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Macroeconomic Models for Monetary Policy at the NBU

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University of Bergen
Bergen, 24 August 2017

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Decision-making process based on macroeconomic forecast

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Decision-making process and communication – building a routine cycle

Monetary Policy Committee

(Wednesday)

14:00-16:00

Markets, Financial stability

Board meeting on monetary policy issues

(Thursday)

10:00-12:00

Press release
Press briefing

(Thursday)

14:00

Formation of staff proposal / Staff meetings

Monetary Policy Committee

(Wednesday)

10:00-12:00

Macroeconomic outlook

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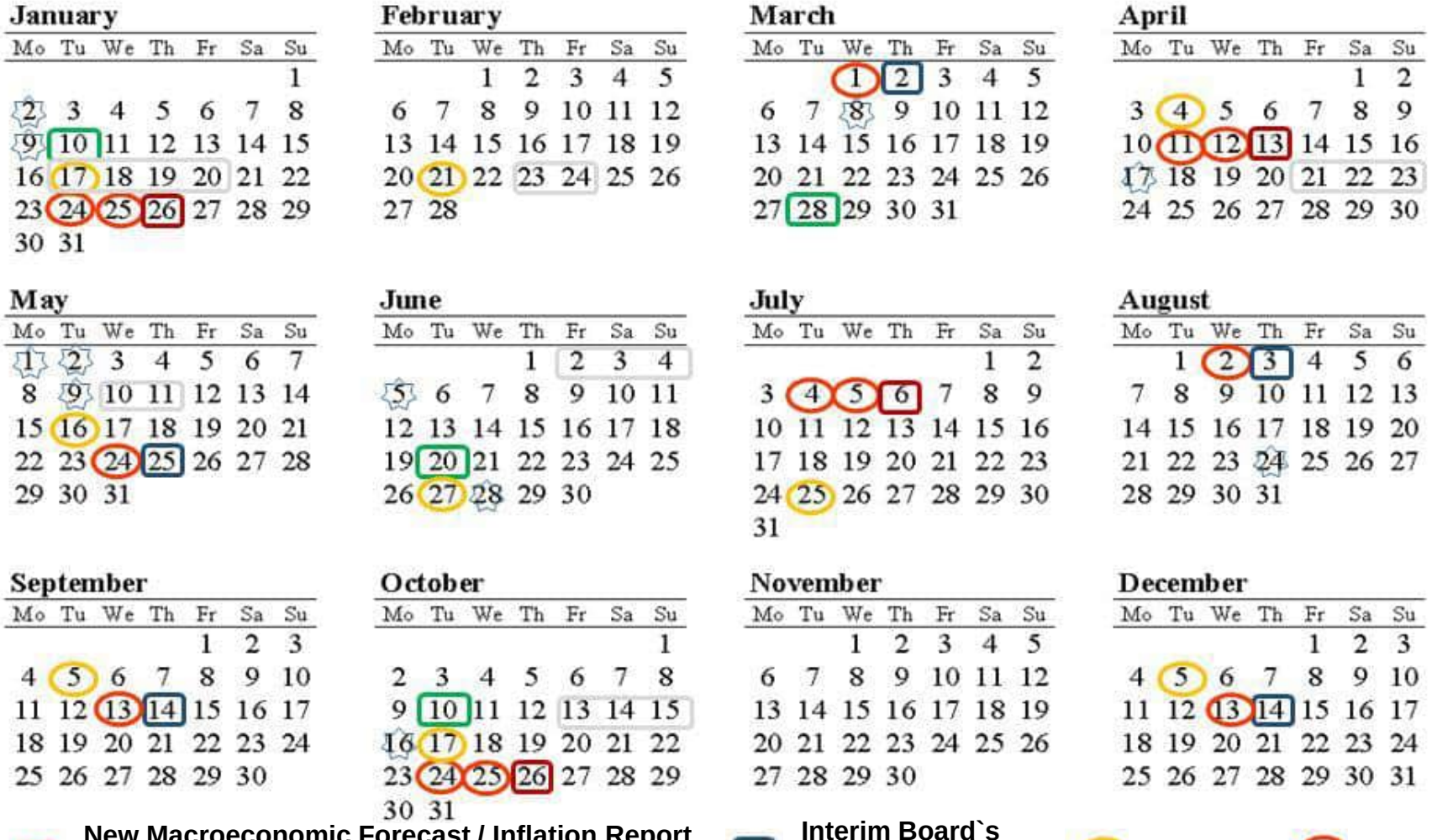
Predefined monetary policy decision-making calendar for 2017



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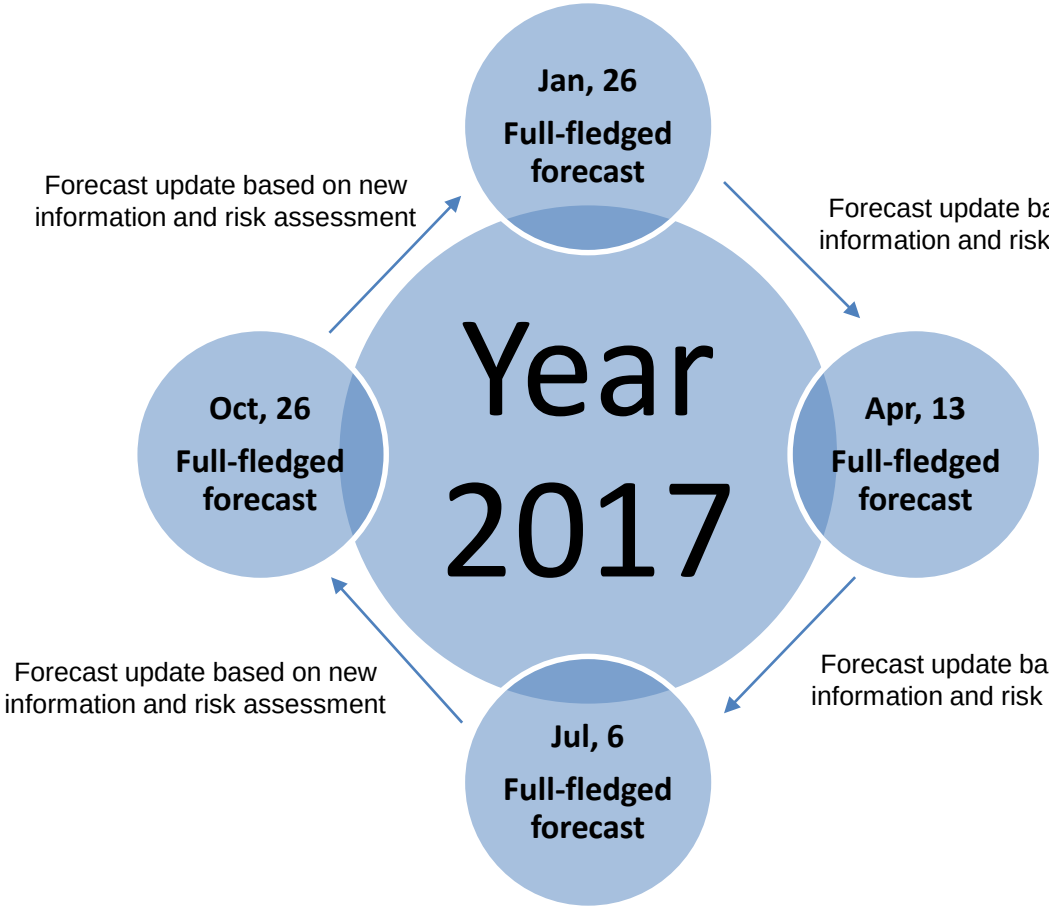
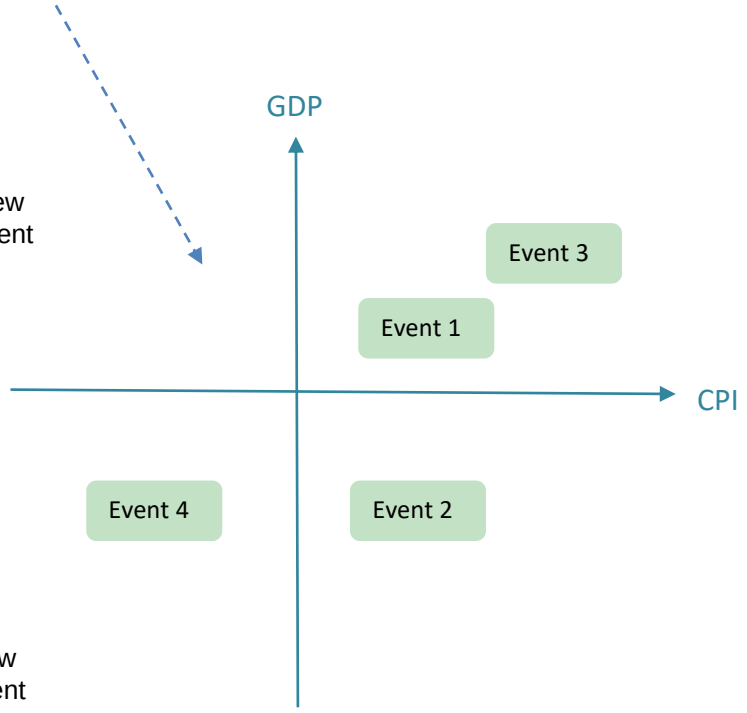
Forecasting process density

- **Main meetings** (4 times per year)
  - full macroeconomic forecast based on the core model
- **Intermediate meetings** (5 times per year)
  - New data vs forecast
  - Short-term forecast update (simple models)
  - Balance of risks





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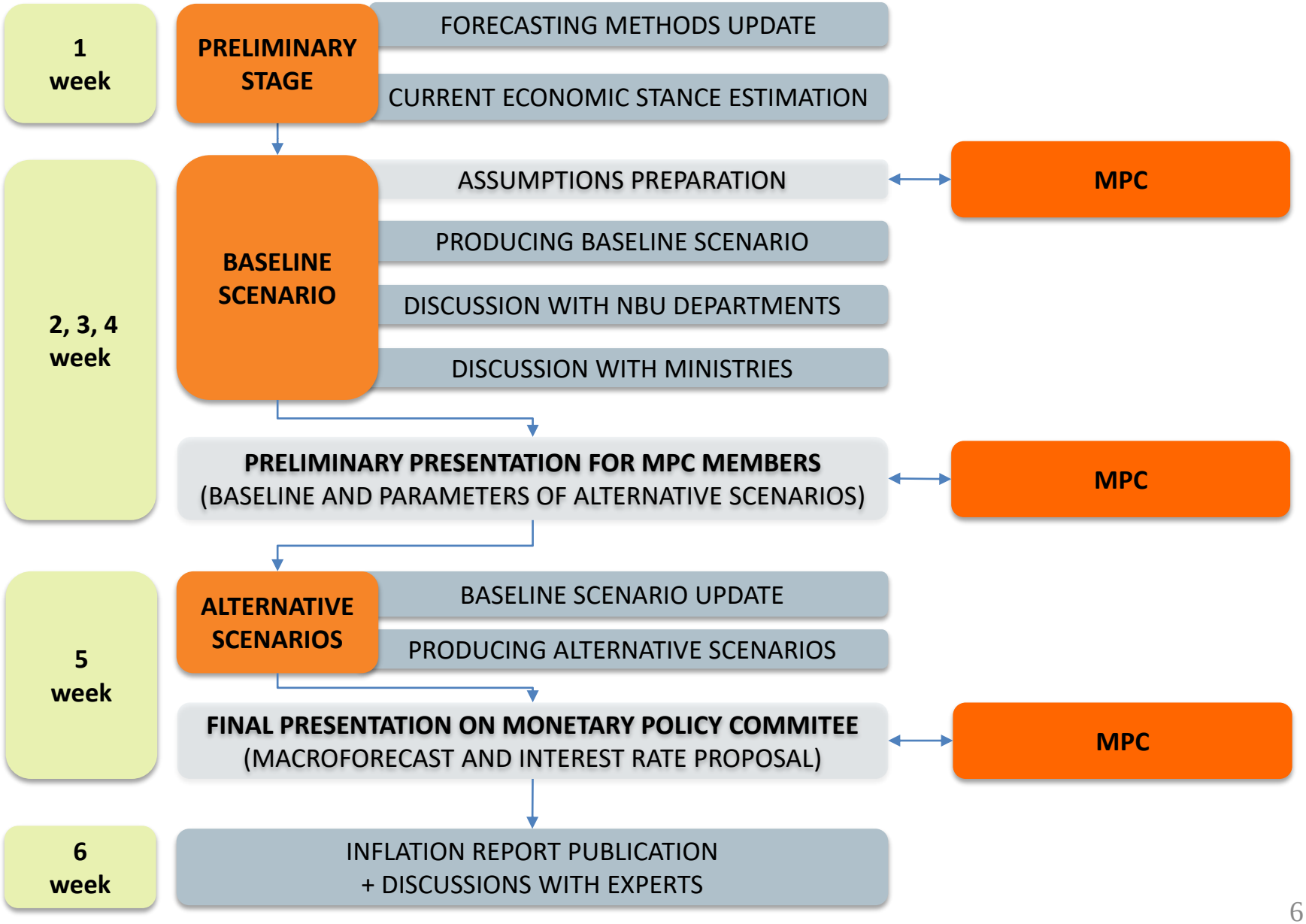
Forecasting process stages



