Eurasian Economic Commission

Eurasian Development Bank

Centre for Integration Studies

FORECASTING SYSTEM FOR THE EURASIAN ECONOMIC UNION

Joint Report by the Eurasian Economic Commission and the Eurasian Development Bank

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Moscow, Saint Petersburg

2016

UDC 339.97+338.26
BBK 65.012.3.65.054

Editor of the series of reports:	Evgeny Vinokurov, PhD (Econ)
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The authors would like to thank Amat Adarov, Sergey Akhlebinin, Andrey Orlov, Igor Dmitriev, Vahagn Grigoryan , Seilbek Urustemov, Aleksei Kuznetsov, Anton Malakhov, David Vavra, Sergey Plotnikov, Jan Vlcek, Armen Mirzoyan, Kirill Sosunov, Katalin Szilàgyi.

Forecasting System for the Eurasian Economic Union. — Moscow: EEC; St. Petersburg: EDB Centre for Integration Studies, 2016. — p. 104

ISBN 978-5-906157-26-3

The online version of the report is available at the websites of the Eurasian Economic Commission and the Eurasian Development Bank: http://www.eurasiancommission.org/ru/act/integr_i_makroec/dep_makroec_pol/investigations/ and http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/

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ISBN 978-5-906157-26-3

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Tel.: +7 (812) 320 44 41 E-mail: centre@eabr.org

Design, layout and publishing: Airoplan design studio. www.airoplan.ru. 8a Zaozernaya, St. Petersburg, Russia.

Signed to print on January 15, 2016. Circulation 300 copies.
Format 205×260 mm.
Printed by PSP-Print. 32A Bela Kun st., Saint-Petersburg, Russia, 192236.

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GLOSSARY

ADI — Automated Data Interface
BoR — Bank of Russia
DSFS — Dynamic Stochastic Forecasting System
DSGE — Dynamic Stochastic General Equilibrium (models)
EDB — Eurasian Development Bank
EEC — Eurasian Economic Commission
EAEU — Eurasian Economic Union
FP — Financial Programming
IT — Inflation Targeting
ISM — Integrated System of Models
MCM — Multi-County Model
OGR — OGResearch
QPM — Quarterly Projection Model
UIP — Uncovered Interest Rate Parity

PREFACE BY EDB

The evolution of the Eurasian Economic Union (EAEU) and the deepening integration within that alliance present many challenges for economists, with intriguing questions regarding the mechanisms for coordinated economic policies and the governing principles to achieve common objectives. Previously, to make informed decisions, it was enough to be familiar with the relevant national economy. Now it takes much more: first, a profound understanding of the numerous linkages among regional economies and shock-transmission channels, and second, an ability to view the EAEU economy as an indivisible unity. Successful completion of those tasks calls for creating, and making ample use of, state-of-the-art macroeconomic analysis and forecasting tools.

This work builds upon the findings of the joint research undertaken by the Eurasian Development Bank (EDB) and the Eurasian Economic Commission (EEC) to create a system capable of generating economic forecasts for EAEU member states, subject to any applicable country-specific social components. The project has yielded an Integrated System of Models covering five countries. It can be used to analyze economic processes, make projections, and develop proposals and guidance on streamlining economic policies within the EAEU. An important advantage of the Integrated System of Models is that it enables application of analytical and forecasting tools both separately (to individual EAEU member states) and collectively (to the entire integrated alliance), taking into consideration the linkages that exist between its economies and the external world.

Similar systems have been successfully employed by international financial organizations, central banks, and other institutions. They are based on dynamic stochastic models of general equilibrium between the monetary and fiscal sectors. Models of this class make it possible not only to assess the position of an economic system within the business cycle and project fundamental variable movements, but also to analyze the sources of, and optimal responses to, various shocks, fiscal indicator changes, and interactions between monetary and fiscal policy instruments. Currently, this framework is extensively used by the EDB to examine the prospects, instruments, and optimal strategies of EAEU monetary and fiscal policy coordination. The Integrated System of Models is a modern analytical tool designed to add a systemic and structured dimension to the work carried out by analytical units of the Eurasian Development Bank and the Eurasian Economic Commission as they generate joint projections, prepare regular analytical documents, and develop recommendations to boost macroeconomic policies pursued by EAEU member states.

EDB Chairman of the Management Board
Dmitry Pankin

PREFACE BY EEC

The mutual influence of economies is a critical element of any economic integration, one that implies carrying out coordinated or agreed policy measures. Moreover, participation in such integration alliance involves further strengthening of economic ties between the partners over the mid- and long-term horizon. This is affirmed by the stages and logic of development of the Eurasian Economic Union (EAEU, Union). Moreover, the integration offers additional tools for coordination of economic policy measures carried out by the partners.

According to the Treaty on EAEU, member states are implementing agreed macroeconomic policy. Its key objective is to assure compliance with quantitative values of macroeconomic indicators determining sustainability of economic development by keeping inflation, fiscal deficit and public debt levels within certain limits. This promotes sustainable development of the common market—and of the Union as a whole. With that in mind, the Eurasian Economic Commission is engaged in an ongoing monitoring exercise seeking not only to analyze the actual economic developments of member state economies, but also assess medium-term prospects, i.e. preparation of forecasts.

Member states make their own forecasts or projections. However, the forecast for the Union cannot be obtained by simply aggregating the data from national forecasts of the individual member states applying certain "weights". The key element is the mutual influence of member states through trade, financial, and information channels. Therefore, in addition to internal and external factors, the forecasting process must take into account the EAEU's partners development paths. This is particularly relevant for the EAEU's largest economies. For this reason, the creation of the Union puts before us a challenging yet critically important task—preparation of a forecast for the Union as a whole. The Commission has been making forecasts for individual member states since 2012. During our quarterly forecasting meetings with national economic authorities, we formulate and adopt common external hypotheses and assumptions, compare it with official national forecasts, and cross-check the accuracy of our own forecasts. In the course of those regular discussions, we realized that we need a Union-wide model that comprise all possible mutual economic linkages, is built on uniform external parameters, assumptions and, among other things, can be used to verify national forecasts.

In 2013–2014 the Commission together with the Eurasian Development Bank created the Integrated System of Models which meets all those requirements and makes ample use of the latest advances in contemporary macroeconomic theory and best experience in applied modelling techniques. Let me note that this is the first successful implementation, in the former USSR, of a state-of-the-art set of dynamic stochastic general equilibrium models that apply not to separate countries, but to a group of countries, specifically, to the EAEU member states. The Integrated System of Models makes it possible to generate on a regular (quarterly) basis forecasts for the entire Union with close attention to the interplay of monetary and fiscal policy measures, and is subject to further consultations with the parties involved in a process of macroeconomic policy design and implementation according to the Treaty on EAEU.

Tatyana Valovaya, Member of the Board – Minister in charge of the Development of Integration and Macroeconomics of the Eurasian Economic Commission

INTRODUCTION

The Integrated System of Models (ISM) addresses the needs of the Eurasian Development Bank (EDB) and the Eurasian Economic Commission (EEC) to analyze and forecast macroeconomic developments in the region; their ability to analyze policy responses to shocks and risks in the world and the domestic economy, and to shocks to commodity prices; the impact of different policies; and the EDB and EEC's power to advise on coordination of macroeconomic policies in the Eurasian Economic Union (EAEU).

The creation of the EAEU, and especially further steps towards deep monetary integration, poses many challenges for policy coordination at the national as well as multinational levels. As the Eurozone's protracted crisis demonstrates, policy coordination is of primary importance, especially since the EAEU members are heterogeneous in their economic structure. It is expected that the individual economies will be prone to different shocks and will react differently to common shocks affecting the region. For instance, an increase in the world price of oil has different macroeconomic consequences depending on whether the country is a net oil exporter or importer.

Managing the economic integration under such conditions requires a sound analytical and forecasting framework capable of studying these issues in-depth and providing policy guidance. Therefore, the forecasting and analysis system—the ISM—has been built to help quantify various policy options and to support the decision-making process in the face of these shocks. Though the ISM framework does not address structural issues explicitly and deals with macroeconomic aggregates only, it helps to assess the synchronization of business cycles and to evaluate the progress of nominal convergence among the member countries' economies—key conditions for the success of further economic integration. Besides, it is a unique tool for evaluating the medium-term sustainability of the member states' fiscal policies, thus facilitating fiscal policy coordination and providing an early-warning system prior to the eventual introduction of fiscal transfer mechanisms.

A unique feature of the ISM is the capacity to analyze policy reactions against the backdrop of different policy frameworks, including independent monetary and fiscal policies based on a floating, managed, or fixed exchange rate and on tighter integration. With this in mind, the multi-country, structural, and dynamic macroeconomic model has been developed as the core of the ISM. It covers the three founding members of the EAEU (Belarus, Kazakhstan, and Russia) and two accessing countries (Armenia and Kyrgyzstan). The multi-country model sees the member countries as a coherent block and allows for various degrees of their economic integration, such as (i) no coordination among the member countries' policies, i.e., each country chooses its own monetary and fiscal policy, (ii) common monetary but not fiscal policy, i.e., the countries form a monetary union but do not have a common fiscal policy or other types of fiscal transfers; and (iii) common monetary and fiscal policies, i.e., both a monetary union and fiscal transfers exist.

At the same time, each country can be analyzed independently within the multi-country framework to provide additional flexibility. As the country does not coordinate its mone-

tary and fiscal policy with other countries, the model enables the analysis of macroeconomic developments and policy reactions for each country's economy independently, with an option for different policy frameworks. Such frameworks include a fixed, managed, or floating exchange rate regime and different fiscal rules.

The country models are based on a New-Keynesian paradigm with an explicit role and explicit targets for monetary and fiscal policy. The models have been derived in a reduced form with the aim to forecast the medium term (one to four years). While the modeling framework borrows many ideas and implications from dynamic stochastic general equilibrium (DSGE) models, it is much more malleable as it avoids the unnecessary complexities involved in the rigorous derivation, calibration, and data testing of DSGE models. The integrated forecasting system is then implemented as a simple, ready-to-use tool that is easily applicable to a wide array of countries.

Despite the high consistency of projections and analysis provided by the multi-country model, communicating the model-based output outside the modeling team is very challenging. The team works with many reduced-form indicators to keep the models easily maintained and flexible. However, the broader public does not understand these indicators, such as the output gap, the real price of oil, or real marginal costs. Therefore, a set of spreadsheet tables, called the Automated Data Interface (ADI), was designed to decompose model-based, medium-term forecasts into a detailed set of standardized sector accounts such as national accounts, balance of payments, the monetary survey, and fiscal statistics. The system features key identities and stock-flow accounting with relatively simple behavioral mechanisms that include both non-Ricardian and neo-Keynesian features.

While the ISM is designed for constructing medium-term projections of the main macroeconomic variables of the EAEU countries, it also allows for a wide range of important policy experiments, including long-term simulations, analyses of real and nominal convergence, evaluations of medium-term fiscal sustainability, counter-factual scenarios, consistency checks, and a risk analysis:

- Transmission and impacts of the real and nominal shocks hitting the EAEU countries.
- Anticipated versus non-anticipated shocks and policies.
- Fiscal consolidation and monetary convergence of the EAEU countries: (i) world economy scenarios, such as a double-dip world economic recovery, a permanent decline in the output level/growth caused by deteriorating terms of trade, and a permanent increase in the world real interest rate; and (ii) changing macroeconomic fundamentals, such as potential growth and real-exchange-rate appreciation in EAEU countries.
- Effects of independent monetary policy on fiscal consolidation trajectories, including a transition to a coordinated monetary policy and inflation-based fiscal consolidation strategies.
- Performance of various fiscal rules specified in terms of debt and/or a structural deficit.
- Implications of optimistic nominal income/potential growth assumptions on fiscal consolidation and projections in EAEU countries.

1

MAIN FORECASTING MODEL FOR EAEU COUNTRIES

1.1 General Description

Effective coordination of macroeconomic policies in the Eurasian Economic Union is a crucial condition for the long-term success of integration efforts. The experience of the European Union economies during the global financial crisis and the protracted post-crisis recovery provides ample examples of how insufficient policy coordination has almost unraveled decades of integration efforts by exacerbating the imbalances between the southern and northern regions.

However, it is a challenging task to make policy coordination effective. For success, a solid understanding of member economies, their structural developments, and macroeconomic dynamics needs to be developed. With such an analytical toolkit in place, the member states can be provided with appropriate recommendations to coordinate their actions. Only a harmonized effort by all member states will form the bedrock for broader macroeconomic stability and enhance growth prospects.

The EDB and EEC have jointly been building forecasting and modeling capacities to spearhead the policy coordination efforts in the past two years. The result is the Integrated System of Models (ISM), a multi-country, macroeconomic, model-based framework consisting of several country-model blocks, mutual interactions among the economies, spreadsheet tables designed to decompose model-based forecasts into a detailed set of standardized sector accounts, a software environment enabling an effective regular use of the models in policy analysis and forecasting, and a well-maintained database.

At the core of the ISM, there are semi-structural models with monetary and fiscal authorities. The software solution integrates the models with data analysis and the forecaster's judgment, producing user-defined reports.

The model design meets several criteria. First, the model forecasts should aim at a period of one to four years, the typical business cycle. Short-term macroeconomic developments can be better analyzed by judgment and simple time-series analyses than by complex models. Second, the models need to be easy to operate. Any complicated model structure would be restricted in its use as a flexible platform for macroeconomic analyses, simulations of various policy scenarios, and experiments with different degrees of integration within the common economic space.

Another criterion for the model design is that the models display some key structural properties. Although certain reduced-form interpretation is possible to allow for easier operability, it is important that users be able to interpret economic developments and macroeconomic shocks in an intuitive way, a feature available in structural (or semi-structural, in the ISM case) models only. Moreover, only structural models can adequately interpret the underlying structural changes.

Finally, the models need to be forward-looking, complying with the rational expectations theory, as the credibility of monetary and fiscal policies will play an important role in the integration process of the EAEU member countries. In addition, while the models should embed general equilibrium concepts, they do not necessarily require the complexities involved in the rigorous dynamic stochastic general equilibrium (DSGE) framework.

The ISM benchmark model, developed jointly by the EDB and the EEC, is a semi-structural "gap" model of monetary transmission based on the New-Keynesian paradigm. As a New-Keynesian model, it has both nominal and real rigidities. As a gap model, the main mechanisms that drive inflation over the business cycle is the fluctuations of real variables (such as output) around their long-term trends. As a semi-structural model, all shocks are orthogonal, and each equation and parameter have an economic interpretation. In modeling monetary transmission, the model embodies the main principles of monetary policy-making and general equilibrium, such as long-term monetary neutrality. The interest rate serves as a key monetary policy instrument, while fiscal transmission is modeled around the structurally adjusted budget balance.

Because of the semi-structural form, the model is a shortcut to a full structural model derived from optimization of all economic agents in a dynamic stochastic general equilibrium. Although the model structure is well grounded in theory, its parameterization is flexible in order to account for the many empirical phenomena that are country-specific and difficult for theory to capture. The benchmark ISM country model consists of six behavioral equations: the IS curve, the aggregate supply curve, the wage Phillips curve, the monetary policy reaction function, the fiscal policy reaction function, and the uncovered interest parity condition. There are other country-specific, behavioral equations in the model. In addition, the ISM multi-country model encompasses a block of multi-country linkages and many identities.

Specifically, the ISM multi-county model enables its user to:

a) Construct forecasts, including a risk analysis for all EAEU member countries or a subgroup of countries.
b) Analyze the sources of shocks and various policy responses to them.
c) Estimate trends and the position of the economies in a business cycle.
d) Analyze fiscal developments and a monetary–fiscal policy mix.
e) Analyze the implications of a monetary union and a fiscal union (fiscal transfers).

The key behavioral parameters of the ISM multi-country model have been calibrated. The emerging markets do not usually have series that are long enough for a robust estimation of parameters, which would have been the first choice when building a dynamic model for developed economies. Moreover, the dynamic developments in many emerging markets and the underlying structural changes restrict the availability of consistent data samples even further, so estimated models often suffer from overfitting.[1]

[1] Overfitting may occur whenever there is a large set of explanatory variables and/or a limited number of observations involved in estimated equations. Overfitted models tend to produce seemingly very good within-sample fit, while their out-of-sample performance remains poor, and the estimated relationships are not robust and are very sensitive to new data. Moreover, overfitted models tend to produce models with unintuitive dynamics. Indeed, the simultaneous dynamics of key behavioral variables and the forward-looking nature of modern economies imply a high degree of multicollinearity in the series, complicating the estimation.

The role of expectations and regime changes is another reason that the model parameterization cannot rely only on data relationships inherited from the past. A model for macroeconomic forecasting and policy analysis needs to encompass not only actual, but also expected future transmission channels in the economy. Therefore, while it is still important that the models fit data reasonably well, a wider set of techniques has been applied to determine the parameters of the ISM multi-country model.

In the following text, we provide a description of the key behavioral model equations and parameters. However, all the parameters need to be seen in the context of a dynamic model with rational expectations. In this respect, the overall model dynamics and its predictive power are more important than the values of particular parameters. The models were designed to produce plausible dynamics that correspond with macroeconomic theory, international experience, and the developers' expert judgment.

The software environment designed to operate the macroeconomic models of the ISM consists of a set of MATLAB-/IRIS-based programs, which are split into several categories. These include programs for (i) preparing the database, including various data transformations and statistical filtering; (ii) calibrating the model, including the impulse responses; (iii) filtering the model on historical data and the decomposition of the observed data into the contributions of various shocks; (iv) forecasting and reporting; and (v) evaluating the model's forecasting performance using various techniques, such as historical in-sample simulations.

1.2 Russia

The core model for the Russian economy can be characterized as a semi-structural business cycle model of an open economy with two extensions: the labor and fiscal blocks. Usually, this type of model is referred to as a New-Keynesian gap model of a business cycle.[2] The key behavioral links of such a model are (i) the Aggregate Demand curve, in which the output gap depends negatively on the Real Monetary Conditions (a weighted average of the real interest rate gap and the real exchange rate gap); (ii) the Aggregate Supply curve, with inflation depending positively on the Real Marginal Costs (a weighted average of the output gap, the real wage gap, and the real exchange rate gap); (iii) the Monetary Policy Rule, where the market interest rate depends positively on expected inflation; and (iv) the Uncovered Interest Parity condition, linking the expected change of the nominal exchange rate to the interest rate differential.[3]

An important feature of the Russian economy is its high dependence on oil and gas exports. While the total volume of production is relatively rigid, the prices of these commodities display high volatility, with strong transmission to the Russian real economy. To capture these dynamics, Equation (RU.1) calculates the real price of oil (rp_t^{oil}) as the nominal price of oil in USD $(p_t^{oil^{USD}})$ over the U.S. CPI (p_t^{us}). At the same time, we decompose oil price developments into a business-cycle movement $(\hat{rp}_t^{oil})$ and the long-term trend $(\overline{rp}_t^{oil})$, in order to distinguish between temporary and permanent oil price movements. Both the trend and gap components are described using simple autoregressive equations, as the ISM does not intend to project oil price movements.

[2] For a basic reference, see Berg, Karam, and Laxton (2006); Erceg, Henderson, and Levin (2000). For theoretical foundations of the model, see, e.g., Walsh (2010).

[3] In total, the Russian block of the multi-country model consists of 59 equations, many of which are identities and definitions (see the Appendix B).

$$rp_t^{oil} = p_t^{oil^{USD}} - p_t^{us} \tag{RU.1}$$

$$rp_t^{oil} = \overline{rp}_t^{oil} + \widehat{rp}_t^{oil} \tag{RU.2}$$

$$\widehat{rp}_t^{oil} = c_{12}\, \widehat{rp}_{t-1}^{oil} + \varepsilon_t^{\widehat{rp}^{oil}} \tag{RU.3}$$

$$\Delta\overline{rp}_t^{oil} = c_{13}\, \Delta\overline{rp}_{t-1}^{oil} + (1 - c_{13})\, \Delta\overline{rp}_{ss}^{oil} + \varepsilon_t^{\Delta\overline{rp}^{oil}} \tag{RU.4}$$

$$\Delta\overline{rp}_t^{oil} = 4 \left(\overline{rp}_t^{oil} - \overline{rp}_{t-1}^{oil} \right) \tag{RU.5}$$

$$\Delta oil_t = 4 \left(p_t^{oil^{USD}} - p_{t-1}^{oil^{USD}} \right) \tag{RU.6}$$

c_{12}	c_{13}	$\Delta\overline{rp}_{ss}^{oil}$
0.50	0.85	−1.00

As described in the paragraphs below, the oil price enters the Russian model in several places, affecting both the equilibrium trajectories and the cyclical components of the variables.

In terms of **aggregate demand**, we follow the usual structure of New-Keynesian gap models in which the output gap is a reduced-form indicator of a business cycle. Equation (RU.7) shows that the output gap $(\hat{y}_t^{ru})$, in addition to backward- and forward-looking expectation elements, depends on the local real short-term interest rate $(\hat{r}_t^{ru})$ and a term premium on the Russian money-market $(\widehat{sp}_t)$, the real effective exchange rate $(\hat{z}_t^{eff,ru})$, foreign demand $(\hat{y}_t^{f,ru})$, a fiscal deficit $(\widehat{def2gdp}_t^{ru})$, and the real price of oil $(\widehat{rp}_t^{oil})$, all expressed in terms of a deviation from their respective equilibriums.

$$\hat{y}_t^{ru} = c_{44}\, \hat{y}_{t+1}^{ru} + c_{45}\, \hat{y}_{t-1}^{ru} - c_{46}\, (\hat{r}_t^{ru} + c_{51}\, \widehat{sp}_t) + c_{49}\, \hat{z}_t^{eff,ru} + \\ + c_{47}\, \widehat{rp}_t^{oil} + c_{48}\, \hat{y}_t^{f,ru} + c_{50}\, \widehat{def2gdp}_t^{ru} + \varepsilon_t^{\hat{y}^{ru}} \tag{RU.7}$$

c_{44}	c_{45}	c_{46}	c_{51}	c_{49}	c_{47}	c_{48}	c_{50}
0.10	0.60	0.09	0.50	0.12	0.06	0.20	0.20

Typically, the sum of c_{44} and c_{45} is between 0.5 and 0.9.[4] These parameters have to account for the relative magnitude, regional dominance, and openness of the Russian economy, as well as high growth volatility, which points the values to 0.1 and 0.6 respectively. Russia also exhibits a relatively standard pass-through of monetary policy conditions to domestic demand. In this respect, parameters c_{46} and c_{49} were calibrated for a typical market economy. Usually, the sum of the parameters hovers between 0.1 and 0.3. Parameter c_{51} then adds dynamics of the long-term interest rate (with a weight of 0.5) and parameter c_{50} a cyclical budget deficit (with a weight of 0.2) to the system, both within the usual regional pattern.

Effective foreign demand $(\hat{y}_t^{f,ru})$ is approximated by a trade-weighted composite measure dominated by the U.S. and the Eurozone (see Subsection 1.7. for details). In reflecting the historical cross-correlations between this measure and Russian demand, parameter c_{48} has been set to 0.2.

Russia exhibits a large dependence of domestic demand on the development of the

[4] For general calibration guidelines, see, e.g., Berg, Karam, and Laxton (2006). Full calibration of the model is presented in Appendix D. This version of the calibration is an illustrative one and may be subject to significant changes during the forecasting rounds. The changes in calibrations are usually based on the consensus of the working group on the prospects of the macroeconomic situation in the country/region/world.

oil price, which to a large extent approximates the terms of trade. An increasing price of oil (and gas) adds windfall income to the economy and stimulates domestic demand (unless stored as budget profit). Parameter c_{47} has been calibrated at 0.06 to account for the historical patterns observed in the data.

The **long-term component of Russian output** then depends on technology growth driven by the commodity sector (approximated by trend growth in the real price of oil — $\Delta\overline{rp}_t^{oil}$ —with an elasticity of 0.15) and oscillates around the steady-state level (Δy_{ss}^{ru}) calibrated to 2%, somewhat below the historical average to address the general deceleration in world growth:

$$\Delta\bar{y}_t^{ru} = c_{53}\,\Delta\bar{y}_{t-1}^{ru} + (1-c_{53})\left(\Delta y_{ss}^{ru} + c_{54}\,c_{43}\left(\Delta\overline{rp}_t^{oil} - \Delta\overline{rp}_{ss}^{oil}\right)\right) + \varepsilon_t^{\Delta\bar{y}^{ru}} \qquad \text{(RU.8)}$$

c_{43}	c_{53}	c_{54}	Δy_{ss}^{ru}
0.45	0.75	0.40	2.00

Similar to long-term economic growth, the **long-term dynamics of the real exchange rate** is also closely related to productivity and technology improvements driven by the commodity sector. Based on historical patterns, the elasticity to the real price of oil $(\Delta\overline{rp}_t^{oil})$ is estimated at 0.45:

$$\Delta\bar{z}_t^{ru} = c_{72}\,\Delta\bar{z}^{ru}{}_{t-1} + (1-c_{72})\left(-c_{42}\,\Delta\overline{rp}_t^{oil}\right) + \varepsilon_t^{\Delta\bar{z}^{ru}} \qquad \text{(RU.9)}$$

c_{72}	c_{42}
0.75	0.45

The main element of the **labor market block** is a Phillips curve determining nominal wage growth (Δw_t^{ru}) based on the cyclical components of real wages $(\widehat{wr}_t^{ru})$ and output (the output gap, $\hat{y}_t^{ru}$). This formulation assumes that nominal wage growth accelerates in booms (and vice versa), but decelerates when real wages are already too high relative to equilibrium—a standard result in the labor market literature.[5]

The cyclical component (a gap) of real wages $(\widehat{wr}_t^{ru})$ is a detrended part of the observed real wage, whose trend $(\Delta\overline{wr}_t^{ru})$ in growth terms is modeled as an autoregressive process around the assumed long-term steady-state value of real wage growth, closely related to potential growth $(\Delta\bar{y}_t^{ru})$, plus an additional wedge (c_{68}), which was estimated at 1.25 on the historical sample.

$$\Delta w_t^{ru} = c_{64}\,{}^{e}\Delta w_t^{ru} + (1-c_{64})\,\Delta w_{t-1}^{ru} + c_{65}\,(-c_{66}\,\widehat{wr}_t^{ru} + (1-c_{66})\,\hat{y}_t^{ru}) + \varepsilon_t^{\Delta w^{ru}} \qquad \text{(RU.10)}$$

$$wr_t^{ru} = \widehat{wr}_t^{ru} + \overline{wr}_t^{ru} \qquad \text{(RU.11)}$$

$$\Delta\overline{wr}_t^{ru} = c_{67}\,\Delta\overline{wr}_{t-1}^{ru} + (1-c_{67})(\Delta\bar{y}_t^{ru} + c_{68}) + \varepsilon_t^{\Delta\overline{wr}^{ru}} \qquad \text{(RU.12)}$$

c_{64}	c_{65}	c_{66}	c_{67}	c_{68}
0.00	0.15	0.85	0.75	1.25

Our calibration assumes a forward-looking nature of the wage-setting process in Russia. Indeed, the data show that shocks to wage growth do not exhibit high persistence.

[5] In fact, the ratio of output to real wages proxies for the marginal rate of substitution between consumption and leisure by labor-supplying households—the key wage determinant. See Erceg, Henderson, and Levin (2000).

Therefore, parameter c_{64} was set to 0.7 to mimic such a pattern. At the same time, the real wage gap has not been open for extended periods in recent years, suggesting a strong error-correction mechanism in the labor market (c_{65} and c_{66} calibrated to 0.15 and 0.85, respectively).

Short-term **aggregate supply** is represented by the traditional link between the business cycle position and inflation. As inflation is influenced by domestic demand, the labor market situation, and import prices, we model the overall pressure on domestic inflation by combining the gaps in real consumption and real wages with the real exchange rate gap. The real exchange rate gap approximates the marginal costs of importers and depends on the nominal exchange rate and on foreign and domestic inflation rates. Equation (RU.13) determines CPI inflation, and Equation (RU.14) the way the marginal costs are constructed using the gaps in the real exchange rate, real consumption, and real wages.

$$\pi_t^{ru} = c_{55}\,{}^{e}\pi_t^{ru} + (1 - c_{55} - c_{59})\,\pi_{t-1}^{ru} + c_{56}\,(rmc_t^{ru}) + c_{59}\,\pi_{t-1}^{im,ru} + \varepsilon_t^{\pi,ru} \qquad \text{(RU.13)}$$

$$rmc_t^{ru} = c_{57}\,\hat{z}_t^{eff,ru} + (1 - c_{57} - c_{58})\,\hat{y}_t^{ru} + c_{58}\,\widehat{wr}_t^{ru} \qquad \text{(RU.14)}$$

c_{55}	c_{56}	c_{59}	c_{57}	c_{58}
0.35	0.10	0.03	0.50	0.10

The coefficients of expected, lagged, and imported inflation add up to one, allowing monetary policy to target any level of inflation. It means the model does not determine a "natural" level of inflation. Consistently with the Russian data, we set parameter c_{55} to 0.35, closely mirroring the Calvo pricing, which allows only a limited set of economic agents to change their prices every period.[6] The direct impact of import prices on Russian inflation is low, bringing parameter c_{59} to as low as 0.03. Parameter c_{56} defines the effect of real marginal costs *(rmc)* on inflation and has been set to 0.1. This figure is relatively low in a regional comparison, and it is determined by the relative rigidity of the Russian market. The decomposition of the real marginal costs reflects the openness of the Russian economy ($c_{57} = 0.5$), while the labor market contribution to price formation is lower ($c_{58} = 0.1$).

Monetary policy is represented by a forward-looking Taylor-type reaction function (Equation (RU.15)). The central bank sets the short-term money market interest rate (i_t^{ru}) in order to stabilize CPI inflation around the inflation target $(\pi_{t+3}^{t\ ar,ru})$, defined for year-on-year CPI inflation three periods ahead. This horizon is chosen so as to include the current-period shock in the policy reaction function. In a forecast, the trajectory of the inflation target is set by the forecaster, and so are, typically, the parameters of the reaction functions, depending on the presumed policy preferences. Here we use such a rule, which in our view mimics well the preferences of the Russian monetary authority in the last few years, as revealed by the data.

Exchange rate growth and the output gap are additional possible terms introduced in the monetary policy rule, representing high preference of the local authorities for smoothing the exchange rate.

$$i_t^{ru} = c_{61}\,i_{t-1}^{ru} + (1 - c_{61})\left(\bar{r}_t^{ru} + \pi_{t+3}^{4,ru} + c_{62}\left(\pi_{t+3}^{4,ru} - \pi_{t+3}^{tar,ru}\right) + c_{63}\,s_t^{dev,ru}\right) + \\ + c_{64}\,\hat{y}_t^{ru} + \varepsilon_t^{i,ru} \qquad \text{(RU.15)}$$

c_{61}	c_{62}	c_{63}	c_{64}
0.75	0.40	0.00	0.00

[6] See, e.g., Rotemberg and Woodford (1999), Woodford (2005).

Expected nominal exchange rate depreciation is, in addition to the interest rate differential, driven by the risk premium through the Uncovered Interest Rate Parity (UIP) condition:

$$ {}^{e}s_t^{RUB/USD} - s_t^{RUB/USD} = i_t^{ru}/4 - i_t^{us}/4 - prem_t^{ru}/4 + \varepsilon_t^{s^{RUB/USD}} \qquad \text{(RU.16)} $$

To capture the rigidities in the Russian financial market, the expected one-quarter-ahead nominal exchange rate is modeled as a composite of a model-consistent forecast ($c_{60} = 0.7$) and the past level of the exchange rate, adjusted by equilibrium nominal depreciation.[7]

$$ {}^{e}s_t^{RUB/USD} = c_{60}\, s_{t+1}^{RUB/USD} + (1 - c_{60})\left(s_{t-1}^{RUB/USD} + 2\left(\pi_t^{tar,ru} + \Delta\bar{z}^{ru}{}_t - \pi_{ss}^{us}\right)/4\right) \qquad \text{(RU.17)} $$

Another block of the model deals with **fiscal rules and fiscal accounting**. The ultimate fiscal policy variable is the observed deficit $(def2gdp_t^{ru})$.[8] For the sake of empirical coherence, we split the dynamics of the observed overall deficit into two parts.

$$ \overline{def2gdp}_t^{ru} = c_{73}\,\overline{def2gdp}_{t-1}^{ru} + (1 - c_{73})\left(def2gdp_t^{tar,ru} - c_{78}\,(\Delta\bar{y}_t^{ru} - \Delta y_{ss}^{ru})\right) + \varepsilon_t^{\overline{def2gdp}^{ru}} \qquad \text{(RU.18)} $$

$$ \begin{aligned} def2gdp_t^{ru} = {} & c_{75}\, def2gdp_{t-1}^{ru} + \\ & + (1 - c_{75})\left(def2gdp_t^{tar,ru} - c_{76}\left(def2gdp_{t-1}^{ru} - def2gdp_{t-1}^{tar,ru}\right) - c_{77}\,\hat{y}_t\right) + \\ & + \varepsilon_t^{def2gdp^{ru}} \end{aligned} \qquad \text{(RU.19)} $$

$$ def2gdp_t^{ru} = \overline{def2gdp}_t^{ru} + \widehat{def2gdp}_t^{ru} \qquad \text{(RU.20)} $$

c_{73}	c_{75}	c_{76}	c_{77}	c_{78}	$def2gdp_{ss}^{tar,ru}$
0.50	0.50	0.50	0.80	0.30	0.50

First, the structural deficit $(\overline{def2gdp}_t^{ru})$ must be consistent with the medium- to long-term target of the government $(def2gdp_t^{tar,ru}$, Equation (RU.18)), but can deviate from the target path for an extended period. The key factors identified are persistence in the structural deficit ($c_{73} = 0.5$) and the development of the real economy, when persistently slow economic growth undermines fiscal stabilization ($c_{78} = 0.3$). The target itself is a policy variable and is determined either by an assumption or with the help of the Automated Data Toolkit.

Second, as depicted in Equation (RU.19), the overall deficit deviates from the structural one by (i) the impact of automatic stabilizers, which is relatively strong in Russia, implying $c_{77} = 0.8$, and (ii) the government's reaction to the deviation of the debt level from the debt target, calibrated here according to historical experience ($c_{76} = 0.5$), but adjustable according to the forecaster's judgment about policy preferences.

1.3 Kazakhstan

The model for Kazakhstan is close to the Russian model, reflecting the fact that the two economies are fairly similar, with oil exports playing an important role in both. The model is also composed of the following building blocks: aggregate demand, short-term aggregate supply, monetary and exchange-rate policy, fiscal policy, the labor market, and long-term trends. In total, the Kazakhstan model consists of 58 equations, many of which are identities and definitions, and is presented in Appendix B. We focus only on the key differences from the Russian block in the following text.

7 See, e.g., Benes, Hurnik, and Vavra (2008).

8 A positive/negative value in the overall deficit corresponds to a negative/positive overall balance.

The structure and calibration of the equations describing aggregate demand are similar to the Russian model. The business cycle component of aggregate demand (the output gap) is modeled as a function of monetary and fiscal policy, foreign demand, and the oil price. The long-term component then depends on technology growth driven by the commodity sector and investment activity.

Aggregate supply is represented by the traditional Phillips curve, relating a business cycle position to inflation. As inflation is influenced by both domestic demand and import prices, we model the pressure on inflation by combining the output gap with the gap in the real exchange rate—the latter approximating the marginal costs of importers, depending on the nominal exchange rate and foreign and domestic inflation rates. Unlike in the Russian model, a change in import prices does not enter the Phillips curve directly because the evidence for direct price transmission is weak in Kazakhstan. Consequently, the indirect transmission through real marginal costs is calibrated to be relatively stronger.

$$\pi_t^{kz} = c_{294}\, {}^{e}\pi_t^{kz} + (1 - c_{294})\, \pi_{t-1}^{kz} + c_{295}\, rmc_t^{kz} + \varepsilon_t^{\pi,kz} \qquad \text{(KZ.1)}$$

$$rmc_t^{kz} = c_{296}\, \hat{z}_t^{eff,kz} + (1 - c_{296} - c_{311})\, \hat{y}_t^{kz} + c_{311}\, \widehat{wr}_t^{kz} \qquad \text{(KZ.2)}$$

c_{294}	c_{295}	c_{296}	c_{311}
0.65	0.20	0.40	0.10

Monetary policy sets the short-term money market rate by a standard forward-looking Taylor-type policy reaction function. Its aim is to stabilize CPI inflation around the inflation target defined in terms of year-on-year CPI inflation.

A notable difference with the Russian model is the mechanism for determining the nominal exchange rate. Over the long term, the UIP arbitrage is assumed to prevail, as Kazakhstan cannot escape from the international equilibrating flows on a systemic basis. However, contrary to the Russian model and its flexible exchange rate assumption, short-term exchange rate movement in Kazakhstan is largely a policy choice, enforced in the market by various instruments.

$$\begin{aligned} s_t^{KZT/USD} = c_{283}\,(s_{t-1}^{KZT/USD} + (c_{315}\,\Delta s_{t-1}^{KZT/USD}/4 + (1 - c_{315})\,\Delta\bar{s}_t^{KZT/USD}/4) + \\ + c_{316}\,(-\hat{z}_{t-1}^{eff,kz})) + (1 - c_{283})({}^{e}s_t^{KZT/USD} - i_t^{kz}/4 + i_t^{us}/4 + prem_t^{kz}/4) + \\ + \varepsilon_t^{s^{KZT/USD}} \end{aligned} \qquad \text{(KZ.3)}$$

$$\Delta\bar{s}_t^{KZT/USD} = \Delta\bar{z}_t^{kz} + \pi_t^{tar,kz} - \pi_{ss}^{us} \qquad \text{(KZ.4)}$$

c_{283}	c_{315}	c_{316}
0.85	0.70	0.08

The policy preferences over the exchange rate are modeled by the first part of Equation (KZ.3) in which the exchange rate policy rule is designed as a crawl-like arrangement to the US dollar.[9] The arrangement is set in line with the relative version of the Purchasing Power Parity (PPP). The rule assumes that the crawl rate is highly persistent ($c_{315} = 0.7$) but follows the country's long-term fundamentals, defined as nominal trend depreciation ($\Delta\bar{s}_t^{KZT/USD}$), on average. An error-correction term expressed in a form of the lagged real effective exchange rate gap ($\hat{z}_{t-1}^{eff,kz}$) helps to stabilize the business cycles in the economy.

[9] See the 2012 edition of the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions.

Using estimation based on historical data, we set parameter c_{316} to a relatively modest value of 0.08. The second part of Equation (KZ.3) is the standard UIP condition.

The fiscal block of the model is similar to the Russian one. The general principle of the government behavior is that the overall deficit-to-GDP ratio is set so that the debt-to-GDP ratio converges to some target (policy choice), and the ultimate fiscal policy variable is the observed deficit.[10]

The structure of the labor market block is also identical to the Russian model, with a wage Phillips curve determining nominal wage growth using the cyclical components of real wages and output (the output gap).

1.4 Belarus

As in the case of the Russian and the Kazakh models, at the core of the Belarus model sits a New-Keynesian model that can be characterized by the building blocks of aggregate demand, short-term aggregate supply, monetary policy, the labor market, fiscal policy, and long-term trends. However, as Belarus is not an oil exporter, oil prices are less prominent in the model and generally affect the economy in the opposite way than they do in Russia and Kazakhstan. In total, the Belarus model consists of 71 equations, many of which are identities and definitions (see the Appendix B).

