Monetary Policy and Macroprudential Policy: Rivals or Teammates?

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Outline

1 Motivation and research questions

2 Empirical framework

3 Results

4 Discussion and conclusions

Motivation

- Monetary and macroprudential policy not independent, affect both the monetary and credit conditions via their effect on credit growth (Borio, 2014)
- Macroprudential tools becoming used more actively & prolonged period of very accommodative monetary easing
- Building up of vulnerabilities?
  - A highly accommodative monetary policy can increase risks to financial stability and lead to a buildup of financial vulnerabilities (e.g excessive credit growth) - negative effect on real economy in the future (Adrian & Liang, 2014; Lowe & Borio, 2002)
- Policy coordination? Proper policy mix?
  - Coordination difficult - different probabilities of failure to fulfil the two main objectives (Adrian & Liang, 2014)
  - Risks to price stability materialize in short-to-medium run, risks to financial stability in medium-to-long run

Objective and research questions

- **Objective:** to study the extent to what monetary policy may contribute to a buildup of financial vulnerabilities and the effect of macroprudential capital regulation on macroeconomy and credit cycle
  - What is the effect of monetary policy on credit cycle and banks' capital ratio?
  - Does this effect change over time?
  - What are international spillovers to Czech credit cycle and banks' capital?
  - Does monetary policy affect risk-taking behavior of banks?
  - What is the effect of macroprudential capital policy tightening on credit cycle and real economy?
- **How?**
  - Empirical framework at the macro level – panel VAR with time-varying coefficients estimated using Bayesian approach
  - Empirical framework at the micro level – simple panel regression model estimated using GMM

Empirical framework at the macro level

- Panel VAR model with time-varying coefficients
  - to study possible spillover from abroad to Czech economy,
  - to capture mutual interdependencies,
  - to compare the dynamics of Czech and closely related economies.
- High dimensional problem reduced to low dimensional using *common factors* as proposed by Canova & Ciccarelli (2009)
- The factors capture components in the coefficient vector which are common in some way, for example, across units, variables or lags
- Final combination of common factors chosen based on the maximum marginal log-likelihood
- Model is estimated using Bayesian approach with standard set of priors (Normal-inverse-Wishart distribution)
- Shock identified using Cholesky decomposition, benchmark ordering subjected to a number of robustness checks