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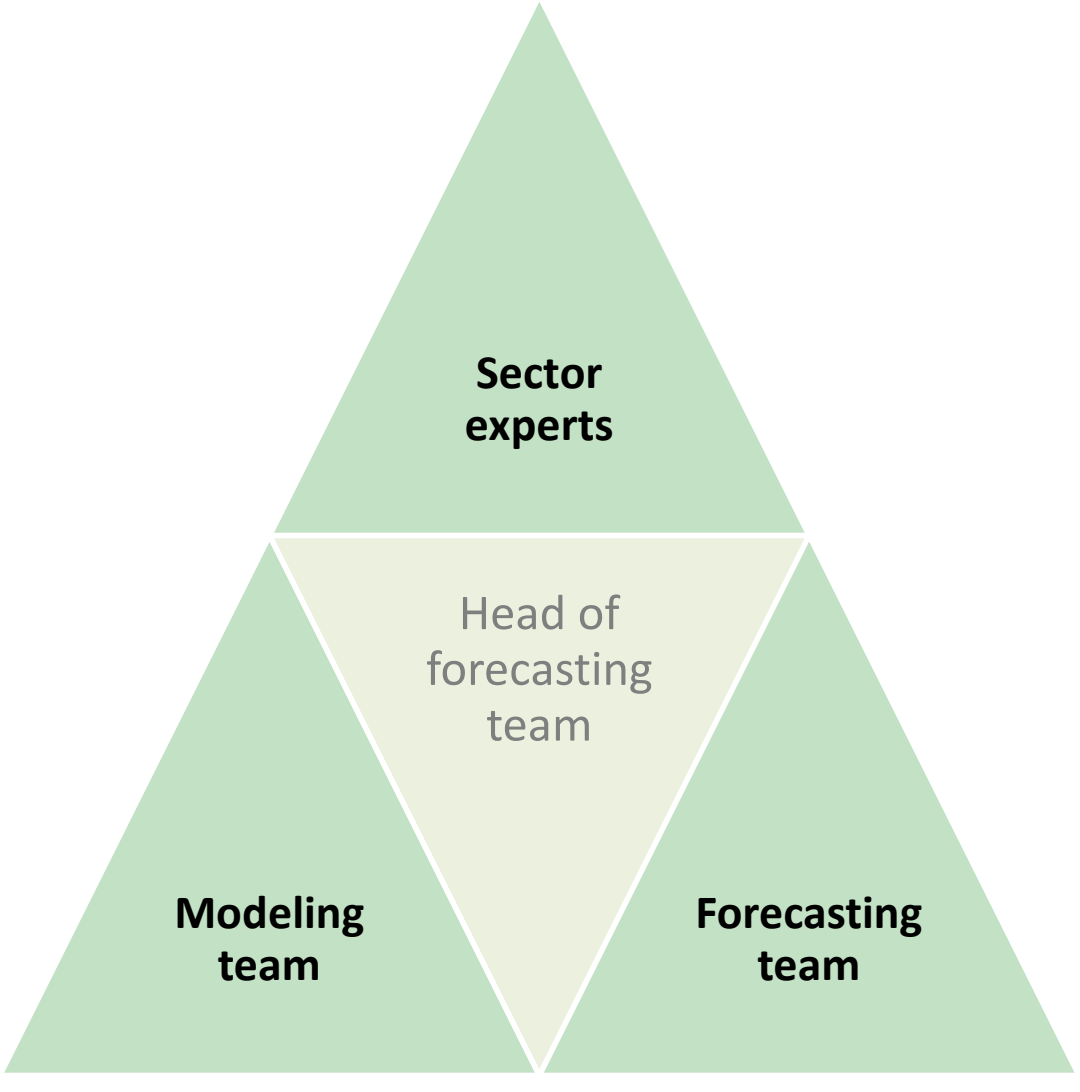
Forecasting team



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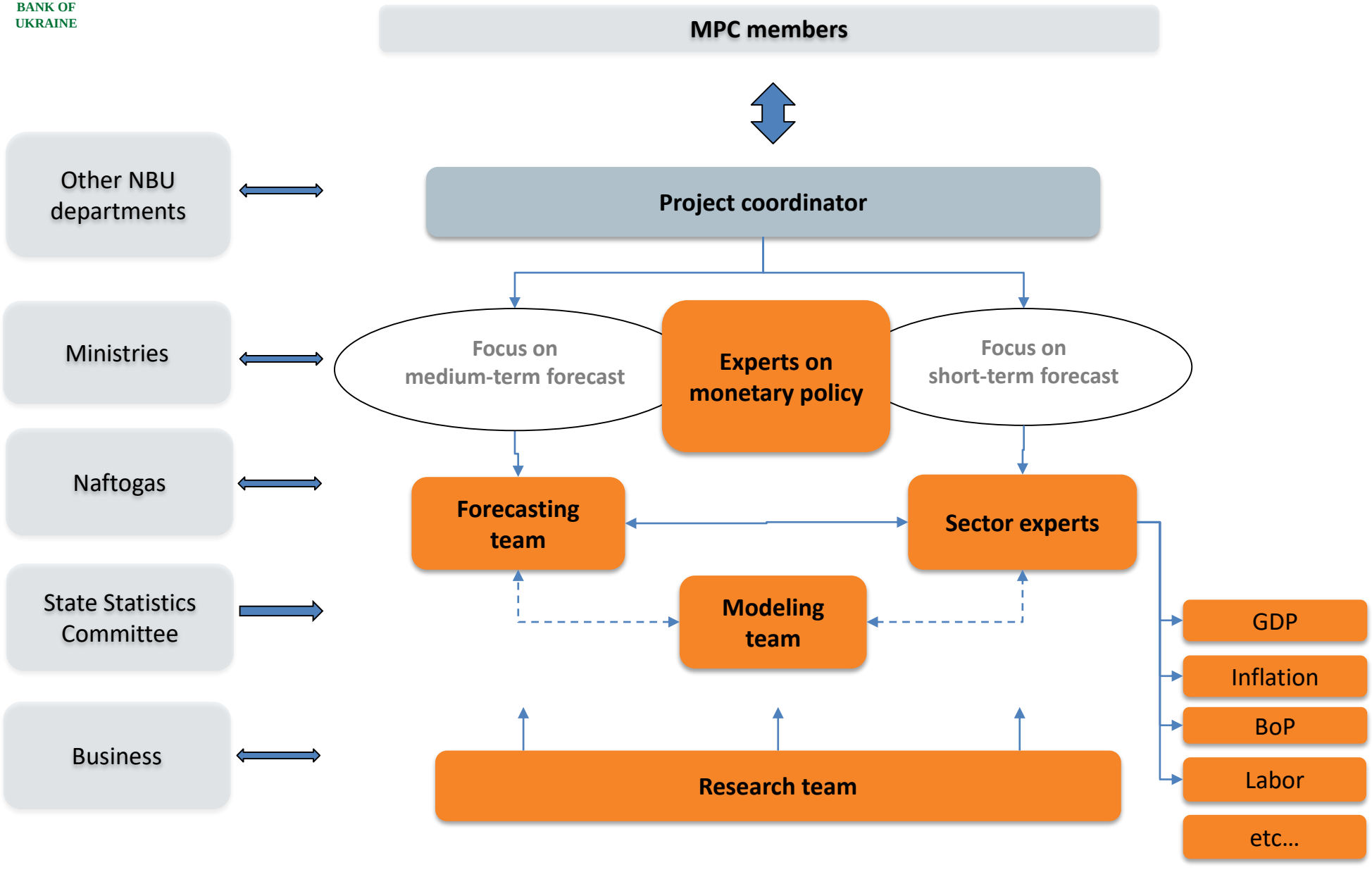
Cooperation during forecasting process



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Senior management involvement

- Regular meetings during forecasting process
  - assumptions and policy scenarios approval
  - presentation of the forecast
- Presentation on typical reaction to the different types of shocks (based on the QPM impulse responses)
- Presentation on special issues research results
  - monetary transmission mechanism
  - *neutral real interest rate*
- Board members visited other central banks in order to take part in MPC meetings or discuss relevant experience (Canada, Czech Rep, New Zealand)

Forecasting and Policy Analysis System (FPAS)

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Changing environment for modeling and forecasting team

2001-2013 **SILENT MODE**

- Lack of interest in forecasts (due to fixed ER regime)
- Board was not involved into forecasting process
- Requests for the analysis of individual events effects

Since 2014 **ACTIVE MODE**

- Huge interest in the forecasts and policy simulations
- Focus on targets achievement
- Board is a real counterpart in forecasting process (several meetings during forecast preparation)
- Board members go deep into details of the forecast
- Regular communications of the forecasts and policy decisions for the society

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Modeling toolkit development history

2001

- Simple regressions model for CPI components

2005

- Classical Quarterly Projection Model (QPM)

2007

- QPM with different policy modes (stable ER <-> Floating)

2015

- Extended QPM
- Bunch of nowcasting and NTF techniques

2016

- Data warehouse and reports automation

2017

- Global Simulation Model
- DSGE for policy analysis

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Modeling toolkit: General overview

Data warehouse

Modeling toolkit

Nowcasting and short-term forecasting models

- **CPI nowcasting**
  - webscraping
  - SSSU weekly
- **CPI NTF system** (OLS by components)
- **CPI food forecast** (ECM by components)
- **GDP nowcasting**
  - FAVAR
  - OLS based on monthly sectoral data
  - OLS based on surveys results
- **GDP NTF system** (OLS by components, FAVAR)

Core semi-structural macroeconomic model (QPM)

- **an extended version of canonical New-Keynesian medium-term forecasting model of a monetary policy transmission mechanism**
- nominal rigidities in the short-term and monetary neutrality in the long-term
- "gap" model
- **a skeleton for forecasting process** (combining empirical data, expert judgments and short-term forecasts into middle-term forecast)

Additional models

- **fiscal stance model**
- **REER equilibrium models**
- **money growth model**
- **Global Simulation Model**
- etc.

