



**NATIONAL BANK OF UKRAINE**

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## **Research activities at the NBU**

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Sergiy Nikolaychuk

Director of Monetary Policy and Economic Analysis Department

National Bank of Ukraine

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University of Bergen

Bergen, 24 August 2017



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## Outline of Research activities at the NBU

- Research Unit is founded in 2015
- Reformatting the “Visnyk of the NBU” according to the requirements of international citation databases
- Launched the Working Paper Series of the NBU
- 15 open research seminars (including 7 seminars in 2017)
- Annual Research Conference:
  - “Transformation of Central Banking” organized in cooperation with Narodowy Bank Polski (19-20 May 2016)
  - “The Role of the Central Bank in Economic Development” organized in cooperation with Narodowy Bank Polski (18-19 May 2017)
- The conference for students and young researchers «Banking sector and monetary policy: the prospects for development» (21 April 2017)
- Launched Internship Program at the Research Unit
- Enhanced international cooperation with Riksbank, BOFIT, NBP and foreign academics
  - Visiting Scholar Program (2 participants in 2017)
  - Secondment from Swedish Riksbank (1 participant in 2017)



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## Research Unit staff

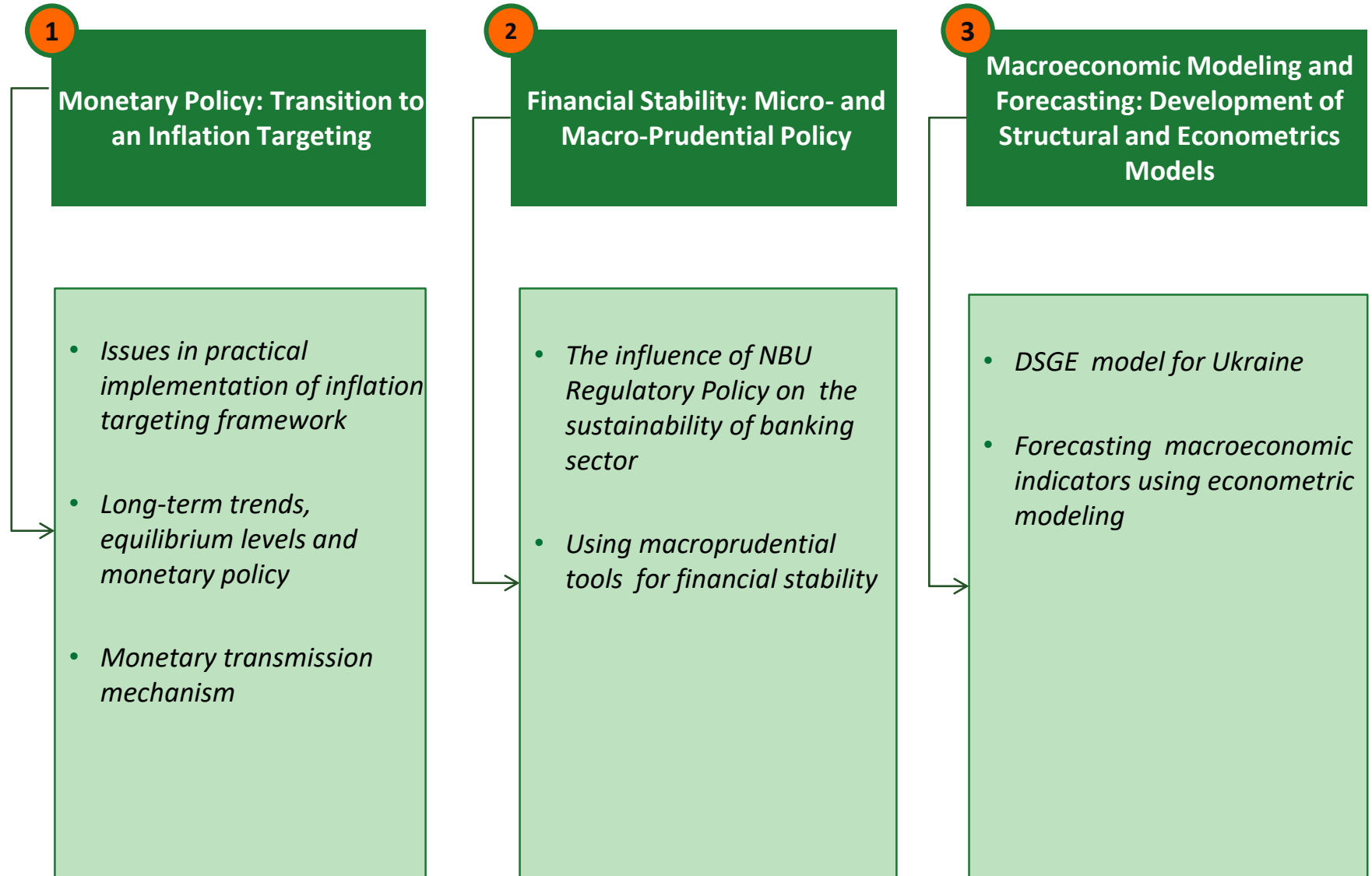
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- Andriy Tsapin, Deputy Head of Unit, PhD
  - Research Interests: Corporate finance, emerging markets
  
- Roman Lysenko, Senior Economist, PhD
  - Research Interests: Monetary policy, macroeconomic forecasting and modeling, financial stability
  
- Oleksandr Faryna, Senior Economist, PhD
  - Research Interests: Macroeconomics, macroeconomic modeling, monetary economics, international economics, econometrics
  
- Artem Vdovychenko, Senior Economist, PhD
  - Research Interests: Macroeconomics; Forecasting and modeling; Econometrics; Monetary and fiscal policy
  
- Roman Pidvysotskyi, Senior Economist
  - Administrative work



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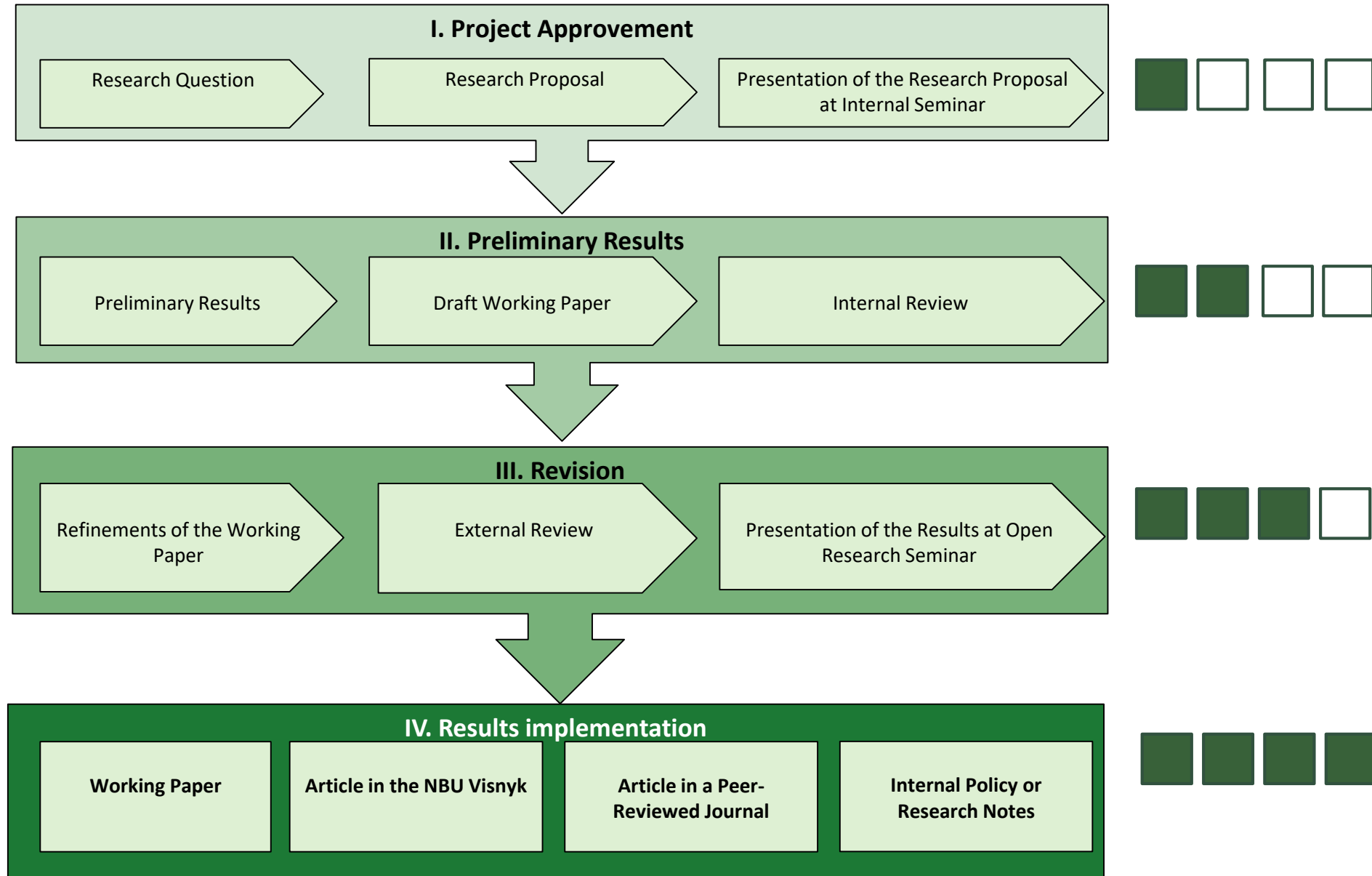
# Research Priorities of the NBU (2017-2019)





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# “Life Cycle” of a Research Project: Key Stages





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# Research Projects of the NBU (1)

No	Topic	Author	Status	Comments
<b>Monetary Policy: transition to an Inflation Targeting</b>				
1	The Transmission of International Shocks to CIS Economies: A Global VAR Approach	Faryna (NBU) Simola (BOFIT)		Working paper to be submitted
2	Switching from Exchange Rate Peg towards Inflation Targeting in Ukraine	Faryna (NBU) Shapovalenko (NBU)		Interim report to be prepared
3	Studying Exchange Rate Pass-Through to Domestic Prices Using Web Scraping Tools	Talavera (Swansea University) Faryna (NBU) Yukhymenko (NBU)		Extended proposal to be submitted
4	Determinants of Capital Flows to Ukraine	Volosovych (Erasmus University Rotterdam) Nikolaychuk (NBU)		Extended proposal to be submitted
5	Nonlinear estimation of fiscal multiplier in Ukraine	Vdovychenko (NBU)		Interim report to be prepared
6	Fiscal impulse estimation basing on Ukrainian data	Khakhuda, Vdovychenko (NBU)		Interim report to be prepared
7	The evaluation of the equilibrium interest rate for Ukraine	Grui, Lepushynskyy, Nikolaychuk (NBU)		Interim report to be prepared
8	Real financial conditions index	Kozyuk, Nikolaychuk, Khvedchuk (NBU)		Interim report to be revised
9	The evaluation of core inflation indicators	Skok (NBU)		Interim report to be revised



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## Research Projects of the NBU (2)

