

A multicountry macroeconometric model for the Eurasian Economic Union

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Abstract

This paper introduces a multicountry macroeconometric model for the Eurasian Economic Union (EAEU). The model consists of five single-country models of the union member states: Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia. The purpose of the research is to explain the structural relationship between the economies, evaluate the impact of internal and external shocks, and analyze the transmission mechanism of shocks across countries. The single-country models are linked to each other by the equations of bilateral trade and bilateral exchange rate. We find that the model fits actual data on main macroeconomic indicators of the countries in a dynamic ex-post simulation over 2004–2018. We also evaluate the effect of world trade and monetary policy shocks on the economies of the EAEU member states.

Keywords: Eurasian Economic Union, EAEU, structural macroeconomic model.

JEL classification: B22, E17, E27.

1. Introduction

The role of regional economic integration strengthens due to the opportunities created from the establishment of common markets and the removal of trade barriers. As a result, it is important to analyze the depth of the economic interrelationship between member states of an economic union. Macroeconomic modeling of economic integration turns out to be one of the most useful tools for this purpose as it allows one to examine the structure of interrelated economies and the effects of internal and external shocks on policy decisions of all member states. The present paper builds a multicountry macroeconometric model for the Eurasian Economic Union (EAEU) which consists of the following member states: Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia. The EAEU aims to ensure the freedom of movement of goods, services, capital and labor, as

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well as implement a joint policy for various sectors of the economy.¹ The main purpose of the model we build for the union is to bring in greater clarity about the structural interrelationship among the EAEU members.

There has been an increasing interest in the literature on the properties of multicountry macroeconometric models due to the rising number of regional economic unions. One of the vital contributions in this field was made by Edison et al. (1987) for the Federal Reserve Board. They built a multicountry model (MCM) as a system of macroeconometric models of the USA, FR Germany, Canada, Japan and the UK. Another multicountry macroeconometric model named MEMMOD was introduced in the research work by Deutsche Bundesbank (2000). MEMMOD connects nine country-specific models and three regions for fiscal and monetary policy analysis. In terms of model complexity and specification, the present work mostly relies on Weyerstrass (2015), who builds a multicountry model for the former Yugoslavia countries. The paper compares the forecasting ability of the structural model with the performance of time-series models such as ARMA and VAR models. Canova and Ciccarelli (2009) present a multicountry Bayesian VAR model to generate conditional forecasts and analyze impulse responses of endogenous variables to various shocks. Demidenko et al. (2016) construct a macroeconomic model-based system to study economic relationships between the member states of the EAEU, evaluate policy responses to different shocks, and generate forecasts for macroeconomic indicators. Carabenciov et al. (2008) discuss a small quarterly multicountry projection model for the economies of the USA, the Euro area and Japan. The authors apply Bayesian method to estimate parameters of the model. There is also research with more microfounded DSGE models developed for the Euro area by Albonico et al. (2019), Dieppe et al. (2018) and Razandrabe (2016).

The multicountry models are widely used at central banks and research organizations. The Federal Reserve Board developed a MCM in the late 1970s as a system of macroeconometric models of the USA, FR Germany, Canada, Japan and the UK (Edison et al., 1987). Later, it has been restructured and re-estimated resulting in a large-scale multicountry macroeconomic model FRB/Global (Levin et al., 1997). The Federal Reserve Board also builds a multicountry open economy SDGE model SIGMA for policy analysis (Erceg et al., 2005). The model embodies a more theoretical framework including rational expectations with learning and non-Ricardian households. The Bank of England constructs a multicountry model of equity market volatility and the business cycle using a common factor approach (Censa-Bianchi et al., 2018). The European Commission develops a multi-region macroeconomic model QUEST which contains tradable goods, non-tradable goods and housing sectors (Burgert et al., 2020). There is also a global multicountry DSGE model developed by Albonico et al. (2019) for three regions: the four largest Euro area countries, other Euro area countries and the rest of the world.

In this paper, we build a multicountry macroeconometric model based on the framework of five structural single-country macroeconometric models of Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia. Each single-country model consists of the following blocks: aggregate supply, goods market, labor

¹ Treaty on the Eurasian Economic Union. https://docs.eaeunion.org/docs/en-us/0027353/itia_05062014_doc.pdf

market, prices, financial markets, and the government sector. We use quarterly data starting from 2001 to 2018. In total, the multicountry model includes 357 equations and identities. The equations are estimated in the form of error correction model, ARIMA model and Tobit regression. The countries are linked through bilateral trade and bilateral exchange rate. The properties of the multicountry model are examined by conducting an ex-post simulation for the period from 2004 to 2018. The results indicate good performance of the model in fitting actual data on the main macroeconomic indicators of Kazakhstan and Russia. However, the simulation results are less accurate for the rest of the countries in the model. In addition, we use the model to evaluate the effect of various shocks on important macroeconomic variables across the member states of the union. The model provides us with a clearer picture on the propagation mechanisms of various shocks across the EAEU countries. We conduct two scenario analyses with world trade and monetary policy shocks. In the first scenario, we assume a 10% contraction in world trade and produce a dynamic simulation of the model. In the second scenario, we evaluate 2 percentage points cut of the key rate by the Central Bank of Russia. An analysis of the influence of the latter shock is important as Russia has the largest economy among the EAEU member states.

We find that macroeconomic indicators of the EAEU countries respond to the world trade shock in different ways, both in terms of magnitude and timing. We find that real GDP in Armenia falls below the baseline more significantly than in other countries, while the Russian economy is less affected by the shock. In the case of an expansionary monetary policy shock in Russia we find that it causes domestic output and inflation rate to temporarily increase. Nevertheless, the ruble's appreciation and strong aggregate demand raise total imports resulting in lower real GDP growth. The monetary policy shock in Russia exhibits the largest effect on Belarus among all other countries which partially reflects a very high share of the Russian economy in the exports and imports of Belarus. Most macroeconomic indicators in Belarus experience a more prolonged return to the baseline level than the same indicators for other countries. At the same time, the results reveal a negligible effect of the shock on the economy of Kyrgyzstan.