Reporting system *(historical analysis, forecasts comparison)*

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Quarterly **P**rojection **M**odel**: Main features**

QPM is small semi-structural new-Keynesian model with rational expectations

- ad-hoc structure (follows microeconomic principles derived equations but does not use such approach explicitly)
- forward looking variables, thus is not subject to Lucas critics

- *The origins of the model came from QPM of the Bank of Canada and Czech National Bank (similar models are used by central banks of Serbia, Armenia, Slovak Republic and many others)*
- Describes monetary policy transmission mechanism policy channels and is not neutral to monetary shocks in short and middle run
  - QPM reflects monetary policy neutrality and consistent with inflation target in long run
- The model is calibrated (both - parameters and steady state values)
- Model can be used under fixed exchange rate, under floating and in transition between them

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Quarterly **P**rojection **M**odel**: Trend and gaps**

- The concept of the model is the state space representation of macroeconomic variables where trends and gaps are unobservable components (state variables)
- State variables are linked together by putting to relationships the same theory as in nutshell FQPM model
- Advantages:
  - allows to explain gaps in terms of other variables
  - has a low sensitivity to sample length and number of parameters

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Quarterly **P**rojection **M**odel: **Main equations**

- IS curve (output gap equation)

- Forward-looking expectation augmented Phillips curve
  - core CPI
  - raw food prices
  - administratively regulated prices
  - fuel prices

- UIP condition (nominal exchange rate and interest rate relationship)

- Monetary policy rule

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Typical questions rising during the forecast preparation

- **What is the current economy stance?**
  - *assessing the size of actual data deviation from equilibrium*
- **What are the most important shocks leading to the deviation of inflation from the target?**
  - *previous, current and future expected shocks*
- **Behavior of main indicators' equilibrium levels**
  - *how should we incorporate additional information?*
- **How strong should be monetary policy reaction on shocks and how fast should inflation return to the target?**
  - *direction, duration, effects on the other indicators*
  - *Which shocks should be responded and which are not?*
- **How quickly should we return to the target?**
  - *GDP losses estimation*
- **What are the alternative scenarios and their implications for monetary policy?**

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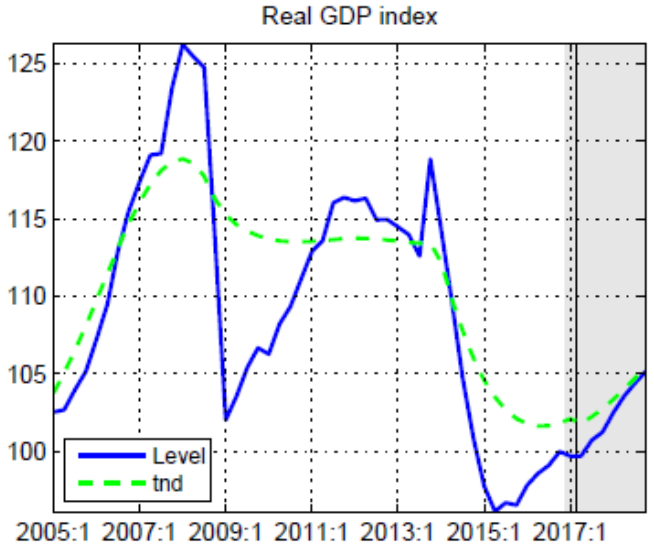
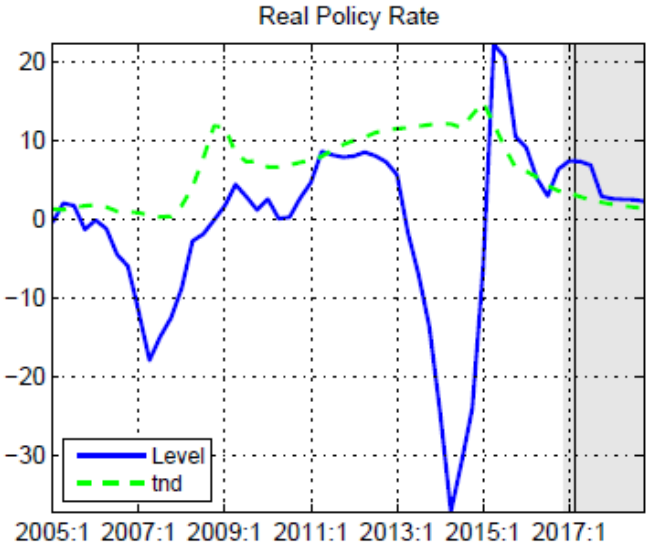
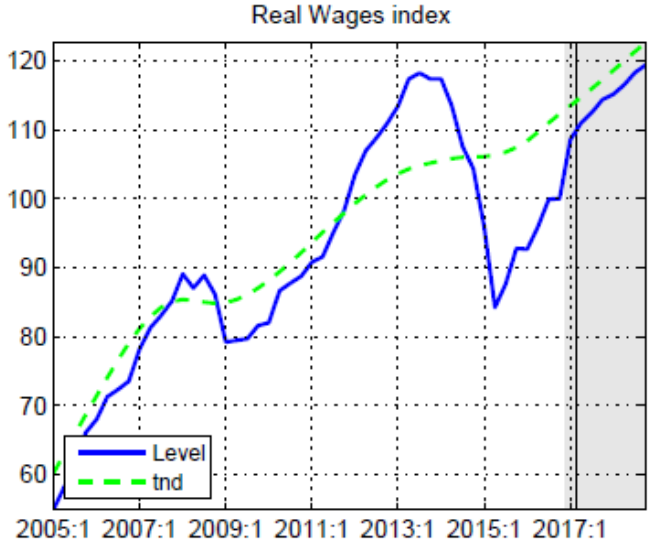
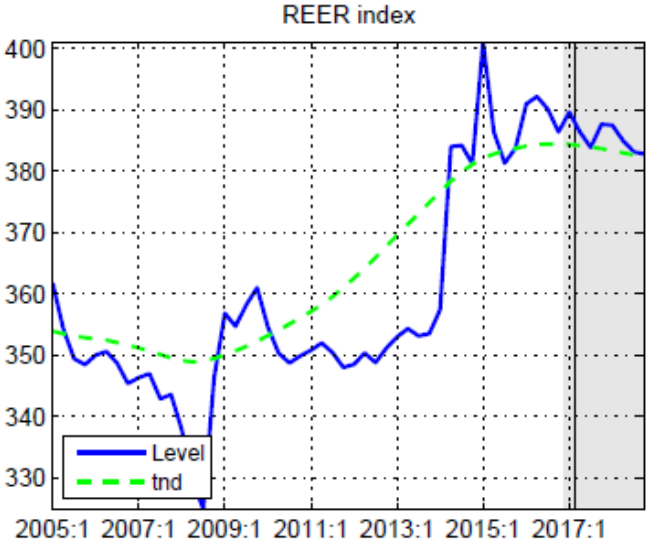
Quarterly Projection Model: assessing the deviation from equilibrium









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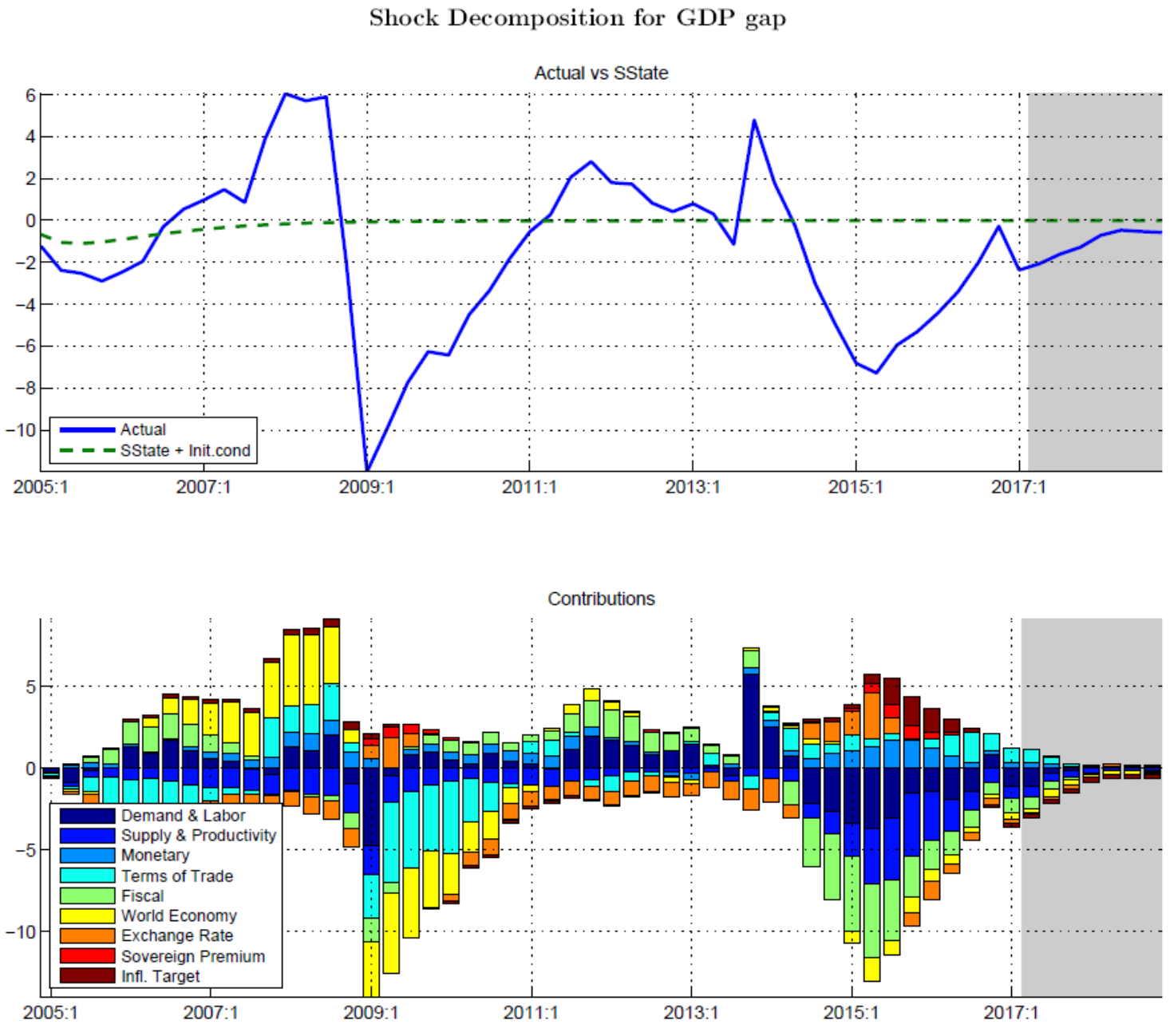
Quarterly Projection Model: which shocks determine deviation from equilibrium



