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From Regional Development Sustainability to Global Economic Growth

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Khalid S. Soliman

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Table of Content

Mutual Influence of Macroeconomic Indicators Of Kazakhstan and its Trading Partners

Bulat Mukhamediyev, al-Farabi Kazakh National University, Almaty, Kazakhstan,
bulat.mukhamediyev@kaznu.kz

Azimzhan Khitakhunov, al-Farabi Kazakh National University, Almaty, Kazakhstan,
xit8_89@mail.ru

Abstract

The paper investigates interdependence of real and financial indicators of members of the Eurasian Economic Union and other countries. First of all, attention is paid to the study of their impact on the dynamics of macroeconomic indicators of Kazakhstan taking into account its linkages to the global economy. The study is based on the method of global vector autoregression. Individual country vector autoregression and error correction models for 33 countries are constructed. On this basis, the global vector autoregression model was estimated and calculations for the forecast of macroeconomic indicators responses in each country on the different economic shocks (including world oil price shock) were performed. The results may be of interest to the different governments in terms of rapidly changing world of interconnected economies.
Keywords: Interdependence of indicators, global vector autoregressive model, Eurasian Economic Union, economic shocks, functions of pulse return.

Introduction

The dynamics of macroeconomic variables in each country is affected by the behavior of macroeconomic variables of other countries, especially its main trading partners. To investigate the interdependence of macroeconomic variables, it would be natural to apply the method of vector auto regression, which does not impose any a priori assumptions about the relationships of the investigated processes.

However, there appears a problem of so-called "curse of dimensionality", due to which its decision is almost impossible, even for a relatively small number of countries and indicators taken into consideration. It became possible to overcome this problem in the framework of the global vector auto regression. This approach is carried out by decomposition of large models to individual country models, which are then summarized in a correct manner in the global model.

Global vector autoregression method was proposed in Pesaran et al. (2004). Model of great dimension in this approach is decomposed into individual country vector auto regression model and error correction model, based on which the estimates are obtained for the initial global model. For the correctness of the results it is necessary to conduct a series of statistical tests, such as checking the variables on stationarity, determining the order of integration, weak exogenous external variables, determine the number of cointegrating relations and others. Further development of the method of global vector auto regression was obtained in the works of Dées, di Mauro, Pesaran, and Smith

(2007), Galesi and Lombardi (2009), Dées, Pesaran, Smith, and Smith (2009), Chudik and Smith (2013), Dreger and Zhang (2013), Sun, Heinz, and Ho (2013), Favero, Giavazzi, and Perego (2011), Chudik and Pesaran (2014), Ganelli and Tawk (2016).

Such studies are generally carried out in developed countries. At the same time, the behavior of economic growth, inflation, interest rates and other in developing countries depends significantly on the dynamics of such indicators in the developed countries, for example, in Feldkircher and Korhonen (2012). It is therefore of interest to identify the interaction of macroeconomic indicators for the developing countries, particularly the newly independent states that emerged after the collapse of the USSR, Khitakhunov, Mukhamediyev, and Pomfret (2016). From the perspective of the study on interdependence of macroeconomic indicators of Kazakhstan and other countries of greatest interest are its links with Russia, China, the European Union and the United States.

The research method

A current stage of development of the world economy is characterized by a high degree of interdependence of macroeconomic indicators by countries. For the analysis of economic policy an appropriate modeling tool is required.

The structure of the model

Business cycles impulse transmission can occur through many channels. They can occur as a result of shocks of observed global factors, such as the world price of oil, food products, and unobservable factors, such as the spread of new technologies. Let's briefly present here a GVAR modeling method, which allows you to explore and evaluate the complex relationships of indicators, both at the country level and between the countries. This approach was first proposed in Pesaran et al. (2004). Let's briefly describe the model. Detailed description and review can be found in the book of Mauro and Pesaran (2013). Let there be $N+1$ countries or regions. They are numbered by the indices $i = 0, 1, \dots, N$. Each country i has its own set of variables, for example, GDP, inflation rate, exchange rate and others, that form components of the vector x_{it}, where t – period number (year, quarter). Variables in vector x_{it} are arranged in the same manner for all the countries. The dynamics of all these variables as well as observed global variables is advisable to model as endogenous variables. But in the framework of VAR model, this becomes practically impossible due to rapid growth of estimated parameters with the increase of the number of countries in the model. In the approach of the global auto regression model, individual model $VARX^*(p_i,\ q_i)$ of the country i has the following form:

$$x_{it} = a_{i0} + a_{i1}t + \sum_{j=1}^{p_i} \Phi_{ij} x_{it-j} + \sum_{j=0}^{q_i} \Psi_{ij} x^*_{it-j} + v_{it},$$

