Financial cycle in the Bulgarian economy and its interaction with the business cycle

Tania Karamisheva, Gergana Markova,
Boyan Zahariev, Svilen Pachedzhiev

Bulgarian National Bank

CBBH International Research Conference:"Macroeconomic Imbalances and EU Convergence"

November 7, 2019, Sarajevo

The views expressed in this presentation represent the views of the authors and do not necessarily reflect the views of the Bulgarian National Bank.

Introduction

- This study proposes an estimate of the phases of the financial cycle in the Bulgarian economy using a variety of financial and macroeconomic indicators and investigates its interaction with the business cycle
- The financial cycle arises from the self-reinforcing interaction between the financial constraints of economic agents and the change in their risk perceptions and risk tolerance (Borio,2014)

Approaches for assessing the financial cycle in the literature

- The length of the financial cycle is within predefined ranges
  - HP filter
  - Band-pass filter
  - Turning point analysis
- No ex ante constraints are imposed on the length of the financial cycle
  - UCM
  - Wavelet analysis

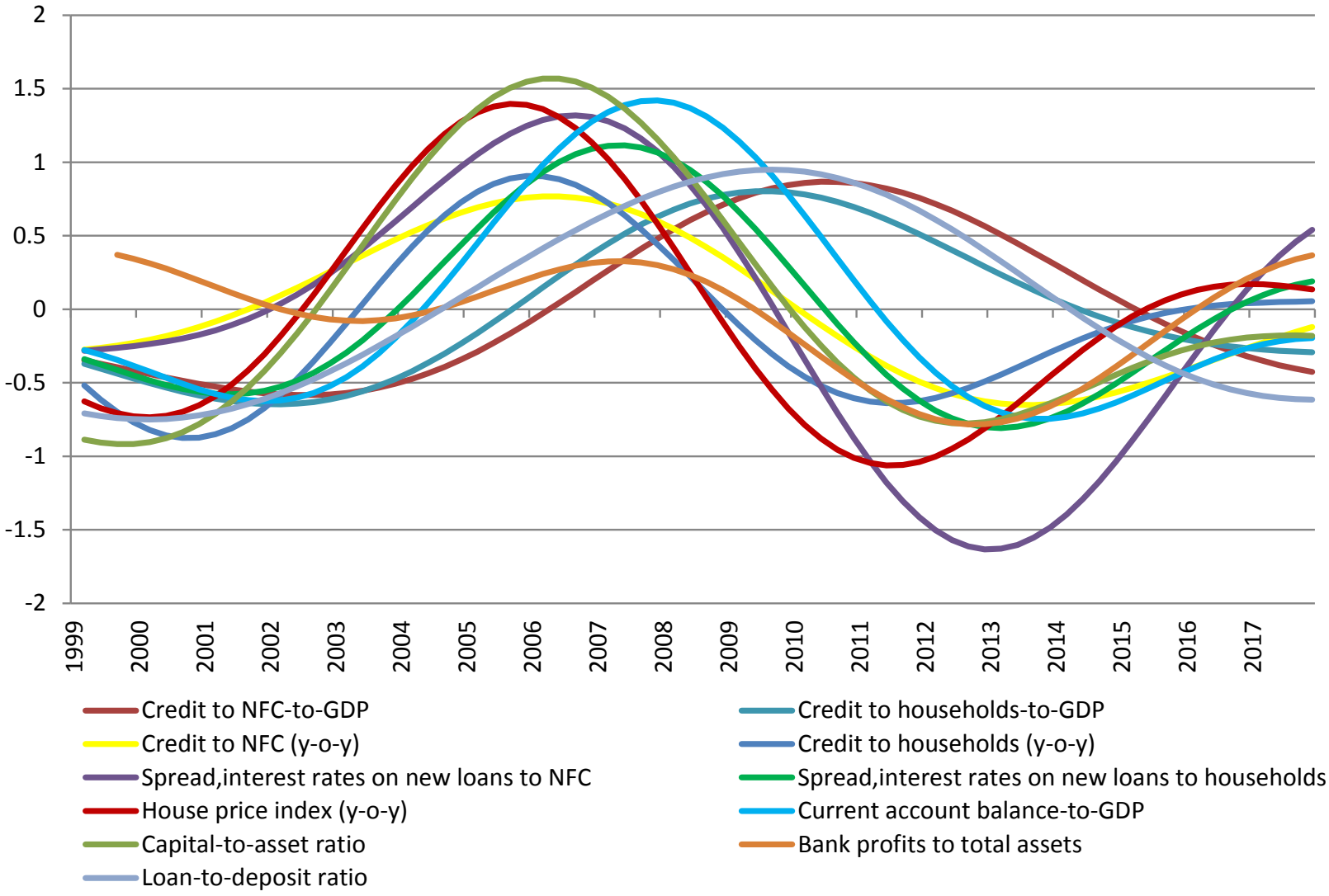
Methods applied for the assessment of the financial cycle in Bulgaria