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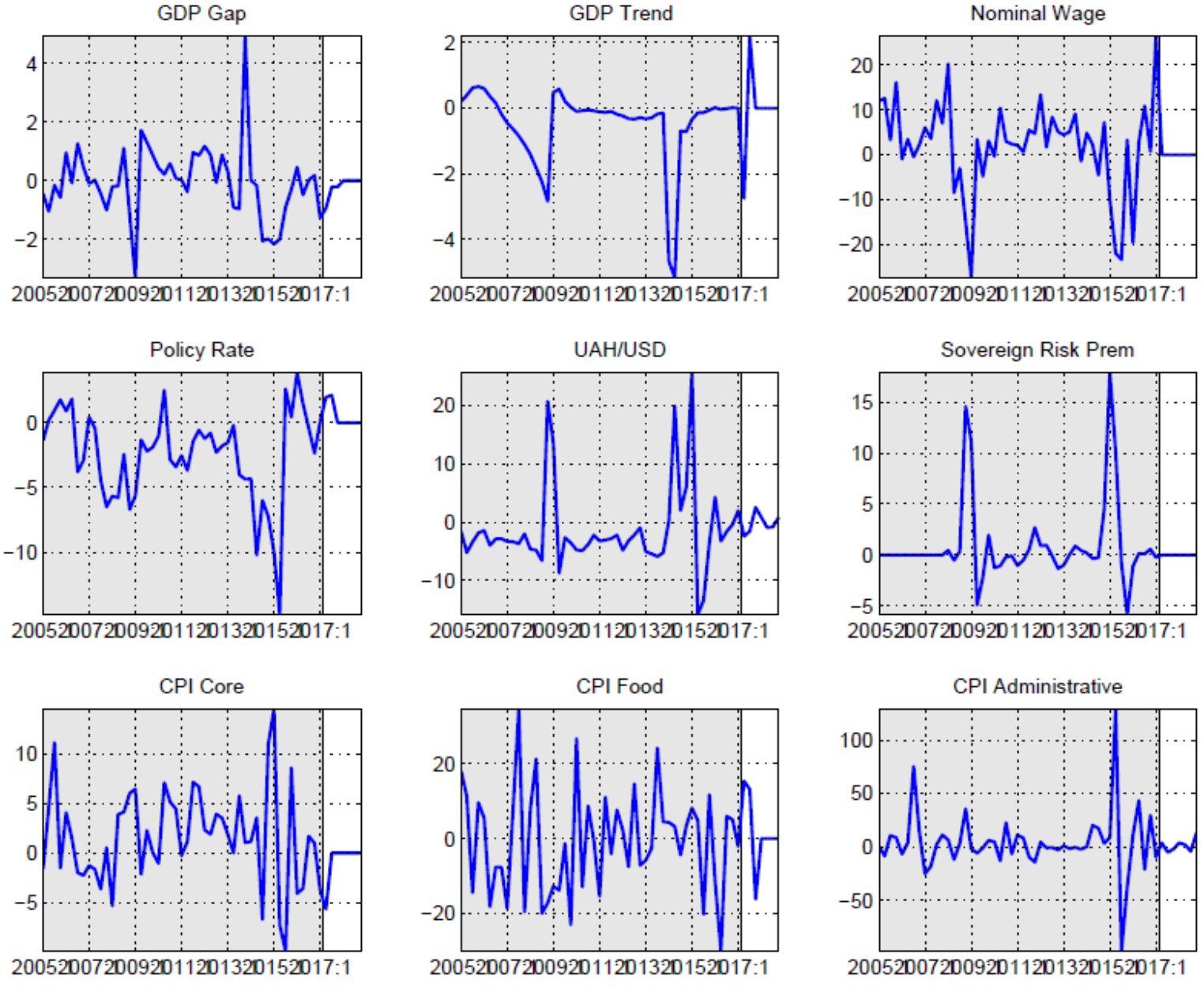
Quarterly Projection Model: Analysis of residuals



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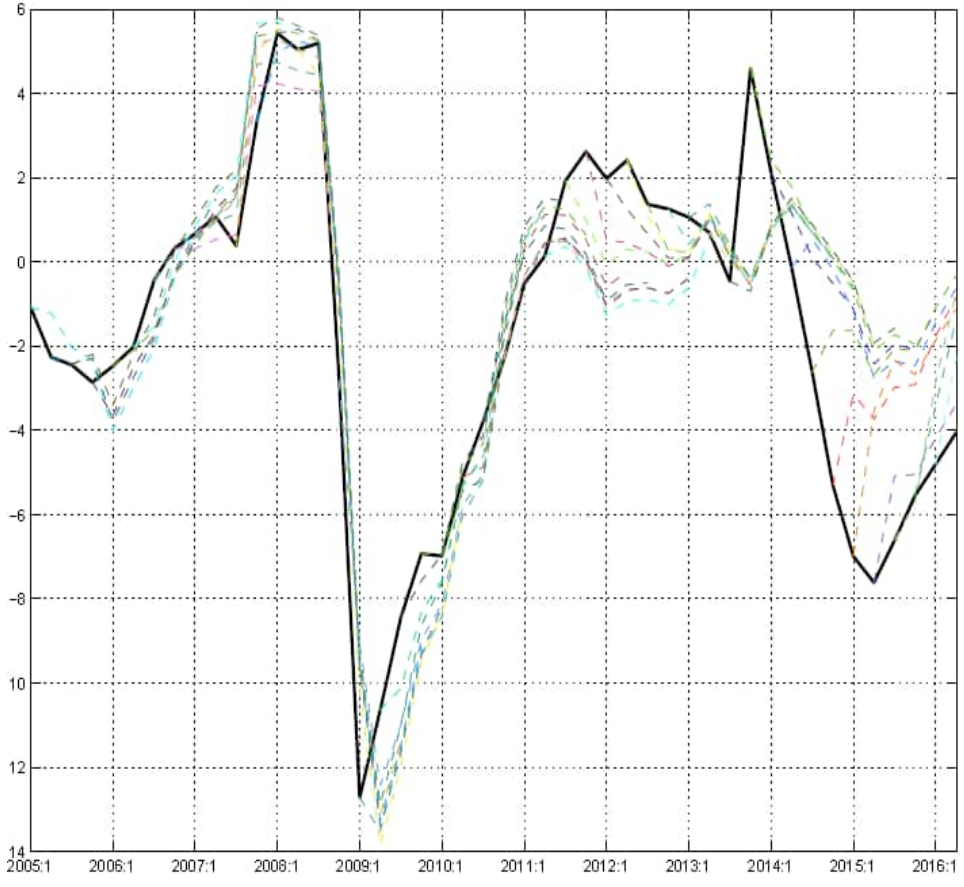
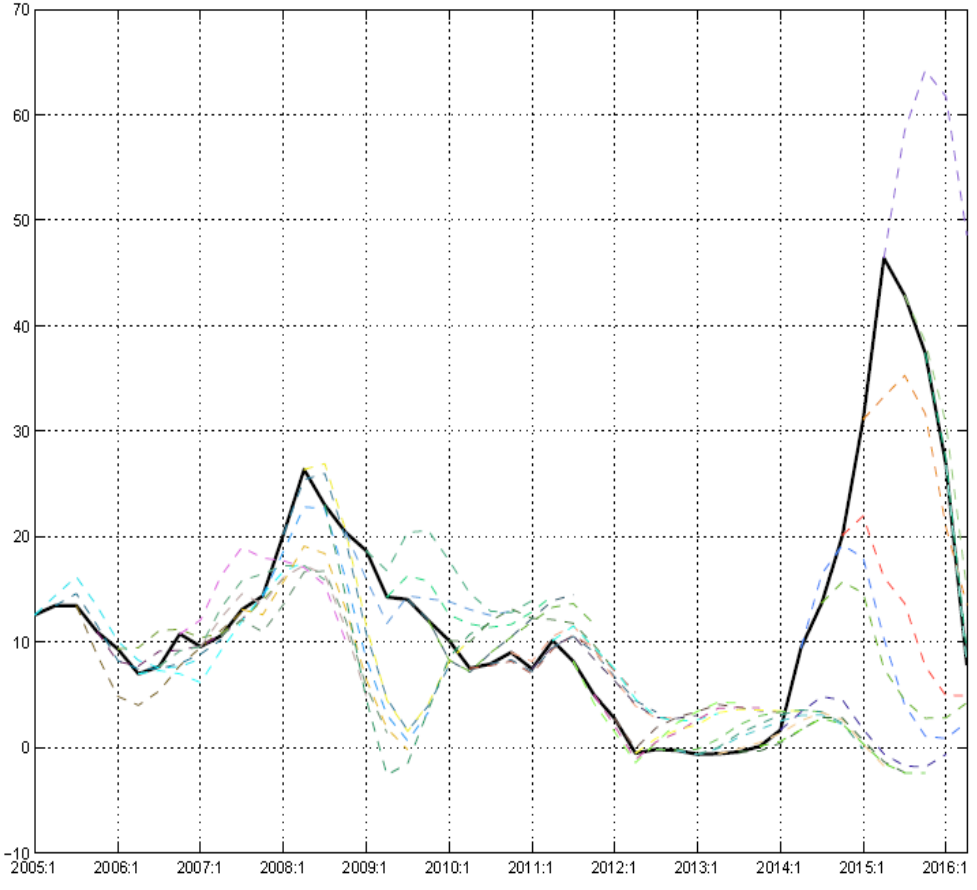
Quarterly **P**rojection **M**odel: **Historical simulations analysis**

GDP gap [l_gdp_gap]



Headline CPI y-o-y changes [d4l_cpi]



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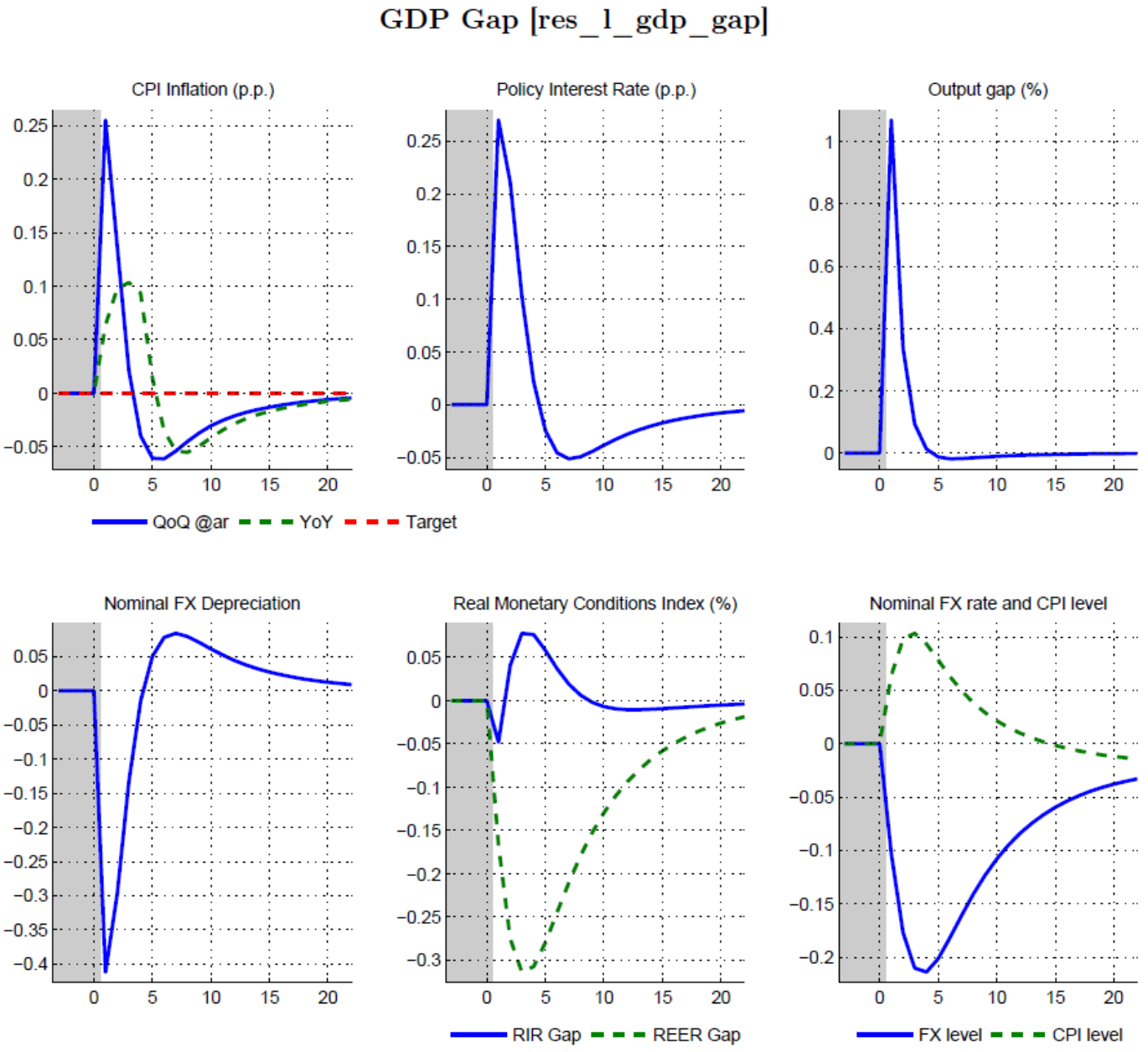
Model properties. Demand shock and policy reaction