The paper is organized as follows. The following section presents the data description and discusses adjustments that have been applied to the data. Section 3 outlines the structure of single-country models and discusses channels that link the economies of the member states. Section 4 examines the ability of the multicountry model to fit actual dynamics of the main macroeconomic indicators. Section 5 provides scenario analyses with world trade and monetary policy shocks. Section 6 makes concluding remarks.

2. Data description

The multicountry model is based on quarterly data from 2001 to 2018. In total, the data contains 405 variables for the five countries which include both country-specific and foreign variables. The data for the EAEU members are collected from national statistics agencies, central banks and finance ministries of the member countries. All other variables are retrieved from the IMF and Bloomberg databases. There is only annual data available for some variables which we convert to quarterly frequency via extrapolation. Quarterly data on

capital stock is not available for all countries during the sample. Therefore, we apply the Perpetual Inventory Method (PIM) to calculate suitable capital stock series. We have chosen the first quarter of 2010 as the base year for national income account variables in our data set. That is, the data on GDP and its expenditure components have been adjusted for each country to calculate them in 2010 prices. The approach used to adjust the data for Kazakhstan is presented in detail in Abilov et al. (2019) whereas a similar approach applied for the data on Russia is described in Bolatbayeva et al. (2020). For Armenia and Kyrgyzstan, we adopt the same approach as for Kazakhstan, while we adjust Belarus data using the same methodology used for Russia.

As in the two-country model by Bolatbayeva (2020), data on bilateral trade for each country have been collected in U.S. dollars. There is a statistical discrepancy between the data on exports of a shipping country and the data on imports of a recipient country, even though these quantities must be equivalent by definition. In order to model bilateral trade flows between the economies, one can use the data either on exports or imports. The present model uses the data on exports of shipping countries as a measure of bilateral trade flows between the countries. Due to the equivalence of exports of a shipping country and imports of a recipient country, we calculate the imports of the recipient country by multiplying the exports of the shipping country by the bilateral exchange rate.

3. The model

This section briefly describes the structure of a macroeconometric model for the EAEU. Single-country models are constructed with the same underlying principles. Each model is divided into six blocks: supply side, goods market, labor market, prices, financial market, and government sector (Table 1). As in Abilov et al. (2019) and Bolatbayeva et al. (2020), multiple tests have been conducted to test for the presence of unit root in each time series in the data set.² Test results show that the majority of the series are non-stationary in levels. Therefore, we take a year-over-year (YoY) difference of logarithm of the series to make them stationary, which allows us to neglect seasonality present in the data.³ The test results are presented in Appendix S4, Supplementary material 1.

The multicountry model includes 357 equations and identities, which are presented in Appendix S2 and Appendix S3 (see Supplementary material 1). We specify most equations in an error correction form due to the cointegrating relations between dependent and independent variables in the model. We test for the presence of cointegrating relations using ADF, Phillips–Perron, and KPSS tests on the residuals of regressions in levels (Appendix S6, Supplementary material 1). The error correction specification captures both the neoclassical long-run relation and the short-run dynamics of the variables. Error correction terms are defined as deviations from the long-run equilibrium that is specified in the spirit of neoclassical models. The error correction specification also allows for deviations from the long run equilibrium, and these deviations are driven by short-run fluctuations

² We use the following tests for unit root: Augmented Dickey–Fuller (ADF), Phillips–Perron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS).

³ YoY measure is defined as $X_t - X_{t-4}$.

Table 1
The macroeconomic model for the EAEU countries.

Country <i>i</i>		Block		Country <i>j</i>	
Exogenous	Endogenous			Endogenous	Exogenous
Working age population Government consumption Oil price World trade	Potential output Labor force NAIRU TFP	Supply		Potential output Labor force NAIRU TFP	Working age population
	Private consumption Investment Export to other countries Export to country <i>j</i> Import from country <i>j</i> Import from other countries			Private consumption Investment Export to other countries Export to country <i>i</i> Import from country <i>i</i> Import from other countries	
	Nominal wages Employment	Labor market		Nominal wages Employment	Government consumption Oil price World trade
	CPI GDP deflator GDP expenditure components deflators			CPI GDP deflator GDP expenditure components deflators	
Foreign CPI		Prices			Foreign CPI
Nominal exchange rate with foreign currency	Real effective exchange rate UIP condition Nominal interest rate	Financial market		Real effective exchange rate Nominal interest rate	Nominal exchange rate with foreign currency
Income tax rate Corporate tax rate VAT rate	Central Bank policy rate Personal income taxes Corporate income taxes VAT revenues Excise taxes Other taxes	Government sector		Central Bank policy rate Personal income taxes Corporate income taxes VAT revenues Excise taxes Other taxes	Income tax rate Corporate tax rate VAT rate

Note: *i, j* = Armenia, Belarus, Kyrgyzstan, Kazakhstan and Russia; *i* ≠ *j*
Source: Author's compilation.

in the economy. As a result, apart from the long-run relationship in the error correction model we also add on the right-hand side of the regressions explanatory variables that are responsible for generating a wedge between the long-run and short-run equilibrium dynamics of the model. Other equations are estimated in the form of ARIMA and Tobit regression models. The results of the residual diagnostics for all equations are given in Appendix S5, Supplementary material 1.

We start building a multi-country model by modeling aggregate supply for each country. Potential output in each economy is estimated using the Cobb–Douglas production function with constant returns to scale:

$$Y_t = BA_t K_t^\alpha L_t^{1-\alpha}, \quad (1)$$

where A_t stands for total factor productivity (TFP) and B represents some normalizing constant. Capital and labor shares in Kazakhstan are fixed at 0.44 and 0.56 respectively whereas they are equal to 0.4 and 0.6 for Russia (see Abilov et al., 2019; Bolatbayeva et al., 2020). As for the rest of the countries, we estimate the coefficients of capital and labor shares via OLS regression. The estimated coefficients for capital and labor shares in Kyrgyzstan are 0.37 and 0.63 respectively. In Armenia, the capital share is 0.39 and the labor share is 0.61. The Belarusian economy is characterized by the lowest capital share with an estimated coefficient of 0.28 while the value of the labor share is equal to 0.72. The supply block also consists of equations for labor force, TFP and non-accelerating inflation rate of unemployment (NAIRU).

