

Macroprudential Policies and Housing Prices

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A New Database and Empirical Evidence from Central, Eastern and Southeastern Europe



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Outline

- Motivation
- Preview of results / literature review
- Background: Housing price and credit developments in CESEE
- Construction of the prudential/macroprudential policy measures dataset
- Measuring the relative strength of policy measures
- Econometric analysis
- 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 credit boom/bust

Preview of results

- We find evidence of significant impact on housing prices of 4 instruments:
 1. Minimum Capital Adequacy Ratio
 2. Maximum Sectoral Leverage Ratio (for Loans to Households)
 3. “Credit ceilings” (marginal reserve requirements related to credit growth)
 4. Marginal reserve requirements on foreign borrowing

Existing empirical literature (1)

- MPPs and housing prices:
 - LTV and DTI in Korea (Igan and Kang, 2011)
 - LTV and stamp duties in Hong Kong (Craig and Hua, 2011)
 - LTV in U.S. (Duca, Muellbauer and Murphy, 2011)
 - LTV and “exposure limits” in panel of 55 countries (Kuttner and Shim, 2012)
 - LTV and capital requirements in cross-section of 36 countries (IMF, 2013)

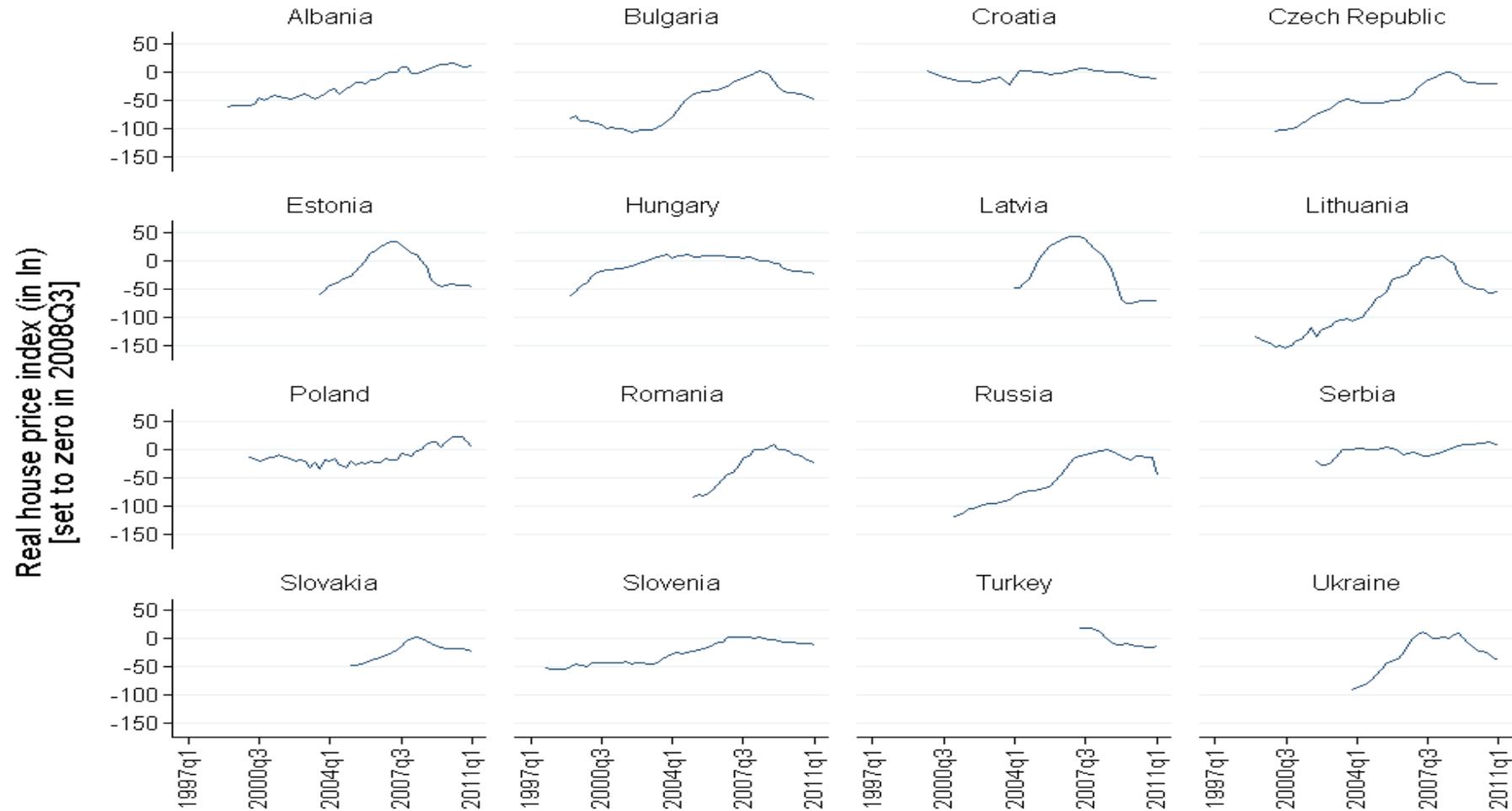
Existing empirical literature (2)

