



EUROPEAN CENTRAL BANK

EUROSYSTEM

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# Has private sector credit in CESEE approached levels justified by fundamentals? A post-crisis assessment

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*Opinions expressed do not necessarily reflect the official viewpoint of the OeNB, the Bank of Lithuania, the ECB or the Eurosystem. This is an ESCB Schuman Program project started at OeNB.  
**The results are preliminary.***

1. Motivation and literature overview
2. Estimation of equilibrium credit levels in CESEE:  
methodological framework
3. Results / gap charts
4. Summary & policy implications

# 1) MOTIVATION & LITERATURE OVERVIEW

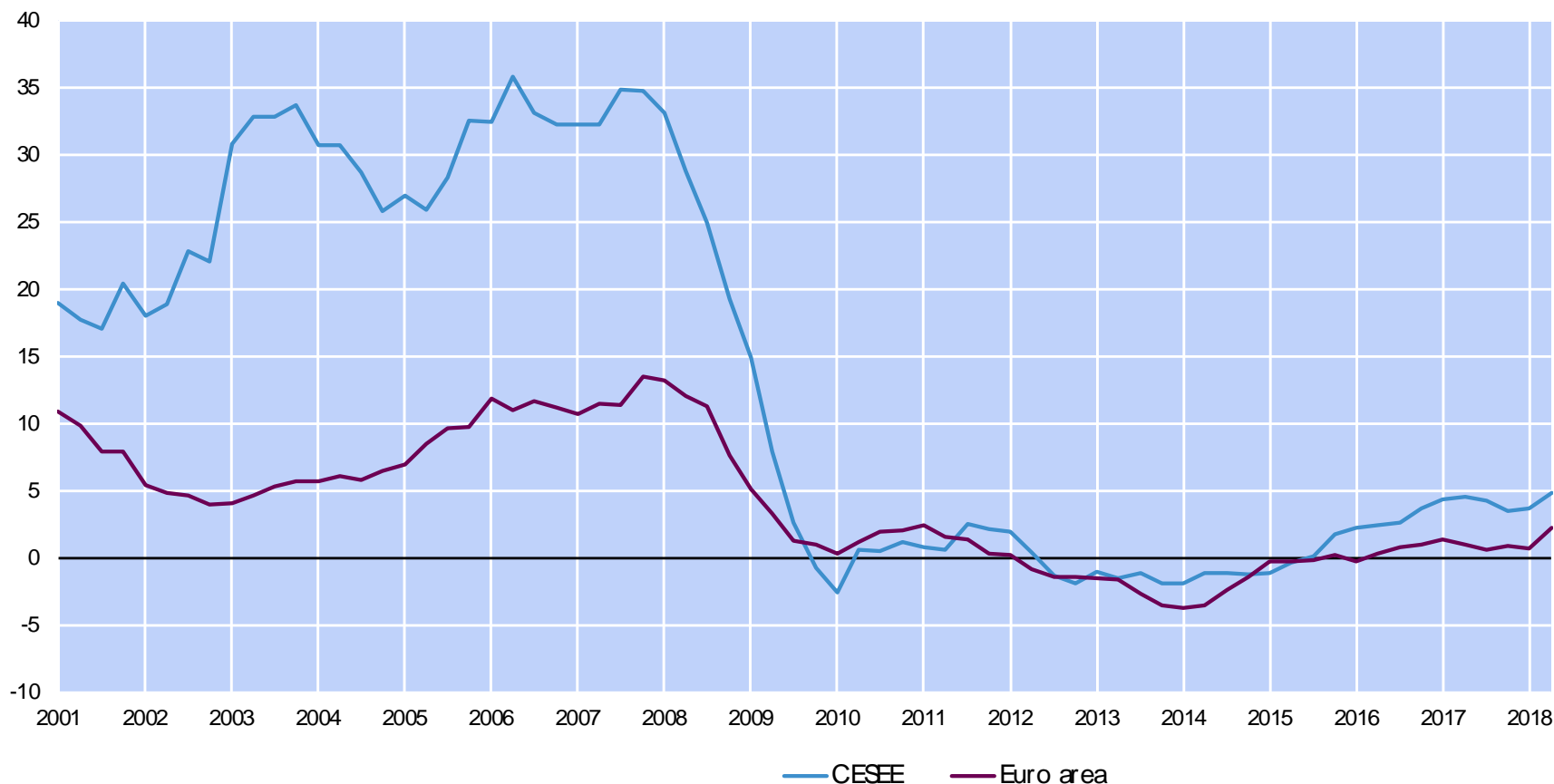
- Rapid credit expansion before the 2008/2009 global financial crisis (GFC), marked slowdown in the wake of the GFC, some recovery or acceleration more recently
  - **Have credit levels eventually turned back to equilibrium** or can under- or overshooting tendencies (still) be identified?
- **Cross-border credit** as important source of financing of companies in CESEE → added to the domestic private sector credit stock.
- **Role of external variables** has so far been disregarded: pay attention to global GDP developments and/or spillovers from global/European credit cycles
- **Different candidate models** to come up with equilibrium estimates
  - Focus not only on credit *levels* but also on credit *growth*

# Motivation

Have credit levels eventually approached levels justified by macroeconomic and financial fundamentals?

## Domestic credit to the nonbank private sector in the CESEE countries and the euro area

Year-on-year changes in %



Source: ECB, national central banks (aggregated balance sheets of other MFIs).

Note: Domestic banks' claims on resident nonbank private sector. CESEE reflects unweighted averages across the 11 CESEE EU member states.

# Considerable decline in total private sector credit-to-GDP ratio; increase in CZ, PL and SK

## Domestic and direct cross-border credit to the nonbank private sector

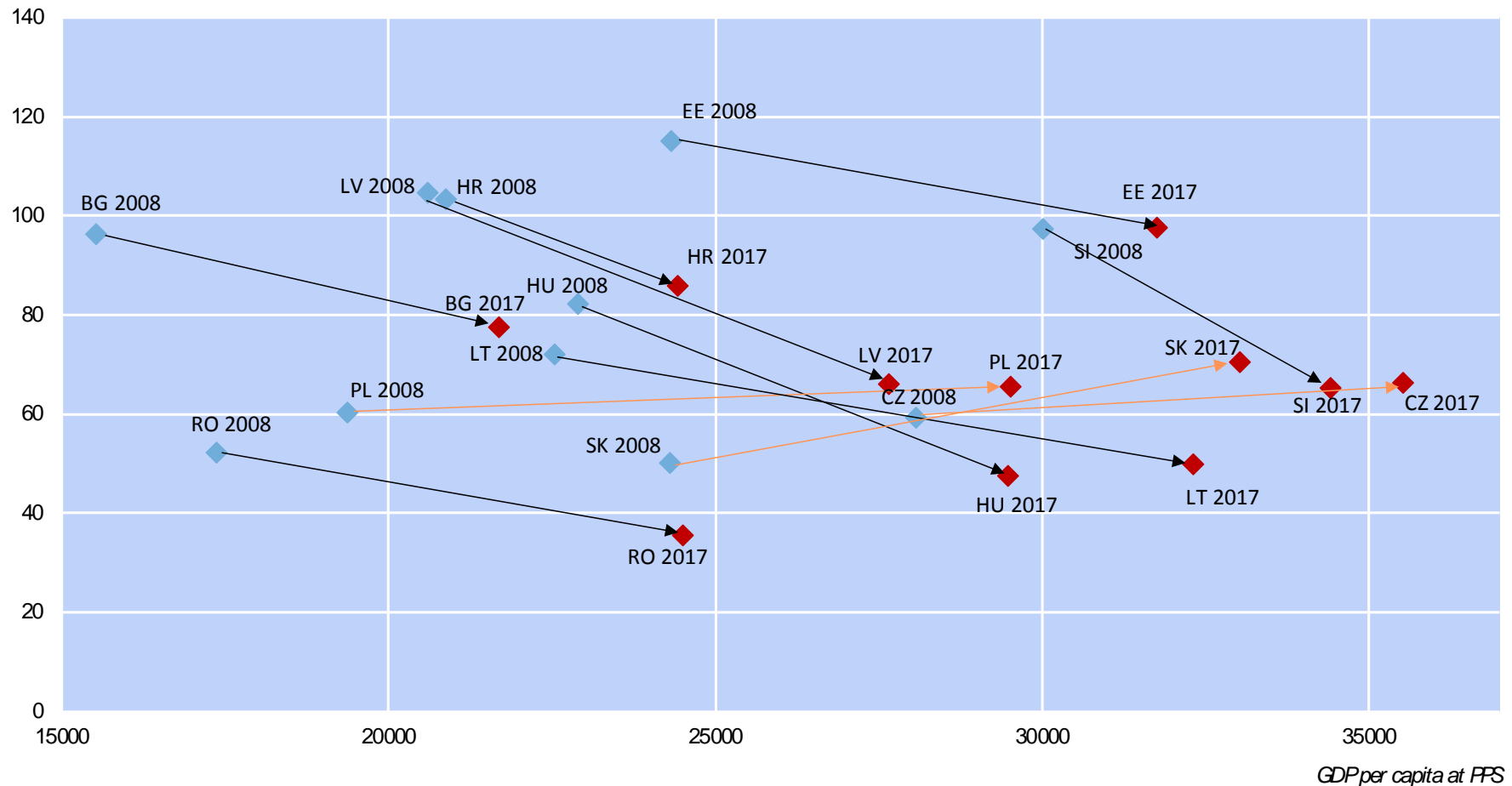


Sources: National central banks, Eurostat.

# Credit vs. income: has the downward adjustment removed possible overshooting tendencies?

## Total credit-to-GDP ratios in relation to GDP per capita at PPS

Total credit in % of GDP



Source: National central banks, Eurostat, IMF.

- Before the GFC: rapidly rising credit levels in most CESEE countries → credit bubbles or convergence-related financial deepening?
  - e.g. Boissay et al., 2005; Duenwald et al., 2005; Égert et al., 2006; Kiss et al., 2006
- Post-GFC work has continued to study the deviation of observed credit levels from long-run equilibrium levels
  - e.g. Zumer et al., 2009; Eller et al., 2010; Geršl & Seidler, 2015; IMF REI, 2015; Stojanović & Stojanović, 2015; Jovanovic et al., 2017
    - Focus on domestic bank credit to the private sector
    - Linking countercyclical capital buffers (CCyBs) to credit gaps
    - Foreign credit determinants largely disregarded
    - Switch from out-of-sample to in-sample approaches
    - Static and dynamic panel data models (addressing either credit *levels* or credit *growth*)



- **Cross-border credit** as important source of corporate financing in CESEE → added to the domestic private sector credit stock
- **Foreign credit determinants** added
  - Strong openness of the region in terms of trade and banking ([Fadejeva et al., 2017](#)) & potential role of global “supply push” factors in determining credit ([Bruno & Shin, 2015](#))
  - Pay attention to global GDP developments and spillovers from global/European credit cycles
- **Different candidate models** for estimating fundamental credit levels
  - Static panel model accounting for heterogeneous coefficients, cross-sectional dependence, nonstationarity and cointegration
  - Comparison of different estimators, static vs. dynamic: [companion working paper](#)

## Sample

- 11 CESEE EU member states:  
BG, CZ, EE, HR, HU, LV, LT, PL, RO, SI, SK
- For the estimations: quarterly data from mid-1990s until end-2016
- **Main variable of interest:** total private sector credit-to-GDP ratio
  - a) **Domestic banks' credit to resident nonbank private sector**
  - b) **Direct cross-border credit**, i.e. external debt of the nonbank private sector (IIP), excl. intercompany loans and trade credits (liabilities)
    - In a robustness check: wider definition, including ICLs and trade credit

## **2) METHODOLOGY**

- Regressing credit over GDP on set of determinants (static for levels and dynamic for growth rates);
- Using these coefficients to build fundamental credit levels and growth rates;
- Making an assessment country-by-country and time-varying.

