Kopytin, Ivan Aleksandrovich; Pilnik, Nikolay Petrovich; Stankevich, Ivan Pavlovich

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Modelling Five Variables BVAR for Economic Policies and Growth in Azerbaijan, Kazakhstan and Russia: 2005–2020

Ivan Aleksandrovich Kopytin[1], Nikolay Petrovich Pilnik[2], Ivan Pavlovich Stankevich[3]*

[1]Head of Center for Energy Research, Primakov National Research Institute of World Economy and International Relations, Russian Academy of Sciences, Profsoyuznaya Str.23, Moscow, 117997, Russian Federation, [2]Senior Research Fellow, Primakov National Research Institute of World Economy and International Relations, Russian Academy of Sciences, Profsoyuznaya Str.23, Moscow, 117997, Russian Federation, [3]Junior Research Fellow, Primakov National Research Institute of World Economy and International Relations, Russian Academy of Sciences, Profsoyuznaya Str.23, Moscow, 117997, Russian Federation. *Email: npilnik@gmail.com

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ABSTRACT

The paper applies the Bayesian Vector Auto Regression (BVAR) framework to analysis of the influence of world oil price and exchange rate and interest rate policies on economic growth and consumer inflation in three post-Soviet oil exporters: Azerbaijan, Kazakhstan and Russia. It is shown that transition to inflation targeting regime with floating exchange rate in 2014–2015 weakened the link between economic growth and world oil price in Russia and Kazakhstan. In Azerbaijan previously nonexistent systemic link between GDP growth and world oil price has emerged. It is also shown that all three countries de facto diverted from free floating exchange rate regime after 2017.

Keywords: Brent Oil Price, Nominal Exchange Rate, Economic Growth, Interest Rate, Inflation
JEL Classifications: C11, C32, E37, E61, F43

1. INTRODUCTION

In 2014 and 2015 facing deep decline in world oil price monetary authorities in Kazakhstan and Russia enacted significant changes in their economic policy. The policy of a managed exchange rate, which was more strict in Kazakhstan (at some periods it was nearly equivalent to the regime of a fixed exchange rate) and softer in Russia (the policy of the currency band, the width of which could change significantly over time), was replaced by the policy of inflation targeting. The regulators in both countries abandoned the control of the exchange rate of the national currency and declared transition to a free floating exchange rate regime. This policy shift was quite natural as the experience of the overwhelming majority of countries which tried to combine the simultaneous use of inflation targeting and tight management of the exchange rate proved to be unsuccessful. Azerbaijan declared the intention to shift to inflation targeting regime as early as in 2007, but recurrently delayed the transition. In 2014/2015 the country shifted from the tightly managed to more flexible exchange rate regime.

For analysis of the influence of world oil price and exchange rate and interest rate policy on economic growth and consumer inflation in Azerbaijan, Kazakhstan and Russia the article uses the Bayesian vector auto regression (BVAR). The choice of BVAR framework is conditioned by the structure and span of time series data underlying the research. The research goal is to identify economic policy mechanisms that operated in three countries in 2005 – 2020 and especially to compare these policies before and after the decisive changes initiated in 2014–2015. The second time subperiod covering 2015–2020, even if monthly data is used, contains insufficient number of observations to be modelled within the standard vector autoregresions (VAR) or vector error correction models (VECM) frameworks. In structural vector autoregresions

(SVAR) additional a priori restrictions on the data are required, but the identification of the actual system of constrains in which the researched variables operate independently of any a prori judgement is precisely the primary task of this research. In our opinion, BVAR type modelling, replacing point estimates with estimates of parameter distributions, is the most adequate tool in such a situation.

Naturally, the choice of priors is extremely important for BVAR models. We use the hierarchical Minnesota prior for two reasons. On the one hand, it is quite simple and does not apply excessive prerequisites to the data, it is sufficient just to determine the degree of data rigidity. On the other hand, it is known from the literature that the prior allows to receive good quality of forecasts due to its ability to estimate hyperparameters in a way that protects from the possibility of error when choosing these hyperparameters.

2. LITERATURE REVIEW

In this paper, we develop a Bayesian Vector Auto Regression (BVAR) model to analyze the influence of world oil price and exchange rate and interest rate policies on GDP growth and consumer inflation in three post-Soviet oil exporters, namely Azerbaijan, Kazakhstan and Russia.