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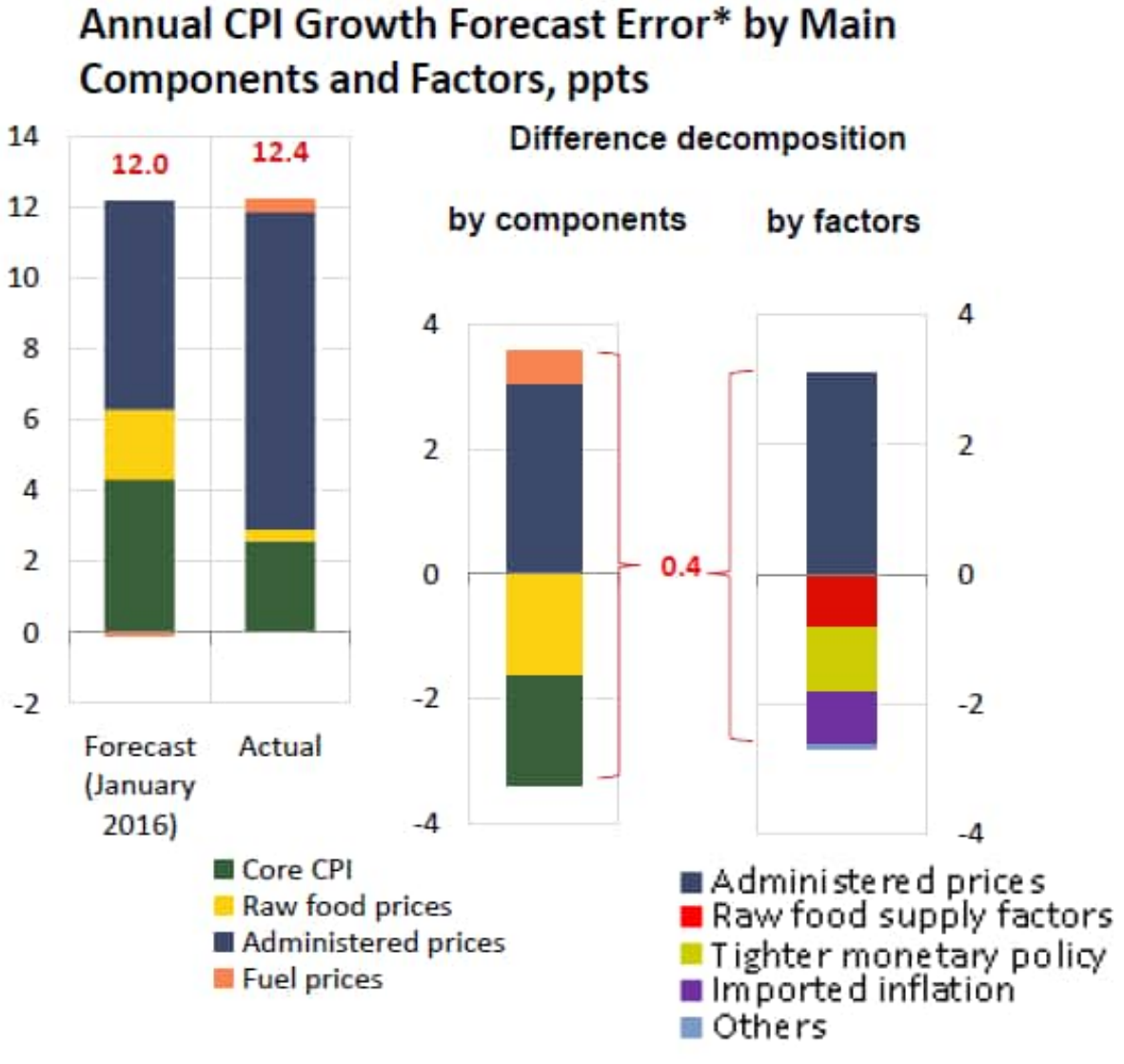
Results evaluation - decomposition of 1.5-year old forecast errors



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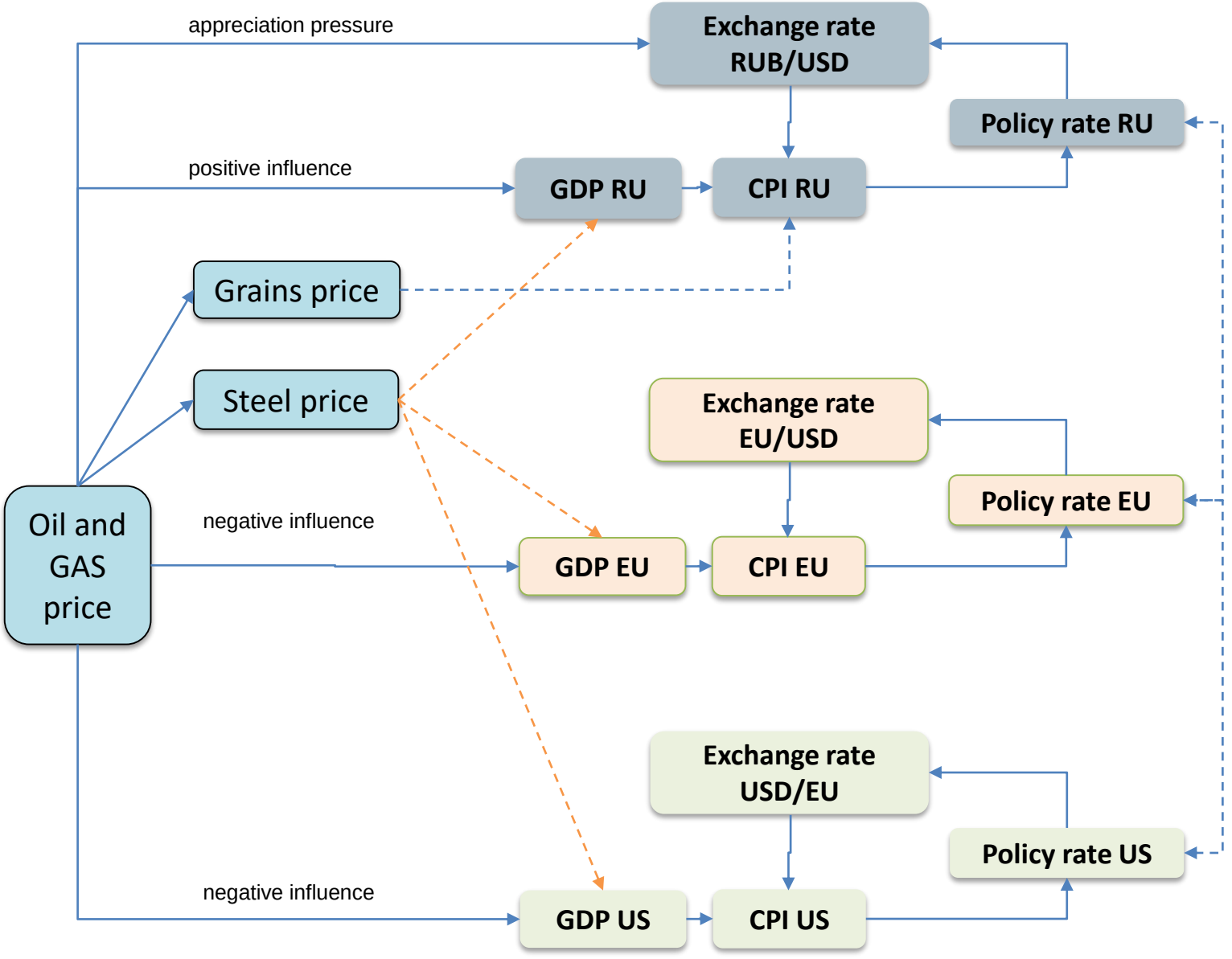
Global Simulation Model: Overall Structure



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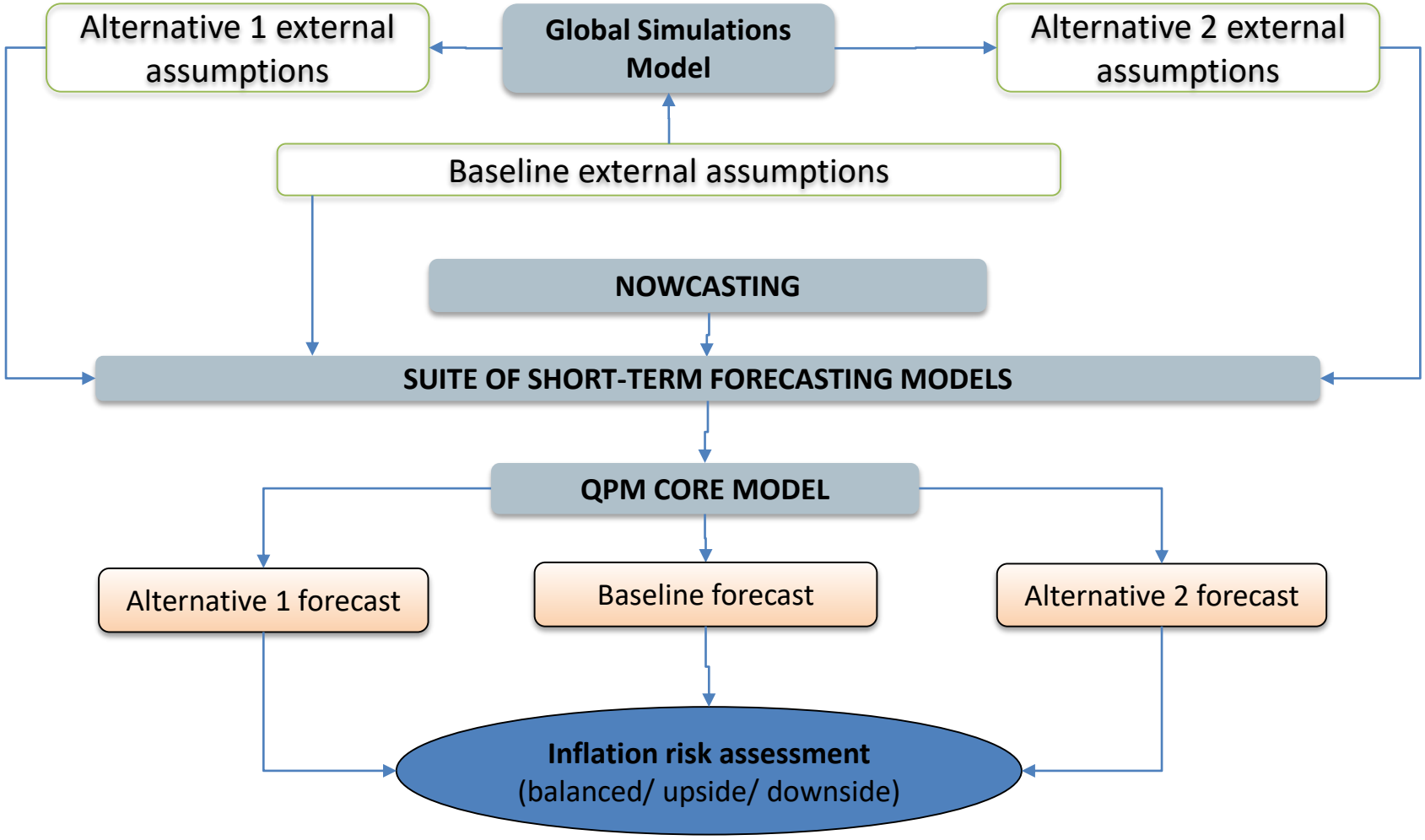
Global Simulation Model: Using for alternative scenarios



