8	78.7	76.3
Lithuania[b]	44.8	49.8	66.9	69.3
Poland	60.1	28.6	48.1	42.6
Romania	49.5	53.1	19.8	n.a.
Russia[c]	25.8	12.6	39.1	n.a.
Serbia[d]	39.9	77.4	37.6	n.a.
Slovakia[b]	43.1	3.0	38.5	33.5
Slovenia	27.5	15.8	32.4	49.5
Turkey	39.8	2.8	33.7	n.a.
Ukraine	39.4	63.6	25.4	n.a.

We use housing prices as our dependent variable

- large movements in housing prices in several CESEE countries during the boom years
- house prices matter for macro-financial stability
  - are related to bank and household leverage / can amplify shocks
- why not also look at impact of domestic credit ?
  - benefits of using housing prices in CESEE context:
    - avoids problem of valuation effects due to currency movements
    - reflects effect of *total* household credit (domestic banks + domestic non-banks + cross-border) → better gauge of macro-impact of prudential measures (after possible circumvention)
  - drawbacks:
    - unbalanced panel / some series are short
    - cross-country comparability issues
    - data quality issues (housing quality adjustments; listing versus transaction prices, etc…)
- various data sources (BIS, central banks, statistical offices, private real estate agencies)

Construction of the prudential policy measures dataset

- objective: take stock of major banking sector regulatory measures affecting credit supply and timing of implementation across 16 CESEE countries for period matching that of housing prices data series
- measures may be taken for macroprudential reasons or not (e.g. harmonization with E.U. regulatory framework)
- data sources:
  - Central banks/National supervisors: Financial stability reports, Annual reports, Monetary policy reports, press releases, individual pieces of regulation
  - IMF: Staff reports, FSAP documents, AREAER, MCM MPP survey, country desks
  - academic/policy papers

29 types of measures in the dataset

category	prudential measures	frequency of use
capital	minimum CAR	13
	target CAR (penalties imposed below threshold)	1
	capital eligibility	8
	minimum CAR as a function of credit growth	2
	risk weights (consumer, mortgage, corporate (LC and FC), credit-growth-related)	46
	maximum ratio of household lending to share capital	8
	maximum ratio of lending in foreign currency to share capital	3
provisioning	loan classification and provisioning rules (LC and FC)	25
	general provisions	7
liquidity	reserve requirement ratios (LC and FC)	147
	reserve base	46
	liquidity requirements	5
	marginal reserve requirements (on foreign liabilities)	5
	special reserve requirements (on domestic bonds issued to nonresidents)	2
	reserve requirements linked to credit growth / credit growth reserve	9
eligibility criteria	LTV (LC and FC)	9
	DTI (LC and FC)	9
other	direct limits on FC lending	3

Examples: Bulgaria 2005Q2 and Romania 2007Q1

2005Q2	**cc**: introduction of credit ceilings. A bank is subject to marginal reserve requirements of 200% if (i) it expands credit by more than 6% per quarter on average, taking end-Q1 2005 as the base period; and (ii) the sum of its loans and the risk-weighted off-balance sheet items converted into assets, reduced by the amount of own funds, exceeds 60% of all attracted funds (excluding those attracted from financial institutions) **dp**: loans overdue by more than 30 days, 60 days, or 90 days, have to remain classified as "watch," "substandard" and "non-performing," respectively, for a minimum of 6 months. Loans that are classified as such need to be provisioned in line with BNB regulations for these categories	CB AR 2005: 12, 39 EOR: 150, 151