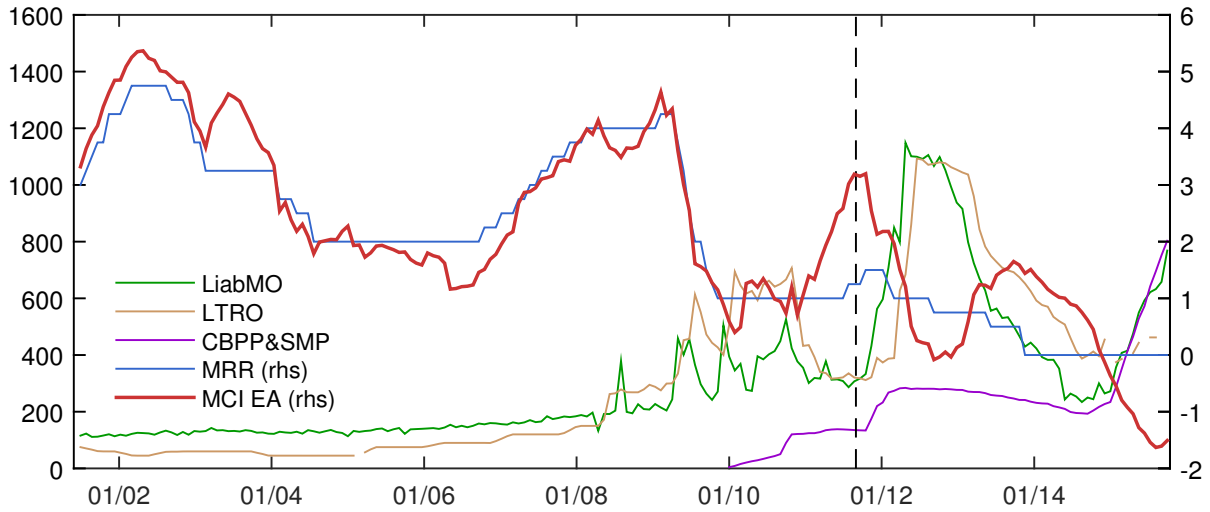
Data at the macro level

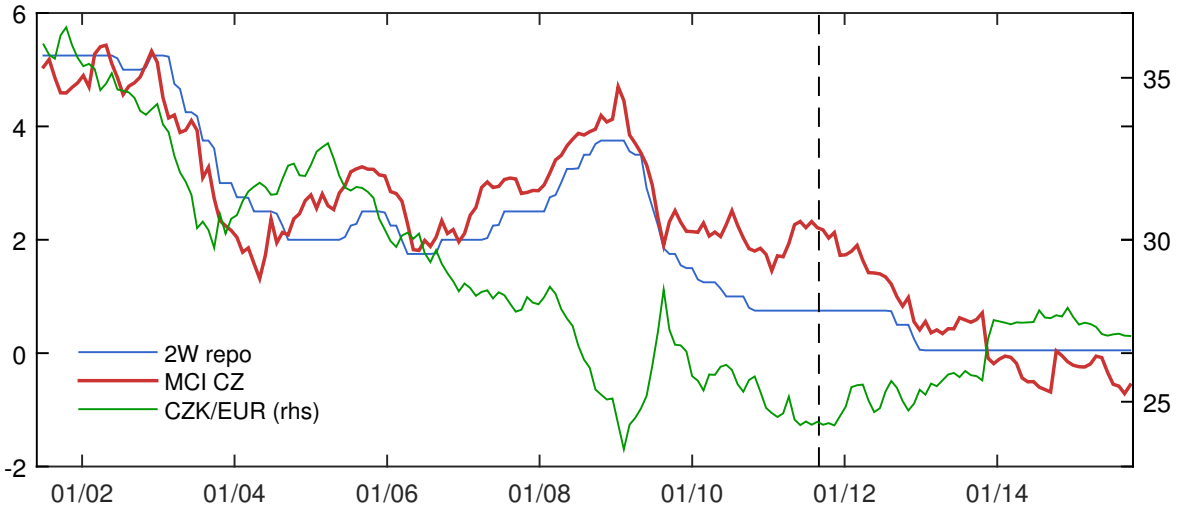
- 6 countries – CZ, DE, FR, IT, AT, BE
  - CZ and closely related countries (through trade and financial links)
  - 70% of total euro area banks' assets, 72% of euro area GDP
- 5 variables – credit of private non-financial sector to GDP, banks' non-risk-weighted capital-to-asset ratio, real GDP, CPI, monetary policy proxy
  - Quarter-on-quarter growth rates, annualized, scaled by s.d.
- Time period – 1Q/2000 to 3Q/2015

Monetary Condition Index

- ZLB, unconventional measures - alternative index estimated
- Dynamic factor analysis, the EM algorithm, set of variables related to conventional and unconventional monetary policy in CZ and EA
- Robust to different specifications

Monetary Condition Index





Empirical framework at the micro level

- Why? Lack of data at the macro level; potentially different transmission of policies for different groups of banks; verification of hypotheses which emerged at the macro level