- MPPs and credit growth:
 - Minimum CAR in the U.K. (Aiyar, Calomiris and Wieladek, 2012)
 - Dynamic provisioning in Spain (Jimenez et al., 2013)
 - Reserve requirements in 5 Latin American countries (Tovar et al., 2012)
 - “Credit Ceilings” in Croatia (Galac, 2010)
 - Risk-weights on mortgages and provisioning in panel of 55 countries (Kuttner and Shim, 2012) [housing credit only]
- MPPs and procyclicality of credit
 - LTV, DTI, reserve requirements, “countercyclical capital requirements” in panel of 48 countries (Lim et al., 2011)
- MPPs and banks’ balance sheets
 - Several types of MPPs in panel of 48 countries (Claessens, Ghosh and Mihet, 2013)
- Asymmetric effects (IMF, 2013; Claessens et al. 2013)

Background (1): Housing prices developments in CESEE

- 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 ?
 - Work in progress
 - Benefits of using housing prices in CESEE context:
 - avoids problem of valuation effects due to currency movements (need to make assumptions about currency composition of credit LC/EUR/CHF/USD; fine breakdown not consistently available)
 - 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)

Background (2): Different patterns of real housing price developments across CESEE



Background (3): Housing booms were credit-funded

CESEE: Credit Growth and Foreign Currency Loans, 2003-2008

	<u>Change in credit to private sector-to-GDP ratio</u>	<u>Share of FX loans</u>	
	2003-2008	2008	2003
Latvia 1/	56.1	83.0	47.5
Ukraine	49.3	60.6	41.3
Estonia 1/	48.1	79.8	44.4
Bulgaria	45.3	54.9	41.0
Slovenia	43.9	n/a	n/a
Lithuania 1/	43.9	61.0	49.4
Albania	27.6	71.5	80.4
Hungary	26.8	53.1	23.1
Romania	23.9	57.7	55.4
Czech Republic	22.2	8.1	11.0
Poland	21.6	32.2	29.9
Russian Federation	20.4	21.5	n/a
Serbia, Republic of	20.2	65.6	54.2
Croatia	18.8	66.1	n/a
Turkey	18.0	18.9	31.3
Slovak Republic	13.7	17.3	17.7

Source: Dell'Ariccia et al. (2012)

1/ Data lagged by one year

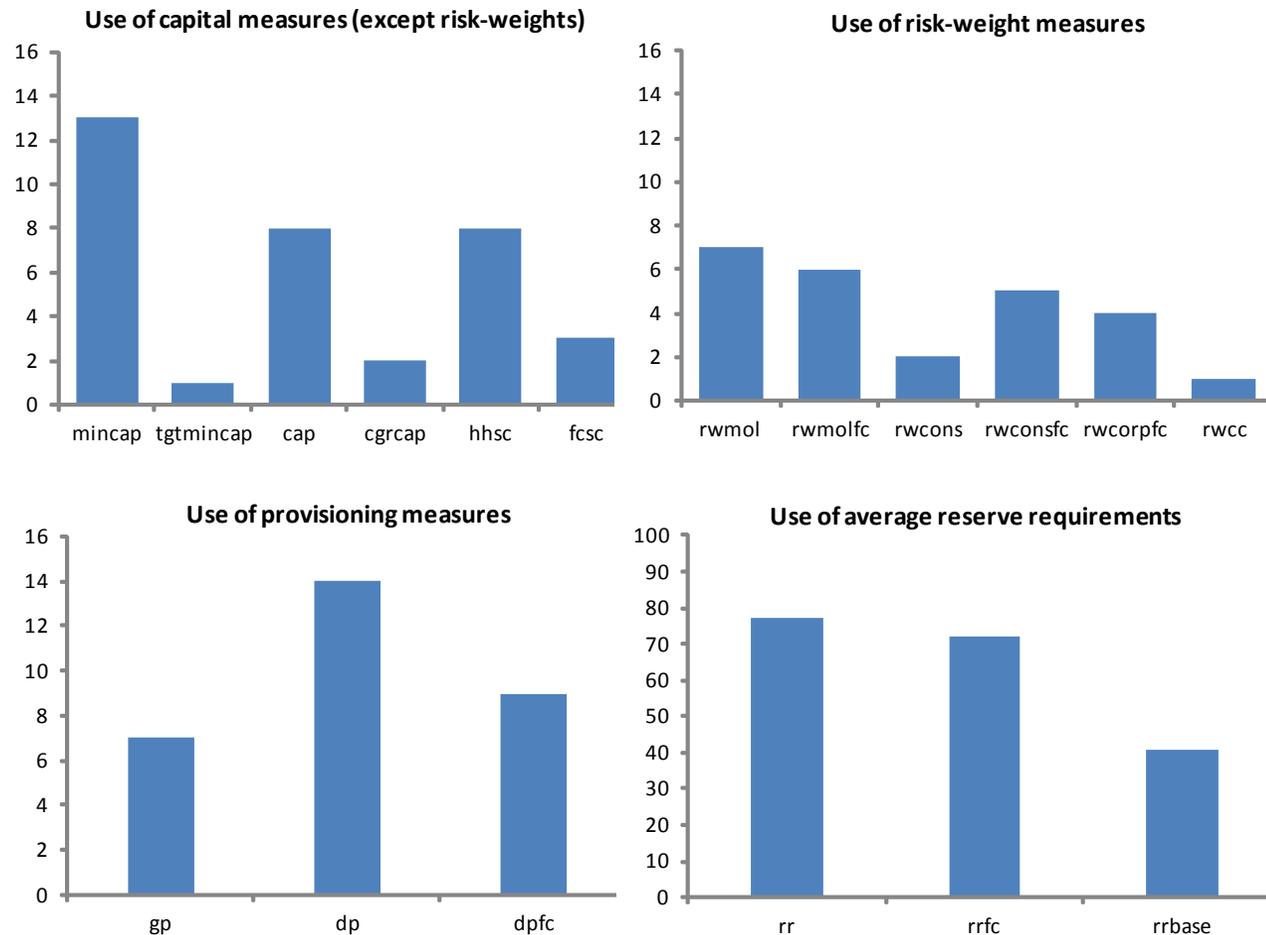
Construction of the prudential policy measures dataset