The model features a description of the business cycle similar to that for the Russian model. However, there is no linkage between oil prices and aggregate demand, and the output gap is determined only by monetary and fiscal policy and foreign demand. Otherwise, the calibration is similar to the Russian model.

$$\hat{y}_t^{by} = c_{153}\,\hat{y}_{t+1}^{by} + c_{154}\,\hat{y}_{t-1}^{by} - c_{155}\,rmci_{t-1}^{by} + c_{156}\,\hat{y}_{t-1}^{f,by} + c_{158}\,\widehat{def2gdp_t}^{by} + \varepsilon_t^{\hat{y}^{by}} \qquad \text{(BY.1)}$$

$$rmci_t^{by} = c_{157}\left(\hat{r}_t^{by} + c_{320}\,\widehat{sp}_t^{by}\right) + (1 - c_{157})\left(-\hat{z}_t^{eff,by}\right) \qquad \text{(BY.2)}$$

c_{153}	c_{154}	c_{155}	c_{156}	c_{157}	c_{158}	c_{320}
0.10	0.60	0.10	0.30	0.20	0.35	0.20

Aggregate supply is represented by a traditional Phillips curve, relating the output gap and inflation. Contrary to the Russian and Kazakh models, the marginal costs are affected by oil prices through the gap of the real oil price, reflecting the position of Belarus as an oil importer.

$$\pi_t^{by} = c_{160}\,{}^{e}\pi_t^{by} + (1 - c_{160} - c_{165})\,\pi_{t-1}^{by} + c_{161}\,rmc_t^{by} + c_{165}\,\pi_t^{im,by} + \varepsilon_t^{\pi,by} \qquad \text{(BY.3)}$$

$$rmc_t^{by} = c_{162}\,\hat{y}_t^{by} + c_{163}\,\widehat{rp}_t^{oil} + c_{164}\,\widehat{wr}_t^{CPI,by} + (1 - c_{162} - c_{163} - c_{164})\,\hat{z}_t^{eff,by} \qquad \text{(BY.4)}$$

c_{160}	c_{161}	c_{162}	c_{163}	c_{164}	c_{165}
0.50	0.20	0.60	0.05	0.10	0.05

Interest rates are governed by a Taylor-type reaction function, assuming inflation regulation to be the main objective of monetary policy. Unlike in Russia and Kazakhstan, we

[10] A positive/negative value in the overall deficit corresponds to a negative/positive overall balance.

introduce the authorities' preference for smoothing exchange rate volatility into the reaction function as an additional short-run objective. This additional term will smooth nominal exchange rate volatility relative to the trend implied by the real exchange trend and a difference in inflation targets at home and abroad. This formulation reconciles the exchange rate objective with the inflation objective over the long term, making policy consistent.

$$i_t^{by} = c_{167}\, i_{t-1}^{by} + (1 - c_{167})\left(\bar{r}_t^{by} + {}^{e4}\pi_t^{tar,by} + c_{168}\left({}^{e3}\pi_t^{4,by} - {}^{e3}\pi_t^{tar,by}\right) + \right.$$
$$\left. + c_{173}\left(c_{174}\,\Delta s_{devt}^{BYR/USD} + (1 - c_{174})\,{}^{e}\Delta s_{devt}^{BYR/USD}\right)\right) + \varepsilon_t^{i,by} \quad \text{(BY.5)}$$

$$\Delta s^{dev,by} = \Delta s_t^{BYR/USD} - \left(\Delta \bar{z}_t^{by} + \pi_t^{tar,by} - \pi_{ss}^{us}\right) \quad \text{(BY.6)}$$

c_{167}	c_{168}	c_{173}	c_{174}
0.60	1.15	0.20	0.50

Because there is no dominant commodity-exporting sector in Belarus, the technology process driving the block of long-term trends is not explicitly modeled. Therefore, equilibrium real exchange rate growth and equilibrium growth of real GDP are assumed to follow simple autoregression processes towards long-term steady-state levels of 0 and 2.5%, respectively.

1.5 Armenia

The model for the Armenian economy follows a structure similar to the other models of the ISM, consisting of several building blocks: aggregate demand, the labor market, short-term aggregate supply, monetary policy, fiscal policy, and long-term trends. Unlike the other models, the model for Armenia features a block of remittances, which play a very important role in the Armenian economy (hovering at around 10–15% of GDP). Besides, as in Belarus and contrary to Russia and Kazakhstan, Armenia is a net oil and gas importer, making the role of oil prices less prominent and affecting the costs of production rather than determining export values and wealth effects (as in the models of Russia and Kazakhstan).

The inflow of remittances from abroad, driven partly by the world business cycle and developments in Russia, influences domestic demand and long-term macroeconomic trends in the Armenian economy. The remittance block of the model accounts for these effects.

Remittances are measured in U.S. dollars and modeled in real terms (Equation AM.1). However, to account for the fact that Armenian migrant workers are predominantly settled in Russia, not in the U.S., real remittances are expressed effectively with respect to Russia by adding the Russia–U.S. real exchange rate z_t^{ru} to the identity:

$$qrem_t^{USD,am} = rem_t^{USD,am} - p_t^{us} + z_t^{ru} \quad \text{(AM.1)}$$

As with other real variables, we decompose real remittances into a long-term trend and a gap. The trend component is described with a simple autoregressive equation with a steady state, while the cyclical movement of real remittances acknowledges that the business cycle in Russia affects the dollar value of the remittances sent home. The parameters were estimated where possible, and the calibration of steady-state growth reflects our expectations of a future remittance inflow that is below the historical average of 9.0%.

$$qrem_t^{USD,am} = \overline{qrem}_t^{USD,am} + \widehat{qrem}_t^{USD,am} \quad \text{(AM.2)}$$

$$\Delta\overline{qrem}_t^{USD,am} = c_{130}\,\Delta\overline{qrem}_{t-1}^{USD,am} + (1-c_{130})\,\Delta\overline{qrem}_{ss}^{USD,am} + \varepsilon_t^{\Delta\overline{qrem}^{USD,am}} \quad \text{(AM.3)}$$

$$\widehat{qrem}_t^{USD,am} = c_{131}\,\widehat{qrem}_{t-1}^{USD,am} + c_{132}\,\hat{y}_t^{ru} + \varepsilon_t^{\widehat{qrem}^{USD,am}} \quad \text{(AM.4)}$$

$$\Delta\overline{qrem}_t^{USD,am} = 4\left(\overline{qrem}_t^{USD,am} - \overline{qrem}_{t-1}^{USD,am}\right) \quad \text{(AM.5)}$$

c_{130}	c_{131}	c_{132}	$\Delta\overline{qrem}_{ss}^{USD,am}$
0.95	0.43	1.90	3.00

In terms of aggregate demand, the usual structure employs the output gap as a reduced-form indicator of the business cycle. Equation (AM.6) shows that the output gap, in addition to the backward- and forward-looking expectation elements, depends on the local real interest rate, the real effective exchange rate, foreign demand, a fiscal deficit, and the dram-denominated real remittances, all expressed in terms of a deviation from their respective equilibriums. While the parameters are relatively standard, underlying the key features of the small and open Armenian economy, the impact of the real exchange rate is relatively strong in a regional comparison. The pass-through takes place through a direct channel, captured by parameters $c_{99}(1-c_{103})$, and an indirect channel, embodied in remittance inflows, parameter c_{101}.

$$\hat{y}_t^{am} = c_{97}\,\hat{y}_{t+1}^{am} + c_{98}\,\hat{y}_{t-1}^{am} - c_{99}\left(c_{103}\,\hat{r}_t^{am} - (1-c_{103})\,\hat{z}_t^{eff,am}\right) + \\ + c_{100}\,\hat{y}_t^{f,am} + c_{102}\,\widehat{def2gdp}_t^{am} + c_{101}\,\widehat{qrem}_t^{AMD} + \varepsilon_t^{\hat{y}^{am}} \quad \text{(AM.6)}$$

$$\widehat{qrem}_t^{AMD} = \widehat{qrem}_t^{USD,am} + \hat{z}_t^{am} - \hat{z}_t^{ru} \quad \text{(AM.7)}$$

c_{97}	c_{98}	c_{99}	c_{100}	c_{101}	c_{102}	c_{103}
0.10	0.60	0.15	0.50	0.21	0.20	0.70

The block describing long-term trends reflects the fact that a large part of remittances is used to finance investments (in housing, but also in productive capacity). In addition, remittance flows replace exports, to a certain extent, as a stable source of financing of the trade deficit. In fact, one can understand the remittances in Armenia as revenues from exporting labor. A faster and sustainable remittance growth is therefore likely to produce faster growth of potential GDP $(\Delta\bar{y}_t^{am})$ and also a sustainable and faster real exchange rate appreciation $(\Delta\bar{z}_t^{am})$, set at 3.0 and 0%, respectively.

$$\Delta\bar{y}_t^{am} = c_{104}\,\Delta\bar{y}_{t-1}^{am} + (1-c_{104})\,\Delta y_{ss}^{am} + c_{105}\left(\Delta\overline{qrem}_t^{USD,am} - \Delta\overline{qrem}_{ss}^{USD,am}\right) + \varepsilon_t^{\Delta\bar{y}^{am}} \quad \text{(AM.8)}$$

$$\Delta\bar{z}_t^{am} = c_{118}\,\Delta\bar{z}_{t-1}^{am} + (1-c_{118})\,\Delta\bar{z}_{ss}^{am} - c_{119}\left(\Delta\overline{qrem}_t^{USD,am} - \Delta\overline{qrem}_{ss}^{USD,am}\right) + \varepsilon_t^{\Delta\bar{z}^{am}} \quad \text{(AM.9)}$$

c_{104}	c_{105}	c_{118}	c_{119}	Δy_{ss}^{am}	$\Delta\bar{z}_{ss}^{am}$
0.85	0.065	0.75	0.20	3.00	0.00

Aggregate supply is represented by the traditional Phillips curve, which relates a business cycle position (the output gap) to inflation. Imported inflation does not enter the Phillips curve (as in the model of Kazakhstan), because the evidence for direct price transmission is weak. Following the logic of the model for Belarus, the marginal costs are affected by oil prices through the gap of the real oil price.

$$\pi_t^{am} = c_{106}\, {}^{e}\pi_t^{am} + (1 - c_{106})\, \pi_{t-1}^{am} + c_{107}\, rmc_t^{am} + \varepsilon_t^{\pi,am} \quad \text{(AM.10)}$$

$$rmc_t^{am} = c_{108}\, \hat{z}_t^{eff,am} + (1 - c_{108} - c_{110} - c_{109})\, \hat{y}_t^{am} + c_{110}\, \widehat{wr}_t^{am} + c_{109} \left(\widehat{rp}_t^{oil} + \hat{z}_t^{am} \right) \quad \text{(AM.11)}$$

c_{106}	c_{107}	c_{108}	c_{109}	c_{110}
0.70	0.08	0.35	0.04	0.10

Monetary policy is represented by a forward-looking Taylor-type reaction function with an additional objective representing a reaction to the deviation of current and expected exchange rate depreciation from a nominal depreciation trend (as in the model of Belarus). This additional term represents the preference of the monetary authority for exchange rate smoothing. The reaction function has been calibrated to fit historically observed dynamics in short-term market interest rates.

$$i_t^{am} = c_{112}\, i_{t-1}^{am} + (1 - c_{112}) \left(\bar{r}_t^{am} + \pi_{t+3}^{tar,am} + c_{113}\, \pi_t^{4,dev,am} + c_{114}\, s_t^{dev,am} \right) + \varepsilon_t^{i,am} \quad \text{(AM.12)}$$

$$\pi_t^{4,dev,am} = \pi_{t+3}^{4,am} - \pi_{t+3}^{tar,am} \quad \text{(AM.13)}$$

$$s_t^{dev,am} = \left(\Delta s_t^{AMD/USD} - \Delta \bar{s}_t^{AMD/USD} \right) \quad \text{(AM.14)}$$

$$\Delta \bar{s}_t^{AMD/USD} = \Delta \bar{z}_t^{am} + \pi_t^{tar,am} - \pi_{ss}^{us} \quad \text{(AM.15)}$$

c_{112}	c_{113}	c_{114}
0.55	1.30	0.05

The structures of the exchange rate UIP equation, the labor market block, and the fiscal block are identical to the Russian model. For more details and for a full model calibration, see the appendices.

1.6 Kyrgyzstan

In general, the Kyrgyz model is very similar to the Armenian model, as both economies display similar features and rigidities. The National Bank of the Kyrgyz Republic focuses on price stability, with a high preference for smooth exchange rate development. The key monetary policy instrument is open-market operations on the interbank market, and the exchange rate regime is characterized as a managed float. Both countries depend on remittance inflows, from Russia in particular, and have no energy resources of their own, being net importers of oil products and natural gas.

Therefore, as with the Armenian model, at the core of the Kyrgyz model block is a New-Keynesian model, structured in terms of the blocks of remittances, aggregate demand, the labor market, short-term aggregate supply, monetary policy, fiscal policy, and long-term trends.

A unique feature of the Kyrgyz economy is the large gold extraction at the Kumtor mine, representing about 6% of GDP, providing 1.5% of GDP in the state budget revenues, in addition to being a source of foreign currency. As a result, the Kyrgyz model includes the world price of gold, with ramifications for domestic demand, potential output, and the exchange rate.

In total, the Kyrgyz block of the multi-country model consists of 67 equations, many of which are identities and definitions (see Appendix B). Because of the many similarities

with the other ISM models, we present here only those equations specific to the model of Kyrgyzstan.

The price of gold is modeled in real terms and is decomposed into an exogenous trend and a gap, which is the approach followed by the ISM models for oil prices too. The gap of the real price is a purely exogenous process, subject to the judgment of the forecaster; a similar treatment is applied to the price of oil in other ISM models. Steady-state growth of the real gold price has been calibrated according to long-term consensus forecasts by professional forecasters (and widely available from various information vendors):

$$rp_t^{gold} = p_t^{gold^{USD}} - p_t^{us} \tag{KG.1}$$

$$rp_t^{gold} = \overline{rp}_t^{gold} + \widehat{rp}_t^{gold} \tag{KG.2}$$

$$\widehat{rp}_t^{gold} = c_{14}\, \widehat{rp}_{t-1}^{gold} + \varepsilon_t^{\widehat{rp}^{gold}} \tag{KG.3}$$

$$\Delta\overline{rp}_t^{gold} = c_{15}\, \Delta\overline{rp}_{t-1}^{gold} + (1 - c_{15})\, \Delta\overline{rp}_{ss}^{gold} + \varepsilon_t^{\Delta\overline{rp}^{gold}} \tag{KG.4}$$

c_{14}	c_{15}	$\Delta\overline{rp}_{ss}^{gold}$
0.50	0.50	1.00

Gold prices, together with remittances, enter the Kyrgyz model in several places, affecting both the equilibrium trajectories and the cyclical components of the variables.

In the aggregate demand block, we follow the usual structure, relying on the output gap as a reduced-form indicator of the business cycle. In addition to the usual explanatory variables driving the output gap, we also account for the effect of short-term fluctuations in the price of gold on domestic demand—mainly through fiscal expenditures—with parameter c_{210} calibrated to 0.025, reflecting the historical pass-through of gold price developments into the economy.

$$\hat{y}_t^{kg} = c_{205}\, \hat{y}_{t+1}^{kg} + c_{206}\, \hat{y}_{t-1}^{kg} - c_{207} \left(c_{212}\, \hat{r}_t^{kg} - (1 - c_{212})\, \hat{z}_t^{eff,kg} \right) + c_{208} \left(\widehat{rp}_t^{gold} + \hat{z}_t^{eff,kg} \right) + \\ + c_{209}\, \hat{y}_t^{f,kg} + c_{211}\, \widehat{def2gdp}_t^{kg} + c_{210}\, \widehat{qrem}_t^{KGS} + \varepsilon_t^{\hat{y}^{kg}} \tag{KG.5}$$

c_{205}	c_{206}	c_{207}	c_{208}	c_{209}	c_{210}	c_{211}	c_{212}
0.05	0.50	0.08	0.025	0.20	0.025	0.20	0.40

A specific of the Kyrgyz model is that quarterly GDP data are very volatile. Some of the volatility can be attributed to the volatile output of the Kumtor mine, which is highly sensitive to weather conditions, strikes, and accidents. The agricultural sector is also highly volatile, given the weather conditions. Finally, some of the volatility is probably also caused by GDP mismeasurement.

In coping with this high volatility, we introduce a new transitory variable $(\omega_t^{\Delta\bar{y}^{kg}})$ in Equation (KG.6) for potential GDP growth $(\Delta\bar{y}_t^{kg})$, which is designed to filter out the noise in the GDP data. In this way, the noise will not be attributed to the output gap, which should express only inflationary pressures coming from excess supply or demand, but not from idiosyncratic shocks. This auxiliary variable is modeled as an AR(1) process with persistence of $c_{216} = 0.5$:

$$\Delta\bar{y}_t^{kg} = c_{213}\, \Delta\bar{y}_{t-1}^{kg} + (1 - c_{213})\, \Delta y_{ss}^{kg} + c_{214} \left(\Delta\overline{qrem}_t^{USD,kg} - \Delta\overline{qrem}_{ss}^{USD} \right) + \\ + \omega_t^{\Delta\bar{y}^{kg}} - c_{215}\, \omega_{t-1}^{\Delta\bar{y}^{kg}} + \varepsilon_t^{\Delta\bar{y}^{kg}} \tag{KG.6}$$

$$\omega_t^{\Delta\bar{y}^{kg}} = c_{216}\,\omega_{t-1}^{\Delta\bar{y}^{kg}} + \varepsilon_t^{\omega^{\Delta\bar{y}^{kg}}} \qquad \text{(KG.7)}$$

c_{213}	c_{214}	c_{215}	c_{216}	Δy_{ss}^{kg}
0.75	0.015	0.90	0.50	3.00

1.7 Integrated Model and Linkages Among the EAEU Economies

The individual country models are integrated into the ISM by incorporating the main economic linkages among the economies, working through trade and financial markets. While the individual models assume independent monetary and fiscal policy, the integrated model provides for the possibility of simultaneous coordination among the countries, leaving it up to the forecaster's discretion whether to use this option or not. In the future, the integrated model block can simulate an integration of the EAEU countries into a monetary union (all countries following a single monetary policy) and a fiscal union (implying large transfers among the countries).

Table 1.1 Export Destination Shares

	AM	BY	KZ	KG	RU	EU	US
AM		0.0041	0.0036	0.0002	0.2671	0.4703	0.2547
BY	0.0009		0.0158	0.0030	0.4700	0.3971	0.1132
KZ	0.0001	0.0014		0.0073	0.1254	0.4724	0.3933
KG	0.0001	0.0054	0.1583		0.4651	0.0558	0.3152
RU	0.0020	0.0318	0.0294	0.0034		0.5717	0.3618
EU	0.0005	0.0050	0.0046	0.0002	0.0960		0.8938
US	0.0004	0.0009	0.0073	0.0033	0.0661	0.9220	

Legend: share of row *i*'s exports to column *j* in terms *i*'s total exports, average 2007–2012

Table 1.2 Import Origin Shares

	AM	BY	KZ	KG	RU	EU	US
AM		0.0125	0.0024	0.0001	0.3625	0.3511	0.2715
BY	0.0002		0.0036	0.0003	0.5653	0.3605	0.0702
KZ	0.0001	0.0147		0.0054	0.3610	0.2294	0.3894
KG	0.0000	0.0116	0.0535		0.1715	0.0458	0.7176
RU	0.0010	0.0485	0.0246	0.0018		0.5333	0.3909
EU	0.0003	0.0064	0.0145	0.0000	0.1223		0.8564
US	0.0002	0.0021	0.0139	0.0002	0.0887	0.8949	

Legend: share of row *i*'s imports from column *j* in terms of *i*'s total imports in 2007–2012

Trade Linkages

The integration of the countries into one large model brings inter-country trade linkages into the forecasting system. The trade linkages affect demand and supply conditions of the individual model economies. They are included in the integrated model through various "effective" variables, such as effective foreign demand and the real effective exchange rate in particular. These effective variables measure the exposure of individual economies to the other economies of the ISM and the rest of the world. They are computed using trade matrices measuring import and export shares, as shown in Tables 1.1 and 1.2 below, and the resulting trade weights (exports plus imports).

To approximate effective foreign demand in the country models, we use the export weights according to the matrices above. For example, effective foreign demand for the Russian economy $(\hat{y}_t^{f,ru})$ is defined as:

$$\hat{y}_t^{f,ru} = c_{29}\,\hat{y}_t^{us} + c_{28}\,\hat{y}_t^{ez} + c_{25}\,\hat{y}_t^{by} + c_{24}\,\hat{y}_t^{am} + c_{26}\,\hat{y}_t^{kz} + c_{27}\,\hat{y}_t^{kg} \qquad \text{(RU.21)}$$

where superscripts *US*, *EZ*, *am*, *by*, *kg,* and *kz* refer to the output gaps in the US, Eurozone, Armenia, Belarus, Kyrgyzstan, and Kazakhstan, respectively.

The effective trade-weighted real exchange rates for the Russian economy are computed using the following identities, which define the gap, the trend, and the level, respectively:

$$\hat{z}_t^{eff,ru} = c_{41}\,\hat{z}_t^{ru} + c_{40}\,(\hat{z}_t^{ru} - \hat{z}_t^{ez}) + c_{37}\left(\hat{z}_t^{ru} - \hat{z}_t^{by}\right) + c_{36}\,(\hat{z}_t^{ru} - \hat{z}_t^{am}) + \\ + c_{39}\left(\hat{z}_t^{ru} - \hat{z}_t^{kg}\right) + c_{38}\left(\hat{z}_t^{ru} - \hat{z}_t^{kz}\right) \qquad \text{(RU.22)}$$

$$\bar{z}_t^{eff,ru} = c_{41}\,\bar{z}_t^{ru} + c_{40}\,(\bar{z}_t^{ru} - \bar{z}_t^{ez}) + c_{37}\left(\bar{z}_t^{ru} - \bar{z}_t^{by}\right) + c_{36}\,(\bar{z}_t^{ru} - \bar{z}_t^{am}) + \\ + c_{39}\left(\bar{z}_t^{ru} - \bar{z}_t^{kg}\right) + c_{38}\left(\bar{z}_t^{ru} - \bar{z}_t^{kz}\right) \qquad \text{(RU.23)}$$

$$z_t^{eff,ru} = \bar{z}_t^{eff,ru} + \hat{z}_t^{eff,ru} \qquad \text{(RU.24)}$$

Superscripts *ru*, *EZ*, *am*, *by, kz,* and *kg* refer to bilateral real exchange rates of the Russian ruble to the US dollar, the euro, the Armenian dram, the Belarussian ruble, the Kazakh tenge, and the Kyrgyz som, respectively. The coefficients reflect the trade weights, computed from the above matrices.

The effective output gap and effective real exchange rates for the other four economies are computed in a similar manner. In country models, the effective variables enter the block of domestic demand equations, in which the output gap is affected both by trade-weighted foreign demand and the real effective exchange rate gap (see Equation (RU.7) in the Russian model).

The effective variables also affect the supply side of the models through the marginal costs in aggregate supply curves. In addition, the models for Belarus and Russia feature an effective foreign inflation rate, adjusted by the growth rate of the real effective exchange rate trend (see Equation (RU.13) in the Russian model, and Equation (RU.25) below).

$$\pi_t^{im,ru} = c_{41}\,(\Delta z_t^{USD}) + c_{40}\,(-\Delta z_t^{ez}) + c_{36}\,(-\Delta z_t^{am}) + c_{37}\left(-\Delta z_t^{by}\right) + \\ + c_{39}\left(-\Delta z_t^{kg}\right) + c_{38}\left(-\Delta z_t^{kz}\right) + \pi_t^{us} + \Delta s_t^{RUB/USD} - \Delta \bar{z}_t^{eff,ru} \qquad \text{(RU.25)}$$

Financial Linkages

The models assume near-perfect capital mobility among the EAEU countries, expressed by individual UIP equations. If the forecaster decides that all economies in the integrated model follow the exchange rate policy of Russia, the UIP equations in the country blocks will determine the levels of local short-term interest rates.

The financial linkages guarantee that the models respond to financial shocks affecting only one of the economies. For instance, a capital outflow from Russia would be manifested as an increase in the risk premium in the Russian model and depreciate the ruble to the dollar. This would imply appreciation of the real effective exchange rates in other countries, jeopardizing competitiveness and growth, thus triggering nominal depreciation in these economies too.

Further Extensions

In the future, other integration mechanisms can be added. For instance, convergence of long-term macroeconomic trends, productivity growth rates, wage growth, and country risk premiums are likely to become more important with the growing economic interconnections among the economies of the EAEU. In addition, the economies' integration may eventually lead to common fiscal and monetary policy in the block.

2

AUTOMATED DATA INTERFACE

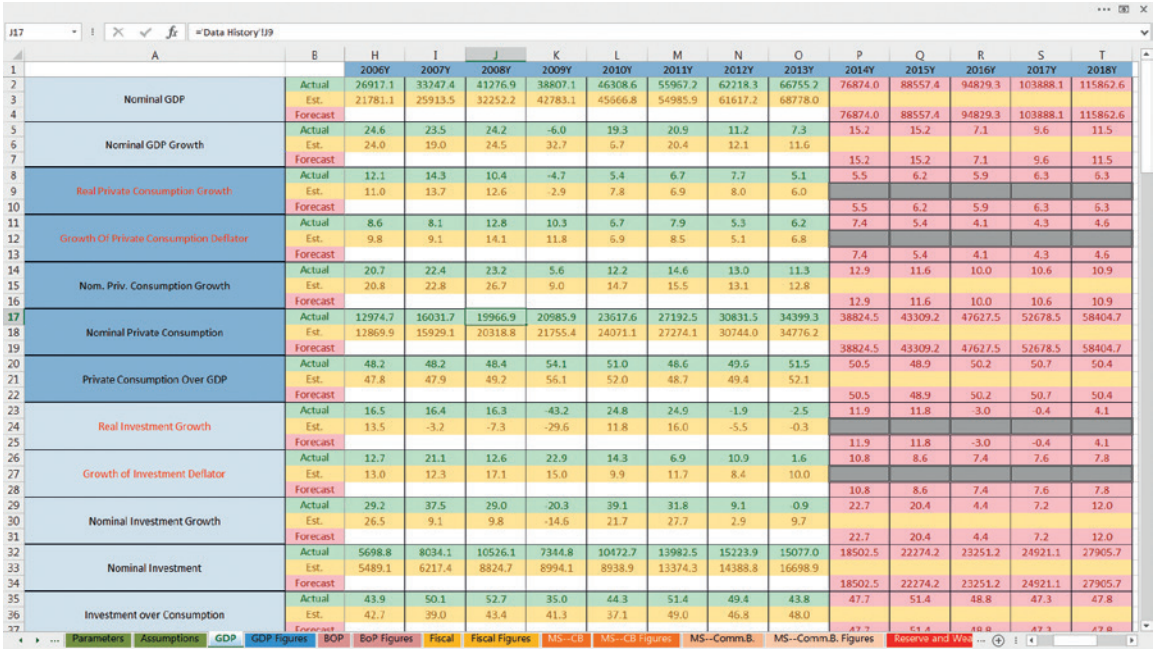
2.1 Methodology of the Automated Data Interface

The Automated Data Interface (ADI) establishes a new approach to financial programming (FP). It takes a forecast of key macroeconomic variables done by a semi-structural (gap) model and computes more detailed macroeconomic indicators on this basis, trying to achieve a large degree of consistency. Thus, the ADI adds an extra layer of macroeconomic relationships to the model-based forecast. It allows for keeping the core model stylized and thus operable on a regular basis, while enriching the forecast with a more detailed insight into various sectors. This approach is consistent with the recent experience of many central banks, which have found complex DSGE models too difficult to operate on a regular basis. As a result, many central banks still use satellite models around a relatively compact core forecasting model.

The ADI is designed for users with basic knowledge of the MS Excel spreadsheet environment. The Excel platform ensures flexibility and operability of the ADI without deep knowledge of state-of-the-art modeling software. Each country is represented by one file-workbook encompassing several sheets. For instance, historical data are collected in the "Actual Data" sheet, and the model-based forecast is uploaded in the "Model Data" sheet (see Display 2.1). The key parameters are assigned in the "Parameters" sheet and expert assumptions in the "Assumptions" sheet. Several sheets follow with projections of national accounts, balance of payments, the monetary survey (for both the commercial banks and the central bank), and the fiscal policy. There are also the wealth and reserve funds in the case of Russia and Kazakhstan. Table 2.1 lists the model variables used as input for the ADI. A detailed list of all ADI variables is in Table 2.2.

The ADI toolkit is built top–down. It starts from aggregate variables delivered by the model forecasts and breaks them down into details. Therefore, the ADI is not intended to work without a model forecast. This approach is in stark contrast to the common bottom–up approach of financial programming, drawing aggregate forecasts from sector projections. The top–down approach has several benefits. First, the forecast's macroeconomic consistency, while far from perfect, is much stronger using the ADI than in the standard approach, both in a dynamic and a static sense. To achieve the same degree of static consistency in the standard framework would require a complex iterative procedure, and the dynamic consistency could hardly be replicated at all. Second, evaluating the effects of policy actions in

Display 2.1. Typical Layout of an ADI Block in MS Excel



		2006Y	2007Y	2008Y	2009Y	2010Y	2011Y	2012Y	2013Y	2014Y	2015Y	2016Y	2017Y	2018Y
Nominal GDP	Actual	26917.1	33247.4	41276.9	38807.1	46308.6	55967.2	62218.3	66755.2	76874.0	88557.4	94829.3	103888.1	115862.6
	Est.	21781.1	25913.5	32252.2	42783.1	45666.8	54985.9	61617.2	68778.0					
	Forecast									76874.0	88557.4	94829.3	103888.1	115862.6
Nominal GDP Growth	Actual	24.6	23.5	24.2	-6.0	19.3	20.9	11.2	7.3	15.2	15.2	7.1	9.6	11.5
	Est.	24.0	19.0	24.5	32.7	6.7	20.4	12.1	11.6					
	Forecast									15.2	15.2	7.1	9.6	11.5
Real Private Consumption Growth	Actual	12.1	14.3	10.4	-4.7	5.4	6.7	7.7	5.1	5.5	6.2	5.9	6.3	6.3
	Est.	11.0	13.7	12.6	-2.9	7.8	6.9	8.0	6.0					
	Forecast									5.5	6.2	5.9	6.3	6.3
Growth Of Private Consumption Deflator	Actual	8.6	8.1	12.8	10.3	6.7	7.9	5.3	6.2	7.4	5.4	4.1	4.3	4.6
	Est.	9.8	9.1	14.1	11.8	6.9	8.5	5.1	6.8					
	Forecast									7.4	5.4	4.1	4.3	4.6
Nom. Priv. Consumption Growth	Actual	20.7	22.4	23.2	5.6	12.2	14.6	13.0	11.3	12.9	11.6	10.0	10.6	10.9
	Est.	20.8	22.8	26.7	9.0	14.7	15.5	13.1	12.8					
	Forecast									12.9	11.6	10.0	10.6	10.9
Nominal Private Consumption	Actual	12974.7	16031.7	19966.9	20985.9	23617.6	27192.5	30831.5	34399.3	38824.5	43309.2	47627.5	52678.5	58404.7
	Est.	12869.9	15929.1	20318.8	21755.4	24071.1	27274.1	30744.0	34776.2					
	Forecast									38824.5	43309.2	47627.5	52678.5	58404.7
Private Consumption Over GDP	Actual	48.2	48.2	48.4	54.1	51.0	48.6	49.6	51.5	50.5	48.9	50.2	50.7	50.4
	Est.	47.8	47.9	49.2	56.1	52.0	48.7	49.4	52.1					
	Forecast									50.5	48.9	50.2	50.7	50.4
Real Investment Growth	Actual	16.5	16.4	16.3	-43.2	24.8	24.9	-1.9	2.5	11.9	11.8	3.0	-0.4	4.1
	Est.	13.5	-3.2	-7.3	-29.6	11.8	16.0	-5.5	-0.3					
	Forecast									11.9	11.8	-3.0	-0.4	4.1
Growth of Investment Deflator	Actual	12.7	21.1	12.6	22.9	14.3	6.9	10.9	1.6	10.8	8.6	7.4	7.6	7.8
	Est.	13.0	12.3	17.1	15.0	9.9	11.7	8.4	10.0					
	Forecast									10.8	8.6	7.4	7.6	7.8
Nominal Investment Growth	Actual	29.2	37.5	29.0	20.3	39.1	31.8	9.1	0.9	22.7	20.4	4.4	7.2	12.0
	Est.	26.5	9.1	9.8	-14.6	21.7	27.7	2.9	9.7					
	Forecast									22.7	20.4	4.4	7.2	12.0
Nominal Investment	Actual	5698.8	8034.1	10526.1	7344.8	10472.7	13982.5	15223.9	15077.0	18502.5	22274.2	23251.2	24921.1	27905.7
	Est.	5489.1	6217.4	8824.7	8994.1	8938.9	13374.3	14388.8	16698.9					
	Forecast									18502.5	22274.2	23251.2	24921.1	27905.7
Investment over Consumption	Actual	43.9	50.1	52.7	35.0	44.3	51.4	49.4	43.8	47.7	51.4	48.8	47.3	47.8
	Est.	42.7	39.0	43.4	41.3	37.1	49.0	46.8	48.0					

the standard financial programming framework is very cumbersome as expectations are not treated correctly. The ADI benefits from consistent monetary and fiscal policy reactions that are already embedded in the model-based forecast. Third, the top–down approach reduces the costs of maintenance as the users may decide on the level of detail they want to see in the decomposition (in other words, they can opt for a higher degree of aggregation, thus reducing maintenance costs). The standard bottom–up approach, on the other hand, starts from the detailed sectoral accounts. Finally, the top–down approach changes the role of the financing gap (or the change in FX reserves) in sector accounts (see Box 1).

The process of decomposing the model forecast into sector indicators exploits structural relationships based on economic theory and empirical regularities as well as statistical identities and links among economic sectors. For instance, the ADI ensures that the nominal shares of expenditure components on GDP are stable over time, reflecting an important empirical regularity present in the data. This property is a key element affecting the dynamics of GDP components and is technically achieved by using iterative solution algorithms in MS Excel.

The elasticity parameters of key structural equations in the ADI are estimated using historical data. Ordinary Least Squares (OLS) with a sign penalty function are applied to guarantee consistency with economic theory. Nevertheless, as the economies covered by the ADI are subject to structural changes, users are allowed to calibrate model parameters within the ADI Excel workbook (Display 2.2) instead of following historical estimation. This property is particularly important in the case of parameters affecting the long-term properties (steady-state) of the projection. To enable the user to identify potential problems with built-in equations, the ADI evaluates and reports the historical fit of key variables (Display 2.3).

Still, following the best forecasting practices, users can apply expert judgment and fine-tune particular values of the forecasted variables over the forecasting horizon and override the ADI-based projection. This property is crucial for capturing exogenous shocks, adding near-term projections, as well as for conducting a scenario analysis.

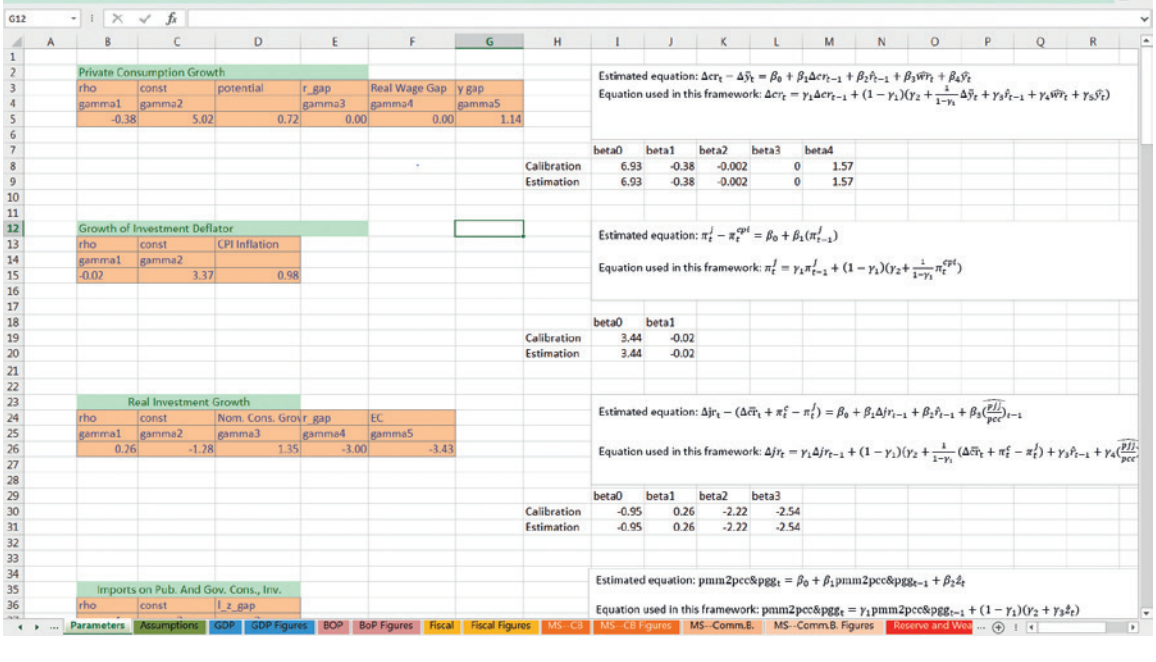
Box 1: Role of the Financial Gap in the Automated Data Interface

The key differences between the Automated Data Interface (ADI) and the standard financial programming framework (as applied by the IMF, for instance) can be summarized as follows:

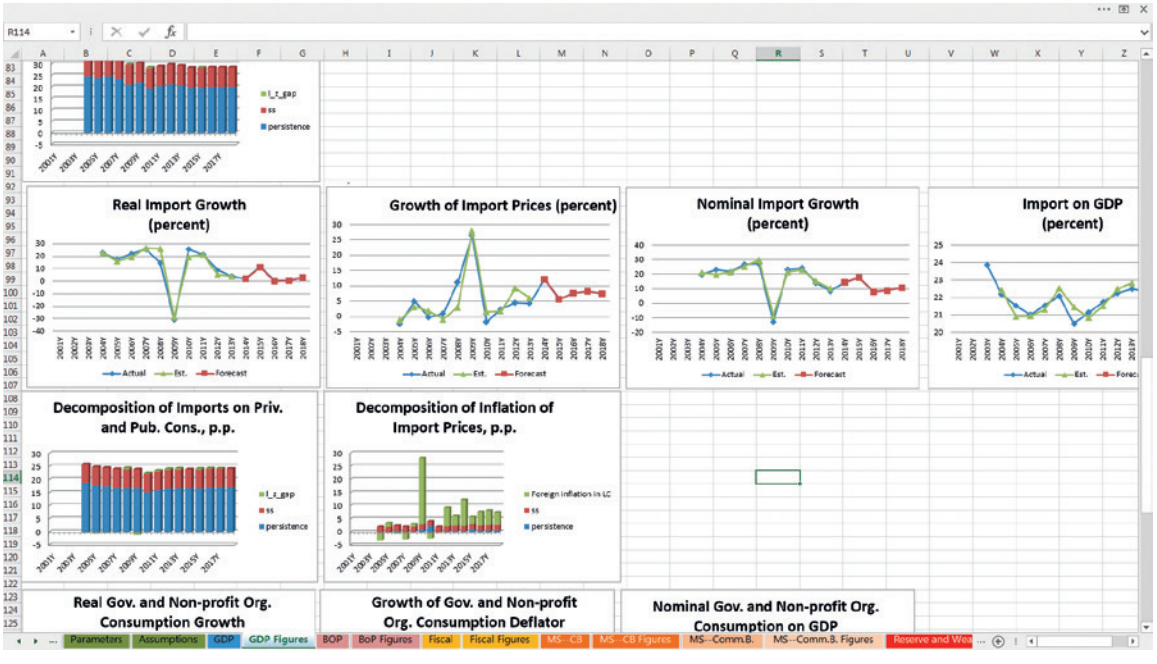
- The standard toolkit of Financial Programming (FP) assumes a fixed exchange rate and results in a financial gap expressing the country's financing needs to keep the currency level sustainable. Therefore, by design, the main constraint of the standard FP approach is that the main policy question is the magnitude of the financial flows consistent with keeping the exchange rate fixed, under various assumptions about the external environment and domestic (especially monetary and fiscal) policies.
- The ADI results in an outlook that equilibrates the exchange rate over the medium term. At the same time, the financial gap is still calculated as a change in the country's foreign reserves. Indeed, it can be modified further by expert assumptions about financial account flows.
- The standard FP is essentially a static exercise, iterating over a number of statistics from various sectors in excruciating detail, but is hardly capable of producing consistent trajectories of macroeconomic variables over the medium term, especially when the exchange rate is flexible. By contrast, the ADI toolkit starts from a dynamically consistent, macroeconomic model-based scenario and calculates more detailed variables on this basis.

Nevertheless, the ADI allows for various layers of complexity. The system is malleable and can be extended to cover various detailed statistics, corresponding to the interest of users and their capacity to maintain a complex system and datasets. For example, to provide EDB/EEC users with an option to analyze and discuss data of higher frequencies, a satellite quarterly block was implemented in the ADI for key macroeconomic variables.

Display 2.2. Parameters and Estimation Framework



Display 2.3. Automatic Data Visualization Tool for the National Accounts Block (Same for Other Blocks of the Model)



2.2 Automated Data Interface Mechanisms

The ADI tool has a symmetric structure across the five countries in terms of the flow of information and the inter-linkages among economic variables. Figure 2.1 gives an overview of the general structure of the tool, also highlighting the main exogenous inputs to the system.

The inputs comprise (i) the results of the model-based projection (Table 2.1), (ii) the historical series for the variables not covered by the model-based projection (Table 2.2), and (iii) the parameters of the equations used by the ADI, and other assumptions (Display 2.2). These other assumptions comprise various exogenous trends (such as the trend of the ratio of nominal investment to GDP).