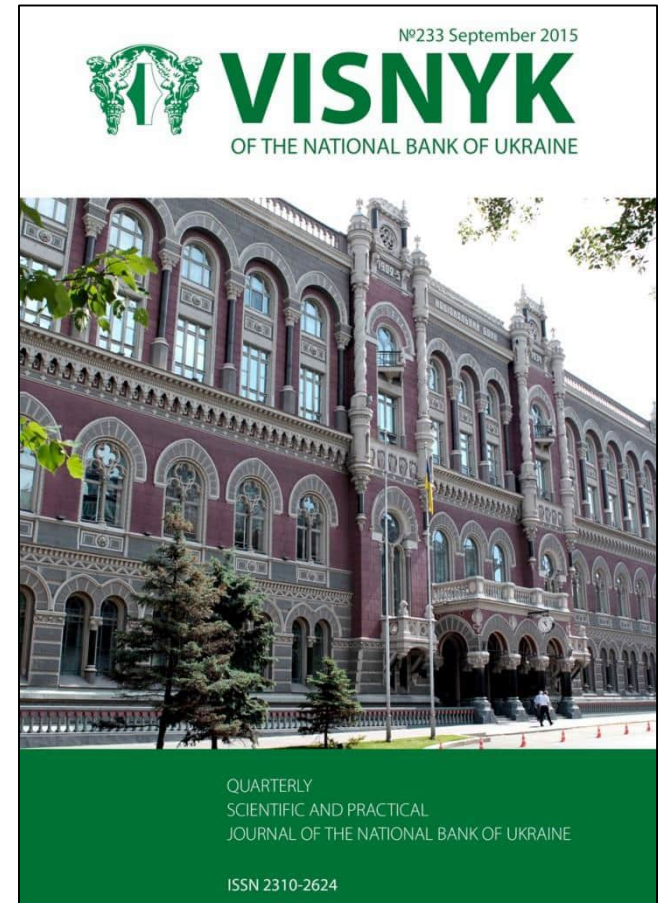
No	Topic	Author	Status	Comments
<b>Macroeconomic modeling and forecasting: development of structural and econometrics models</b>				
1	Short-term forecasting of economic activity in Ukraine using business survey data	Kolesnichenko, Lysenko (NBU)		Draft WP to be internally reviewed
2	Forecasting Economic Activity with Dynamic Factor Models	Grui, Lysenko (NBU)		Research proposal presented at internal seminar (14.12.2016) Proposal to be revised
3	Nowcasting Inflation with Online Price Data	Talavera (Swansea University) Faryna (NBU) Yukhymenko (NBU)		Extended proposal to be submitted
4	Nowcasting GDP growth using business survey data in CIS countries	Lysenko (NBU)		Presentation at internal seminar of BOFIT (15.11.2016) Proposal to be revised
<b>Financial stability: micro- and macro-prudential policy</b>				
1	Corporate Cash Holdings and Trade Credit: Does Price (In)Stability Matter?	Tsapin (NBU)		Under external review
2	Shock propagation through banking networks	Volosovych (Erasmus University Rotterdam) Tsapin (NBU)		Extended proposal to be submitted
3	The Effects of Product Diversification on Bank Performance	Talavera (Swansea University) Tsapin (NBU)		Extended proposal to be submitted



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## Visnyk of the NBU

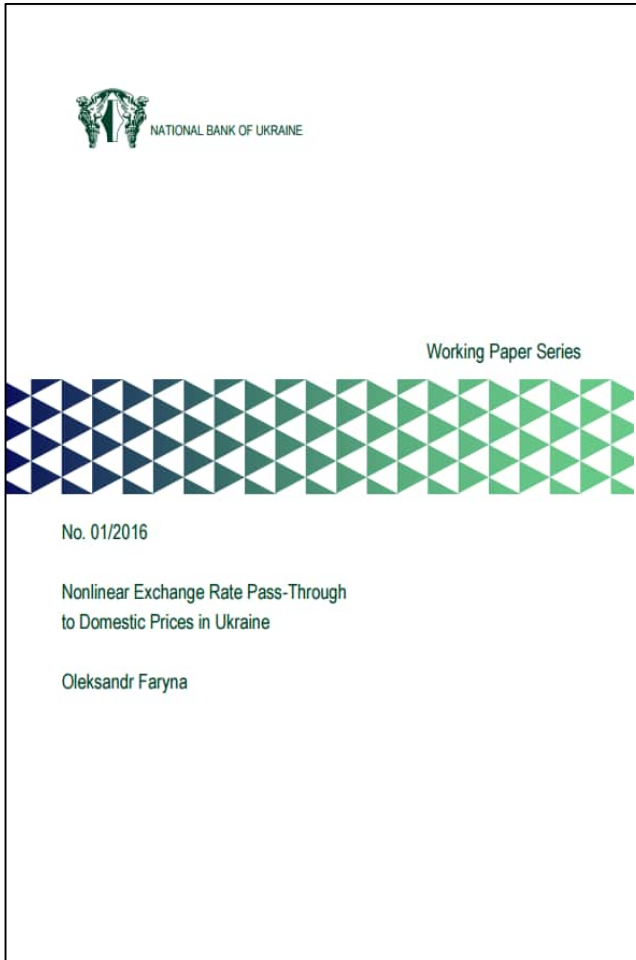
- The Journal “Visnyk of the National Bank of Ukraine” is a quarterly journal of the central bank, in which staff members of the National Bank and outside experts and researchers publish original research articles
- Our authors and reviewers are international experts and academics from the USA, Canada, EU, Ukraine.
- **Priority thematic areas** of the articles:
  - monetary policy
  - financial stability
  - macroeconomic modeling and forecasting
  - other issues from the scope of the NBU
- **Nearest plans:**  
to be indexed by Web of Science and Scopus





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## NBU Working Paper Series



### ■ **Published Working Paper:**

- Faryna (2016) Nonlinear Exchange Rate Pass-Through to Domestic Prices in Ukraine
- Coibion, Gorodnichenko & Ulate (2017) Secular Stagnation: Policy Options and the Cyclical Sensitivity in Estimates of Potential Output

### ■ **Forthcoming Working Papers:**

- Lysenko, Kolesnichenko (2017) Short-term forecasting of economic activity in Ukraine using business survey data
- Tsapin (2017) Corporate Cash Holdings and Trade Credit: Does Price (In)Stability Matter?
- Faryna, Simola (2017) The Transmission of International Shocks to CIS Economies: A Global VAR Approach



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## Other Papers Published

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### Published

- Faryna O. (2016). Exchange rate pass-through and cross-country spillovers: Some evidence from Ukraine and Russia. BOFIT Discussion Paper, No. 14/2016.

### Forthcoming

- Tsapin A., Tsapin O. Corporate Investment and Bank Financing: Evidence from Recent Financial Crisis. Revise-Resubmit (CJEF)
- Lysenko R. Nowcasting of the GDP growth using business survey data in CIS countries. BOFIT Discussion Paper



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## Open Research Seminars in 2017

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- Tor Jacobson (Sveriges Riksbank), 27/01 Curbing Shocks to Corporate Liquidity: The Role of Trade Credit
- Volodymyr Vakhitov (Kyiv School of Economics), 3/02 Non-tariff Measures, Exporting, and Productivity: Evidence from Microdata in Food Processing Industry
- Vadym Volosovych (Erasmus University Rotterdam), 10/02 Foreign Investment and Domestic Productivity: Identifying Knowledge Spillovers and Competition Effects
- Fabio Rumler (Oesterreichische Nationalbank), 17/02 Inflation Literacy and Inflation Expectations
- Philipp Engler (DIW-Berlin), 11/04 Fiscal Policy in Recession
- Laurence Ball (Johns Hopkins University), 17/05 Understanding Inflation in India
- Oleksandr Talavera (Swansea University), 20/07 Managing the Diversity: Board Age Diversity, Directors' Personal Values, and Bank Performance
- Inessa Love (University of Hawaii at Manoa), 8/08 The Use of Panel Vector Autoregression (VAR) Models in Applied Research



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## Research and Students Conferences

### Annual research conferences:

- 19-20 May 2016, the First Annual Research Conference of the National Bank of Ukraine “Transformation of Central Banking” organized in cooperation with Narodowy Bank Polski  
*Keynote lecture by Maurice Obstfeld (IMF) and Philipp Hildebrand (BlackRock)*
- 18-19 May 2017, 2nd Annual National Bank of Ukraine Conference “The Role of the Central Bank in Economic Development” organized by the National Bank of Ukraine in cooperation with Narodowy Bank Polski  
*Keynote lecture by John Taylor (Stanford University)*

**Conferences for students and young researchers**, who study micro- and macroeconomic aspects of the banking sector and monetary policy





The topics discussed:

- macroeconomic aspects of monetary policy
- problems of choosing monetary policy instruments
- macro- and microeconomic study of the monetary sector
- effective regulation of the banking sector
- bank lending and economic development
- other issues



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# Research internship program at the NBU: Key features

Goal	Participants	Duration	Expected Results
 <ul style="list-style-type: none"><li>• to encourage high quality research projects in the areas the central bank is interested in</li><li>• to attract young researchers to practical activity of the NBU</li></ul> <p><b>• Researchers gain new knowledge, practical skills, and contribute to decision-making process at the NBU</b></p>	 <ul style="list-style-type: none"><li>• MA students</li><li>• PhD students</li><li>• Post-doc students</li></ul> <p><b>• Obtained experience enables enhancing the empirical contribution of investigations</b></p>	 <ul style="list-style-type: none"><li>• Up to 3 months</li></ul> <p><b>• Optimal duration for active research work</b></p>	 <ul style="list-style-type: none"><li>• Presentations at internal and open research seminars</li><li>• Publications in the “Visnyk of the National Bank of Ukraine”</li></ul> <p><b>• Joint research projects with NBU staff are welcome</b></p>



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## Secondment

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- **From Riksbank**
  - **Magnus Jonsson**
  - Time: September 2017 – February 2018
  - Financing: SIDA
  - Scope of work:
    - Organizational support (25% of working time)
    - Participation in joint research projects (75% of working time)
      - DSGE model for monetary policy analysis
      - DSGE model for financial stability issues
  
- **From ECB and Bank of England**
  - Preliminary agreement is reached but financing is under negotiation
  
- **From Central Bank of Austria**
  - Scheduled for 2018



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# Visiting Scholar Program in the NBU

## Who?

- prominent researchers with an established reputation in fields relevant to NBU (from academia, research institutions, and other central banks)

## What is expected from visitors

- conducting research on prespecified topics and disseminating the results publicly
- advising NBU research staff on their ongoing projects
- discussing policy issues with NBU management

## Timing and Duration

Visiting Scholars may start at any time during the year.