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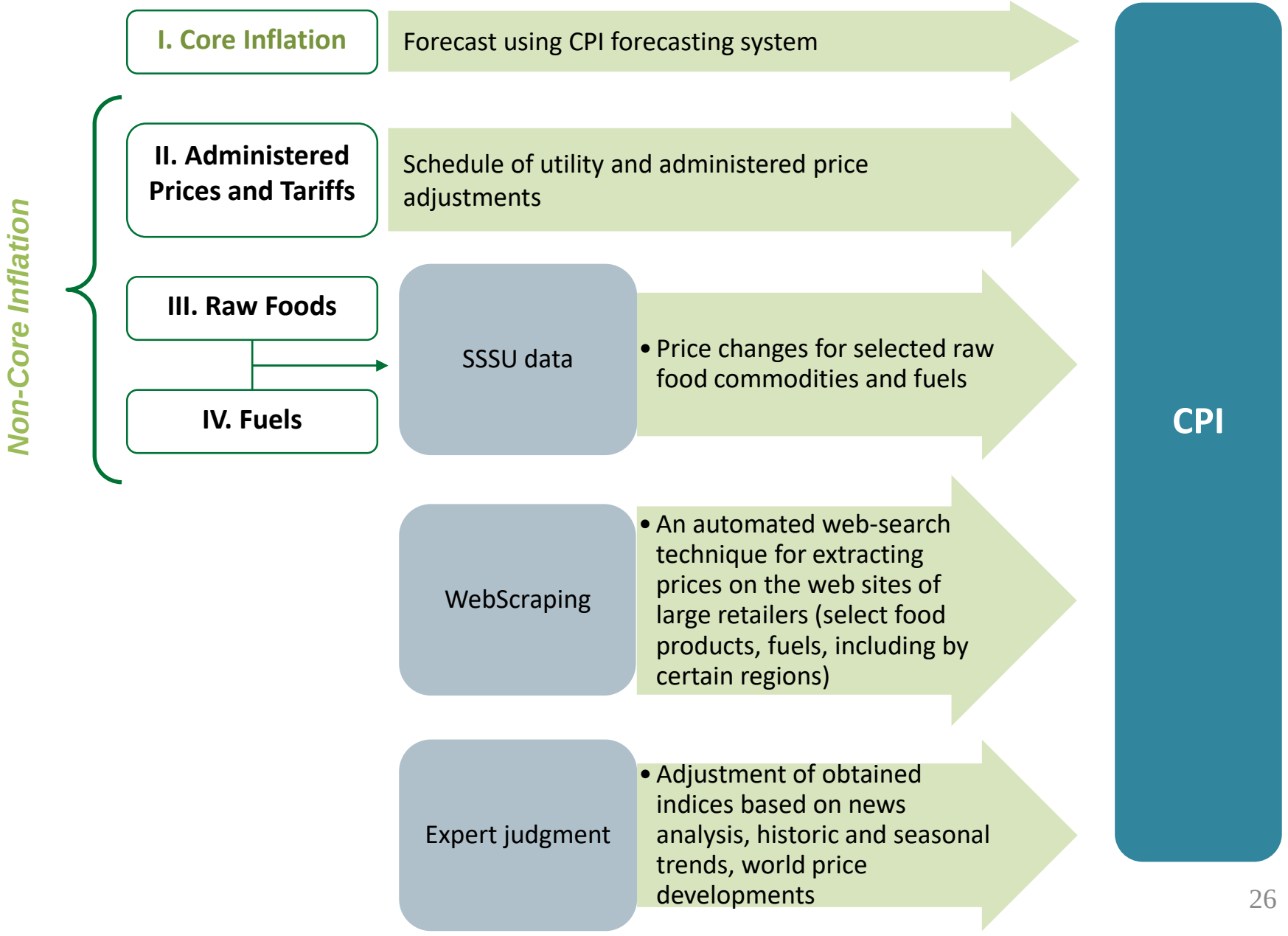
CPI nowcasting



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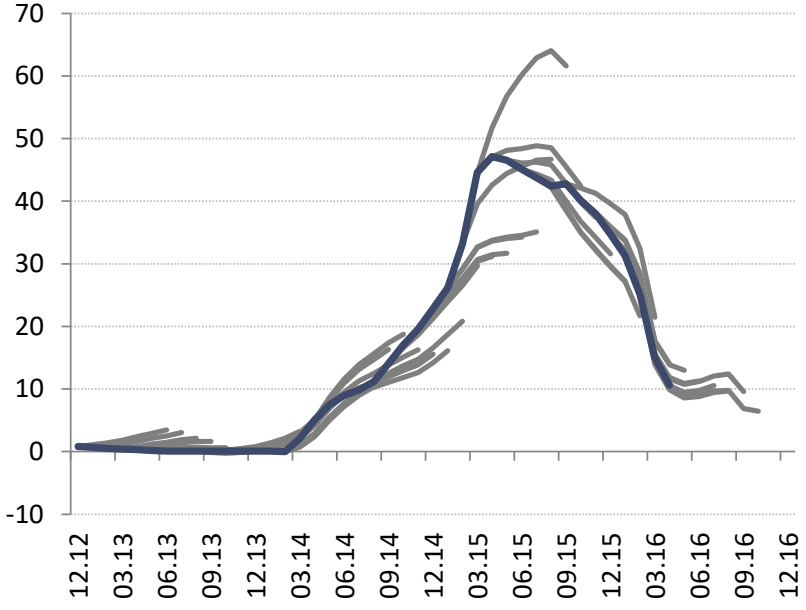
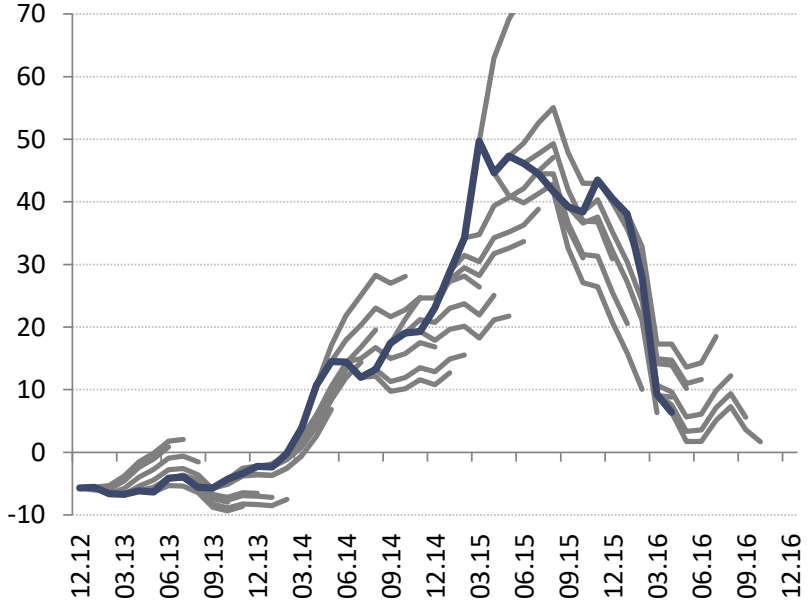
CPI forecasting system

- Used for forecasting and consistency check of QPM results
- System based on equations for: CPI components, producer price index, GDP deflator
- CPI depends on a few variables (world oil, metal and food prices, exchange rate). Each indicator has persistency, core cpi depends on raw food prices.
- Contributions of all factors to each CPI component are visible
- System is constructed on monthly and quarterly basis, results are combined by expert
- Equation coefficients can be changed on-the fly with immediate reflection on: outcomes, equations historical residuals, recalculation of forecast simulations

Core CPI Forecast Simulations, annual change, %



Raw Food Price Forecast Simulations, annual change, %



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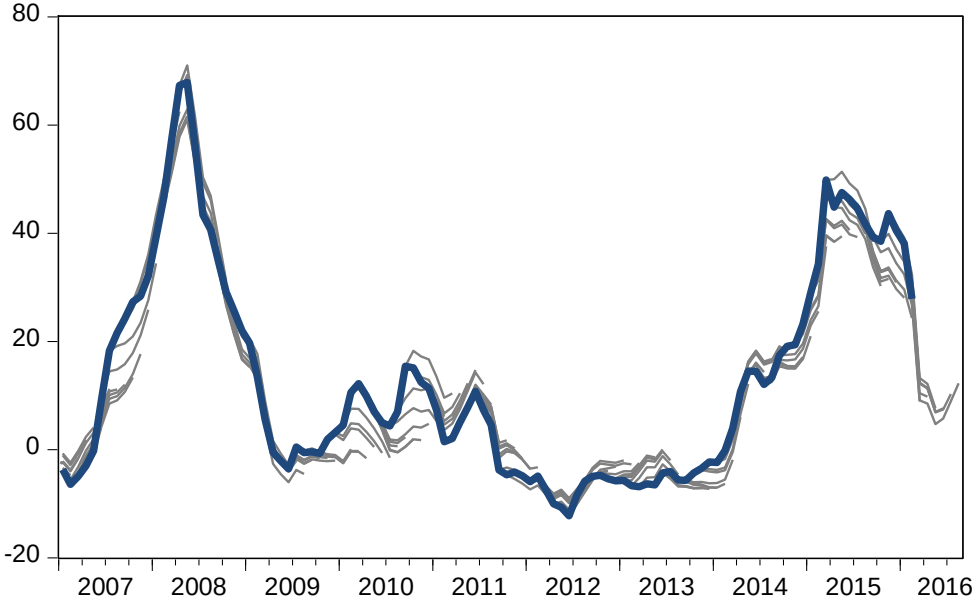
NTF of Raw food prices

- The model consists of 11 ECM equations for RAW food components
- Main focus on supply side factors
  - international commodity prices (raw food, fertilizers, energy)
  - domestic supply side factors (energy prices, commodity prices, production/harvest)
- FAVAR approach is under development