The tool itself is comprised of four main blocks: national accounts (GDP), balance of payments (BoP), fiscal accounts (Fiscal), and the monetary survey (MS). For Russia

Table 2.1. Model Variables Used in ADI (Example of Belarus)

Real GDP Growth (Percent)	Output Gap (Percent)
Interest Rate (Percent p.a.)	Real Effective Exchange Rate Gap (Percent)
CPI Inflation (Percent)	Real Interest Rate Trend (Percent, p.a.)
Nom. Exchange Rate (BYR per USD)	Fed Funds Rate (Percent p.a.)
Real Interest Rate Gap (Percent)	Effective Foreign Demand Gap (Percent)
Real Wage Gap (Percent)	CPI Inflation in Russia (Percent)
Potential GDP Growth (Percent)	Budget Deficit (Percent of GDP)

and Kazakhstan, the ADI also features a simple block computing the contributions to or requirements from the country's strategic reserve funds.

National Accounts

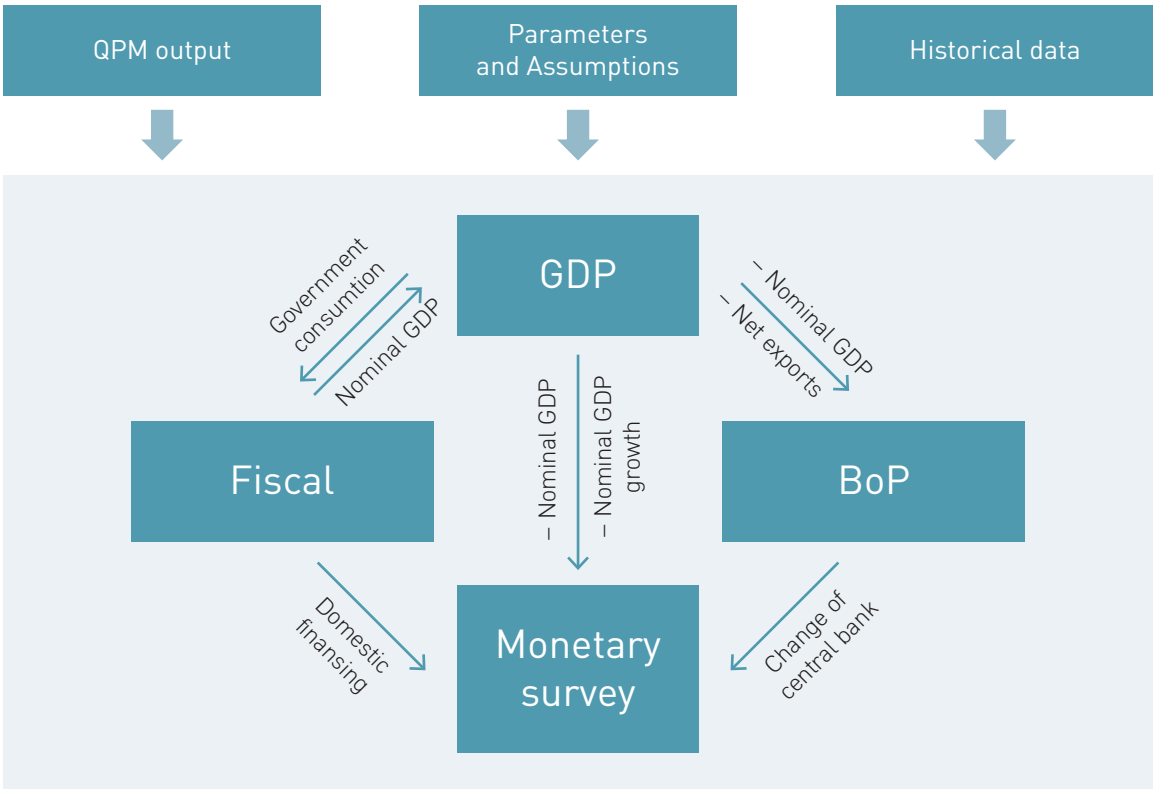
Figure 2.2 is a flowchart of the main mechanisms of the block, and how they interact with the other three blocks of the ADI.

The key variables from which the flow starts are investments and private and public consumption. Private consumption and investments are projected using the results of an OLS regression with inputs from the model forecast, such as the output gap, the real wage gap, the real interest rate gap, and potential growth. Public consumption is taken from the fiscal block. The respective deflators are projected on the basis of a simple regression on the model forecast of CPI inflation.

Table 2.2. ADI Main Blocks and Variables

National Accounts (by Expenditure Approach)	Nominal and Real GDP
	GDP Components
	GDP Component Deflators
	Shares of GDP Components (percent of GDP)
Balance of Payments	Current Account (Incl. the Trade and Income Balances)
	Financial Account
	Capital Account
	International Reserves
Fiscal Block	Tax and Non-Tax Revenues
	Other Revenues
	Current Expenditures
	Capital Expenditures
	Budget Financing
	Domestic and Foreign Debt
Monetary Survey	Net Foreign Assets
	Net Domestic Assets
	Money Base
	Broad Money
	Deposits in Local and Foreign Currency
	Credit to Private and Public Sectors

Figure 2.1 The General Structure of the ADI Tool



Imports are then derived from the assumption of a constant share of nominal imports on consumption and investment. The import deflator is computed on the basis of a simple regression using the exchange rate and foreign inflation.

Nominal exports are computed from the ratio of nominal exports to GDP, which is modeled using a regression on the real exchange rate gap (from the model forecast) and the foreign output gap. The decomposition to real exports and deflator is designed to preserve macroeconomic identities where weighted real growths of GDP components add up to real GDP growth.

Finally, net exports, as a residual term, are an exogenous input to the Balance of Payments block to approximate the trade balance. The National Accounts block also provides a series of nominal GDP used in all other blocks of the ADI.

Balance of Payments

Figure 2.3 is a flowchart of the main mechanisms of the BoP block, and how they interact with the other three blocks of the ADI.

The key inputs here are nominal GDP and net exports (as a proxy for the trade balance) from the National Accounts block. The income, financial, and capital accounts are derived from their respective ratios to GDP, modeled as simple autoregressive processes. The current account is obtained by aggregating the trade and income balances.

The balance of financial and capital accounts on one side, and the current account on the other, are represented as the change of the central bank reserves. This serves as an approximation for a change in the net foreign assets in the Monetary Survey block. Alterna-

Figure 2.2 ADI National Accounts Block and Its Relation to Other Blocks

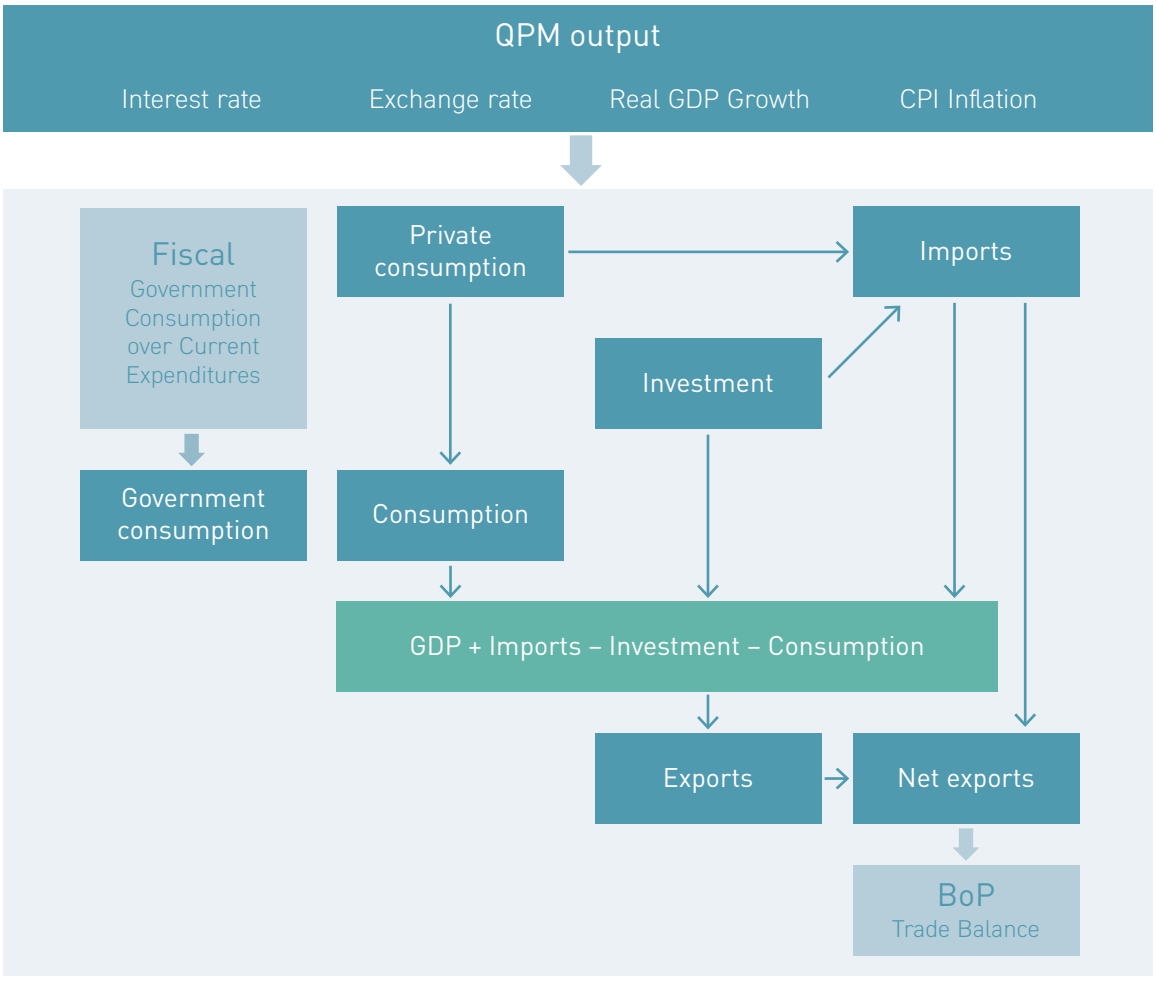
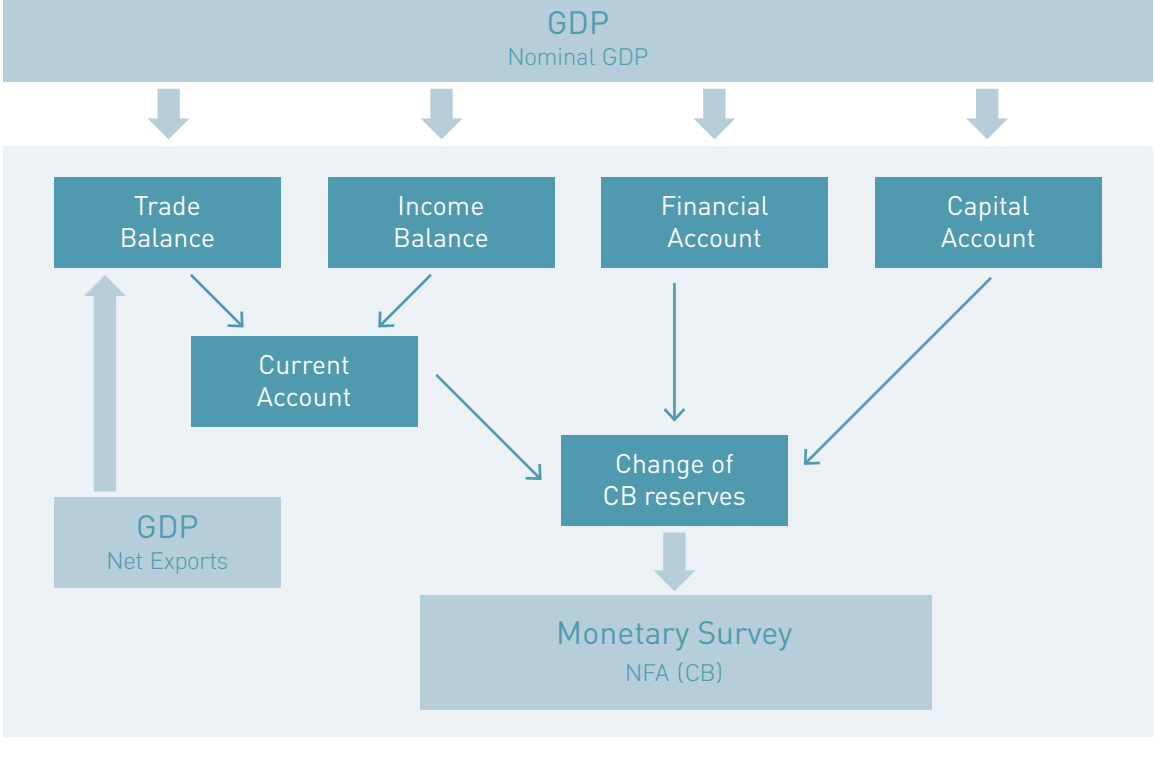


Figure 2.3 ADI Balance of Payments Block and Its Relation to Other Blocks



tively, the user may choose to keep the level of reserves unchanged and compute the necessary adjustment in the financial or current accounts. This may involve an iterative procedure in which the model forecast can be altered to imply different current account dynamics, should its assumptions be inconsistent with a stable level of reserves.

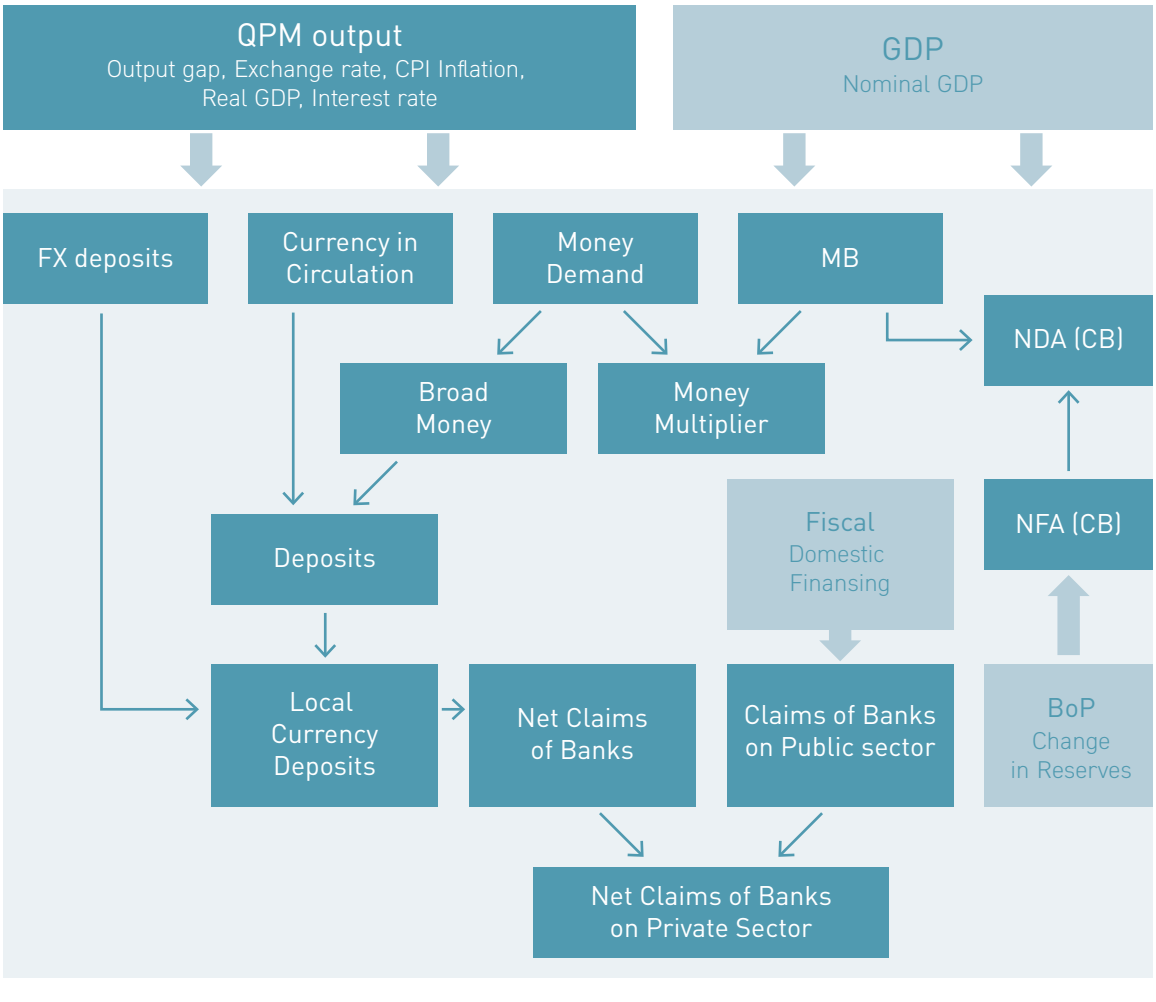
Monetary Survey

Figure 2.4 is a flowchart of the main mechanisms of the Monetary Survey block, and how they interact with the other three blocks of the ADI.

The Monetary Survey takes as inputs a number of variables from the model forecast plus nominal GDP from the National Accounts block, a change in the reserves (a proxy for a change in the net foreign assets) from the BoP block, and domestic financing from the Fiscal block.

Most variables in this block are computed as identities, with the exception of money demand, which is computed in two stages from real money demand and CPI as the cointegration process. In the first stage, the real money gap (real money overhang) is computed using a cointegration regression featuring GDP, nominal interest rates (both from the model forecast), and money velocity (an assumption). In the second stage, real money growth is computed using a regression with GDP, the nominal interest rate, money velocity, and the real money gap (error-correction vector). The money demand then implies a broad money indicator.

Figure 2.4 ADI Monetary Survey Block and Its Relation to Other Blocks



The net foreign assets from the BoP block and broad money are then used to construct a measure of net domestic assets. At the same time, the cash in circulation is derived from an assumption about the ratio of the currency in circulation to broad money. Broad money, adjusted for the currency in circulation, pins down deposits, which are further broken down into local and foreign currency deposits. The domestic financing from the Fiscal block, together with the net claims derived from domestic currency deposits, pins down the claims of the private sector.

Fiscal Block

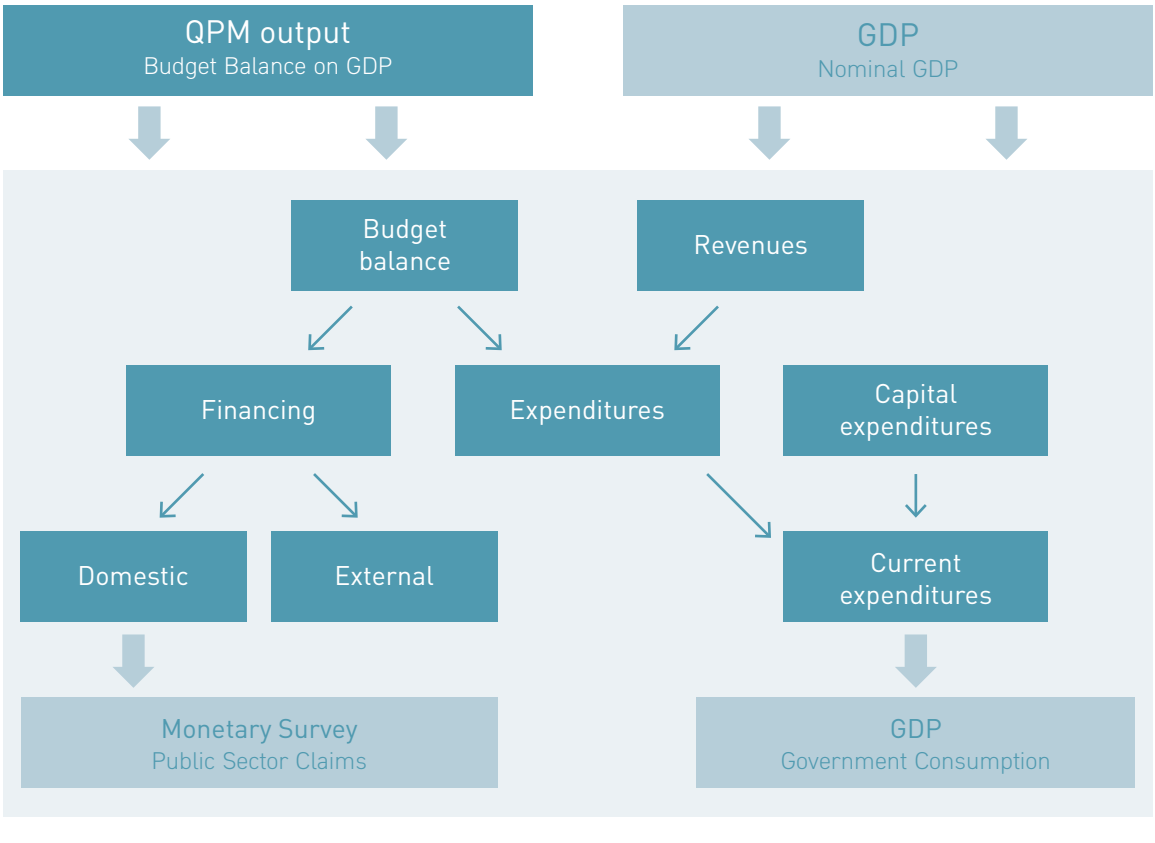
Figure 2.5 is a flow chart of the main mechanisms of the Fiscal block, and how they interact with the other three blocks of the ADI.

The key inputs here are the overall budget balance from the model forecast and nominal GDP from the National Accounts block. Fiscal revenues are computed as a simple autoregressive process based on the ratio of fiscal revenues to GDP. For Russia and Kazakhstan, a category of oil revenues has been introduced, using regressions with the model-based real-price-of-oil gap to account for oil price volatility.

The overall fiscal balance, adjusted for revenues, pins down the total expenditures, which are further decomposed into current and capital expenditures. First, the capital expenditures are computed using a simple regression and an assumption about the ratio of the capital expenditures to GDP. Then, adjusting the total expenditures for the capital expenditures derives the current expenditures.

To derive the government consumption that is used as an input to the National Ac-

Figure 2.5 ADI Fiscal Block and Its Relation to Other Blocks



counts block, an assumption about the share of government consumption in current expenditures is used.

Finally, the deficit financing is decomposed into its domestic and foreign components using an assumption about the evolution of the share of domestic debt.

Reserve and Wealth Funds

For Russia and Kazakhstan, the ADI features a simple block computing the contributions to or requirements from the country's reserve funds. In the case of Russia, the transfer from the fund reduces external financing needs. In the case of Kazakhstan, the transfer from the Samruk-Kazyna fund is an additional part of budget revenues based on an active fiscal rule. The net payments to the wealth funds are obtained using an estimated equation featuring the output gap and the real–price-of-oil gap (both from model forecasts).

3

FORECASTING PROCESS AT THE EDB/EEC

The EEC (the "Commission") jointly with the EDB provides regular updated projections of member states' key economic indicators over the medium term (up to four years). The forecasting process involves a number of procedures designed to analyze the current economic situation, both globally and in specific EAEU member states, and then to define and negotiate consistent hypotheses regarding socioeconomic-development-related risks and prospects. This is followed by computations using the ISM that are further enhanced by expert adjustments to account for factors not directly captured by the models. Finally, presentation of the resultant projections is prepared in the form of an analytical report.

Forecasting is performed on a quarterly basis. Implementation of each projection round typically takes two months and comprises the following stages:

- Stage 1 — Stage-Setting Activities and Database Update
- Stage 2 — Analysis of the Current Macroeconomic Situation in EAEU Member States
- Stage 3 — Negotiation of Initial Conditions and Forecast Hypotheses
- Stage 4 — Projection Buildup and Presentation of Findings

3.1 First stage: Stage-Setting Activities and Database Update

At the first stage, preparations are made to ensure smooth implementation of the projection round, and standard operating procedures are formulated within the context of all other tasks carried out by the Commission and the EDB. All those involved in the process are identified, and work assignments are given to each of them. A work schedule is drawn up and agreed to for the conduct of joint workshops and meetings with the participation of third-party experts, and databases are updated.

Determination of Projection-Round Participants and Objectives

The projection round starts with a discussion of the outcomes of the previous projection round and task-setting for the next projection round. This work involves the creation and allocation of the following functional roles among forecasters representing the Commission and the EDB: external sector and EAEU member state database updates; review of

the current situation in the global economy and EAEU member state economies; assessment of risks and prospects associated with further growth of the global economy and EAEU member state economies; technical work related to model simulation and application of expert adjustments; and presentation of resultant projections. These are standard tasks. In addition, over the course of the projection round, there may arise a need for additional work, for example to undertake a supplementary analysis of the impact that certain factors have on macroeconomic variables, or to recalibrate or modify the model.

Development of the Projection-Round Work Schedule

The tasks are distributed among Commission/EDB experts in line with their functional duties. Steps are also taken to set the time and place for joint workshops to be conducted within the framework of the projection round, and to determine the format and timeframe for negotiations with third-party experts (central banks, and ministries' staffs). Based on the standard work schedule, a detailed work schedule is created, providing in-depth coverage of the tasks specific to the current projection round.

Database and Short-Term Estimates Update

In addition to dealing with administrative issues, this stage involves an update of forecasting databases to obtain new data series and the latest short-term forecasts. The ISM operates with macroeconomic databases for Belarus, Kazakhstan, Russia, Armenia, and Kyrgyzstan. Each EAEU member-state database uses several dozen variables representing the real, monetary, financial, and fiscal sectors. In addition, a database that contains Eurozone and U.S. real and monetary sector variables as well as commodity prices has been built to support the system. The variables have different periodicities: monthly, quarterly, or annual. More information about the ISM databases is provided in Sections 2 and 4.

All statistical series are updated on the basis of official data sourced from national statistical agencies and financial/economic ministries of EAEU member states, central (national) banks, international economic organizations, the European Central Bank, the U.S. Federal Reserve System, and assorted Bloomberg publications. Over the course of the update, the databases are revised, and requisite variable transformations are performed to enable their use in model-based computations. In particular, all variables are remeasured on a quarterly basis and tested for seasonality; if any seasonality is discovered, seasonal adjustments are applied using the X-13-ARIMA or TRAMO/SEATS tools.[11]

The EAEU forecasting system is maintained on a quarterly basis, while some current data are received on a monthly basis or with certain time lags. Accordingly, all incoming statistical information is divided into hard data and estimates. The former includes series observations available for the actual full quarter, while the latter comprises quarterly estimates extrapolated from available monthly data. The most important series that are typically extended by the short-term estimates (for the current or next quarter) include GDP growth, inflation rate, interest rate, and nominal exchange rate. Estimates

[11] For a more detailed description of the X-13-ARIMA tool, go to the developer's site at http://www.census.gov/srd/www/x12a/; the TRAMO/SEATS tool is presented at http://www.bde.es/bde/en/secciones/servicios/Profesionales/Programas_estadi/Programas_estad_d9fa7f3710fd821.html.

are generated on the basis of a suite of satellite models and external sources, including international organizations, official EAEU member-state publications, ARIMA/VAR econometric models, leading indicator-based expert opinions, etc. The need to implement short-term forecasting (up to two quarters ahead) and back-casting with respect to key macroeconomic variables is dictated by the weak predictive validity of mid-term structural models over the immediate horizon, as such models are specifically designed to be used over the medium term where they tend to produce a clearer picture of structural linkages between variables, free of the confusing effect of short-term fluctuations largely driven by incidental aberrations unrelated to any fundamental factors. This enables a more precise assessment of macroeconomic variable movements for the short run and improves the overall quality of projections.

3.2 Second stage: Analysis of the Current Macroeconomic Situation in EAEU Member States

The second stage involves an analysis of the current macroeconomic situation in EAEU member states. It includes a primary filtering (post-update launch) of the model and a critical scrutiny of various sectors of EAEU member-state economies with a view to producing a quarterly review of major trends and prospects affecting those economies (the "quarterly review"). The key deliverable at this stage is a vision of the current macroeconomic situation in EAEU member states. This stage is also important from the perspective that many relevant time series are published with lags, making solid analysis of the current economic situation such an important part of the forecasting process.

DSFPAS Model Primary Filtering[12]

Primary filtering provides a model-based interpretation of the current economic situation in each of the EAEU economies. Primary filtering of the model is performed following an update of external sector and EAEU databases, including back-casting of relevant indicators. Such primary filtering represents a model launch ("simulation") over historical series using updated data. It yields a first-approximation view of the past and current macroeconomic situations through the prism of interactions among interlinked macroeconomic variables. In particular, the filtering process results in decomposition of major macroeconomic variable movements into trends and gaps and the identification of individual structural factor inputs, which enables an assessment of possible imbalances emerging in various sectors of the economy. Filtering supplements current economic situation analyses presented in the quarterly review. In technical terms, primary filtering is an application of the Kalman filter[13] to the model's equation system.

Primary filtering — when used in conjunction with the quarterly review, external analyses and economic research findings — provides an opportunity to verify the adequacy of the model (to see how accurately it describes actual data). If any expert user finds a model-gen-

[12] See Chapter 4, "Applying the Models to Data."

[13] Kalman filtering is an algorithm that uses a series of measurements observed over time, containing statistical noise and other inaccuracies, and produces estimates of unknown variables that tend to be more precise than those based on a single measurement alone. For more information, see Kalman (1960).

erated interpretation of macroeconomic changes unlikely, this might be an indication of the need to reexamine statistical data accuracy or model parametrization. In the latter case, it may be necessary to recalibrate the model or modify its structure.

Preparation of Quarterly Review of EAEU Economic Trends

At this stage, a draft version of the quarterly review is produced. The review depicts major trends and prospects affecting EAEU member-state economies. It is subject to subsequent adjustments based on the feedback generated at the third stage of the projection round. Upon completion of the projection round, the final version of projections is incorporated into the review.

The review consists of two logical blocks, which contain a description of the current macroeconomic conditions, supported by primary-filtering results and an assessment of risks and prospects related to economic growth in EAEU member states.

The first block provides a detailed account of the current macroeconomic situation in each member state. The analysis starts with a summary of GDP movements, including their decomposition by final-use components. There is also an assessment of internal and external economic growth factors. Final output during the reporting period is compared against labor market trends. This is followed by a monetary policy review. The main monetary policy drivers are examined in the context of key monetary indicators. The section dedicated to fiscal policy matches budget assumptions to the latest macroeconomic trends and explores budget revenue/expenditure and public debt movements. A separate section of the quarterly review deals with the external sector and BoP performance.

The second block contains a survey of risks and prospects related to economic growth in EAEU member states, with a breakdown by external and internal exposures. In particular, there is a discussion of global commodity market trends; the macroeconomic situation in key global economies; and potential risks related to geopolitical developments, structural factors of economic growth, and monetary and fiscal policies, *inter alia*, in the light of the interdependence and mutual influence of EAEU economies.

3.3 Third Stage: Negotiation of Initial Conditions and Forecast Hypotheses

During the third stage, the vision of the current macroeconomic situation examined at the second stage is discussed by the projection-round participants representing the Commission and the EDB, and third-party experts invited on an as-needed basis. The key deliverable at this stage is a common understanding of the macroeconomic status of the EAEU economy and of the most probable scenario for the timeframe underlying mid-term projections.

Discussion of Primary-Filtering Findings

Upon completion of a draft quarterly review and receipt of primary-filtering findings, the Commission and the EDB discuss and agree upon a common view of the current macroeconomic situation and EAEU development-related risks and prospects. As a

rule, third-party experts (central banks, and ministries' staffs) are requested to join the discussion, which promotes a better understanding of macroeconomic trends affecting EAEU member states. The discussion takes the form of a workshop focusing on the foreign economic environment and social and economic development in Belarus, Kazakhstan, Russia, Armenia, and Kyrgyzstan. Amendments necessitated by the discussion (if any) are then introduced to the appropriate sections of the quarterly review.

Negotiation of Initial Conditions and Forecast Hypotheses

At this stage, assessment of the current situation is supplemented by a discussion of the key hypotheses regarding evolution of the macroeconomic situation in the EAEU over the mid-term perspective. In particular, the participants consider possible foreign economic developments and any changes in oil prices and exogenous external sector parameters (demand in U.S. and Eurozone GDP, inflation rate, and interest rates) anticipated over the forecast horizon.

This is followed by a discussion of risks and prospects related to social and economic development of EAEU member states over the forecast horizon, including expected trajectories of major macroeconomic variables, taking into account the analyses furnished by the participants and the primary-filtering findings obtained through the use of the system of models.

Based on the outcome of the discussion, the participants make adjustments to the plain model-based interpretation of historical movements of macroeconomic variables (i.e., movements preceding the commencement of the projection round), if needed, and determine the starting point for all model variables (i.e., they formulate the initial conditions for the projection exercise and the framework for the overall economic interpretation of baseline projections).

3.4 Fourth Stage: Projection Buildup and Presentation of Findings

During the final stage of the projection round, the participants perform technical work related to incorporation of expert judgments regarding the initial conditions and external sector variable trajectories; perform the actual forecast computations; make any expert adjustments to the projected trajectories (if necessary); and write and publish an analytical report.

Final Filtering and Projection Buildup

During the fourth stage, previous discussion feedback serves to guide and inform a final filtering of the model, where the model-based interpretation of the initial conditions of the projection is adjusted to incorporate expert judgments. If necessary, short-term estimates applicable to macroeconomic variables can be reviewed and refined.

The post-filtering universe of macroeconomic variables, as projected by the default model, may differ from its *a priori* perception by the expert, necessitating a supplementary adjustment of the projected trajectories, as any model is a simplified approximation of the

economy based on a limited set of factors. After the requisite discussion, the participants perform an adjusted model filtering to incorporate expert judgments into the projected baseline scenario (the "expert adjustments").

Consistency Evaluation and Expert Adjustment of Projected Macroeconomic Variable Trajectories

The final filtering process takes into account short-term projections, expert judgments, and inputs from the ADI analysis regarding the trajectories of projected and model-specific macroeconomic variables. Expert adjustments are performed individually for each model variable, and generally involve monitoring and assessment of changes in the trajectories of all projected variables and an in-depth analysis of model simulation outcomes under the baseline scenario for each economy covered by the multi-country model. In particular, expert adjustments are applied to model interpretation of trend and gap movements, decomposition of model variables, incorporation of diverse shocks, and evaluation of the consistency of projected macroeconomic variable trajectories. Model-related work and intermediate discussions take the form of joint workshops conducted on an as-needed basis.

Writing and Publication of an Analytical Report

Having reached a consensus regarding forecasting outcomes, the participants of the projection round write an analytical report detailing projections with respect to the main macroeconomic indicators for each EAEU member state (real GDP, GDP use component decomposition, CPI inflation). The report describes projection-related assumptions and hypotheses, and presents projected trajectories of the key macroeconomic variables in graphic or tabular format. The final version of the report is approved by the participants of the projection round. The analytical report is then published on the websites of the Commission and the EDB. Projection materials are also used in the preparation of monthly reviews and are included in quarterly reviews and the annual report on results and prospects of social and economic development in EAEU member states.

4

APPLYING THE MODELS TO DATA

This section describes an application of the ISM to the data of the five EAEU member countries: Russia, Belarus, Kazakhstan, Armenia, and Kyrgyzstan. It presents the results of the estimation of the initial state of the EAEU economies, especially as regards the initial cyclical position and the long-term growth rate in these economies. The data are for the period from 2004Q2 to 2014Q3.[14]

In summary, the estimation suggests that growth in Russia will be subdued, corresponding to the outlook of low commodity prices, a low oil price in particular. The subdued growth in Russia pins down growth of the other EAEU member countries well below their historical averages. To absorb the unfavorable implications for each country's current account, dollar exchange rates will be under pressure, spurring inflation and requiring tighter monetary policy. Nevertheless, if policy measures are well coordinated, the ongoing adjustment can build a sustainable base for future economic expansion, and all five countries might start recovering in 2016.

4.1 Russia

Before the financial crisis started, real GDP was growing by an average annual rate of 7.5%; the currency was appreciating gradually against the dollar; and inflation had slowed to below 10% by 2007. However, the global financial crisis hit Russia in a similar way as other emerging market economies, and the high share of foreign funding in the domestic banking sector was an important factor that aggravated the shock. The dramatic increase in the perceived riskiness of Russian assets led to a sudden and marked depreciation of the currency by more than 20% in early 2009. With lending in the economy coming to a halt and external demand collapsing, GDP decreased dramatically.

After a temporary recovery in 2010 and 2011, real GDP growth in Russia slowed to about 1.5% year-on-year in 2013. There was sluggish growth in real consumption and, most importantly, a drop in investment activity. While decreasing oil prices and weak foreign demand undermined economic growth, inflation has remained above the

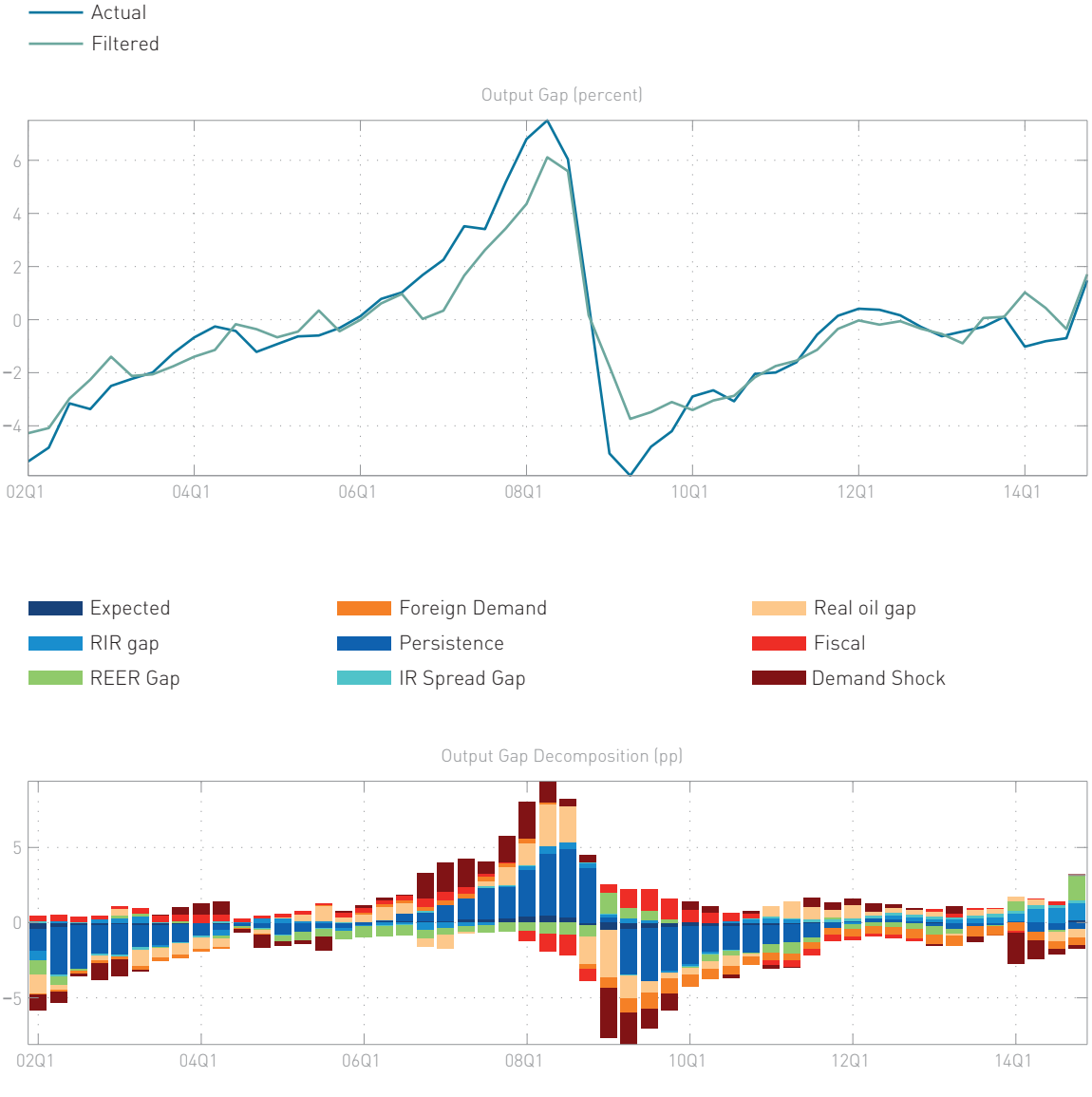
[14] With respect to the macroeconomic forecasts for the five EAEU economies produced with the integrated model, please follow the official publication of the EDB/EAEU, which is updated on a regular basis: http://www.eurasiancommission.org/ru/act/integr_i_makroec/dep_makroec_pol/Pages/sogl.aspx.

central bank's target range amid temporary supply-side shocks. The volatility of the exchange rate has increased, and the ruble has depreciated substantially during the last two years.

According to the model estimation, the recent slowdown in economic activity is predominantly attributable to lower potential growth, although the cyclical position of the economy has also deteriorated since the beginning of 2012, amid subdued demand from Russia's main trading partners (Figure 2.1). According to the model estimation, potential growth declined from above 4% in 2010–2011 to around 1% in late 2014, mainly due to declining oil prices.