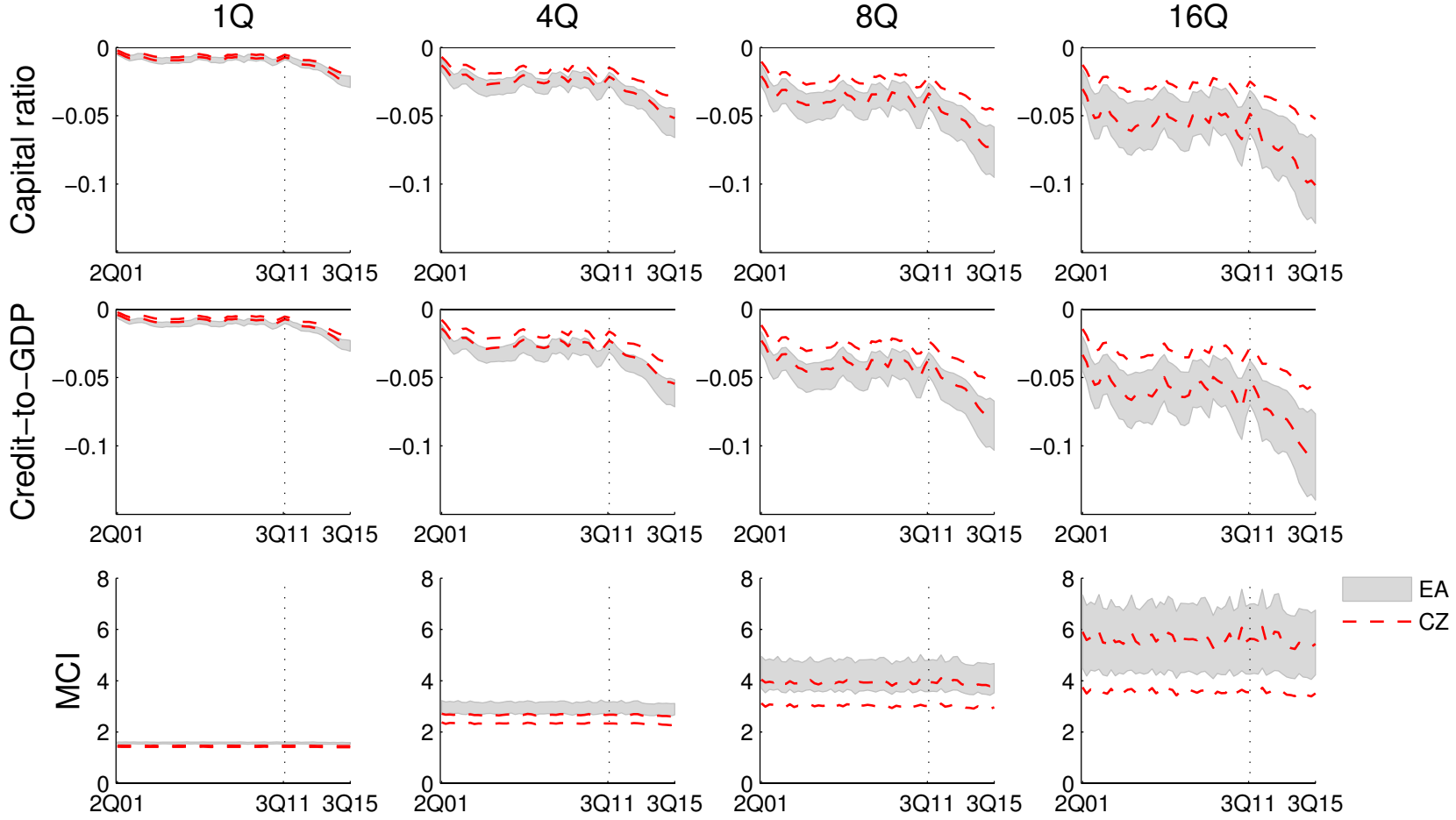
$$Y_{i,j,t} = \alpha Y_{i,j,t-1} + \beta_1 rate_{j,t} + \beta_2 slope_{j,t} + \gamma_1 C_{i,j,t} + \gamma_2 C_{i,j,t-1} + \delta_1 \,\%\, \Delta GDP_{j,t} + \delta_2 inflation_t + \delta_3 VIX_t + crisis + IFRS + v_i + \epsilon_{i,j,t} \quad (1)$$

$$\%\Delta loan_{i,j,t} = \alpha \,\%\, \Delta loan_{i,j,t-1} + \beta_1 rate_{j,t} + \beta_2 slope_{j,t} + \beta_3 CAR_{i,j,t} + \beta_3 CAR_{i,j,t-1} + \gamma_1 C_{i,j,t} + \gamma_2 C_{i,j,t-1} + \delta_1 \,\%\, \Delta GDP_{j,t} + \delta_2 inflation_{j,t} + \delta_3 VIX_t + crisis + IFRS + v_i + \epsilon_{i,j,t} \quad (2)$$