- We tested for cross-sectional dependence (CSD), non-stationarity and cointegration.
  1. Pesaran (2004) **test for cross-sectional independence**, which is strongly rejected. Need corrections to avoid inconsistent estimates and misleading inference. CSD-corrected FE or using global factors and spillovers in static and dynamic panels.
    - These global “supply push” factors, may play an important role in determining credit (Bruno and Shin, 2013). Credit in CESEE can be affected by others countries’ performance, given the strong interlinkages, for instance via the banking sector (see Fadejeva et al., 2017).
  2. If CSD, no IPS test but second-generation **panel unit root test** by Pesaran (2003) is applied. The null hypothesis assumes that all series are non-stationary. Our panel cannot reject non-stationarity for some of the series.
  3. The **cointegration** test by Pedroni (2004). The test’s null hypothesis is no cointegration. We can always reject no cointegration at 5% in the group mean statistics for baseline.

- Static setup (for levels) + external variables

$$\left(\frac{\text{credit}}{\text{GDP}}\right)_{i,t} = \beta_{1i}X_{i,t-1} + \beta_{2i}G_{t-1} + \beta_{2i}S_{i,t-1} + \mu_i + \varepsilon_{i,t}$$

**Preferred: Group Mean-Fully Modified OLS (GM-FMOLS) as Pedroni (2000)**

**Robustness checks:** Mean Group (Pesaran and Smith, 1995) and CSD-corrected FE

- $X$  are the **domestic explanatory variables**, namely (log) GDP per capita, (log) general government credit-to-GDP ratio, PPI inflation, (log) lending rate and (log) spread is the ratio between lending and deposit rate.
- $G$  is the **common global factor**, defined as the (log) seasonally adjusted global GDP.
- $S$  is a country-specific, time-varying variable for **cross-country spillovers in credit**.  
This is the trade-weighted (weights from EU Commission) measure of partners' credit taken in logs.
- Lastly,  $\mu_i$  is the country fixed effect.

- Dynamic setup (for growth rates) + external variables
- ARDL (1,1) – lag selection based on SBIC and AIC

$$\left(\frac{\text{credit}}{\text{GDP}}\right)_{i,t} = \alpha_i + \beta_i \left(\frac{\text{credit}}{\text{GDP}}\right)_{i,t-1} + \zeta_{1i} X_{i,t} + \zeta_{2i} X_{2i,t-1} + \lambda_{1i} G_t + \lambda_{2i} G_{t-1} + \eta_{1i} S_{1i,t} + \eta_{2i} S_{2i,t-1} + \varepsilon_{i,t}$$

- Reparametrized into a Panel ECM

$$\begin{aligned} \Delta \left(\frac{\text{credit}}{\text{GDP}}\right)_{i,t} &= \phi_i \left( \left(\frac{\text{credit}}{\text{GDP}}\right)_{i,t-1} - \theta_{0i} - \theta_{1i} X_{i,t-1} - \theta_{2i} G_{t-1} - \theta_{3i} S_{i,t-1} \right) + \zeta_{1i} \Delta X_{i,t} + \lambda_{1i} \Delta G_t \\ &+ \eta_{1i} \Delta S_{i,t} + \mu_i + \varepsilon_{i,t} \end{aligned}$$

**Preferred:** tested for the best estimator by using a Hausman test as in Blackburne and Frank (2007), finding that the difference in coefficients between the MG and Dynamic FE is not systematic → **Dynamic FE** is applied as it allows for more degrees of freedom.

**Robustness check:** Dynamic factor model (Augmented Mean Group estimator for ARDL) – Y in levels NOT in differences as in the ECM.

# Building the equilibria

- We follow the approach by the IMF Consultative Group on Exchange Rate Issues CGER normally used for the REER (Ricci et al., 2013; Comunale, 2017), the current account (Lee et al., 2008; Comunale, 2018) and credit growth (Jovanovic et al., 2017).
- 1. We estimate the coefficients for the fundamentals of the credit-to-GDP ratios (see before);
- 2. The equilibrium rate is then calculated as the sum of the estimated coefficients from the equations multiplied by the correspondent HP-filtered values of the fundamentals.

## Static (equilibrium levels)

$$\left(\frac{\text{credit}}{\text{GDP}}\right)_{i,t}^{eq.} = \hat{\beta}'_i X_{i,t}^{HP} = \sum_j^J \hat{\beta}_i X_{i,t}^{HP}$$

## Dynamic (equilibrium growth yoy)

$$\Delta\left(\frac{\text{credit}}{\text{GDP}}\right)_{i,t}^{eq.} = \widehat{\theta}^{LR'}_i X_{i,t}^{HP} - \widehat{\theta}^{LR'}_i X_{i,t-4}^{HP} = \sum_j^J \widehat{\theta}^{LR}_i X_{i,t}^{HP} - \sum_j^J \widehat{\theta}^{LR}_i X_{i,t-4}^{HP}$$

$\hat{\beta}'_i$  represents any coefficients in the equation ( $\widehat{\theta}^{LR'}_i$  for the long run in ECM) and  $X_{i,t}^{HP}$  are the filtered values of the fundamentals (HP is the baseline).



# 3) RESULTS

- **Static framework:**
  1. Baseline with different estimators
  2. Checks with alternative determinants
  3. Comparison domestic vs. total credit [reserve slides]
  4. Different filters [reserve slides]
  
- **Dynamic framework:**
  1. Baseline vs. checks

# Static framework for levels

# Static panel results with different estimators

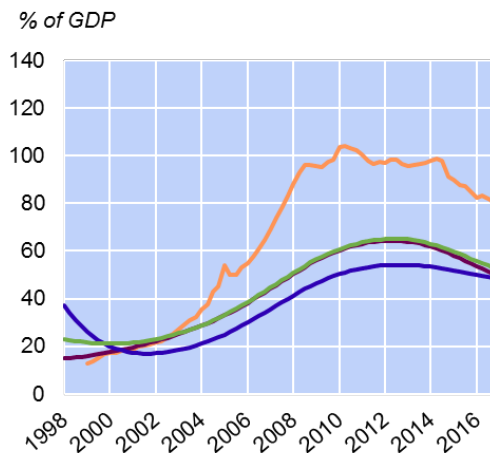
## Total credit

	<b>baseline</b>		
	(1)	(2)	(3)
Method	<b>GM-FMOLS</b>	<b>MG</b>	<b>FE</b>
<b>GDP per capita</b>	<b>0.918***</b>	<b>0.879***</b>	<b>1.452***</b>
	<b>[0.084]</b>	<b>[0.289]</b>	<b>[0.157]</b>
Domestic general government credit/GDP	-0.041	-0.018	0.018
	[0.020]	[0.081]	[0.036]
PPI inflation rate	-0.022	0.112	0.351**
	[0.130]	[0.344]	[0.139]
Lending rate	0.064***	0.077	0.230***
	[0.030]	[0.058]	[0.034]
<b>Interest rate spread</b>	<b>-0.172***</b>	<b>-0.155***</b>	<b>-0.113***</b>
	<b>[0.010]</b>	<b>[0.046]</b>	<b>[0.024]</b>
Global GDP	0.313***	0.298	-0.135
	[0.080]	[0.196]	[0.100]
Total credit spillovers	0.842***	0.915**	0.949***
	[0.110]	[0.379]	[0.342]
Constant	-14.790***	-14.141***	-13.093***
	[0.740]	[2.107]	[1.009]
Observations	811	811	811
Number of co	11	11	11
Standard errors in brackets			
*** p<0.01, ** p<0.05, * p<0.1			

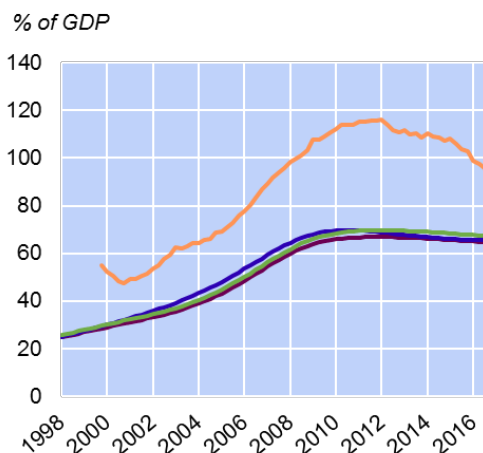
# Results - with different estimators

Chart 1

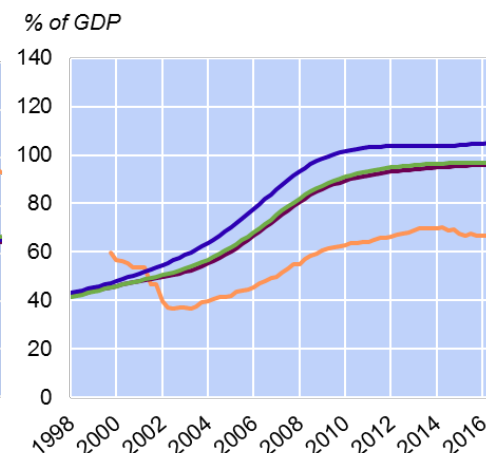
## Bulgaria



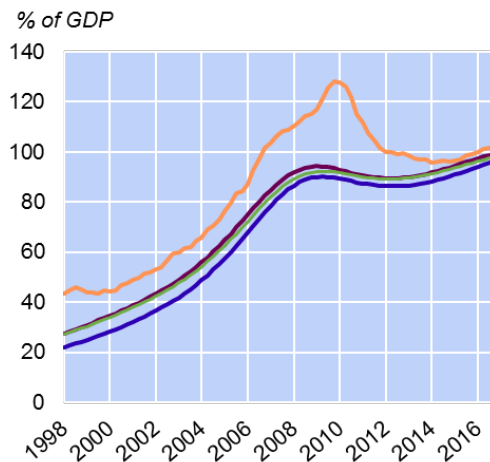
## Croatia



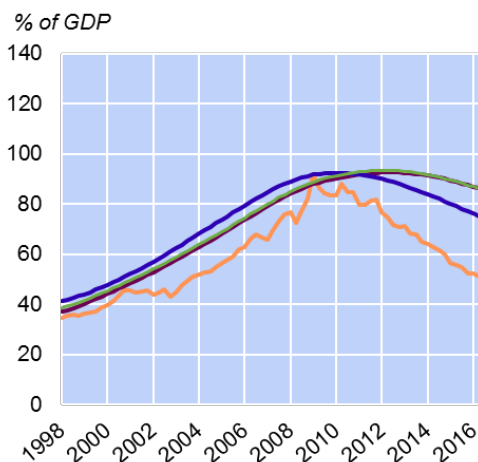
## Czech Republic



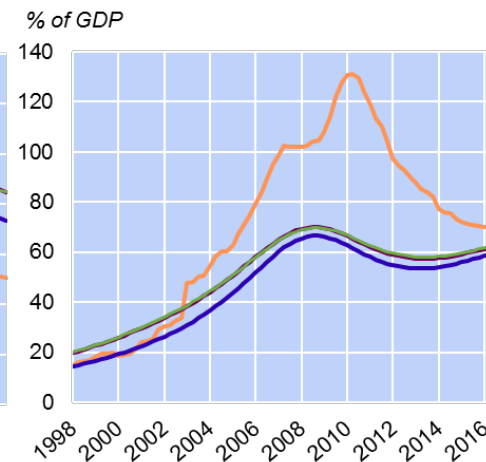
## Estonia



## Hungary



## Latvia



— Total private sector credit

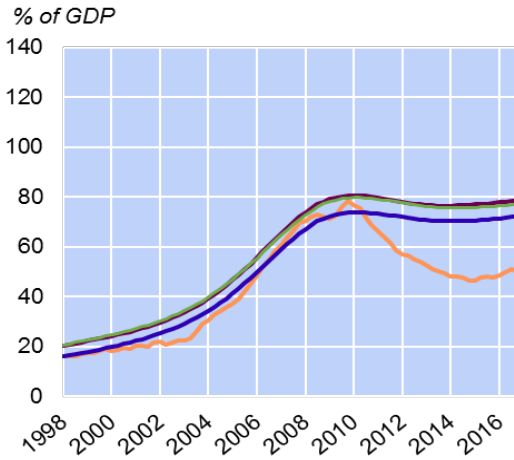
— Fundamental level (based on FE)