- Band-pass filter and principal component analysis
- Structural unobserved components model
- Findings
  - The length of the financial cycle is estimated in the range of 11-12 years
  - The business cycle is found to exceed the generally assumed maximal length of 8 years
  - The financial cycle is to a large extent synchronized with the business cycle

Indicators used to obtain a measure of the financial cycle in Bulgaria

Groups of indicators	Indicators	Notation	Source
Measures of credit developments and private sector debt burden	Credit to NFC-to-GDP (domestic credit+external debt*)	CR_GDP_NFC	BNB: Monetary statistics, Gross external debt; NSI
	Credit to households-to-GDP	CR_GDP_H	BNB: Monetary statistics NSI
	Credit to NFC (annual growth rate)	CR_NFC_Y	BNB: Monetary statistics
	Credit to households (annual growth rate)	CR_H_Y	BNB: Monetary statistics
Measures of potential overvaluation of property prices	House price index (annual growth rate)	HPI_Y	NSI
Measures of external imbalances	Current account balance-to-GDP	CA_GDP	BNB: Balance of payments NSI
Interest rate spreads	Spread between interest rates on new loans to NFC and 3-Month EURIBOR	LIRC_EUR	BNB: Interest rate statistics; ECB
	Spread between interest rates on new loans to households and 3-Month EURIBOR	LIRH_EUR	BNB: Interest rate statistics; ECB
Measures of the strength of banks' balance sheets	Capital-to-asset ratio (leverage)	C_A	BNB: Banking supervision
	Bank profits to total assets	P_A	BNB: Banking supervision
	Loan-to-deposit ratio	L_D	BNB: Banking supervision