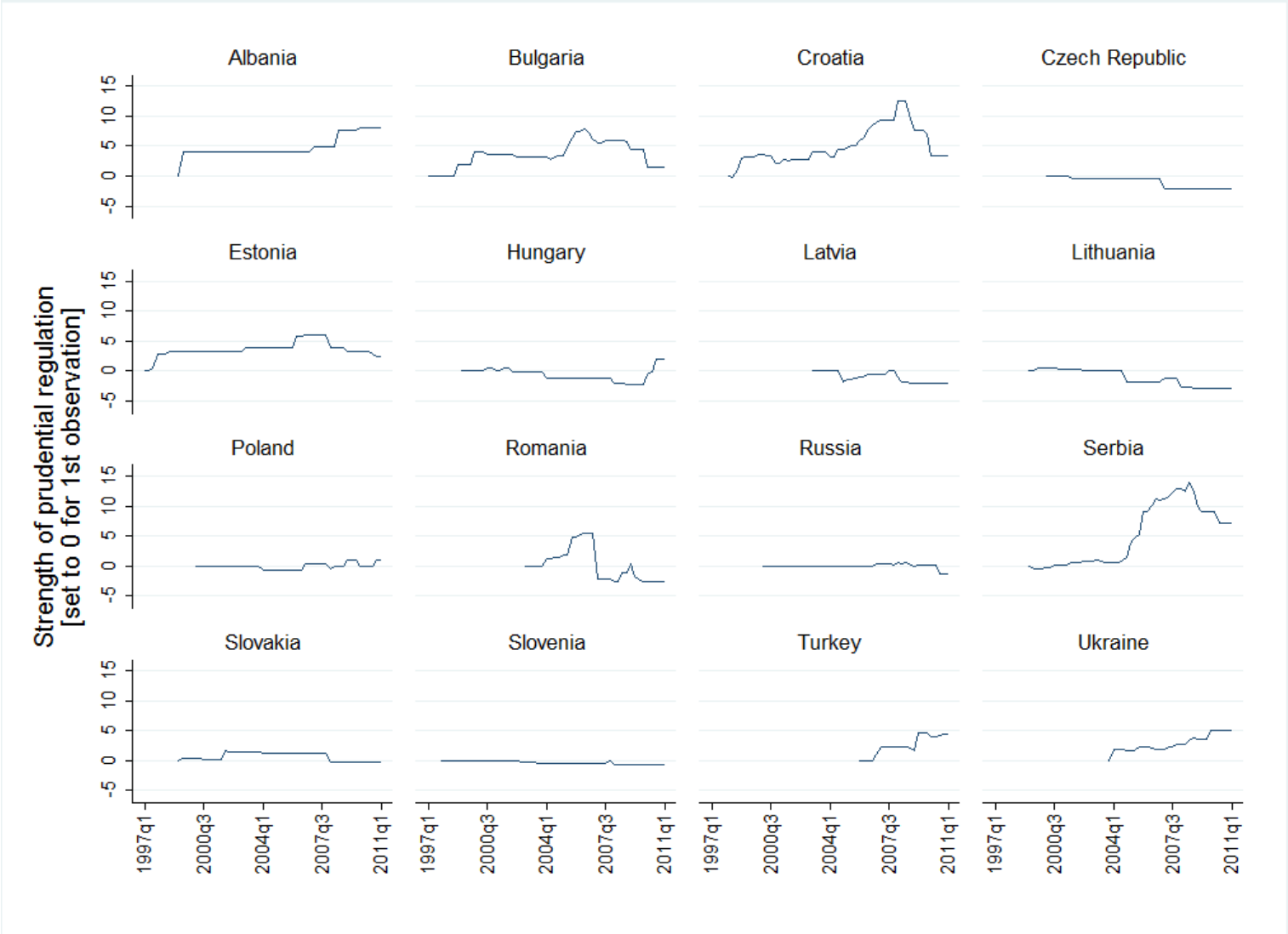
2007Q1	**mincap**: following EU entry, minimum capital requirements drops from 12 to 8% **dti**: Regulation 3/2007: Eligibility criteria are now defined by banks' internal models, effective Mar. 14th **ltv**: LTV limit was abandoned f**csc**: exposure limits out when Romania enters EU (repeal of Regulation 11/2005)	FSR 2008: 27 (fn 17) FSR 2008: 33 (fn) FSR 2007: 21 (fn 8) CB AR 2007: 33 (fn)

Measuring the relative strength of policy measures

- we avoid dummy/index-like approach whenever feasible:
  - we try to quantify relative strength and so account for policy changes of different magnitudes
  - judgment necessarily involved
  - use of rules-based scoring methods

- examples:
  - increase in minimum CAR by x pps: +x
  - increase in risk-weight on mortgages by x pps: +x/25
  - increase in RRs by x pps: +x/10
  - decrease in LTV by x pps: +x/20