— Fundamental level (based on GM-FMOLS)

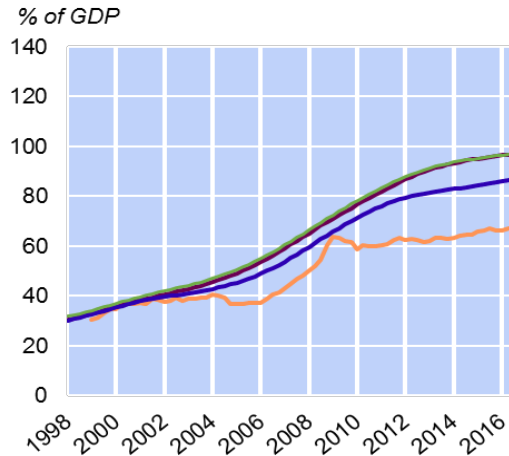
— Fundamental level (based on MG)

# Results - with different estimators

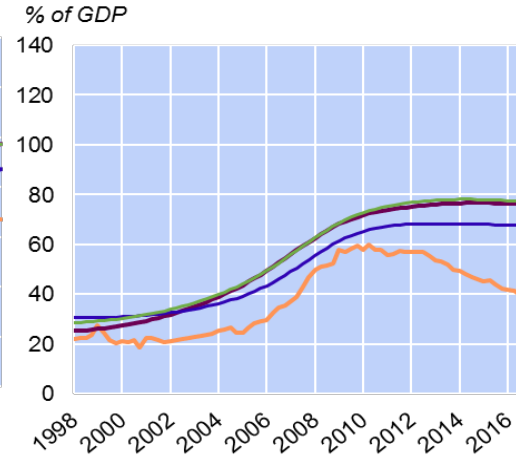
## Lithuania



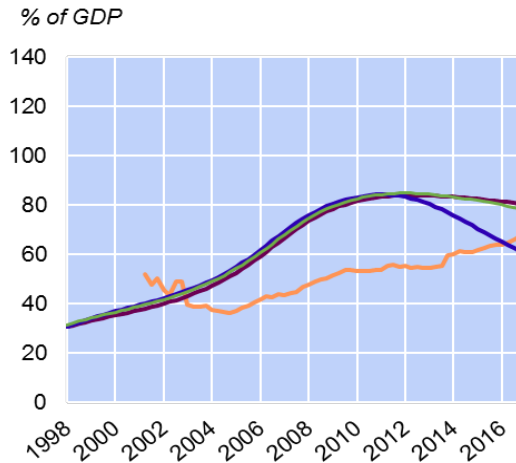
## Poland



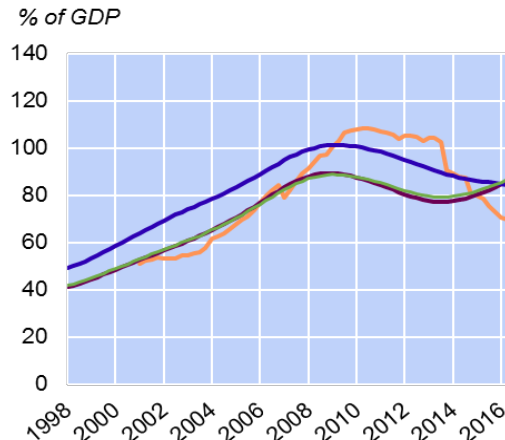
## Romania



## Slovakia



## Slovenia



— Total private sector credit

— Fundamental level (based on FE)

— Fundamental level (based on GM-FMOLS)

— Fundamental level (based on MG)

# Static panel results with GM-FMOLS

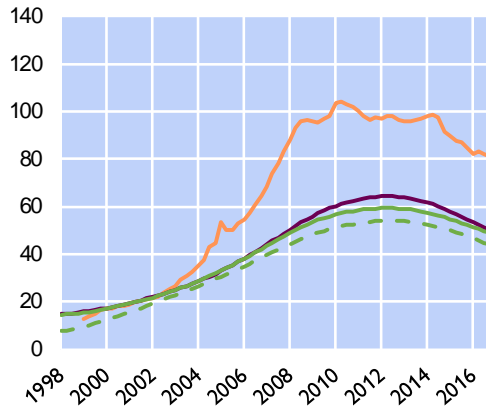
	<b>baseline</b>	baseline without common factors	with leverage	with equity	with alternative common factors	with post crisis dummy
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Total credit/GDP	Total credit/GDP	Total credit/GDP	Total credit/GDP	Total credit/GDP	Total credit/GDP
<b>GDP per capita</b>	<b>0.918***</b>	<b>1.383***</b>	<b>0.599***</b>	<b>0.859***</b>	<b>1.364***</b>	<b>1.093***</b>
	<b>[0.084]</b>	<b>[0.036]</b>	<b>[0.077]</b>	<b>[0.336]</b>	<b>[0.055]</b>	<b>[0.089]</b>
Domestic general government credit/GDP	-0.041	0.028*	-0.079**	-0.007*	0.035*	-0.094***
	[0.020]	[0.020]	[0.020]	[0.060]	[0.020]	[0.030]
PPI inflation rate	-0.022	-0.244	0.269**	0.115**	-0.105*	0.122**
	[0.130]	[0.140]	[0.090]	[0.090]	[0.140]	[0.130]
<b>Lending rate</b>	<b>0.064***</b>	<b>0.023***</b>	<b>0.200***</b>	<b>0.050***</b>	<b>0.124***</b>	<b>0.044***</b>
	<b>[0.030]</b>	<b>[0.040]</b>	<b>[0.020]</b>	<b>[0.020]</b>	<b>[0.030]</b>	<b>[0.020]</b>
<b>Interest rate spread</b>	<b>-0.172***</b>	<b>-0.204***</b>		<b>-0.144***</b>	<b>-0.166***</b>	<b>-0.193***</b>
	<b>[0.010]</b>	<b>[0.020]</b>		<b>[0.010]</b>	<b>[0.020]</b>	<b>[0.010]</b>
Leverage ratio			0.339***			
			[0.030]			
Equity				0.134***		
				[0.030]		
Global GDP	<b>0.313***</b>		0.371***	-0.050		-0.006
	<b>[0.080]</b>		[0.060]	[0.060]		[0.010]
Total credit spillovers	<b>0.842***</b>		<b>1.328***</b>	<b>0.470***</b>		<b>0.705***</b>
	<b>[0.110]</b>		<b>[0.120]</b>	<b>[0.120]</b>		<b>[0.1320]</b>
VIX					0.012	
					[0.020]	
GDP spillovers					-0.011	
					[0.060]	
post-crisis dummy						<b>0.125**</b>
						<b>[0.030]</b>
Constant	-14.790***	-13.810***	-13.970***	-9.140***	-13.670***	-8.660***
	[0.740]	[0.040]	[0.580]	[0.760]	[0.570]	[0.855]
Observations	819	811	775	819	819	819

- With a further supply-side variable: **equity** to account for the source of funds available within the country → *results for the baseline robust, minor role for global GDP (smaller in magnitude)*
  - Accounting for **post-crisis deleveraging**
    - with a **dummy for the post-crisis period** → *results for the baseline robust, minor role for global GDP*
    - or the **leverage ratio** (bank assets over equity) instead of interest rate spread → *positive coefficient, other regressors remain robust (except for inflation – turns positive)*
  - With **alternative external variables**
    - for risk/common global factor (log VIX) → *coefficient smaller than for global GDP*
    - GDP growth spillovers → *still positive but smaller than for credit spillovers: bigger role of financial spillovers rather than real ones*
- ⇒ **The coefficients of GDP per capita, interest rates and credit spillovers remain fairly robust**

# Results – alternative external determinants

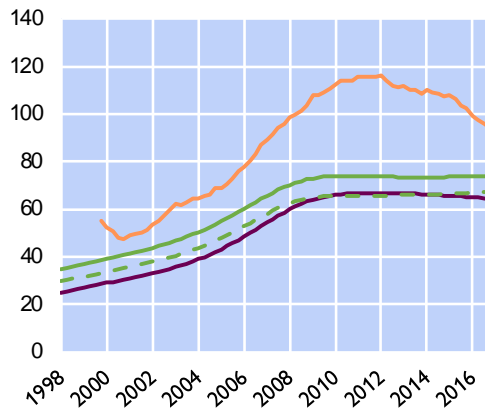
## Bulgaria

% of GDP



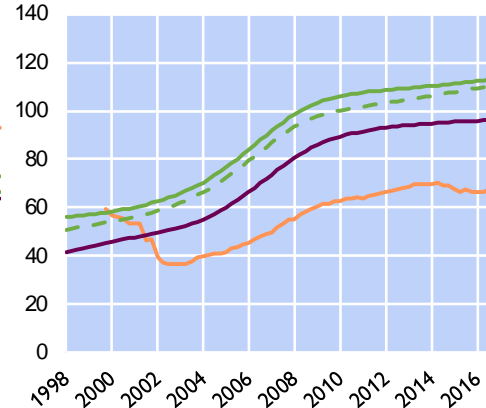
## Croatia

% of GDP



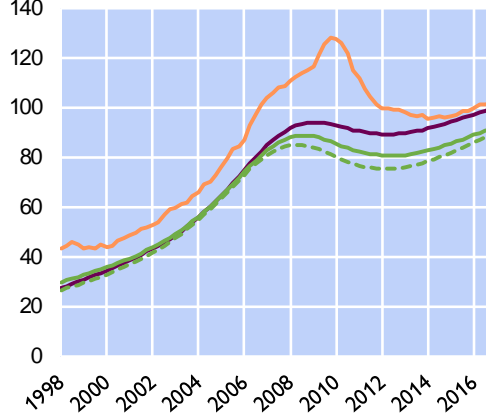
## Czech Republic

% of GDP



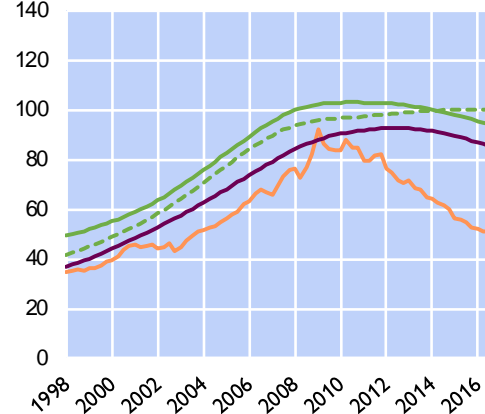
## Estonia

% of GDP



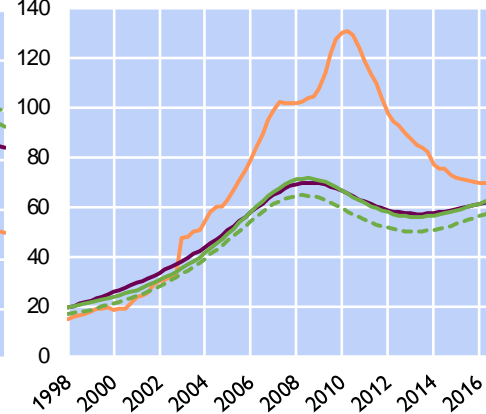
## Hungary

% of GDP



## Latvia

% of GDP

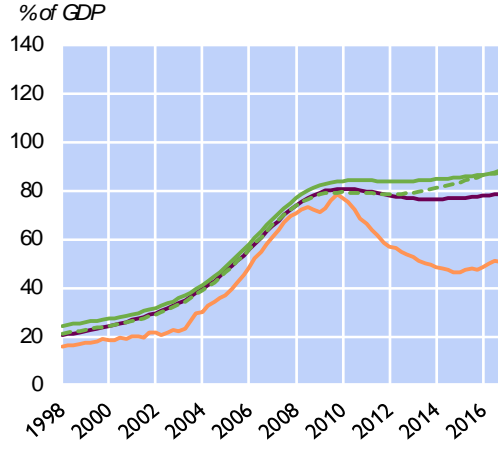


- Actual level
- Fundamental level (baseline)
- Fundamental level without external variables
- Fundamental level with alternative external variables (table 4, column 4)