- 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

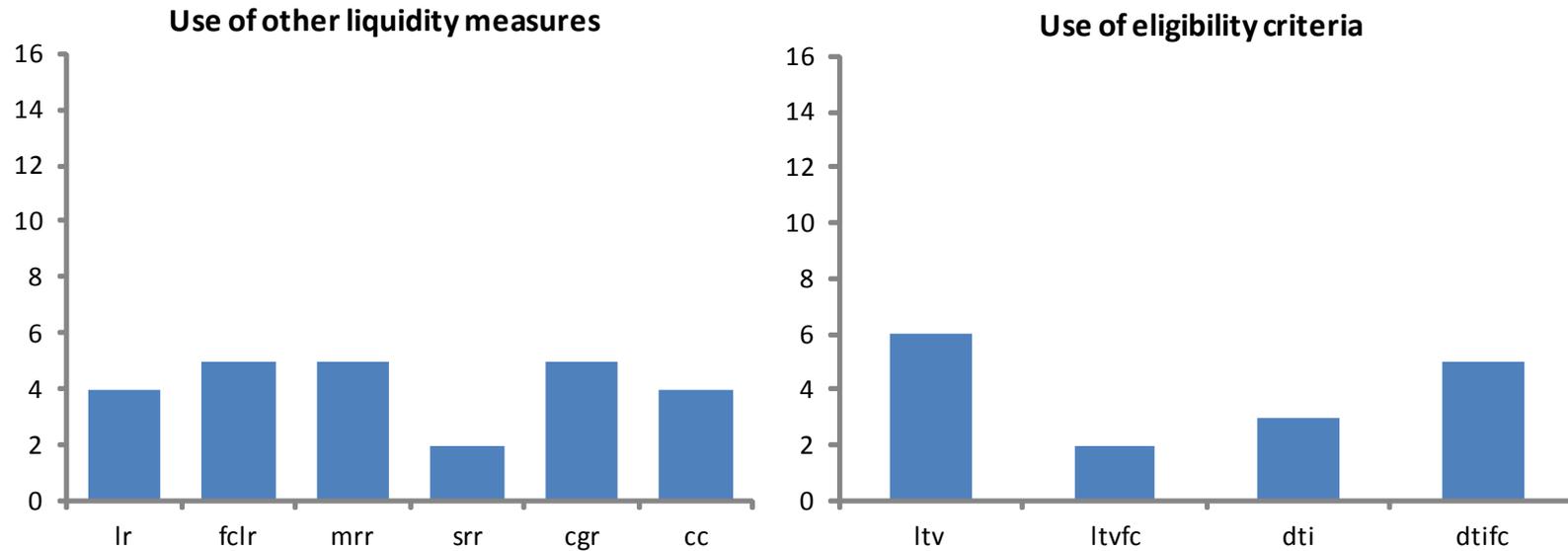
29 types of prudential measures in the dataset