To date, a fairly rich world experience of many countries in shifting macroeconomic policy from a managed exchange rate to inflation targeting has been accumulated and comprehended. Nevertheless, given their specific structural characteristics as well as peculiarities of interaction of Azerbaijan, Kazakhstan and Russia economies with external economy direct use of standard policy recipes for the post-Soviet oil exporters is not possible. The arguments in favor of transition to inflation targeting and analysis of the first outcomes of this transition in Russia are discussed in (Yudaeva, 2018), Kazakhstan in (Garifollaevna and Bauirzhanovna, 2019), Azerbaijan in (Dikkaya and Doyar, 2017; Mukanov and Mekenbaeva, 2017).The most popular approaches to analysis of economic effects arising with the change in the macroeconomic policy regime from exchange rate management to inflation targeting are one-dimensional and multidimensional time series models. For example, one-dimensional models of the autoregressive distributed lag (ADL) type model for Chile can be found in (Schmidt-Hebbel and Tapia, 2002), Russia in (Andreev, 2019; Korishchenko and Pilnik, 2017), Kazakhstan in (Mukanov and Mekenbaeva, 2017; Oshakbaev et al., 2019), Azerbaijan in (Mukhtarov et al., 2019). As a rule such works focus on dynamics of a single indicator – the most popular ones are inflation and exchange rate – depending on the external environment modelled via the state of world commodity markets and also on economic policy pursued.

Within the framework of multidimensional models, the most popular ones are vector autoregression models (VAR) and the vector error correction model (VECM), examples of which for Chile can be found in (Morandé and Schmidt-Hebbel, 2000; Schmidt-Hebbel and Werner, 2002), for Kazakhstan in (Akhmedov, 2019; Rakisheva et al., 2020; Baikulakov and Erzan, 2019), for Azerbaijan in (Hasanov and Samadova, 2010; Majidli and Guliyev, 2020). In these models two sets of variables are usually used: the first set reflects changes in the external environment as reflected in prices in world commodity markets; the second set comprised of exchange rate of the national currency against the US dollar, consumer inflation, economic growth rates, interest rate, volume of foreign exchange reserves instrumentally characterize the present economic policy.

One can also find more advanced versions of multidimensional autoregressive models of the structural VAR type (SVAR) (Tuleuov, 2017). For the Russian economy, examples of SVAR can be found in (Hotulev, 2020; Hotulev and Styrin, 2019), for Kazakhstan in (Hlédik, 2017).

3. DATA AND RESEARCH METHODOLOGY

The modelling uses data on three post-Soviet oil exporting countries – Azerbaijan, Kazakhstan and Russia – who over the past 15 years actively experimented with various regimes of exchange rate and inflation management. Time series monthly data from January 2004 to September 2020 was collected.

Economic dynamics in all three countries crucially depends on export of hydrocarbons. Following (Akhmedov, 2019; Dikkaya and Doyar, 2017; Kartaev and Medvedev, 2019) the exogenously given price of Brent crude oil $brent_t$ is chosen as a variable reflecting the dynamics of world commodity markets. The price of natural gas remains largely linked to the oil price with three to 6 months lag. Nominal exchange rate of national currency to the US dollar $exch\_rate_t$ and nominal key rate of the Central bank key_rate_t are used to reflect macroeconomic policies of monetary authorities. Being economic policies variables both $exch\_rate_t$ and key_rate_t to a large extent depend on export and import flows, transactions in the balance of payments, dynamics of currency market and for this reason are not totally exogenous from external sector developments (Mishkin, 2000; 2004). Official index of consumer inflation cpi_t is used to represent inflation.

Indicators of the average monthly prices of Brent crude oil, the average monthly exchange rate against the US dollar, the key interest rate of the Central Bank and consumer inflation index are initially available on a monthly basis for the three countries. To make seasonal adjustment, all the variables, except for the key rate, are recalculated into the growth rates relative to the corresponding month of the previous year. Therefore, data starting from January 2005 is used in estimations.

Data on GDP growth rate gdp_t to the corresponding period of the previous year is used to describe the economic dynamics. For Azerbaijan, Kazakhstan and Russia the official GDP data is present only on quarterly and annual basis, therefore, the quarterly GDP indicators were recalculated into monthly time series assuming a constant linear growth trend within the quarter. At the time of writing the paper, the official data on GDP growth was available through the third quarter of 2020, so the time period under study ends in September 2020.