Various visiting schedules, e.g.:

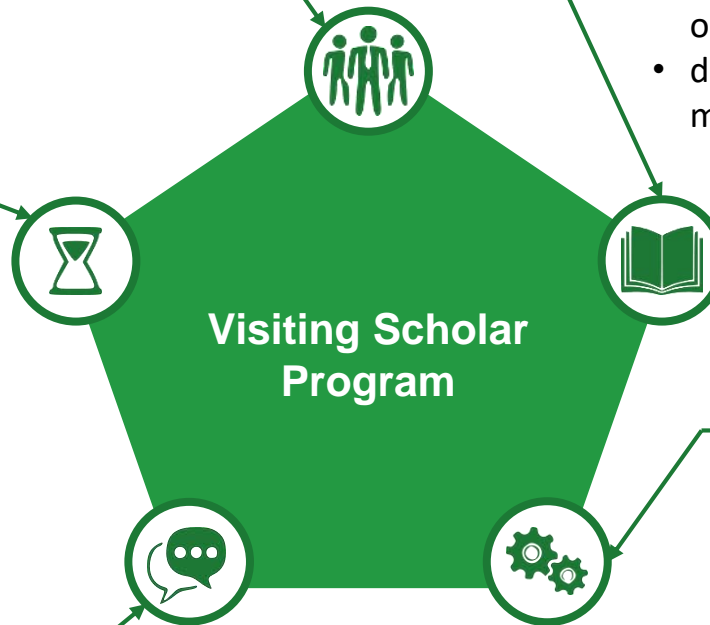
- one research visit run for one to four weeks
- few short-term visits (up to one week)

## Procedure

- by invitation based on proposal from NBU staff
- applications are also considered

## What the NBU offers

- stimulating research environment in close proximity to policymaking process
- reimbursement of travel and accommodation costs, per diem allowance
- other administrative support





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## Visiting Scholar Program: Current projects

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- **Oleksandr Talavera (Swansea University)**

- Projects:
  - Studying Exchange Rate Pass-Through to Domestic Prices Using Web Scraping Tools
  - The Effects of Product Diversification on Bank Performance
- Duration: July 2017 – June 2018
- Financing: IMF-Canada project

- **Vadym Volosovych (Erasmus University Rotterdam)**

- Projects:
  - Trends in the external capital flows of Ukraine
  - Shock propagation through banking networks
- Duration: July 2017 – June 2018
- Financing: IMF-Canada project



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## Selected Research Projects

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1. CPI Nowcasting: Web Scraping
2. Estimating Exchange Rate Pass-Through Using Micro Price Data
3. Short-term Forecasting of Economic Activity in Ukraine Using Business Survey Data
4. Forecasting Economic Activity with Dynamic Factor Models
5. Assessing Financial Conditions
6. Fiscal Impulse Estimation
7. Forecasting with DSGE



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# CPI Nowcasting: Web Scraping (1)

Extracting prices data out of HTML web pages using Python programming language



Converting data into csv and processing using SQL



Calculating price indices for selected products and headline CPI

## Data Sources

Online supermarkets



Zakaz.ua



Analytical websites



ТЕРМИНАЛ Нефтяное обозрение

## Tool



## Product coverage

### FMCG:

- Fruits, vegetables and mushrooms
- Meat (beef, pork, chicken)
- Dairy products and eggs
- Alcoholic drinks and tobacco
- Household goods

### Fuels

## Geography

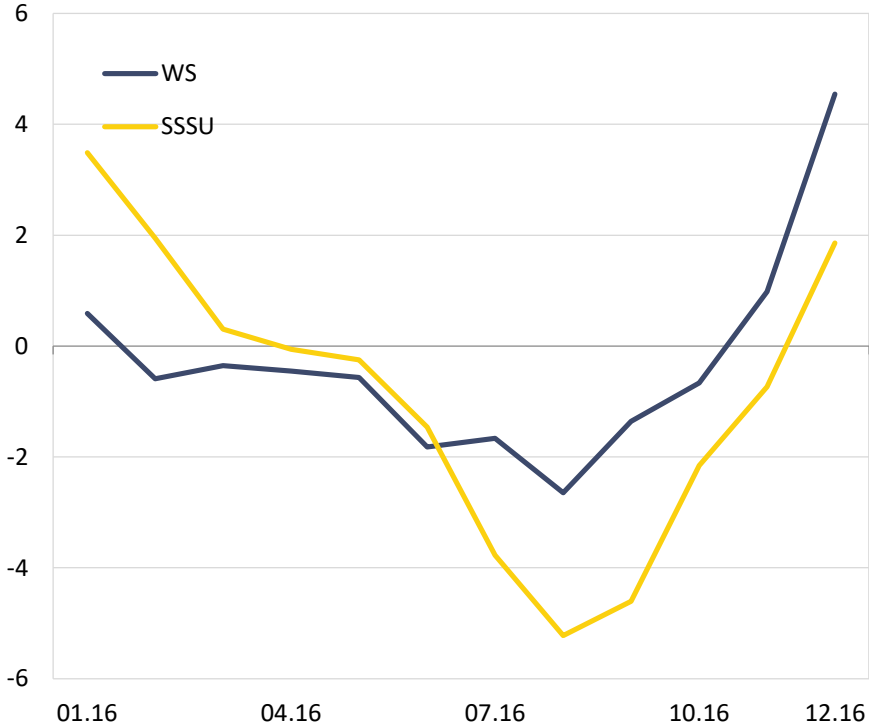




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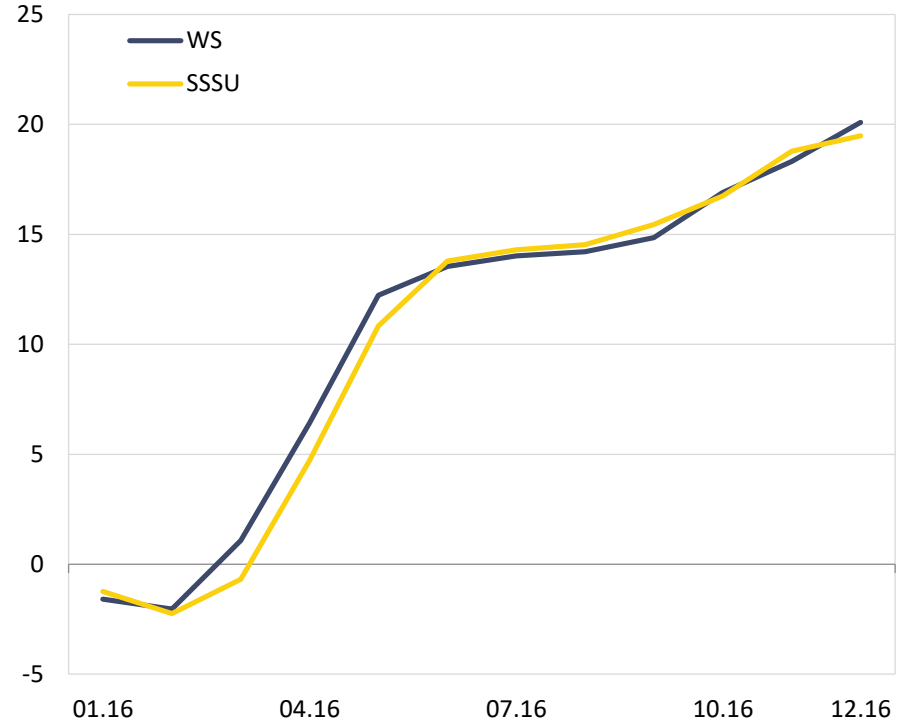
# CPI Nowcasting: Web Scraping (1)

### Raw Food Prices, % ytd



Source: SSSU; NBU staff estimates.

### Fuel Food Prices, % ytd



Source: SSSU; NBU staff estimates.

Changes in prices for most consumer goods by WS overall confirm data published with some time lag by SSSU



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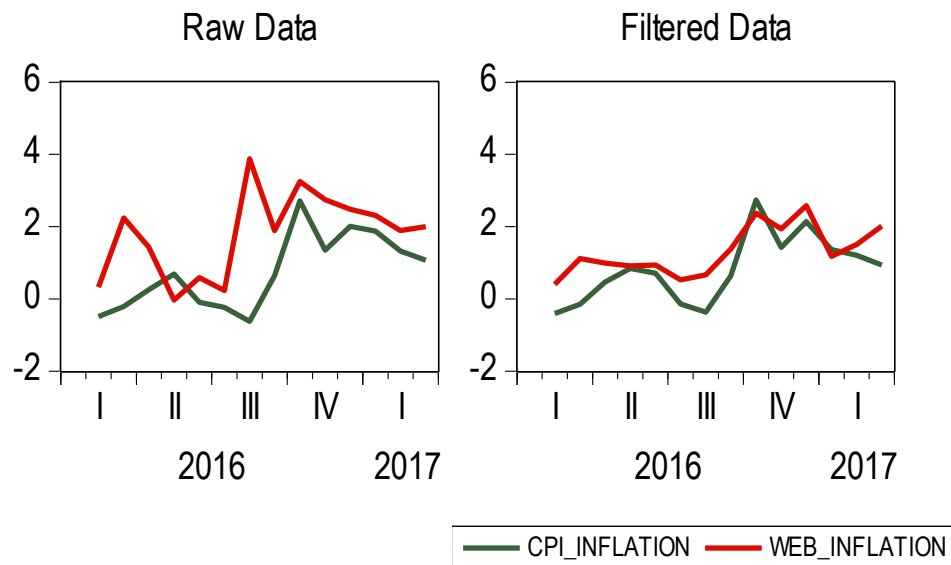
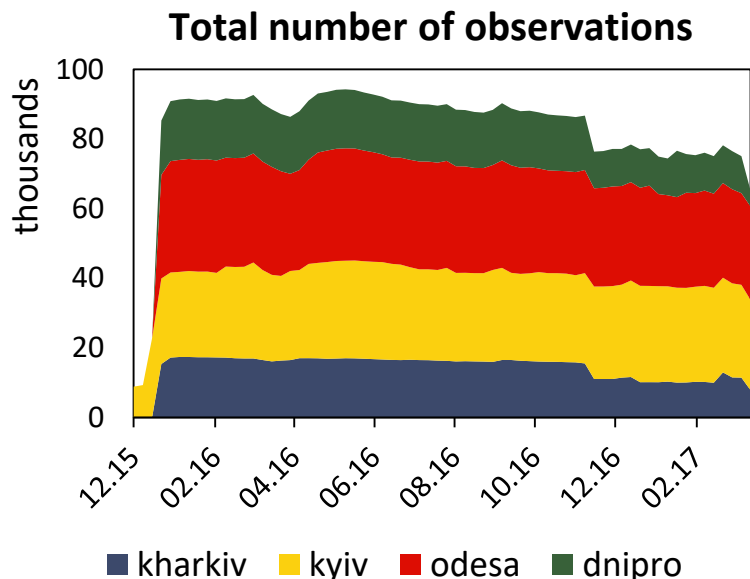
## Estimating Exchange Rate Pass-Through Using Micro Price Data (2)

### ■ Online prices for FMCG products:

- 5 online FMCG stores from 4 regions
- Product type and trademark identifiers
- Country of origin identifier
- 68 weeks of observations
- Up to 130 k of time series
- Up to 5.5 m of observations

### ■ CPI Dataset:

- Reduced time span – 65 weeks
- CPI components only
- Filtering:
  - Min 20 obs. in time series
  - Min 10 time series in group
  - Excluded upper 5% quintile of max jumps and standard deviations of inflation across each group
- Filtered dataset:
  - Number of time series  $\approx$  58k
  - Share of CPI  $\approx$  45%
  - Correlation with official data – 0.73





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# Estimating Exchange Rate Pass-Through Using Micro Price Data (2)