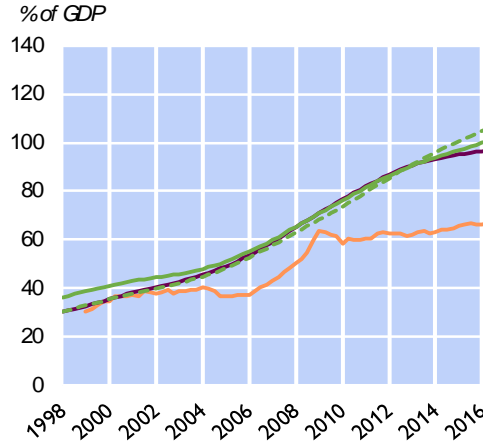


# Results – alternative external determinants

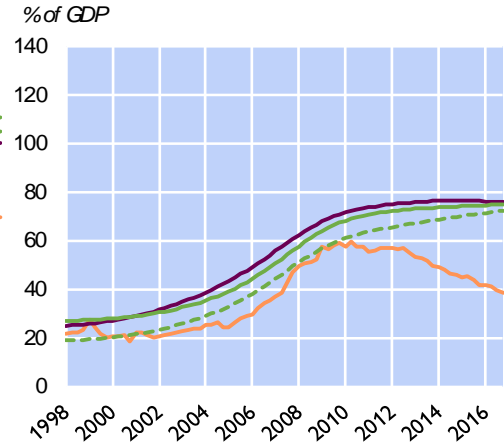
## Lithuania



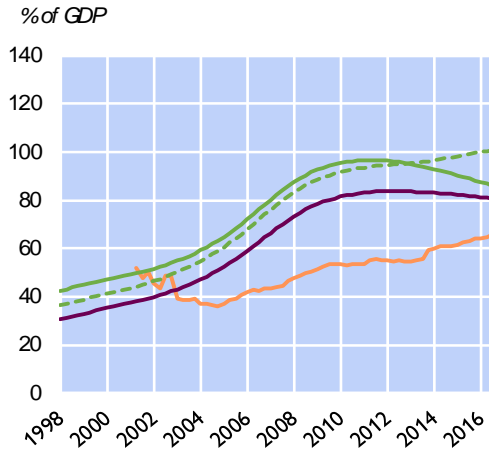
## Poland



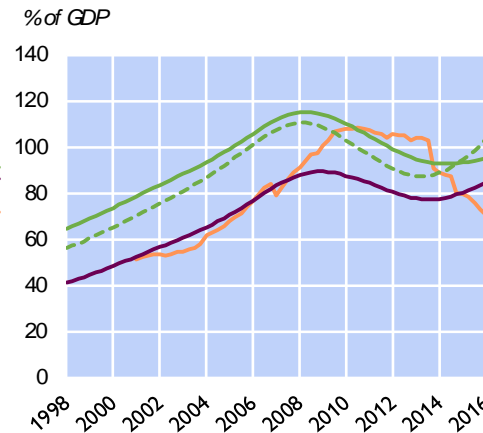
## Romania



## Slovakia



## Slovenia



- Actual level
- Fundamental level (baseline)
- - - Fundamental level without external variables
- Fundamental level with alternative external variables (table 4, column 4)

Source: National central banks, IMF, authors' calculations.

# Dynamic framework for growth rates

(work in progress, for the WP version)

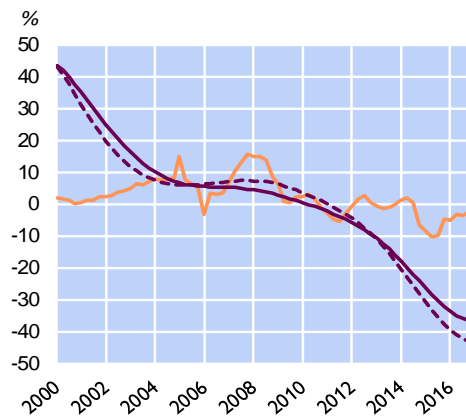
## PECM results for variation of total credit – baseline and without external variables

VARIABLES	(1)	(2)	(1)	(2)
	baseline	without external variables	baseline	without external variables
	<b>short-run</b>		<b>long-run</b>	
Error correction term	-0.0271*** (0.00625)	-0.0310*** (0.00603)		
GDP per capita	-14.20* (8.425)	-8.354 (8.122)	<b>190.2***</b> <b>(46.02)</b>	<b>74.78***</b> <b>(11.22)</b>
Domestic general government credit/GDP	-0.201** (0.0904)	-0.238*** (0.0904)	-3.017*** (1.127)	-4.709*** (1.189)
PPI inflation rate	1.256 (2.281)	1.326 (2.263)	-41.04 (58.63)	-40.23 (51.09)
Lending rate	0.0195 (0.0451)	0.0577 (0.0564)	0.266 (0.751)	0.392 (0.666)
Interest rate spread	-0.00312 (0.0231)	0.00576 (0.0305)	<b>-3.831***</b> <b>(0.942)</b>	<b>-3.887***</b> <b>(0.798)</b>
Total credit spillovers	0.0488 (0.0359)		-0.485 (0.508)	
Global GDP	0.820 (3.262)		<b>-129.8***</b> <b>(43.43)</b>	
Constant	11.66 (8.175)	-18.17*** (4.813)		

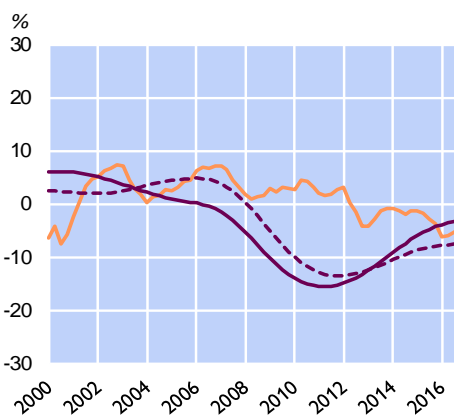
Note: DFE estimator, only GDP per capita in logs. Dependent variable is credit/GDP in first difference, in the short-run the regressors are in first difference, in the long-run they are in levels (1 lag is applied).

# Results - dynamic

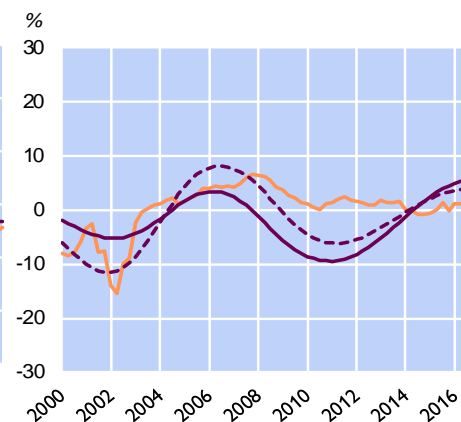
## Bulgaria (different scale)



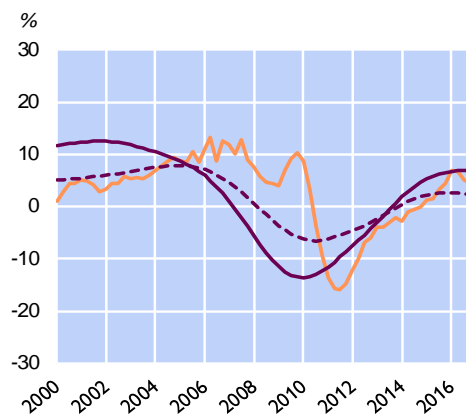
## Croatia



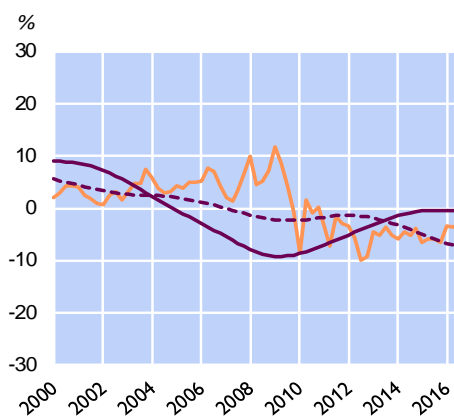
## Czech Republic



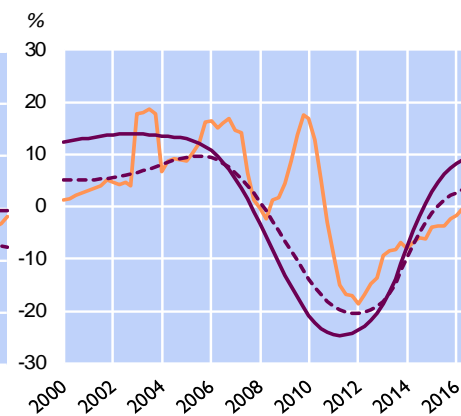
## Estonia



## Hungary



## Latvia

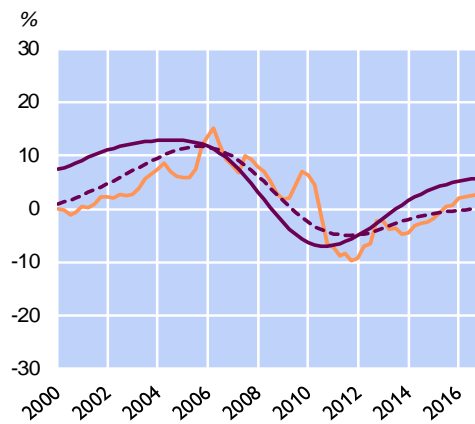


- Actual (yoy) growth of credit-to-GDP ratio
- Fundamental (yoy) growth
- - - Fundamental (yoy) growth (without external variable)

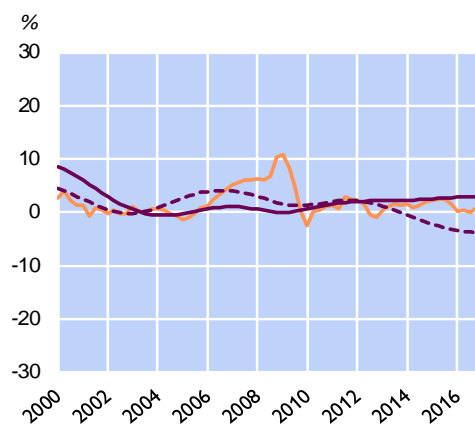
Source: National central banks, IMF, authors' calculations.