- A wide range of bank-specific control
- System GMM (Blundell & Bond, 1998); standard errors are robust and corrected for finite-sample bias Windmeijer (2005)
- Annual bank-level data obtained from BankScope between 2005–2015

Transmission of monetary policy *at the macro level*

Figure: Cumulative impulse responses - shock to MCI



Note: Responses to a 1 pp shock, 68% confidence bands reported.

Effect of shock to MCI on bank capital ratio

- Transmission through negative short-term impact on profitability and positive impact on loan loss provisions
- Flattening of the yield curve; imperfect pass-through; reduced margins – net interest revenues – retained earnings
- Higher loan losses and recognised loan loss provisions – reduced retained earnings (Borio *et al.* (2015) and Borio & Zhu (2014))
  - Increase debt service burdens and consequently probabilities of default (*stock of loans*)
  - Increase the perceived riskiness of new clients and induce less risk-taking on *new loans*

Testable hypotheses

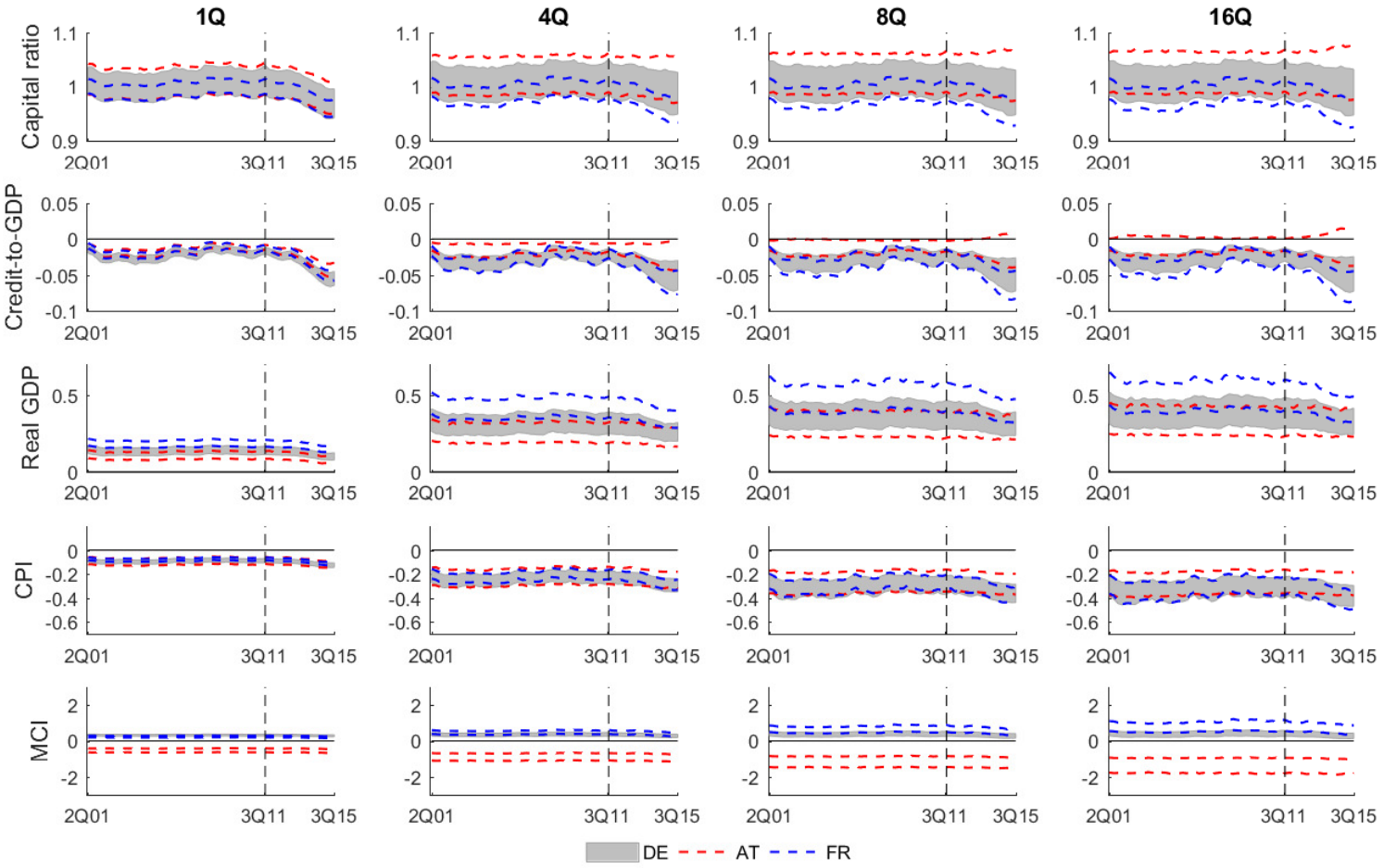
Controlling for macroeconomic conditions and bank characteristics, we should expect