## Filtered Web CPI Data: Descriptive Summary

Consumer Price Index		RAW DATA			FILTERED DATA					
		Weight	# ts, k	# obs, k	weight, %	Number of time series, k			CPI weight, %	
CPI group name	Total					Domestic	Imported	Total	Domestic	Imported
Food & non-alcoholic beverages	41.8	45.8	2003	39.7	33.2	25.0	8.2	33.3	31.0	2.4
Bread and Cereals	7.84	8.1	360	7.7	6.0	4.8	1.2	7.7	7.3	0.4
Meat	9.27	3.2	135	8.3	2.2	1.9	0.3	6.6	6.5	0.1
Fish	2.68	3.3	146	2.4	2.4	1.9	0.4	2.3	1.7	0.6
Milk, Cheese and Eggs	5.56	6.1	252	5.4	4.3	3.4	0.9	5.3	5.2	0.1
Oils and Fats	4.28	1.1	53	4.1	0.9	0.5	0.4	3.2	3.2	0.0
Fruit	2.7	0.5	18	2.4	0.3	0.3	0.0	0.4	0.4	0.0
Vegetables	3.29	2.7	128	3.1	2.0	1.4	0.6	1.8	1.8	0.1
Sugar	3.51	7.4	285	3.5	5.0	3.8	1.2	3.5	3.2	0.3
Food Products (other)	1.12	4.2	201	1.1	3.2	2.3	0.9	1.0	0.9	0.1
Non-alcoholic beverages	1.55	9.1	425	1.6	6.9	4.7	2.2	1.6	1.0	0.6
Alcohol & tobacco	7.9	11.5	536	7.6	8.4	3.9	4.5	7.2	6.0	1.2
Clothing & footwear	5.4	0.9	34	1.0	0.5	0.2	0.4	0.4	0.0	0.4
Housing, water, electricity, & fuels	7.5	-	-	-	-	-	-	-	-	-
Furniture & household goods	4.74	6.3	273	2.3	4.6	1.8	2.8	1.5	0.6	0.9
Health	6.66	-	-	-	-	-	-	-	-	-
Transport	12.12	-	-	-	-	-	-	-	-	-
Communication	3.17	-	-	-	-	-	-	-	-	-
Recreation & culture	3.2	6.2	213	1.2	3.9	1.8	2.1	1.0	0.4	0.6
Education	1.59	-	-	-	-	-	-	-	-	-
Restaurants & hotels	2.21	-	-	-	-	-	-	-	-	-
Miscellaneous goods & services	3.72	9.5	413	1.8	7.3	1.4	5.8	1.7	0.3	1.4
<b>CPI TOTAL</b>	<b>100</b>	<b>80.2</b>	<b>3473</b>	<b>53.6</b>	<b>57.9</b>	<b>34.1</b>	<b>23.8</b>	<b>45.2</b>	<b>38.2</b>	<b>7.0</b>



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## Estimating Exchange Rate Pass-Through using Micro Price Data: Empirical Approach and Preliminary Results (2)

- Separate pooled OLS equations for specific types of products:

$$\Delta_4 cpi_{i,t} = \sum_{n=0}^K b_{i,n} \Delta_4 e_{t-4n} + \varepsilon_{i,t},$$

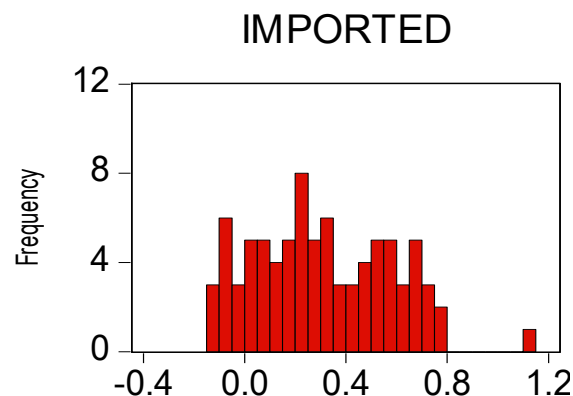
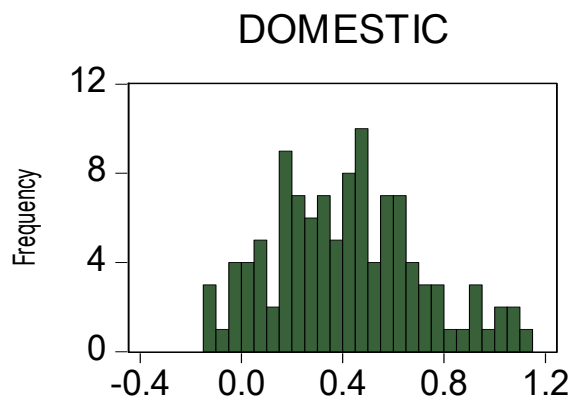
$$ERPT_{joint} = \sum_{i=1}^N \left( w_i \sum_{n=0}^K b_{i,n} \right)$$

- where

- $i=1,2,\dots,N$  – identifies specific product  $i$  (separately imported and domestic)
- $\Delta_4 cpi$  – 4-week change in price of product  $i$ , in logs
- $n=1,2,\dots,K$  – identifies the number of FX coefficients (based on AIC for each product type)
- $\Delta_4 e$  – 4-week change in bilateral US dollar exchange rate, in logs
- $b_{i,n}$  – exchange rate coefficients
- $w_i$  - weights of each product  $i$  in CPI basket

- **Preliminary results:**

- Joint ERPT – **0.41**
- Distribution of estimated ERPT coefficients:





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## Data for Forecasting Economic Activity: Business Survey Expectations (3)

### Business survey expectations (BSE)

- Balance of answers for about 700 Ukrainian firms
- Period: since 1<sup>st</sup> quarter 2006
- Data frequency: quarterly

#### ■ *Main items:*

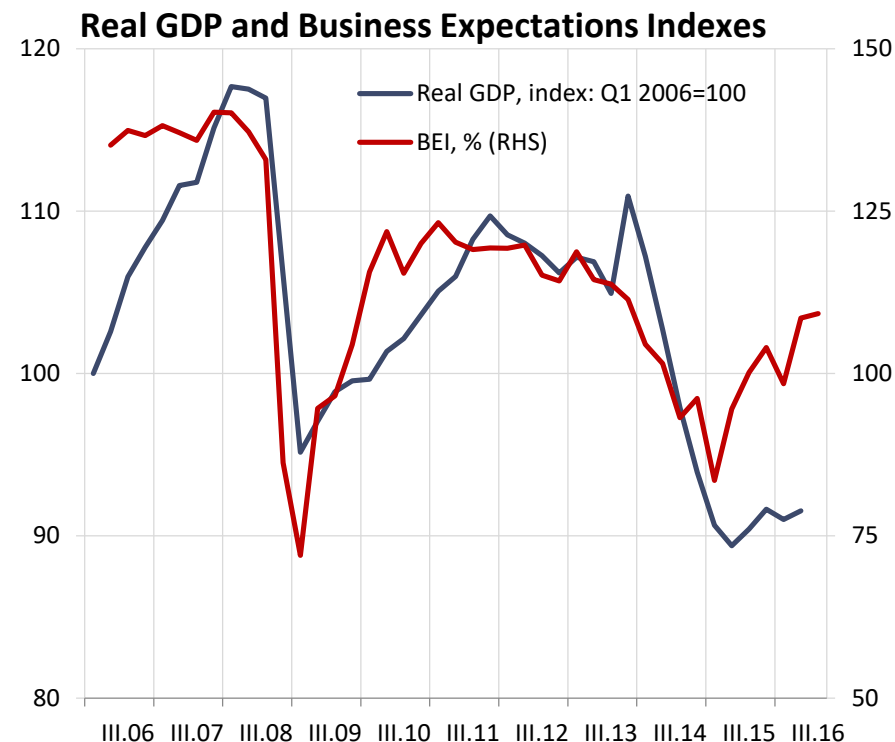
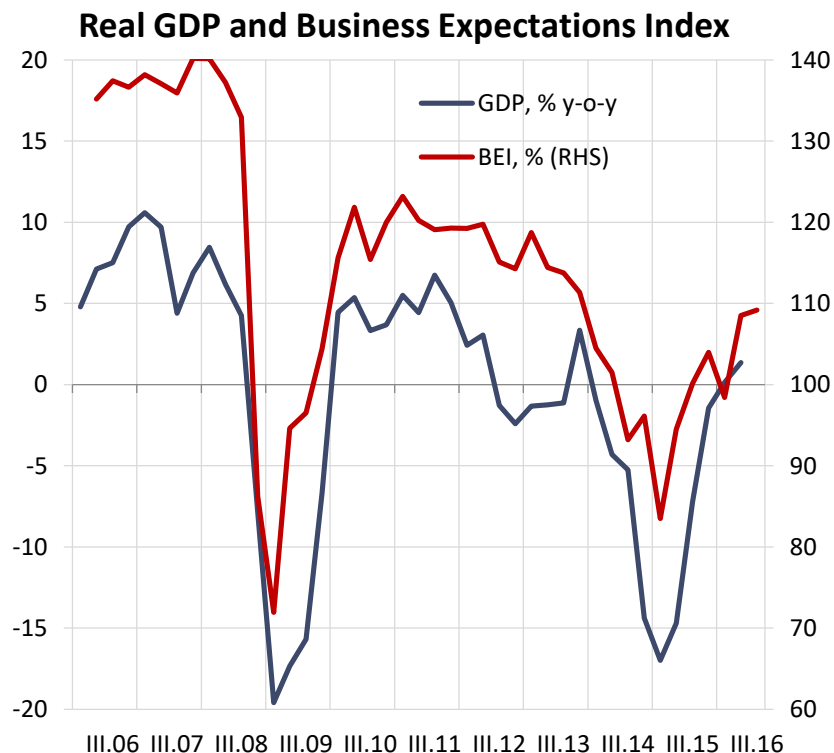
- Assessment of Current Financial and Economic Conditions of Business
- Assessment of Current Stocks of Finished Goods
- Assessment of Current Ability to Meet an Unexpected Demand Increase
- Expectations of Foreign Investment for the next 12 months (versus the previous 12 months)
- Expectations of External Sales for the next 12 months
- Expectations of Unit Costs for the next 12 months
- Expectations of Wages per Employee for the next 12 months
- Assessment of Financial and Economic Conditions for the next 12 months (component of **BEI**)
- Expectations of Total Sales for the next 12 months (component of **BEI**)
- Expectations of Investment in Building for next the 12 months (component of **BEI**)
- Expectations of Investment in Equipment, Machinery and Instruments for the next 12 months (component of **BEI**)
- Employment Expectations for the next 12 months (component of **BEI**)

#### ■ **BEI** – Business Expectation Index



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# ST Forecasting of Economic Activity in Ukraine based on BSE: Business Expectations Index (BEI) and GDP (3)



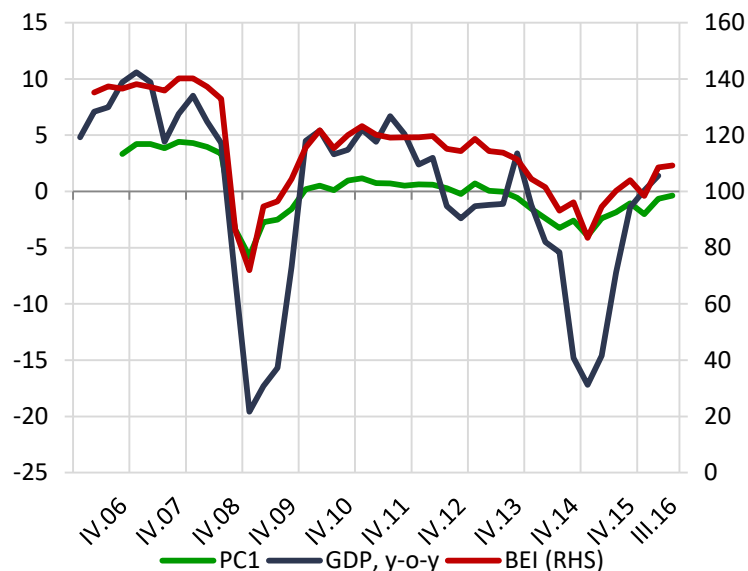
- BEI can be used as a leading indicator to nowcast GDP and its components
- Firms' responses reflect rather current situation



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# ST Forecasting of Economic Activity in Ukraine based on BSE: Correlations Between PC1, BEI, and GDP (3)

## Real GDP, First Principal Component and Business Expectations Index, %



- PC1 includes all the forecasts of firms for the next 12 months (investments, employment, future economic and financial conditions, sales) and current estimations of financial and economic conditions.
- PC1 is strongly correlated with real GDP changes in quarterly (seasonally adjusted) and y-o-y terms.