where x_{it} – vector dimension k_i of internal variables, x^*_{it} - vector dimension k^*_i of external variables for country i in period t, a_{i0}, a_{i1} – vectors, Φ_{ij}, Ψ_{il} - matrices of corresponding dimensions. Vector of external variables x^*_{it} is calculated as a weighted average of the vectors of internal variables in all countries excepting country i: $x^*_{it} = \sum_{j=0}^{N} w_{ij} x_{jt}$, where $w_{ij}, j = 0, 1, \dots, N$, represent the weights that determine the importance of other countries to the country i, and $w_{ii} = 0$, $\sum_{j=0}^{N} w_{ij} = 1$. They are determined on the basis of data on trade, financial and other relationship with the partner countries. The economy of each country is expected to be small compared with the

rest of the world, except for the country 0, which is large US economy. Consider the model$VARX^*(2,2)$:

$$x_{it} = a_{i0} + a_{i1}t + \Phi_{i1}x_{it-1} + \Phi_{i2}x_{it-2} + \Psi_{i0}x_{it}^* + \Psi_{i1}x_{it-1}^* + \Psi_{i2}x_{it-2}^* + v_{it}. \quad (1)$$

Let x_{it} и x_{it}^* are the integrated processes of the first order that is $x_{it}\sim I(1)$ и $x_{it}^*\sim I(1)$. Then corresponding $VECMX^*(1,1)$ id as follows:

$$\Delta x_{it} = c_{i0} - \alpha_i\beta_i'[z_{it-1} - \gamma_i(t-1)] + \Psi_{i0}\Delta x_{it}^* + \Gamma_i\Delta z_{it-1} + v_{it}. \quad (2)$$

Columns of matrix β_i forms a basis of r_i cointegrating vectors, which can be chosen orthonormal, matrix α_i distributes their impact on dynamics Δx_{it} and determines the speed of convergence to sustainable condition. Wherein $\beta_i'[z_{it-1} - \gamma_i(t-1)]\sim I(0)$, that is components of this vector are the stationary time-series.

$VECMX^*$ is estimated for each country separately conditionally by x_{it}^*, and their components are integrated processes of the first order, weakly exogenous with respect to the $VECMX^*$ model parameters. Estimation of $VECMX^*$ model parameters by inverse transformations are translated into the parameters of the original model $VARX^*$. On their basis, a global VAR model is formed. Note that due to the large dimension of the vector x_t estimation of the usual VAR model of vector autoregression is almost impossible.

Data

In this study, such a model is constructed for 33 countries, including the EAEU countries: Belarus, Kazakhstan, and Russia, which are the core countries of this union. The main attention was paid to the influence on macroeconomic indicators of Kazakhstan as well as Russia and Belarus from the part of their trading partners. Quarterly data from 1995 to 2013 were used. Compared with other studies time series in this research are shorter. In the first years after independence behavior of CIS macroeconomic variables characterized by high degree of volatility.

In the model macroeconomic indicators were used: nominal domestic product in the national currency GDP_{it}, the country's consumer price index CPI_{it} in period *t*, reduced to 100 in the base year, E_{it} - real effective exchange rate of the country *i* in period *t*, EQ_{it} - the nominal share price index of country *i* in period *t*, R_{it}^S - the nominal short-term interest rate on an annual basis as a percent, R_{it}^L - nominal long-term interest rate on an annual basis as a percent, $POIL_t$ - the price of oil in US dollars. Internal variables of the model for each country are determined in logarithmic form:

$$y_{it} = \ln\left(\frac{GDP_{it}}{CPI_{it}}\right),\ \pi_{it} = \ln(CPI_{it}) - ln(CPI_{it-1}),\ e_{it} = \ln(E_{it}),\ \ q_{it} = \ln\left(\frac{EQ_{it}}{CPI_{it}}\right),$$
$$r_{it}^S = 0.25 * \ln\left(1 + \frac{R_{it}^S}{100}\right),\ \ r_{it}^L = 0.25 * \ln\left(1 + \frac{R_{it}^L}{100}\right), p_t^o = \ln(POIL_t).$$

The corresponding external variables for each country are formed using a matrix of weights:

$$y_{it}^* = \sum_{j=0}^{N} w_{ij}y_{jt},\ \ \pi_{it}^* = \sum_{j=0}^{N} w_{ij}\pi_{jt},\ \ e_{it}^* = \sum_{j=0}^{N} w_{ij}e_{jt},$$

$$q_{it}^{*} = \sum_{j=0}^{N} w_{ij} q_{jt}, \quad \rho_{it}^{S*} = \sum_{j=0}^{N} w_{ij} \rho_{it}^{S}{}_{jt}, \quad \rho_{it}^{L*} = \sum_{j=0}^{N} w_{ij} \rho_{it}^{L}{}_{jt}.$$

There are 3 global variables: $poil_t = lnPOI_t$ - logarithm of world oil prices, $pmat_t = lnPMAT_t$ - logarithm of the world prices for raw materials, $pme_t = lnPMETAL_t$ - logarithm of the world metal prices.