- a negative relationship between bank profitability and the short-term interest rate (consistently with loan pricing frictions),
- a positive relationship between loan loss provisions and the short-term interest rate (impact of higher interest rates on defaults; potential forward-looking provisioning),
- a positive relationship between profitability and equity to total assets (impact on retained earnings which are part of the equity capital),
- a negative relationship between equity to risk-weighted assets and the short-term interest rate (impact of higher interest rates on banks perception and measuring of risks – impact on estimates of probability of default, loss given default and volatilities).

Micro-level analysis

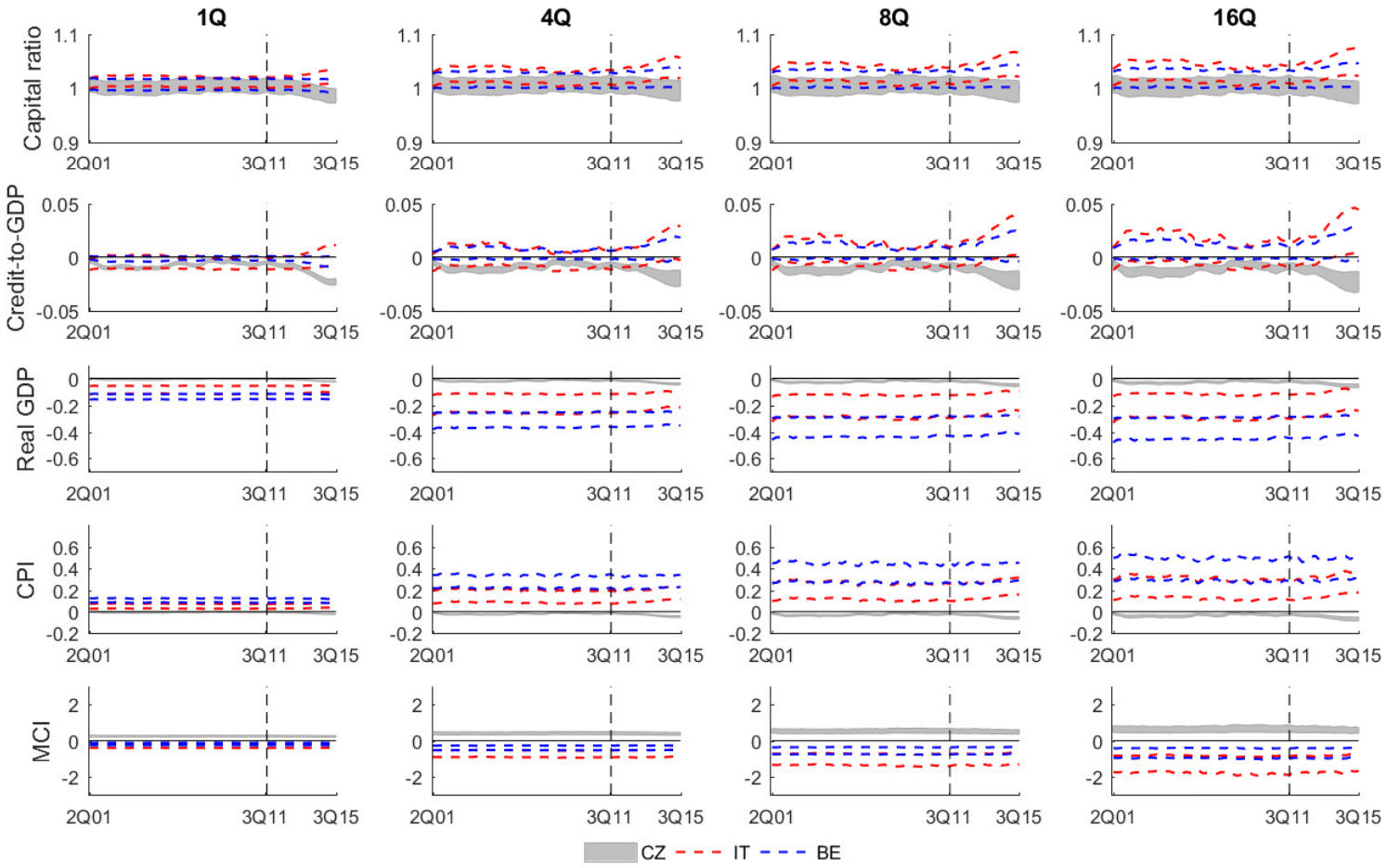
Dependent variable Y (t)	(1) ROA	(2) ROA (A over 5 mil euro)	(3) ROA	(4) LLP/A	(5) LLP/A (A over 5 mil euro)	(6) E/A	(7) E/RWA
Y (t-1)	**0.319*** **	**0.127** **	0.112	**0.529*** **	**0.550*** **	**0.818*** **	0.036
	(0.110)	**(0.063)**	(0.113)	**(0.052)**	**(0.078)**	**(0.098)**	(0.055)
Short-term rate	**-0.153*** **	**-0.419*** **	**-0.064** **	**0.099*** **	**0.245*** **	-0.103	**-18.171***