The goods market of single-country models consists of equations for private consumption, gross capital formation, imports and exports. Government consumption is treated as an exogenous variable in all single-country models. Equations for private consumption are built in the form of Keynesian consumption function in which it depends on current disposable income. We also resort to permanent income hypothesis in specifying the consumption equation where we use the interest rate as an explanatory variable on the right-hand side. However, the effect of the interest rate is significant only for Belarus, Kyrgyzstan, and Russia. Therefore, we drop the interest rate from the right-hand side of private consumption equation for the two remaining countries. In addition, we include lagged consumption on the right-hand side to capture the effect of habit persistence. We model investment as depending on real domestic demand and long-term real interest rate for Belarus, Kazakhstan, and Russia. At the same time, investment in Armenia and Kyrgyzstan is modeled according to the neoclassical theory of investment whereby the user cost of capital is included as an explanatory variable in the regression equation for investment.

Single-country models form the multicountry framework through the channels of bilateral trade and bilateral exchange rate. We construct four bilateral export equations for each single-country model to determine a country's exports to its trading partners within the EAEU. Bilateral export equations are estimated in an error correction form where exports depend on the lagged value of itself, foreign demand and the bilateral exchange rate. The world trade index is used as an explanatory variable in some equations for bilateral exports. The country's exports to the rest of the world are also modeled within the multicountry framework. The lagged dependent variable, the real effective exchange rate (REER) of

a shipping country and the world trade index are used as explanatory variables in the equations for exports to the rest of the world. We also use the oil price as an independent variable on the right-hand side of regression equations for the exports of Kazakhstan and Russia to the rest of the world. The total exports of each country are determined by summing the bilateral exports and exports to the rest of the world. The modeling approach of imports is simple as we define bilateral imports with respect to bilateral exports using the following identity:

$$M_{ij} = X_{ji} E_{ij}, \quad (2)$$

where M_{ij} represents bilateral imports of a receiving country, X_{ji} stands for bilateral exports of a shipping country and E_{ij} is the exchange rate of a receiving country's currency in terms of the currency of a shipping country. At the same time, an equation for imports from the rest of the world is estimated in an error correction form in each single-country model. The variable is mainly determined by the lagged dependent variable, domestic demand and REER.

The bilateral exchange rates are key elements of the financial markets in this model. Together with the trade equations, it forms the main channel through which the single-country models affect each other. We estimate 10 bilateral exchange rate equations and define 10 corresponding bilateral exchange rate identities in the multicountry model. As in Bolatbayeva (2020), we assume that the Uncovered Interest Parity (UIP) condition holds for bilateral exchange rates:

$$E_t \left(\frac{S_{t+k}}{S_t} \right) = i_t - i_t^* + \epsilon_t, \quad (3)$$

where S_t stands for the bilateral exchange rate in terms of domestic currency, i_t refers to the domestic interest rate and i_t^* is the foreign interest rate and ϵ_t is the risk premium. We also specify a regression equation for REER where it depends on bilateral nominal exchange rates. REER in Russia is also determined by real GDP, while REER in Belarus and Kyrgyzstan is significantly affected by the domestic price levels. We also build equations for medium term government bond rates in Armenia, Belarus, Kazakhstan, and Russia, whereas for Kyrgyzstan we model the household saving rate.

The labor market in each single-country model is characterized by the equations of nominal wages and labor demand. Nominal wages are primarily determined by the lagged value of itself and unemployment rate. A negative sign of the coefficient of unemployment rate in the nominal wage equations is in line with the bargaining model. Domestic inflation is also used as an explanatory variable in the nominal wage equation in all single-country models except for Armenia. Nominal wages in Armenia, Kyrgyzstan, and Russia are also determined by labor productivity. All nominal wage equations are specified in an error correction form. At the same time, the employment equation in each single-country model is estimated via Tobit regression. Labor demand in Armenia, Kazakhstan, and Russia is explained by the lagged dependent variable, domestic output and real wages. Employment in Kyrgyzstan depends on unit labor costs, while employment in Belarus is determined by the lagged dependent variable and GDP.

The model consists of the following price variables: CPI, GDP deflator, consumption deflator, investment deflator, government consumption deflator, export

and import deflators. The dependent variable in the equation for CPI is measured as annual CPI inflation. An inflation persistence parameter in the estimated CPI equations has a wide range as it varies from 0.45 in Armenia to 0.87 in Kazakhstan. CPI inflation in Kazakhstan is largely determined by domestic output and US inflation. Inflation rates in Belarus and Russia depend on real GDP and the exchange rate of a domestic currency vis-a-vis the US dollar. Consumption deflator and real GDP are used as explanatory variables in modeling CPI inflation in Armenia. At the same time, CPI inflation in Kyrgyzstan depends on domestic output and CPI inflation in Russia and China. On the other hand, the GDP deflator is determined by the domestic and foreign CPI inflation for all five countries. Other deflators are modeled in a similar fashion.

Equations for revenue components of the government sector are also estimated for each single-country model. We specify the equations in an error correction form for personal income taxes, corporate income taxes, VAT revenues, excise taxes and other taxes. The government sector includes an equation for a central bank's policy rate. A policy interest rate in each country is explained by the lagged dependent variable and the inflation rate. The key rate in Russia also depends on the output gap and REER. The interest rate in Belarus mainly depends on the output gap, while the base rate in Kazakhstan is set with a look towards a nominal exchange rate.