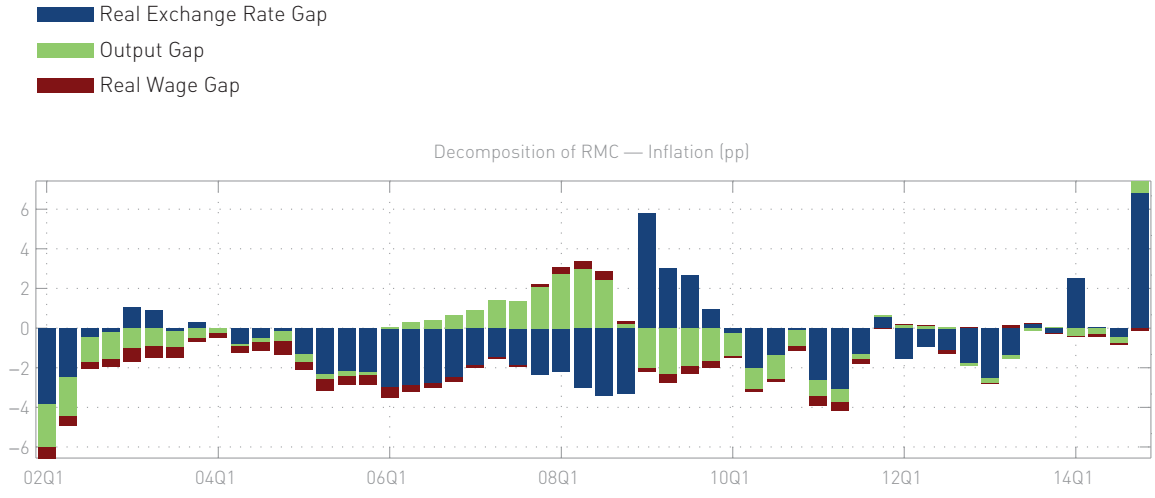
Despite the slowdown in real economic activity, inflation accelerated above the Bank of Russia's target range in late 2014. The model estimation identifies a number of reasons. One is the spillover effects of the Russian sanctions on imported food products, which provided an initial stimulus to the recent inflation surge. Another force is the real exchange rate gap, which increases with the weakening currency (Figure 4.2).

Figure 4.1 Estimation of the Output Gap and Its Factors in Russia



Source: own computations

Figure 4.2 Decomposing the Real Marginal Costs into Its Components



Source: own computations

The nominal exchange rate has been under constant and strong depreciation pressure since the beginning of 2014, due to capital outflows and weak country fundamentals vis-à-vis stagnant oil prices. As a result, the ruble lost almost a third of its value in 2014Q4 with respect to the same period a year ago. Most recently, the Bank of Russia decided to commit to a free-float of the ruble and has lifted trading bands. In addition, the Bank of Russia repeatedly increased its key rate during 2014 to support the currency and stabilize the growing inflation pressure.

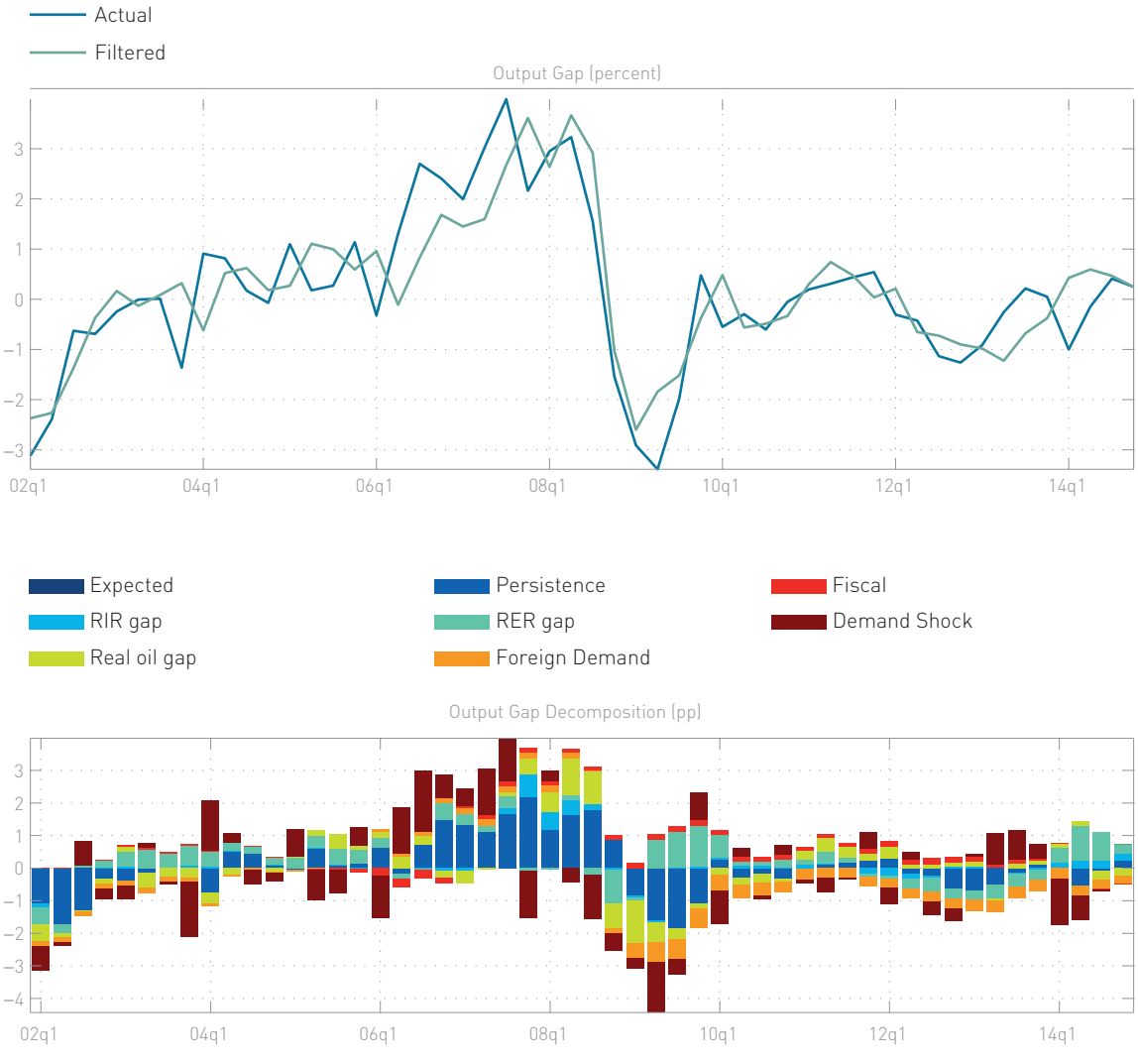
4.2 Kazakhstan

The Kazakh economy has been slowing recently due to decreasing oil prices and weak foreign demand. The authorities, in an effort to promote the country's competiveness, weakened the tenge in early 2014 by 20%. While this step has supported domestic demand temporarily, inflation has increased, partially mopping up the gains in competitiveness.

The world financial crisis put an end to the robust growth of the Kazakh economy. From the average of 10% year-on-year growth before the crisis, GDP growth declined to about 7.5% in 2010 and 2011, and further to around 4.5% in 2014. Still, the external position of Kyrgyzstan has remained solid. The robust commodity exports before the crisis had allowed reduction of the already low government debt below 6% of GDP. After the crisis, the counter-cyclical spending has led to fiscal deficits, and the debt has grown back to above 10% of GDP but remains very low by international standards (slightly above 13% of GDP in 2014).

The gap in real output, which approximates the business cycle position of the economy, was mostly depressed in the course of 2014 (Figure 2.3). The depressed demand comes on the back of weak external demand and an overvalued currency, while showing the stimulating effect of extra government spending in response to the crisis. Only in mid-2014, following sharp depreciation, did domestic demand receive additional momentum, and the output gap has turned slightly positive since.

Figure 4.3 Output Gap in Kazakhstan and Its Decomposition



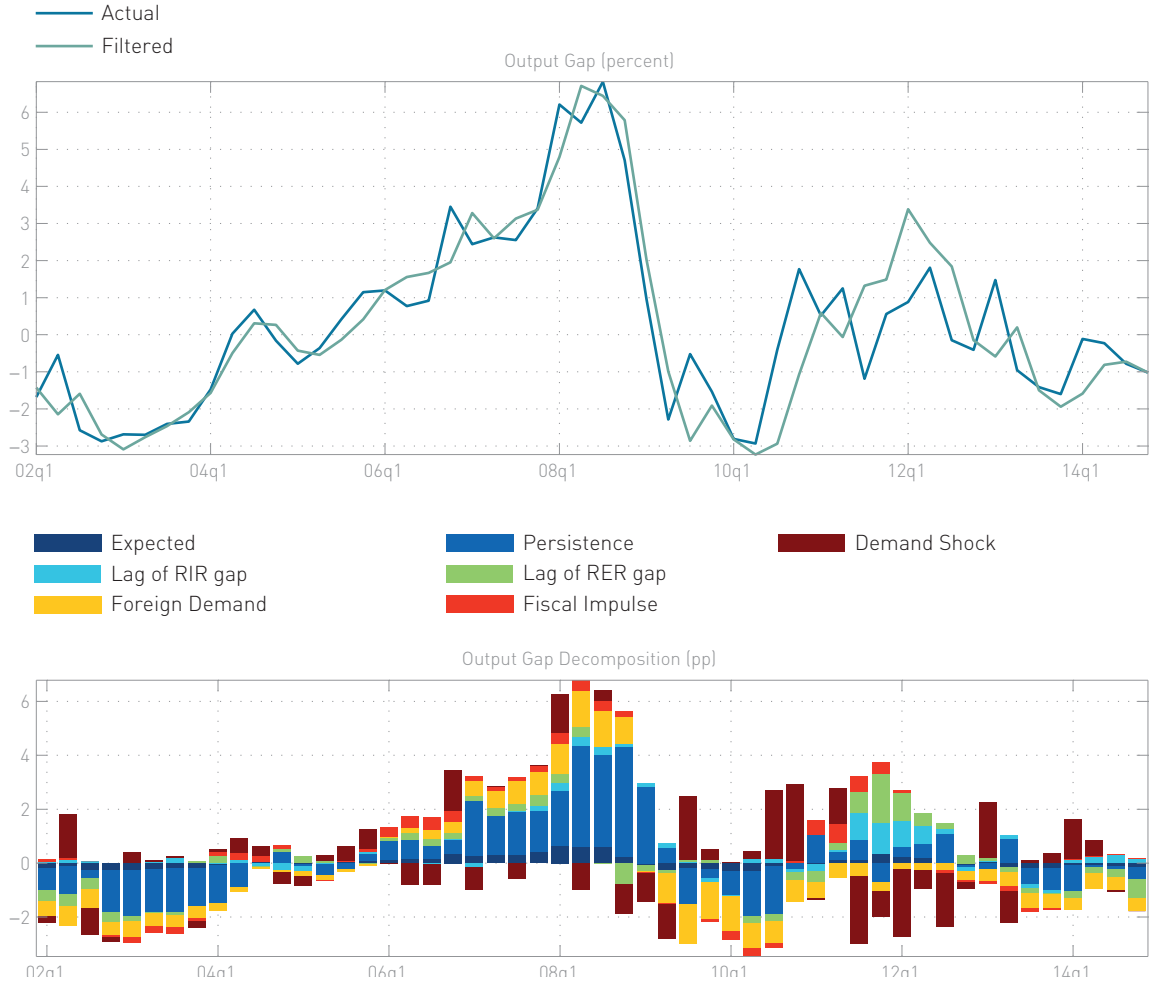
Source: own computations

4.3 Belarus

The high growth rates of the Belarusian economy during 2003–2008 can be explained by robust external demand and generous oil contracts from Russia. However, the period of economic growth close to 10% was disrupted by the world financial crisis. In 2009, there was no economic growth recorded in Belarus. As the reversal in 2010 was more due to base-year effects rather than any change in the Belarus macroeconomic model, accumulating imbalances and worsening terms of trade were accompanied by a sharp drop in exports followed by a drop in aggregate demand. The negative tendencies resulted in the balance-of-payments crisis and in the sharp devaluation of the Belarus ruble in the second half of 2011.

A number of factors contributed to the decline: The need of households to restore their savings and tight monetary policy imposed to restore stability were combined with weak external demand. These factors more than offset the competitiveness gains brought about by the devaluation (Figure 4.4).

Figure 4.4 Output Gap in Belarus and Its Decomposition



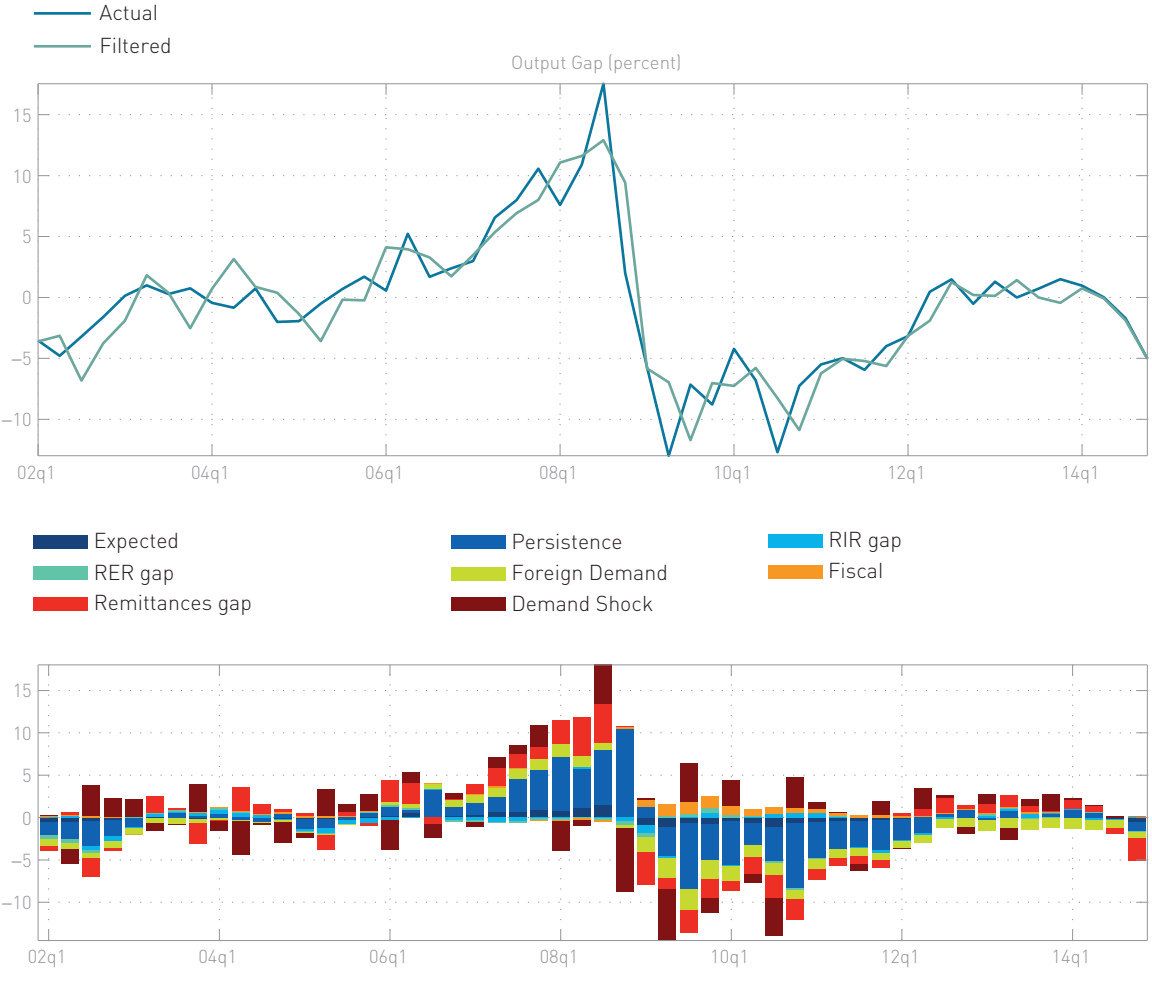
Source: own computations

4.4 Armenia

The Armenian economy enjoyed double-digit economic growth in 2004–2007. The economic boom in Russia increased the remittances from the Armenian diaspora, helping to reduce poverty and boosting private consumption and residential construction. At the same time, the strong inflows of capital (including FDI) and remittances put strong appreciation pressure on the dram, which helped to contain inflation despite the high growth. Nevertheless, the Armenian economy began to exhibit symptoms of a self-inflicted Dutch disease, with deteriorating competitiveness, declining exports, and a widening trade deficit.

The Armenian economy was hit hard by the global economic crisis. Although the Armenian financial sector was relatively isolated from global markets—and although the banking system remained sound—a sharp drop in remittances, low foreign demand, and receding FDI were the main reasons for the economic downturn of more than 14% in 2009. Declining incomes, increasing costs of lending, and high uncertainty brought the output gap to minus 10% in early 2009 (see Figure 2.5). The model-based decomposition indicates that the drop could have been even larger, had the authorities not applied for concessional loans provided by the IMF and Russia. Consequently, the debt of the general government more than doubled from 14% to 34% of GDP between 2007 and 2009.

Figure 4.5 Output Gap in Armenia and Its Decomposition (percent)



Source: own computations

Rising uncertainty among foreign investors and receding FDI put additional pressure on the Armenian dram. To partially equilibrate the large imbalances, the authorities let the nominal exchange rate depreciate by close to 35% (with respect to the US dollar) between early 2009 and early 2010, once the country's international reserves had been largely exhausted.

Despite unfavorable weather conditions, low external demand, and difficult access to foreign financing, the Armenian economy has been growing again, albeit unimpressively, since early 2010. The main factors of the rebound in private demand were low real interest rates and gradually recovering remittances (Figure 4.5). Government demand also contributed to the recovery, as the authorities—helped by international institutions—succeeded in continuing counter-cyclical policies.

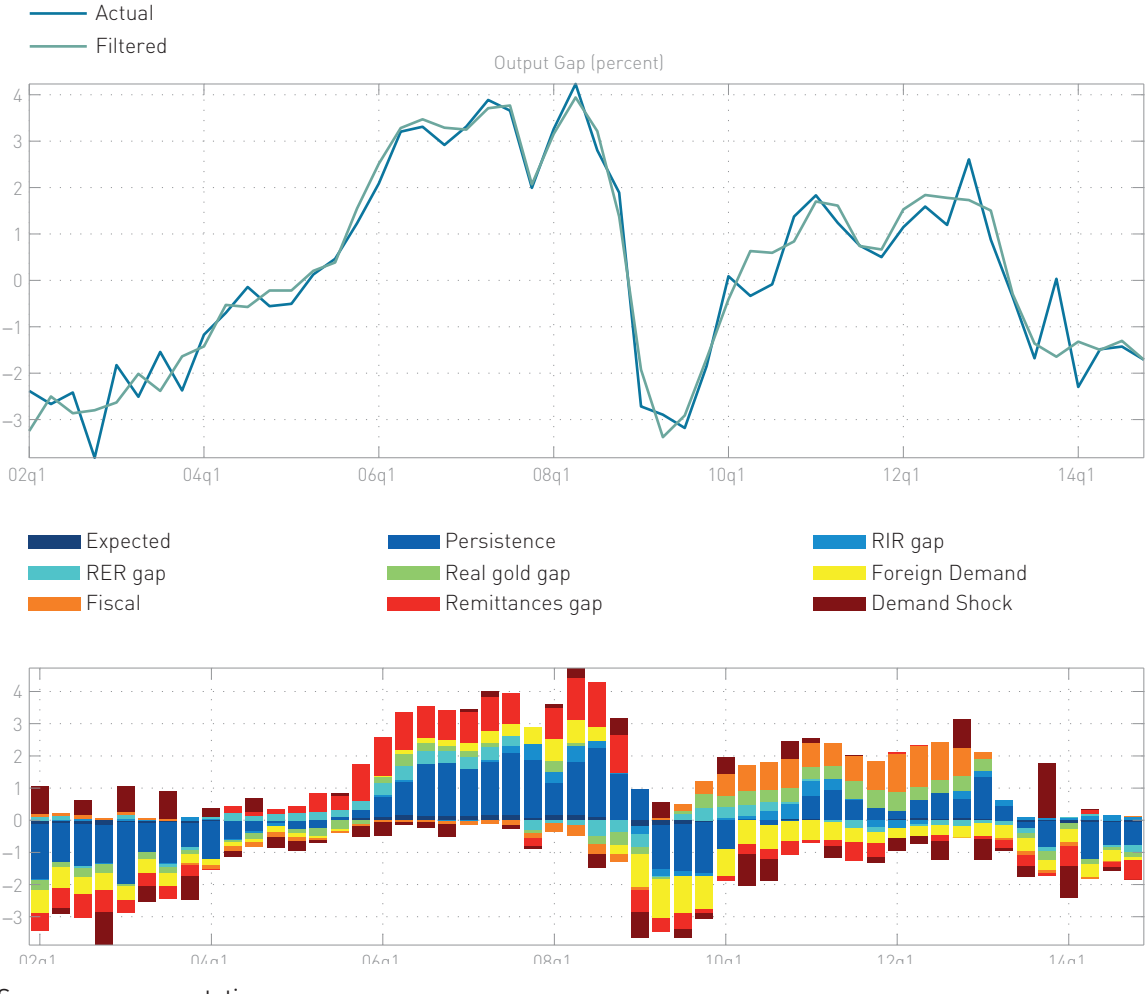
However, the recovery has been very fragile: GDP growth has been hovering around 4%, well below the pre-crisis average. According to the model estimation, potential growth, equilibrium real appreciation, and equilibrium inflow of real remittances are slower than before the crisis. At the same time, the country risk premium remains elevated. These results are in line with a significant decline in investment activity (both private and public), depreciation of capital assets, and relatively high government debt. In the meantime, inflation has remained very volatile, driven by varying weather conditions and movements in prices of imported energies and food.

4.5 Kyrgyzstan

Like many other developing countries in the region, Kyrgyzstan experienced a boom before 2008, which was maintained by high capital and remittance inflows. The resulting fast real appreciation brought about an overvalued currency and a large current-account deficit. When the financial crisis started, capital flows abruptly changed direction, and the Kyrgyz economy faced large currency pressures. Food price shocks and a volatile exchange rate led to two periods of surging inflation. First, inflation accelerated in late 2007 and early 2008 but dropped fast in 2009 before accelerating in 2011 and dropping again in 2012.

A high level of export concentration in the gold industry makes the economy of Kyrgyzstan vulnerable to gold prices and gold production volumes. One of the implications is large volatility of GDP and fiscal revenues that transmit to high volatility of the nominal exchange rate and indirectly to high inflation variability through both demand and cost channels. The Kumtor-mine effect appeared to be particularly important in 2012 and 2013, during a period of declining gold prices and political disputes about the future of the mine. The estimated large residuals for the output gap can be attributed mostly to a series of suspensions of the Kumtor mine followed by abrupt production spikes.

Figure 4.6 Output Gap in Kyrgyzstan and Its Decomposition (percent)



Source: own computations

The Kyrgyz economy experienced a broad-based slowdown in the first half of 2014 caused by the adverse developments in both the Russian and Kazakh economies. Besides declining exports, the real net inflow of remittances also dropped, mainly due to the slowdown of the Russian economy and the sharp depreciation of the ruble. It is expected that a low export base and declining remittance inflows will keep the currently overvalued som under continuous pressure.

5

SENSITIVITY OF THE RESULTS TO DIFFERENT PARAMETERIZATIONS: A BASE FOR ALTERNATIVE SCENARIOS

This section tests the sensitivity of ISM models to the calibration of several key parameters. In summary, the models' behavior and forecasts are fairly robust to most transitory parameters, with the exception of the share of the real exchange rate in the real marginal costs and smoothing of interest rates in the monetary policy rule. At the same time, the results are very sensitive to all parameters affecting the transmission of oil prices in Russia and Kazakhstan and remittances in Armenia and Kyrgyzstan, pointing to the need to carefully monitor structural changes in these economies.

We have tested the sensitivity of the model results to several key parameters by studying the impulse response functions of the models under different parameter specifications. The parameters of interest and their values used in the experiments for the Russian model are shown in Table 5.1:[15]

Table 5.1. Alternative Calibrations of the Model

Parameter	Baseline calibration [RU]	Alternative calibration [RU]
elasticity of aggregate demand to the real interest rate gap	0.09	0.2
elasticity of aggregate demand to the real exchange rate gap	0.12	0.25
sensitivity of inflation to the real marginal costs	0.1	0.05
share of the real exchange rate in the real marginal costs	0.5	0.7
smoothing of the interest rate	0.75	0.5
responsiveness of the interest rate to the deviation of future inflation from the target	0.4	1.4

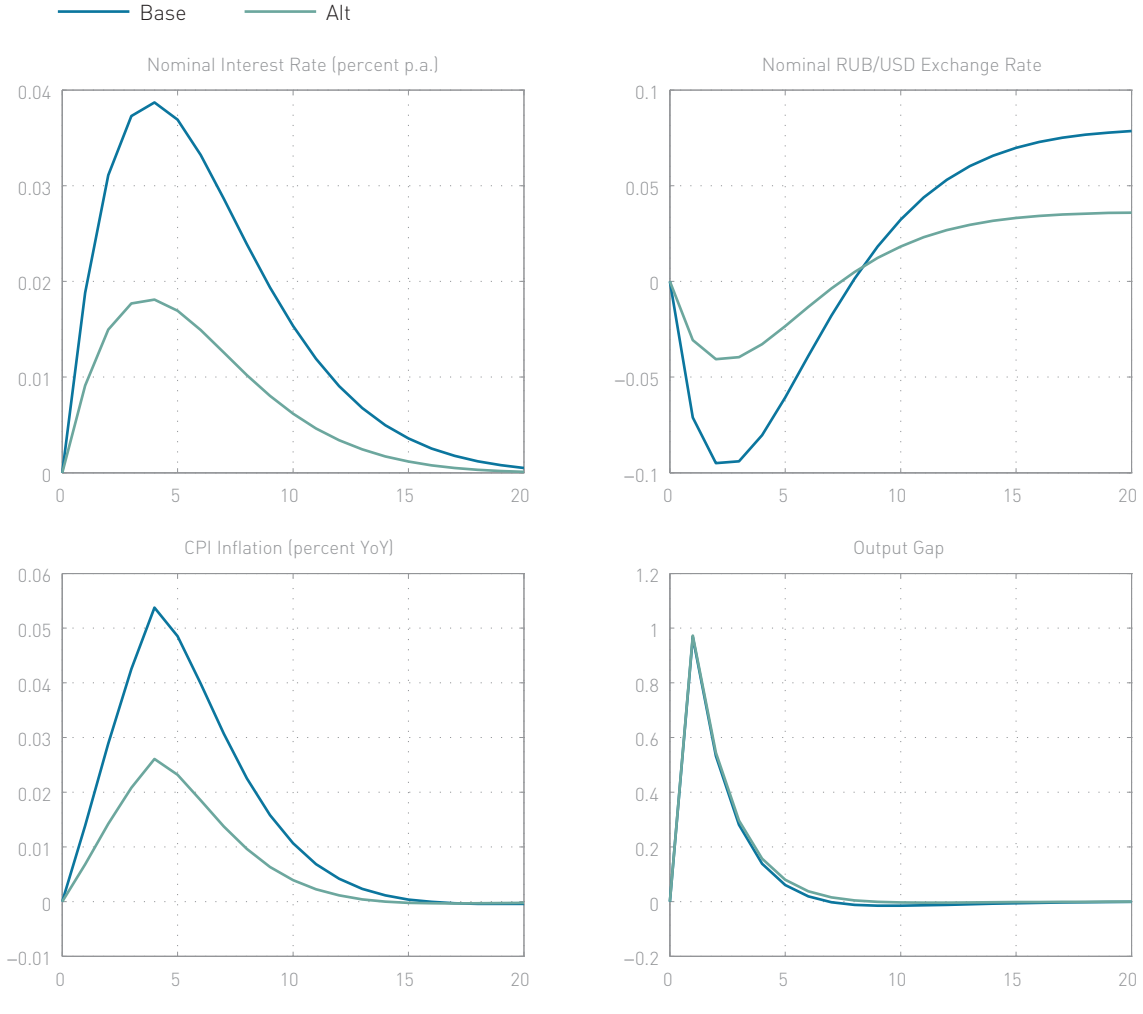
[15] Similar experiments were carried out for the other behavioral coefficients. Results can be obtained upon request.

We have used these parameter values in creating impulse response functions to all major structural shocks of the model. We illustrate the results for the Russian model by showing the responses to a demand shock under different parameterizations for the composition of the real marginal costs and the policy reaction function. Figure 5.1 shows the responses of the main Russian variables to a sudden demand shock in Russia under the two calibrations for the share of the real exchange rate gap. Figure 5.2 shows the same shock under the two calibrations of the policy reaction function.[16]

The difference in the impulse responses points to the need to monitor changes in the economies that might lead to different calibrations in these equations. For instance, progress in inflation targeting in Russia may lead to more aggressive responses of interest rates to inflation, requiring a recalibration of the model, as we explain in the next section. Alternatively, a closer integration of EAEU economies may lead to a slower pass-through of the real exchange rate to inflation.

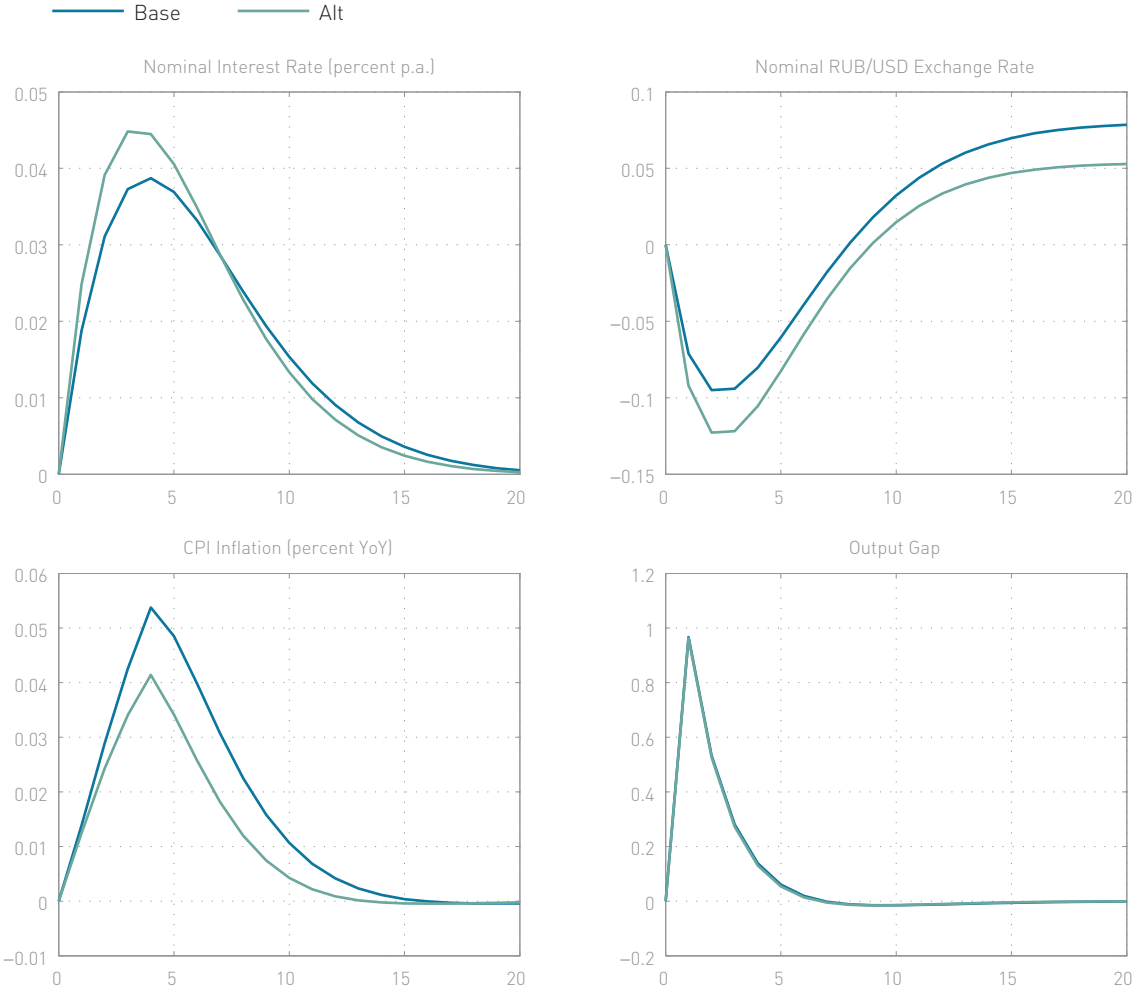
Next, we have tested the sensitivity of the model behavior to the transmission of the price of oil in Russia and Kazakhstan. Because there are several parameters involved in this transmission, we have created fan charts showing the forecast uncertainty caused by com-

Figure 5.1 Responses of the Russian Model to a Demand Shock in Russia under Two Calibrations of the Real Exchange Rate Share in the Real Marginal Costs (0.5 – Base, 0.7 – Alt)



[16] Other results can be shown upon request.

Figure 5.2 Responses of the Russian Model to a Demand Shock in Russia under Two Calibrations of the Responsiveness of Interest Rates to the Deviation of Future Inflation from the Target (0.4 – Base, 1.4 – Alt)



mon volatility in the price of oil (instead of impulse responses, as above). Specifically, we have switched off all other sources of uncertainty except for the volatility of the gap and the trend in the real price of oil, which were left at their historically estimated values.

Figure 5.3 shows the effects of this volatility on the forecast for Kazakhstan. Results for Russia can be provided upon request. As expected, the high sensitivity of the forecast to the price of oil is clearly visible. The oil price uncertainty affects GDP growth and the nominal interest rate, due to the rigid exchange rate regime exercised by the monetary authority.

Finally, we have tested the sensitivity of the model behavior to the transmission of remittance inflows in the cases of Armenia and Kyrgyzstan. There are several parameters involved in this transmission. Therefore, instead of impulse responses, we examine fan charts showing the forecast uncertainty caused by common volatility in the remittance inflow. Specifically, we have switched off the other sources of uncertainty except for (i) volatility of foreign demand, (ii) idiosyncratic shocks to the remittances gap, and (iii) volatility of the remittances trend, which were all left at their historically estimated values. Figure 5.4 shows the effects of this volatility on the forecasts for Armenia.

As expected, the results show high sensitivity of the forecast to remittance inflows. Their uncertainty particularly affects the nominal exchange rate, as the cross-border flows need to adjust to a different level of foreign-currency flows.

Figure 5.3 Kazakhstan: Forecast Uncertainty Caused by Volatility of the Price of Oil

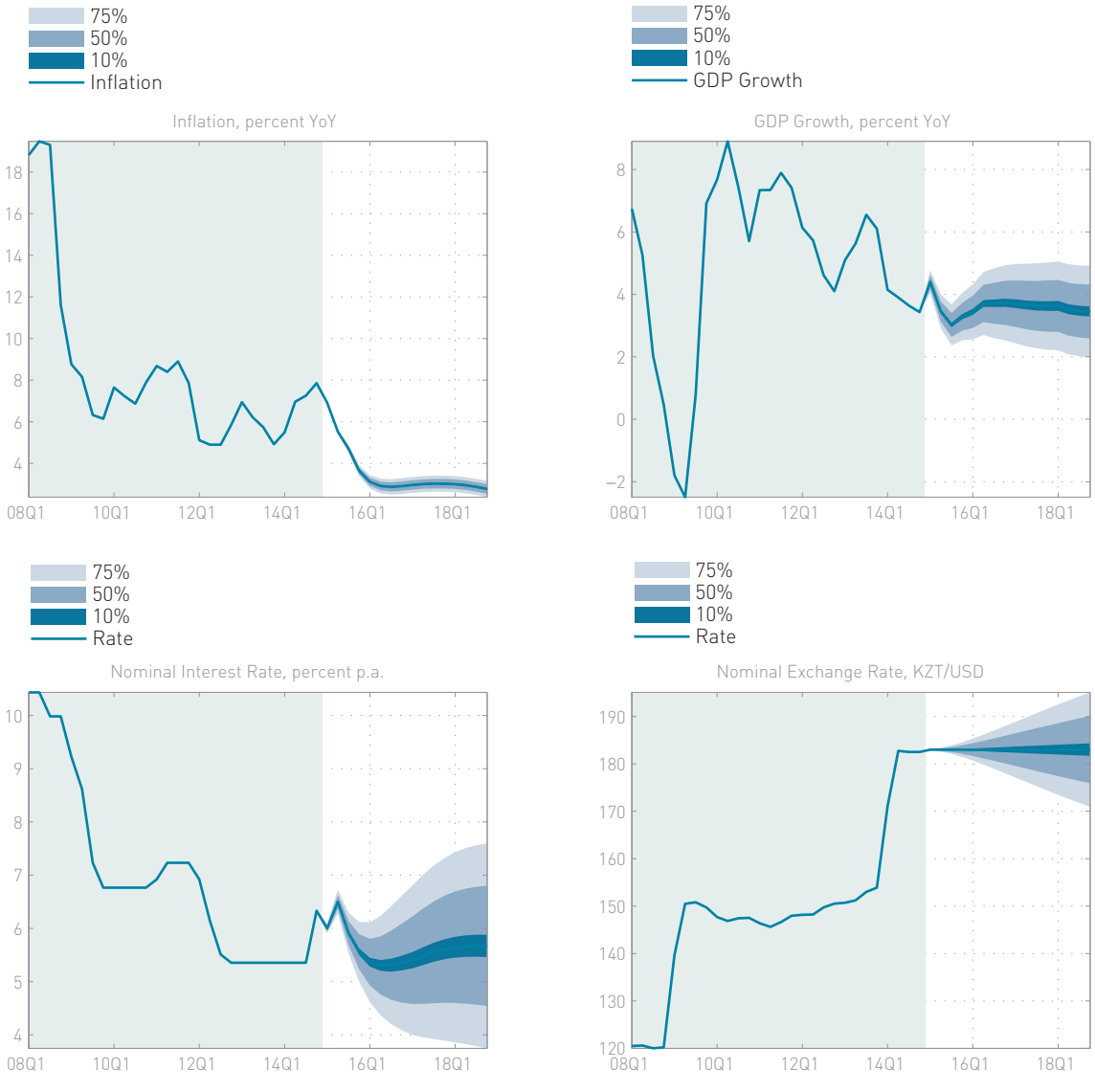
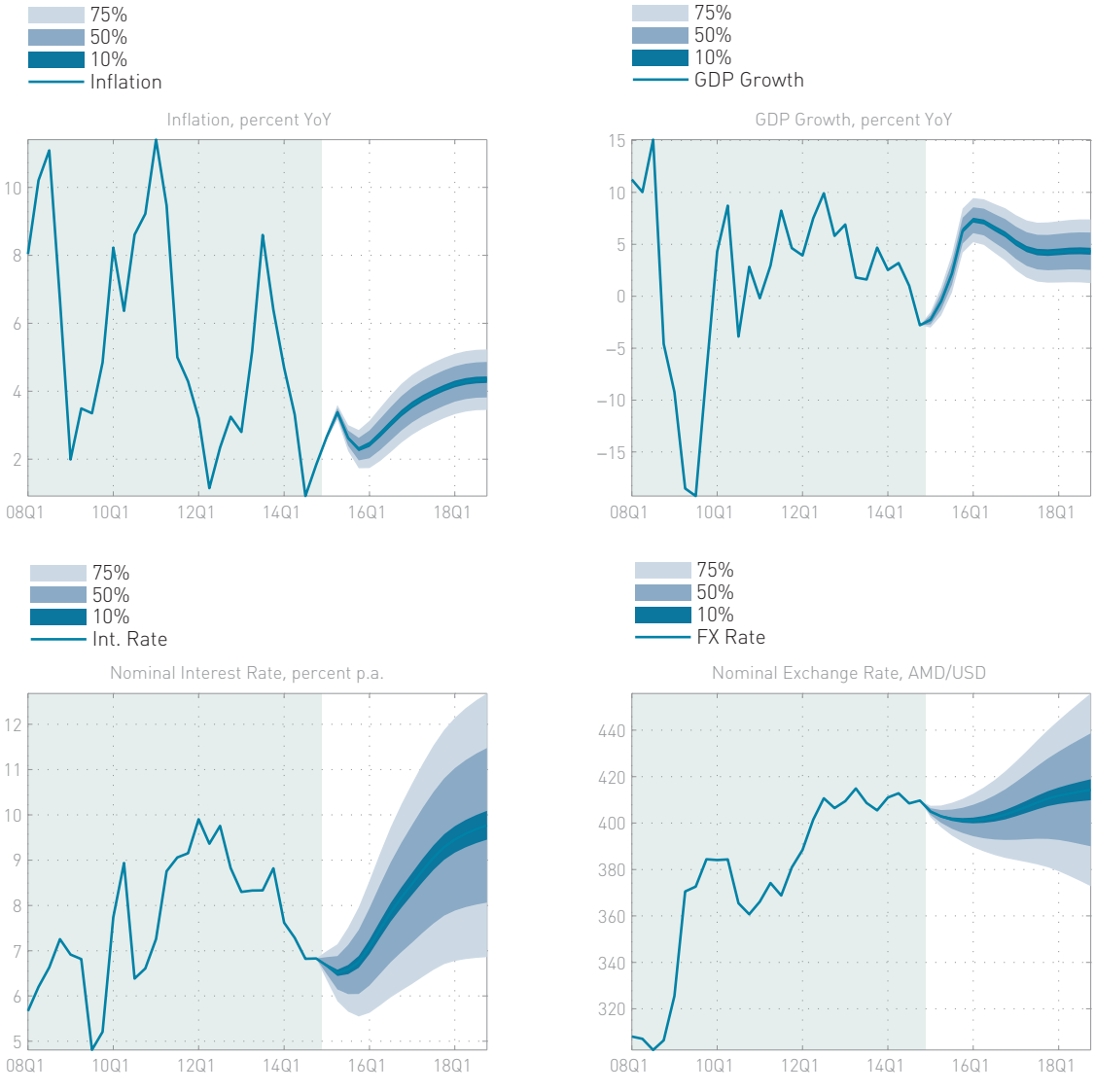


Figure 5.4 Armenia: Forecast Uncertainty Caused by Volatility of the Remittance Inflow



6

WORKING WITH STRUCTURAL CHANGES IN THE EAEU ECONOMIES

The model's calibration reflects the current economic mechanisms in the EAEU economies, which makes the model a reasonable forecasting tool for the coming medium-term period of three to four years, assuming these mechanisms do not undergo a substantial structural change. While the economies will gradually be evolving, there is no reason to change the model's calibration very frequently. As we demonstrated in Section 3, the forecasts are reasonably robust to changing values of many transitory parameters. Therefore, unless the structural mechanisms embedded in the model design change substantially, it is sufficient to recalibrate the model approximately once every year.