	(0.045)	**(0.112)**	**(0.029)**	**(0.034)**	**(0.078)**	(1.013)	**(10.438)**
Yield curve slope	-0.074	0.016	0.039	**0.095*** **	**0.096** **	-0.040	3.506
	(0.052)	(0.068)	(0.044)	**(0.033)**	**(0.051)**	(0.174)	(2.561)
Real GDP growth	0.051	0.118	0.029	-0.038	-0.051	-0.004	1.430
	(0.043)	(0.073)	(0.028)	(0.031)	(0.051)	(0.145)	(1.693)
CPI inflation	**0.062** **	**0.118*** **	0.017	**-0.048*** **	**-0.095** **	0.050	-0.273
	(0.028)	**(0.036)**	(0.023)	**(0.017)**	**(0.037)**	(0.033)	(0.470)
LLP/A			**-0.956*** **			0.132	-1.159
			(0.095)			(0.219)	(1.952)
LLP/A (t-1)			0.135			-0.070	0.637
			(0.117)			(0.192)	(1.088)
ROA						**0.753*** **	1.338
						(0.175)	(1.096)
ROA (t-1)						-0.001	(0.785)
						(0.049)	(0.785)
+ other controls	...	...	...	...	...	...	...
Observations	2415	866	2415	2415	866	1565	1565
Banks	1027	338	1027	1027	338	752	752
Instruments	119	74	129	119	74	62	62

Shock to bank capital ratio *at the macro level* (1)



Note: Responses to a 1 pp shock, 68% confidence bands reported.

Shock to bank capital ratio *at the macro level* (2)



Note: Responses to a 1 pp shock, 68% confidence bands reported.