# Results - dynamic

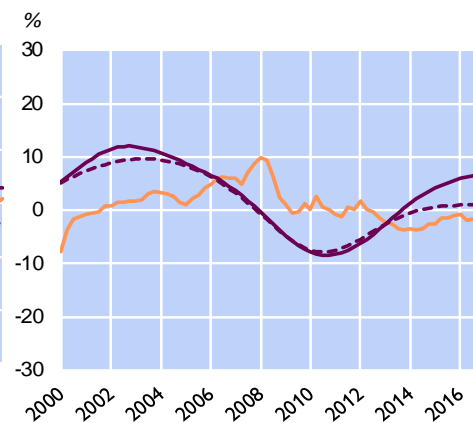
## Lithuania



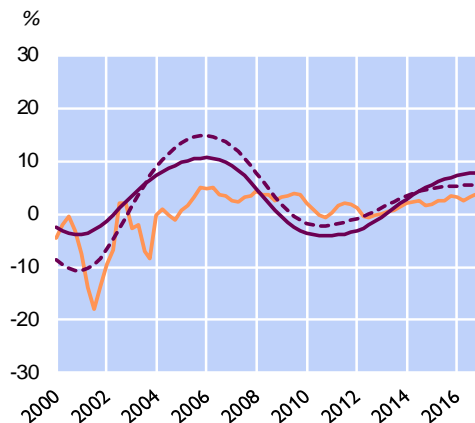
## Poland



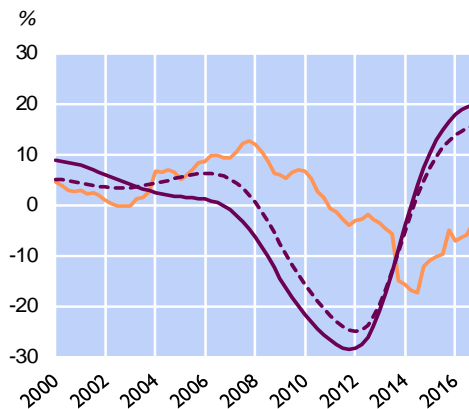
## Romania



## Slovakia



## Slovenia



- Actual (yoy) growth of credit-to-GDP ratio
- Fundamental (yoy) growth
- - - Fundamental (yoy) growth (without external variable)

Source: National central banks, IMF, authors' calculations

- Results for **total credit growth** (preliminary):
  - Most countries within equilibrium range
  - Current credit growth  $>$  equilibrium growth: only clearly in BG
  - Current credit growth  $<$  equilibrium growth: to some extent in CZ, LV, RO, SI
  - Recall different equations in the static and dynamic setup: no 1:1 mapping b/w equilibrium levels and equilibrium growth rates
  - Should be seen together with levels  $\rightarrow$  as the growth rates should help levels reaching the fundamental levels in the medium-long run.

## **4) SUMMARY & IMPLICATIONS**

1. Countries featuring positive credit gaps at the start of the GFC **have managed to adjust their credit ratios downward** toward levels justified by fundamentals
  - In a few countries, though, adjustment is not yet accomplished (BG, HR)
2. In most countries characterized by credit levels close to or below the “fundamental” levels of credit at the start of the GFC, **negative credit gaps have emerged or widened**
  - Post-GFC deleveraging often driven by the specific composition of credit (e.g. high shares of FX-denominated loans)
3. The **inclusion of cross-border credit matters considerably** for credit gap assessments as it results in larger gaps in most cases



- **Fundamentals-based approach vs. filtering approach** (e.g. when setting CCyBs): use them **complementarily** (as recommended by [Geršl & Seidler, 2015](#))
  - Case 1: BG and HR
    - Positive credit gap based on fundamentals but no positive gap based on filtering b/c of recently moderate credit growth rates
    - Policymakers may nevertheless want to consider policy measures to steer credit ratios towards the level justified by fundamentals
  - Case 2: CZ
    - Negative credit gap based on fundamentals but an expansionary financial cycle stage
    - Regulatory measures to smoothen the financial cycle may well make sense to boost the banking sector's resilience
  - Important that the regulatory framework taken as a whole contributes to / does not hinder the credit-to-GDP ratio moving towards the level justified by fundamentals in the longer term!

- Gear policy measures not only to the size of the gap, but also to the **adjustment path**
  - Put restrictions on credit growth in order to contribute to shrinking positive credit gaps *if and only if* macrofinancial conditions are favorable
- **Role of direct cross-border lending**
  - One position: cross-border credit does not constitute credit risk from a domestic point of view
  - However: impact on domestic banking sector via other (indebted) sectors, sluggish adjustment during macrofinancial stress episodes
  - Cross-border lending & **reciprocity of macroprudential measures** activated in another EU country ([ESRB, 2018](#))

**Thank you very much for your attention and  
looking forward to your comments! 😊**

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[mcomunale@lb.it](mailto:mcomunale@lb.it)

# RESERVE SLIDES

- **Broad literature on rapid pre-crisis credit expansion in CESEE**
  - Boissay, Calvo-Gonzalez & Kozluk (2005); Duenwald, Gueorguiev & Schaechter (2005); Égert, Backé & Zumer (2006); Kiss, Nagy & Vonnák (2006); ...
- **Main research questions:**
  - Financial deepening or credit bubble?
  - Convergence-phenomenon or boom?
  - How effective are policy measures to rein in excessive credit growth?
  - Role of excessive credit growth for boom/bust cycles in emerging markets
  - Which contribution of excessive credit growth to macroeconomic imbalances?

## “Excessive” credit growth :=

- Symptom: credit growth is likely to have exceeded the capacity of bank risk management systems and supervisory institutions
- Diagnosis in empirical studies:
  - sharp deviation of credit growth from historical trends
    - EBRD (2009): credit boom as a period during which credit was growing by more than two percentage points of GDP per year
  - sharp deviation of credit growth from GDP growth
  - sharp deviation of observed credit levels from long-run equilibrium levels

- **Égert, Backé & Zumer (2006); Zumer, Égert & Backé (2009)**
  - Domestic private sector credit, CESEE-11
  - Accounting for initial undershooting → out-of-sample approach (benchmark: 14 small open economies in OECD)
  - Preferred estimation technique: panel OLS with country-FE
- **Eller, Frömmel & Srzentic (*FEEI*, 2010)**
  - Domestic private sector credit, CESEE-11
  - Markov-Switching ECM:
    - Distinguish sub-periods with different credit growth determination
    - Focus on changing adjustment process instead of deviation from equilibrium alone
    - Demand and supply factors

- **Geršl & Seidler (2012, *EEE* 2015)**

- Linking countercyclical capital buffers to credit gaps
- Domestic private sector credit, CESEE-10
- HP filter and out-of-sample approach (benchmark: advanced EU countries net of euro area periphery countries)
- ECM with pooled mean group (PMG) estimator

- **IMF-REI (2015)**

- Credit gap derived from fundamentals-consistent private sector debt per capita
- ARDL model for 36 European countries
  - Static: pooled OLS and FE
  - Dynamic: pooled OLS, FE and system GMM



# Data description

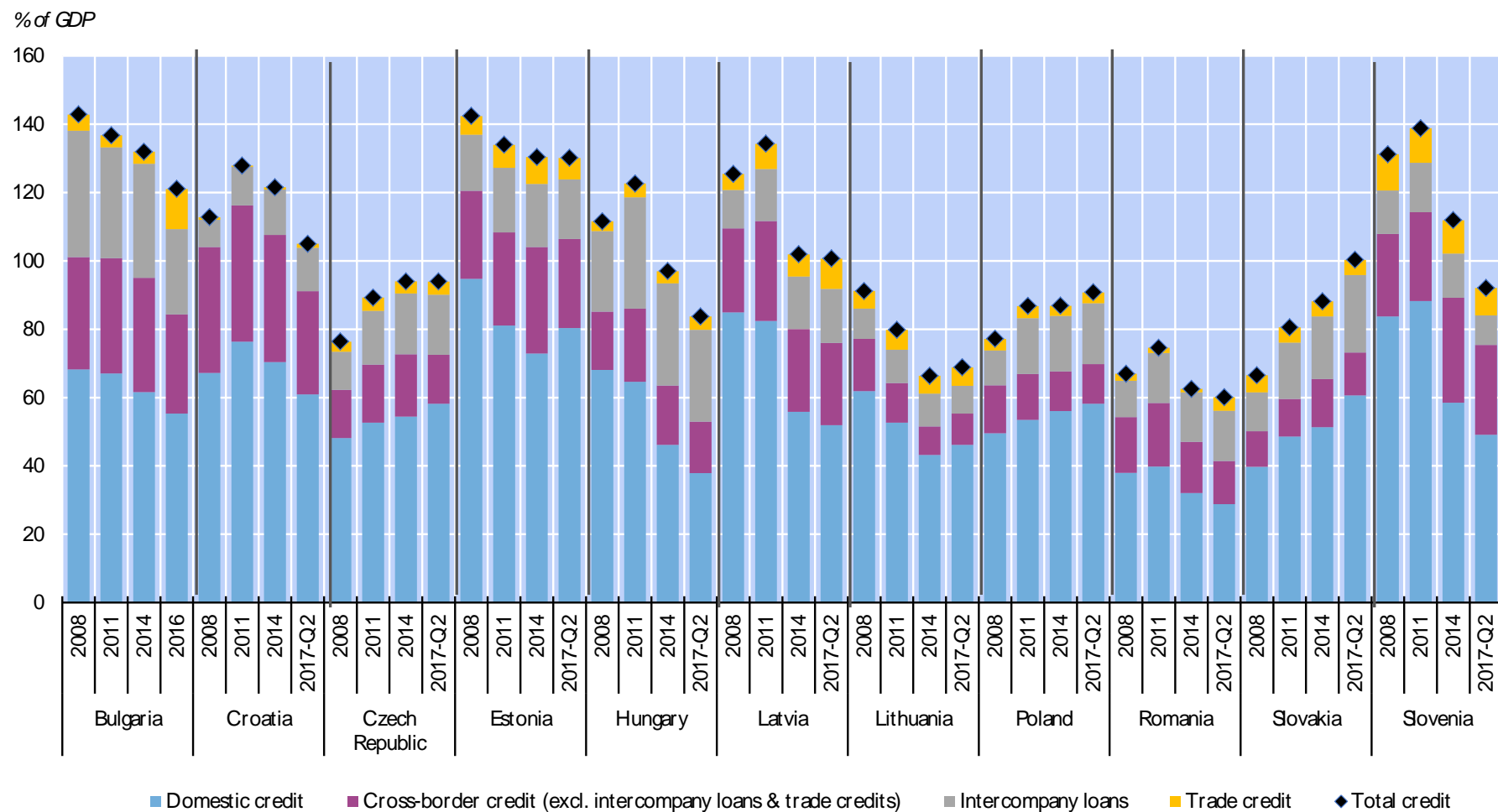
Variables	Description	Source
Domestic private sector credit	Domestic banks' credit to resident nonmonetary financial institutions (non-MFIs), excluding the general government, in local currency (LC) million, end of period	National Central Banks
Direct cross-border credit	Calculated as external debt of the nonbank private sector, excluding intercompany loans and trade credits (liabilities); in EUR million, end of period (conversion to LC million by using the end-of-period exchange rate).	National Central Banks and IMF, Macrobond for exchange rates
Domestic general government credit	Domestic banks' credit to the general government, in local currency (LC) million, end of period	National Central Banks
Nominal GDP	Nominal GDP in LC million used for calculating credit ratios	Eurostat
GDP per capita	GDP per capita in thousands of purchasing-power-parity U.S. dollars. Available only on a yearly basis and thus we interpolated the time series linearly to quarterly frequency	IMF World Economic Outlook Database
PPI inflation rate	Year-on-year percentage change of the producer price index (PPI, 2010=100)	IMF International Financial Statistics
Lending rate	Other depository corporations rate that usually meets the short- and medium-term financing needs of the private sector. Gaps filled with interpolation using dynamics of long-term interest rates and data from national sources.	IMF International Financial Statistics
Deposit rate	Rates offered to resident customers for demand, time, or savings deposits. Gaps filled with interpolation using dynamics of short-term interest rates and data from national sources.	IMF International Financial Statistics
Interest rate spread	Ratio of lending rate over deposit rate in %	Authors' calculation
Global GDP	Sum of the nominal GDP of 42 countries in million USD. Seasonally adjusted.	Authors' calculation from IMF International Financial Statistics
Credit spillovers	Trade weighted (weights from EU Commission, Price and Competitiveness database) measure of 42 partners' private sector credit, % of GDP (BIS).	Authors' calculation from EU Commission and Bank for International Settlements