Category	Prudential measures
Capital	<ul style="list-style-type: none">minimum CARtarget CAR (penalties imposed below threshold)capital eligibilityminimum CAR as a function of credit growthrisk weights (consumer, mortgage, corporate / DC, FC / credit-growth-related)maximum ratio of household lending to share capital (DC and FC)
Provisioning	<ul style="list-style-type: none">loan classification and provisioning rules (DC and FC)general provisions
Liquidity	<ul style="list-style-type: none">reserve requirement ratios (DC and FC)reserve baseliquidity requirement (DC and FC)marginal reserve requirements (on foreign liabilities)special reserve requirements (on domestic bonds issued to nonresidents)reserve requirements linked to credit growth
Eligibility criteria	<ul style="list-style-type: none">LTV (DC and FC)DTI (DC and FC)
Other	<ul style="list-style-type: none">direct limits on FC lending

Frequency of use of prudential measures in the dataset (1)



Frequency of use of prudential measures in the dataset (2)



Examples: Bulgaria 2005Q2 and Romania 2007Q1

2005Q2	<p>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)</p> <p>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</p>	<p>CB AR 2005: 12, 39 EOR: 150, 151</p>
2007Q1	<p>mincap: following EU entry, minimum capital requirements drops from 12 to 8%</p> <p>dti: Regulation 3/2007: Eligibility criteria are now defined by banks' internal models, effective Mar. 14th</p> <p>ltv: LTV limit was abandoned</p> <p>fcsc: exposure limits out when Romania enters EU (repeal of Regulation 11/2005)</p>	<p>FSR 2008: 27 (fn 17) FSR 2008: 33 (fn) FSR 2007: 21 (fn 8) CB AR 2007: 33 (fn)</p>

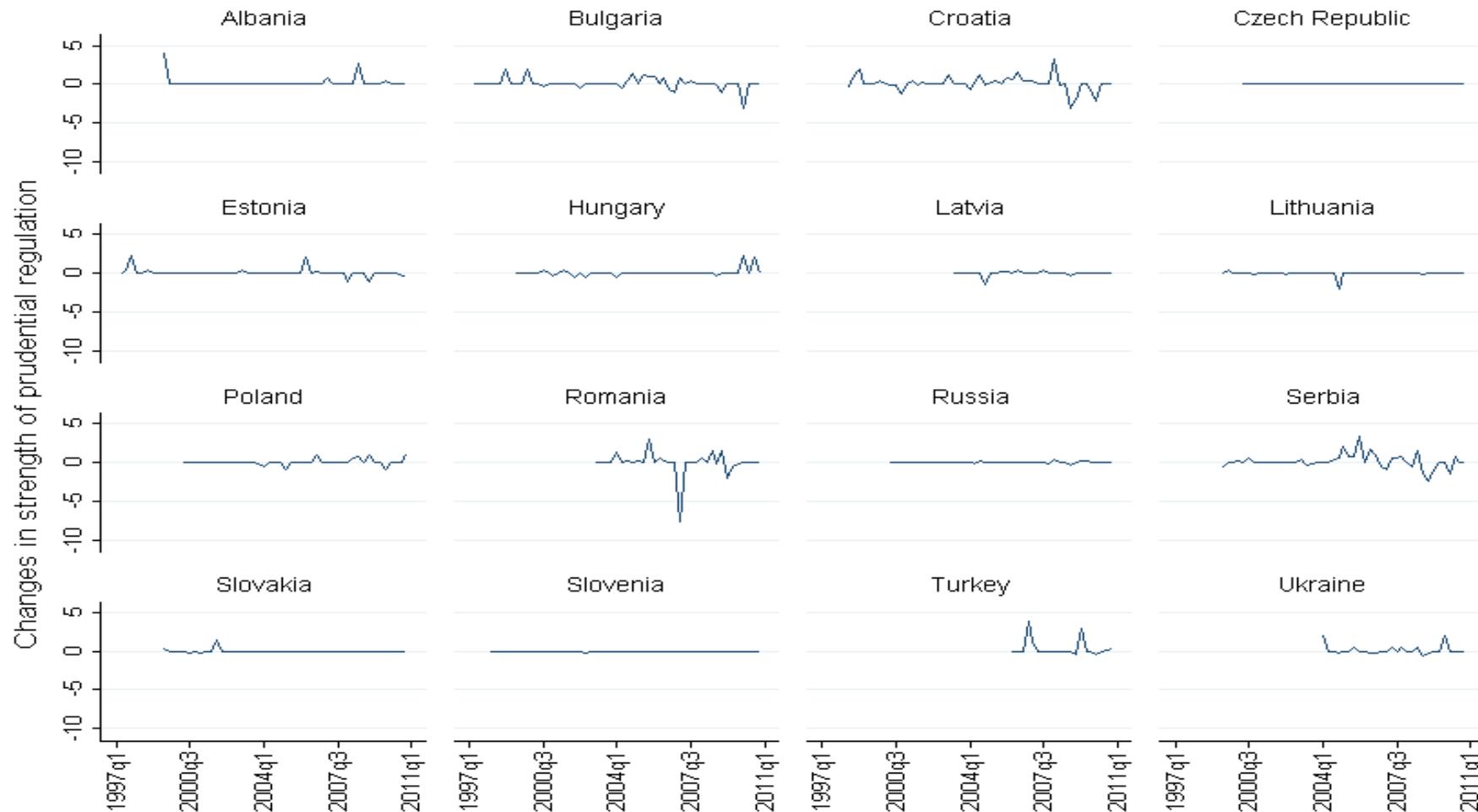
Differences with other cross-country MPP datasets