RFPI forecast simulations, 12-month percent change



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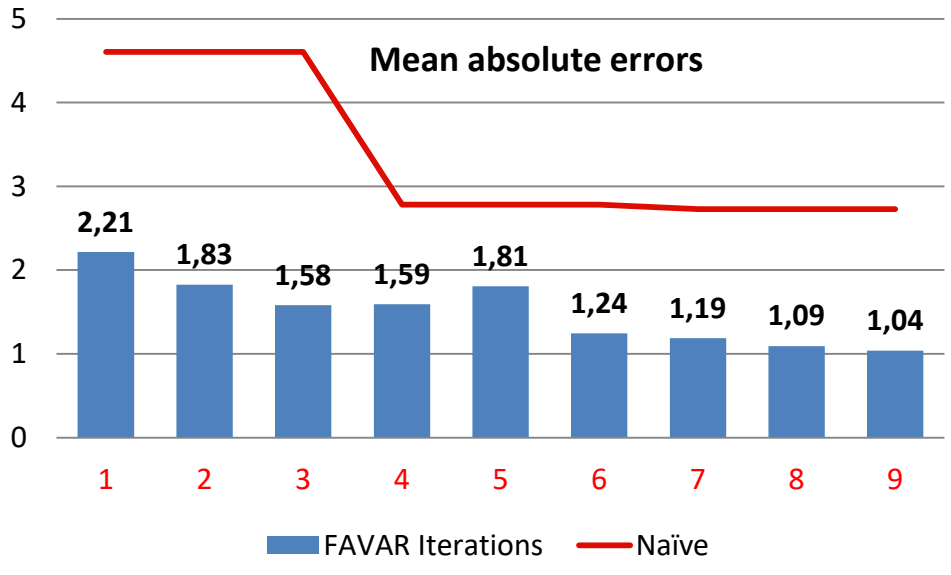
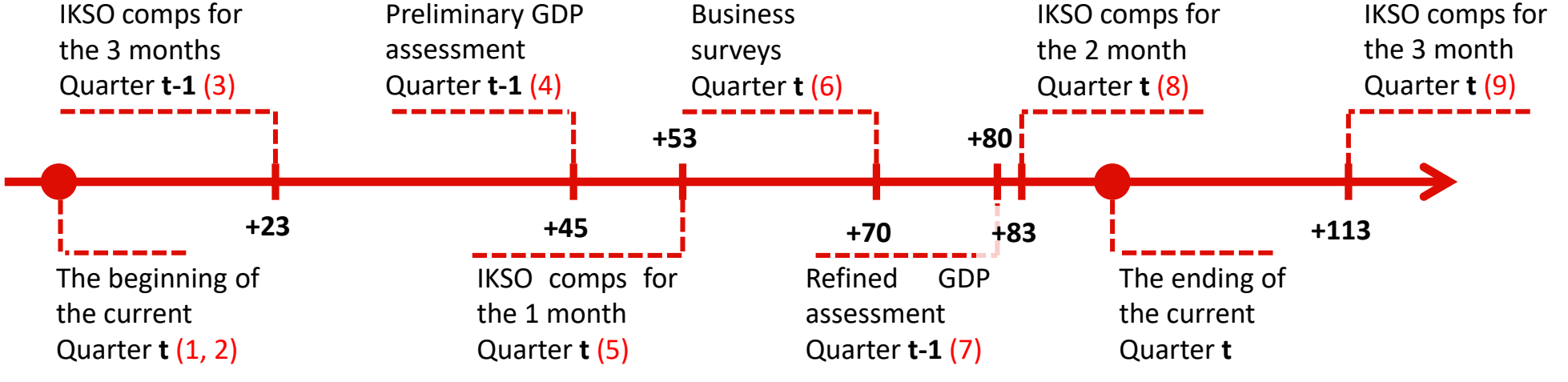
Forecasting Economic Activity with Dynamic Factor Models: Mean Absolute Errors



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

1. 2 months of IKSO Components and Business Surveys for the **previous** quarter
2. 2 months of IKSO Comps for the previous quarter
3. 3 months of IKSO Comps for the previous quarter
4. Preliminary GDP assessment for the previous quarter
5. 1 months of IKSO Comps for the **current** quarter
6. 1 months of IKSO Comps and Business Surveys
7. Refined GDP assessment for the previous quarter
8. 2 months of IKSO Comps and Business Surveys
9. 3 months of IKSO Comps and Business Surveys



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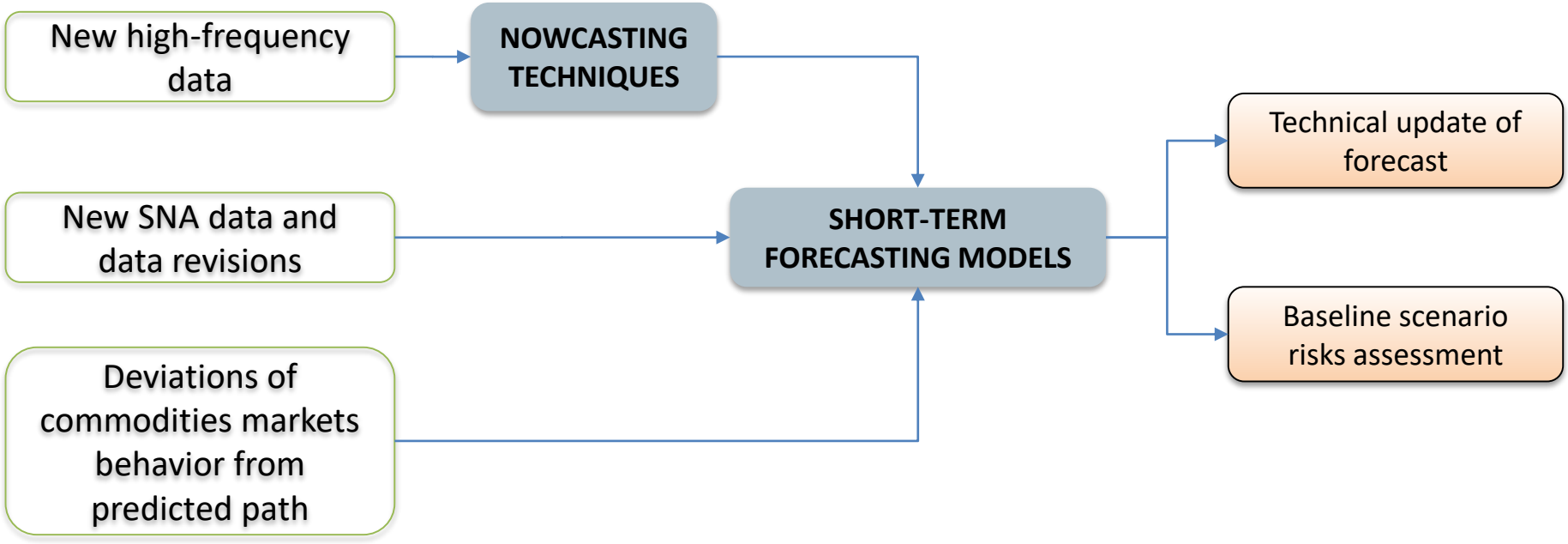
Intermediate forecast updates based on econometric techniques and expert judgments



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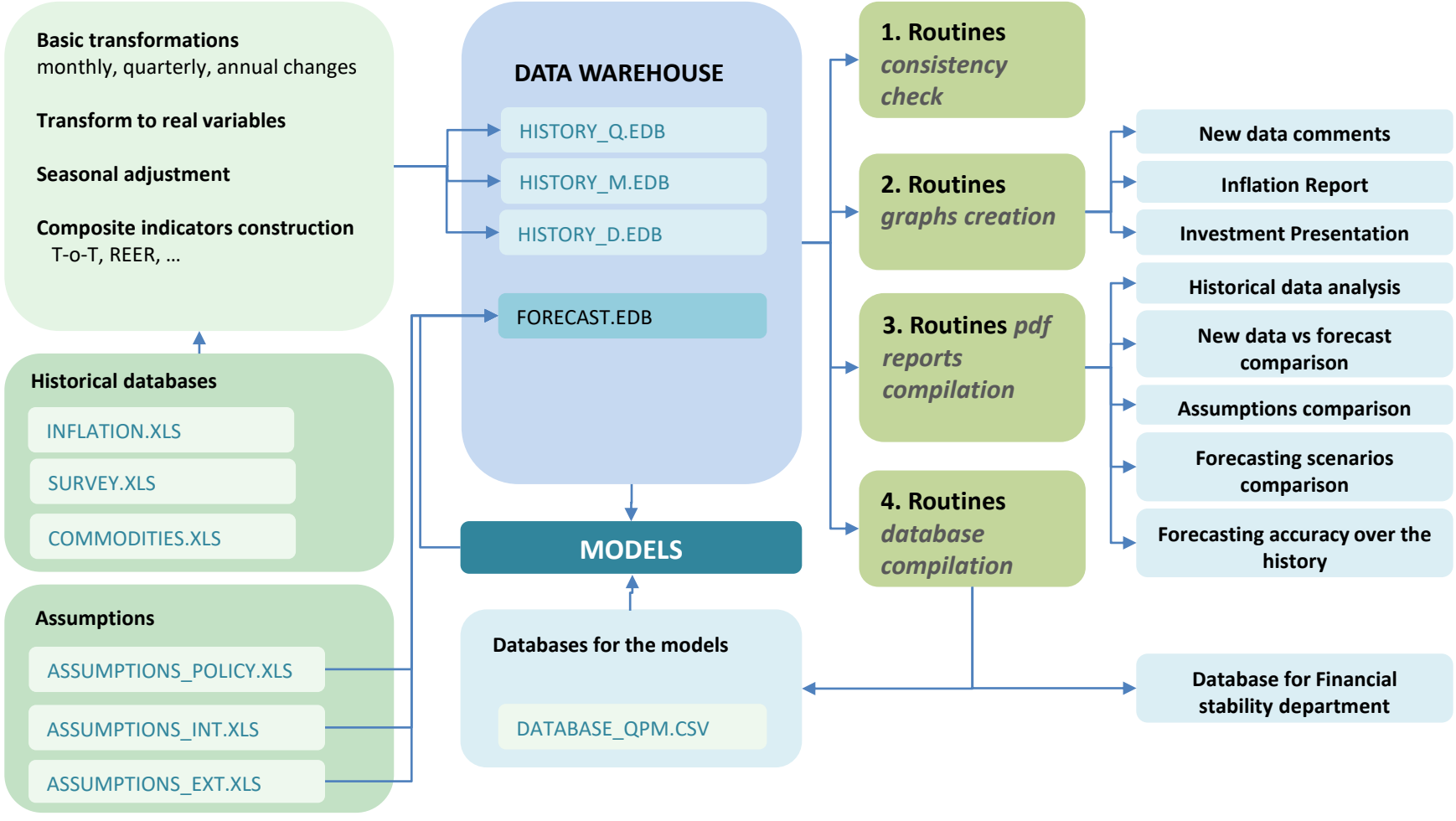
Data warehouse structure