## Robustness checks variables

VIX	United States, CBOE, S&P 500 Volatility Index	Macrobond
GDP (growth) spillovers	Trade weighted (weights from EU Commission, Price and Competitiveness database) measure of 42 partners' GDP (growth)	Authors' calculation from EU Commission and IMF International Financial Statistics
Post-crisis dummy	Dummy is one from 2008Q4, zero otherwise.	Authors' calculation
Bank equity	Capital and reserves of the banking sector	National Central Banks and IMF
Leverage ratio	Total assets over capital & reserves of the banking sector	National Central Banks and IMF

## Wider definition of cross-border credit, including intercompany loans and trade credit

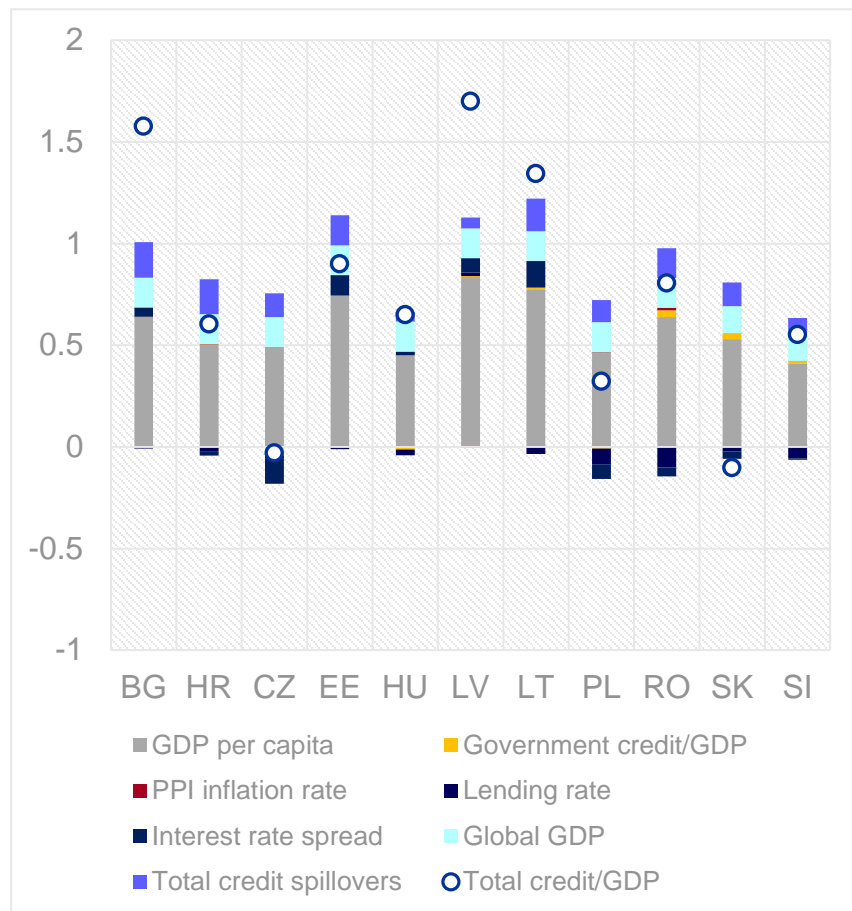
### Domestic and cross-border credit to the nonbank private sector



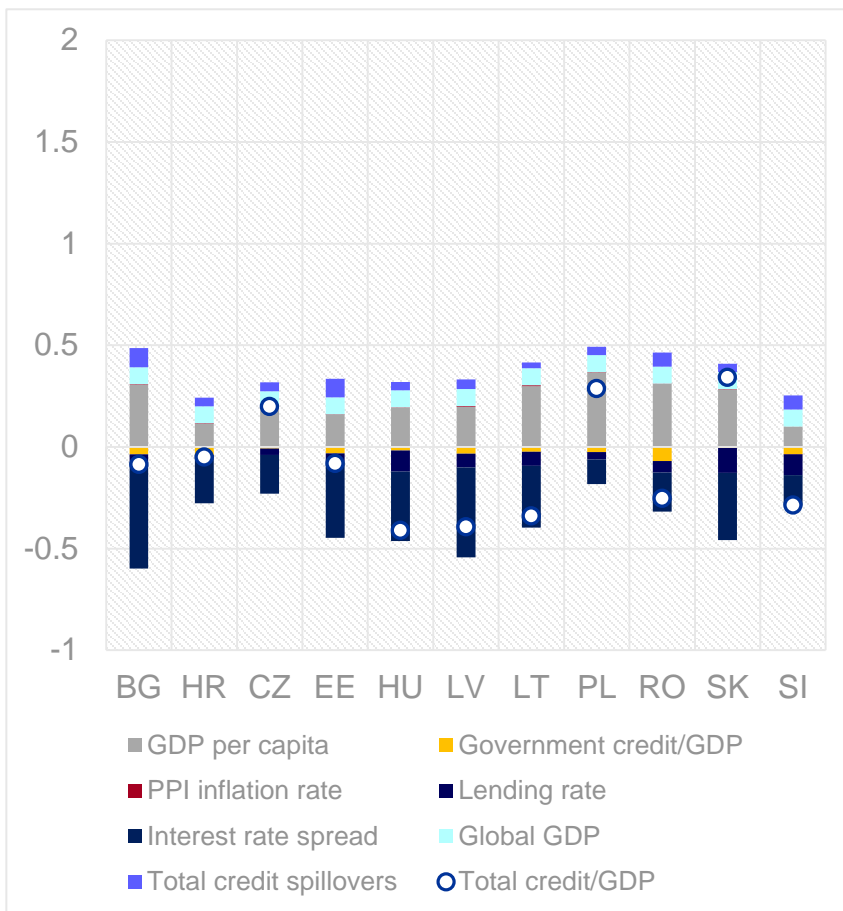
# Results

## Contribution of change in determinants to changes in actual total credit (domestic + cross-border)

2000-2008



2009-2016



Estimators: GM-FMOLS (preferred).

Contribution of change in determinants to changes in actual total credit → calculations

$$\Delta\left(\frac{\text{Credit}}{\text{GDP}}\right)_i^{2007-2000} = \left(\frac{\text{Credit}}{\text{GDP}}\right)_i^{2007} - \left(\frac{\text{Credit}}{\text{GDP}}\right)_i^{2000}$$

$$\Delta\left(\frac{\text{Credit}}{\text{GDP}}\right)_i^{2016-2008} = \left(\frac{\text{Credit}}{\text{GDP}}\right)_i^{2016} - \left(\frac{\text{Credit}}{\text{GDP}}\right)_i^{2008}$$

Factors contributions (X are the determinants, constant not included,  $\beta_i$  are the coefficients from the preferred static model GM-FMOLS):

$$\begin{aligned} &\Delta X_i^{2007-2000} * \beta_i \\ &\Delta X_i^{2016-2008} * \beta_i \end{aligned}$$

Where

$$\Delta X_i^{2007-2000} = X_i^{2007} - X_i^{2000}$$

$$\Delta X_i^{2016-2008} = X_i^{2016} - X_i^{2008}$$

# Results – domestic credit only

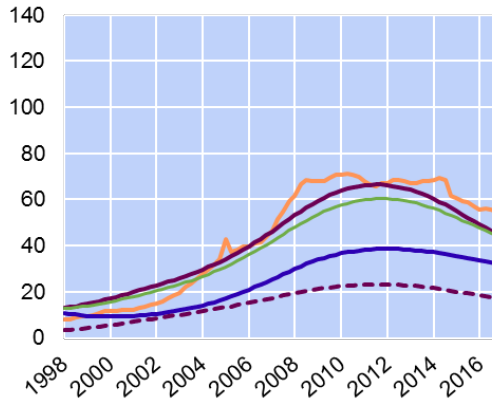
	BASELINE	(1)	(2)
VARIABLES	Total credit/GDP	Domestic credit/GDP	Domestic credit/GDP
GDP per capita	<b>0.918***</b>	1.340***	<b>1.003***</b>
	<b>[0.084]</b>	[0.040]	<b>[0.095]</b>
Domestic general government credit/GDP	-0.041	-0.056	-0.157***
	[0.020]	[0.020]	[0.020]
PPI inflation rate	-0.022	-0.279	-0.117**
	[0.130]	[0.170]	[0.150]
Lending rate	0.064***	0.153***	0.177***
	[0.030]	[0.030]	[0.030]
Interest rate spread	<b>-0.172***</b>	-0.192***	<b>-0.169***</b>
	<b>[0.010]</b>	[0.020]	<b>[0.020]</b>
Global GDP	<b>0.313***</b>		<b>0.325***</b>
	<b>[0.080]</b>		<b>[0.080]</b>
Total (or domestic) credit spillovers	<b>0.842***</b>		<b>0.331***</b>
	<b>[0.110]</b>		<b>[0.080]</b>
Constant	-14.790***	-14.790***	-16.220***
	[0.740]	[0.730]	[0.780]
Observations	811	924	924
Number of co	11	11	11
Standard errors in brackets			
*** p<0.01, ** p<0.05, * p<0.1			