	Our paper	BIS (Shim et al., 2013)	Lim et al. (2011)
Public Availability	Dec. 2012	Sept. 2013	No
No. of countries	16	60	48
o/w CESEE	16	15	9(?)
Period	1997Q1-2010Q4	1990m1-2012m6	2000Q1-2010Q4
Sources	official publications	official publications	surveys
Are sources cited?	Y	N	authorities / IMF desks
Readiness for empirical analysis	Y	N	n/a
Instruments			
Average reserve requirements	Y	Y	Y
Marginal reserve requirements	Y	Y	Y
Liquidity ratios	Y	Y	Y
Eligibility measures (LTV, DTI)	Y	Y	Y
CAR	Y	N	N
Risk weights	Y	Housing only	Y
Sectoral leverage ratio	Y	Y	Y
Other capital measures	Y	N	Y
Provisioning	Y	Housing only	Y

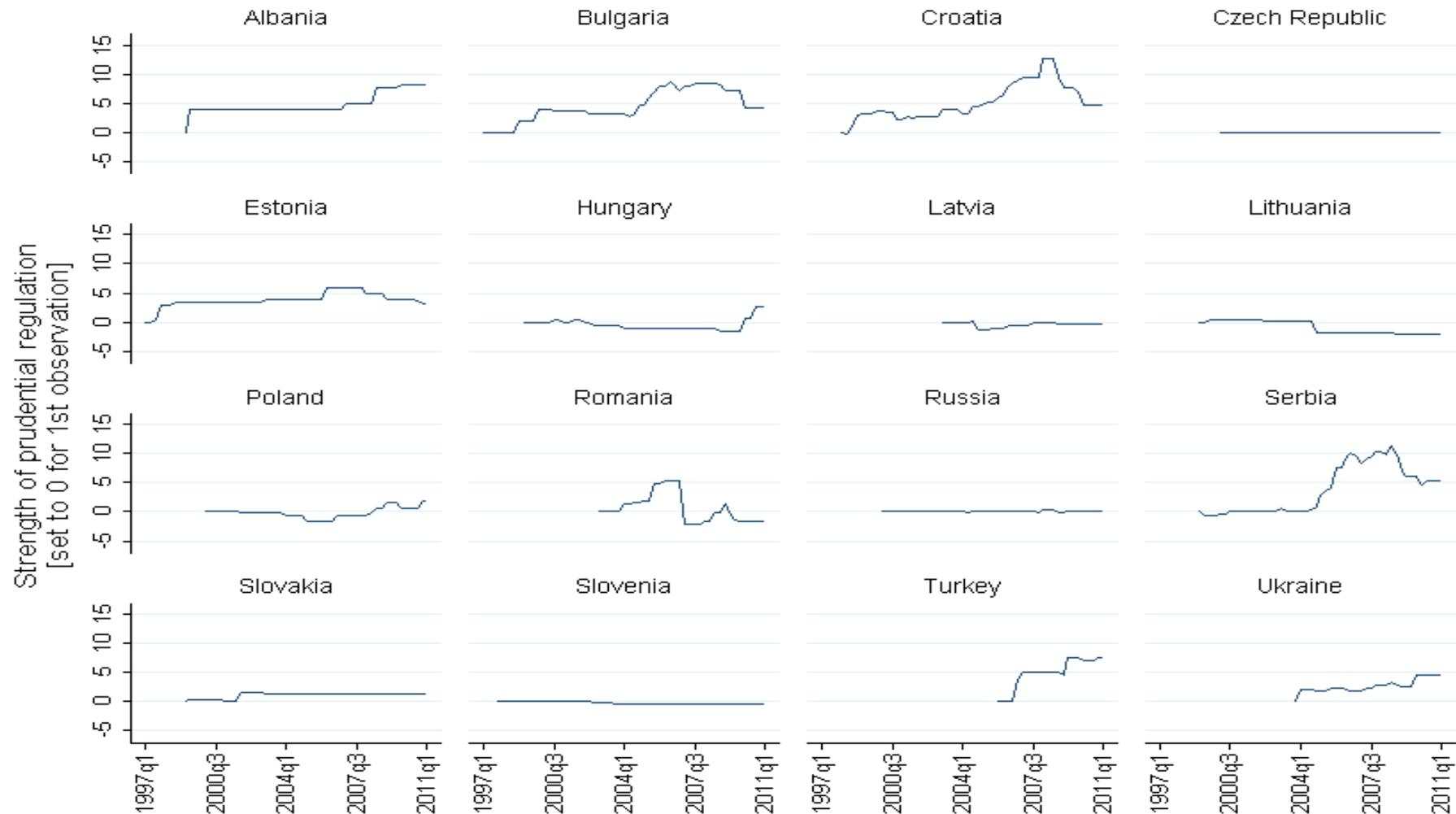
Measuring the relative strength of policy measures