Cyclical movements of individual indicators



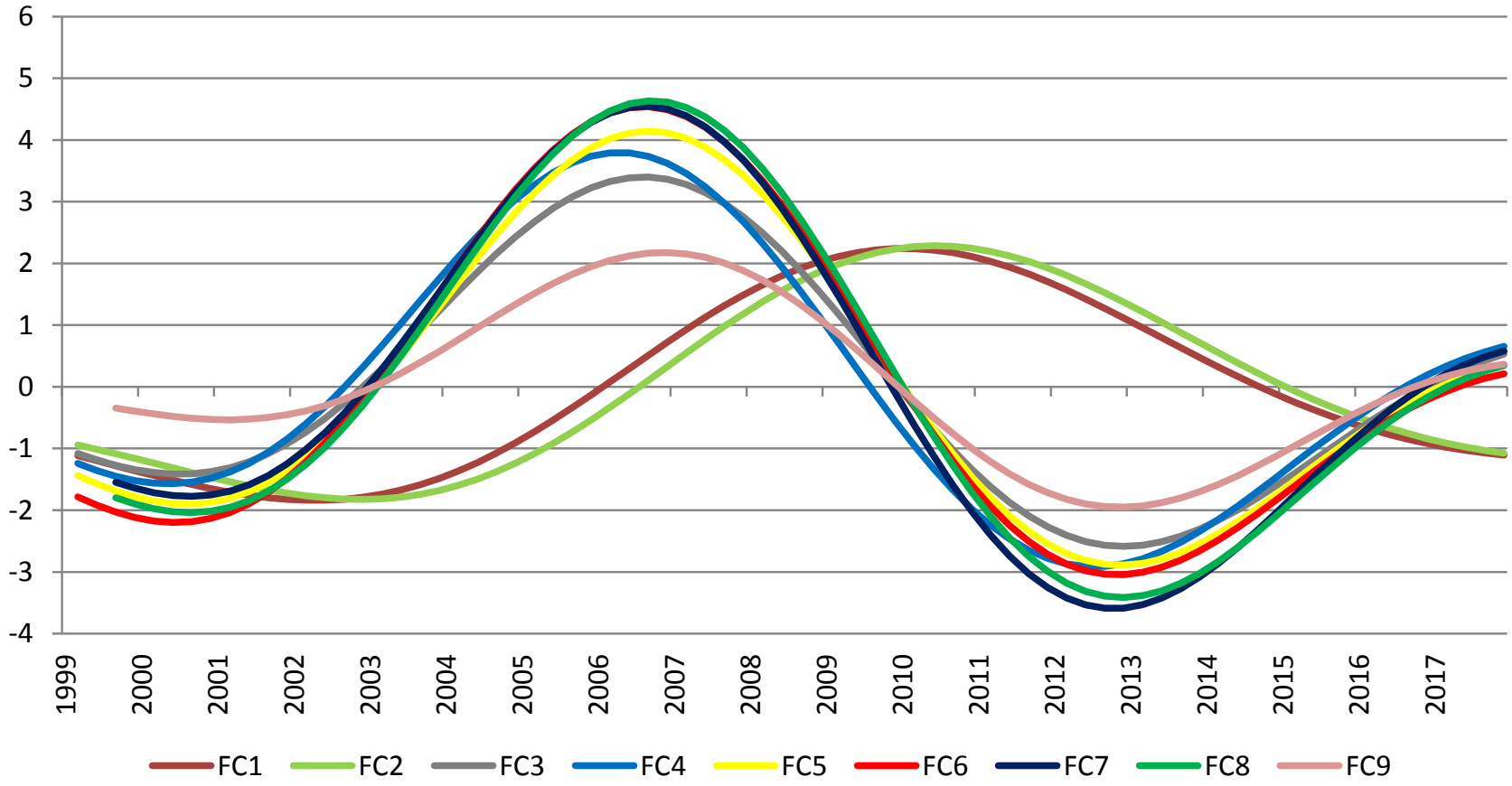
Potential measures of the financial cycle

	Financial cycle measure								
Bandpassed variables included (cyclical components)	**FC1**	**FC2**	**FC3**	**FC4**	**FC5**	**FC6**	**FC7**	**FC8**	**FC9**
CR_GDP_NFC	×	×	×	×	×	×	×	×	
CR_GDP_H	×	×	×	×	×	×	×	×	
CR_NFC_Y		×	×	×	×	×	×	×	
CR_H_Y		×	×	×	×	×	×	×	
LIRC_EUR			×	×	×	×	×	×	
LIRH_EUR			×	×	×	×	×	×	
HPI_Y				×	×	×	×	×	
CA_GDP					×	×	×	×	
C_A						×	×	×	×
P_A							×	×	×
L_D								×	×

Results of the principal component analysis

		FC1	FC2	FC3	FC4	FC5	FC6	FC7	FC8	FC9
	PCA1	**0.98**	**0.49**	**0.58**	**0.62**	**0.62**	**0.66**	**0.64**	**0.58**	**0.51**
Loadings	CR_GDP_NFC	0.71	0.71	-0.06	-0.11	-0.02	-0.01	-0.06	-0.03	
	CR_GDP_H	0.71	0.68	0.08	0.01	0.10	0.09	0.05	0.08	
	CR_NFC_Y		-0.15	0.51	0.45	0.42	0.38	0.37	0.37	
	CR_H_Y		-0.08	0.47	0.44	0.40	0.37	0.35	0.34	
	LIRC_EUR			0.51	0.46	0.42	0.38	0.38	0.37	
	LIRH_EUR			0.51	0.43	0.43	0.39	0.37	0.38	
	HPI_Y				0.45	0.39	0.36	0.35	0.34	
	CA_GDP					0.38	0.34	0.32	0.33	
	C_A						0.40	0.38	0.38	0.75
	P_A							0.28	0.27	0.64
	L_D								0.13	0.17