GM-FMOLS applied here

# Results – domestic credit only

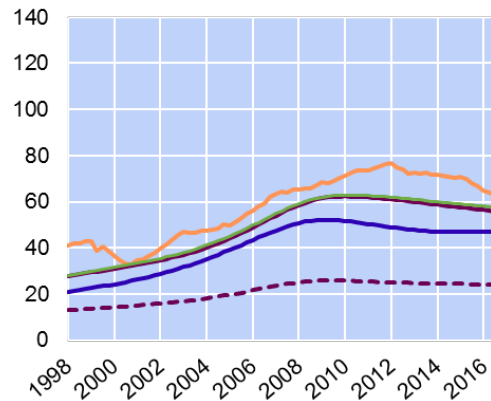
## Bulgaria

% of GDP



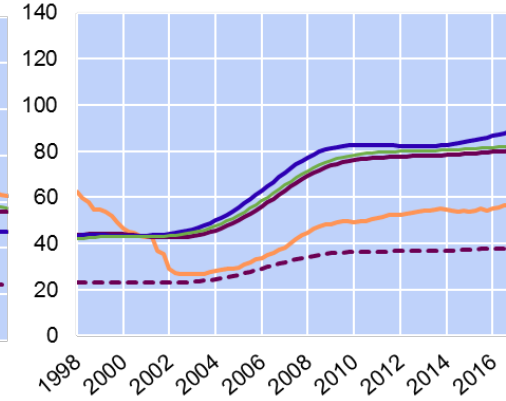
## Croatia

% of GDP



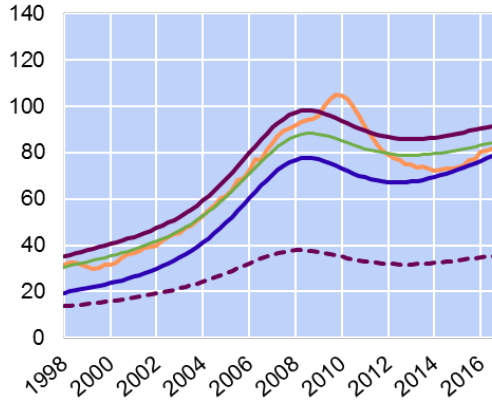
## Czech Republic

% of GDP



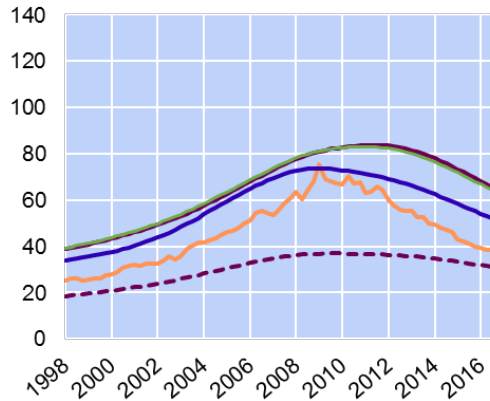
## Estonia

% of GDP



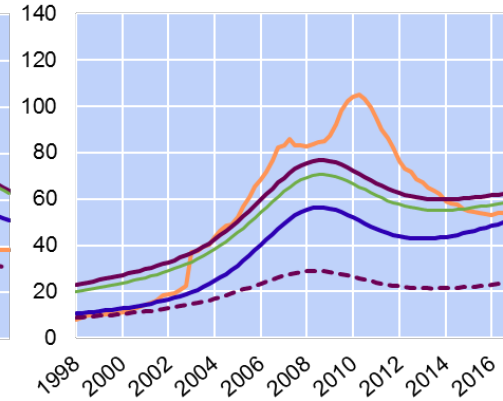
## Hungary

% of GDP



## Latvia

% of GDP



— Domestic private sector credit

— Fundamental level (based on GM-FMOLS)

- - - Fundamental level (based on GM-FMOLS, without external variables)

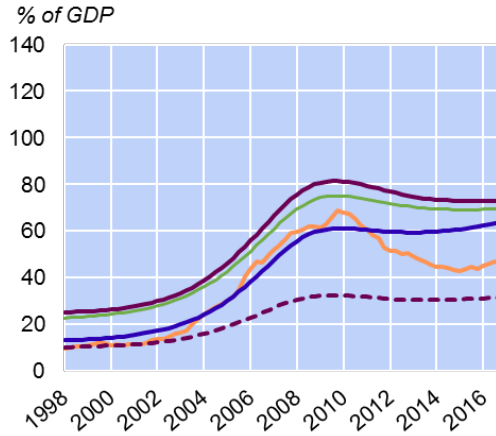
— Fundamental level (based on FE)

— Fundamental level (based on MG)

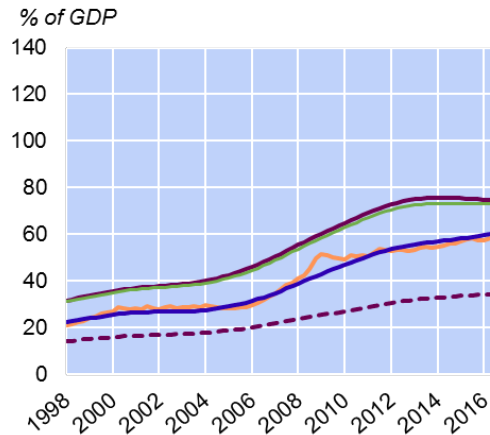
Source: National central banks, IMF, authors' calculations

# Results – domestic credit only

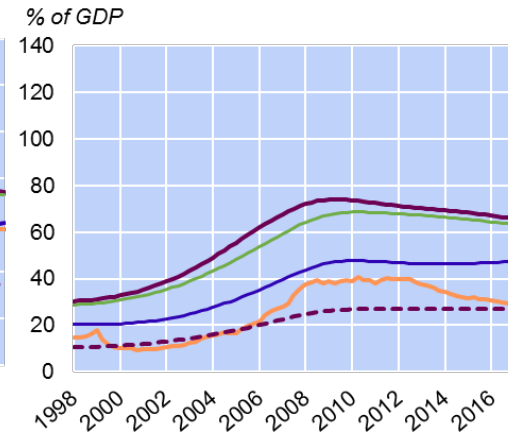
## Lithuania



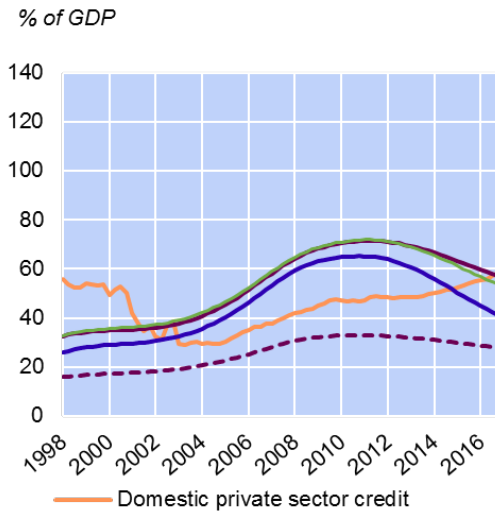
## Poland



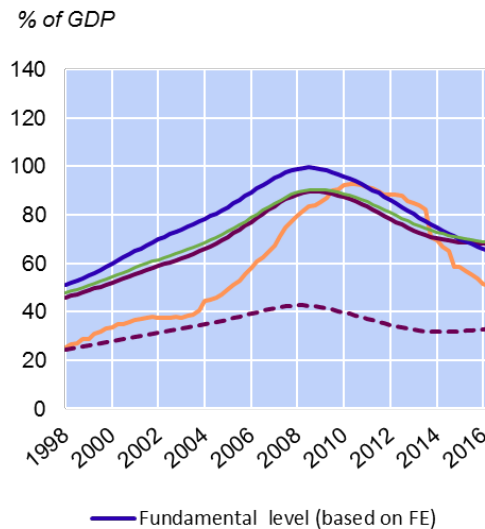
## Romania



## Slovakia



## Slovenia



— Domestic private sector credit

— Fundamental level (based on GM-FMOLS)

--- Fundamental level (based on GM-FMOLS, without external variables)

— Fundamental level (based on FE)

— Fundamental level (based on MG)