Cumulative change in regulation has differed across countries



Econometric analysis

- error-correction framework
- dependent variable: sa qoq real housing price inflation
- determinants of changes in housing prices
  - changes in prudential policies
  - changes in macro/demographic fundamentals: GDP/capita, real interest rate on LC deposits, FC policy rate adjusted for inflation and appreciation rate over past 4 quarters, working age population,
  - changes in other policies (taxes, regulation of non-bank credit institutions)
- preliminary regressions (one policy at a time), then baseline regression (all significant policies in preliminary stage → "core" MPP variables)

$$\Delta h_{i,t} = \varphi\left(h_{i,t-1} - \theta y_{i,t-1}\right) + \sum_{j=1}^{2}\left(\rho_j \cdot \Delta h_{i,t-1}\right) + \alpha_1 \cdot \Delta y_{i,t-1} + \alpha_2 \cdot \Delta r_{i,t-1} + \alpha_3 \cdot \Delta r^{*}_{i,t-1} + \alpha_4 \cdot \Delta_4 wp_{i,t}$$

$$+ \sum_{j=1}^{2}\left(\beta_1 \cdot \Delta x_{i,t-j} + \gamma_j \cdot C^{X}_{i,t-j}\right) + \sum_{j=1}^{4} ukr_j + \delta_i + \mu_t + \varepsilon_{i,t}$$

„Core“ variables

- we find evidence of significant impact on housing prices of four instruments:

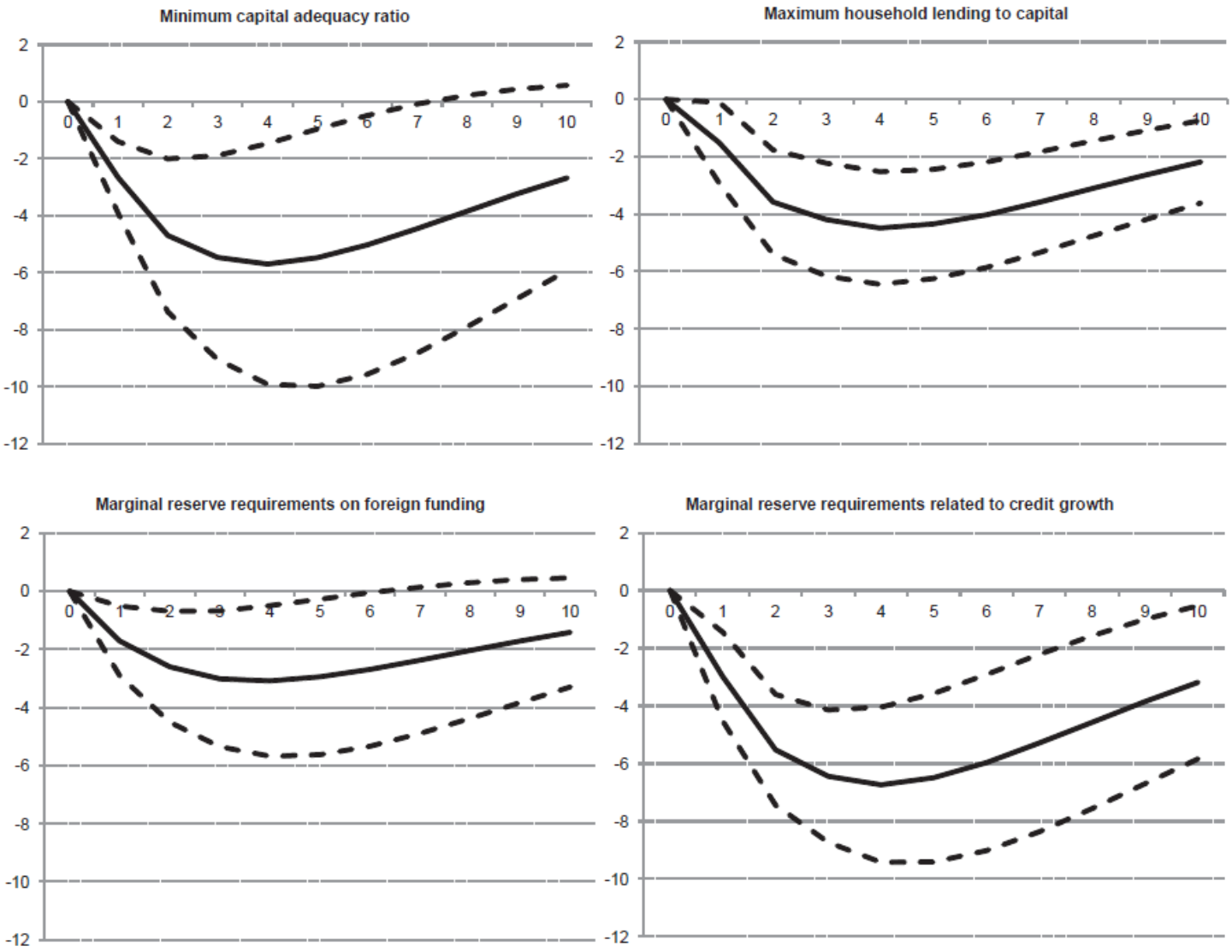
  1. minimum capital adequacy ratio
  2. maximum sectoral leverage ratio (for Loans to Households)
  3. marginal reserve requirements on foreign borrowing
  4. “credit ceilings” (marginal reserve requirements related to credit growth)