However, if the economies undergo substantial structural changes, fundamentally affecting the model's mechanisms, the model and its calibration will need to be adjusted without delay to reflect the new macroeconomic reality and thus remain a good forecasting tool. Examples of such structural changes, especially relevant for the EAEU, include:

- Reducing the dependence of economic growth on oil, both in a structural and a cyclical sense, in Russia and Kazakhstan, and the dependence on gold in Kyrgyzstan.
- Strengthening the interest rate transmission and decreasing the exchange rate pass-through in Russia and Kyrgyzstan, following the introduction and deepening of the forward-looking regime aimed at lowering inflation volatility.
- Changing the monetary policy regimes in Belarus, Armenia, and Kazakhstan, either by allowing the currencies to be more flexible (imitating the regime in Russia) or by integrating policies of all EAEU countries more closely.
- Reducing mark-ups in response to a more competitive environment brought about by the common market among the EAEU economies.
- Reducing energy intensity of production and household consumption, especially in Belarus.

Some of these structural changes may materialize over many years, such as an increase in energy efficiency, so the forecaster will have plenty of time to do research and adjust the model in a timely fashion. Other changes can happen fast: For instance, both Belarus and Kazakhstan have adjusted their exchange rates abruptly several times in the recent past and could do so again in the near future. In the rest of this Section, we provide general guidelines for how to deal with some of these structural changes in the model's design and calibration. It is expected that in reality such changes will be implemented after additional research and using the forecaster's insight and judgment about the nature of the underlying structural changes.

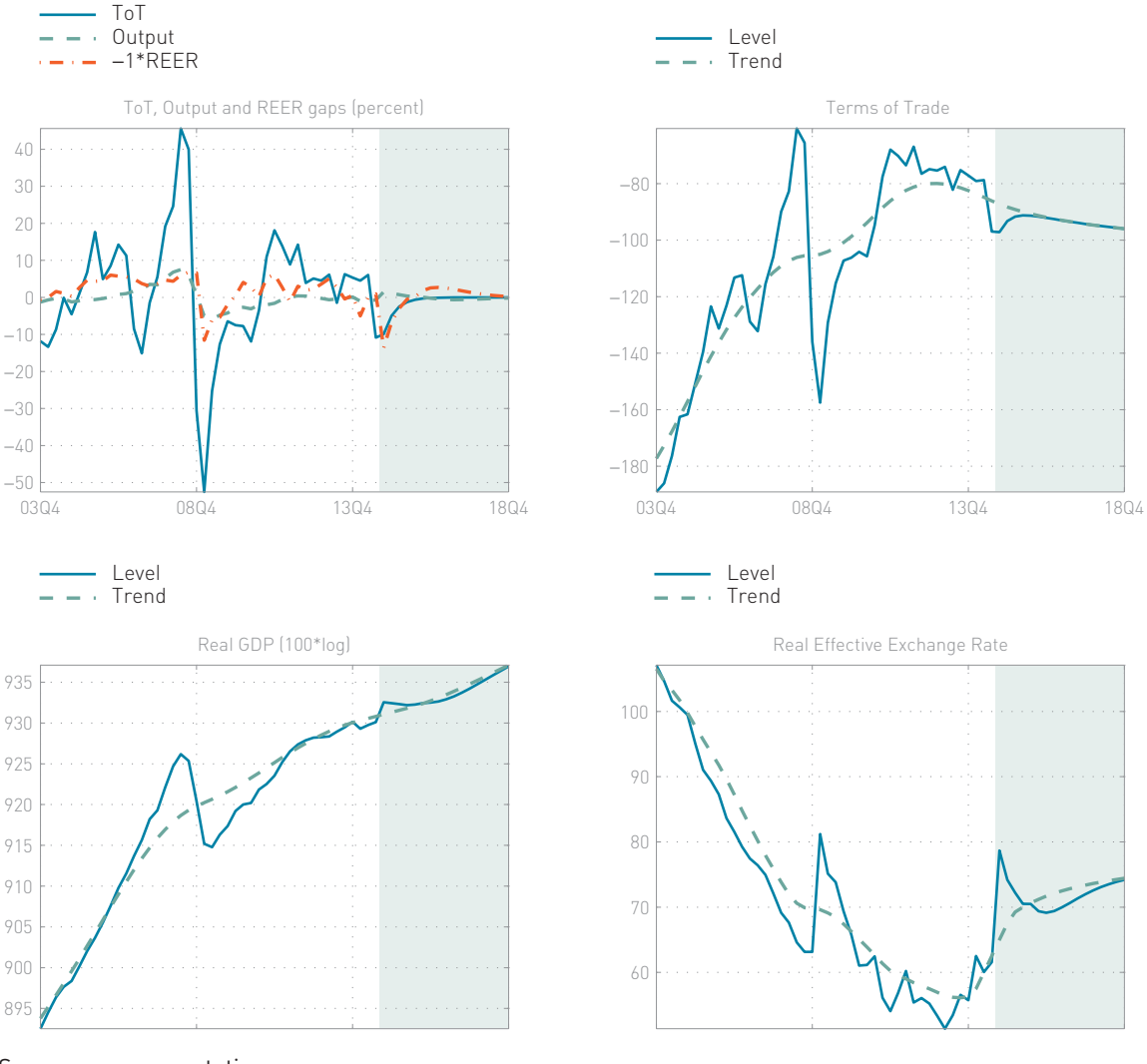
Economic Growth and Oil

In the past, long-term economic growth in Russia and Kazakhstan has been closely linked to the price of oil on the world market. In addition, the fiscal policies in these economies closely followed the price of oil, thus making the cyclical component of growth very oil-dependent. This dependence is illustrated in Figure 5.1, showing the correlation between the real price of oil, real exchange rate, and GDP in Russia. The Kazakh economy shows a similar pattern.

This dependence has been reflected in the current calibration of both models. Going forward, however, structural reforms may induce the development of non-oil industries and service sectors, thus eroding the link between growth and the price of oil. In that case, the models' structure should change in two ways:

First, the models will have to take into account the growing proportion of non-oil exports. The new underlying trends in the real exchange rate and potential output need to be identified as the economy becomes less dependent on terms-of-trade movements (the price of oil in particular).

Figure 6.1 Correlations among Output, the Real Effective Exchange Rate, and the Relative Price of Oil (Terms-of-Trade)



Source: own computations

Second, the effect of the relative price of oil on the economic cycle, presented in the equation for domestic demand, will become less pronounced and may eventually disappear. However, the cyclical effects from the redefined terms-of-trade and a more prominent pass-through of the real exchange rate should substitute for the weaker effect of oil price changes.

A similar approach can address a potentially weakening importance of remittance inflows in Armenia and Kyrgyzstan, which is likely to happen with improving living standards in both countries.

Strengthening of Inflation-Targeting Regime in Russia

Russia's monetary policy has recently undertaken many important reforms, and the Bank of Russia has unveiled plans to formally introduce inflation targeting in the coming years, but current practices are already very close to inflation targeting, de facto. Similar tendencies, although not so prominent, are underway in Kyrgyzstan.

As the regimes gain strength, monetary policy transmission through interest rates will become stronger while the exchange rate will be even more flexible than today, and its effect on expectations and pass-through to inflation will decline. This process may require the following changes in the model's design and calibration:

First, the effect of real interest rates on demand will strengthen. There may also be a merit in introducing a yield curve into the model and working with the effect of long-term rates on demand and output.

Second, the exchange rate determination will be increasingly forward-looking, and the effect of the past exchange rate level in the UIP equation will decrease.

Third, the share of the real exchange rate in the definition of the real marginal costs will decline, reflecting the less important role of the exchange rate in affecting inflation and inflationary expectations.

Finally, the parameters of the interest rate rule will also likely change, although it is difficult to predict exactly how at this moment. What seems certain, though, is that policy will react to inflation in the more distant future, reflecting the medium-term perspective of the inflation-targeting regime and increasing confidence in forecast-based policymaking at the Bank of Russia. At the same time, however, the rule may include other variables, such as output growth (gap) or variables reflecting financial stability.

Changing Monetary Policy Regime and Exchange Rate Adjustments

Monetary policy regimes in the EAEU countries may change in the future. They may become more coordinated by linking their exchange rates more tightly. This will require changes in the exchange rate blocks of all countries: The exchange rate equations will feature the corresponding links, and the UIP equations will determine the levels of short-term interest rates in the individual economies.

Alternatively, Belarus and Kazakhstan may decide to adopt a variant of the inflation-targeting regime practiced by the Bank of Russia, the Central Bank of Armenia, and, to some extent, the National Bank of Kyrgyzstan. In this case, the interest rate and exchange rate blocks will have to be modified towards a more flexible exchange rate and a more prominent role of expected inflation in the monetary policy rules.

Still, the EAEU member economies may opt for an eclectic approach, adjusting the

parameters of the exchange rate regime and monetary policy as they see fit. For instance, both Belarus and Kazakhstan have in the recent past devalued their currencies in order to safeguard competitiveness and preserve external stability. Modeling and forecasting of such a policy require a complex adjustment of the model mechanisms along the following lines:

First, we need to estimate how much the real effective exchange rate has to depreciate to equilibrate the BoP, so that we can adjust the projection of the real effective exchange rate trend accordingly. This can be done using the Automated Data Interface (ADI) tool of the ISM. The elasticity of the trade balance to the exchange rate can be checked with the survey results of Tokarick (2010).

Second, we need to assess whether the growing net foreign liabilities (implied by the ADI) would negatively affect the country's ability to repay its sovereign debt, so as to adjust the calibration of the country's risk premium.

Third, we need to assess the consistency of all measures taken by the authorities to support the new policy. For instance, when there is a panic and the authorities do not restrict monetary policy and increase market interest rates enough (as happened, for instance, in Belarus in 2011), the model should reflect this by a sharp increase in the inflation target and additional UIP shocks depreciating the currency. The actual recalibration in this respect depends very much on the forecaster's experience and the perspective of the unfolding currency crisis.

Fourth, the pass-through of the exchange rate to inflation during a period of abrupt exchange rate movements should increase, as it is expected that people will rush to buy goods to protect the value of their savings. Again, the exact magnitude and duration of this increase will depend on the judgment of the forecaster. For instance, the pass-through may increase more sharply if the situation occurs before a major general shopping event (e.g., Christmas) than before a summer break. If the change in the pass-through is considered permanent, the coefficients of the Phillips curve should be increased. In most cases, however, the change will be temporary and can be handled by (i) adding positive shocks to inflation, (ii) adding negative shocks to the demand gap as the savings will need to increase to adjust for balance sheet losses, and (iii) reducing potential growth, acknowledging lower investment and productivity growth in this period.

Finally, if the authorities decide to restrict financial cross-border flows (as happened in Belarus in 2011), the lack of arbitrage opportunities will limit the implications for the domestic real interest rate trend implied by a higher risk premium and slower real exchange rate appreciation. At the same time, it should be carefully monitored whether a parallel exchange rate market develops, and whether it is adequately incorporated in the model (e.g., by weighing the developments of the official exchange rate).

History can be a good guide in deciding on the value of the shocks. For instance, the Kalman filter estimation applied to Belarus can show the size of these shocks in 2011 and 2009 when the exchange rate was being adjusted. Most of these shocks should be classified as unanticipated.

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APPENDIX A: DATA SOURCES

Data Sources, External Sector QPM

Monthly Series

Variable Name	Short Description	Source
cpi_ez_su	Eurozone (17) weighted consumer price index, 2005	Bloomberg
cpi_us_su	CPI all items MoM inflation, 2010	Bloomberg
usd_eur	Nominal USD per EUR	Bloomberg
ir_fed_us	US Fed funds rate and projection	Bloomberg and Federal Reserve
gold	Gold spot price, USD/oz.	Bloomberg
pfood	Average monthly nominal wage	International Monetary Fund

Quarterly series

Variable Name	Short Description	Source
ir_ecb_ref	ECB main refinancing rate	Bloomberg
poil_urals	Crude oil price (Urals), USD per barrel	Bloomberg
poil_brent	Crude oil price (Brent), USD per barrel	Bloomberg
poil_imf	Crude oil price projection	International Monetary Fund
gdp_gap_ez_imf	Eurozone output gap and projection	International Monetary Fund
gdp_gap_us_imf	US output gap and projection	International Monetary Fund
cpi_eop_a_ez_imf	Annual CPI inflation projection, Eurozone	International Monetary Fund
cpi_eop_a_us_imf	Annual CPI inflation projection, US	International Monetary Fund

Data Sources, Armenia QPM

Monthly Series

Variable Name	Short Description	Source
amd_usd_cba	Nominal exchange rate AMD/USD	Central Bank of Armenia
cpi_mom_2010_su	CPI all items MoM inflation, 2010	Central Bank of Armenia
ir_repo_rate	Interbank repo rate	Central Bank of Armenia
rem_in_su	Inflow of remittances	Central Bank of Armenia
rem_out_su	Outflow of remittances	Central Bank of Armenia
wage_nom_su	Average monthly nominal wage	National Statistical Service of Armenia

Quarterly Series

Variable Name	Short Description	Source
gdp_yoy_su	Real GDP growth, YoY	Central Bank of Armenia
gov_def_su	General government consolidated budget deficit	National Statistical Service of Armenia
gdp_nom_su	GDP at current prices	National Statistical Service of Armenia

Data Sources, Belarus QPM

Quarterly Series

Variable Name	Short Description	Source
gdp_2009_su	Real GDP in BYR, 2009	National Statistical Committee of the Republic of Belarus
gdp_nom_su	Nominal GDP in BYR	National Statistical Committee of the Republic of Belarus

Yearly Series

Variable Name	Short Description	Source
bgt_def	Annual budget balance	Ministry of Finance of the Republic of Belarus

Data Sources, Kazakhstan QPM

Monthly Series

Variable Name	Short Description	Source
kzt_usd	Reference USD/KZT exchange rate	Bloomberg
ir_ref	Refinancing rate	National Bank of the Republic of Kazakhstan
cpi_mom_su	CPI, MoM: overall	Agency of Statistics of the Republic of Kazakhstan

Quarterly Series

Variable Name	Short Description	Source
gdp_nom_su	Nominal GDP	Agency of Statistics of the Republic of Kazakhstan
w_su	Average nominal wage	Agency of Statistics of the Republic of Kazakhstan
gdp_1994_su	Real GDP, 1994	EEC calculations

Yearly Series

Variable Name	Short Description	Source
bgt_bal_state	State budget balance	Ministry of Finance of the Republic of Kazakhstan

Data Sources, the Kyrgyz Republic QPM

Monthly Series

Variable Name	Short Description	Source
kgs_usd	Nominal exchange rate KGS/USD	Bloomberg
cpi_05_su	Overall CPI, 2005	Statistical Agency of the Kyrgyz Republic
ir_ib	Interbank nominal repo rate	National Bank of the Kyrgyz Republic
remitt_in_su	Remittances inflows	National Bank of the Kyrgyz Republic
remitt_out_su	Remittances outflows	National Bank of the Kyrgyz Republic

Квартальные ряды

Variable Name	Short Description	Source
gdp_chain_su	GDP in prices of the previous year	National Bank of the Kyrgyz Republic
gdp_nom_su	Nominal GDP	National Bank of the Kyrgyz Republic
wage	Average nominal wage	National Bank of the Kyrgyz Republic
fiscal_def_su	Deficit of the government budget	National Statistical Committee of the Kyrgyz Republic

Data Sources, the Russian Federation QPM

Monthly Series

Variable Name	Short Description	Source
cpi_mom_su	CPI, MoM: all items	Bloomberg
rub_usd	Reference exchange rate RUB/USD	Bloomberg
wage_nom_su	Nominal average monthly wage	Federal State Statistics Service of the Russian Federation
budget_bal	Budget balance	Ministry of Finance of the Russian Federation

Quarterly Series

Variable Name	Short Description	Source
gdp_nom_su	Nominal GDP	Federal State Statistics Service of the Russian Federation
gdp_rso_su	Real GDP, 2008	Federal State Statistics Service of the Russian Federation
ir_miacr	MIACR interest rate	Bloomberg
ir_cred	Interest rate on credits	Bank of Russia

Data Sources, Armenia ADI

Economic Category	Source
National Accounts	Central Bank of Armenia
Balance of Payments	Central Bank of Armenia
Consolidated Budget	National Statistical Service of Armenia
Debt	National Statistical Service of Armenia
Monetary Survey	Central Bank of Armenia

Data Sources, Belarus ADI

Economic Category	Source
National Accounts	National Statistical Committee of the Republic of Belarus
Balance of Payments	National Bank of the Republic of Belarus
Consolidated Budget	Ministry of Finance of the Republic of Belarus
Debt	National Bank of the Republic of Belarus
Monetary Survey	National Bank of the Republic of Belarus

Data Sources, Kazakhstan ADI

Economic Category	Source
National Accounts	Eurasian Economic Commission calculations
Balance of Payments	National bank of the Republic of Kazakhstan
State Budget	Ministry of Finance of the Republic of Kazakhstan
Monetary Survey	National bank of the Republic of Kazakhstan
Debt	National bank of the Republic of Kazakhstan
Wealth and Reserve Funds	Ministry of Finance of the Republic of Kazakhstan

Data Sources, Kyrgyzstan ADI

Economic Category	Source
National Accounts	National Statistical Committee of the Kyrgyz Republic
Balance of Payments	National Bank of the Kyrgyz Republic
Central Government Budget	National Statistical Committee of the Kyrgyz Republic
Debt	National Bank of the Kyrgyz Republic
Monetary Survey	National Bank of the Kyrgyz Republic

Data Sources, Russia ADI

Economic Category	Source
National Accounts	Federal State Statistics Service of the Russian Federation
Balance of Payments	Bank of Russia
Consolidated Budget	Ministry of Finance of the Russian Federation
Debt	Bank of Russia
Monetary Survey	Bank of Russia
Wealth and Reserve Funds	Ministry of Finance of the Russian Federation

APPENDIX B: MODEL EQUATIONS

External Sector

EZ Nominal Rates

$$i_t^{ez} = c_1\, i_{t-1}^{ez} + (1-c_1)\left(r_t^{ez} + \pi_{t+1}^{ez}\right) \tag{1}$$

EZ Real Rates

$$r_t^{ez} = \hat{r}_t^{ez} + \bar{r}_t^{ez} \tag{2}$$

EZ Equilibrium Real Interest Rate

$$\bar{r}_t^{ez} = c_2\, \bar{r}_{t-1}^{ez} + (1-c_2)\, \bar{r}_{ss}^{ez} + \varepsilon_t^{\bar{r}^{ez}} \tag{3}$$

EZ Real Rate Gap

$$\hat{r}_t^{ez} = c_3\, \hat{r}_{t-1}^{ez} + \varepsilon_t^{\hat{r}^{ez}} \tag{4}$$

EZ Output Gap

$$\hat{y}_t^{ez} = c_5\, \hat{y}_{t-1}^{ez} + \varepsilon_t^{\hat{y}^{ez}} \tag{5}$$

$$\hat{y}_t^{a,ez} = \left(\hat{y}_t^{ez} + \hat{y}_{t-1}^{ez} + \hat{y}_{t-2}^{ez} + \hat{y}_{t-3}^{ez}\right)/4 \tag{6}$$

EZ Inflation

$$\pi_t^{ez} = c_4\, \pi_{t-1}^{ez} + (1-c_4)\, \pi_{ss}^{ez} + \varepsilon_t^{\pi^{ez}} \tag{7}$$

EZ Inflation Expectations

$${}^{e}\pi_t^{ez} = \pi_{t+1}^{ez} \tag{8}$$

EZ Price Level

$$\pi_t^{ez} = 4\left(p_t^{ez} - p_{t-1}^{ez}\right) \tag{9}$$

Cross USD/EUR Exchange Rate

$$s_t^{USD/EUR} = s_{t-1}^{USD/EUR} + \Delta s_t^{USD/EUR}/4 \tag{10}$$

$$z_t^{ez} = p_t^{us} - s_t^{USD/EUR} - p_t^{ez} \tag{11}$$

$$z_t^{ez} = \bar{z}_t^{ez} + \hat{z}_t^{ez} \tag{12}$$

$$\bar{z}_t^{ez} = \bar{z}_{t-1}^{ez} + \Delta\bar{z}_t^{ez}/4 \tag{13}$$

$$\Delta z_t^{ez} = \left(z_t^{ez} - z_{t-1}^{ez}\right) 4 \tag{14}$$

$$\Delta\bar{z}_t^{ez} = c_{16}\, \Delta\bar{z}_{t-1}^{ez} + (1-c_{16})\left(\pi_{ss}^{us} - \Delta s_{ss}^{USD/EUR} - \pi_{ss}^{ez}\right) + \varepsilon_t^{\Delta\bar{z}^{ez}} \tag{15}$$

$$\hat{z}_t^{ez} = c_6\, \hat{z}_{t-1}^{ez} + \varepsilon_t^{\hat{z}^{ez}} \tag{16}$$

US Nominal Rates

$$i_t^{us} = c_7\, i_{t-1}^{us} + (1-c_7)\left(r_t^{us} + \pi_{t+1}^{us}\right) \tag{17}$$

US Real Rates

$$r_t^{us} = \hat{r}_t^{us} + \bar{r}_t^{us} \tag{18}$$

US Equilibrium Real Interest Rate

$$\bar{r}_t^{us} = c_8\, \bar{r}_{t-1}^{us} + (1 - c_8)\, \bar{r}_{ss}^{us} + \varepsilon_t^{\bar{r}^{us}} \tag{19}$$

US Real Rate Gap

$$\hat{r}_t^{us} = c_9\, \hat{r}_{t-1}^{us} + \varepsilon_t^{\hat{r}^{us}} \tag{20}$$

US Output Gap

$$\hat{y}_t^{us} = c_{11}\, \hat{y}_{t-1}^{us} + \varepsilon_t^{\hat{y}^{us}} \tag{21}$$

$$\hat{y}_t^{a,us} = \left(\hat{y}_t^{us} + \hat{y}_{t-1}^{us} + \hat{y}_{t-2}^{us} + \hat{y}_{t-3}^{us}\right)/4 \tag{22}$$

US Inflation and Price level

$$\pi_t^{us} = c_{10}\, \pi_{t-1}^{us} + (1 - c_{10})\, \pi_{ss}^{us} + \varepsilon_t^{\pi^{us}} \tag{23}$$

$$\pi_t^{us} = 4\left(p_t^{us} - p_{t-1}^{us}\right) \tag{24}$$

US Inflation Expectations

$${}^{e}\pi_t^{us} = \pi_{t+1}^{us} \tag{25}$$

Real Oil Price (approximated terms of trade)

$$rp_t^{oil} = p_t^{oil^{USD}} - p_t^{us} \tag{26}$$

$$rp_t^{oil} = \overline{rp}_t^{oil} + \widehat{rp}_t^{oil} \tag{27}$$

$$\widehat{rp}_t^{oil} = c_{12}\, \widehat{rp}_{t-1}^{oil} + \varepsilon_t^{\widehat{rp}^{oil}} \tag{28}$$

$$\Delta\overline{rp}_t^{oil} = c_{13}\, \Delta\overline{rp}_{t-1}^{oil} + (1 - c_{13})\, \Delta\overline{rp}_{ss}^{oil} + \varepsilon_t^{\Delta\overline{rp}^{oil}} \tag{29}$$

$$\Delta\overline{rp}_t^{oil} = 4\left(\overline{rp}_t^{oil} - \overline{rp}_{t-1}^{oil}\right) \tag{30}$$

$$\Delta oil_t = 4\left(p_t^{oil^{USD}} - p_{t-1}^{oil^{USD}}\right) \tag{31}$$

Real Gold Price (approximated terms of trade)

$$rp_t^{gold} = p_t^{gold^{USD}} - p_t^{us} \tag{32}$$

$$rp_t^{gold} = \overline{rp}_t^{gold} + \widehat{rp}_t^{gold} \tag{33}$$

$$\widehat{rp}_t^{gold} = c_{14}\, \widehat{rp}_{t-1}^{gold} + \varepsilon_t^{\widehat{rp}^{gold}} \tag{34}$$

$$\Delta\overline{rp}_t^{gold} = c_{15}\, \Delta\overline{rp}_{t-1}^{gold} + (1 - c_{15})\, \Delta\overline{rp}_{ss}^{gold} + \varepsilon_t^{\Delta\overline{rp}^{gold}} \tag{35}$$

$$\Delta\overline{rp}_t^{gold} = 4\left(\overline{rp}_t^{gold} - \overline{rp}_{t-1}^{gold}\right) \tag{36}$$

$$\Delta gold_t = 4\left(p_t^{gold^{USD}} - p_{t-1}^{gold^{USD}}\right) \tag{37}$$

Russia

Output Gap

$$\hat{y}_t^{ru} = c_{44}\,\hat{y}_{t+1}^{ru} + c_{45}\,\hat{y}_{t-1}^{ru} - c_{46}\,(\hat{r}_t^{ru} + c_{51}\,\widehat{sp}_t) + c_{49}\,\hat{z}_t^{eff,ru} + \\ + c_{47}\,\widehat{rp}_t^{oil} + c_{48}\,\hat{y}_t^{f,ru} + c_{50}\,\widehat{def2gdp}_t^{ru} + \varepsilon_t^{\hat{y}^{ru}} \quad (38)$$

$$\widehat{sp}_t = c_{52}\,\widehat{sp}_{t-1} + \varepsilon_t^{\widehat{sp}} \quad (39)$$

Real GDP — Trend

$$\Delta\bar{y}_t^{ru} = c_{53}\,\Delta\bar{y}_{t-1}^{ru} + (1-c_{53})\left(\Delta y_{ss}^{ru} + c_{54}\,c_{43}\,\left(\Delta\overline{rp}_t^{oil} - \Delta\overline{rp}_{ss}^{oil}\right)\right) + \varepsilon_t^{\Delta\bar{y}^{ru}} \quad (40)$$

$$y_t^{ru} = \bar{y}_t^{ru} + \hat{y}_t^{ru} \quad (41)$$

Effective Foreign Demand

$$\hat{y}_t^{f,ru} = c_{29}\,\hat{y}_t^{us} + c_{28}\,\hat{y}_t^{ez} + c_{25}\,\hat{y}_t^{by} + c_{24}\,\hat{y}_t^{am} + c_{26}\,\hat{y}_t^{kz} + c_{27}\,\hat{y}_t^{kg} \quad (42)$$

Nominal Wage Setting

$$\Delta w_t^{ru} = c_{64}\,{}^{e}\Delta w_t^{ru} + (1-c_{64})\,\Delta w_{t-1}^{ru} + c_{65}\,(-c_{66}\,\widehat{wr}_t^{ru} + (1-c_{66})\,\hat{y}_t^{ru}) + \varepsilon_t^{\Delta w^{ru}} \quad (43)$$

$${}^{e}\Delta w_t^{ru} = \Delta w_{t+1}^{ru} \quad (44)$$

$$wr_t^{ru} = w_t^{ru} - p_t^{ru} \quad (45)$$

$$wr_t^{ru} = \widehat{wr}_t^{ru} + \overline{wr}_t^{ru} \quad (46)$$

$$\Delta\overline{wr}_t^{ru} = c_{67}\,\Delta\overline{wr}_{t-1}^{ru} + (1-c_{67})(\Delta\bar{y}_t^{ru} + c_{68}) + \varepsilon_t^{\Delta\overline{wr}^{ru}} \quad (47)$$

$$\Delta w_t^{ru} = 4\left(w_t^{ru} - w_{t-1}^{ru}\right) \quad (48)$$

$$\Delta^4 w_t^{ru} = w_t^{ru} - w_{t-4}^{ru} \quad (49)$$

$$\Delta\overline{wr}_t^{ru} = 4\left(\overline{wr}_t^{ru} - \overline{wr}_{t-1}^{ru}\right) \quad (50)$$

Aggregate Supply

$$\pi_t^{ru} = c_{55}\,{}^{e}\pi_t^{ru} + (1-c_{55}-c_{59})\,\pi_{t-1}^{ru} + c_{56}\,(rmc_t^{ru}) + c_{59}\,\pi_{t-1}^{im,ru} + \varepsilon_t^{\pi,ru} \quad (51)$$

Imported Inflation

$$\pi_t^{im,ru} = 4\left(p_t^{im,ru} - p_{t-1}^{im,ru}\right) \quad (52)$$

$$\pi_t^{im,ru} = c_{41}\,(\Delta z_t^{USD}) + c_{40}\,(-\Delta z_t^{ez}) + c_{36}\,(-\Delta z_t^{am}) + c_{37}\left(-\Delta z_t^{by}\right) + c_{39}\left(-\Delta z_t^{kg}\right) + \\ + c_{38}\left(-\Delta z_t^{kz}\right) + \pi_t^{us} + \Delta s_t^{RUB/USD} - \Delta\bar{z}_t^{eff,ru} \quad (53)$$

Real Marginal Costs

$$rmc_t^{ru} = c_{57}\,\hat{z}_t^{eff,ru} + (1-c_{57}-c_{58})\,\hat{y}_t^{ru} + c_{58}\,\widehat{wr}_t^{ru} \quad (54)$$

UIP

$$s_t^{RUB/USD} = \left({}^{e}s_t^{RUB/USD} - i_t^{ru}/4 + i_t^{us}/4 + prem_t^{ru}/4\right) - \varepsilon_t^{s^{RUB/USD}} \quad (55)$$

Weighted Exchange Rate Expectations

$${}^{e}s_t^{RUB/USD} = c_{60}\,s_{t+1}^{RUB/USD} + (1-c_{60})\left(s_{t-1}^{RUB/USD} + 2\,\left(\pi_t^{tar,ru} + \Delta\bar{z}^{ru}{}_t - \pi_{ss}^{us}\right)/4\right) \quad (56)$$

Country Risk and Currency Premium

$$prem_t^{ru} = c_{69}\, prem_{t-1}^{ru} + (1 - c_{69})\, prem_{ss}^{ru} + \varepsilon_t^{prem,\,ru} \tag{57}$$

Trend UIP

$$\bar{r}_t^{ru} = c_{70}\, \bar{r}_{t-1}^{ru} + (1 - c_{70})\left(4\left(\bar{z}_{t+1}^{ru} - \bar{z}_t^{ru}\right) + \bar{r}_t^{us} + prem_t^{ru}\right) \tag{58}$$

Monetary Policy Rule

$$i_t^{ru} = c_{61}\, i_{t-1}^{ru} + (1 - c_{61})\left(\bar{r}_t^{ru} + \pi_{t+3}^{4,\,ru} + c_{62}\left(\pi_{t+3}^{4,\,ru} - \pi_{t+3}^{tar,\,ru}\right) + c_{63}\, s_t^{dev,\,ru}\right) + c_{64}\, \hat{y}_t^{ru} + \varepsilon_t^{i,\,ru} \tag{59}$$

$$\Delta\bar{s}_t^{RUB/USD} = \Delta\bar{z}^{ru}{}_t + \pi_t^{tar,\,ru} - \pi_{ss}^{us} \tag{60}$$

$$s_t^{dev,\,ru} = \left(\Delta s_t^{RUB/USD} - \Delta\bar{s}_t^{RUB/USD}\right) \tag{61}$$

Inflation Target

$$\pi_t^{tar,\,ru} = c_{71}\, \pi_{t-1}^{tar,\,ru} + (1 - c_{71})\, \pi_{ss}^{tar,\,ru} + \varepsilon_t^{\pi^{tar,\,ru}} \tag{62}$$

Real Exchange Rates

$$z_t^{ru} = s_t^{RUB/USD} + p_t^{us} - p_t^{ru} \tag{63}$$

$$z_t^{ru} = \bar{z}_t^{ru} + \hat{z}_t^{ru} \tag{64}$$

$$\Delta z_t^{us,\,ru} = 4\left(z_t^{ru} - z_{t-1}^{ru}\right) \tag{65}$$

$$\Delta^4 z_t^{ru} = z_t^{ru} - z_{t-4}^{ru} \tag{66}$$

Equilibrium Real Exchange Rate

$$\Delta\bar{z}_t^{ru} = c_{72}\, \Delta\bar{z}^{ru}{}_{t-1} + (1 - c_{72})\left(-c_{42}\, \Delta\overline{rp}_t^{oil}\right) + \varepsilon_t^{\Delta\bar{z}^{ru}} \tag{67}$$

$$\Delta\bar{z}^{ru}{}_t = 4\left(\bar{z}_t^{ru} - \bar{z}_{t-1}^{ru}\right) \tag{68}$$

$$\hat{z}_t^{eff,\,ru} = c_{41}\, \hat{z}_t^{ru} + c_{40}\left(\hat{z}_t^{ru} - \hat{z}_t^{ez}\right) + c_{37}\left(\hat{z}_t^{ru} - \hat{z}_t^{by}\right) + c_{36}\left(\hat{z}_t^{ru} - \hat{z}_t^{am}\right) + \\ + c_{39}\left(\hat{z}_t^{ru} - \hat{z}_t^{kg}\right) + c_{38}\left(\hat{z}_t^{ru} - \hat{z}_t^{kz}\right) \tag{69}$$

$$\bar{z}_t^{eff,\,ru} = c_{41}\, \bar{z}_t^{ru} + c_{40}\left(\bar{z}_t^{ru} - \bar{z}_t^{ez}\right) + c_{37}\left(\bar{z}_t^{ru} - \bar{z}_t^{by}\right) + c_{36}\left(\bar{z}_t^{ru} - \bar{z}_t^{am}\right) + \\ + c_{39}\left(\bar{z}_t^{ru} - \bar{z}_t^{kg}\right) + c_{38}\left(\bar{z}_t^{ru} - \bar{z}_t^{kz}\right) \tag{70}$$

$$z_t^{eff,\,ru} = \bar{z}_t^{eff,\,ru} + \hat{z}_t^{eff,\,ru} \tag{71}$$

$$\Delta\bar{z}_t^{eff,\,ru} = 4\left(\bar{z}_t^{eff,\,ru} - \bar{z}_{t-1}^{eff,\,ru}\right) \tag{72}$$

Real Interest Rate

$$r_t^{ru} = i_t^{ru} - \pi_{t+1}^{4,\,ru} \tag{73}$$

$$\hat{r}_t^{ru} = r_t^{ru} - \bar{r}_t^{ru} \tag{74}$$

Fiscal Block

$$def2gdp_t^{ru} = \overline{def2gdp_t}^{ru} + \widehat{def2gdp_t}^{ru} \tag{75}$$

$$\overline{def2gdp}_t^{ru} = c_{73}\,\overline{def2gdp}_{t-1}^{ru} + (1-c_{73})\left(def2gdp_t^{tar,ru} - c_{78}\,(\Delta\bar{y}_t^{ru} - \Delta y_{ss}^{ru})\right) + \varepsilon_t^{\overline{def2gdp}^{ru}} \tag{76}$$

$$def2gdp_t^{tar,ru} = c_{74}\,def2gdp_{t-1}^{tar,ru} + (1-c_{74})\,def2gdp_{ss}^{tar,ru} + \varepsilon_t^{def2gdp^{tar,ru}} \tag{77}$$

$$\begin{aligned} def2gdp_t^{ru} = {} & c_{75}\,def2gdp_{t-1}^{ru} + \\ & + (1-c_{75})\left(def2gdp_t^{tar,ru} - c_{76}\left(def2gdp_{t-1}^{ru} - def2gdp_{t-1}^{tar,ru}\right) - c_{77}\,\hat{y}_t\right) + \\ & + \varepsilon_t^{def2gdp^{ru}} \end{aligned} \tag{78}$$

$$def_t^{RUB,ru} = def2gdp_t^{ru} + y_t^{ru} \tag{79}$$

Identities

$$\Delta\bar{y}_t^{ru} = 4\left(\bar{y}_t^{ru} - \bar{y}_{t-1}^{ru}\right) \tag{80}$$

$$\Delta s_t^{RUB/USD} = 4\left(s_t^{RUB/USD} - s_{t-1}^{RUB/USD}\right) \tag{81}$$

$$\Delta y_t^{ru} = 4\left(y_t^{ru} - y_{t-1}^{ru}\right) \tag{82}$$

$$\pi_t^{ru} = 4\left(p_t^{ru} - p_{t-1}^{ru}\right) \tag{83}$$

$$\pi_t^{4,ru} = p_t^{ru} - p_{t-4}^{ru} \tag{84}$$

$$\Delta^4 y_t^{ru} = y_t^{ru} - y_{t-4}^{ru} \tag{85}$$

$$\Delta z_t^{eff,ru} = z_t^{eff,ru} - z_{t-4}^{eff,ru} \tag{86}$$

Log Transform

$$y_t^{ru} = 100\log\left(Y_t^{ru}\right) \tag{87}$$

$$def_t^{RUB,ru} = 100\log\left(DEF_t^{RUB,ru}\right) \tag{88}$$

$$\begin{aligned} def2gdp_t^{a,ru} = {} & 100\log\left(\left(DEF_t^{RUB,ru} + DEF_{t-1}^{RUB,ru} + DEF_{t-2}^{RUB,ru} + DEF_{t-3}^{RUB,ru}\right)/4\right) - \\ & - 100\log\left(\left(Y_t^{ru} + Y_{t-1}^{ru} + Y_{t-2}^{ru} + Y_{t-3}^{ru}\right)/4\right) \end{aligned} \tag{89}$$

Expected

$${}^{e}\pi_t^{ru} = \pi_{t+1}^{ru} \tag{90}$$

$${}^{e}\pi_t^{4,ru} = \pi_{t+1}^{4,ru} \tag{91}$$

$${}^{e}\bar{z}_t^{ru} = \bar{z}_{t+1}^{ru} \tag{92}$$

$${}^{e}\hat{y}_t^{ru} = \hat{y}_{t+1} \tag{93}$$

$${}^{e4}\pi_t^{tar,ru} = \pi_{t+4}^{tar,ru} \tag{94}$$

$${}^{e4}\pi_t^{4,ru} = \pi_{t+4}^{4,ru} \tag{95}$$

Armenia

$$\begin{aligned} \hat{y}_t^{am} = {} & c_{97}\,\hat{y}_{t+1}^{am} + c_{98}\,\hat{y}_{t-1}^{am} - c_{99}\left(c_{103}\,\hat{r}_t^{am} - (1-c_{103})\,\hat{z}_t^{eff,am}\right) + \\ & + c_{100}\,\hat{y}_t^{f,am} + c_{102}\,\widehat{def2gdp_t}^{am} + c_{101}\,\widehat{qrem}_t^{AMD} + \varepsilon_t^{\hat{y}^{am}} \end{aligned} \tag{96}$$