It is not necessary that all of the variables are included in the individual countries model. Some of them may not be available in models because of the unavailability of statistical data of individual macroeconomic indicators. 135 internal variables, 128 external variables and 3 global variables are included in the model. For the US, the exchange rate is not included in the model, it is taken into account by exchange rates of other countries, expressed in US dollars.

The calculations use the quarterly statistics from 1995 to 2013 of IFS IMF, World Bank, and the Committee on Statistics of the Ministry of National Economy of Kazakhstan, National Bank of Kazakhstan, Russian Federal Service for Statistics, Central Bank of Russia, National Bank of Belarus, and based on Smith and Galesi (2014) Gvar toolbox. Previously there had been eliminated seasonality. European countries, such as Austria, Belgium, Finland, France, Germany, Italy, the Netherlands and Spain united in the name of the region with the Euro (Euro) and in the model are considered as one country.

Estimation of GVAR model

The model evaluation process includes a number of tests (stationarity test, determination of the time series integration order). For all internal, external and global variables ADF (augmented Dikey-Fuller) tests and WS (weighted symmetric estimation) unit root tests were implemented. Lag length in these tests is determined with the Akaike (AIC) and Schwartz (SBC) criteria. The constant is included in all regressions, but the trend is included only in the regressions for levels as after first differences linear trend disappears. Therefore, on the basis of test results assumption about the first order integration for all of the internal variables of the model is accepted.

Similarly, a unit root test for external variables and global variable is conducted. Global variable here is the logarithm of the world price of oil. Lags of internal and external variables for the model of vector autoregression $VARX^{*}(p_i,\ q_i)$ are determined based on the value of information criteria AIC, SBC and Loglik.

Testing for weak exogeneity. In the global VAR method, which was firstly proposed in Pesaran et al. (2004), the basic assumption is weak exogeneity of external variables in relation to the long-term parameters of $VECMX^{*}$ model. Testing of this hypothesis for external variables can be executed by a method developed in Johansen (1992). For the vector error correction model variant IV was selected without any restrictions on the constant and with restrictions on the trend coefficients. The amounts of cointegrating relations are determined by the analysis of the number of unit roots of the matrix $\Pi_i = \alpha_i \beta_i^{'}$ and by persistence profile.

All of the curves corresponding to cointegrating relations for 40 periods converge to zero level. The number of curves is equal to 77, that is the total number of cointegrating relations. For each country individual VAR or error correction models were constructed.

Estimation results

Constructed individual autoregression and error correction models for all countries included in the study, allow to estimate the global VAR model and the interdependences of macroeconomic indicators of countries in the form of responses to shocks originating in these countries and in the global economy as a whole. In terms of impact on the economy of Kazakhstan the major interest is influence from Russia, China, European countries, USA, as well as global variables, such as the world oil prices.

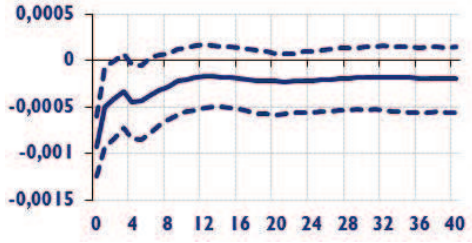
The impact of world oil prices on the macroeconomic indicators

Estimated global VAR model allows to conduct a study on the consequences of various economic shocks in all countries. The following shocks were simulated: positive or negative shocks of oil prices, the real exchange rate and production growth, short-term and long-term interest rates for all countries in which changes in macroeconomic indicators could have a noticeable impact on the economy of Kazakhstan. All the shocks in magnitude equal to one standard error of the corresponding variable, which is calculated with statistical data.

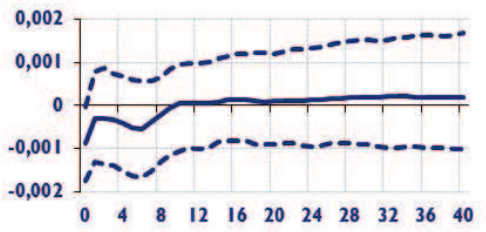
We obtained a function of pulse returns that are responses of all variables on each shock for all countries. In all diagrams in this section on the horizontal time axis marked quarters from 1 to 40, and on the vertical axis - the value of the corresponding variable in logarithmic form. It is not possible to bring all the graphs in the article due to limited space. This article shows mainly those which show statistically significant responses to various shocks.

Along with median response curve (solid line) in each diagram two dotted lines show boundaries of 90 percent confidence interval. Responses should be considered to be statistically significant in the periods in which the curves of pulse returns deviate from zero along with the boundaries of the confidence interval (dashed lines are both either above or below the horizontal axis). Fig. 1 shows the pulse function returns of the rate of inflation to negative oil price shock in several countries.