### Correlations between PC1, BEI and GDP

Lag	GDP, q-o-q		GDP, y-o-y	
	BEI	PC1	BEI	PC1
-4	0.14	-0.02	0.10	-0.04
-3	0.46	0.35	0.27	0.15
-2	0.65	0.56	0.48	0.39
-1	0.74	0.65	0.73	0.65
0	0.71	0.62	0.91	0.86
1	0.32	0.21	0.83	0.75
2	0	-0.08	0.59	0.49
3	-0.11	-0.26	0.31	0.18
4	-0.18	-0.36	0	-0.17



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# ST Forecasting of Economic Activity in Ukraine Based on BSE: In-Sample Forecast Performance (3)

- Evaluation of predictive power of BSE is based on the model:

$$Y_{t+1} - Y_t = \alpha + \beta \times \Delta Y_t + \gamma \times X_t + \omega_{t+1},$$

where  $Y_t$  – dependent variable (GDP, consumption or investment)

$X_t$  – an independent variable (PC1, BEI or  $\Delta$ BEI)

### In-sample predictive tests

Forecast variable	Adj. R <sup>2</sup>		
	PC1	BEI	$\Delta$ BEI
Real GDP q-o-q	0.32	0.45	0.68
Real GDP y-o-y	0.82	0.87	0.88
Consumption q-o-q	0.48	0.55	0.40
Consumption y-o-y	0.84	0.85	0.83
Investment q-o-q	0.41	0.37	0.39
Investment y-o-y	0.77	0.84	0.82

- GDP (y-o-y; q-o-q), investment (y-o-y; q-o-q), and consumption(y-o-y): The best models in terms of Adj. R<sup>2</sup> are based on the  $\Delta$ BEI.



# ST Forecasting of Economic Activity in Ukraine Based on BSE: Out-of-Sample Forecast Performance (3)

RMSE statistics, relative to the benchmark AR model

Horizon	GDP (y-o-y)			Investment (y-o-y)			Consumption (y-o-y)		
	PC1	BEI	ΔBEI	PC1	BEI	ΔBEI	PC1	BEI	ΔBEI
1 q ahead forecast	0,74	0,47	0,33	2,85	2,17	1,88	0,84	0,78	0,74
2 q ahead forecast	0,68	0,55	0,41	1,69	0,68	0,77	0,84	0,87	0,76
3 q ahead forecast	0,54	0,64	0,45	1,34	0,58	0,66	0,74	0,87	0,66
4 q ahead forecast	0,62	0,71	0,65	1,16	0,51	0,70	0,59	0,85	0,54

RMSE statistics, relative to the benchmark AR model

Horizon	GDP (q-o-q)			Investment (q-o-q)			Consumption (q-o-q)		
	PC1	BEI	ΔBEI	PC1	BEI	ΔBEI	PC1	BEI	ΔBEI
1 q ahead forecast	0,98	1,49	0,56	2,17	2,00	1,88	0,65	0,53	0,68
2 q ahead forecast	1,92	2,26	1,15	2,40	1,75	0,77	0,71	0,65	0,93
3 q ahead forecast	1,75	1,9	1,20	1,67	1,34	0,66	4,63	5,31	1,19
4 q ahead forecast	2,23	2,65	1,31	1,30	1,15	0,70	5,77	7,00	2,08

- We exploit the same equations to evaluate out-of-sample with “expanded windows”.
- Most of the results GDP, consumption, and investment (q-o-q) are worse than those for the naïve model AR (1).
- GDP (y-o-y) and consumption(y-o-y): The best models in terms of forecasting performance are based on the ΔBEI.



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## Nowcasting Economic Activity (4)

**BSE** and **IKSO** are used to nowcast economic activity

### ■ Index of Key Sectors Output (IKSO) covers

- Agriculture
- Industry
- Construction
- Wholesale trade
- Retail trade
- Transportation

### ■ Index of Key Sectors Output (IKSO)

$$IKSO_{t/t-12} = \sum q_{i,t/t-12} \times w_{i,t-12}$$

where  $IKSO_{t/t-12}$  – annual rate of change of IKSO in the month  $t$ ,

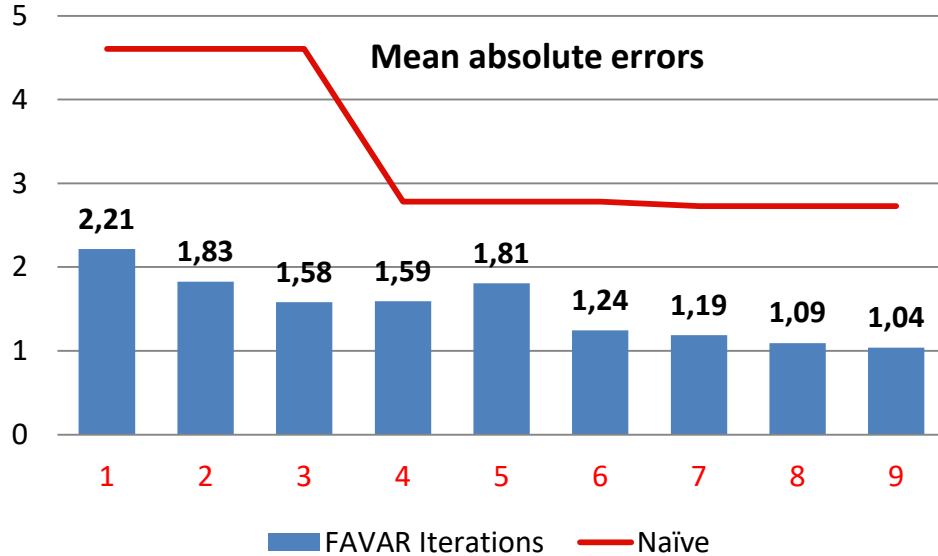
$q_{i,t/t-12}$  – annual change in output in  $i$  type of activity,

$w_{i,t-12}$  – weight factor for  $i$  type of activity.



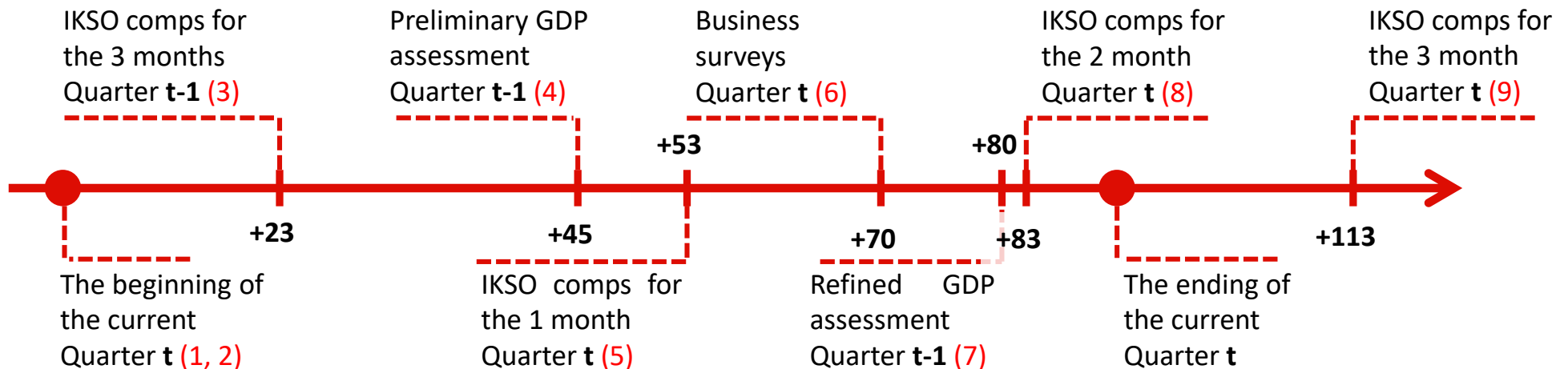
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# Forecasting Economic Activity with Dynamic Factor Models: Mean Absolute Errors (4)



Comparing forecast performance of FAVAR with benchmarks - naïve random walk (RW).

- 2 months of IKSO Components and Business Surveys for the **previous** quarter
- 2 months of IKSO Comps for the previous quarter
- 3 months of IKSO Comps for the previous quarter
- Preliminary GDP assessment for the previous quarter
- 1 months of IKSO Comps for the **current** quarter
- 1 months of IKSO Comps and Business Surveys
- Refined GDP assessment for the previous quarter
- 2 months of IKSO Comps and Business Surveys
- 3 months of IKSO Comps and Business Surveys





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## Estimation of Financial Conditions (5)

- Financial conditions serve as an unobservable factor that is embodied in financial market indicators
- The most relevant financial time series to be considered in estimation of the FCI for :
  - interest rates (loans, deposits, interbank, spread between domestic and US government bonds)
  - quantities of money (money supply, monetary base, loans)
  - real effective exchange rate of hryvnia (REER)
  - lending standards (soft data from surveys)
  - real estate prices
  - external commodity price index (ECPI)
- Required financial data is available from January 2006
- The common variation of mentioned variables is assumed to describe financial conditions
- Although the weighted-sum approach is often used to construct FCIs, the common variation approach has advantages due to erratic macroeconomic environment and shift in monetary policy regime during analyzed period