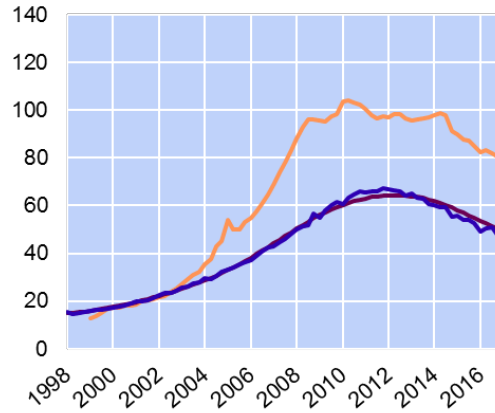


# Results with different filter

Chart 3

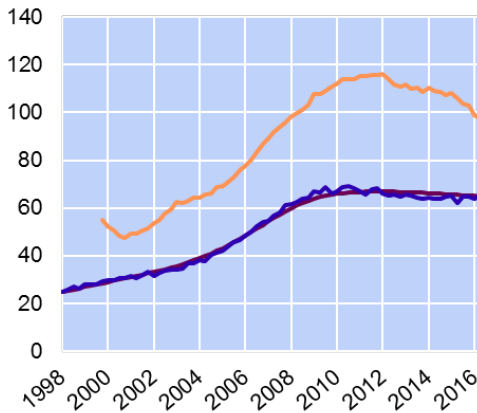
## Bulgaria

% of GDP



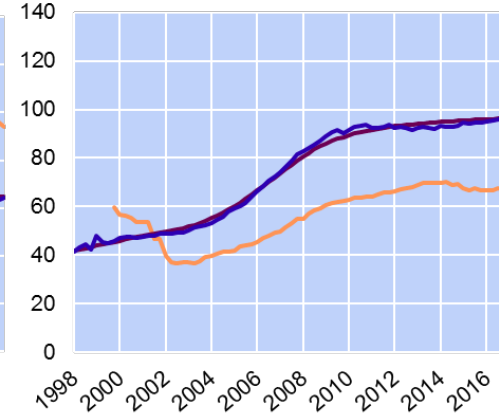
## Croatia

% of GDP



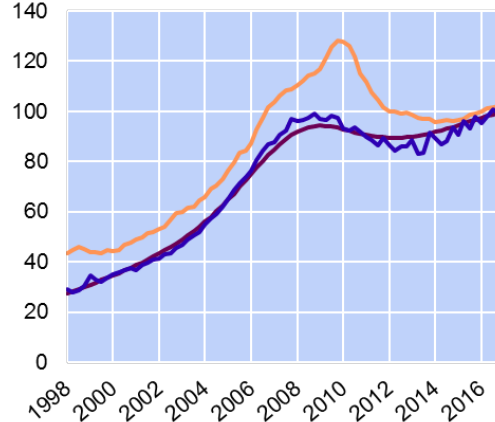
## Czech Republic

% of GDP



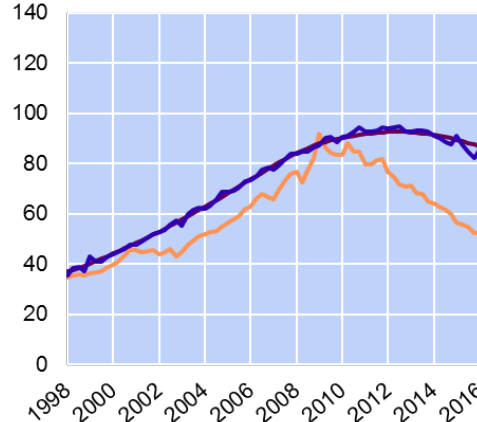
## Estonia

% of GDP



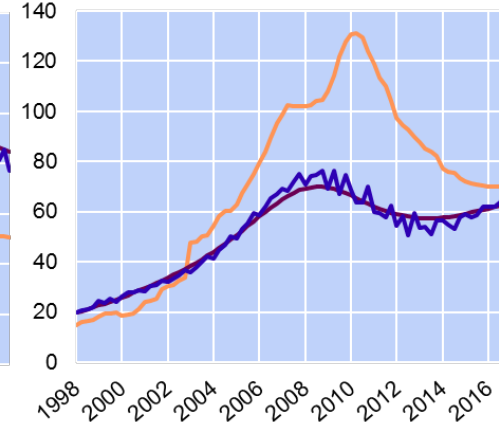
## Hungary

% of GDP



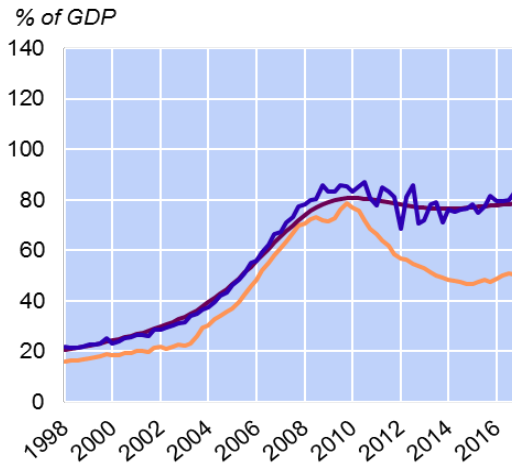
## Latvia

% of GDP

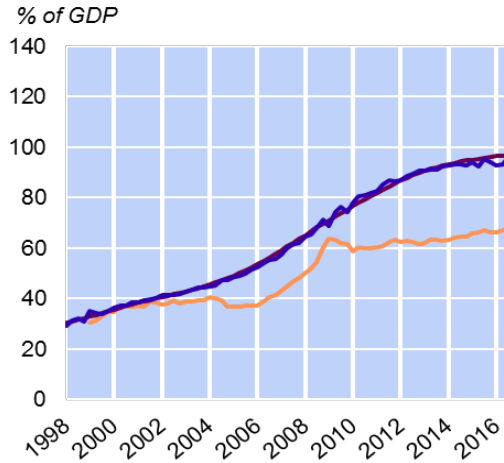


# Results with different filter

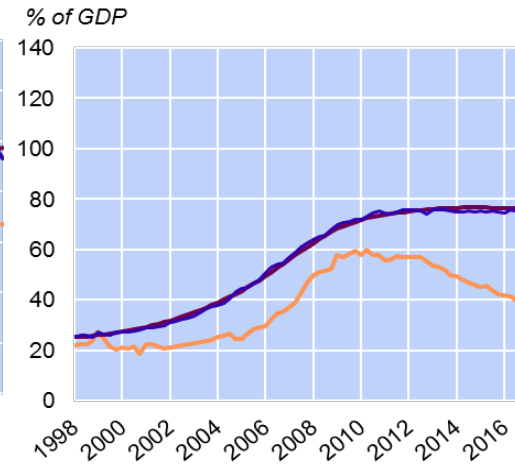
## Lithuania



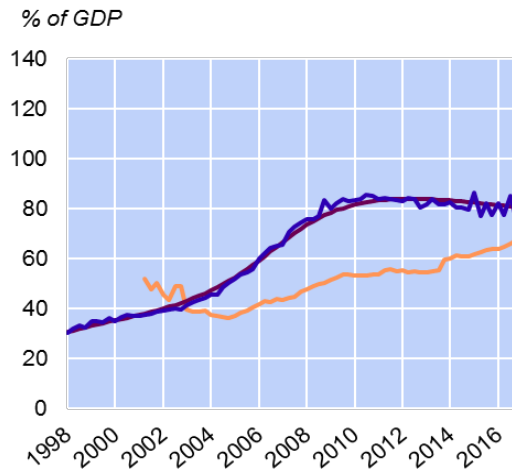
## Poland



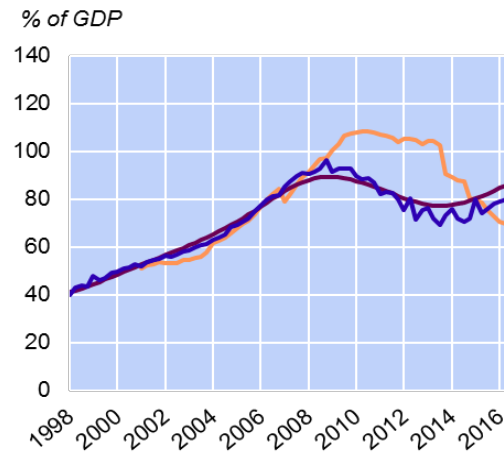
## Romania



## Slovakia



## Slovenia



— Total private sector credit

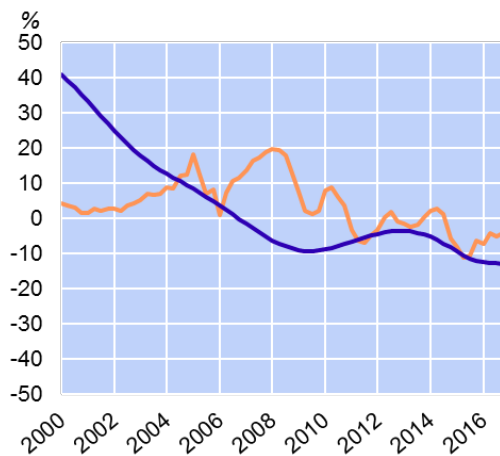
— Fundamental level (based on GM-FMOLS)

— Fundamental level with alternative filter (based on GM-FMOLS)

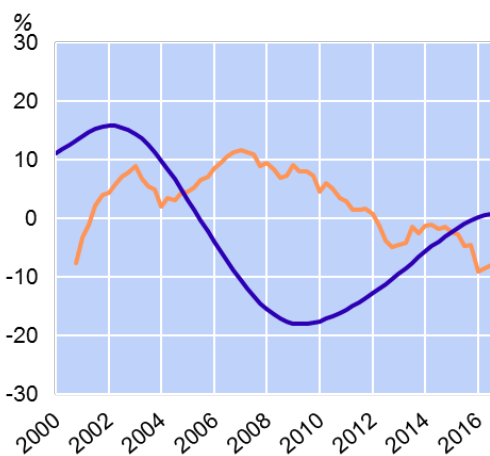
# Results – dynamic (leverage)

Chart 4

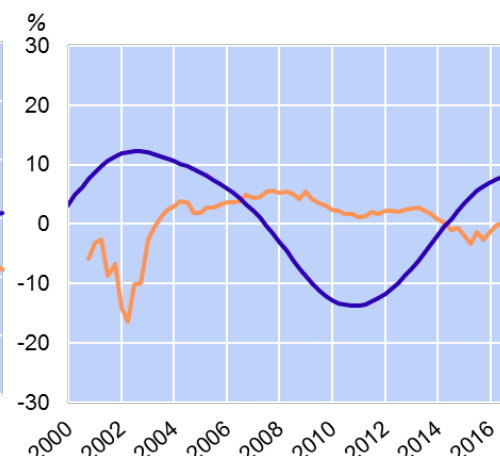
## Bulgaria (different scale!)



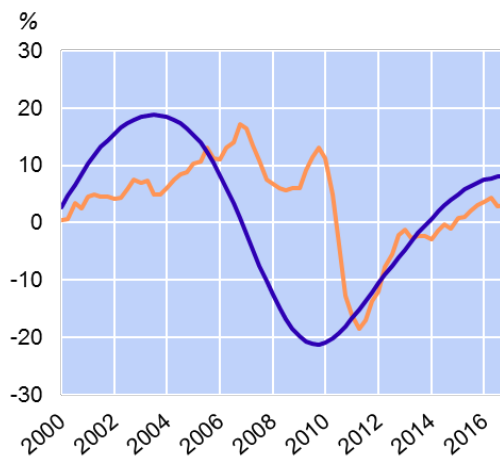
## Croatia



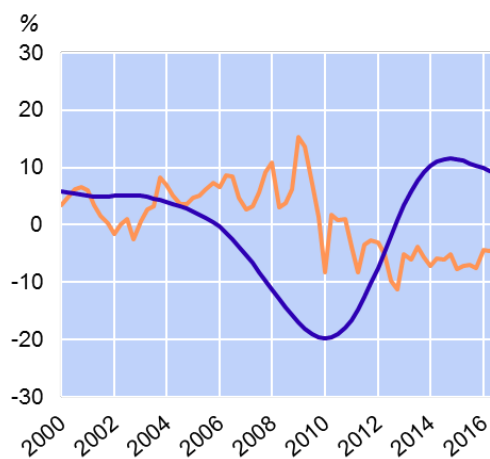
## Czech Republic



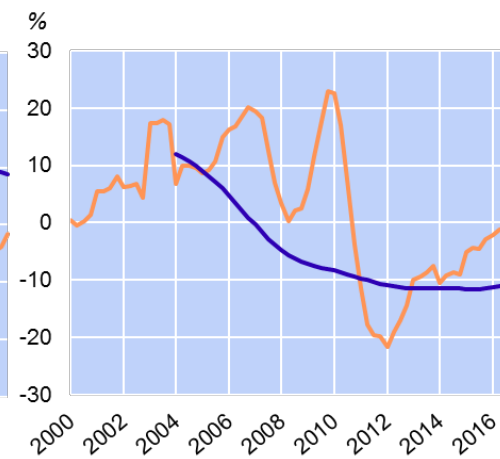
## Estonia



## Hungary

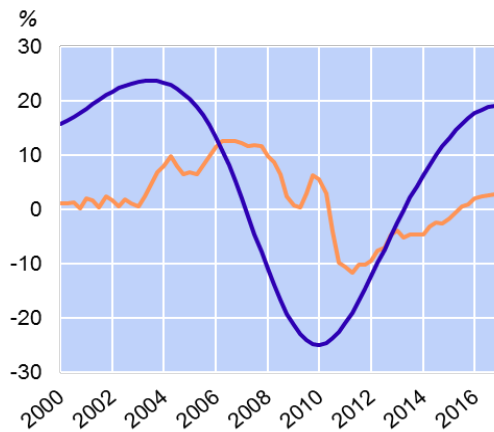


## Latvia

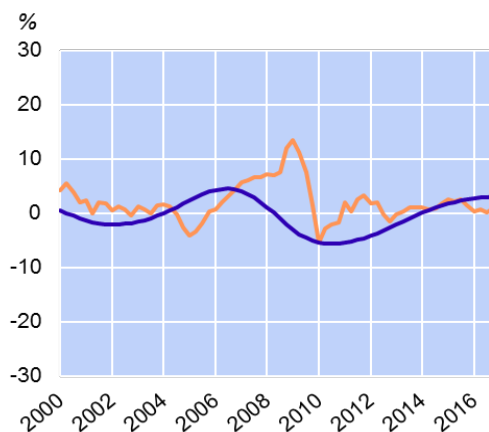


# Results – dynamic (leverage)

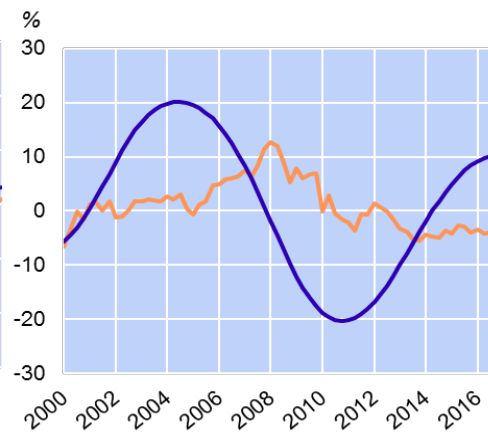
## Lithuania



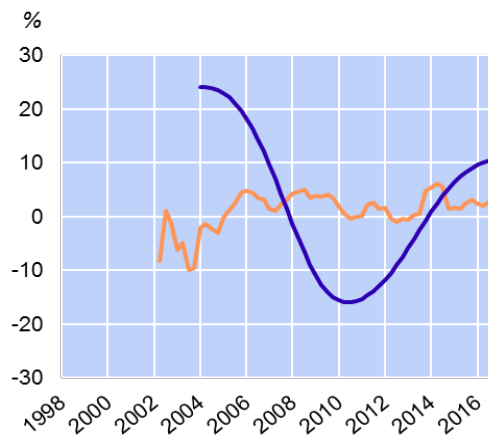
## Poland



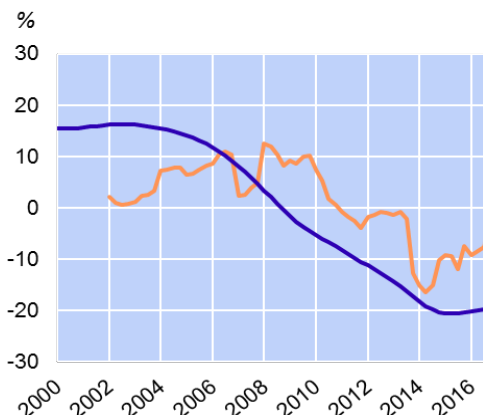
## Romania



## Slovakia



## Slovenia



— Total credit growth  
— Fundamental year-on-year growth rates