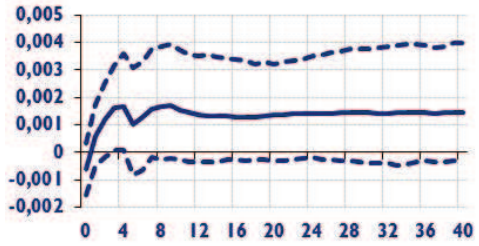
According to Fig. 1, the growth of world oil prices causes a short-term decline in prices in the Europe, the UK and the US. For China, the median response rate of inflation shows the reduction of inflation for about 10 quarters, but this change is not statistically significant. Both boundaries of the confidence interval do not lie at the same time above or below the zero level.



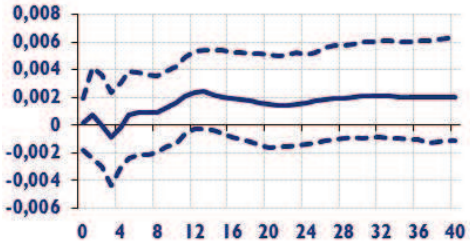
a) Euro



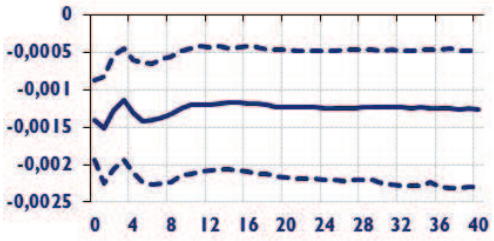
b) China



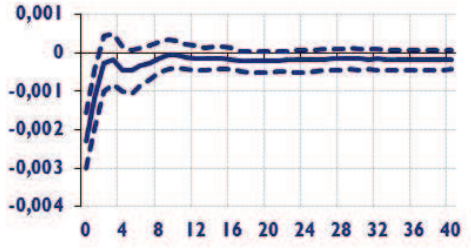
c) Kazakhstan



d) Russia



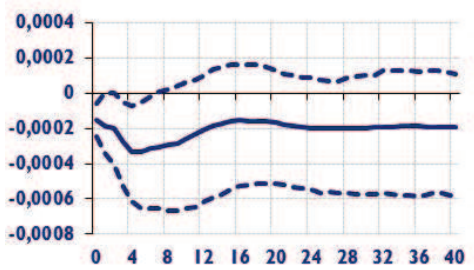
e) The United Kingdom



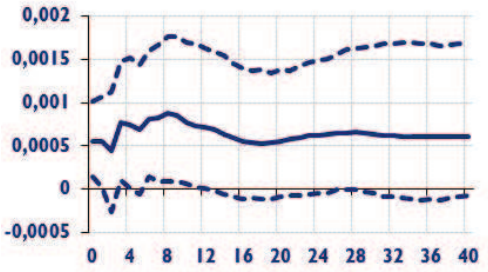
f) The United States

Fig. 1. Response rate of inflation to a negative shock of world oil prices

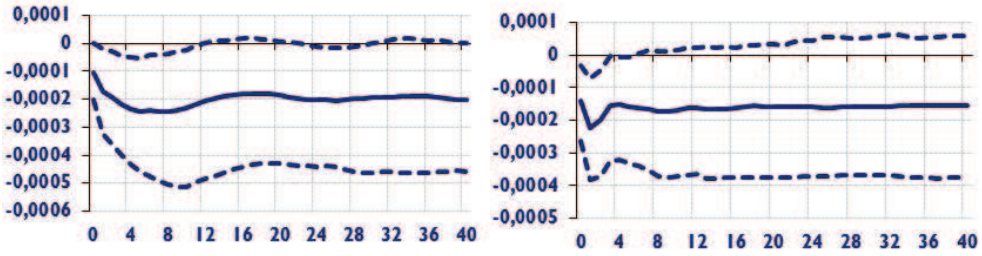
The response rate of inflation in Russia and Kazakhstan are also not statistically significant. This can be explained by the fact that both Russia and Kazakhstan are oil-producing countries, and domestic prices are less affected by fluctuations of the world price of oil than in the oil-importing countries. Impact of the negative world oil price shock on the long-term nominal interest rate is shown in Fig. 2.