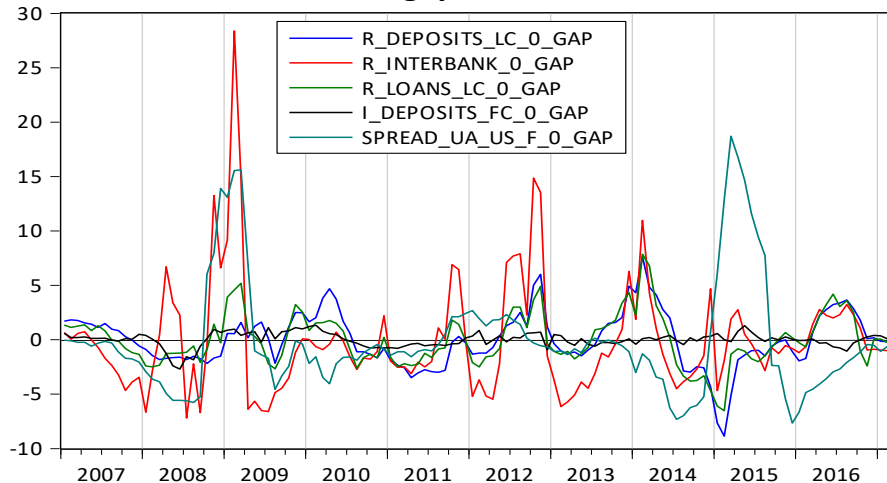
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# Estimation of FCI-1, Based on Gaps in Real Financial Indicators (5)

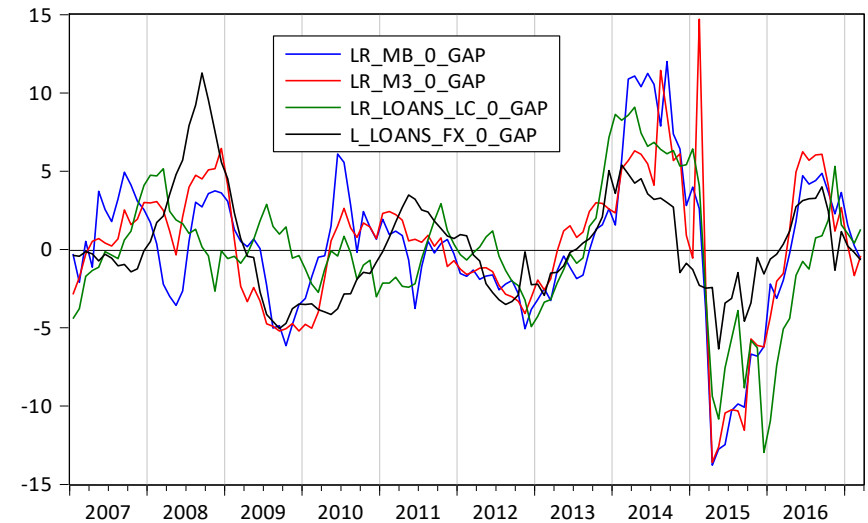
The **first approach**. Step 1:

- Transformation of variables into real terms and obtaining gaps
- Real interest rates in hryvnia are deflated by inflation expectations (from business surveys); Interest rates in FX are not adjusted
- Quantities of monetary base, money supply and loans are deflated by the CPI
- Hodrick–Prescott filter ( $\lambda=1600$ ) is used to subtract trend from financial variables. Gap assessment of the latest observations is improved by the forecast with regressions of each variable against its lagged values and real GDP growth

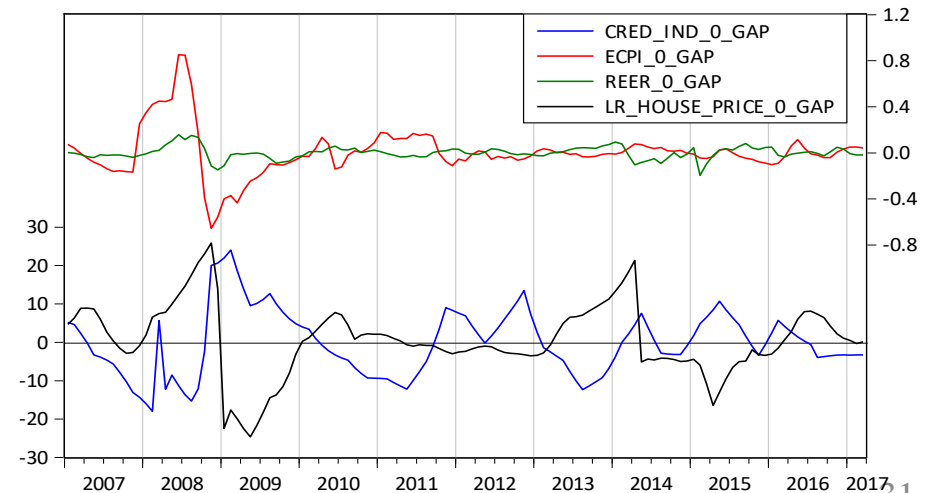
Estimated gaps: Interest rates



Estimated gaps: Quantities



Estimated gaps: Other indexes





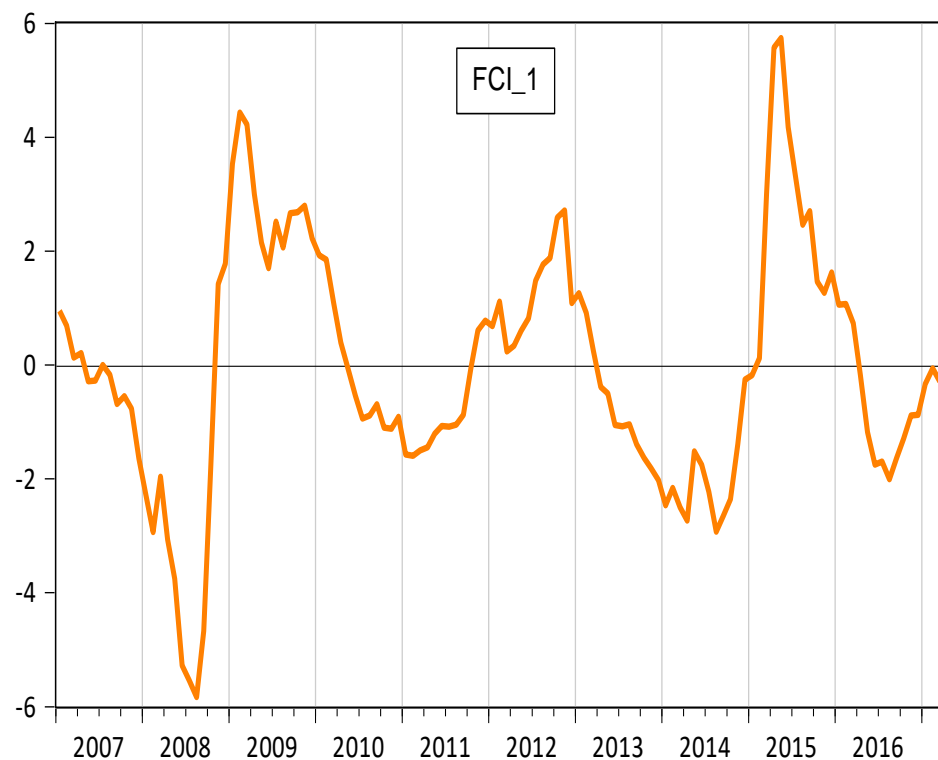
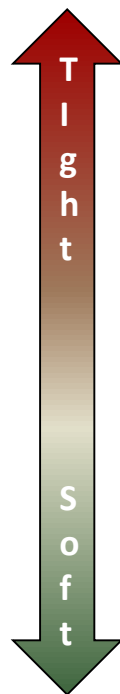
# Estimation of FCI-1, Based on Gaps in Real Financial Indicators (5)

## Step 2:

- The FCI is estimated with the Principal Components Approach (PCA) and represent the largest common variation of the gaps of financial variables. First principal component is used as the FCI (represents 32% of all variables variation).
- Variables' loadings correspond with economic intuition. An increase in money stimulates an economy, while an increase in interest rates and tightening lending standards restrain it.

### Composition of FCI-1

	Indicator (gap)	Loading
Interest rates	Deposits LC	+0.03
	Interbank LC	+0.13
	Loans LC	+0.08
	Deposits FC	+0.34
Indexes	Lending standards	+0.37
	UA-US bonds spread	+0.30
	ECPI (external commodity prices)	-0.30
	REER	-0.17
	Real estate prices	-0.34
Quantities	Monetary base	-0.30
	Money supply	-0.36
	Loans LC	-0.28
	Loans FC	-0.32



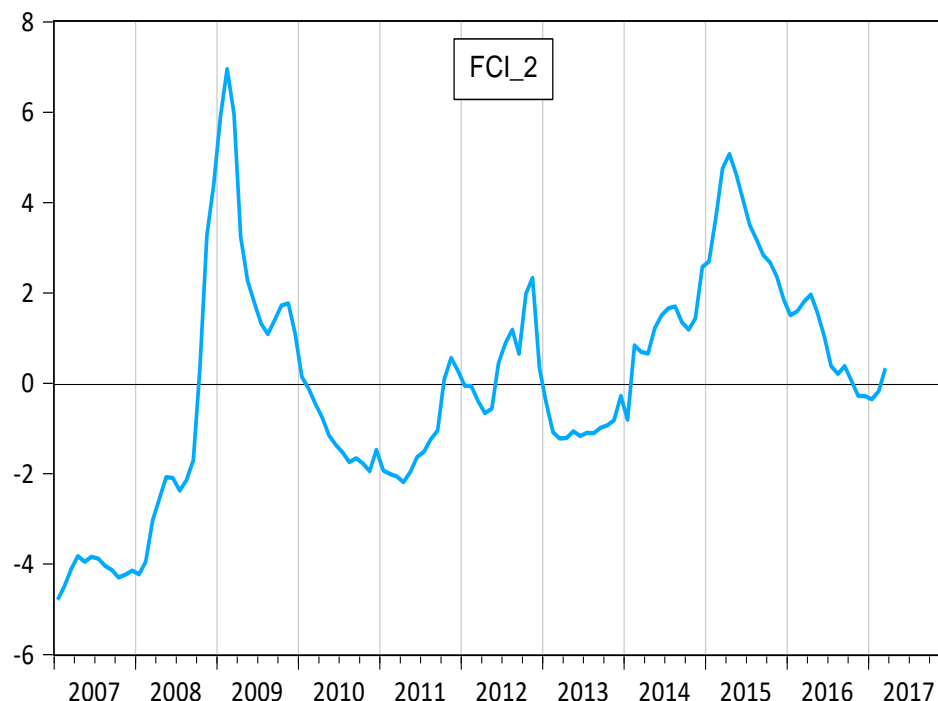
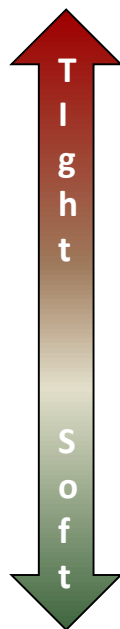


## Estimation of FCI-2, Based on Nominal Financial Indicators (5)

- The **second approach** uses nominal levels and changes of financial variables. We exploit interest rates, interest spread and index of lending standards in levels. Quantities of money, real exchange rate, real estate prices, external commodity prices are transformed in moving average quarterly changes.
- The PCA is used to investigate common variance of variables. First principal component explains 54% of the variation and is used as the FCI
- Variable loadings correspond with economic intuition

### Composition of FCI-2

	Indicator	Loading
Interest rates	Interbank LC	+0.32
	Deposits LC	+0.32
	Loans LC	+0.35
	UA-US bonds spread	+0.34
Indexes	Lending standards	+0.36
	REER, q-o-q	-0.12
	Real estate prices, q-o-q	-0.24
	ECPI (external commodity prices), q-o-q	-0.23
Quantities	Money supply	-0.38
	Loans	-0.32
	Monetary base	-0.25





## Estimation of FCI-3, Purged of Macroeconomic Conditions (5)

- The **third approach** is a modification of FCI-2 that takes into account current and past macroeconomic conditions according to Hatzius et al. (2010).