Official announcements of policy changes related to shifts in the exchange rate regulation in Kazakhstan and Russia took place in the period of 2014–2015 when the world oil price was falling. Therefore, to identify complex causal relationships in the economies, the period under study from January 2005 to September 2020 was divided into two sub periods. The first subperiod lasts from 2005 to 2013, and the second one lasts from 2015 to 2020. The period of 2014 was deliberately excluded from both parts of the sample, since its inclusion may lead to a bias in the estimates of the models because of the transitionary effects embedded in gradual changes in the economic policies.

The empirical part of the paper is based on Bayesian Vector Autoregressions with Minnesota prior. The models were run on monthly data Standard VAR model of order p, further referred to as VAR(p) model, with K endogenous variables, can be expressed as:

$$y_t = b0 + B_1 y_{t-1} + \dots B_p y_{t-p} + \epsilon_1,\ \epsilon_t \sim N(0,\Sigma), \quad (1)$$

Where y_t is an $K\times1$ vector of endogenous variables at time t, b_0 is an $K\times1$ intercept vector, B_s, $s = 1,\dots, p$ are $K\times K$ coefficient matrices and ϵ_t is a vector of Gaussian shocks with zero mean and covariance matrix Σ.

We assume that the vector n is comprised of five variables:

$$y_t = \begin{pmatrix} brent_t \\ key\_rate_t \\ exch\_rate_t \\ cpi_t \\ gdp_t \end{pmatrix} \quad (2)$$

One of the common problems with VAR models is what is called the curse of dimensionality: the number of coefficients is rising quadratically with the number of endogenous variables of the model and linearly with the lag order p. This problem aggravates for models with relatively high-frequency data as low lag orders are not sufficient to model the processes relevantly. Bayesian Vector Autoregressions impose additional restrictions on the model structure and coefficients, thus allowing to estimate high frequency and higher-order models. Hierarchical Minnesota prior BVARs are used widely in the literature and yield good results (see, among others, Cross et al., 2020; Lenza and Primiceri, 2020; Del Negro et al. 2017, 2019). The calculations are conducted in R with BVAR package (Kuschnig and Vashold, 2019).

The Minnesota prior (Litterman, 1980) requires all the endogenous variables in the model to follow random walk processes. It is known from the literature (Kilian and Lütkepohl, 2017) that such models perform well for macroeconomic time series and yield rather accurate forecasts. The Minnesota prior belongs to the family of Normal-inverse-Wishart priors that imply that

$$\beta \mid \Sigma \sim (b, \Sigma \otimes \Omega)$$

$$\Sigma \sim IW(\Psi, d) \quad (3)$$

Where $\beta = vec([b_0, B_1,\dots,B_p])$, b, Ω, Ψ, d are hyperparameters.

Specifically, the Minnesota prior assumes that:

$$E[(B_s)_{ij} \mid \Sigma] = \begin{cases} 1, \text{ if } i = j, s = 1 \\ 0, \text{ otherwise} \end{cases} \quad (4)$$

that is, the current value of every indicator included in the model equals to its previous value and does not depend on higher order lags of itself and other variables, and

$$cov[(B_s)_{ij}, (B_r)_{kl} \mid \Sigma] = \begin{cases} \lambda^2 \dfrac{1}{s^\alpha} \dfrac{\Sigma_{ik}}{\psi_j / (d-K-1)}, \text{ if } l = j, r = s \\ 0, \text{ otherwise} \end{cases} \quad (5)$$

Where λ, α and Ψ_i are hyperparameters that control the tightness of the prior. For lower values of λ the model tends to be closer to a set of random walk processes. With higher λ values we allow for higher variances of our prior beliefs and the models tend to follow the data more closely. Higher α hyperparameter values make the model shrink the higher lag coefficients to zero stronger, α=0 allows the coefficients for different lags have the same variance. Ψ_i is the i-th value in Ψ and controls the variance of lags of variables other than the variable.

Instead of specifying values of prior hyperparameters, in this paper we utilize the hierarchical approach of (Giannone et al., 2015), in which hyperparameters are treated as additional parameters to be estimated and have their own prior distributions. By specifying reasonably high standard deviations for hyperparameters' priors, we allow the model to select the optimal hyperparameter values itself based on the data. The modes for hyperparameters are chosen to equal the commonly used values as in (Del Negro et al., 2017).