- DTI also meets our selection criterion, but result appears fragile
  → not included in the core set

Baseline regression output

	Coefficient	*p*-value	*F*-test *p*-value
Error-correction (EC) equation			
L.GDP growth	1.83**	(0.02)	
Short-run equation			
Error correction term	−0.08***	(0.00)	
Δ(log housing price index) $t-1$	0.28***	(0.01)	
Δ(log housing price index) $t-2$	0.22***	(0.00)	
Δ(log GDP/capita) $t-1$	0.18	(0.34)	
Δ(domestic currency real interest rate) $t-1$	−0.17	(0.38)	
Δ(effective foreign currency real interest rate) $t-1$	0.06	(0.24)	
Δ(log working age population)	−0.23	(0.65)	
Δ(mininum CAR)			(0.00)
First lag	−2.65***	(0.00)	
Second lag	−1.53**	(0.03)	
Δ(maximum household loans/capital)			(0.00)
First lag	−1.52**	(0.02)	
Second lag	−1.76***	(0.00)	
Δ(MRRs on foreign funding)			(0.00)
First lag	−1.71***	(0.00)	
Second lag	−0.55	(0.21)	
Δ(MRRs related to credit growth)			(0.00)
First lag	−2.98***	(0.00)	
Second lag	−1.96**	(0.02)	
Δ(other policies)			(0.41)
First lag	−0.01	(0.95)	
Second lag	0.48	(0.32)	
R^2	0.471		
Adj. R^2	0.398		
Number of observations	565		

Dynamic multipliers



Insignificant policy variables

- we do not find evidence of impact for several measures but:
  1. endogeneity works against finding evidence of negative impact
  2. some measures may not have been binding at the time of implementation
  3. impact may happen at time of announcement / be contemporaneous / be delayed or more gradual
  4. some instruments may only be first line of defense
  5. RR is also a multi-dimensional monetary instrument (used in conjunction with other monetary instruments, e.g. central bank bills, which we do not control for)
  6. small number of observations in some cases

Robustness checks

1. using the “standard” dummy approach for all MPPs
2. adding one MPP at a time to the baseline
3. adding the third lag of the core MPPs
4. excluding the error-correction term
5. excluding the non-significant control variables
6. excluding one country at a time
7. controlling for aggregate banking sector characteristics

→ all robustness checks confirm our previous results

Isolating policy changes that are exogenous

- endogeneity may lead to underestimation of the impact of the MPPs
- however, alternative model is not feasible
- to address endogeneity and obtain less biased estimates we isolate the effects of changes in MPPs
  - that are known to be exogenous (eg. because of EU accession)
    - we can study minimum CAR, MRRs related to credit growth and risk weights on consumer loans
    - changes in minimum CAR and MRRs related to credit growth are significant
  - that were „easing during the boom“
    - 10 measures were eased during the boom (incl. 3 of our “core” measures)
    - core measures are significant, but none of the others

Macroprudential policies and household credit growth

- for 2 out of our core measures we also find significant impact on credit growth

→ channel of transmission is through the volume of credit

	Coefficient	*p*-value	*F*-test *p*-value
Δ(mininum CAR)			(0.01)
First lag	−0.26	(0.32)	
Second lag	−0.69**	(0.03)	
Δ(maximum household loans/capital)			(0.99)
First lag	−0.79***	(0.00)	
Second lag	0.78**	(0.02)	
Δ(MRRs on foreign funding)			(0.92)
First lag	0.14	(0.57)	
Second lag	−0.18	(0.53)	
Δ(MRRs related to credit growth)			(0.00)
First lag	−1.44*	(0.10)	
Second lag	−0.82	(0.11)	

Conclusions

- several types of prudential measures have had an impact on housing price inflation during the recent boom-bust cycle in CESEE
  - minimum CAR, sectoral leverage ratio (household loans)
  - non-standard liquidity measures (marginal RR on foreign borrowing, credit growth “ceilings” in the form of marginal RR)
  - effects are very robust
  - minimum CAR and credit ceilings also had an impact on hh credit
- few observations of LTV, DTI may explain lack of robustness/significance
- challenges we have tried to address:
  - quantification of relative strength of policy measures
  - endogeneity of policy measures
  - transmission channel