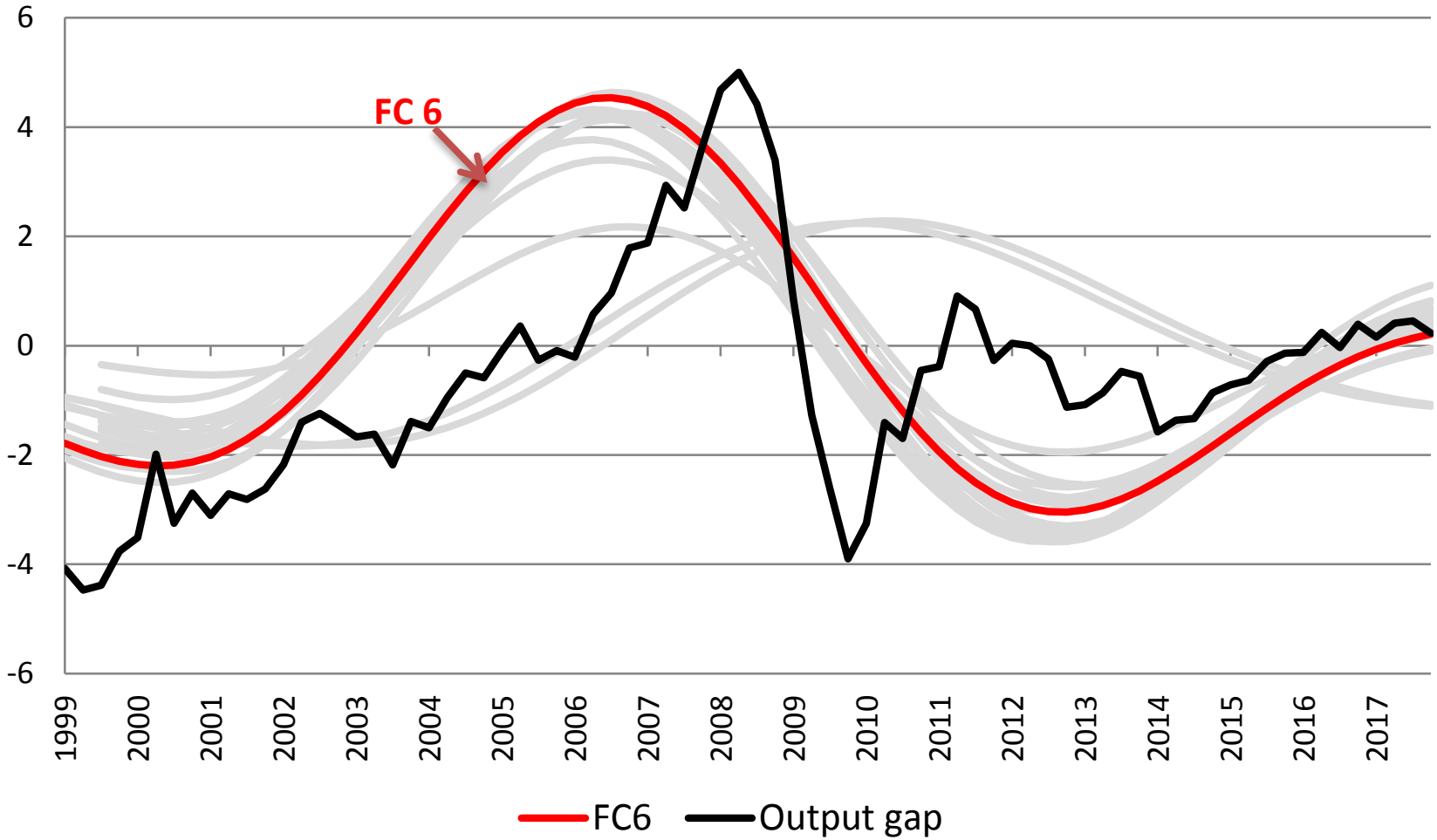
Potential measures of the financial cycle in Bulgaria



Concordance index

	Financial cycle measure								
Bandpassed variables included (cyclical components)	**FC1**	**FC2**	**FC3**	**FC4**	**FC5**	**FC6**	**FC7**	**FC8**	**FC9**
CR_GDP_NFC	×	×	×	×	×	×	×	×	
CR_GDP_H	×	×	×	×	×	×	×	×	
CR_NFC_Y		×	×	×	×	×	×	×	
CR_H_Y		×	×	×	×	×	×	×	
LIRC_EUR			×	×	×	×	×	×	
LIRH_EUR			×	×	×	×	×	×	
HPI_Y				×	×	×	×	×	
CA_GDP					×	×	×	×	
C_A						×	×	×	×
P_A							×	×	×
L_D								×	×
Concordance Index	**97%**	**64%**	**74%**	**73%**	**76%**	**78%**	**78%**	**76%**	**74%**