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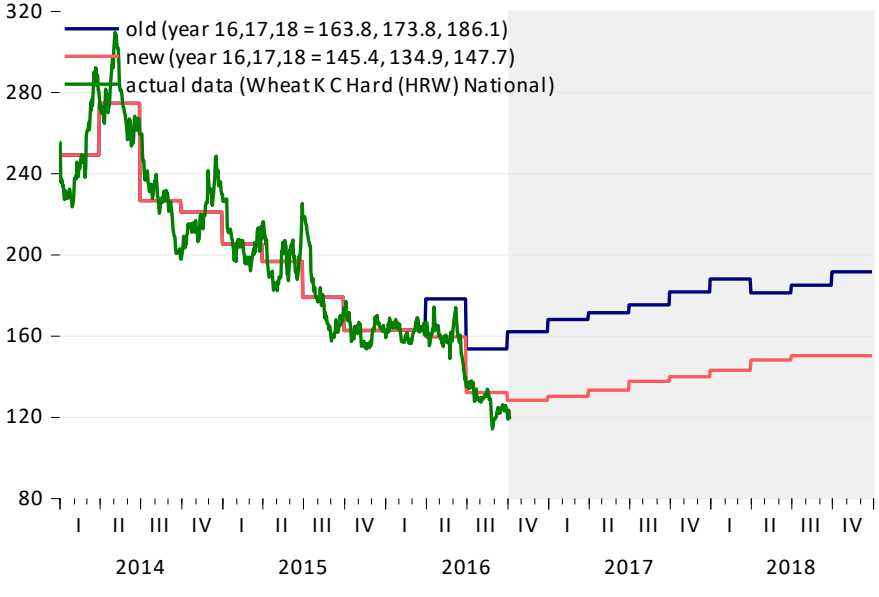
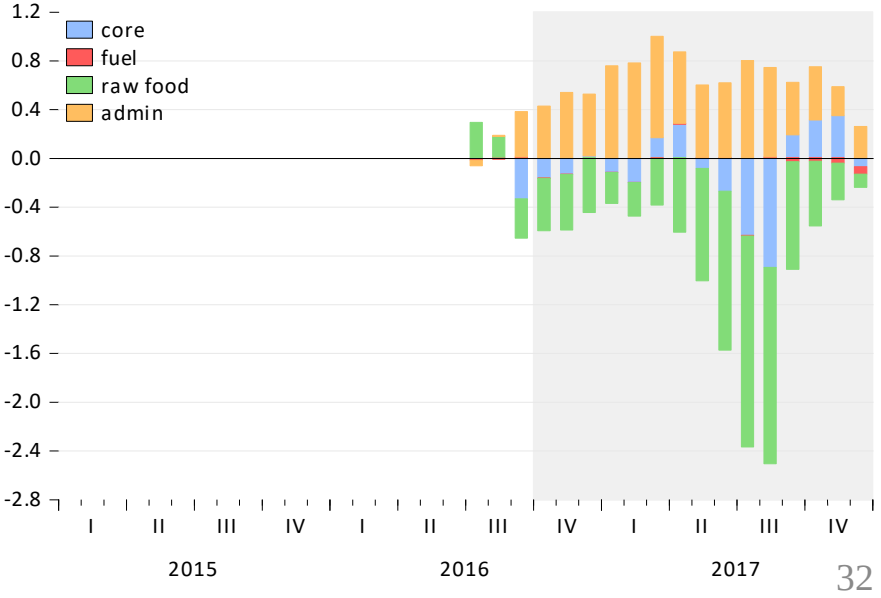
Reporting system

- Automated pdf report creation for each block (CPI, GDP, BOP, ASSUMPTIONS,…)
- Comparison of:
  - different scenarios
  - new forecast vs previous forecast
  - new data vs forecast
- Very easy to use *(code example that should be changed in Eviews)*
  - %compare_scenarios="1610s1r2 1610s2r2 1610s3r2“ ‘(alternatives)
  - %compare_scenarios="1607s1 1610s1r2“ ‘(new vs old)
  - %compare_scenarios="1610s1r1 1610s1r2 1610s1r3“ ‘(forecast rounds)

Wheat world price, $ per t.



Forecast change decomposition, annual, p.p.



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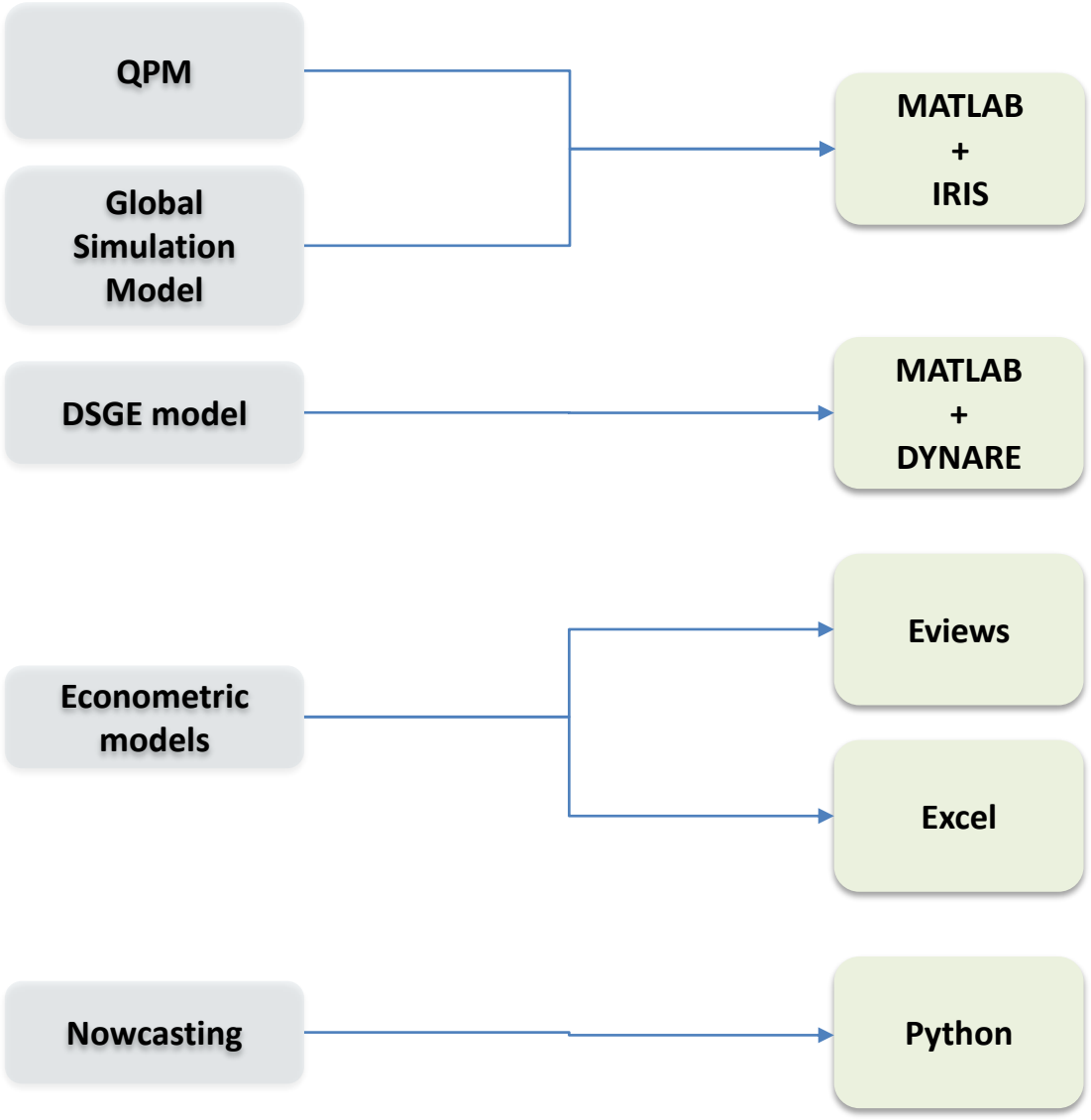
Software



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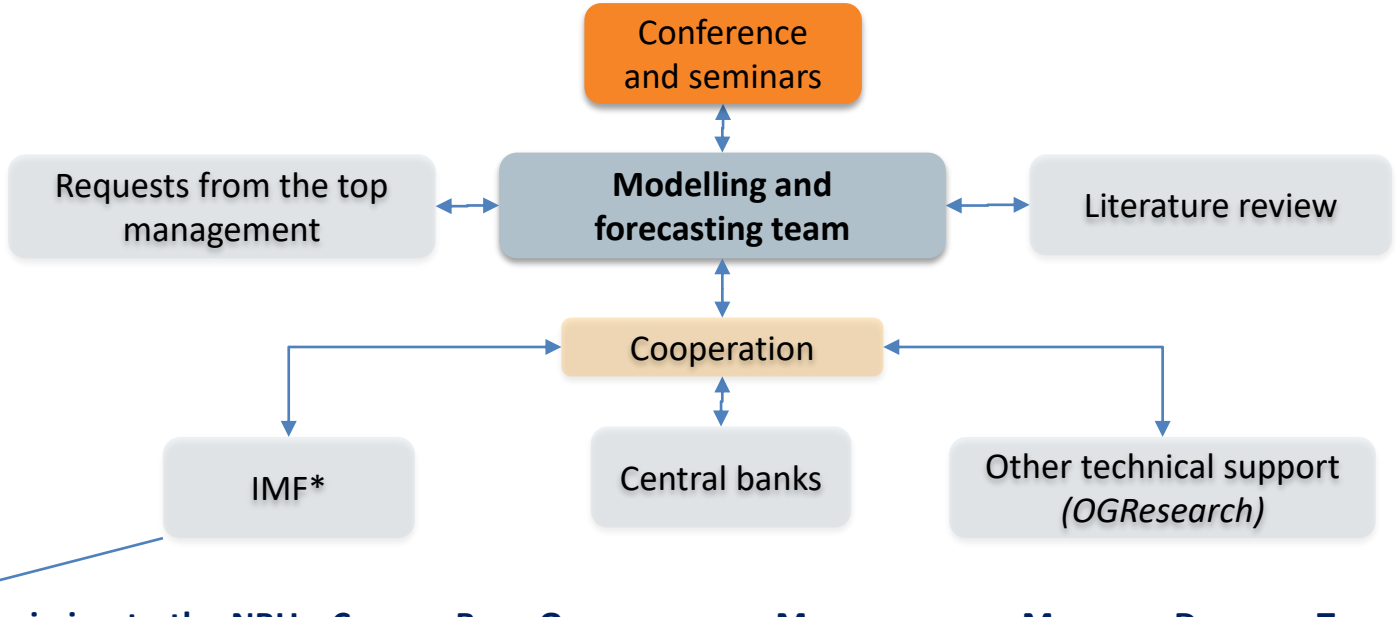
Improving the FPAS



*** IMF Report, TA mission to the NBU - Central Bank Operations and Macroeconomic Modeling During a Transition to Inflation Targeting (December 2016)**

- **Important progress has also been made in the analytical support to policy decisions.** Unlike in the past, policy decisions are now based on medium-term macroeconomic forecasts, which feature prominently in policy briefs and focus on the determination of the trajectory of the key policy rate consistent with achieving the inflation target. The forecasts are based on a medium-term macroeconomic model (QPM) with judgmental inputs from both sector experts as well as policy makers. While the core projection model is key in providing the medium-term consistency and analyzing policy implications of risks, the input from near-term forecasting tools and expert judgment is equally important in shaping the forecast and furnishing sectorial detail.
- **The forecasting properties of the QPM are satisfactory and the model has provided a robust and reliable guidance in the current phase of policy loosening and disinflation.** However, the model's calibration and structure should get ready for future challenges, which may require analysis of credibility effects and monetary-fiscal policy interactions.
- **The model's projections are supported by the short-term forecasting system, which is very advanced and performs reasonably well despite large economic volatility.** Still, attention should be paid to the forecasting bias of some of the econometric equations and replace them gradually by more advanced VAR, Bayesian VARs and FAVAR methods.

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Main obstacles on the way

- Equilibrium levels estimations problems
  (huge structural break)
- Administrative decisions on utility prices have significant effect on inflation
  (huge changes in relative price)
- High elasticity of inflation to agricultural supply shocks
  (large share of foods in the consumer basket)
- High vulnerability of economy to external shocks
  (commodity-oriented export – steel and agriculture)
- Lack of observations with active monetary policy
  (need to rely to peers' experience)
- Weak interest rate channel
  (depressed banking system)
- High role of FX interventions and capital controls

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Conclusions and next steps …

The National Bank of Ukraine has achieved substantial progress in improving FPAS as part of the preparation for transition to IT regime

Next steps …

- Developing the models for scenarios simulations
  - BOP scenarios simulations (based on elasticity's)
  - Alternative forecast simulations (ALFOsim) user-friendly system
- Enhancing QPM (FX interventions in explicit way, external sector, etc.)
- Improving nowcasting and short-term data-driven methods
- Developing DSGE model (for research and policy analysis)
- Combination of forecast in more structural way
- Development of the system for forecasts' evaluation
- Matching the model properties to reflect the MPC members' views on monetary transmission mechanism