Effect of shock to bank capital ratio

- Effect can be divided into two main categories:
  - resulting in monetary tightening which in turn decreases inflation and reduces the credit-to-GDP ratio (DE, FR, CZ),
  - resulting in monetary easing which in turn increases inflation and pushes up the credit-to-GDP ratio (BE, IT, AT).
- Different capitalisation of banking sector in each country may play a role
- Higher capital ratio may increase confidence in under-capitalised banks, reduce banks' overall funding costs and help underpin a sustained recovery in credit growth and vice versa

Table: Cross-country comparison of mean and median equity-to-assets ratio, Bankscope

	AT	BE	CZ	DE	FR	IT
Mean	7.49%	7.18%	10.07%	8.24%	9.18%	8.08%
Median	7.29%	6.21%	9.52%	8.13%	8.46%	7.71%

Testable hypotheses

Controlling for macroeconomic conditions and bank characteristics, we should expect

- a generally negative correlation between bank capital ratio and its loan growth,
- a positive correlation between bank capital ratio and its loan growth in case of under-capitalised banks (impact of higher capitalisation on bank confidence which in turn reduces its funding cost and boosts up the loan growth).

Micro-level analysis

Dependent variable	(1) Loan growth	(2) Loan growth	(3) Loan growth	(4) Loan growth	(5) Loan growth
Capital ratio	E/A	E/RWA	Regulatory capital ratio	E/A lower q.	E/A upper q.
Loan growth (t-1)	**0.194***	**0.147***	0.119	**0.279****	**-0.184****
	(0.099)	**(0.079)**	(0.0810)	**(0.111)**	**(0.072)**
Short-term rate	**-26.350***	**-31.366***	**-30.703***	**1.386***	**-3.044****
	(15.044)	**(16.304)**	**(16.592)**	**(0.747)**	**(1.291)**
Yield curve slope	5.225	**5.736***	5.214	**-0.471**	**2.321***
	(3.211)	**(3.353)**	(3.324)	**(1.158)**	**(1.280)**
Real GDP growth	**4.442****	**4.703****	**4.374****	0.695	**2.018****
	(2.051)	**(2.051)**	**(2.154)**	(0.589)	**(0.853)**
CPI inflation	-0.268	-0.224	-0.195	-0.519	1.252
	(0.398)	(0.452)	(0.484)	(0.559)	(1.216)
Capital ratio	2.692	0.512	0.14	**4.802****	0.195
	(2.275)	(0.359)	(0.207)	**(2.423)**	(0.873)
Capital ratio (t-1)	-2.386	-0.219	**-0.231***	-3.473	-0.034
	(2.141)	(0.376)	**(0.139)**	(2.295)	(0.669)
+ other controls	...	...	...	...	...
Observations	971	971	971	253	243
Banks	688	688	688	163	175
Instruments	37	37	37	51	37

Discussion and conclusions

- Monetary tightening (easing) lead to a significant drop (increase) in credit-to-GDP of private non-financial sector and banks' capital ratio, with a pronounced effect in recent years.
  - **Accomodative monetary policy** contribute to buildup financial vulnerabilities, i.e. boost the credit cycle up; prolonged period of very accomodative monetary policy increases the sensitivity of financial variables
  - **Monetary policy tightening** may decrease the resilience of banking sector,
  - e.g., in a credit boom monetary tightening would have a desired effect of slowdown in credit-to-GDP growth, but undesired one of decrease in capital ratio
- Macroprudential policy associated with uncertainty; lag in effect and in implementation
- Information sharing and policy coordination necessary to avoid an improper policy mix which would prevent an effective achievement of the main objective of each authority

THANK YOU FOR YOUR ATTENTION

References I

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Model

Standard time-varying parameter multicountry panel VAR model

$$Y_t = X_t \alpha_t + E_t \qquad E_t \sim N(0, \Omega) \tag{3}$$

where α_t depends on a much lower dimension vector θ_t (e.g. is factorized)

$$\alpha_t = \sum_f \Xi_f \theta_{ft} + u_t \tag{4}$$

Factors capture **common components** in the coefficient vector and u_t captures all the unmodelled features.