All dependent variables are specified either in logarithmic differences or in levels, meaning that in the former case we use the growth rate of a dependent variable. As a result, a constant term in a regression equation represents the deterministic trend growth of the dependent variable when the latter is in growth rates. At the same time, a constant coefficient captures the constant mean of a dependent variable when it is specified in levels.

An insignificant constant coefficient in a regression with a dependent variable in growth rates implies that there is no deterministic trend growth in the dependent variable, and its trend, if there is any, is purely driven by the independent variables on the right-hand side. For example, price deflator equations in the model are specified in growth rates, and constants in these regressions tend to be insignificant which means they do not have a deterministic trend. However, it is a well-known empirical regularity that prices tend to rise over time, but in this case the trend in prices is driven by independent variables on the right-hand side. The same logic applies to all other dependent variables specified in growth rates. For example, a constant term in the consumption equation for Belarus is insignificant, but it does not mean that there is no trend growth in consumption. It simply means that the variable does not exhibit a deterministic time trend, but it exhibits trend growth due to the rising disposable income appearing on the right-hand side as an explanatory variable.

The equations with dependent variables specified in levels have insignificant constant coefficients, if they do not have constant means or their constant means are already captured by some of the independent variables on the right-hand side. For example, equations for interest rates tend to have insignificant constant coefficients, and we also include the lagged interest rate as an explanatory variable. Therefore, a constant mean of an interest rate is usually captured by its own lag because the mean of the interest rate does not change much from one period to the next. In general, we do not drop constant coefficients from the regressions,

even if they are insignificant because in case residuals have a non-zero mean the intercept of the regression absorbs the constant mean of the residuals.

4. Simulation

To analyze the ability of the multicountry model to fit the historical growth path of the main macroeconomic indicators in the EAEU countries, we conduct a baseline simulation from 2004 to 2018. An assessment of the model's ability to fit the actual data in the baseline simulation is an important procedure to validate the present multicountry model for conducting policy and shock analyses. In particular, we focus on the model's ability to repeat the dynamics of real GDP, potential output, inflation rate and unemployment rate. The results of the model simulation for all countries are presented in Appendix A Figs. A.1 and A.5.

Appendix A Fig. A.1 shows actual data and simulated data for key macroeconomic indicators in Kazakhstan. As in Bolatbayeva (2020), the baseline simulation results illustrate good accuracy in reproducing the actual dynamics of the variables. A moderate deviation of fitted values from actual data can be marked in 2005 and 2016 in Appendix A Fig. A.1a. Nevertheless, the present model as the two-country model in Bolatbayeva (2020) outperforms a structural macroeconometric model for Kazakhstan in Abilov et al. (2019) in terms of the results of ex-post simulation. Appendix A Fig. A.2 demonstrates the results of baseline simulation for key macroeconomic indicators of Russia. The results reveal only negligible differences between the ability of the multicountry model and the two-country model by Bolatbayeva (2020) to reproduce the historical path of macroeconomic indicators of the Russian economy. This can be interpreted as a robustness of the single-country model presented in Bolatbayeva (2020).

The dynamics of macroeconomic indicators for Kyrgyzstan are presented in Appendix A Fig. A.3. Compared with the model fit to Kazakhstan and Russia, the multicountry model performs worse in the case of Kyrgyzstan as the model is unable to reproduce high volatility present in GDP growth and inflation rate. There is also a significant gap between actual and simulated values of the unemployment rate for the period from 2004 to 2008. These problems might be due to the poor quality of the data for Kyrgyzstan. Nevertheless, Appendix A Fig. A.3 shows a reasonable level of accuracy in reproducing the actual dynamics of key macroeconomic indicators. Appendix A Fig. A.4 displays actual and simulated values of the main endogenous variables for the Armenian economy. The baseline simulation demonstrates a satisfactory performance of the multicountry model in repeating the dynamics of GDP growth rate, potential output and the inflation rate. At the same time, we find that the model is better capable of explaining the actual dynamics of unemployment rate in the baseline simulation. As in Kyrgyzstan's case, the inability of the model to fit the actual data in some periods possibly reflects measurement errors present in the data. The results in Appendix A Fig. A.5 indicate that simulated values for macroeconomic indicators of Belarus match the dynamics of actual data relatively better than for Armenia and Kyrgyzstan. Nevertheless, the model is not able to catch the spike in the inflation rate in 2011.

5. Scenario analysis

In this section, we discuss two simulation exercises with two different shocks to illustrate the propagation mechanisms of shocks in the multicountry model. In particular, we consider the world trade shock and the positive monetary policy shock in Russia. Appendix A Figs. A.6 and A.7 demonstrate the response to the shocks of GDP growth and inflation rates in Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia. The results are presented in terms of percentage point differences between the actual data and the simulated data.

Appendix A Fig. A.6 illustrates the effect of the world trade shock on real GDP growth, inflation, household consumption, investment, exports, imports, real wages, and REER across the EAEU countries. The current exercise also allows us to detect how fast an economy can rebound in a few quarters after the realization of the shock. We assume the world trade contraction of 10% in 2011 followed by a moderate recovery in 2012. The shock affects countries mainly through the international trade channels. Exports in all countries decrease, leading to a decline in real domestic demand, which in turn negatively affects gross capital formation. As a result, GDP in the EAEU member countries contracts substantially, putting a downward pressure on disposable income which exacerbates the contraction in GDP due to a decrease in household consumption. Armenia experiences the harshest fall in output among the EAEU countries. GDP in Armenia responds immediately to the shock falling 5 percentage points relative to the actual level. At the same time, the shock has the lowest impact on the Russian GDP, which falls below the baseline level by 0.8 percentage points. Inflation rates across the EAEU decrease due to the weak aggregate demand with Belarus experiencing the most significant decline in inflation. Real wages in Belarus, Kazakhstan, and Kyrgyzstan rise negligibly due to the decline in the inflation rate. On the other hand, real wages in Armenia and Russia decline as they experience a substantial fallback in productivity level which negative effect on the real wage outweighs the positive effect of the falling inflation. The effect of the world trade shock on the REER of the EAEU countries is negative with Belarus having the most significant decline in the real value of their currency. In general, most of the macroeconomic variables show a gradual return to the baseline level by the end of the simulation period.