Additional slides

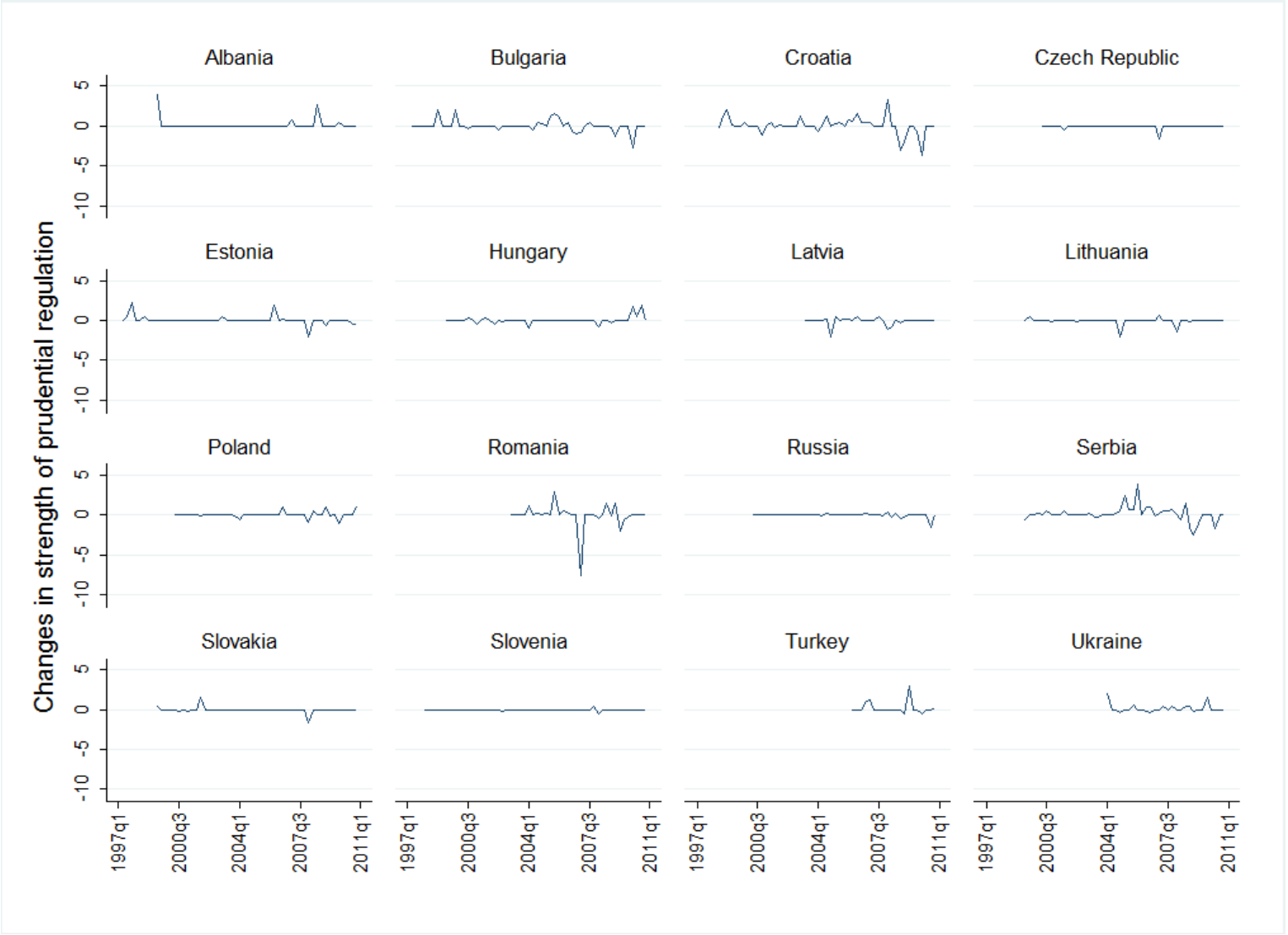
Macroprudential measures by country [1/2]