Remittances

$$\widehat{qrem}_t^{AMD} = \widehat{qrem}_t^{USD,am} + \hat{z}_t^{am} - \hat{z}_t^{ru} \tag{97}$$

$$qrem_t^{USD,am} = rem_t^{USD,am} - p_t^{us} + z_t^{ru} \tag{98}$$

$$qrem_t^{USD,am} = \overline{qrem}_t^{USD,am} + \widehat{qrem}_t^{USD,am} \tag{99}$$

$$\Delta\overline{qrem}_t^{USD,am} = c_{130}\,\Delta\overline{qrem}_{t-1}^{USD,am} + (1-c_{130})\,\Delta\overline{qrem}_{ss}^{USD,am} + \varepsilon_t^{\Delta\overline{qrem}^{USD,am}} \tag{100}$$

$$\widehat{qrem}_t^{USD,am} = c_{131}\,\widehat{qrem}_{t-1}^{USD,am} + c_{132}\,\hat{y}_t^{ru} + \varepsilon_t^{\widehat{qrem}^{USD,am}} \tag{101}$$

$$\Delta\overline{qrem}_t^{USD,am} = 4\left(\overline{qrem}_t^{USD,am} - \overline{qrem}_{t-1}^{USD,am}\right) \tag{102}$$

Real GDP — Trend

$$\Delta\bar{y}_t^{am} = c_{104}\,\Delta\bar{y}_{t-1}^{am} + (1-c_{104})\,\Delta y_{ss}^{am} + c_{105}\left(\Delta\overline{qrem}_t^{USD,am} - \Delta\overline{qrem}_{ss}^{USD,am}\right) + \varepsilon_t^{\Delta\bar{y}^{am}} \tag{103}$$

$$y_t^{am} = \bar{y}_t^{am} + \hat{y}_t^{am} \tag{104}$$

Effective Foreign Demand

$$\hat{y}_t^{f,am} = c_{84}\,\hat{y}_t^{us} + c_{83}\,\hat{y}_t^{ez} + c_{82}\,\hat{y}_t^{ru} + c_{80}\,\hat{y}_t^{by} + c_{81}\,\hat{y}_t^{kz} + c_{79}\,\hat{y}_t^{kg} \tag{105}$$

Nominal Wage Setting

$$\Delta w_t^{am} = c_{121}\,{}^{e}\Delta w_t^{am} + (1-c_{121})\,\Delta w_{t-1}^{am} + c_{122}\left(c_{123}\left(-\widehat{wr}_t^{am}\right) + (1-c_{123})\,\hat{y}_t^{am}\right) + \varepsilon_t^{\Delta w^{am}} \tag{106}$$

$${}^{e}\Delta w_t^{am} = \Delta w_{t+1}^{am} \tag{107}$$

$$wr_t^{am} = w_t^{am} - p_t^{am} \tag{108}$$

$$wr_t^{am} = \widehat{wr}_t^{am} + \overline{wr}_t^{am} \tag{109}$$

$$\Delta\overline{wr}_t^{am} = c_{120}\,\Delta\overline{wr}_{t-1}^{am} + (1-c_{120})(\Delta\bar{y}_t^{am} + c_{133}) + \varepsilon_t^{\Delta\overline{wr}^{am}} \tag{110}$$

$$\Delta w_t^{am} = 4\left(w_t^{am} - w_{t-1}^{am}\right) \tag{111}$$

$$\Delta^4 w_t^{am} = w_t^{am} - w_{t-4}^{am} \tag{112}$$

$$\Delta\overline{wr}_t^{am} = 4\left(\overline{wr}_t^{am} - \overline{wr}_{t-1}^{am}\right) \tag{113}$$

Aggregate Supply

$$\pi_t^{am} = c_{106}\,{}^{e}\pi_t^{am} + (1-c_{106})\,\pi_{t-1}^{am} + c_{107}\,rmc_t^{am} + \varepsilon_t^{\pi,am} \tag{114}$$

Real Marginal Costs

$$rmc_t^{am} = c_{108}\,\hat{z}_t^{eff,am} + (1-c_{108}-c_{110}-c_{109})\,\hat{y}_t^{am} + c_{110}\,\widehat{wr}_t^{am} + c_{109}\left(\widehat{rp}_t^{oil} + \hat{z}_t^{am}\right) \tag{115}$$

UIP

$$s_t^{AMD/USD} = (1-c_{134})\left({}^{e}s_t^{AMD/USD} - i_t^{am}/4 + i_t^{us}/4 + prem_t^{am}/4\right) + \\ + c_{134}\left(s_{t-1}^{AMD/USD} + \left(\Delta z_t^{USD} - \pi_t^{us} + \pi_t^{ru}\right)/4\right) + \varepsilon_t^{s^{AMD/USD}} \tag{116}$$

Weighted Exchange Rate Expectations

$${}^{e}s_t^{AMD/USD} = c_{111}\,s_{t+1}^{AMD/USD} + (1-c_{111})\left(s_{t-1}^{AMD/USD} + 2\,\Delta\bar{s}_t^{AMD/USD}/4\right) \tag{117}$$

$$\hat{\varepsilon}_t^{s^{AMD/USD}} = \varepsilon_t^{s^{AMD/USD}} \tag{118}$$

$$\Delta s_t^{AMD/USD} = 4\left(s_t^{AMD/USD} - s_{t-1}^{AMD/USD}\right) \tag{119}$$

$$\Delta \bar{s}_t^{AMD/USD} = \Delta \bar{z}_t^{am} + \pi_t^{tar,am} - \pi_{ss}^{us} \tag{120}$$

Country Risk and Currency Premium

$$prem_t^{am} = c_{115}\, prem_{t-1}^{am} + (1 - c_{115})\, prem_{ss}^{am} + \varepsilon_t^{prem,am} \tag{121}$$

Trend UIP

$$\bar{r}_t^{am} = c_{116}\, \bar{r}_{t-1}^{am} + (1 - c_{116})({}^{e}\Delta \bar{z}_t + \bar{r}_t^{us} + prem_t^{am}) \tag{122}$$

Monetary Policy Rule

$$i_t^{am} = c_{112}\, i_{t-1}^{am} + (1 - c_{112})\left(\bar{r}_t^{am} + \pi_{t+3}^{tar,am} + c_{113}\, \pi_t^{4,dev,am} + c_{114}\, s_t^{dev,am}\right) + \varepsilon_t^{i,am} \tag{123}$$

$$\pi_t^{4,dev,am} = \pi_{t+3}^{4,am} - \pi_{t+3}^{tar,am} \tag{124}$$

$$s_t^{dev,am} = \left(\Delta s_t^{AMD/USD} - \Delta \bar{s}_t^{AMD/USD}\right) \tag{125}$$

Inflation Target

$$\pi_t^{tar,am} = c_{117}\, \pi_{t-1}^{tar,am} + (1 - c_{117})\, \pi_{ss}^{tar,am} + \varepsilon_t^{\pi^{tar,am}} \tag{126}$$

Real Interest Rate

$$r_t^{am} = i_t^{am} - \pi_{t+1}^{4,am} \tag{127}$$

$$\hat{r}_t^{am} = r_t^{am} - \bar{r}_t^{am} \tag{128}$$

Real Exchange Rates

$$z_t^{am} = s_t^{AMD/USD} + p_t^{us} - p_t^{am} \tag{129}$$

$$\hat{z}_t^{am} = z_t^{am} - \bar{z}_t^{am} \tag{130}$$

Equilibrium Real Exchange Rate

$$\bar{z}_t^{am} = \bar{z}_{t-1}^{am} + \Delta \bar{z}_t^{am}/4 \tag{131}$$

$$\Delta \bar{z}_t^{am} = c_{118}\, \Delta \bar{z}_{t-1}^{am} + (1 - c_{118})\, \Delta \bar{z}_{ss}^{am} - c_{119}\left(\Delta \overline{qrem}_t^{USD,am} - \Delta \overline{qrem}_{ss}^{USD,am}\right) + \varepsilon_t^{\Delta \bar{z}^{am}} \tag{132}$$

Effective RER — Trade-Weighted

$$\hat{z}_t^{eff,am} = c_{96}\, \hat{z}_t^{am} + c_{95}\,(\hat{z}_t^{am} - \hat{z}_t^{ez}) + c_{94}\,(\hat{z}_t^{am} - \hat{z}_t^{ru}) + c_{92}\left(\hat{z}_t^{am} - \hat{z}_t^{by}\right) + \\ + c_{93}\left(\hat{z}_t^{am} - \hat{z}_t^{kz}\right) + c_{91}\left(\hat{z}_t^{am} - \hat{z}_t^{kg}\right) \tag{133}$$

$$\bar{z}_t^{eff,am} = c_{96}\, \bar{z}_t^{am} + c_{95}\,(\bar{z}_t^{am} - \bar{z}_t^{ez}) + c_{94}\,(\bar{z}_t^{am} - \bar{z}_t^{ru}) + c_{92}\left(\bar{z}_t^{am} - \bar{z}_t^{by}\right) + \\ + c_{93}\left(\bar{z}_t^{am} - \bar{z}_t^{kz}\right) + c_{91}\left(\bar{z}_t^{am} - \bar{z}_t^{kg}\right) \tag{134}$$

$$\Delta \bar{z}_t^{eff,am} = 4\left(\bar{z}_t^{eff,am} - \bar{z}_{t-1}^{eff,am}\right) \tag{135}$$

$$\Delta^4 \bar{z}_t^{eff,am} = \bar{z}_t^{eff,am} - \bar{z}_{t-4}^{eff,am} \tag{136}$$

$$z_t^{eff,am} = \bar{z}_t^{eff,am} + \hat{z}_t^{eff,am} \tag{137}$$

Identities

$$\Delta\bar{y}_t^{am} = 4\left(\bar{y}_t^{am} - \bar{y}_{t-1}^{am}\right) \tag{138}$$

$$\Delta y_t^{am} = 4\left(y_t^{am} - y_{t-1}^{am}\right) \tag{139}$$

$$\pi_t^{am} = 4\left(p_t^{am} - p_{t-1}^{am}\right) \tag{140}$$

$$\Delta z_t^{eff,am} = 4\left(z_t^{eff,am} - z_{t-1}^{eff,am}\right) \tag{141}$$

$$\Delta z_t^{am} = 4\left(z_t^{am} - z_{t-1}^{am}\right) \tag{142}$$

$$\pi_t^{4,am} = p_t^{am} - p_{t-4}^{am} \tag{143}$$

$$\Delta^4 y_t^{am} = y_t^{am} - y_{t-4}^{am} \tag{144}$$

$$\Delta^4 \bar{z}_t^{am} = \bar{z}_t^{am} - \bar{z}_{t-4}^{am} \tag{145}$$

$$\Delta rem_t^{USD,am} = 4\left(rem_t^{USD,am} - rem_{t-1}^{USD,am}\right) \tag{146}$$

$$\Delta^4 rem^{USD,am} = rem_t^{USD,am} - rem_{t-4}^{USD,am} \tag{147}$$

Fiscal Block

$$def2gdp_t^{am} = \overline{def2gdp}_t^{am} + \widehat{def2gdp}_t^{am} \tag{148}$$

$$\overline{def2gdp}_t^{am} = \mathrm{c}_{124}\,\overline{def2gdp}_{t-1}^{am} + (1-\mathrm{c}_{124})\,def2gdp_t^{tar,am} + \varepsilon_t^{\overline{def2gdp}^{am}} \tag{149}$$

$$def2gdp_t^{tar,am} = \mathrm{c}_{125}\,def2gdp_{t-1}^{tar,am} + (1-\mathrm{c}_{125})\,def2gdp_{ss}^{tar,am} + \varepsilon_t^{def2gdp^{tar,am}} \tag{150}$$

$$\begin{aligned} def2gdp_t^{am} = {} & \mathrm{c}_{126}\,def2gdp_{t-1}^{am} + \\ & + (1-\mathrm{c}_{126})\left(def2gdp_t^{tar,am} - \mathrm{c}_{127}\left(def2gdp_{t-1}^{am} - def2gdp_{t-1}^{tar,am}\right) - \mathrm{c}_{128}\,\hat{y}_t^{am}\right) + \\ & + \varepsilon_t^{def2gdp^{am}} \end{aligned} \tag{151}$$

$$def_t^{AMD} = def2gdp_t^{am} + y_t^{am} \tag{152}$$

$$\begin{aligned} def2gdp_t^{a,am} = {} & 100\log\left(\left(DEF_t^{AMD} + DEF_{t-1}^{AMD} + DEF_{t-2}^{AMD} + DEF_{t-3}^{AMD}\right)/4\right) - \\ & - 100\log\left(\left(Y_t^{am} + Y_{t-1}^{am} + Y_{t-2}^{am} + Y_{t-3}^{am}\right)/4\right) \end{aligned} \tag{153}$$

Log Transform

$$y_t^{am} = 100\log\left(Y_t^{am}\right) \tag{154}$$

$$def_t^{AMD} = 100\log\left(DEF_t^{AMD}\right) \tag{155}$$

Expected

$$^{e}\pi_t^{am} = \pi_{t+1}^{am} \tag{156}$$

$$^{e}\pi_t^{4,am} = \pi_{t+1}^{4,am} \tag{157}$$

$$^{e}\bar{z}_t = \bar{z}_{t+1}^{am} \tag{158}$$

$$^{e}\hat{y}_t^{am} = \hat{y}_{t+1}^{am} \tag{159}$$

$$^{e}\pi_t^{tar,am} = \pi_{t+3}^{tar,am} \tag{160}$$

$$^{e}\Delta\bar{z}_t = \Delta\bar{z}_{t+1}^{am} \tag{161}$$

$$\Delta y_t^{a,am} = \left(\Delta^4 y_t^{am} + \Delta^4 y_{t-1}^{am} + \Delta^4 y_{t-2}^{am} + \Delta^4 y_{t-3}^{am}\right)/4 \tag{162}$$

Belarus

Real GDP — Gap

$$\hat{y}_t^{by} = c_{153}\,\hat{y}_{t+1}^{by} + c_{154}\,\hat{y}_{t-1}^{by} - c_{155}\,rmci_{t-1}^{by} + c_{156}\,\hat{y}_{t-1}^{f,by} + c_{158}\,\widehat{def2gdp_t}^{by} + \varepsilon_t^{\hat{y}^{by}} \tag{163}$$

$$rmci_t^{by} = c_{157}\left(\hat{r}_t^{by} + c_{320}\,\widehat{sp}_t^{by}\right) + (1 - c_{157})\left(-\hat{z}_t^{eff,by}\right) \tag{164}$$

$$\hat{r}_t^{by} = r_t^{by} - \bar{r}_t^{by} \tag{165}$$

$$\hat{y}_t^{f,by} = c_{140}\,\hat{y}_t^{us} + c_{138}\,\hat{y}_t^{ru} + c_{139}\,\hat{y}_t^{ez} + c_{136}\,\hat{y}_t^{kz} + c_{135}\,\hat{y}_t^{am} + c_{137}\,\hat{y}_t^{kg} \tag{166}$$

Real GDP — Trend

$$\Delta\bar{y}_t^{by} = c_{159}\,\Delta\bar{y}_{t-1}^{by} + (1 - c_{159})\,\Delta y_{ss}^{by} + \varepsilon_t^{\Delta\bar{y}^{by}} \tag{167}$$

$$\Delta^4\bar{y}_t^{by} = \bar{y}_t^{by} - \bar{y}_{t-4}^{by} \tag{168}$$

Real GDP

$$y_t^{by} = \bar{y}_t^{by} + \hat{y}_t^{by} \tag{169}$$

Nominal GDP

$$ny_t^{by} = py_t^{by} + y_t^{by} \tag{170}$$

GDP Deflator and CPI

$$\Delta py_t^{by} - \pi_t^{by} = c_{170}\left(\Delta py_{t-1}^{by} - \pi_{t-1}^{by}\right) + \varepsilon_t^{\Delta py^{by}} \tag{171}$$

Nominal Wage Setting

$$\Delta w_t^{by} = c_{176}\,{}^{e}\Delta w_t^{by} + (1 - c_{176})\,\Delta w_{t-1}^{by} + c_{177}\left(-c_{178}\,\widehat{wr}_t^{by} + (1 - c_{178})\,\hat{y}_t^{by}\right) + \varepsilon_t^{\Delta w^{by}} \tag{172}$$

$${}^{e}\Delta w_t^{by} = \Delta w_{t+1}^{by} \tag{173}$$

$$wr_t^{by} = w_t^{by} - py_t^{by} \tag{174}$$

$$wr_t^{by} = \widehat{wr}_t^{by} + \overline{wr}_t^{by} \tag{175}$$

$$\Delta\overline{wr}^{by}{}_t = c_{175}\,\Delta\overline{wr}^{by}{}_{t-1} + (1 - c_{175})\left(\Delta\bar{y}_t^{by} + c_{179}\right) + \varepsilon_t^{\Delta\overline{wr}^{by}} \tag{176}$$

$$\Delta w_t^{by} = 4\left(w_t^{by} - w_{t-1}^{by}\right) \tag{177}$$

$$\Delta\overline{wr}^{by}{}_t = 4\left(\overline{wr}_t^{by} - \overline{wr}_{t-1}^{by}\right) \tag{178}$$

$$wr_t^{CPI,by} = w_t^{by} - p_t^{by} \tag{179}$$

$$wr_t^{CPI,by} = \widehat{wr}_t^{CPI,by} + \overline{wr}_t^{CPI,by} \tag{180}$$

$$\overline{wr}_t^{CPI,by} = \overline{wr}_t^{by} + py_t^{by} - p_t^{by} \tag{181}$$

Spread between Long and Short Rates

$$\widehat{sp}_t^{by} = c_{319}\,\widehat{sp}_{t-1}^{by} + \varepsilon_t^{\widehat{sp}^{by}} \tag{182}$$

Aggregate Supply

$$\pi_t^{by} = c_{160}\,{}^{e}\pi_t^{by} + (1 - c_{160} - c_{165})\,\pi_{t-1}^{by} + c_{161}\,rmc_t^{by} + c_{165}\,\pi_t^{im,by} + \varepsilon_t^{\pi,by} \tag{183}$$

$$\pi_t^{im,by} = c_{152}\,(0) + c_{151}\,(-\Delta z_t^{ez}) + c_{147}\,(-\Delta z_t^{am}) + c_{150}\,(-\Delta z_t^{USD}) + c_{149}\left(-\Delta z_t^{kg}\right) + \\ + c_{148}\left(-\Delta z_t^{kz}\right) + \pi_t^{us} + \Delta s_t^{BYR/USD} - \Delta \bar{z}_t^{eff,by} \tag{184}$$

Real Marginal Costs

$$rmc_t^{by} = c_{162}\,\hat{y}_t^{by} + c_{163}\,\widehat{rp}_t^{oil} + c_{164}\,\widehat{wr}_t^{CPI,by} + (1 - c_{162} - c_{163} - c_{164})\,\hat{z}_t^{eff,by} \tag{185}$$

UIP

$$s_t^{BYR/USD} = (1 - c_{186})\left({}^{e}s_t^{BYR/USD} - i_t^{by}/4 + i_t^{us}/4 + prem_t^{by}/4\right) + \\ + c_{186}\left(s_{t-1}^{BYR/USD} + (\Delta z_t^{USD} - \pi_t^{us} + \pi_t^{ru})/4\right) + \varepsilon_t^{s^{BYR/USD}} \tag{186}$$

$$\Delta s^{dev,by} = \Delta s_t^{BYR/USD} - \left(\Delta \bar{z}_t^{by} + \pi_t^{tar,by} - \pi_{ss}^{us}\right) \tag{187}$$

Weighted Exchange Rate Expectations

$${}^{e}s_t^{BYR/USD} = c_{166}\,s_{t+1}^{BYR/USD} + (1 - c_{166})\left(s_{t-1}^{BYR/USD} + 2/4\,\left(\Delta \bar{z}_t^{by} + \pi_t^{tar,by} - \pi_{ss}^{us}\right)\right) \tag{188}$$

Country Risk and Currency Premium

$$prem_t^{by} = c_{169}\,prem_{t-1}^{by} + (1 - c_{169})\left(prem_{ss}^{by}\right) + \varepsilon_t^{prem,by} \tag{189}$$

Trend UIP

$$\bar{r}_t^{by} = \Delta \bar{z}_{t+1}^{by} + \bar{r}_t^{us} + prem_t^{by} \tag{190}$$

Monetary Policy Rule

$$i_t^{by} = c_{167}\,i_{t-1}^{by} + (1 - c_{167})\left(\bar{r}_t^{by} + {}^{e4}\pi_t^{tar,by} + c_{168}\,\left({}^{e3}\pi_t^{4,by} - {}^{e3}\pi_t^{tar,by}\right) + \right. \\ \left. + c_{173}\,\left(c_{174}\,\Delta s_{dev_t}{}^{BYR/USD} + (1 - c_{174})\,{}^{e}\Delta s_{dev_t}{}^{BYR/USD}\right)\right) + \varepsilon_t^{i,by} \tag{191}$$

Inflation Target

$$\pi_t^{tar,by} = c_{171}\,\pi_{t-1}^{tar,by} + (1 - c_{171})\,\pi_{ss}^{tar,by} + \varepsilon_t^{\pi^{tar,by}} \tag{192}$$

Real Exchange Rates

$$z_t^{by} = s_t^{BYR/USD} + p_t^{us} - p_t^{by} \tag{193}$$

$$\hat{z}_t^{by} = z_t^{by} - \bar{z}_t^{by} \tag{194}$$

$$\Delta z_t^{by} = 4\left(z_t^{by} - z_{t-1}^{by}\right) \tag{195}$$

$$\Delta^4 z_t^{by} = z_t^{by} - z_{t-4}^{by} \tag{196}$$

Equilibrium Real Exchange Rate

$$\bar{z}_t^{by} = \bar{z}_{t-1}^{by} + \Delta\bar{z}_t^{by}/4 \tag{197}$$

$$\Delta\bar{z}_t^{by} = c_{172}\,\Delta\bar{z}_{t-1}^{by} + (1-c_{172})\left(\Delta\bar{z}_{ss}^{by}\right) + \varepsilon_t^{\Delta\bar{z}^{by}} \tag{198}$$

Effective RER — Trade-Weighted

$$\hat{z}_t^{eff,by} = c_{152}\,\hat{z}_t^{by} + c_{151}\left(\hat{z}_t^{by} - \hat{z}_t^{ez}\right) + c_{150}\left(\hat{z}_t^{by} - \hat{z}_t^{ru}\right) + \\ + c_{148}\left(\hat{z}_t^{by} - \hat{z}_t^{kz}\right) + c_{147}\left(\hat{z}_t^{by} - \hat{z}_t^{am}\right) + c_{149}\left(\hat{z}_t^{by} - \hat{z}_t^{kg}\right) \tag{199}$$

$$\bar{z}_t^{eff,by} = c_{152}\,\bar{z}_t^{by} + c_{151}\left(\bar{z}_t^{by} - \bar{z}_t^{ez}\right) + c_{150}\left(\bar{z}_t^{by} - \bar{z}_t^{ru}\right) + \\ + c_{148}\left(\bar{z}_t^{by} - \bar{z}_t^{kz}\right) + c_{147}\left(\bar{z}_t^{by} - \bar{z}_t^{am}\right) + c_{149}\left(\bar{z}_t^{by} - \bar{z}_t^{kg}\right) \tag{200}$$

$$\Delta\bar{z}_t^{eff,by} = 4\left(\bar{z}_t^{eff,by} - \bar{z}_{t-1}^{eff,by}\right) \tag{201}$$

$$\Delta^4 z_t^{eff,by} = z_t^{eff,by} - z_{t-4}^{eff,by} \tag{202}$$

$$z_t^{eff,by} = \bar{z}_t^{eff,by} + \hat{z}_t^{eff,by} \tag{203}$$

Real Interest Rate

$$r_t^{by} = i_t^{by} - \pi_{t+1}^{4,by} \tag{204}$$

Fiscal Block

$$def2gdp_t^{by} = \overline{def2gdp_t}^{by} + \widehat{def2gdp_t}^{by} \tag{205}$$

$$\overline{def2gdp_t}^{by} = c_{180}\,\overline{def2gdp}_{t-1}^{by} + (1-c_{180})\left(def2gdp_t^{tar,by} - c_{185}\left(\Delta\bar{y}_t^{by} - \Delta y_{ss}^{by}\right)\right) + \varepsilon_t^{\overline{def2gdp}^{by}} \tag{206}$$

$$def2gdp_t^{tar,by} = c_{181}\,def2gdp_{t-1}^{tar,by} + (1-c_{181})\,def2gdp_{ss}^{tar,by} + \varepsilon_t^{def2gdp^{tar,by}} \tag{207}$$

$$def2gdp_t^{by} = c_{182}\,def2gdp_{t-1}^{by} + \\ + (1-c_{182})\left(def2gdp_t^{tar,by} - c_{183}\left(def2gdp_{t-1}^{by} - def2gdp_{t-1}^{tar,by}\right) - c_{184}\,\hat{y}_t^{by}\right) + \\ + \varepsilon_t^{def2gdp^{by}} \tag{208}$$

$$def_t^{BYR} = def2gdp_t^{by} + y_t^{by} \tag{209}$$

$$def_t^{BYR} = 100\log\left(DEF_t^{BYR}\right) \tag{210}$$

$$def2gdp_t^{a,by} = 100\log\left(\left(DEF_t^{BYR} + DEF_{t-1}^{BYR} + DEF_{t-2}^{BYR} + DEF_{t-3}^{BYR}\right)/4\right) - \\ - 100\log\left(\left(Y_t^{by} + Y_{t-1}^{by} + Y_{t-2}^{by} + Y_{t-3}^{by}\right)/4\right) \tag{211}$$

Identities

$$\Delta y_t^{by} = 4\left(y_t^{by} - y_{t-1}^{by}\right) \tag{212}$$

$$\Delta\bar{y}_t^{by} = 4\left(\bar{y}_t^{by} - \bar{y}_{t-1}^{by}\right) \tag{213}$$

$$\Delta s_t^{BYR/USD} = 4\left(s_t^{BYR/USD} - s_{t-1}^{BYR/USD}\right) \tag{214}$$

$$\pi_t^{by} = 4\left(p_t^{by} - p_{t-1}^{by}\right) \tag{215}$$

$$\Delta ny_t^{by} = 4\left(ny_t^{by} - ny_{t-1}^{by}\right) \tag{216}$$

$$\Delta py_t^{by} = 4\left(py_t^{by} - py_{t-1}^{by}\right) \tag{217}$$

$$\Delta z_t^{eff,by} = 4\left(z_t^{eff,by} - z_{t-1}^{eff,by}\right) \tag{218}$$

$$\pi_t^{4,by} = p_t^{by} - p_{t-4}^{by} \tag{219}$$

$$\Delta^4 py_t^{by} = py_t^{by} - py_{t-4}^{by} \tag{220}$$

$$\Delta^4 y_t^{by} = y_t^{by} - y_{t-4}^{by} \tag{221}$$

$$\Delta^4 y^{a,by}{}_t = \left(\Delta y_t^{by} + \Delta y_{t-1}^{by} + \Delta y_{t-2}^{by} + \Delta y_{t-3}^{by}\right)/4 \tag{222}$$

Log Transform

$$ny_t^{by} = 100\log\left(NY_t^{by}\right) \tag{223}$$

$$y_t^{by} = 100\log\left(Y_t^{by}\right) \tag{224}$$

$$py_t^{by} = 100\log\left(PY_t^{by}\right) \tag{225}$$

Expected

$${}^e\pi_t^{by} = \pi_{t+1}^{by} \tag{226}$$

$${}^e\pi_t^{4,by} = \pi_{t+1}^{4,by} \tag{227}$$

$${}^e\bar{z}_t^{eff,by} = \bar{z}_{t+1}^{eff,by} \tag{228}$$

$${}^e\widehat{yg}_t^{by} = \hat{y}_{t+1}^{by} \tag{229}$$

$${}^e\Delta\bar{z}^{eff,by}{}_t = \Delta\bar{z}_{t+1}^{eff,by} \tag{230}$$

$${}^e\Delta\bar{z}_t^{by} = \Delta\bar{z}_{t+1}^{by} \tag{231}$$

$$\pi_{t+3}^{4,by} = {}^{e3}\pi_t^{4,by} \tag{232}$$

$$\pi_{t+3}^{tar,by} = {}^{e3}\pi_t^{tar,by} \tag{233}$$

$$\Delta s_{dev}{}_{t+1}^{BYR/USD} = {}^e\Delta s_{dev}{}_t^{BYR/USD} \tag{234}$$

Kyrgyzstan

Real GDP — Gap

$$\hat{y}_t^{kg} = c_{205}\,\hat{y}_{t+1}^{kg} + c_{206}\,\hat{y}_{t-1}^{kg} - c_{207}\left(c_{212}\,\hat{r}_t^{kg} - (1-c_{212})\,\hat{z}_t^{eff,kg}\right) + c_{208}\left(\widehat{rp}_t^{gold} + \hat{z}_t^{eff,kg}\right) + \\ + c_{209}\,\hat{y}_t^{f,kg} + c_{211}\,\widehat{def2gdp}_t^{kg} + c_{210}\,\widehat{qrem}_t^{KGS} + \varepsilon_t^{\hat{y}^{kg}} \tag{235}$$

Remittances

$$\widehat{qrem}_t^{KGS} = \widehat{qrem}_t^{USD,kg} + \hat{z}_t^{kg} - \hat{z}_t^{ru} \tag{236}$$

$$qrem_t^{USD,kg} = rem_t^{USD,kg} - p_t^{us} + z_t^{ru} \tag{237}$$

$$qrem_t^{USD,kg} = \overline{qrem}_t^{USD,kg} + \widehat{qrem}_t^{USD,kg} \tag{238}$$

$$\Delta\overline{qrem}_t^{USD,kg} = c_{259}\,\Delta\overline{qrem}_{t-1}^{USD,kg} + (1-c_{259})\Delta\overline{qrem}_{ss}^{USD,kg} + \varepsilon_t^{\Delta\overline{qrem}^{USD,kg}} \tag{239}$$

$$\widehat{qrem}_t^{USD,kg} = c_{260}\,\widehat{qrem}_{t-1}^{USD,kg} + c_{261}\,\hat{y}_t^{ru} + \varepsilon_t^{\widehat{qrem}^{USD,kg}} \tag{240}$$

$$\Delta\overline{qrem}_t^{USD,kg} = 4\left(\overline{qrem}_t^{USD,kg} - \overline{qrem}_{t-1}^{USD,kg}\right) \tag{241}$$

Real GDP — Trend

$$\Delta\bar{y}_t^{kg} = c_{213}\,\Delta\bar{y}_{t-1}^{kg} + (1-c_{213})\,\Delta y_{ss}^{kg} + c_{214}\left(\Delta\overline{qrem}_t^{USD,kg} - \Delta\overline{qrem}_{ss}^{USD}\right) + \omega_t^{\Delta\bar{y}^{kg}} - c_{215}\,\omega_{t-1}^{\Delta\bar{y}^{kg}} + \varepsilon_t^{\Delta\bar{y}^{kg}} \tag{242}$$

$$\omega_t^{\Delta\bar{y}^{kg}} = c_{216}\,\omega_{t-1}^{\Delta\bar{y}^{kg}} + \varepsilon_t^{\omega^{\Delta\bar{y}^{kg}}} \tag{243}$$

$$y_t^{kg} = \bar{y}_t^{kg} + \hat{y}_t^{kg} \tag{244}$$

Effective Foreign Demand

$$\hat{y}_t^{f,kg} = c_{192}\,\hat{y}_t^{us} + c_{191}\,\hat{y}_t^{ez} + c_{190}\,\hat{y}_t^{ru} + c_{188}\,\hat{y}_t^{by} + c_{189}\,\hat{y}_t^{kz} + c_{187}\,\hat{y}_t^{am} \tag{245}$$

Nominal Wage Setting

$$\Delta w_t^{kg} = c_{250}\,{}^{e}\Delta w_t^{kg} + (1-c_{250})\,\Delta w_{t-1}^{kg} + c_{251}\left(c_{252}\left(-\widehat{wr}_t^{kg}\right) + (1-c_{252})\,\hat{y}_t^{kg}\right) + \varepsilon_t^{\Delta w^{kg}} \tag{246}$$

$${}^{e}\Delta w_t^{kg} = \Delta w_{t+1}^{kg} \tag{247}$$

$$wr_t^{kg} = w_t^{kg} - p_t^{kg} \tag{248}$$

$$wr_t^{kg} = \widehat{wr}_t^{kg} + \overline{wr}_t^{kg} \tag{249}$$

$$\begin{aligned}\Delta\overline{wr}_t^{kg} = {} & c_{249}\,\Delta\overline{wr}_{t-1}^{kg} + \\ & + (1-c_{249})\left(\Delta y_{ss}^{kg} + c_{214}/(1-c_{213})\left(\Delta\overline{qrem}_t^{USD,kg} - \Delta\overline{qrem}_{ss}^{USD}\right) + c_{263}\right) + \varepsilon_t^{\Delta\overline{wr}^{kg}}\end{aligned} \tag{250}$$

$$\Delta w_t^{kg} = 4\left(w_t^{kg} - w_{t-1}^{kg}\right) \tag{251}$$

$$\Delta^4 w_t^{kg} = w_t^{kg} - w_{t-4}^{kg} \tag{252}$$

$$\Delta\overline{wr}_t^{kg} = 4\left(\overline{wr}_t^{kg} - \overline{wr}_{t-1}^{kg}\right) \tag{253}$$

Aggregate Supply

$$\pi_t^{kg} = c_{217}\,{}^{e}\pi_t^{kg} + (1-c_{217})\,\pi_{t-1}^{kg} + c_{218}\,rmc_t^{kg} + \varepsilon_t^{\pi,kg} \tag{254}$$

Real Marginal Costs

$$rmc_t^{kg} = c_{219}\,\hat{z}_t^{eff,kg} + (1-c_{219}-c_{220}-c_{221})\,\hat{y}_t^{kg} + c_{220}\,\widehat{wr}_t^{kg} + c_{221}\left(\widehat{rp}_t^{oil} + \hat{z}_t^{kg}\right) \tag{255}$$

UIP

$$\begin{aligned}s_t^{KGS/USD} = {} & (1-c_{264})\left({}^{e}s_t^{KGS/USD} - i_t^{kg}/4 + i_t^{us}/4 + prem_t^{kg}/4\right) + \\ & + c_{264}\left(s_{t-1}^{KGS/USD} + \left(\Delta z_t^{USD} - \pi_t^{us} + \pi_t^{ru}\right)/4\right) + \varepsilon_t^{s^{KGS/USD}}\end{aligned} \tag{256}$$

Weighted Exchange Rate Expectations

$$ {}^{e}s_t^{KGS/USD} = c_{222}\, s_{t+1}^{KGS/USD} + (1-c_{222})\left(s_{t-1}^{KGS/USD} + 2\Delta\bar{s}_t^{KGS/USD}/4\right) \tag{257} $$

$$ \Delta s_t^{KGS/USD} = 4\left(s_t^{KGS/USD} - s_{t-1}^{KGS/USD}\right) \tag{258} $$

$$ \Delta\bar{s}_t^{KGS/USD} = \Delta\bar{z}_t^{kg} + \pi_t^{tar,kg} - \pi_{ss}^{us} \tag{259} $$

Country Risk and Currency Premium

$$ prem_t^{kg} = c_{231}\, prem_{t-1}^{kg} + (1-c_{231})\, prem_{ss}^{kg} + \varepsilon_t^{prem,kg} \tag{260} $$

Trend UIP

$$ \bar{r}_t^{kg} = c_{232}\,\bar{r}_{t-1}^{kg} + (1-c_{232})\left({}^{e}\Delta\bar{z}_t + \bar{r}_t^{us} + prem_t^{kg}\right) \tag{261} $$

Monetary Policy Rule

$$ i_t^{kg} = (1-c_{264})\left(c_{223}\, i_{t-1}^{kg} + (1-c_{223})\left(\bar{r}_t^{kg} + \pi_{t+3}^{4,tar,kg} + c_{224}\,\pi_t^{4,dev,kg} + c_{225}\, s_t^{dev,kg}\right)\right) + $$
$$ + c_{264}\left(4\left(s_{t+1}^{KGS/USD} - s_t^{KGS/USD}\right) + i_t^{us} + prem_t^{kg}\right) + \varepsilon_t^{i,kg} \tag{262} $$

$$ \pi_t^{4,dev,kg} = \pi_{t+3}^{4,kg} - \pi_{t+3}^{4,tar,kg} \tag{263} $$

$$ s_t^{dev,kg} = \left(\Delta s_t^{KGS/USD} - \Delta\bar{s}_t^{KGS/USD}\right) \tag{264} $$

Inflation Target

$$ \pi_t^{tar,kg} = c_{234}\,\pi_{t-1}^{tar,kg} + (1-c_{234})\,\pi_{ss}^{tar,kg} + \varepsilon_t^{\pi^{tar,kg}} \tag{265} $$

$$ \pi_t^{4,tar,kg} = \left(\pi_t^{tar,kg} + \pi_{t-1}^{tar,kg} + \pi_{t-2}^{tar,kg} + \pi_{t-3}^{tar,kg}\right)/4 \tag{266} $$

Real Interest Rate

$$ r_t^{kg} = i_t^{kg} - \pi_{t+1}^{4,kg} \tag{267} $$

$$ \hat{r}_t^{kg} = r_t^{kg} - \bar{r}_t^{kg} \tag{268} $$

Real Exchange Rates

$$ z_t^{kg} = s_t^{KGS/USD} + p_t^{us} - p_t^{kg} \tag{269} $$

$$ \hat{z}_t^{kg} = z_t^{kg} - \bar{z}_t^{kg} \tag{270} $$

Equilibrium Real Exchange Rate

$$ \Delta\bar{z}_t^{kg} = c_{235}\,\Delta\bar{z}_{t-1}^{kg} + (1-c_{235})\,\Delta\bar{z}_{ss}^{kg} - c_{236}\left(\Delta\overline{qrem}_t^{USD,kg} - \Delta\overline{qrem}_{ss}^{USD,kg}\right) + \varepsilon_t^{\Delta\bar{z}^{kg}} \tag{271} $$

Effective RER — Trade-Weighted

$$ \hat{z}_t^{eff,kg} = c_{204}\,\hat{z}_t^{kg} + c_{203}\left(\hat{z}_t^{kg} - \hat{z}_t^{ez}\right) + c_{202}\left(\hat{z}_t^{kg} - \hat{z}_t^{ru}\right) + c_{200}\left(\hat{z}_t^{kg} - \hat{z}_t^{by}\right) + $$
$$ + c_{201}\left(\hat{z}_t^{kg} - \hat{z}_t^{kz}\right) + c_{199}\left(\hat{z}_t^{kg} - \hat{z}_t^{am}\right) \tag{272} $$

$$ \bar{z}_t^{eff,kg} = c_{204}\,\bar{z}_t^{kg} + c_{203}\left(\bar{z}_t^{kg} - \bar{z}_t^{ez}\right) + c_{202}\left(\bar{z}_t^{kg} - \bar{z}_t^{ru}\right) + c_{200}\left(\bar{z}_t^{kg} - \bar{z}_t^{by}\right) + $$
$$ + c_{201}\left(\bar{z}_t^{kg} - \bar{z}_t^{kz}\right) + c_{199}\left(\bar{z}_t^{kg} - \bar{z}_t^{am}\right) \tag{273} $$

$$ z_t^{eff,kg} = \bar{z}_t^{eff,kg} + \hat{z}_t^{eff,kg} \tag{274} $$

Identities

$$\Delta\bar{y}_t^{kg} = 4\left(\bar{y}_t^{kg} - \bar{y}_{t-1}^{kg}\right) \tag{275}$$

$$\Delta y_t^{kg} = 4\left(y_t^{kg} - y_{t-1}^{kg}\right) \tag{276}$$

$$\Delta^4 y_t^{kg} = y_t^{kg} - y_{t-4}^{kg} \tag{277}$$

$$\Delta^4 y_t^{a,kg} = \left(\Delta^4 y_t^{kg} + \Delta^4 y_{t-1}^{kg} + \Delta^4 y_{t-2}^{kg} + \Delta^4 y_{t-3}^{kg}\right)/4 \tag{278}$$

$$\pi_t^{kg} = 4\left(p_t^{kg} - p_{t-1}^{kg}\right) \tag{279}$$

$$\pi_t^{4,kg} = p_t^{kg} - p_{t-4}^{kg} \tag{280}$$

$$\Delta\bar{z}_t^{eff,kg} = 4\left(\bar{z}_t^{eff,kg} - \bar{z}_{t-1}^{eff,kg}\right) \tag{281}$$

$$\Delta^4\bar{z}_t^{eff,kg} = \bar{z}_t^{eff,kg} - \bar{z}_{t-4}^{eff,kg} \tag{282}$$

$$\Delta z_t^{eff,kg} = 4\left(z_t^{eff,kg} - z_{t-1}^{eff,kg}\right) \tag{283}$$

$$\Delta z_t^{kg} = 4\left(z_t^{kg} - z_{t-1}^{kg}\right) \tag{284}$$

$$\Delta\bar{z}_t^{kg} = 4\left(\bar{z}_t^{kg} - \bar{z}_{t-1}^{kg}\right) \tag{285}$$

$$\Delta^4\bar{z}_t^{kg} = \bar{z}_t^{kg} - \bar{z}_{t-4}^{kg} \tag{286}$$

$$\Delta rem_t^{USD,kg} = 4\left(rem_t^{USD,kg} - rem_{t-1}^{USD,kg}\right) \tag{287}$$

$$\Delta^4 rem_t^{USD,kg} = rem_t^{USD,kg} - rem_{t-4}^{USD,kg} \tag{288}$$

Fiscal Block

$$def2gdp_t^{kg} = \overline{def2gdp}_t^{kg} + \widehat{def2gdp}_t^{kg} \tag{289}$$

$$\overline{def2gdp}_t^{kg} = c_{253}\,\overline{def2gdp}_{t-1}^{kg} + (1-c_{253})\,def2gdp_t^{tar,kg} + \varepsilon_t^{\overline{def2gdp}^{kg}} \tag{290}$$

$$def2gdp_t^{tar,kg} = c_{254}\,def2gdp_{t-1}^{tar,kg} + (1-c_{254})\,def2gdp_{ss}^{tar,kg} + \varepsilon_t^{def2gdp^{tar,kg}} \tag{291}$$

$$\begin{aligned} def2gdp_t^{kg} = {} & c_{255}\,def2gdp_{t-1}^{kg} + \\ & + (1-c_{255})\left(def2gdp_t^{tar,kg} - c_{256}\left(def2gdp_{t-1}^{kg} - def2gdp_{t-1}^{tar,kg}\right) - c_{257}\,\hat{y}_t^{kg}\right) + \\ & + \varepsilon_t^{def2gdp^{kg}} \end{aligned} \tag{292}$$

$$def_t^{KGS} = def2gdp_t^{kg} + y_t^{kg} \tag{293}$$

$$def_t^{KGS} = 100\log\left(DEF_t^{KGS}\right) \tag{294}$$

$$\begin{aligned} def2gdp_t^{a,kg} = {} & 100\log\left(\left(DEF_t^{KGS} + DEF_{t-1}^{KGS} + DEF_{t-2}^{KGS} + DEF_{t-3}^{KGS}\right)/4\right) - \\ & - 100\log\left(\left(Y_t^{kg} + Y_{t-1}^{kg} + Y_{t-2}^{kg} + Y_{t-3}^{kg}\right)/4\right) \end{aligned} \tag{295}$$