Appendix A Fig. A.7 presents the responses of main endogenous variables to a 2 percentage point cut in the key rate by the Central Bank of Russia. The shock triggers a decrease in government bond yields of Russia followed by a rise in domestic gross fixed capital formation and household consumption. At the same time, the expansionary monetary policy leads to the ruble's appreciation against the currencies of its trading partners, because we have assumed that the UIP condition holds. Although the appreciation of the Russian ruble negatively affects its exports, low interest rates stimulate investment and consumption which temporarily boost domestic economic activity. Real wages start rising due to an increase in productivity. Nevertheless, strong domestic demand and local currency appreciation lead to increasing imports which in turn results in a slowdown of real GDP growth.

At the same time, the response of macroeconomic indicators in other countries to the monetary policy shock in Russia varies in terms of directions and magni-

tudes. Real GDP and the inflation rate in Kazakhstan respond to the shock negatively. The strong aggregate demand in Russia and the value effect of the local currency depreciation temporarily increase imports in Kazakhstan. Although exports of Kazakhstan also rise due to the currency depreciation, the effect of the shock on imports outweighs the impact of the increased exports, leading to a decline in GDP and the inflation rate. The impact of the shock on real GDP of Kyrgyzstan is negligible since bilateral trade between Kyrgyzstan and Russia is small. At the end of 2018, it accounted for 0.02% of Kyrgyzstan's total trade volume. Real GDP in Armenia responds positively to the monetary policy shock in Russia. The shock affects macroeconomic indicators in Armenia mainly through the channel of the bilateral exchange rate. Belarus is the hardest hit economy by the shock among the EAEU countries. The Belarusian ruble depreciates and the strong aggregate demand in Russia raises exports of Belarus. However, the later slowdown in the aggregate demand in Russia exhibits a negative impact on real GDP of Belarus. The inflation rate in Belarus also falls since the negative monetary policy shock in Russia results in lower aggregate demand for Belarus. Macroeconomic indicators in Belarus and Russia experience a more prolonged return to the baseline level than in other countries.

6. Conclusion

This paper presents a multicountry macroeconometric model for the EAEU. It is constructed based on five macroeconometric models of Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia. The research aims to describe the structural relationship between the economies, assess the effects of various shocks on main macroeconomic indicators, and investigate the transmission mechanisms of shocks across the EAEU member states. The single-country models are connected through equations of bilateral trade and bilateral exchange rates. We evaluate the goodness of fit of the multicountry model by conducting the ex-post simulation for the period from 2004 to 2018. The simulation results demonstrate that the model is able to match the observed data on the main macroeconomic indicators in Kazakhstan and Russia. At the same time, the results of the ex-post simulation also show that the goodness of fit is satisfactory for Armenia, Belarus, and Kyrgyzstan but it is inferior to the fit of the model for Kazakhstan and Russia.

The multicountry model is used to analyze the responses of important macroeconomic indicators to foreign and domestic shocks. Therefore, we perform two scenario analyses with a negative world trade shock and a positive monetary policy shock in Russia. In the first scenario, we consider the effect of a 10% world trade contraction on macroeconomic indicators across the member states. The counterfactual analysis shows that all the countries experience an economic downturn in response to the world trade contraction. Nevertheless, we find that the impact of the shock differs across them. The hardest hit economy by the world trade contraction is Armenia, whose economy largely depends on tourism, while the least affected country is Russia. Real GDP in Armenia falls below the baseline level by 5 percentage points whereas domestic production in Russia falls only by 0.8 percentage points. This proves the vulnerability of the Armenian economy to external shocks negatively affecting the world trade whereas the Russian economy is relatively immune to international trade shocks.

In the second scenario, we analyze the impact of an expansionary monetary policy in Russia. The results indicate stronger influence of the Russian monetary policy shock on domestic output of Belarus relative to other countries. At the same time, the response of real GDP in Kyrgyzstan is negligible which implies that its economy is less dependent on the Russian economy compared with other EAEU countries. In general, the model allows us to evaluate the impact of changes in monetary or fiscal policies of trading partners on the domestic economies of the EAEU member states. Therefore, the multicountry macroeconomic model can be considered as a useful tool for simulating main macroeconomic indicators across the EAEU in response to changes in policy and global economic conditions.

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Supplementary material 1

The multicountry model equations and test results

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Data type: Text

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Link: <https://doi.org/10.32609/j.ruje.7.72368.suppl1>

Appendix A

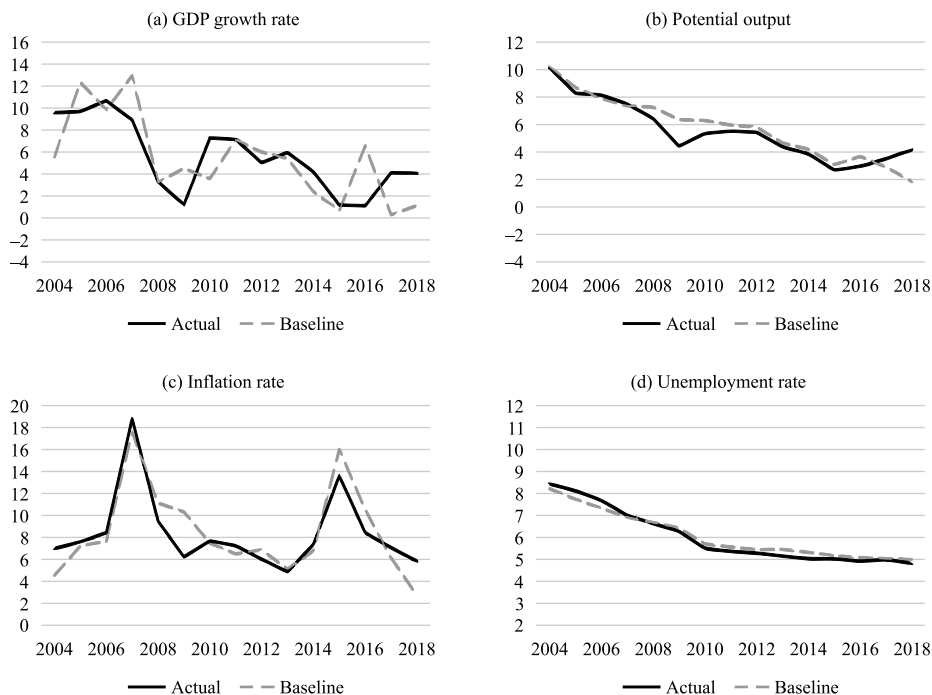


Fig. A1. Macroeconomic indicators of Kazakhstan (%).