$$\begin{aligned} Y_t &= X_t(\Xi\theta_t + u_t) + E_t & u_t &\sim N(0, \Psi) \\ &= \mathcal{X}_t \theta_t + \gamma_t & \gamma_t &= X_t u_t + E_t \sim N(0, \Upsilon_t) \end{aligned} \tag{5}$$

where $\Psi = \Omega \otimes (\sigma^2 I)$, $\Upsilon_t = (1 + \sigma^2 \mathbf{X_t'} \mathbf{X_t})\Omega$ and $\alpha_t \sim N(\Xi\theta_t, \Psi)$.

The time-variation is modelled through the law of motion of factors θ_t

$$\theta_t = \theta_{t-1} + \eta_t \qquad \eta_t \sim N(0, B) \tag{6}$$

Bayesian inference I

Likelihood of factorized SUR model

$$\mathcal{L}(\theta, \Upsilon|Y) \propto \prod_t |\Upsilon_t|^{-1/2} exp\Big[-\frac{1}{2} \sum_t (Y_t - \mathcal{X}_t\theta_t)' \Upsilon_t^{-1} (Y_t - \mathcal{X}_t\theta_t) \Big] \quad (7)$$

Prior distribution $p(\Omega, B) = p(\Omega) \prod_f p(B_f)$ where

$$p(\Omega) \sim i\mathcal{W}(k_\Omega^2 \cdot \Omega_{OLS} \cdot (T-k), k+1) \quad (8)$$

$$p(B_f) \sim i\mathcal{W}(k_B^2 \cdot I_{dim(\theta_t^f)}, dim(\theta_t)+1) \quad (9)$$

- Standard values from literature
- Loose and less informative - to minimize the influence and to achieve fast convergence
- $k_B = 0.01$, supported by model selection

Bayesian inference II

Conditional posterior distributions:

$$p(\Omega|Y^T, \Theta_{-\Omega}) = i\mathcal{W}(\hat{V}_1, n_1 + T)$$
$$p(B_f|Y^T, \Theta_{-B_f}) = i\mathcal{W}(\hat{V}_{2f}, n_{2f} + T * dim(\theta_t^f)) \quad (10)$$

Scale matrices:

$$\hat{V}_1 = V_1 + \sum_t (Y_t - \mathcal{X}_t\theta_t)\sigma_t^{-1}(Y_t - \mathcal{X}_t\theta_t)' \qquad \hat{V}_{2f} = V_{2f} + \sum_t (\theta_t^f - \theta_{t-1}^f)(\theta_t^f - \theta_{t-1}^f$$

$(\theta_1, ..., \theta_T|Y^T, \Theta_{-\theta_t})$ obtained using Kalman filter:

$$\theta_{t|t} = \theta_{t|t-1} + (P_{t|t-1}\mathcal{X}_t f_{t|t-1}^{-1})(Y_t - \mathcal{X}_t\theta_t)$$
$$P_{t|t} = (I - (P_{t|t-1}\mathcal{X}_t f_{t|t-1}^{-1})\mathcal{X}_t)(P_{t|t-1} + B)$$
$$f_{t|t-1} = \mathcal{X}_t P_{t|t-1}\mathcal{X}_t' + \Upsilon_t \quad (11)$$

Draws simulated from the posterior distribution $p(\Theta|Y^T)$ using Gibbs sampler, cycling through conditions in (10) and (11).

Model selection

- 10 runs x 7000 draws (1500 discarted), convergence achieved with 1000
- Model comparison - marginal log-likelihood
  - Different common factors for countries, variables, all parameters
  - Different time-variation
  - Different heteroscedasticity of errors
- Model without a country-specific factor is preferred over all other combinations
  - Consistent with a high cyclical alignment of Czech economic activity with the EA, strong trade and ownership links with the EA
- Model with no time variation is the worst across all factor specifications - justifies our approach