Variable	Prudential measure	ALB	BGR	HRV	CZE	EST	HUN	LVA	LTU	POL	ROM	RUS	SRB	SVK	SVN	TUR	UKR
Capital measures (except risk-weights)																	
mincap	Minimum capital adequacy ratio	■	■	■		■		■	■		■	■	■				■
tgtmincap	(Target) capital adequacy ratio below which restrictions are imposed															■	
cap	Capital eligibility		■							■	■						
cgrcap	Minimum capital adequacy ratio as a function of credit growth			■													
hhsc	Maximum ratio of household loans to share capital												■				
fcsc	Maximum ratio of FC loans to own funds	■									■						
Risk-weights measures																	
rwmol	Risk-weights/mortgage loans		■	■	■	■	■	■	■	■	■	■		■	■		
rwmolfc	Risk-weights surcharge/FC mortgage loans	■		■						■			■				
rwcons	Risk-weights/consumer loans		■	■	■	■	■	■	■	■	■	■		■			
rwconsfc	Risk-weights surcharge/FC consumer loans	■		■									■				
rwcorpfc	Risk-weights on FC corporate loans			■									■				
rwcc	Risk-weights/credit growth	■															
Provisioning measures																	
gp	Rules for general provisions			■									■			■	
dp	Rules for specific provisions		■	■						■	■		■			■	■
dpfc	FC loans rules for specific provisions	■		■							■		■				■
Liquidity measures																	
rr	Reserve requirements rate on LC deposits		■	■		■	■	■	■	■	■	■	■	■	■	■	■
rrfc	Reserve requirements rate on FC deposits		■	■		■	■	■	■	■	■	■	■	■	■	■	■
rrbase	Reserve requirements base		■	■	■	■	■	■			■	■	■	■	■	■	■
lr	Liquidity regulation	■							■	■			■			■	
fclr	Foreign currency liquidity requirement			■									■				
mrr	Marginal reserve requirements			■													

Macroprudential measures by country [2/2]

Variable	Prudential measure	ALB	BGR	HRV	CZE	EST	HUN	LVA	LTU	POL	ROM	RUS	SRB	SVK	SVN	TUR	UKR
srr	Special reserve requirements			■													
cgr	Credit growth reserve (max permissible growth, for exceeding growth banks need to hold low-yielding CB bills)			■													
cc	Marginal reserve requirements on excess credit growth		■														
Eligibility measures																	
ltv	Loan-to-value ceiling						■	■			■			■		■	
ltvfc	FC loan-to-value ceiling						■			■							
dti	Debt-service-to-income ceiling									■	■						
dtifc	FC debt-service-to-income ceiling						■			■	■				■		
dtitot	Debt-service-to-income ceiling (combined)						■			■	■						
Other bank regulatory measures																	
otherfc	Other quantitative limits on FC-lending as a share of total lending						■									■	■

Intensity and frequency of changes in prudential regulation



Isolating the effects of changes in MPPS that are exogenous

	Coefficient	*p*-value	*F*-test *p*-value
Δ(mininum CAR)			(0.00)
Exogenous change, first lag	−3.69***	(0.00)	
Exogenous change, second lag	−2.93***	(0.00)	
Other change, first lag	−1.39**	(0.05)	
Other change, second lag	−0.23	(0.82)	
Δ(maximum household loans/capital)			
First lag	−-1.57**	(0.02)	
Second lag	−1.84***	(0.00)	
Δ(MRRs on foreign funding)			
First lag	−1.69***	(0.00)	
Second lag	−0.62	(0.19)	
Δ(MRRs related to credit growth)			(0.05)
Exogenous change, first lag	−2.72*	(0.08)	
Exogenous change, second lag	−1.29	(0.13)	
Other change, first lag	−3.12***	(0.00)	
Other change, second lag	−2.02*	(0.06)	

Isolating the effects of easing MPPs during the boom period

	Coefficient	*p*-value	*F*-test *p*-value
Δ(mininum CAR)			(0.00)
Easing during the boom, first lag	−3.72***	(0.00)	
Easing during the boom, second lag	−2.92***	(0.00)	
Other change, first lag	−1.53**	(0.03)	
Other change, second lag	−0.25	(0.80)	
Δ(maximum household loans/capital)			(0.00)
Easing during the boom, first lag	−5.31***	(0.00)	
Easing during the boom, second lag	−3.87***	(0.00)	
Other change, first lag	−0.60	(0.50)	
Other change, second lag	−1.75***	(0.01)	
Δ(MRR on foreign funding)			
First lag	−1.70***	(0.00)	
Second lag	−0.62	(0.20)	
Δ(MRRs on credit growth)			(0.06)
Easing during the boom, first lag	−5.48***	(0.01)	
Easing during the boom, second lag	1.53	(0.34)	
Other change, first lag	−1.20	(0.35)	
Other change, second lag	−4.63**	(0.01)	