- 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
 - We use 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: $+x/20$

Intensity/Frequency of change in prudential regulation has differed across countries



Cumulative change in prudential regulation has differed across countries



Econometric analysis

- 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, working age population, real interest rate on LC deposits, FC policy rate adjusted for inflation and appreciation rate over past 4 quarters
 - 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)
- Error-correction framework

$$\Delta h_{i,t} = \varphi(h_{i,t-1} - \theta y_{i,t-1}) + \sum_{j=1}^2 (\rho_j \Delta h_{i,t-j}) + \alpha_1 \Delta y_{i,t-1} + \alpha_2 \Delta r_{i,t-1} + \alpha_3 \Delta r_{i,t-1}^* + \alpha_4 \Delta_4 \text{WP}_{i,t} \\ + \sum_{j=1}^2 (\beta_j \Delta x_{i,t-j} + \gamma_j \Delta C_{i,t-j}^x) + \sum_{j=1}^4 \text{ukr}_j + \delta_i + \mu_t + \varepsilon_{i,t}$$

“Core” variables (1)

- We find evidence of significant impact on housing prices of 4 instruments:
 1. Minimum capital adequacy ratio
 2. Maximum sectoral leverage ratio (for Loans to Households)
 3. “Credit ceilings” (marginal reserve requirements related to credit growth)
 4. Marginal reserve requirements on foreign borrowing
- DTI also meets our selection criterion, but result appears fragile → not included in the core

“Core” variables (2)

- 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

Baseline regression output

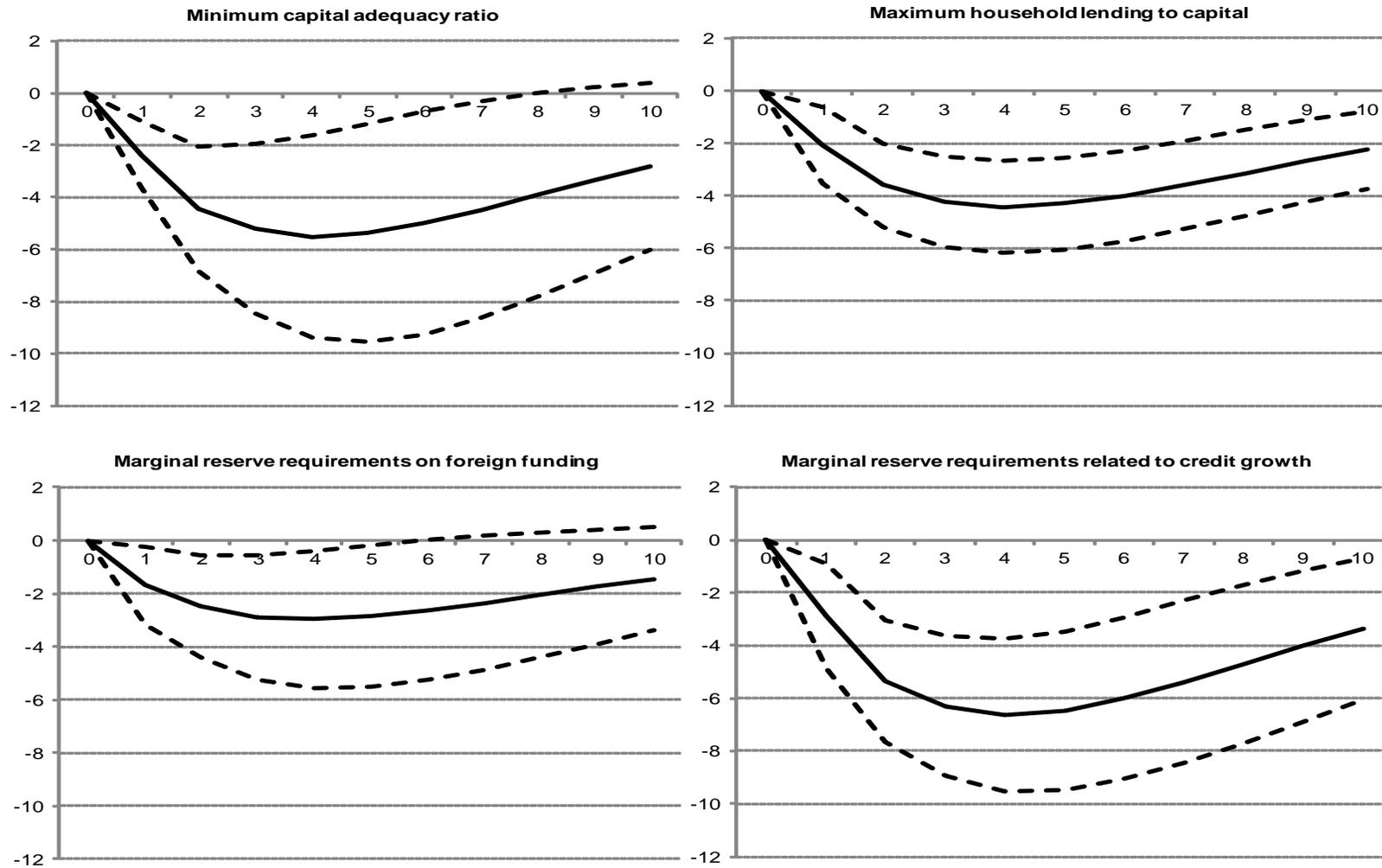
Table 3. Prudential Policies and Housing Prices -- Baseline Regression