Log Transform

$$y_t^{kg} = 100\log\left(Y_t^{kg}\right) \tag{296}$$

Expected

$$ {}^{e}\pi_t^{kg} = \pi_{t+1}^{kg} \tag{297} $$

$$ {}^{e}\pi_t^{4,kg} = \pi_{t+1}^{4,kg} \tag{298} $$

$$ {}^{e}\bar{z}_t = \bar{z}_{t+1}^{kg} \tag{299} $$

$$ {}^{e}\hat{y}_t^{kg} = \hat{y}_{t+1}^{kg} \tag{300} $$

$$ {}^{e3}\pi_t^{4,tar,kg} = \pi_{t+3}^{4,tar,kg} \tag{301} $$

$$ {}^{e}\Delta\bar{z}_t = \Delta\bar{z}_{t+1}^{kg} \tag{302} $$

Kazakhstan

Real GDP — Gap

$$ \hat{y}_t^{kz} = c_{285}\,\hat{y}_{t+1}^{kz} + c_{286}\,\hat{y}_{t-1}^{kz} - c_{287}\left(c_{291}\,\hat{r}_t^{kz} - (1-c_{291})\,\hat{z}_t^{eff,kz}\right) + c_{288}\,\widehat{rp}_t^{oil} + \\ + c_{289}\,\hat{y}_t^{f,kz} + c_{290}\,\widehat{def2gdp}_t^{kz} + \varepsilon_t^{\hat{y}^{kz}} \tag{303} $$

Real GDP — Trend

$$ \Delta\bar{y}_t^{kz} = c_{292}\,\Delta\bar{y}_{t-1}^{kz} + (1-c_{292})\left(\Delta y_{ss}^{kz} + c_{293}\,c_{304}\left(\Delta\overline{rp}_t^{oil} - \Delta\overline{rp}_{ss}^{oil}\right)\right) + \varepsilon_t^{\Delta\bar{y}^{kz}} \tag{304} $$

$$ y_t^{kz} = \bar{y}_t^{kz} + \hat{y}_t^{kz} \tag{305} $$

Effective Foreign Demand

$$ \hat{y}_t^{f,kz} = c_{270}\,\hat{y}_t^{us} + c_{269}\,\hat{y}_t^{ez} + c_{268}\,\hat{y}_t^{ru} + c_{266}\,\hat{y}_t^{by} + c_{265}\,\hat{y}_t^{am} + c_{267}\,\hat{y}_t^{kg} \tag{306} $$

Nominal Wage Setting

$$ \Delta w_t^{kz} = c_{307}\,{}^{e}\Delta w_t^{kz} + (1-c_{307})\,\Delta w_{t-1}^{kz} + c_{308}\left(c_{309}\left(-\widehat{wr}_t^{kz}\right) + (1-c_{309})\,\hat{y}_t^{kz}\right) + \varepsilon_t^{\Delta w^{kz}} \tag{307} $$

$$ {}^{e}\Delta w_t^{kz} = \Delta w_{t+1}^{kz} \tag{308} $$

$$ wr_t^{kz} = w_t^{kz} - p_t^{kz} \tag{309} $$

$$ wr_t^{kz} = \widehat{wr}_t^{kz} + \overline{wr}_t^{kz} \tag{310} $$

$$ \Delta\overline{wr}_t^{kz} = c_{306}\,\Delta\overline{wr}_{t-1}^{kz} + (1-c_{306})\left(\Delta\bar{y}_t^{kz} + c_{310}\right) + \varepsilon_t^{\Delta\overline{wr}^{kz}} \tag{311} $$

$$ \Delta w_t^{kz} = 4\left(w_t^{kz} - w_{t-1}^{kz}\right) \tag{312} $$

$$ \Delta^4 w_t^{kz} = w_t^{kz} - w_{t-4}^{kz} \tag{313} $$

$$ \Delta\overline{wr}_t^{kz} = 4\left(\overline{wr}_t^{kz} - \overline{wr}_{t-1}^{kz}\right) \tag{314} $$

Aggregate Supply

$$ \pi_t^{kz} = c_{294}\,{}^{e}\pi_t^{kz} + (1-c_{294})\,\pi_{t-1}^{kz} + c_{295}\,rmc_t^{kz} + \varepsilon_t^{\pi,kz} \tag{315} $$

Real Marginal Costs

$$ rmc_t^{kz} = c_{296}\,\hat{z}_t^{eff,kz} + (1-c_{296}-c_{311})\,\hat{y}_t^{kz} + c_{311}\,\widehat{wr}_t^{kz} \tag{316} $$

UIP

$$s_t^{KZT/USD} = c_{283}\,(s_{t-1}^{KZT/USD} + (c_{315}\,\Delta s_{t-1}^{KZT/USD}/4 + (1-c_{315})\,\Delta \bar{s}_t^{KZT/USD}/4) + \\ + c_{316}\,(-z_{t-1}^{eff,kz})) + (1-c_{283})({}^{e}s_t^{KZT/USD} - i_t^{kz}/4 + i_t^{us}/4 + prem_t^{kz}/4) + \\ + \varepsilon_t^{s^{KZT/USD}} \quad (317)$$

$$\Delta s_t^{KZT/USD} = 4\left(s_t^{KZT/USD} - s_{t-1}^{KZT/USD}\right) \quad (318)$$

$$\Delta \bar{s}_t^{KZT/USD} = \Delta \bar{z}_t^{kz} + \pi_t^{tar,kz} - \pi_{ss}^{us} \quad (319)$$

Weighted Exchange Rate Expectations

$${}^{e}s_t^{KZT/USD} = c_{297}\,s_{t+1}^{KZT/USD} + (1-c_{297})\left(s_{t-1}^{KZT/USD} + 2\Delta \bar{s}_t^{KZT/USD}/4\right) \quad (320)$$

Country Risk and Currency Premium

$$prem_t^{kz} = c_{300}\,prem_{t-1}^{kz} + (1-c_{300})\,prem_{ss}^{kz} + \varepsilon_t^{prem,kz} \quad (321)$$

Trend UIP

$$\bar{r}_t^{kz} = c_{301}\,\bar{r}_{t-1}^{kz} + (1-c_{301})\left({}^{e}\Delta \bar{z}_t^{kz} + \bar{r}_t^{us} + prem_t^{kz}\right) \quad (322)$$

Inflation Target

$$\pi_t^{tar,kz} = c_{302}\,\pi_{t-1}^{tar,kz} + (1-c_{302})\,\pi_{ss}^{tar,kz} + \varepsilon_t^{\pi^{tar,kz}} \quad (323)$$

Monetary Policy Rule

$$i_t^{kz} = c_{318}\left(4\left(s_{t+1}^{KZT/USD} - s_t^{KZT/USD}\right) + i_t^{us} + prem_t^{kz}\right) + \\ + (1-c_{318})\left(c_{298}\,i_{t-1}^{kz} + (1-c_{298})\left(\bar{r}_t^{kz} + \pi_{t+1}^{tar,kz} + c_{299}\left(\pi_{t+4}^{4,kz} - \pi_{t+4}^{tar,kz}\right)\right)\right) + \varepsilon_t^{i,kz} \quad (324)$$

Real Interest Rate

$$r_t^{kz} = i_t^{kz} - \pi_{t+1}^{4,kz} \quad (325)$$

$$\hat{r}_t^{kz} = r_t^{kz} - \bar{r}_t^{kz} \quad (326)$$

Real Exchange Rates

$$z_t^{kz} = s_t^{KZT/USD} + p_t^{us} - p_t^{kz} \quad (327)$$

$$\hat{z}_t^{kz} = z_t^{kz} - \bar{z}_t^{kz} \quad (328)$$

Equilibrium Real Exchange Rate

$$\bar{z}_t^{kz} = \bar{z}_{t-1}^{kz} + \Delta \bar{z}_t^{kz}/4 \quad (329)$$

$$\Delta \bar{z}_t^{kz} = c_{303}\,\Delta \bar{z}_{t-1}^{kz} + (1-c_{303})\left(-c_{305}\,\Delta \overline{rp}_t^{oil}\right) + \varepsilon_t^{\Delta \bar{z}^{kz}} \quad (330)$$

Effective RER — Trade-Weighted

$$\hat{z}_t^{eff,kz} = c_{282}\,\hat{z}_t^{kz} + c_{281}\left(\hat{z}_t^{kz} - \hat{z}_t^{ez}\right) + c_{280}\left(\hat{z}_t^{kz} - \hat{z}_t^{ru}\right) + c_{278}\left(\hat{z}_t^{kz} - \hat{z}_t^{by}\right) + \\ + c_{277}\left(\hat{z}_t^{kz} - \hat{z}_t^{am}\right) + c_{279}\left(\hat{z}_t^{kz} - \hat{z}_t^{kg}\right) \quad (331)$$

$$\bar{z}_t^{eff,kz} = c_{282}\,\bar{z}_t^{kz} + c_{281}\left(\bar{z}_t^{kz} - \bar{z}_t^{ez}\right) + c_{280}\left(\bar{z}_t^{kz} - \bar{z}_t^{ru}\right) + c_{278}\left(\bar{z}_t^{kz} - \bar{z}_t^{by}\right) + \\ + c_{277}\left(\bar{z}_t^{kz} - \bar{z}_t^{am}\right) + c_{279}\left(\bar{z}_t^{kz} - \bar{z}_t^{kg}\right) \quad (332)$$

$$\Delta\bar{z}_t^{eff,kz} = 4\left(\bar{z}_t^{eff,kz} - \bar{z}_{t-1}^{eff,kz}\right) \quad (333)$$

$$\Delta^4\bar{z}_t^{eff,kz} = \bar{z}_t^{eff,kz} - \bar{z}_{t-4}^{eff,kz} \quad (334)$$

$$z_t^{eff,kz} = \bar{z}_t^{eff,kz} + \hat{z}_t^{eff,kz} \quad (335)$$

Identities

$$\Delta\bar{y}_t^{kz} = 4\left(\bar{y}_t^{kz} - \bar{y}_{t-1}^{kz}\right) \quad (336)$$

$$\Delta y_t^{kz} = 4\left(y_t^{kz} - y_{t-1}^{kz}\right) \quad (337)$$

$$\pi_t^{kz} = 4\left(p_t^{kz} - p_{t-1}^{kz}\right) \quad (338)$$

$$\Delta z_t^{eff,kz} = 4\left(z_t^{eff,kz} - z_{t-1}^{eff,kz}\right) \quad (339)$$

$$\Delta z_t^{kz} = 4\left(z_t^{kz} - z_{t-1}^{kz}\right) \quad (340)$$

$$\pi_t^{4,kz} = p_t^{kz} - p_{t-4}^{kz} \quad (341)$$

$$\Delta^4 y_t^{kz} = y_t^{kz} - y_{t-4}^{kz} \quad (342)$$

$$\Delta^4\bar{z}_t^{kz} = \bar{z}_t^{kz} - \bar{z}_{t-4}^{kz} \quad (343)$$

Fiscal Block

$$def2gdp_t^{kz} = \overline{def2gdp_t}^{kz} + \widehat{def2gdp_t}^{kz} \quad (344)$$

$$\overline{def2gdp_t}^{kz} = c_{312}\,\overline{def2gdp}_{t-1}^{kz} + (1-c_{312})\left(def2gdp_t^{tar,kz} - c_{317}\left(\Delta\bar{y}_t^{kz} - \Delta y_{ss}^{kz}\right)\right) + \varepsilon_t^{\overline{def2gdp}^{kz}} \quad (345)$$

$$def2gdp_t^{tar,kz} = c_{313}\,def2gdp_{t-1}^{tar,kz} + (1-c_{313})\,def2gdp_{ss}^{tar,kz} + \varepsilon_t^{def2gdp^{tar,kz}} \quad (346)$$

$$def2gdp_t^{kz} = c_{314}\,def2gdp_{t-1}^{kz} + \\ + (1-c_{314})\left(def2gdp_t^{tar,kz} - c_{315}\left(def2gdp_{t-1}^{kz} - def2gdp_{t-1}^{tar,kz}\right) - c_{316}\,\hat{y}_t^{kz}\right) + \\ + \varepsilon_t^{def2gdp^{kz}} \quad (347)$$

$$def_t^{KZT} = def2gdp_t^{kz} + y_t^{kz} \quad (348)$$

$$def2gdp_t^{a,kz} = 100\log\left(\left(DEF_t^{KZT} + DEF_{t-1}^{KZT} + DEF_{t-2}^{KZT} + DEF_{t-3}^{KZT}\right)/4\right) - \\ - 100\log\left(\left(Y_t^{kz} + Y_{t-1}^{kz} + Y_{t-2}^{kz} + Y_{t-3}^{kz}\right)/4\right) \quad (349)$$

Log Transform

$$y_t^{kz} = 100\log\left(Y_t^{kz}\right) \quad (350)$$

$$def_t^{KZT} = 100\log\left(DEF_t^{KZT}\right) \quad (351)$$

Expected

$$ {}^{e}\pi_t^{kz} = \pi_{t+1}^{kz} \tag{352} $$

$$ {}^{e}\pi_t^{4,kz} = \pi_{t+1}^{4,kz} \tag{353} $$

$$ {}^{e}\bar{z}_t = \bar{z}_{t+1}^{kz} \tag{354} $$

$$ {}^{e}\hat{y}_t^{kz} = \hat{y}_{t+1}^{kz} \tag{355} $$

$$ {}^{e}\pi_t^{tar,kz} = \pi_{t+1}^{tar,kz} \tag{356} $$

$$ {}^{e}\Delta\bar{z}_t^{kz} = \Delta\bar{z}_{t+1}^{kz} \tag{357} $$

$$ {}^{e4}\pi_t^{tar,kz} = \pi_{t+4}^{tar,kz} \tag{358} $$

$$ {}^{e4}\pi_t^{4,kz} = \pi_{t+4}^{4,kz} \tag{359} $$

$$ \Delta^4 y_t^{a,kz} = \left(\Delta^4 y_t^{kz} + \Delta^4 y_{t-1}^{kz} + \Delta^4 y_{t-2}^{kz} + \Delta^4 y_{t-3}^{kz}\right)/4 \tag{360} $$

APPENDIX C: MODEL VARIABLES GLOSSARY

External Sector

EZ Nominal Interest Rate, % p.a.	i^{ez}
EZ CPI, 100*log	p^{ez}
EZ Real Interest Rate, % p.a.	r^{ez}
EZ Real Interest Rate Trend, % p.a.	$\overline{r}^{ez}$
EZ Real Interest Rate Gap, p.p.	$\hat{r}^{ez}$
Nominal Exchange Rate (USD/EUR), 100*log	$s^{USD/EUR}$
Nominal ER Depreciation (USD/EUR), % QoQ @ar	$\Delta s^{USD/EUR}$
EZ Output Gap, %	$\hat{y}^{ez}$
EZ Output Gap, annual %	$\hat{y}^{a,ez}$
Real Exchange Rate (USD/EUR), 100*log	z^{ez}
RER Trend (USD/EUR), 100*log	$\overline{z}^{ez}$
RER Gap (USD/EUR), % (log approx.)	$\hat{z}^{ez}$
Real Exchange Rate (USD/EUR), QoQ @ar	Δz^{ez}
RER Trend Depreciation (USD/EUR), % QoQ @ar (log approx.)	$\Delta \overline{z}^{ez}$
EZ CPI Inflation, % QoQ @ar (log approx.)	π^{ez}
EZ CPI Inflation Expectations 1q ahead, % QoQ @ar (log approx.)	${}^{e}\pi^{ez}$
Gold Price Inflation, % QoQ @ar	$\Delta gold$
US Nominal Interest Rate, % p.a.	i^{us}
Oil Price Inflation, % QoQ @ar	Δoil
US CPI, 100*log	p^{us}
Gold Price (in USD), 100*log	$p^{gold^{USD}}$
Oil Price (in USD), 100*log	$p^{oil^{USD}}$
US Real Interest Rate, % p.a.	r^{us}
US Real Interest Rate Trend, % p.a.	$\overline{r}^{us}$
US Real Interest Rate Gap, p.p.	$\hat{r}^{us}$
Real Gold Price, 100*log	rp^{gold}
Real Gold Price Trend, 100*log	$\overline{rp}^{gold}$
Real Gold Price Gap, % (log approx.)	$\widehat{rp}^{gold}$
Growth of Real Gold Price Trend, % QoQ @ar (log approx.)	$\Delta\overline{rp}^{gold}$
Real Oil Price, 100*log	rp^{oil}
Real Oil Price Trend, 100*log	$\overline{rp}^{oil}$

Real Oil Price Gap, % (log approx.)	$\widehat{rp}^{oil}$
Growth of Real Oil Price Trend, % QoQ @ar (log approx.)	$\Delta\overline{rp}^{oil}$
US Output Gap, %	$\hat{y}^{us}$
US Output Gap, annual, %	$\hat{y}^{a,us}$
US CPI Inflation, % QoQ @ar (log approx.)	π^{us}
US CPI Inflation Expectations 1q ahead, % QoQ @ar (log approx.)	${}^{e}\pi^{us}$

Russia

Deficit of the Government (bln RUB)	$DEF^{RUB,ru}$
Deficit of the Government, 100*log	$def^{RUB,ru}$
Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{ru}$
Trend of the Government Deficit to GDP (log approx.)	$\overline{def2gdp}^{ru}$
Annual Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{a,ru}$
Target of the Government Deficit to GDP (log approx.)	$def2gdp^{tar,ru}$
Cyclical Part of the Government Deficit to GDP (log approx.)	$\widehat{def2gdp}^{ru}$
Money Market Interest Rate, % p.a.	i^{ru}
Headline CPI, 100*log	p^{ru}
Price Index of Imports (100*log)	$p^{im,ru}$
UIP Long-Term Risk Premium, % p.a.	$prem^{ru}$
Real Money Market Interest Rate, % p.a.	r^{ru}
Eq. Real Money Market Interest Rate, % p.a.	$\bar{r}^{ru}$
Real Interest Rate Gap, %	$\hat{r}^{ru}$
Ex-Food Real Marginal Costs, %	rmc^{ru}
Nominal Exchange Rate (RUB/USD), 100*log	$s^{RUB/USD}$
Deviation of Nominal Exchange Rate from Target	$s^{dev,ru}$
Nominal ER Expectations (RUB/USD) Expectation 1q ahead, 100*log	${}^{e}s^{RUB/USD}$
Nominal ER Depreciation (RUB/USD), % QoQ @ar (log approx.)	$\Delta s^{RUB/USD}$
Eq. Nominal ER Depreciation (RUB/USD), % QoQ @ar (log approx.)	$\Delta\bar{s}^{RUB/USD}$
Gap of Spread between Long-term and Short-term credit interest rate	$\widehat{sp}$
Nominal Wages, 100*log	w^{ru}
Nominal Wage Growth, % QoQ	Δw^{ru}
Nominal Wage Growth, % YoY	$\Delta^4 w^{ru}$
Expected Nominal Wage Growth, % QoQ	${}^{e}\Delta w^{ru}$
Real Wage, 100*log	wr^{ru}

Real Wage Trend, 100*log	$\overline{wr}^{ru}$
Real Wage Gap, 100*log	$\widehat{wr}^{ru}$
Real Wage Trend Growth, % QoQ	$\Delta\overline{wr}^{ru}$
Real GDP, index	Y^{ru}
Real GDP, 100*log	y^{ru}
Real GDP Trend, 100*log	$\bar{y}^{ru}$
Real GDP Gap, %	$\hat{y}^{ru}$
Expected Output Gap 1q Ahead, %	${}^{e}\hat{y}^{ru}$
Effective Foreign Demand Gap, %	$\hat{y}^{f,ru}$
Growth of Real GDP, QoQ @ar	Δy^{ru}
Growth of Real GDP Trend, QoQ @ar	$\Delta\bar{y}^{ru}$
Growth of Real GDP, % YoY (log approx.)	$\Delta^4 y^{ru}$
Real Exchange Rate RUB/USD, 100*log	z^{ru}
RER Trend RUB/USD, 100*log	$\bar{z}^{ru}$
RER Trend Expectations 1q ahead, 100*log	${}^{e}\bar{z}^{ru}$
REER, 100*log	$z^{eff,ru}$
REER Trend, 100*log	$\bar{z}^{eff,ru}$
RER Gap RUB/USD, % (log approx.)	$\hat{z}^{ru}$
REER Gap, % (log approx.)	$\hat{z}^{eff,ru}$
Change of REER (USD/RUB), % YoY (log approx.)	$\Delta^4 z^{ru}$
RER Trend Depreciation RUB/USD, % QoQ @ar (log approx.)	$\Delta\bar{z}^{ru}$
Growth of REER, % YoY (log approx.)	$\Delta z^{eff,ru}$
REER Trend Depreciation, % QoQ @ar (log approx.)ние)	$\Delta\bar{z}^{eff,ru}$
Growth of RER wrt US, % YoY (log approx.)	$\Delta z^{USD,ru}$
RER Depreciation RUB/USD, % QoQ @ar (log approx.)	Δz^{USD}
Headline CPI Inflation, % QoQ @ar (log approx.)	π^{ru}
Headline CPI Inflation, % YoY (log approx.)	$\pi^{4,ru}$
Inflation Expectations 1q ahead, % QoQ (log approx.)	${}^{e}\pi^{ru}$
Inflation Expectations 1q ahead, % YoY (log approx.)	${}^{e}\pi^{4,ru}$
Inflation Expectations 4q ahead, % YoY (log approx.	${}^{e4}\pi^{4,ru}$
Inflation Target Expectations 4q ahead, % YoY (log approx.)	${}^{e4}\pi^{tar,ru}$
Imported Inflation (q-o-q @ar)	$\pi^{im,ru}$
Inflation Target, % QoQ @ar (log approx.)	$\pi^{tar,ru}$

Armenia

Deficit of the Government, 100*log	def^{AMD}
Deficit of the Government (bln AMD)	DEF^{AMD}
Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{am}$
Trend of the Government Deficit to GDP (log approx.)	$\overline{def2gdp}^{am}$
Annual Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{a,am}$
Target of the Government Deficit to GDP (log approx.)	$def2gdp^{tar,am}$
Cyclical Part of the Government Deficit to GDP (log approx.)	$\widehat{def2gdp}^{am}$
Money Market Interest Rate, % p.a.	i^{am}
Headline CPI, 100*log	p^{am}
UIP Long-Term Risk Premium, % p.a.	$prem^{am}$
Real Net Inflow of Remittances, 100*log	$qrem^{USD,am}$
Real Remittances Trend	$\overline{qrem}^{USD,am}$
Real Remittances Gap (in AMD)	$\widehat{qrem}^{AMD}$
Real Remittances Gap (in USD)	$\widehat{qrem}^{USD,am}$
Growth Rate of Real Remittances Trend	$\Delta\overline{qrem}^{USD,am}$
Real Money Market Interest Rate, % p.a.	r^{am}
Eq. Real Money Market Interest Rate, % p.a.	$\bar{r}^{am}$
Real Interest Rate Gap, %	$\hat{r}^{am}$
Net Inflow of Remittances, 100*log	$rem^{USD,am}$
Growth of Inflow of Remittances, % QoQ @ar	$\Delta rem^{USD,am}$
Growth of Inflow of Remittances, % YoY	$\Delta^4 rem^{USD,am}$
Ex-Food Real Marginal Costs, %	rmc^{am}
Nominal Exchange Rate (AMD/USD), 100*log	$s^{AMD/USD}$
Deviation of Nominal Exchange Rate from Target	$s^{dev,am}$
Nominal ER Expectations (AMD/USD) Expectation 1q ahead, 100*log	${}^{e}s^{AMD/USD}$
Nominal Exchange Rate Appreciation (AMD/USD), % QoQ @ar	$\Delta s^{AMD/USD}$
Nominal Exchange Rate Appreciation Trend (AMD/USD), % QoQ @ar	$\Delta\bar{s}^{AMD/USD}$
Nominal Wages, 100*log	w^{am}
Nominal Wage Growth, % QoQ	Δw^{am}
Expected Nominal Wage Growth, % QoQ	${}^{e}\Delta w^{am}$
Nominal Wage Growth, % YoY	$\Delta^4 w^{am}$
Real Wage, 100*log	wr^{am}
Real Wage Trend, 100*log	$\overline{wr}^{am}$
Real Wage Gap, 100*log	$\widehat{wr}^{am}$

Real Wage Trend Growth, % QoQ	$\Delta\overline{wr}^{am}$
Real GDP, index	Y^{am}
Real GDP, 100*log	y^{am}
Real GDP Trend, 100*log	$\bar{y}^{am}$
Real GDP Gap, %	$\hat{y}^{am}$
Expected Output Gap 1q Ahead, %	${}^{e}\hat{y}^{am}$
Effective Foreign Demand Gap, %	$\hat{y}^{f,am}$
Growth of Real GDP, QoQ @ar	Δy^{am}
Growth of Real GDP Trend, QoQ @ar	$\Delta\bar{y}^{am}$
Growth of Real GDP, % YoY (log approx.)	$\Delta^4 y^{am}$
Growth of Annual Real GDP, % YoY	$\Delta^4 y^{a,am}$
Real Exchange Rate USD/AMD, 100*log	z^{am}
RER Trend USD/AMD, 100*log	$\bar{z}^{am}$
RER Trend Expectations 1q ahead, 100*log	${}^{e}\bar{z}$
RER Trend Depreciation Expectations 1q ahead, % QoQ @ar (log approx.)	${}^{e}\Delta\bar{z}$
REER, 100*log	$z^{eff,am}$
REER Trend, 100*log	$\bar{z}^{eff,am}$
RER Gap USD/AMD, % (log approx.)	$\hat{z}^{am}$
REER Gap, % (log approx.)	$\hat{z}^{eff,am}$
RER Depreciation USD/AMD, % QoQ @ar (log approx.)	Δz^{am}
RER Trend Depreciation USD/AMD, % QoQ @ar (log approx.)	$\Delta\bar{z}^{am}$
REER Depreciation, % QoQ @ar (log approx.)	$\Delta z^{eff,am}$
REER Trend Depreciation, % QoQ @ar (log approx.)ние)	$\Delta\bar{z}^{eff,am}$
RER Trend Depreciation USD/AMD, % YoY (log approx.)	$\Delta^4\bar{z}^{am}$
REER Trend Depreciation, % YoY (log approx.)	$\Delta^4\bar{z}^{eff,am}$
Headline CPI Inflation, % QoQ @ar (log approx.)	π^{am}
Headline CPI Inflation, % YoY (log approx.)	$\pi^{4,am}$
Deviation of Inflation from Target	$\pi^{4,dev,am}$
Inflation Expectations 1q ahead, % QoQ (log approx.)	${}^{e}\pi^{am}$
Inflation Expectations 1q ahead, % YoY (log approx.)	${}^{e}\pi^{4,am}$
Inflation Target Expectations 3q ahead, % YoY (log approx.)	${}^{e}\pi^{tar,am}$
Inflation Target, % QoQ @ar (log approx.)	$\pi^{tar,am}$

Belarus

Deficit of the Government (bln BYR)	DEF^{BYR}
Deficit of the Government, 100*log	def^{BYR}
Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{by}$
Trend of the Government Deficit to GDP (log approx.)	$\overline{def2gdp}^{by}$
Annual Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{a,by}$
Target of the Government Deficit to GDP (log approx.)	$def2gdp^{tar,by}$
Cyclical Part of the Government Deficit to GDP (log approx.)	$\widehat{def2gdp}^{by}$
Money Market Interest Rate, % p.a.	i^{by}
Nominal GDP, index	NY^{by}
Nominal GDP, 100*log	ny^{by}
Growth of Nominal GDP, QoQ @ar	Δny^{by}
Headline CPI, 100*log	p^{by}
UIP Long-Term Risk Premium, % p.a.	$prem^{by}$
GDP Deflator, index	PY^{by}
GDP Deflator, 100*log	py^{by}
Inflation of GDP Deflator, QoQ @ar	Δpy^{by}
Inflation of Consumption Deflator, % YoY (log approx.)	$\Delta^4 py^{by}$
Real Money Market Interest Rate, % p.a.	r^{by}
Eq. Real Money Market Interest Rate, % p.a.	$\bar{r}^{by}$
Real Interest Rate Gap, %	$\hat{r}^{by}$
Real Marginal Costs, %	rmc^{by}
Real Monetary Condition Index	$rmci^{by}$
Nominal ER Expectations (BYR/USD) Expectation 1q ahead, 100*log	${}^{e}s^{BYR/USD}$
Nominal ER Depreciation (BYR/USD), % QoQ @ar (log approx.)	$\Delta s^{BYR/USD}$
Deviation of BYR/USD Depreciation, %	$\Delta s_{dev}{}^{BYR/USD}$
Deviation of BYR/USD Depreciation Expectations 1q ahead	${}^{e}\Delta s_{dev}{}^{BYR/USD}$
Long-Term and Short-Term Interest Rate Spread Gap	$\widehat{sp}^{by}$
Nominal Exchange Rate (BYR/USD), 100*log	$s^{BYR/USD}$
Nominal Wages, 100*log	w^{by}
Nominal Wage Growth, % QoQ	Δw^{by}
Expected Nominal Wage Growth, % QoQ	${}^{e}\Delta w^{by}$
Real Wage, 100*log	wr^{by}
Real Wage Trend, 100*log	$\overline{wr}^{by}$
Real Wage (CPI based), 100*log	$wr^{CPI,by}$

Real Wage Trend (CPI based), 100*log	$\overline{wr}^{CPI,by}$
Real Wage Gap, 100*log	$\widehat{wr}^{by}$
Real Wage Gap (CPI based), 100*log	$\widehat{wr}^{CPI,by}$
Real Wage Trend Growth, % QoQ	$\Delta\overline{wr}^{by}$
Real GDP, index	Y^{by}
Real GDP, 100*log	y^{by}
Real GDP Trend, 100*log	$\bar{y}^{by}$
Output Gap, %	$\hat{y}^{by}$
Effective Foreign Demand Gap, %	$\hat{y}^{f,by}$
Growth of Real GDP, QoQ @ar	Δy^{by}
Growth of Real GDP Trend, QoQ @ar	$\Delta\bar{y}^{by}$
Growth of Real GDP, % YoY (log approx.)	$\Delta^4 y^{by}$
Growth of Real GDP Trend, YoY @ar	$\Delta^4\bar{y}^{by}$
Real GDP Growth Rate, % YoY, annual	$\Delta^4 y^{a,by}$
Expected Output Gap 1q Ahead, %	${}^e\widehat{yg}^{by}$
Real Exchange Rate USD/BYR, 100*log	z^{by}
RER Trend USD/BYR, 100*log	$\bar{z}^{by}$
REER Trend Expectations 1q ahead, 100*log	${}^e\bar{z}^{eff,by}$
REER, 100*log	$z^{eff,by}$
REER Trend, 100*log	$\bar{z}^{eff,by}$
RER Gap, % (log approx.)	$\hat{z}^{by}$
REER Gap, % (log approx.)	$\hat{z}^{eff,by}$
RER Depreciation USD/BYR, % QoQ @ar (log approx.)	Δz^{by}
RER Trend Depreciation USD/BYR, % QoQ @ar (log approx.)	$\Delta\bar{z}^{by}$
RER Trend Depreciation Expectations 1q ahead, % QoQ @ar (log approx.)	${}^e\Delta\bar{z}^{by}$
REER Trend Depreciation Expectations 1q ahead, % QoQ @ar (log approx.)	${}^e\Delta\bar{z}^{eff,by}$
REER Depreciation, % QoQ @ar (log approx.)	$\Delta z^{eff,by}$
REER Trend Depreciation, % QoQ @ar (log approx.)ние)	$\Delta\bar{z}^{eff,by}$
RER Depreciation, % YoY @ar (log approx.)	$\Delta^4 z^{by}$
REER Depreciation, % YoY @ar (log approx.)	$\Delta^4 z^{eff,by}$
Headline CPI Inflation, % QoQ @ar (log approx.)	π^{by}
Headline CPI Inflation, % YoY (log approx.)	$\pi^{4,by}$
Inflation Expectations 1q ahead, % QoQ (log approx.)	${}^e\pi^{by}$
Inflation Expectations 3q ahead, % YoY (log approx.)	${}^{e3}\pi^{4,by}$
Inflation Target Expectations 4q ahead, % YoY (log approx.)	${}^{e4}\pi^{tar,by}$

Inflation Expectations 4q ahead, % YoY (log approx.)	${}^{e}\pi^{4,by}$
Imported Inflation (q-o-q @ar)	$\pi^{im,by}$
Inflation Target, % QoQ @ar (log approx.)	$\pi^{tar,by}$

Kyrgyzstan

Deficit of the Government (bln KGS)	DEF^{KGS}
Deficit of the Government, 100*log	def^{KGS}
Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{kg}$
Trend of the Government Deficit to GDP (log approx.)	$\overline{def2gdp}^{kg}$
Annual Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{a,kg}$
Target of the Government Deficit to GDP (log approx.)	$def2gdp^{tar,kg}$
Cyclical Part of the Government Deficit to GDP (log approx.)	$\widehat{def2gdp}^{kg}$
Money Market Interest Rate, % p.a.	i^{kg}
UIP Long-Term Risk Premium, % p.a.	$prem^{kg}$
Headline CPI, 100*log	p^{kg}
Real Remittances Trend	$\overline{qrem}^{USD,kg}$
Real Net Inflow of Remittances, 100*log	$qrem^{USD,kg}$
Real Remittances Gap (in KGS)	$\widehat{qrem}^{KGS}$
Real Remittances Gap (in USD)	$\widehat{qrem}^{USD,kg}$
Growth Rate of Real Remittances Trend	$\Delta\overline{qrem}^{USD,kg}$
Real Money Market Interest Rate, % p.a.	r^{kg}
Eq. Real Money Market Interest Rate, % p.a.	$\bar{r}^{kg}$
Real Interest Rate Gap, %	$\hat{r}^{kg}$
Net Inflow of Remittances, 100*log	$rem^{USD,kg}$
Net Inflow of Remittances, % QoQ @ar (log approx.)	$\Delta rem^{USD,kg}$
Net Inflow of Remittances, % YoY (log approx.)	$\Delta^4 rem^{USD,kg}$
Ex-Food Real Marginal Costs, %	rmc^{kg}
Deviation of Nominal Exchange Rate from Target	$s^{dev,kg}$
Nominal Exchange Rate (KGS/USD), 100*log	$s^{KGS/USD}$
Nominal ER Expectations (KGS/USD) Expectation 1q ahead, 100*log	${}^{e}s^{KGS/USD}$
Nominal Exchange Rate Appreciation (KGS/USD), % QoQ @ar	$\Delta s^{KGS/USD}$
Nominal Exchange Rate Appreciation Trend (KGS/USD), % QoQ @ar	$\Delta\bar{s}^{KGS/USD}$
Nominal Wages, 100*log	w^{kg}
Nominal Wage Growth, % QoQ	Δw^{kg}

Expected Nominal Wage Growth, % QoQ	${}^{e}\Delta w^{kg}$
Nominal Wage Growth, % YoY	$\Delta^4 w^{kg}$
Real Wage, 100*log	wr^{kg}
Real Wage Trend, 100*log	$\overline{wr}^{kg}$
Real Wage Gap, 100*log	$\widehat{wr}^{kg}$
Real Wage Trend Growth, % QoQ	$\Delta\overline{wr}^{kg}$
Real GDP, index	Y^{kg}
Real GDP, 100*log	y^{kg}
Real GDP Trend, 100*log	$\bar{y}^{kg}$
Real GDP Gap, %	$\hat{y}^{kg}$
Expected Output Gap 1q Ahead, %	${}^{e}\hat{y}^{kg}$
Effective Foreign Demand Gap, %	$\hat{y}^{f,kg}$
Growth of Real GDP, QoQ @ar	Δy^{kg}
Growth of Real GDP Trend, QoQ @ar	$\Delta\bar{y}^{kg}$
Growth of Real GDP, % YoY (log approx.)	$\Delta^4 y^{kg}$
Growth of Annual Real GDP, % YoY	$\Delta^4 y^{a,kg}$
Real Exchange Rate USD/KGS, 100*log	z^{kg}
RER Trend USD/KGS, 100*log	$\bar{z}^{kg}$
RER Trend Expectations 1q ahead, 100*log	${}^{e}\bar{z}$
REER, 100*log	$z^{eff,kg}$
REER Trend, 100*log	$\bar{z}^{eff,kg}$
RER Gap USD/KGS, % (log approx.)	$\hat{z}^{kg}$
REER Gap, % (log approx.)	$\hat{z}^{eff,kg}$
RER Depreciation USD/KGS, % QoQ @ar (log approx.)	Δz^{kg}
RER Trend Depreciation USD/KGS, % QoQ @ar (log approx.)	$\Delta\bar{z}^{kg}$
RER Trend Depreciation Expectations 1q ahead, % QoQ @ar (log approx.)	${}^{e}\Delta\bar{z}$
REER Depreciation, % QoQ @ar (log approx.)	$\Delta z^{eff,kg}$
REER Trend Depreciation, % QoQ @ar (log approx.)ние)	$\Delta\bar{z}^{eff,kg}$
RER Trend Depreciation USD/KGS, % YoY (log approx.)	$\Delta^4\bar{z}^{kg}$
REER Trend Depreciation, % YoY (log approx.)	$\Delta^4\bar{z}^{eff,kg}$
Headline CPI Inflation, % QoQ @ar (log approx.)	π^{kg}
Headline CPI Inflation, % YoY (log approx.)	$\pi^{4,kg}$
Deviation of Inflation from Target	$\pi^{4,dev,kg}$
Inflation Target, % YoY (log approx.)	$\pi^{4,tar,kg}$
Inflation Expectations 1q ahead, % QoQ (log approx.)	${}^{e}\pi^{kg}$

Inflation Expectations 1q ahead, % YoY (log approx.)	${}^{e}\pi^{4,kg}$
Inflation Target Expectations 3q ahead, % YoY (log approx.)	${}^{e,3}\pi^{4,tar,kg}$
Inflation Target, % QoQ @ar (log approx.)	$\pi^{tar,kg}$