We begin with financial indicators transformed according to previous approach.

Then obtained variables are “purged” of macroeconomic factors such as inflation and GDP.

Finally common variation of the set of purged variables is obtained through PCA.

- “Purging” model:

$$X_{it} = c_i + \alpha_i * Y_t + v_{it},$$

where  $X_{it}$  – financial indicator,  $Y_t$  – vector of current and past macroeconomic variables, residuals  $v_{it}$  represent purged variables.

To obtain residuals each variable is regressed against current and past inflation and real GDP growth. However, change in external commodity price index (ECPI) is taken as it is.

- Decomposition of residuals:

$$v_{it} = \mu_i * F_t + u_{it}$$

Vector  $F_t$  captures unobservable financial conditions.

The FCI is obtained from the set of purged financial variables by the PCA.

The first principal component explains 42% of variation and represents financial conditions



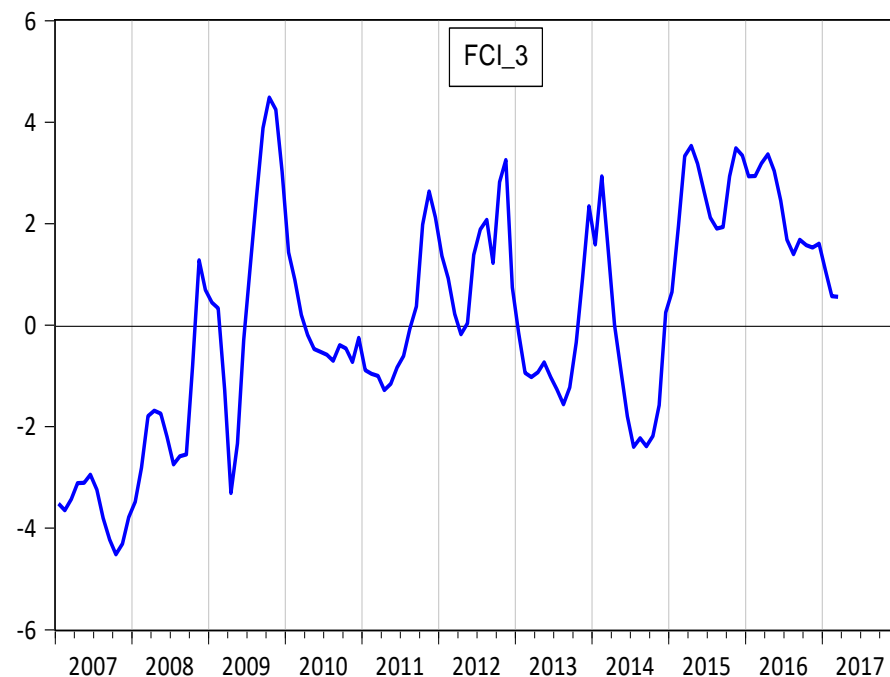
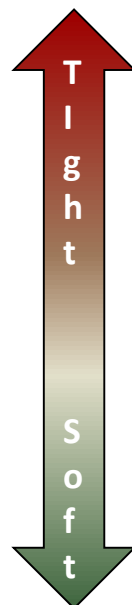
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## Estimation of FCI-3, Purged of Macroeconomic Conditions (5)

- Difference between FCI-2 and FCI-3 is pure input of macroeconomic conditions into financial system.
- Soft financial conditions of early 2009 and 2<sup>nd</sup> half of 2014 reveal slow response of the financial system to macroeconomic shocks. While latest development of FCI-3 exhibits relatively tight financial development conditional on moderate economic recovery.
- Variables' loadings correspond with economic intuition.

### Composition of FCI-3

	Indicator	Loading
Interest rates	Interbank LC	+0.32
	Deposits LC	+0.32
	Loans LC	+0.36
	UA-US bonds spread	+0.32
Indexes	Tough lending conditions	+0.39
	REER, q-o-q	-0.06
	Real estate prices, q-o-q	+0.01
	ECPI (external commodity prices), q-o-q	-0.12
Quantities	Money supply	-0.39
	Loans	-0.36
	Monetary base	-0.31





## Predictive Power of FCIs (in-Sample Performance) (5)

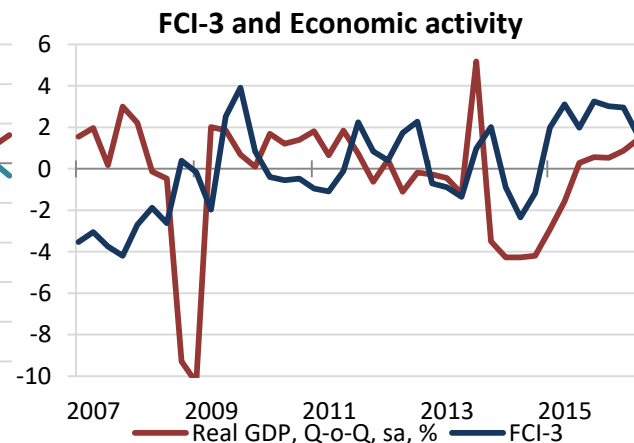
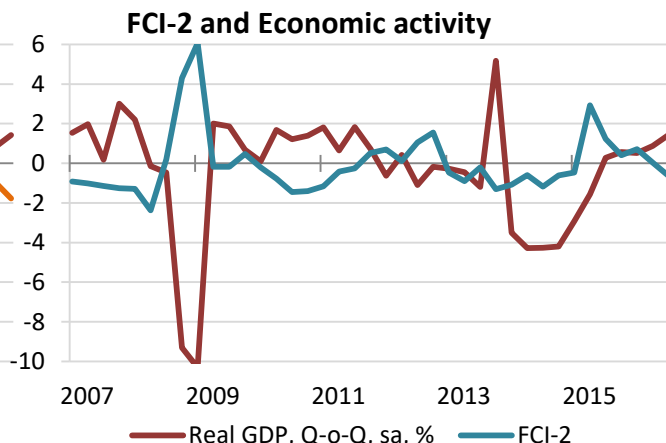
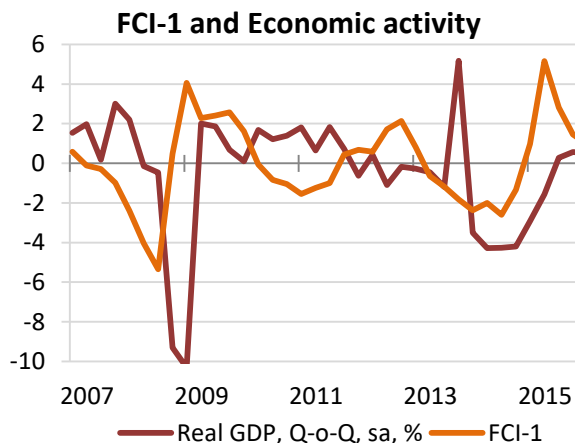
- Evaluation of predictive power of FCIs is based on simple models for GDP and credit growth:

$$\frac{Y_{t+h} - Y_t}{h} = \alpha + \beta \times \Delta Y_t + \gamma \times FCI_t + \omega_{t+h},$$

where  $Y$  – dependent variable, GDP or credit,  
 $FCI$  – one of the three estimated FCIs,  
 $h$  – forecast horizon

### In-sample predictive tests

Forecast variable	F-stat				Partial R <sup>2</sup>			Adj. R <sup>2</sup>			
	AR	FCI1	FCI2	FCI3	FCI1	FCI2	FCI3	AR	FCI1	FCI2	FCI3
Real GDP (1 q ahead forecast)	9.14	11.08	4.46	4.19	0.22	0.01	0.00	0.17	0.34	0.15	0.14
Real GDP (2 q ahead forecast)	3.85	17.25	2.02	1.73	0.43	0.03	0.01	0.07	0.45	0.05	0.04
Real GDP (4 q ahead forecast)	1.23	20.23	1.72	1.06	0.51	0.09	0.05	0.01	0.50	0.04	0.00
Credit growth (1 q ahead forecast)	455.14	264.86	218.66	194.65	0.15	0.10	0.00	0.92	0.93	0.92	0.91
Credit growth (2 q ahead forecast)	285.55	197.94	117.14	104.87	0.27	0.09	0.00	0.88	0.91	0.86	0.85
Credit growth (4 q ahead forecast)	130.59	129.03	45.14	42.89	0.45	0.04	0.01	0.77	0.87	0.72	0.71





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## Predictive Power of FCIs (out-of-sample performance) (5)

- We exploit the same equations to evaluate out-of-sample predictive power of FCIs with rolling window

### Out-of-sample evaluation

Forecast variable	RMSE			
	AR	FCI_1	FCI_2	FCI_3
Real GDP (1 q ahead forecast)	2.255	2.335	2.368	2.283
Real GDP (2 q ahead forecast)	1.997	1.967	2.061	2.053
Real GDP (4 q ahead forecast)	1.862	1.509	1.798	1.869
Credit growth (1 q ahead forecast)	1.615	1.526	1.590	1.682
Credit growth (2 q ahead forecast)	2.009	1.819	1.985	2.174
Credit growth (4 q ahead forecast)	2.652	1.699	2.726	2.643

- FCI-1 contains more information on further GDP and credit growth. Both in-sample or out-of-sample tests reveal a higher forecasting power of FCI-1 but the issue of last point gap estimation complicates its usage for current analysis and forecasting.
- Although the rest FCIs have worse predictive power, they are much more understandable and better suit our goals of current macroeconomic surveillance.
- **Puzzle:**

Instability in the relationship between financial conditions and real economic activity

Correlation between financial conditions and real economy during 2010-2013 and during crisis periods (2008-09, 2014-15) differs a lot



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## Fiscal impulse estimation (6)

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### Dataset:

- Period: 2001-2016
- Data frequency: quarterly

### Variables:

- Primary budget balance is a main fiscal variable
- All variables are in real terms and seasonally adjusted (for elasticities estimates)
- Potential GDP extracted with Kalman filter
- Variables for aggregated models: Output gap, Potential GDP, Budget revenues, Budget primary expenditures

Variables for disaggregated models:

**Revenues side** - personal income tax, corporate income tax, value added tax, excise duty, customs on imports

**Expenditure side** - transfers from the budget to the Pension Fund of Ukraine for covering the deficit



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## Fiscal Impulse Estimation: Empirical strategy (6)

- Fiscal impulse gives monetary policy makers information on tight or loose fiscal policy for making decisions and forecasts.

$$\text{Fiscal impulse}_t = \text{Fiscal stance}_t - \text{Fiscal stance}_{t-1}$$

1. IMF approach to estimation of the fiscal stance (Heller et al, 1986).

$$FB_t = (R_t - G_t)$$

$$FB_t = (r_0 Y_t^* - g_0 Y_t^*) - [r_0 (Y_t^* - Y_t)] - FS_t$$

$$r_0 = R_0 / Y_0$$

- base year primary nominal receipts-to-nominal GDP

$$g_0 = G_0 / Y_0$$

- base year primary nominal expenditure-to-nominal GDP

$$Y_t$$

- actual GDP in nominal prices in year t

$$Y_t^*$$

- potential GDP in nominal prices in year t

$$FB_t$$

- fiscal balance in year t

$$R_t$$

- budget primary revenue

$$G_t$$

- budget primary expenditures

$$FS_t$$

- measure of the fiscal stance in year t



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## Fiscal impulse estimation: Empirical strategy (6)

- Fiscal impulse gives monetary policy makers information on tight or loose fiscal policy for making decisions and forecasts.