	Baseline Regression
<i>Error-correction (EC) equation</i>	
L.GDP growth	1.44* (0.07)
<i>Short-run equation</i>	
Error correction term	-0.07*** (0.00)
$\Delta(\log \text{ housing price index})$ t-1	0.28*** (0.00)
$\Delta(\log \text{ housing price index})$ t-2	0.22*** (0.00)
$\Delta(\log \text{ GDP/capita})$ t-1	0.14 (0.46)
$\Delta(\text{domestic currency real interest rate})$ t-1	-0.04 (0.84)
$\Delta(\text{effective foreign currency real interest rate})$ t-1	-0.06 (0.34)
$\Delta(\log \text{ working age population})$	-0.24 (0.62)
$\Delta(\text{minimum capital adequacy ratio})$ t-1	-2.37*** (0.00)
$\Delta(\text{minimum capital adequacy ratio})$ t-2	-1.60*** (0.01)
$\Delta(\text{maximum household loans/capital})$ t-1	-2.06*** (0.00)
$\Delta(\text{maximum household loans/capital})$ t-2	-1.12** (0.04)
$\Delta(\text{marginal reserve requirements on foreign funding})$ t-1	-1.70** (0.01)
$\Delta(\text{marginal reserve requirements on foreign funding})$ t-2	-0.43 (0.42)
$\Delta(\text{marginal reserve requirements on credit growth})$ t-1	-2.91*** (0.00)
$\Delta(\text{marginal reserve requirements on credit growth})$ t-2	-1.86** (0.01)
$\Delta(\text{other policies})$ t-1	0.03 (0.92)
$\Delta(\text{other policies})$ t-2	0.25 (0.35)
R-sqr	0.461
adj.R-sqr	0.386
Number of observations	555

Notes: The dependent variable is the log difference of the real housing price index. The regressions include time and country fixed effects. P-values are reported in parentheses. *, ** and, *** denote statistical significance at the 10 percent, 5 percent and 1 percent confidence levels respectively.

Dynamic Multipliers

Figure 5. Dynamic Multiplier of Shock to Selected Macprudential Policies



Note: Each shock represents an increase by one unit in the intensity of the policy variable. The cumulative change in house prices is shown on the vertical axis (in percent). Time (in periods) is on the horizontal axis.

Source: Authors' calculations.

Robustness checks

1. Adding one MPP at a time to the baseline
2. Adding the third lag of the core MPPs
3. Excluding the error-correction term
4. Excluding the non significant control variables
5. Excluding one country at a time
6. Using the “standard” dummy approach for all MPPs
 - Remark: LTV is significant in the preliminary stage (one variable at a time)

Are the Effects Asymmetric?

Table 4. Macroprudential Policies and Housing Prices: Are the Effects Asymmetric?

	Minimum capital adequacy ratio	Maximum household loans to share capital	Marginal reserve requirements on foreign funding	Marginal reserve requirements related to credit growth
	(1)	(2)	(3)	(4)
Policy change t-1	-2.37*** (0.00)	-2.06*** (0.00)	-1.70** (0.01)	-2.91*** (0.00)
Policy change t-2	-1.60*** (0.01)	-1.12** (0.04)	-0.43 (0.42)	-1.86** (0.01)
Policy tightening t-1	-1.87* (0.07)	-0.64 (0.63)	-2.29*** (0.00)	-2.24* (0.08)
Policy tightening t-2	-0.57 (0.50)	-2.64** (0.01)	-2.72*** (0.01)	-4.72** (0.02)
Policy easing t-1	-2.56* (0.06)	-3.76*** (0.01)	-1.55* (0.07)	-3.57** (0.04)
Policy easing t-2	-2.57** (0.01)	0.82 (0.26)	0.38 (0.55)	0.99 (0.57)
<i>Boom</i>				
Policy change t-1	-2.34** (0.02)	-1.92*** (0.00)	-2.45*** (0.00)	-3.36*** (0.01)
Policy change t-2	-2.03*** (0.01)	-3.27*** (0.00)	-2.81*** (0.01)	-1.57** (0.01)
<i>Bust</i>				
Policy change t-1	-4.31*** (0.00)	-3.06* (0.10)	-1.59* (0.06)	4.05*** (0.00)
Policy change t-2	1.77** (0.02)	0.78 (0.27)	0.25 (0.66)	-15.32*** (0.00)

Note: The dependent variable is the log difference of the real housing price index. The regressions include time and country fixed effects.