Output gap, financial cycle measure FC6 and alternatives



Concordance between the potential measures of the financial cycle and the output gap

Financial cycle measure	Concordance with the output gap
FC1	43%
FC2	44%
FC3	59%
FC4	53%
FC5	60%
FC6	59%
FC7	59%
FC8	60%
FC9	61%

Peaks and troughs of the business cycle and the potential measures of the financial cycle

	Output gap	FC1	FC2	FC3	FC4	FC5	FC6	FC7	FC8	FC9
1999-2007										
Trough (MIN)	-4.47	-1.84	-1.82	-1.41	-1.57	-1.90	-2.20	-1.78	-2.04	-0.53
Timing	1999 Q2	2002 Q1	2002 Q4	2000 Q2	2000 Q2	2000 Q3	2000 Q2	2000 Q3	2000 Q3	2001 Q1
2008-2017										
Trough (MIN)	-3.90	-1.11	-1.08	-2.59	-2.91	-2.89	-3.04	-3.59	-3.41	-1.95
Timing	2009 Q4	2017 Q4	2017 Q4	2012 Q4	2012 Q2	2012 Q4	2012 Q4	2012 Q4	2012 Q4	2012 Q4
1999-2017										
Peak (MAX)	5.00	2.24	2.29	3.40	3.79	4.14	4.54	4.55	4.63	2.18
Timing	2008 Q2	2009 Q4	2010 Q2	2006 Q3	2006 Q1	2006 Q3	2006 Q3	2006 Q3	2006 Q3	2006 Q4

Univariate UCM

- Originally proposed by Harvey1989
- The observable series is decomposed into a stochastic trend (τ_t), a stochastic cycle component (ψ_t), and a white noise term (ϵ_t)

$$y_t = \tau_t + \psi_t + \epsilon_t, \qquad \epsilon_t \sim NID(0, \sigma_\epsilon^2) \tag{1}$$

- The stochastic trend component is assumed to follow the flexible local linear trend specification

$$\tau_{t+1} = \tau_t + \beta_t + \xi_t, \qquad \xi_t \sim NID(0, \sigma_\xi^2) \tag{2}$$

$$\beta_{t+1} = \beta_t + \zeta_t, \qquad \zeta_t \sim NID(0, \sigma_\zeta^2) \tag{3}$$

- The cyclical component ψ_t is defined as a bivariate AR(1) process:

$$(1-\phi L)\left(I_2 - \rho \begin{bmatrix} cos\lambda & sin\lambda \\ -sin\lambda & cos\lambda \end{bmatrix} L\right) \begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \begin{bmatrix} \kappa_t \\ \kappa_t^* \end{bmatrix}, \begin{bmatrix} \kappa_t \\ \kappa_t^* \end{bmatrix} \sim NID\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_\kappa^2 & 0 \\ 0 & \sigma_\kappa^2 \end{bmatrix} \right) \tag{4}$$

Multivariate UCM

- Model structure similar to the univariate one (following the approach in Runslter and Vlekke, 2016):

$$\boldsymbol{y_t} = \boldsymbol{\tau_t} + \boldsymbol{x_t^C} + \boldsymbol{\epsilon_t}, \qquad \boldsymbol{\epsilon_t} \sim NID(0, \sigma_\epsilon^2) \tag{5}$$

- All trend components are modelled within a *local linear trend* framework
- Each cyclical component is modelled as a linear combination of the stochastic cycles of the cyclical components of all series:

$$x_t^C = [A, A^*] \begin{bmatrix} \boldsymbol{\psi_t} \\ \boldsymbol{\psi_t^*} \end{bmatrix} \tag{6}$$

Estimation of the model

- Estimation is **Maximum Likelihood** based and employs the **Kalman filter**
- Data ranges from 2000Q1 to 2017Q4
- Observable variables entering the model are real GDP, real house prices, and real credit
- Similar cycle restrictions imposed on the stochastic cycles of the real credit and real HPI series