Source: Compiled by the author.

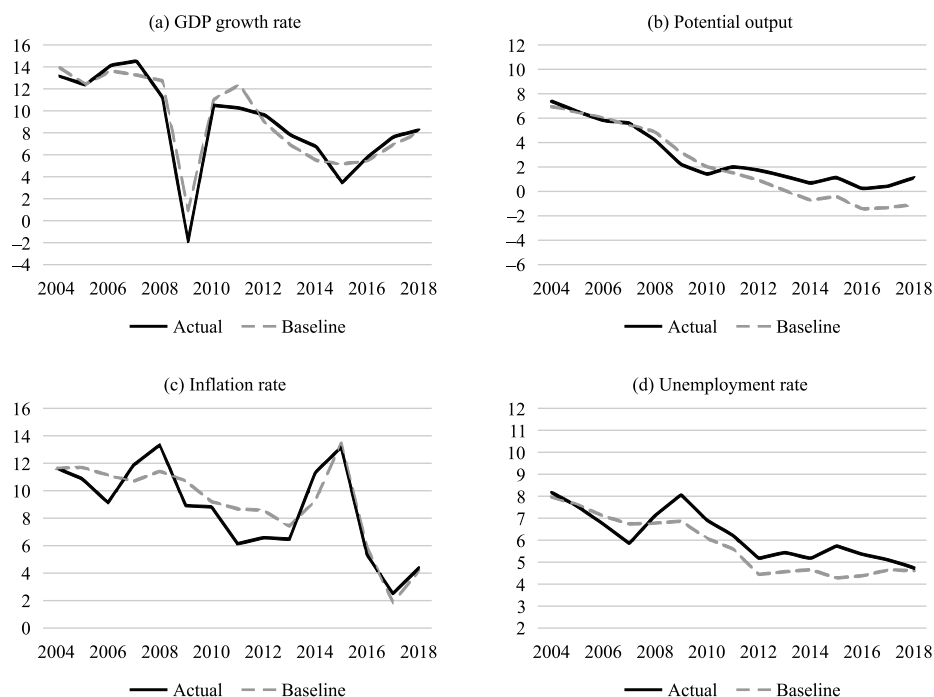


Fig. A2. Macroeconomic indicators of Russia (%).

Source: Compiled by the author.

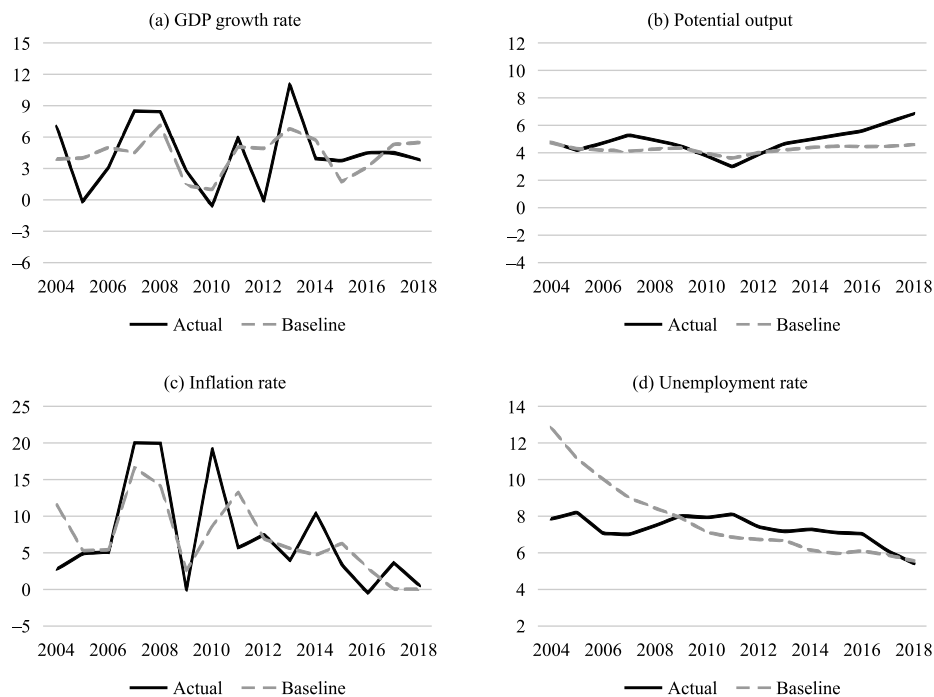


Fig. A3. Macroeconomic indicators of Kyrgyzstan (%).

Source: Compiled by the author.