Kazakhstan

Deficit of the Government (bln KZT)	DEF^{KZT}
Deficit of the Government, 100*log	def^{KZT}
Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{kz}$
Trend of the Government Deficit to GDP (log approx.)	$\overline{def2gdp}^{kz}$
Annual Deficit of the Government as a share to GDP (log approx.)	$def2gdp^{a,kz}$
Target of the Government Deficit to GDP (log approx.)	$def2gdp^{tar,kz}$
Cyclical Part of the Government Deficit to GDP (log approx.)	$\widehat{def2gdp}^{kz}$
Money Market Interest Rate, % p.a.	i^{kz}
Headline CPI, 100*log	p^{kz}
UIP Long-Term Risk Premium, % p.a.	$prem^{kz}$
Real Money Market Interest Rate, % p.a.	r^{kz}
Eq. Real Money Market Interest Rate, % p.a.	$\bar{r}^{kz}$
Real Interest Rate Gap, %	$\hat{r}^{kz}$
Ex-Food Real Marginal Costs, %	rmc^{kz}
Nominal Exchange Rate (KZT/USD), 100*log	$s^{KZT/USD}$
Nominal ER Expectations (KZT/USD) Expectation 1q ahead, 100*log	${}^{e}s^{KZT/USD}$
Nominal Exchange Rate Appreciation (KZT/USD), % QoQ @ar	$\Delta s^{KZT/USD}$
Nominal Exchange Rate Appreciation Trend (KZT/USD), % QoQ @ar	$\Delta\bar{s}^{KZT/USD}$
Nominal Wages, 100*log	w^{kz}
Nominal Wage Growth, % QoQ	Δw^{kz}
Expected Nominal Wage Growth, % QoQ	${}^{e}\Delta w^{kz}$
Nominal Wage Growth, % YoY	$\Delta^{4} w^{kz}$
Real Wage, 100*log	wr^{kz}
Real Wage Trend, 100*log	$\overline{wr}^{kz}$
Real Wage Gap, 100*log	$\widehat{wr}^{kz}$
Real Wage Trend Growth, % QoQ	$\Delta\overline{wr}^{kz}$
Real GDP, index	Y^{kz}
Real GDP, 100*log	y^{kz}
Real GDP Trend, 100*log	$\bar{y}^{kz}$

Real GDP Gap, %	$\hat{y}^{kz}$
Effective Foreign Demand Gap, %	$\hat{y}^{f,kg}$
Expected Output Gap 1q Ahead, %	${}^{e}\hat{y}^{kz}$
Growth of Real GDP, QoQ @ar	Δy^{kz}
Growth of Real GDP Trend, QoQ @ar	$\Delta \bar{y}^{kz}$
Growth of Real GDP, % YoY (log approx.)	$\Delta^4 y^{kz}$
Growth of Annual Real GDP, % YoY	$\Delta^4 y^{a,kz}$
Real Exchange Rate USD/KZT, 100*log	z^{kz}
RER Trend USD/KZT, 100*log	$\bar{z}^{kz}$
RER Trend Expectations 1q ahead, 100*log	${}^{e}\bar{z}$
REER, 100*log	$z^{eff,kz}$
REER Trend, 100*log	$\bar{z}^{eff,kz}$
RER Gap USD/KZT, % (log approx.)	$\hat{z}^{kz}$
REER Gap, % (log approx.)	$\hat{z}^{eff,kz}$
RER Depreciation USD/KZT, % QoQ @ar (log approx.)	Δz^{kz}
RER Trend Depreciation USD/KZT, % QoQ @ar (log approx.)	$\Delta \bar{z}^{kz}$
RER Trend Depreciation Expectations 1q ahead, % QoQ @ar (log approx.)	${}^{e}\Delta \bar{z}^{kz}$
REER Depreciation, % QoQ @ar (log approx.)	$\Delta z^{eff,kz}$
REER Trend Depreciation, % QoQ @ar (log approx.)ние)	$\Delta \bar{z}^{eff,kz}$
RER Trend Depreciation USD/KZT, % YoY (log approx.)	$\Delta^4 \bar{z}^{kz}$
REER Trend Depreciation, % YoY (log approx.)	$\Delta^4 \bar{z}^{eff,kz}$
Headline CPI Inflation, % QoQ @ar (log approx.)	π^{kz}
Headline CPI Inflation, % YoY (log approx.)	$\pi^{4,kz}$
Inflation Expectations 1q ahead, % QoQ (log approx.)	${}^{e}\pi^{kz}$
Inflation Expectations 1q ahead, % YoY (log approx.)	${}^{e}\pi^{4,kz}$
Inflation Expectations 4q ahead, % YoY (log approx.)	${}^{e4}\pi^{4,kz}$
Inflation Target Expectations 4q ahead, % (log approx.)	${}^{e4}\pi^{tar,kz}$
Inflation Target Expectations 1q ahead, % (log approx.)	${}^{e}\pi^{tar,kz}$
Inflation Target, % (log approx.)	$\pi^{tar,kz}$

APPENDIX D: MODEL PARAMETERS

Model Steady-State Parameters

Steady State of Real Oil Price Trend	$\Delta\overline{rp}_{ss}^{oil}$	−1.00
Steady State of Real Gold Price Trend	$\Delta\overline{rp}_{ss}^{gold}$	1.00
Steady State of EZ Real Interest Rate	$\bar{r}_{ss}^{ez}$	1.50
Steady State of EZ Inflation, % QoQ @ar	π_{ss}^{ez}	1.90
Steady State US Inflation, % QoQ @ar	π_{ss}^{us}	2.00
Steady State Real Exchange Rate Depreciation (USD/EUR)	Δz_{ss}^{ez}	0.00
Steady State Exchange Rate Depreciation (USD/EUR)	$\Delta s_{ss}^{USD/EUR}$	0.10
Steady State of US Real Interest Rate	$\bar{r}_{ss}^{us}$	1.50
Steady State of Oil Price Inflation, % QoQ @ar	Δoil_{ss}	1.00
Steady State of Gold Price Inflation, % QoQ @ar	$\Delta gold_{ss}$	3.00
Steady State of Inflation Target	$\pi_{ss}^{tar,ru}$	4.50
Steady State of UIP Long-Term Risk Premium	$prem_{ss}^{ru}$	2.50
Steady State Growth of Real GDP, % QoQ @ar	Δy_{ss}^{ru}	2.00
Steady State of the Government Deficit to GDP target (log approx.)	$def2gdp_{ss}^{tar,ru}$	0.50
Steady State of RER Trend Depreciation USD/RUB, % QoQ @ar	$\Delta\bar{z}_{ss}^{ru}$	0.35
Steady State of Inflation Target	$\pi_{ss}^{tar,am}$	4.00
Steady State of UIP Long-Term Risk Premium	$prem_{ss}^{am}$	5.50
Steady State Growth of Real GDP, % QoQ @ar	Δy_{ss}^{am}	3.00
Steady State of RER Trend Depreciation USD/AMD, % QoQ @ar	$\Delta\bar{z}_{ss}^{am}$	0.00
Steady State of the Government Deficit to GDP target (log approx.)	$def2gdp_{ss}^{tar,am}$	1.00
Steady State of Real Remittances Growth	$\Delta\overline{qrem}_{ss}^{USD,am}$	3.00
Steady State of Inflation Target, % QoQ @ar	$\pi_{ss}^{tar,by}$	9.00
Steady State of UIP Long-Term Risk Premium, % p.a.	$prem_{ss}^{by}$	5.50
Steady State Growth of Real GDP, % QoQ @ar	Δy_{ss}^{by}	2.50
Steady State of RER Trend Depreciation USD/BYR, % QoQ @ar	$\Delta\bar{z}_{ss}^{by}$	0.00
Steady State of the Government Deficit to GDP target (log approx.)	$def2gdp_{ss}^{tar,by}$	0.50
Steady State of Inflation Target	$\pi_{ss}^{tar,kg}$	6.00
Steady State of UIP Long-Term Risk Premium	$prem_{ss}^{kg}$	2.80
Steady State Growth of Real GDP, % QoQ @ar	Δy_{ss}^{kg}	3.00
Steady State of RER Trend Depreciation USD/KGS, % QoQ @ar	$\Delta\bar{z}_{ss}^{kg}$	0.00
Steady State of the Government Deficit to GDP target (log approx.)	$def2gdp_{ss}^{tar,kg}$	0.50

Steady State of Real Remittances Growth	$\Delta\overline{qrem}_{ss}^{USD,kg}$	3.00
Steady State of Inflation Target	$\pi_{ss}^{tar,kz}$	6.00
Steady State of UIP Long-Term Risk Premium	$prem_{ss}^{kz}$	2.00
Steady State Growth of Real GDP, % QoQ @ar	Δy_{ss}^{kz}	3.50
Steady State of the Government Deficit to GDP target (log approx.)	$def2gdp_{ss}^{tar,kz}$	0.50

Model Transition parameters

c_1	0.70	c_{39}	0.00	c_{74}	0.85	c_{111}	0.60	c_{149}	0.00	c_{184}	0.30
c_2	0.85	c_{40}	0.55	c_{75}	0.50	c_{112}	0.55	c_{150}	0.52	c_{185}	0.15
c_3	0.60	c_{41}	0.38	c_{76}	0.50	c_{113}	1.30	c_{151}	0.38	c_{186}	0.00
c_4	0.50	c_{42}	0.45	c_{77}	0.80	c_{114}	0.05	c_{152}	0.09	c_{187}	0.00
c_5	0.80	c_{43}	0.45	c_{78}	0.30	c_{115}	0.85	c_{153}	0.10	c_{188}	0.01
c_6	0.10	c_{44}	0.10	c_{79}	0.00	c_{116}	0.75	c_{154}	0.60	c_{189}	0.16
c_7	0.70	c_{45}	0.60	c_{80}	0.00	c_{117}	0.99	c_{155}	0.10	c_{190}	0.47
c_8	0.85	c_{46}	0.09	c_{81}	0.00	c_{118}	0.75	c_{156}	0.30	c_{191}	0.06
c_9	0.60	c_{47}	0.06	c_{82}	0.27	c_{119}	0.20	c_{157}	0.20	c_{192}	0.32
c_{10}	0.50	c_{48}	0.20	c_{83}	0.47	c_{120}	0.50	c_{158}	0.35	c_{194}	0.01
c_{11}	0.80	c_{49}	0.12	c_{84}	0.25	c_{121}	0.60	c_{159}	0.90	c_{195}	0.05
c_{12}	0.50	c_{50}	0.20	c_{86}	0.01	c_{122}	0.20	c_{160}	0.50	c_{196}	0.17
c_{13}	0.85	c_{51}	0.50	c_{88}	0.36	c_{123}	0.50	c_{161}	0.20	c_{197}	0.05
c_{14}	0.50	c_{52}	0.90	c_{89}	0.35	c_{124}	0.90	c_{162}	0.60	c_{198}	0.72
c_{15}	0.50	c_{53}	0.75	c_{90}	0.27	c_{125}	1.00	c_{163}	0.05	c_{199}	0.00
c_{16}	0.70	c_{54}	0.40	c_{91}	0.00	c_{126}	0.70	c_{164}	0.10	c_{200}	0.01
c_{17}	1.00	c_{55}	0.35	c_{92}	0.01	c_{127}	0.50	c_{165}	0.05	c_{201}	0.11
c_{18}	1.00	c_{56}	0.10	c_{93}	0.00	c_{128}	0.30	c_{166}	0.65	c_{202}	0.32
c_{19}	1.00	c_{57}	0.50	c_{94}	0.31	c_{129}	0.00	c_{167}	0.60	c_{203}	0.05
c_{20}	1.00	c_{58}	0.10	c_{95}	0.41	c_{130}	0.95	c_{168}	1.15	c_{204}	0.52
c_{21}	1.00	c_{59}	0.03	c_{96}	0.26	c_{131}	0.43	c_{169}	0.85	c_{205}	0.05
c_{22}	0.50	c_{60}	0.80	c_{97}	0.10	c_{132}	1.90	c_{170}	0.15	c_{206}	0.50
c_{24}	0.00	c_{61}	0.75	c_{98}	0.60	c_{133}	0.00	c_{171}	1.00	c_{207}	0.08
c_{25}	0.03	c_{62}	0.40	c_{99}	0.15	c_{134}	0.00	c_{172}	0.80	c_{208}	0.025
c_{26}	0.03	c_{63}	0.00	c_{100}	0.50	c_{135}	0.00	c_{173}	0.20	c_{209}	0.20
c_{27}	0.00	c_{64}	0.00	c_{101}	0.21	c_{136}	0.02	c_{174}	0.50	c_{210}	0.025
c_{28}	0.57	c_{65}	0.15	c_{102}	0.20	c_{137}	0.00	c_{175}	0.85	c_{211}	0.20
c_{29}	0.36	c_{66}	0.85	c_{103}	0.70	c_{138}	0.47	c_{176}	0.50	c_{212}	0.40
c_{31}	0.05	c_{67}	0.75	c_{104}	0.85	c_{139}	0.40	c_{177}	0.20	c_{213}	0.75
c_{32}	0.02	c_{68}	1.25	c_{105}	0.065	c_{140}	0.11	c_{178}	0.60	c_{214}	0.015
c_{34}	0.53	c_{69}	0.90	c_{106}	0.70	c_{144}	0.57	c_{179}	0.00	c_{215}	0.90
c_{35}	0.39	c_{70}	0.30	c_{107}	0.08	c_{145}	0.36	c_{180}	0.85	c_{216}	0.50
c_{36}	0.00	c_{71}	0.95	c_{108}	0.35	c_{146}	0.07	c_{181}	0.90	c_{217}	0.55
c_{37}	0.04	c_{72}	0.75	c_{109}	0.04	c_{147}	0.00	c_{182}	0.65	c_{218}	0.20
c_{38}	0.03	c_{73}	0.50	c_{110}	0.10	c_{148}	0.01	c_{183}	0.50	c_{219}	0.25

c_{220}	0.10	c_{237}	0.60	c_{254}	0.90	c_{273}	0.01	c_{291}	0.40	c_{308}	0.40
c_{221}	0.04	c_{238}	0.60	c_{255}	0.70	c_{274}	0.36	c_{292}	0.75	c_{309}	1.00
c_{222}	0.85	c_{239}	0.50	c_{256}	0.50	c_{275}	0.23	c_{293}	0.20	c_{310}	−0.50
c_{223}	0.70	c_{240}	0.20	c_{257}	0.30	c_{276}	0.39	c_{294}	0.65	c_{311}	0.10
c_{224}	1.35	c_{241}	0.75	c_{259}	0.90	c_{277}	0.00	c_{295}	0.20	c_{312}	0.85
c_{225}	0.20	c_{242}	0.75	c_{260}	0.50	c_{278}	0.01	c_{296}	0.40	c_{313}	0.85
c_{226}	0.50	c_{243}	0.50	c_{261}	1.50	c_{279}	0.01	c_{297}	0.80	c_{314}	0.60
c_{227}	0.03	c_{244}	0.50	c_{262}	0.50	c_{280}	0.24	c_{298}	0.70	c_{315}	0.70
c_{228}	0.60	c_{245}	0.01	c_{263}	0.00	c_{281}	0.35	c_{299}	1.20	c_{316}	0.08
c_{229}	0.15	c_{246}	0.50	c_{264}	0.00	c_{282}	0.39	c_{300}	0.70	c_{317}	0.10
c_{230}	0.50	c_{247}	0.75	c_{265}	0.00	c_{283}	0.85	c_{301}	0.70	c_{318}	0.00
c_{231}	0.70	c_{248}	0.75	c_{266}	0.00	c_{285}	0.00	c_{302}	1.00	c_{319}	0.90
c_{232}	0.75	c_{249}	0.50	c_{267}	0.01	c_{286}	0.55	c_{303}	0.75	c_{320}	0.20
c_{233}	0.50	c_{250}	0.70	c_{268}	0.13	c_{287}	0.17	c_{304}	0.70		
c_{234}	0.85	c_{251}	0.15	c_{269}	0.47	c_{288}	0.03	c_{305}	0.26		
c_{235}	0.75	c_{252}	0.50	c_{270}	0.39	c_{289}	0.12	c_{306}	0.30		
c_{236}	0.03	c_{253}	0.80	c_{272}	0.01	c_{290}	0.07	c_{307}	0.70		

APPENDIX E: MODEL SHOCKS GLOSSARY

EZ Real Interest Rate Trend Shock	$\varepsilon^{\bar{r}^{ez}}$
EZ Real Interest Rate Gap Shock	$\varepsilon^{\hat{r}^{ez}}$
EZ Demand Shock	$\varepsilon^{\hat{y}^{ez}}$
EZ Inflation Shock	$\varepsilon^{\pi^{ez}}$
RER Trend Depreciation (USD/EUR)	$\varepsilon^{\Delta\bar{z}^{ez}}$
Shock to Cross Real Exchange Rate Gap	$\varepsilon^{\hat{z}^{ez}}$
US Real Interest Rate Trend Shock	$\varepsilon^{\bar{r}^{us}}$
US Real Interest Rate Gap Shock	$\varepsilon^{\hat{r}^{us}}$
US Demand Shock	$\varepsilon^{\hat{y}^{us}}$
US Inflation Shock	$\varepsilon^{\pi^{us}}$
Real Oil Price Gap Shock	$\varepsilon^{\widehat{rp}^{oil}}$
Growth of Real Oil Price Trend Shock	$\varepsilon^{\Delta\overline{rp}^{oil}}$
Real Gold Price Gap Shock	$\varepsilon^{\widehat{rp}^{gold}}$
Growth of Real Gold Price Trend Shock	$\varepsilon^{\Delta\overline{rp}^{gold}}$
Demand Shock — Shock to Output Gap	$\varepsilon^{\hat{y}^{ru}}$
Spread of Credit Interest Rate Shock	$\varepsilon^{\widehat{sp}}$
Shock to Real GDP Trend Growth	$\varepsilon^{\Delta\bar{y}^{ru}}$
Nominal Wage Growth Shock	$\varepsilon^{\Delta w^{ru}}$
Real Wage Trend Growth Shock	$\varepsilon^{\Delta\overline{wr}^{ru}}$
CPI Inflation Shock	$\varepsilon^{\pi,ru}$
Transitory UIP Shock	$\varepsilon^{s^{RUB/USD}}$
Premium Shock	$\varepsilon^{prem,ru}$
Monetary Policy Shock	$\varepsilon^{i,ru}$
Inflation Target Shock	$\varepsilon^{\pi^{tar,ru}}$
Real Exchange Rate Trend Shock	$\varepsilon^{\Delta\bar{z}^{ru}}$
Trend of the Government Deficit to GDP Shock	$\varepsilon^{\overline{def2gdp}^{ru}}$
Target of the Government Deficit to GDP Shock	$\varepsilon^{def2gdp^{tar,ru}}$
Deficit of the Government as a Share to GDP Shock	$\varepsilon^{def2gdp^{ru}}$
Demand Shock — Shock to Output Gap, %	$\varepsilon^{\hat{y}^{am}}$
Real Remittances Growth Shock	$\varepsilon^{\Delta\overline{qrem}^{USD,am}}$
Real Remittances Growth Shock	$\varepsilon^{\widehat{qrem}^{USD,am}}$
Shock to Real GDP Trend Growth, %	$\varepsilon^{\Delta\bar{y}^{am}}$

Nominal Wage Growth Shock	$\varepsilon^{\Delta w^{am}}$
Real Wage Trend Growth Shock	$\varepsilon^{\Delta \overline{wr}^{am}}$
CPI Inflation Shock, %	$\varepsilon^{\pi, am}$
Transitory UIP Shock, %	$\varepsilon^{s^{AMD/USD}}$
Premium Shock, %	$\varepsilon^{prem, am}$
Monetary Policy Shock, %	$\varepsilon^{i, am}$
Inflation Target Shock, %	$\varepsilon^{\pi^{tar, am}}$
Real Exchange Rate Trend Shock, %	$\varepsilon^{\Delta \bar{z}^{am}}$
Trend of the Government Deficit to GDP Shock	$\varepsilon^{\overline{def2gdp}^{am}}$
Target of the Government Deficit to GDP Shock	$\varepsilon^{def2gdp^{tar, am}}$
Deficit of the Government as a Share to GDP Shock	$\varepsilon^{def2gdp^{am}}$
Exchange Rate Shock for Tuning	$\widehat{\varepsilon}^{s^{AMD/USD}}$
Demand Shock — Shock to Output Gap	$\varepsilon^{\hat{y}^{by}}$
Shock to Real GDP Trend Growth, %	$\varepsilon^{\Delta \bar{y}^{by}}$
Shock to GDP deflator	$\varepsilon^{\Delta py^{by}}$
Wedge Between Deflator and Headline Inflation Shock	$\varepsilon^{\Delta py,^{by}}$
Shock to Nominal Wage Growth	$\varepsilon^{\Delta w^{by}}$
Shock to Real Wage Trend Growth	$\varepsilon^{\Delta \overline{wr}^{by}}$
Interest Rate Spread Shock	$\varepsilon^{\widehat{sp}^{by}}$
CPI Inflation Shock, %	$\varepsilon^{\pi, by}$
Transitory UIP Shock, %	$\varepsilon^{s^{BYR/USD}}$
Premium Shock, %	$\varepsilon^{prem, by}$
Monetary Policy Shock, %	$\varepsilon^{i, by}$
Inflation Target Shock, %	$\varepsilon^{\pi^{tar, by}}$
Real Exchange Rate Trend Shock, %	$\varepsilon^{\Delta \bar{z}^{by}}$
Trend of the Government Deficit to GDP Shock	$\varepsilon^{\overline{def2gdp}^{by}}$
Target of the Government Deficit to GDP Shock	$\varepsilon^{def2gdp^{tar, by}}$
Deficit of the Government as a Share to GDP Shock	$\varepsilon^{def2gdp^{by}}$
Demand Shock — Shock to Output Gap, %	$\varepsilon^{\hat{y}^{kg}}$
Real Remittances Growth Shock	$\varepsilon^{\Delta \overline{qrem}^{USD, kg}}$
Real Remittances Gap Shock	$\varepsilon^{\widehat{\overline{qrem}}^{USD, kg}}$
Shock to Real GDP Trend Growth, %	$\varepsilon^{\Delta \bar{y}^{kg}}$
Shock of Temporary GDP Supply Shock	$\omega^{\Delta \bar{y}^{kg}}$
Temporary GDP Supply Shock	$\varepsilon^{\omega^{\Delta \bar{y}^{kg}}}$
Nominal Wage Growth Shock	$\varepsilon^{\Delta w^{kg}}$

Real Wage Trend Growth Shock	$\varepsilon^{\Delta\overline{wr}^{kg}}$
CPI Inflation Shock, %	$\varepsilon^{\pi,kg}$
Transitory UIP Shock, %	$\varepsilon^{s^{KGS/USD}}$
Premium Shock, %	$\varepsilon^{prem,kg}$
Monetary Policy Shock, %	$\varepsilon^{i,kg}$
Inflation Target Shock, %	$\varepsilon^{\pi^{tar,kg}}$
Real Exchange Rate Trend Shock, %	$\varepsilon^{\Delta\bar{z}^{kg}}$
Trend of the Government Deficit to GDP Shock	$\varepsilon^{\overline{def2gdp}^{kg}}$
Target of the Government Deficit to GDP Shock	$\varepsilon^{def2gdp^{tar,kg}}$
Deficit of the Government as a Share to GDP Shock	$\varepsilon^{def2gdp^{tar,kg}}$
Demand Shock — Shock to Output Gap, %	$\varepsilon^{\hat{y}^{kz}}$
Shock to Real GDP Trend Growth, %	$\varepsilon^{\Delta\bar{y}^{kz}}$
Nominal Wage Growth Shock	$\varepsilon^{\Delta w^{kz}}$
Real Wage Trend Growth Shock	$\varepsilon^{\Delta\overline{wr}^{kz}}$
CPI Inflation Shock, %	$\varepsilon^{\pi,kz}$
Transitory UIP Shock, %	$\varepsilon^{s^{KZT/USD}}$
Premium Shock, %	$\varepsilon^{prem,kz}$
Inflation Target Shock, %	$\varepsilon^{\pi^{tar,kz}}$
Monetary Policy Shock, %	$\varepsilon^{i,kz}$
Real Exchange Rate Trend Shock, %	$\varepsilon^{\Delta\bar{z}^{kz}}$
Trend of the Government Deficit to GDP Shock	$\varepsilon^{\overline{def2gdp}^{kz}}$
Target of the Government Deficit to GDP Shock	$\varepsilon^{def2gdp^{tar,kz}}$
Deficit of the Government as a Share to GDP Shock	$\varepsilon^{def2gdp^{kz}}$

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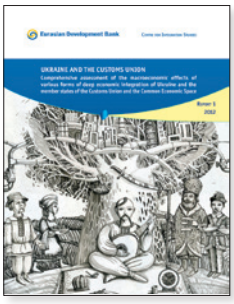
2012



Report 1

Comprehensive assessment of the macroeconomic effect of different forms of intensive economic cooperation by Ukraine with the member states of the Customs Union and the Single Economic Space within the framework of the Eurasian Economic Community (EEC)

The main goal of the project is to assess a macroeconomic effect of the creation of the Customs Union and Single Economic Space of Russia, Belarus and Kazakhstan, and to determine prospects of the development of integration links between Ukraine and the CU. The project was conducted by the team of five research institutions. The results presented in the Report have been widely recognized and become standard.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/ukraine/

Report 2

Studies of Regional Integration in the CIS and in Central Asia: A Literature Survey

This report, published under auspices of the EDB Centre for Integration Studies, summarizes both international studies in the area of regional integration within the former Soviet Union and Russian language materials on this issue, reviewing the research papers and publications in the area of economics, political studies, international relations and international political economy, law and area studies.

Available in Russian and English.

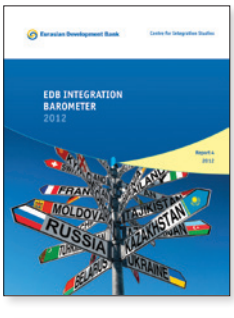
http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/CIS_CentralAsia/

Report 3

Assessment of the economic, institutional and legal impact of labour migration agreements within the framework of the Single Economic Space

The project included analysis of two labour agreements that came into force on January 1, 2012 within the SES of Russia, Belarus and Kazakhstan. It analyzes their economic and social inpact on labour migration processes, labour market and productivity, strengthening of the regional economic relations.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/labour_migration/



Report 4

EDB integration barometer 2012

The EDB Centre for Integration Studies in cooperation with the Eurasian Monitor International Research Agency examined the approaches of population to regional integration.

Available in Russian and English.

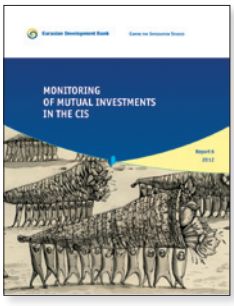
http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/integration_barometer/

Report 5

Threats to public finances of the CIS in the light of the current global instability

The Report deals with the assessment of the risks for the government finances of the CIS countries in the light of current world instability. The report was conducted at the request of the Finance Ministry of the Republic of Kazakhstan, and presented at the permanent council of the CIS Finance Ministers.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/risks/



Report 6

Monitoring of Mutual Investments in the Member States of the CIS

The monitoring of mutual CIS investments provides analytical support for work conducted by state and supranational agencies on developing a suitable strategy for deepening integration processes throughout the post-Soviet space. The Centre in partnership with IMEMO (RAS) has created and is regularly updating the most comprehensive database up to date.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/invest_monitoring/

Report 7

Customs Union and cross-border cooperation between Kazakhstan and Russia

Research on the economic effects of the development of industrial relations under the influence of the Customs Union in the border regions of Russia and Kazakhstan.

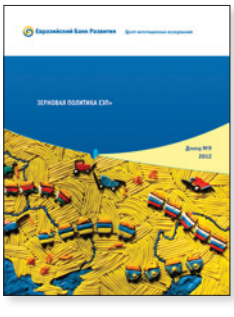
http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/kaz_rus_e/

Report 8

Unified trade policy and addressing the modernization challenges of the SES

The Report presents an analysis of the key economic risks arising under the agreement by SES participants of a foreign trade policy, formulates proposals on the main thrusts of SES Common Trade Policy, and names measures for its reconciled implementation.

http://eabr.org/e/research/centreCIS/projectsandreportsCIS/trade_policy/



Report 9

SES+ Grain policy

Growth in grain production is propelling Kazakhstan, Ukraine and Russia to the leadership ranks of the global grain market. The Report systematically analyzes trends in development of the grain sector and actual policies and regulations in SES countries, Ukraine and other participants of the regional grain market.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/grain_policy/

2013

Report 10

Technological Coordination and Improving Competitiveness within the SES

The report presents a number of proposals aimed at improving SES competitiveness within the international division of labour.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/technological_coordination/

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Report 11

The Customs Union and Neighbouring Countries: Models and Instruments for Mutually Beneficial Partnership

The report proposes a broad spectrum of approaches to the fostering of deep and pragmatic integrational interaction between the CU/SES and countries throughout the Eurasian continent.

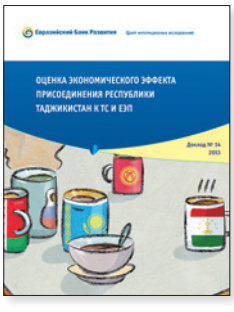
http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/cu_and_neighbors/

Report 13

Labour Migration and Human Capital of Kyrgyzstan: Impact of the Customs Union

The report focuses on the effects of Kyrgyzstan's possible accession to the Customs Union (CU) and Single Economic Space (SES) on the flows of labour resources, the volume of cash remittances, labour market conditions and professional education and training in this country.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/labor_migration_kyrgyzstan_cu/

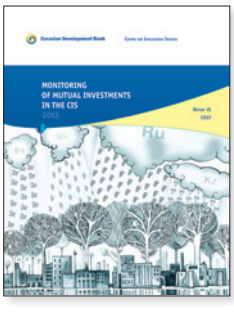


Report 14

Tajikistan's Accession to the Customs Union and Single Economic Space

Tajikistan's accession to the CU and the SES will have a positive economic impact on the country's economy. The Report includes a detailed economic analysis of the issue using various economic models and research methods.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/Tajikistan_CU_SES/



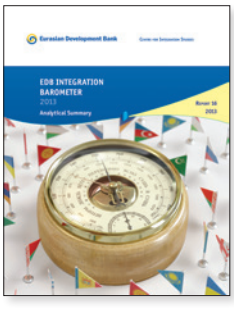
Report 15

Monitoring of Mutual Investments in the CIS

The report contains new results of the joint research project of the Centre for Integration Studies of EDB and the Institute of World Economy and International Relations of the Russian Academy of Sciences. It is aimed at the maintenance and development of the monitoring database of mutual direct investment in the CIS countries and Georgia. A general characteristic of mutual investments in the CIS at the end of 2012 is provided.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/



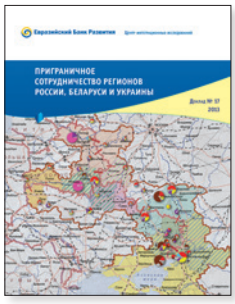
Report 16

EDB Integration Barometer — 2013

The EDB Centre for Integration Studies in cooperation with the Eurasian Monitor International Research Agency examined the approaches of population to regional integration.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/integration_barometer/



Report 17

Cross-Border Cooperation between Russia, Belarus and Ukraine

Cooperation between 27 cross-border regions of Belarus, Russia and Ukraine has significant potential; however the existing frontiers and barriers are a significant factor that fragments the region's economic space.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/project16/

Report 18

Customs Union and Ukraine: Economic and technological cooperation in sectors and industries

The authors of the report study the issue of industrial and inter-industry links between the SES economies and Ukraine and come to a conclusion that cooperation between enterprises has been maintained in practically all segments of the processing industries, while in certain sectors of mechanical engineering this cooperation has no alternatives.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/project18/

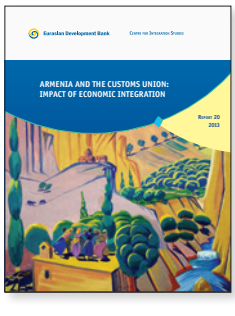
Report 19

Monitoring of direct investments of Belarus, Kazakhstan, Russia, and Ukraine in Eurasia

The Eurasia FDI Monitoring project supplements another research by the EDB Centre for Integration Studies — Monitoring of Mutual Foreign Investment in the CIS Countries (CIS Mutual Investment Monitoring).

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/project19/



Report 20

Armenia and the Customs Union: Impact of Accession

This report provides the assessment of the macroeconomic impact of Armenia joining the Customs Union.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/project20/

2014

System of Indicators of Eurasian Integration

The System of Indicators of Eurasian Integration (SIEI) is designed to become the monitoring and assessment tool for integration processes within the post-Soviet territory.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/siei/index.php?id_16=37610

Report 23

Quantifying Economic Integration: of the European Union and the Eurasian Economic Union: Methodological Approaches

The objective of the project is to discuss and analyse economic integration in Eurasia, both on the continental scale "from Lisbon to Shanghai," and in the EU-EEU dimension "from Lisbon to Vladivostok."

Available in Russian and English.

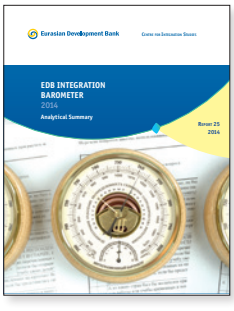
http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/project21/

Report 24

Pension Mobility within the Eurasian Economic Union and the CIS

In the report the experts evaluate the prospects of implementing effective mechanisms in the region to tackle pension problems of migrant workers.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/project24/



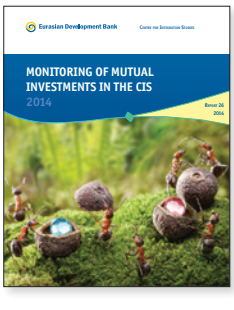
Report 25

EDB Integration Barometer — 2014

The results of the third research into preferences of the CIS region population with respect to various aspects of Eurasian integration suggest that the "integration core" of the Eurasian Economic Union (EEU) continues to form and crystallise.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/integration_barometer/index.php?id_16=42460



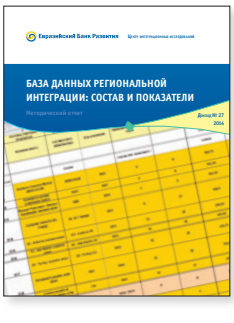
Report 26

Monitoring of mutual CIS investments 2014

This is the fifth report on the results of the long-term research project devoted to monitoring of mutual direct investments in the CIS countries and Georgia. The current report provides detailed information on the scope and structure of mutual investments of CIS countries up to the end of 2013. The report provides information on the most important trends in the first half of 2014, including the situation in Ukraine and its impact on the Russian direct investments in the country. It also presents an analysis of the prospects for mutual direct investments of the Eurasian Economic Union countries.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/invest_monitoring/index.php?id_16=42737



Report 27

EDB Regional Integration Database

This is an applied research project, which represents the creation of a specialized regularly updated database of the most significant regional integration organisations (RIOs) and economic/trade agreements of the world.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/project26/

Report 28

Monitoring of direct investments of Russia, Belarus, Kazakhstan and Ukraine in Eurasia — 2014

The second report presents new results of the permanent annual project dedicated to monitoring of direct investments of Belarus, Kazakhstan, Russia and Ukraine in Eurasia. On the basis of the statistics collected during monitoring, detailed information is provided on the dynamics, actual geographical location and sectoral structure of the investments.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/project24/

2015

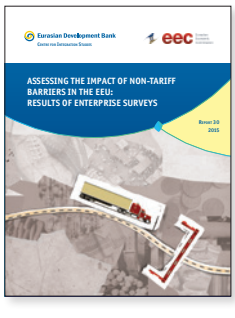
Report 29

An Assessment of the Economic Effects of Lifting Non-Tariff Barriers in the EEU

The EDB Centre for Integration Studies publishes the first comprehensive assessment of the effects of non-tariff barriers on mutual trade in the EEU and provides recommendations as to how to remove them. The report has been prepared by the Centre for Integration Studies based on a poll of 530 Russian, Kazakh and Belarusian exporters.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/index.php?id_4=47863&linked_block_id=0



Report 30

An Assessment of the Impact of Non-Tariff Barriers in the EEU: the Results of the Survey of Exporters

A large-scale poll of 530 enterprises in Belarus, Kazakhstan and Russia suggests that non-tariff barriers account 15% to 30% of the value of exports. Belarusian exporters estimate non-tariff barriers in their trade with Russia and Kazakhstan at 15% of the value of their exports, Kazakh exporters at 16% for exports to Russia and 29% for exports to Belarus, and Russian exporters at about 25% for exports to each of the two other countries.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/index.php?id_4=47864&linked_block_id=0

Report 31

Labour Migration and Labour-Intensive Industries in Kyrgyzstan and Tajikistan: Possibilities for Human Development in Central Asia

Current research deals with the analysis of migration flow, labour potential in Central Asia (the examples of Kyrgyzstan and Tajikistan are taken). The focus is made on the possibilities of both countries to reorient their economies from export of labour to export of labour-intensive goods and services.

http://www.eabr.org/r/research/centre/projectsCII/projects_cii/index.php?id_4=48785&linked_block_id=0

EDB CENTRE FOR INTEGRATION STUDIES PUBLICATIONS

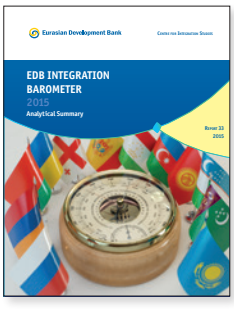
Report 32

Monitoring of Mutual Investments in CIS Countries 2015

According to the sixth report of a years-long research project in 2014 the fall in mutual foreign direct investments (FDI) between the CIS countries was $6.3 billion, or 12% year-on-year. One of the main causes for this drastic decline in all mutual FDI in the CIS was the destabilised economic and political situation in Ukraine. At the same time, while overall investment activity in the CIS has shrunk, the young integration organization – the Eurasian Economic Union (EAEU) – demonstrates stability. Even despite the devaluation of national currencies, mutual FDI in the EAEU region in 2014 grew from $24.8 billion to $25.1 billion. The positive dynamics in investment flows in the EAEU was largely due to the advancement and strengthening of regional economic integration.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/index.php?id_4=48979&linked_block_id=0



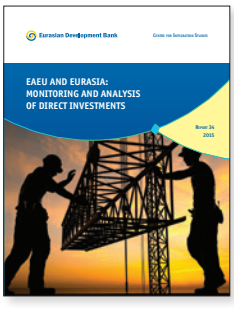
Report 33

EDB Integration Barometer — 2015

The fourth wave of public opinion surveys on integration preferences in the CIS countries suggests that the "integration core" of the Eurasian Economic Union (EAEU) continues to consolidate. In Kazakhstan, Russia and the Kyrgyz Republic 78-86% of the population support the Eurasian integration. At the same time, in Belarus and Armenia the rate of approval of Eurasian integration reduced in the recent year. These are the findings of The EDB Integration Barometer, a yearly research conducted by Eurasian Development Bank's (EDB) Centre for Integration Studies. In 2015, over 11,000 people from nine CIS region countries - Armenia, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic, Moldova, Russia, Tajikistan, and Ukraine - took part in the poll. The research has been conducted by the EDB Centre for Integration Studies since 2012 annually in partnership with "Eurasian Monitor", an international research agency.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/index.php?id_4=48997&linked_block_id=0



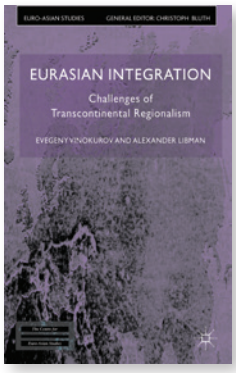
Report 34

EAEU and Eurasia: Monitoring and Analysis of Direct Investments

The report presents new results of the permanent annual project dedicated to monitoring of direct investments in Eurasia. This report focuses on direct investments of Russia, Belarus, Kazakhstan, Armenia, Kyrgyzstan, Tajikistan, and Ukraine in all countries of Eurasia outside the CIS and Georgia as well as reciprocal direct investments of Austria, Netherlands, Turkey, Iran, India, Vietnam, China, the Republic of Korea, and Japan in the seven CIS countries mentioned above.

Available in Russian and English.

http://www.eabr.org/e/research/centreCIS/projectsandreportsCIS/index.php?id_4=49144&linked_block_id=0



Eurasian Integration: Challenges of Transcontinental Regionalism

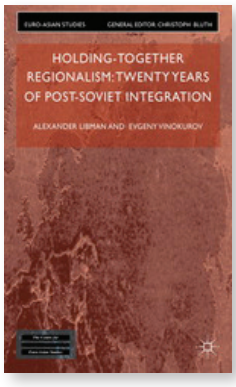
Evgeny Vinokurov, Alexander Libman

Basingtoke: Palgrave Macmillan

"Vinokurov and Libman have pulled together a tremendous range of information and insight about Eurasian economic integration. Their eminently readable book tackles an important and timely topic, which lies at the heart of global economic and political transformation in the 21st century."

Johannes Linn, Brookings Institute

http://eabr.org/e/research/centreCIS/monographsCIS/



Holding-Together Regionalism: Twenty Years of Post-Soviet Integration

Alexander Libman, Evgeny Vinokurov

Basingtoke: Palgrave Macmillan

An in-depth analysis of one of the most important and complex issues of the post-Soviet era, namely the (re-) integration of this highly interconnected region. The book considers the evolution of "holding-together" groups since the collapse of the Soviet Union in 1991, looking at intergovernmental interaction and informal economic and social ties.

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