### 2. Estimation of fiscal stance by simplified decomposition regression (Fatás and Mihov, 2002)

$$\frac{PB_t}{GDP_t} = \beta + \varphi\left(\frac{PB_{t-1}}{GDP_{t-1}}\right) + \alpha \text{GDP\_trend}_t + \rho_0 \text{GDP\_gap}_t \dots + \rho_i \text{GDP\_gap}_{t-i} + \varepsilon_t$$

$PB_t$	- primary balance
$GDP_t$	- nominal GDP
$\text{GDP\_trend}_t$	- real potential GDP
$\text{GDP\_gap}_t$	- real GDP gap
$\varepsilon_t$	- fiscal stance proxy

**Method:** MLE



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## Fiscal impulse estimation: Empirical strategy (6)

- Fiscal impulse gives monetary policy makers information on tight or loose fiscal policy for making decisions and forecasts.

### 3. OECD approach to estimation of the fiscal stance:

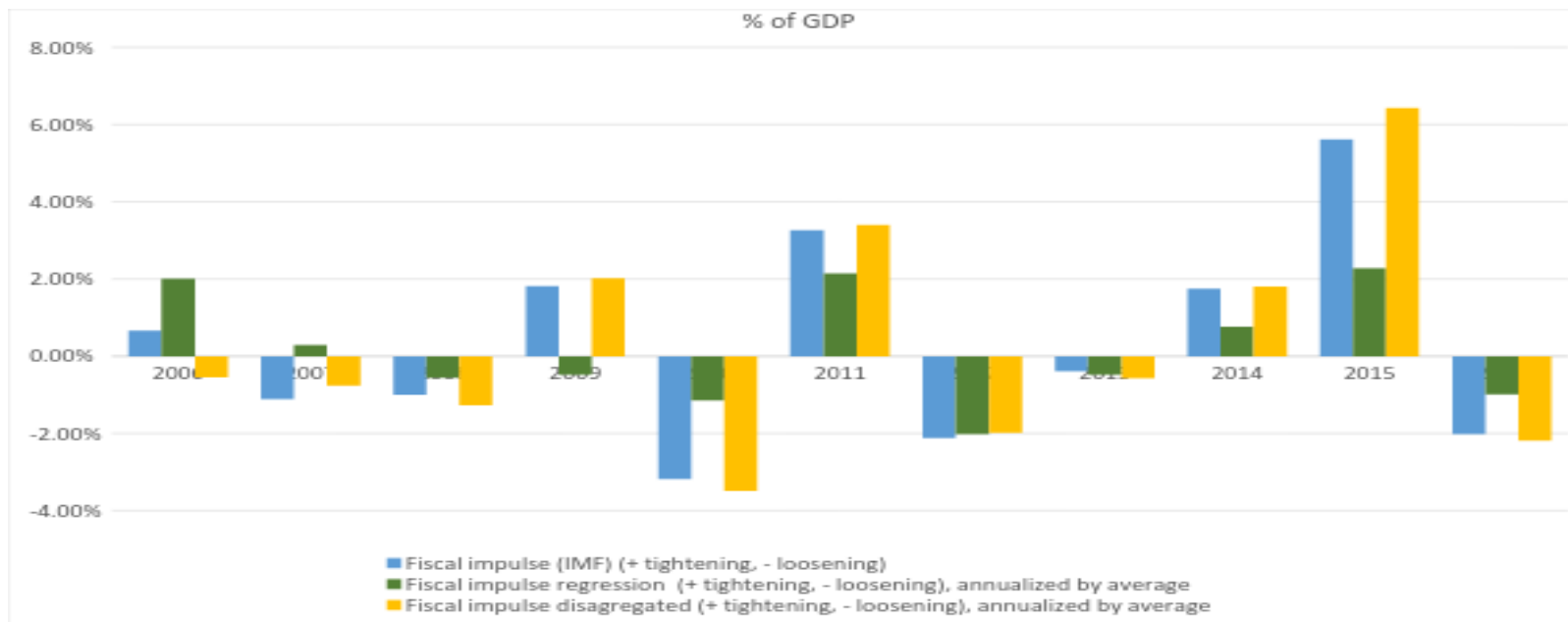
$$B_{c,t}/Y_t = \sum_j (R_t^j/Y_t) \times \varepsilon_{R^j,V^j} \times \varepsilon_{V^j,Y_r} \times y_{r,c,t} - (X_t^U/Y_t) \times \varepsilon_{X^U,U} \times \varepsilon_{U,Y_r} \times y_{r,c,t}$$

$B_{c,t}$	– cyclical fiscal balance
$Y_t$	– GDP
$R_t^j$	– a certain item of revenue
$\varepsilon_{R^j,V^j}$	– the elasticity of revenues to appropriate macroeconomic base ( $V^j$ )
$\varepsilon_{V^j,Y_r}$	– the elasticity of macroeconomic base to real GDP
U	– the number of unemployed
$X_t^U$	– budget expenditures related to unemployment
$y_{r,c,t}$	– real GDP gap

**Method:** DOLS with control for structural breaks in 2003, 2008, 2014



## Fiscal impulse estimation: Results (6)



### Key conclusions:

- In general, different estimates yield robust results on fiscal impulses
- Both IMF and OECD approaches give close results on the magnitudes of fiscal impulses
- Applied approaches identify the periods of tight and loose fiscal policy in the past and make it possible to forecast policy stance



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## Forecasting with DSGE (7)

- **DSGE models are widely used by central banks for policy analysis, forecasting, and research:**
  - Provide framework for studying macroeconomic relationships from the perspective of micro-foundations
  - Insensitive to Lucas Critique and, hence, enable the analysis of e.g., monetary policy changes
- **DSGE and forecasting:**
  - DSGE models are usually less accurate in forecasting compared to data-driven or semi-structural models (Edge & Gurkaynak, 2011; Wickens, 2012)
  - Nevertheless, DSGE models are often used for “shadow” forecasting as they are very useful in understanding future macroeconomic developments from theoretical perspective
  - In addition, DSGE models are used for conducting scenario analysis
- **DSGE modeling at the National Bank of Ukraine (ongoing projects and plans):**
  - Studying alternative monetary policy rules for Ukraine using a simple New Keynesian small open economy DSGE model elaborated within a Riksbank Technical Assistance Programme for the NBU
  - Incorporating macro-prudential policies in Ukraine
  - DSGE model for Ukraine with OLG and demographic trends: impact on consumption-saving behavior
  - Developing and estimating a “working” DSGE model for Ukraine



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# Promising Research Topics in Modeling and Forecasting

- Inflation expectations determinants
- Determinants of the foreign trade balance
  - Estimating export and import functions based on panel data for separate industries (goods categories)
  - Can gravity approach be useful?
- Structural econometric models in forecasting inflation
  - Estimating Philips curve
  - Assessing inflation persistence
- Using FX interventions: assessing their impact on ER
- Money in monetary policy: Does money help to predict inflation?
- Migration Flows and Labor Market
- Impact of IRs on ER:
  - Uncovered interest rate parity: What does data tell us on the relations between interest rates and exchange rate?
- Impact of key IR on Long-term IRs in the Ukrainian money market through Yield Curve
- Interest rate pass-through
- Credit (bank lending) channel of monetary transmission



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## Inflation Expectations in Ukraine: Data

Inflation expectations are collected from 4 types of surveys:

- **Business Survey:**

Sample: quota-based, pro rata region and economic activities, about 700 firms in 22 oblasts  
Period: since 2006  
Data frequency: quarterly

- **Banks Lending Survey:**

Sample: about 70 banks (represents circa 90% of the banks)  
Period: since 2012  
Data frequency: quarterly

- **Households Consumer Confidence Survey:**

Sample: 1000 households, age 16+ (GfK Ukraine)  
Period: since July 2014  
Data frequency: monthly

- **Financial Analysts Survey:**

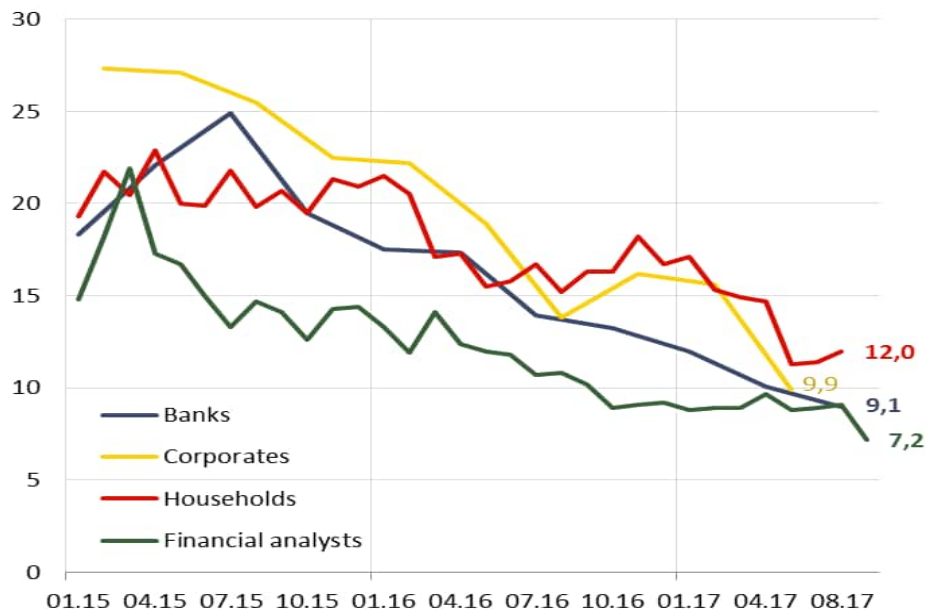
Sample: 21 financial analysts from 17 institutions  
Period: since July 2014  
Data frequency: monthly



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# Inflation Expectations in Ukraine

**Inflation Expectations for the Next 12 Months, %**



Source: NBU; GfK Ukraine surveys; NBU staff estimates

- Inflation expectations questionnaire is in multiple-choice format (except of FA survey).
- Intervals depend on current level of inflation. Distribution of answers approaches to normal.
- Inflation expectations are calculated as sum of the share of respondents who chose the interval, multiplied on interval average value.
- FA Survey: Questions are open. Respondents report figures of their forecasts. Inflation expectations are calculated as average of all answers.

**WHAT CHANGE DO YOU EXPECT IN PRICES OF CONSUMER GOODS AND SERVICES IN UKRAINE OVER THE NEXT 12 MONTHS? WILL THE PRICES OF CONSUMER GOODS:**

Decrease	Increase up to 3%	3.1 – 6.0%	6.1 – 9.0%	9.1 – 12.0%	12.1 – 15.0%	15.1 – 18.0%	above 18.1%
1	2	3	4	5	6	7	8