P-values are reported in parentheses. *, **, and *** denote statistical significance at the 10 percent, 5 percent and 1 percent confidence levels respectively.

Source: Authors' calculations.

Conclusions

- We find that several types of prudential measures have had an impact on housing price inflation during the recent boom-bust cycle in CESEE
 - Minimum capital adequacy ratio, Maximum sectoral leverage ratio (household loans)
 - Some non-standard liquidity measures (marginal RR on foreign borrowing, credit growth “ceilings” in the form of marginal RR)
 - Effects are very robust during the boom, less so during the bust
- Few observations of LTV, DTI may explain lack of robustness/significance
- Challenges we have tried to address:
 - Data quality in cross-country context
 - Quantification of relative strength of policy measures



Additional slides

Table 2. Macroprudential Policies and Housing Prices -- Preliminary Regressions

Category of measure	Instrument	Policy change t-1		Policy change t-2	
		[coefficient]	[p-value]	[coefficient]	[p-value]
Capital measures					
	Minimum capital adequacy ratio	-2.20***	(0.00)	-1.53***	(0.01)
	Regulatory capital definition	0.84	(0.50)	0.43	(0.84)
	Minimum capital adequacy ratio as a function of credit growth	0.07	(0.86)	-0.07	(0.80)
	Maximum household loans/capital	-1.65***	(0.01)	-1.30***	(0.01)
	Maximum forex loans/capital	2.14	(0.37)	-2.64	(0.32)
	<i>Maximum loans/capital ratio</i>	-0.35	(0.79)	-2.09**	(0.05)
	Risk weights on:				
	mortgages	-0.64	(0.70)	0.64	(0.46)
	forex mortgages	4.54**	(0.05)	3.51	(0.21)
	total mortgages	0.73	(0.69)	1.42	(0.10)
	consumer loans	1.70***	(0.01)	0.56	(0.48)
	forex consumer loans	2.98	(0.12)	1.94	(0.32)
	total consumer loans	2.63**	(0.02)	1.38	(0.14)
	mortgages+consumer	-0.32	(0.80)	0.43	(0.55)
	forex mortgages+consumer	1.65	(0.14)	1.28	(0.32)
	total mortgage+ consumer	0.60	(0.54)	0.84	(0.18)
	credit growth	-10.12*	(0.05)	25.69***	(0.00)
	<i>All risk weights</i>	0.56	(0.55)	0.96	(0.16)
Provisioning measures					
	General provisioning	2.08**	(0.01)	1.10	(0.34)
	Specific provisioning rules	-1.53	(0.23)	2.46	(0.30)
	Specific provisioning rules forex	-4.42	(0.29)	1.47	(0.67)
	<i>All Provisioning rules</i>	-1.42	(0.29)	1.69	(0.19)
Liquidity measures					
	Reserve requirement rate	1.74	(0.12)	0.10	(0.95)
	Reserve requirement base	0.62	(0.74)	-0.30	(0.80)
	<i>Total reserve requirement (rate+base)</i>	1.37	(0.20)	-0.17	(0.90)
	Liquidity ratio	5.81***	(0.00)	5.95	(0.41)
	Forex liquidity ratio	2.67	(0.17)	-0.80	(0.63)
	Marginal reserve requirement on foreign funding	-1.47**	(0.04)	-0.23	(0.67)
	Marginal reserve requirement on credit growth	-2.74***	(0.01)	-1.04*	(0.09)
Eligibility measures					
	Loan-to-value ratio	-1.14	(0.29)	-4.14	(0.19)
	Loan-to-value ratio on forex loans	1.87	(0.34)	-3.87	(0.38)
	<i>Total LTV</i>	-0.66	(0.34)	-3.09	(0.24)
	Debt-to-income ratio	-0.48	(0.78)	-3.86***	(0.00)
	Debt-to-income ratio forex loans	5.08	(0.28)	3.91	(0.52)
	<i>Total DTI</i>	0.82	(0.67)	-1.99	(0.12)
	<i>All eligibility measures</i>	-0.11	(0.86)	-1.73**	(0.02)
Other bank regulatory measures					
	Quantitative restrictions on forex lending	-0.30	(0.79)	-0.12	(0.88)

Note: The dependent variable is the log difference of the real housing price index. The regressions include time and country fixed effects. P-values in parentheses.

*, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent confidence levels respectively.

Source: Authors' calculations

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			■													
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						■			■	■						
OTHER BANK REGULATORY MEASURES																	
otherfc	Other quantitative limits on fc-lending as a share of total lending						■									■	■