a) Europe



b) Kazakhstan

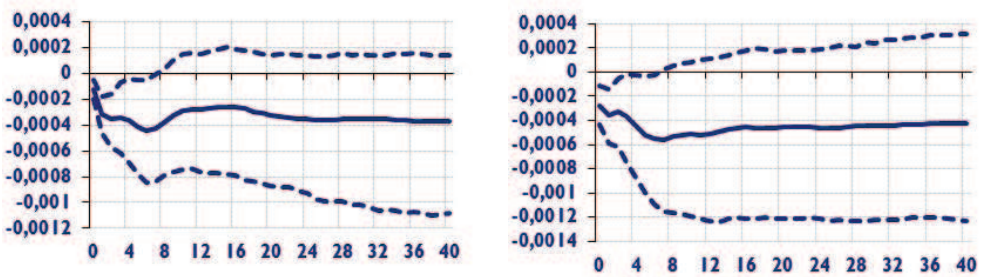


c) The United Kingdom d) The United States

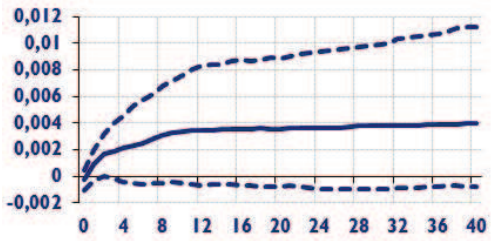
Fig. 2. Responses of long-term nominal interest rate on the negative shock of world oil prices

For the Europe, the United Kingdom and the United States long-term responses of the nominal interest rate from zero level are statistically significant for 4-8 quarters. For them, therefore, its short-term decrease is due to decrease in the world price of oil. For Kazakhstan, the oil-producing country, there is a statistically significant increase in long-term nominal interest rate for 1-2 quarters. For Belarus and Russia responses were not statistically significant.

Fig. 3 shows the response of short-term nominal interest rate to a negative shock of world oil prices. Europe and China have statistically significant deviations in negative side for 6-8 quarters. They are oil-importing countries, and reduced costs for the purchase of oil leads to a decrease in interest rates. For Kazakhstan the impact of world oil prices decline on its interest rate was not statistically significant.



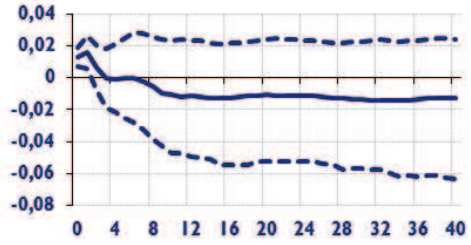
a) Europe b) China



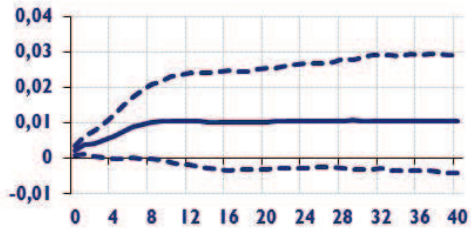
c) Kazakhstan

Fig. 3. Responses of short-term nominal interest rate on the negative shock of world oil prices

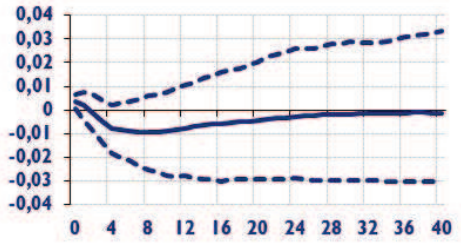
The responses of the exchange rate of the national currency, expressed in US dollars, on the negative pulse of the world price of oil is shown in Fig. 4. For the countries represented in Figure 4 short term appreciation of the national currency are observed. Reducing cost of purchased oil in terms of its price reduction requires a smaller amount of money in dollar terms. Reducing demand for dollars increases the cost of the national currency.



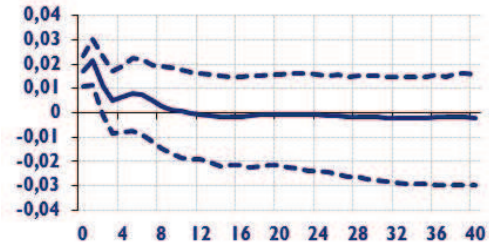
a) Europe



b) China



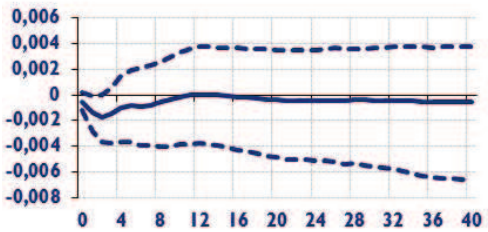
c) Kazakhstan



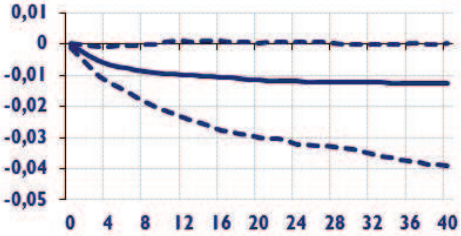
d) Norway

Fig. 4. Exchange rate responses to a positive shock of world oil prices

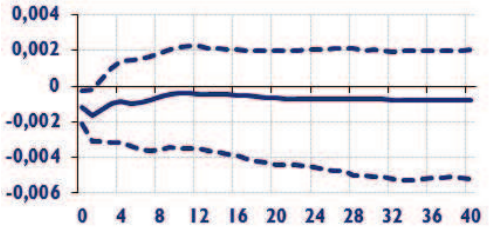
This is true for the Europe, China, which are major consumers of oil. In Norway, which has large oil reserves, almost all oil revenues are accumulated in the Oil Fund. Positive exchange rate jump in Norway for two quarters can be explained by the mutual influence of exchange rates in other countries, particularly countries in the European region.