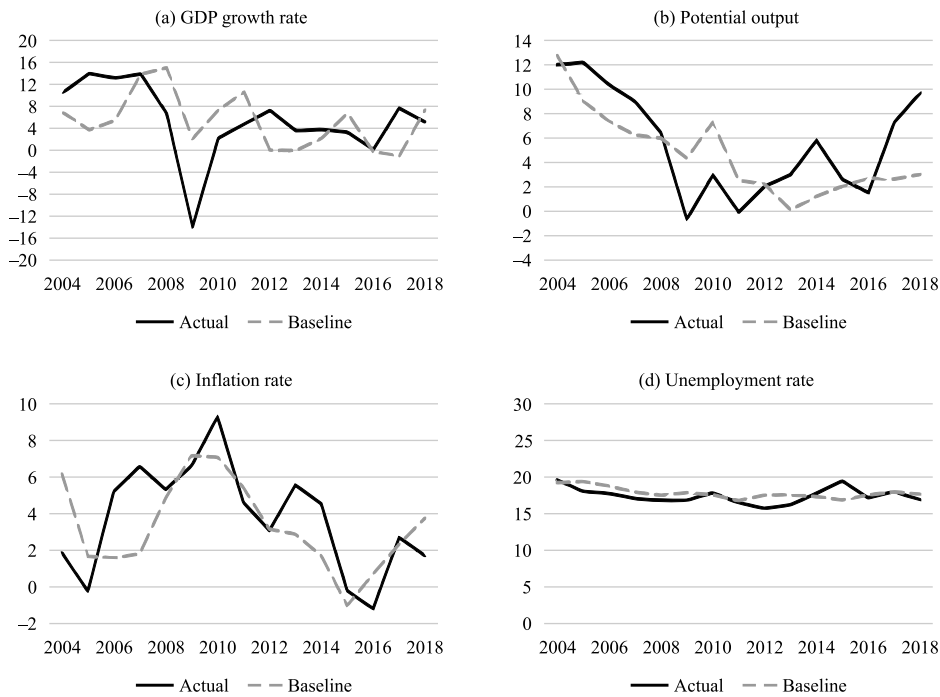


Fig. A4. Macroeconomic indicators of Armenia (%).

Source: Compiled by the author.

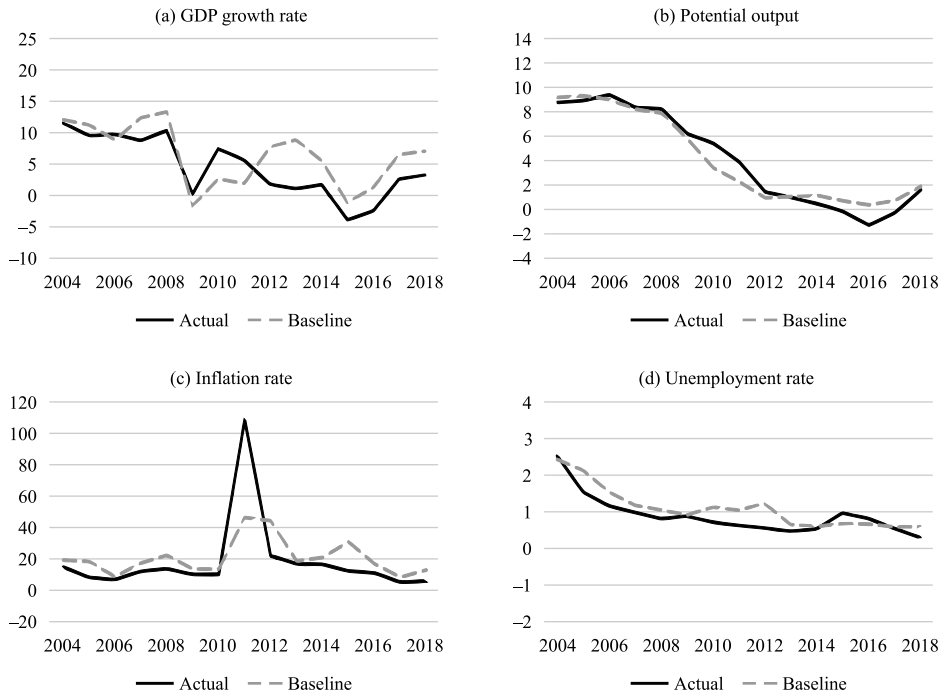


Fig. A5. Macroeconomic indicators of Belarus (%).

Source: Compiled by the author.