Main Parameters Estimate

	Univariate Estimate		Multivariate Estimate		
	Cyclical Component		Cyclical Component	Stochastic Cycle	
	length (in years)		length (in years)		length (in years)
Real GDP	4		11	*SC I*	4.47
Credit	5		10	*SC II*	14.79
House Prices	14		11		
	Standard Deviation		**Standard Deviation**		
	Cyclical Component	**Slope (error term)**	**Cyclical Component**		**Slope (error term)**
Real GDP	0.3	0.1	1.5		0.03
Credit	2.0	0.4	4.7		0.2
House Prices	9.6	0.3	9.1		0.2

Phase Shifts and Coherence

		Phase (years)		
		GDP	Credit	House Prices
Coherence (average)	GDP		0.691	0.676
	Credit	0.634		-0.198
	House Prices	0.949	0.826	

The upper-right half of the table shows by how much each series leads the others in years. It should be noted that if the value is positive, *series row* leads *series column*, whereas if the value is negative, then *series column* leads *series row*. The bottom-left half of the table shows the coherence of each set of series on average for the whole estimation period.

Multivariate Estimate Series Decomposition

Figure: Real GDP Multivariate Decomposition

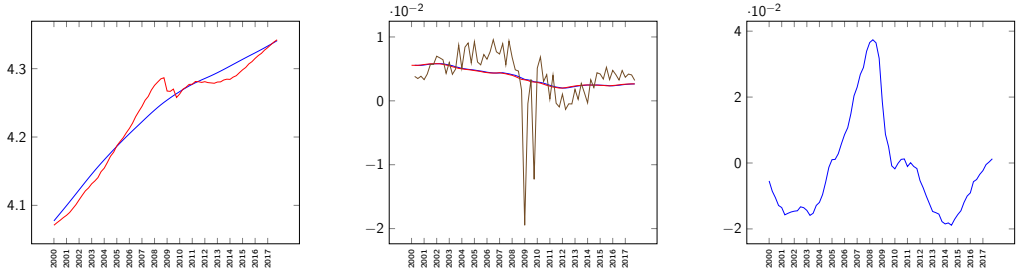


Figure: Real Credit Multivariate Decomposition

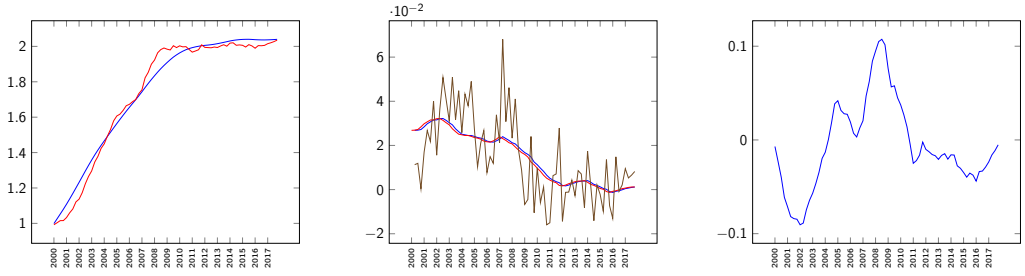
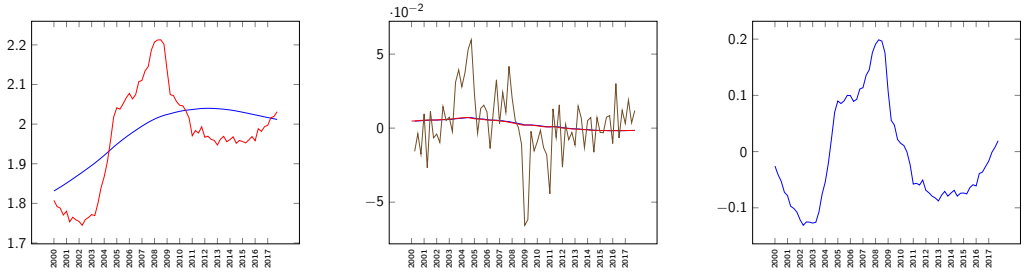


Figure: Real House Prices Multivariate Decomposition



Conclusion

- According to both approaches the length of the financial cycle is estimated in the range of 11-12 years
- The business cycle is found to exceed the generally assumed maximal length of 8 years
- The financial cycle is to a large extent synchronized with the business cycle
- In 2017 the Bulgarian economy is entering an initial phase of cyclical risk accumulation