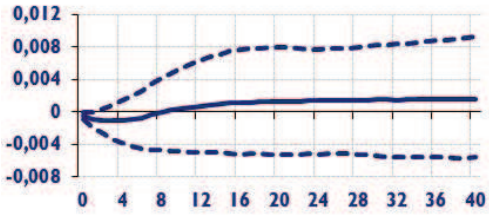
a) Canada



b) Belarus



c) The United States



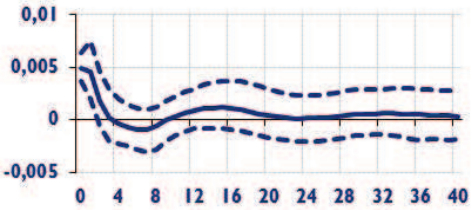
d) Kazakhstan

Fig. 5. Responses of the real GDP to the negative shock of the world oil prices

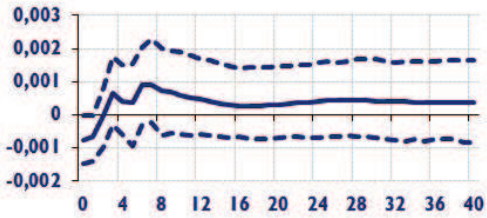
Kazakhstan has a similar situation. Median response curve of the exchange rate after two quarters shows the trend of the weakening of the national currency due to the reduction in oil revenue inflows. Of particular interest is the impact of the world oil prices on economic growth. A negative world oil price shock, as can be seen in Figure 5, affects the dynamics of real gross domestic product. Statistically significant decrease in real GDP occurs in Canada in the 2-3 quarters, in the US - for the 1-2 quarter, in Belarus - for 8 quarters, in Kazakhstan - for 1-2 quarters. In Russia and China, real GDP responses were not statistically significant.

The impact of economic shocks in Russia on macroeconomic indicators

A positive shock of inflation in Russia by virtue of its inertia causes a positive statistically significant deviation of the inflation rate in Russia for 2-3 quarters (Figure 6). It is also have a positive impact on the inflation rate in Kazakhstan, which is statistically significant within 1-2 quarters. Although there are positive responses of the inflation rate in the Europe and Sweden, they are not statistically significant. This reflects the degree of influence of inflationary processes in Russia to other countries, and at the same time points to the close links the economies of Kazakhstan and Russia.



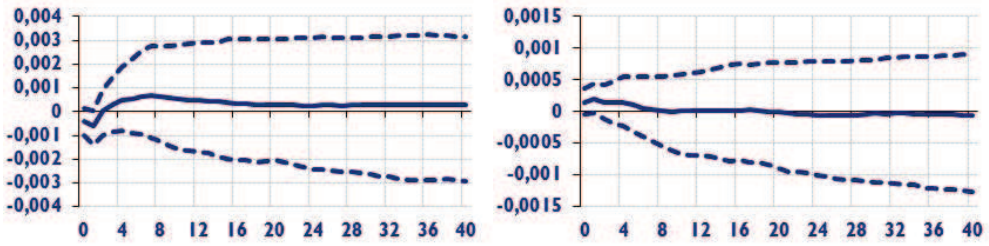
a) Russia



b) Kazakhstan

Fig. 6. The response rate of inflation to a positive shock of inflation in Russia

Fig. 7 shows the effects of a positive shock of inflation in Russia on the short-term interest rate. in Kazakhstan it decreases and statistically significant within 1-2 quarters. While in India short-term interest rates rose significantly within the 1-2 quarter.



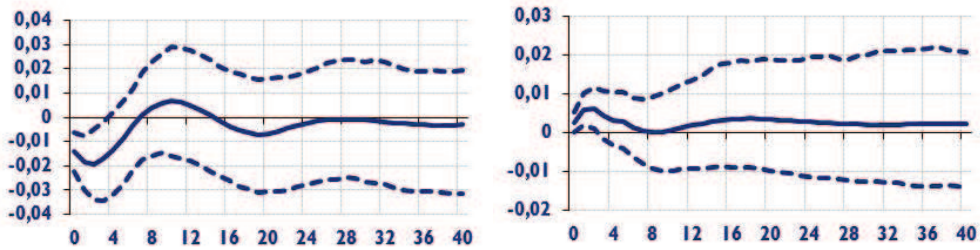
a) Kazakhstan b) India

Fig. 7. Responses of short-term interest rates to the positive shock of inflation in Russia

A positive shock of inflation in Russia may also affect the exchange rates. Inflation in the country contributes to the rise in the cost of foreign currency (Fig. 8). The calculation results show that weakening of the national currency happens in Russia, but in Kazakhstan - a statistically significant strengthening of the national currency within 2-3 quarters.