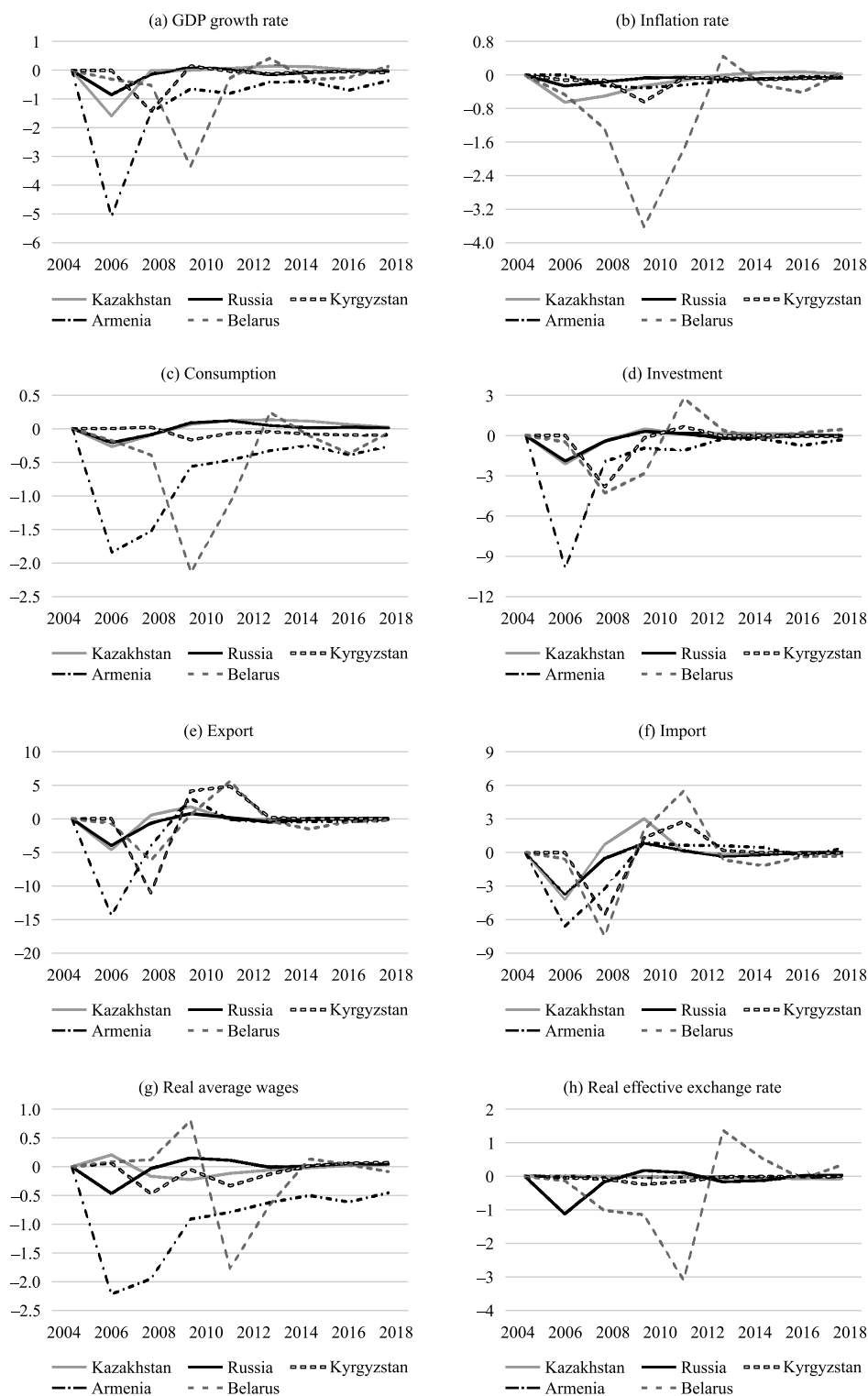


Fig. A6. Response of the main variables of the EAEU countries to the world trade shock (%).

Source: Compiled by the author.

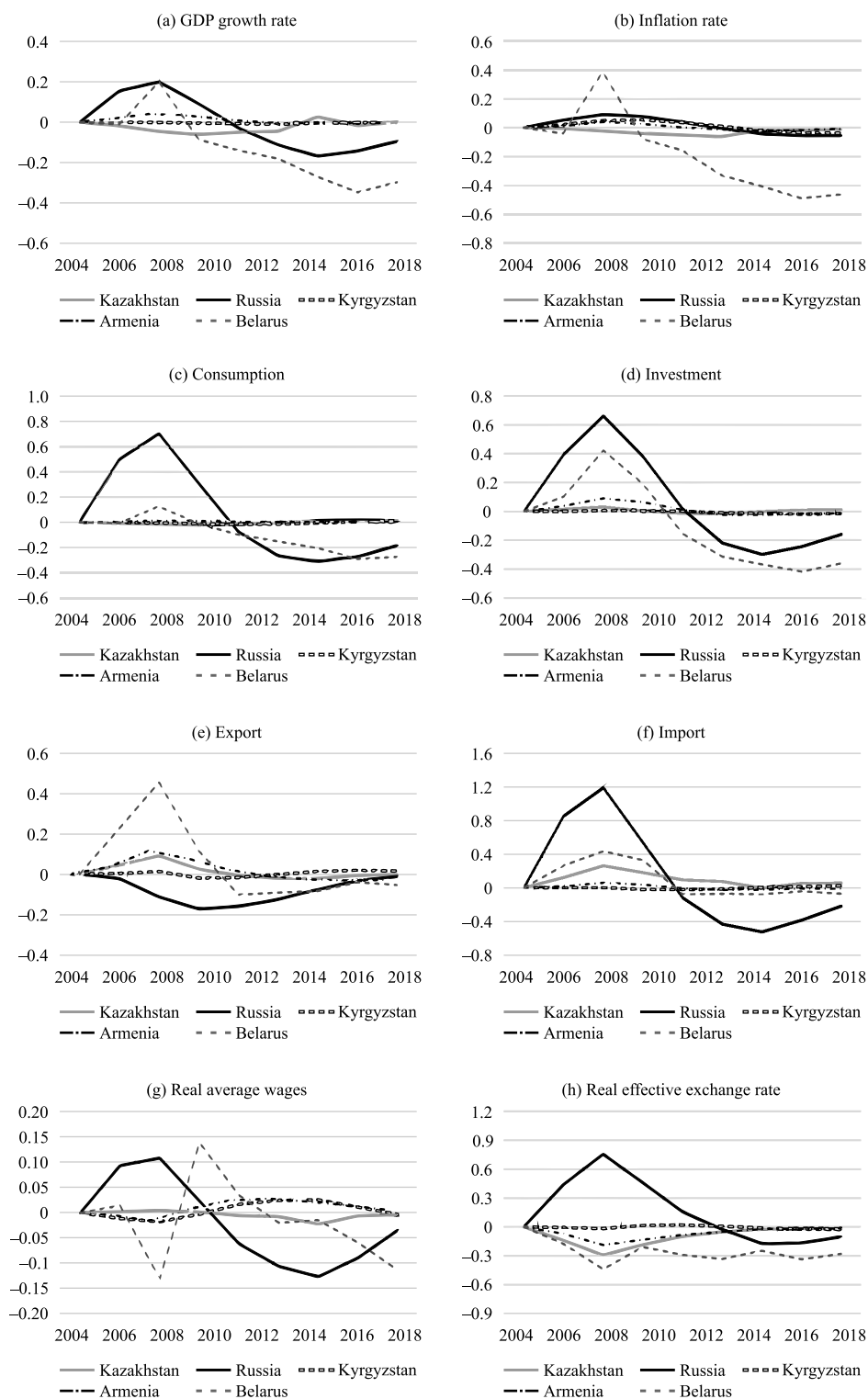


Fig. A7. Response of the main variables of the EAEU countries to the monetary policy shock (%).

Source: Compiled by the author.