It is possible to consider the impact of the exchange rate in Russia on other macroeconomic indicators. Positive exchange rate shock leads to statistically significant decline in the rate of inflation for 2-3 quarters in Russia. While in Kazakhstan, on the contrary, there is be a positive jump in inflation for 1-2 quarters.

Positive exchange rate shock in Russia has a statistically significant reduction in short-term nominal interest rate in Norway for 2-3 quarters. The impact of this shock on the short-term interest rate in Kazakhstan is not statistically significant.



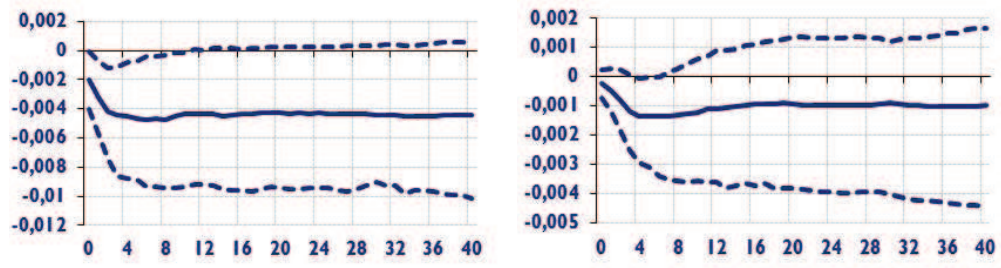
a) Russia b) Kazakhstan

Fig. 8. Exchange rate responses to a positive shock of inflation in Russia

Positive exchange rate shock in Russia has a negative impact on exchange rate in Kazakhstan, a statistically significant for 3 quarters. Such shock means appreciation of the Russian currency and increase of its weight in the basket of currencies in Kazakhstan. Hence, the relative weight of the US currency in the Kazakhstan's currency basket decreases. Impact of this shock in Russia on exchange rates of other countries is insignificant.

The impact on the macroeconomic indicators of economic shocks in China

China is one of the main trade partners of Kazakhstan; therefore it is interesting to examine effects of various economic shocks in China on macroeconomic indicators of Kazakhstan. But oddly enough, the impact of shocks, which may arise in China's economy, not statistically significant for the economy of Kazakhstan. Fig. 9 shows that a positive shock of short-term nominal interest rate in China has a statistically significant downward impact on its real GDP for 10 quarters. It also has a negative impact on real GDP of Europe (significant from 5 to 7 quarters).



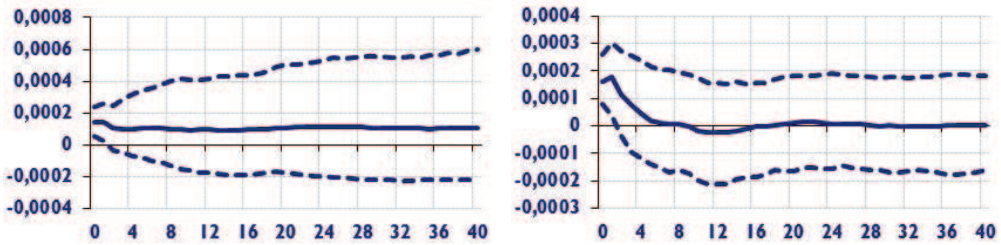
a) China b) Europe

Fig. 9. Responses of real GDP to positive shock of short-term nominal interest rate in China

Exchange rate responses to a positive shock in real GDP in China appear in Europe and New Zealand. In both cases, there are short-term statistically significant reduction in the exchange rate within 2-3 quarters.

The impact economic shocks in the European countries on the macroeconomic indicators

The impact of shocks arising from the European region on macroeconomic indicators of Kazakhstan as well as Russia and Belarus are weak and not statistically significant. Fig. 10 shows graphs of the pulse returns to a positive shock of long term nominal interest rates in Europe. In Norway and Sweden, this shock leads to a positive jump in a long-term nominal interest rate (statistically significant for 2 quarters).

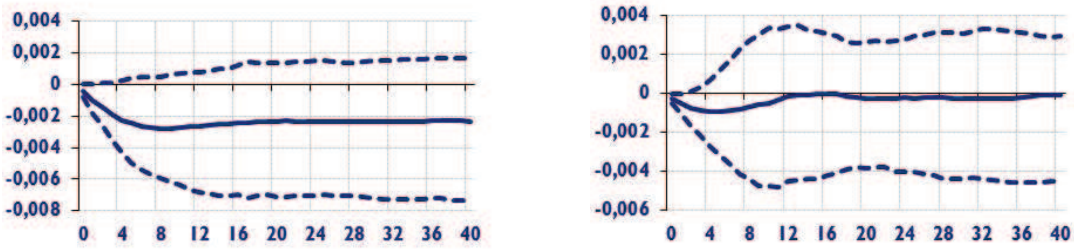


a) Norway b) Sweden

Fig. 10. Responses of long-term nominal interest rate on the positive shock of long term nominal interest rates in Europe

The impact of economic shocks in Kazakhstan on macroeconomic indicators

Although Kazakhstan is a country with a relatively small economy, its economic shocks may affect the individual macroeconomic indicators of its closest trading partners. Fig. 11 shows the pulse return of real GDP to positive shock of short-term nominal interest rate in Kazakhstan. For Kazakhstan and Russia responses of real GDP are negative and statistically significant for 2 quarters.



a) Kazakhstan b) Russia

Fig. 11. Responses of real GDP to positive shock of short-term nominal interest rate in Kazakhstan

The impact of economic shocks in the US on macroeconomic indicators

The US economy is the biggest, and it is expected that the shocks that occur in it, will have a significant impact on the macroeconomic indicators in other countries. For instance, calculations show that a positive shock of inflation in the US has a negative impact on the long-term nominal interest rate in Norway and Russia for a long period of time. The impact of a positive shock of inflation in the US on the short-term nominal interest rate is statistically insignificant for Mexico; and for the UK, Europe and Russia - statistically significant in the long run. A positive shock of inflation in the United States will lead in the long run to the appreciation of the national currencies in Mexico, Turkey, Kazakhstan and Russia. It also has a statistically significant downward pressure on real GDP of Canada, European countries, Mexico, Malaysia and Belarus in the long run. But its impact on the real GDP of Kazakhstan is statistically insignificant.

A positive shock of long term nominal interest rate in the US has a positive statistically significant effect on the long-term nominal interest rate, for example, in Norway and New Zealand. Responses of short-term nominal interest rates in the European countries, Norway, Russia and Kazakhstan to the positive shock of long term nominal interest rate in the United States are positive. But only with some stretch they can be considered as statistically significant. The shock of the long-term nominal interest rate in the US has a statistically significant negative impact on the exchange rate in Brazil in the long run. Its impact on the exchange rate in Russia is also negative. Unlike long-term nominal interest rate impact of the positive shock on short term nominal interest rate occurs only at short time intervals. Responses of short-term nominal interest rates are positive and statistically significant for Canada for 4 quarters and for Europe for 2 quarters.

The impact of a positive shock of the US real GDP on the exchange rate in the UK is positive, statistically significant in the long run, and negative on China's exchange rate (statistically significant for 4 quarters). For Kazakhstan and Russia impact of this shock also negative but statistically insignificant.

The US economy is large and it can, as shown in Fig. 12, influence the world oil prices. A positive shock in real GDP in the United States leads to a long-term increase in world oil prices

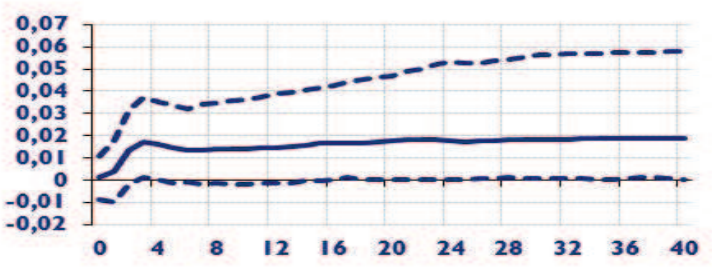


Fig. 12. The response of world oil price shock on the positive real GDP growth in the US

Conclusion

The consequences of the Eurasian integration were trading shocks, increasing protectionism, the industry downturn, a large flow of imports from partner countries. The interconnectedness of economies in the world today requires tools to assess the response of macroeconomic indicators for the various shocks originating in other countries. This article presents the results of the evaluation and simulation model of the global VAR for 33 countries, including the three EAEU countries. In accordance with the purpose of the research, the influence on macroeconomic indicators of Kazakhstan as well as Russia and Belarus on the part of their trading partner is studied. It was revealed that on the macroeconomic indicators of Kazakhstan, a country with small economy, shocks of the global oil prices, inflation and the exchange rate in Russia, short-term interest rates and output in China and the US all have a statistically significant effect.

The latter may seem strange, since the volume of trade between Kazakhstan and the US is very small. However, the shocks occurring in the US economy may be transferred into Kazakhstan's economy indirectly through their impacts on other countries, trade partners of Kazakhstan. No statistically significant effects of shocks in the Euro region on the performance of Kazakhstan and Russia have been identified. Although Kazakhstan's economy is relatively small, the shock of its short-term interest rate has a significant impact on output in Russia. GVAR approach can serve as a useful tool for assessing and forecasting the economy response to events in the outside world.

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