Forecast error variance decomposition (FEVD) is calculated in a standard way. An h steps ahead forecast with origin at time period t is:

$$y_{t+h|t} = B_1 y_{t+h-1|t} + \dots + B_p y_{t+h-p|t} \quad (6)$$

Where $y_{t-i|t} = y_{t-i}$ for $i \geq 0$. The forecast error in this case is:

$$y_{t+h} - y_{t+h|t} = \epsilon_{t+h} + \sum_{i=1}^{h-1} \Phi_i u_{t+h-i} \quad (7)$$

Where Φ_i are coefficient matrices from expansion

$$(I_K - B_1 z - \dots - B_p z^p)^{-1} = I_K + \sum_{i=1}^{\infty} \Phi_i z^i$$

The variance of forecast error in this case is:

$$\Sigma_h = \text{var}(y_{t+h} - y_{t+h|t}) = \Sigma + \sum_{i=1}^{h-1} \Phi_i \Sigma \Phi_i^T \quad (8)$$

If the residual can be decomposed in uncorrelated innovations $\epsilon_t = Au_t$, where $E(u_t)=0$, $var(u_t)=I_k$, then, using Cholesky decomposition we can express $\Sigma = AA^T$ and the forecast error variance can be expressed as $\Sigma_h = \sum_{i=0}^{h-1} \Omega_i \Omega_i^T$, where $\Omega_0=A$, $\Omega_i=\phi_i A, i>0$.

Denoting (n,m) element of Ω_j as $\omega_{nm,j}$ we can express the variance of k-th element of the forecast error vector as a sum:

$$\sigma_k^2 = \sum_{j=0}^{h-1} \sigma_{kj,0}^2 + \ldots + \sigma_{kj,h-1}^2 \tag{9}$$

Where each $(\sigma_{kj,0}^2 + \ldots + \sigma_{kj,h-1}^2)$ term can be interpreted as a contribution of j-th innovation (shock in j-th variable) to the forecast error variance of variable k.

We also calculate historical decomposition – a decomposition of time series in the VAR model into contributions of variables' shocks and some baseline projection.

Rewriting the VAR equation as

$$z_t = Hb_0 + Bz_{t-1} + HAu_t \tag{10}$$

Where

$$z_t = \begin{pmatrix} y_t \\ \ldots \\ y_{t-p+1} \end{pmatrix}, H = \begin{pmatrix} I_K \\ 0_{K(p-1)\times K} \end{pmatrix}, B = \begin{pmatrix} B_1 & \ldots & B_p \\ I_{K(p-1)} & \ldots & 0_{K(p-1)\times K} \end{pmatrix},$$

We can recursively substitute this equation:

$$\begin{aligned} z_t &= Hb_0 + Bz_{t-1} + HAu_t = \\ &= Hb_0 + B\left(Hb_0 + Bz_{t-2} + HAu_{t-1}\right) + HAu_t = \\ &= \ldots = \\ &= \underbrace{\sum_{i=0}^{t-(p+1)} B^j HAu_{t-i}}_{Shocks} + \underbrace{B^{(t-p)} z_p + \left[\sum_{i=0}^{t-(p+1)} B^j\right] Hb_0}_{Baseline} \end{aligned} \tag{11}$$

The shocks component in the equation above is used to obtain historical decomposition.

The study used the BVAR specification with three lags. The number of lags in the model was chosen on two considerations. First, GDP data on a quarterly basis was converted to a monthly format. In this regard it is risky to use less than three lags, since the estimates of the coefficients before the lags of the dependent variable in this case can be strongly biased. The use of more than three lags does not look feasible because the data series are short what would cause instability in the estimates of the coefficients.

The analytical conclusions are not sensitive to use of different ordering of variables in the Cholesky decomposition of historical variance.

4. EMPIRICAL RESULTS AND DISCUSSION

From the point of meaningful interpretation of the changes in the mechanisms of shocks propagation in national economies which followed the announced shifts in economic policies, the impulse response functions (IRF) of such indicators as the change in the exchange rate of the national currency against the dollar, the key interest rate and GDP growth rates to changes in oil prices are of special interest. The study shows that the strongest effects can be detected on the horizon of the first 3–6 months. For analytical convenience, the IRFs in Figures 1-5 are plotted at a depth of 12 months.

4.1. IRFs Modelling

4.1.1. Oil price shocks, key interest rate, exchange rate, GDP growth nexus

The IRFs for the key interest rate for Azerbaijan and Kazakhstan demonstrate that until 2014 the Central Bank rate was increasing countercyclically to rising oil prices (Figure 1). Key rate was used as a stabilizer of economic activity driven by rising oil prices to avoid the risk of overheating. Beginning from 2015 despite recurrent changes in the key rate the latter is insensitive to the oil price shocks. In fact, this means the authorities continued to use the key interest

Figure 1: IRFs: Oil price shock on key interest rate

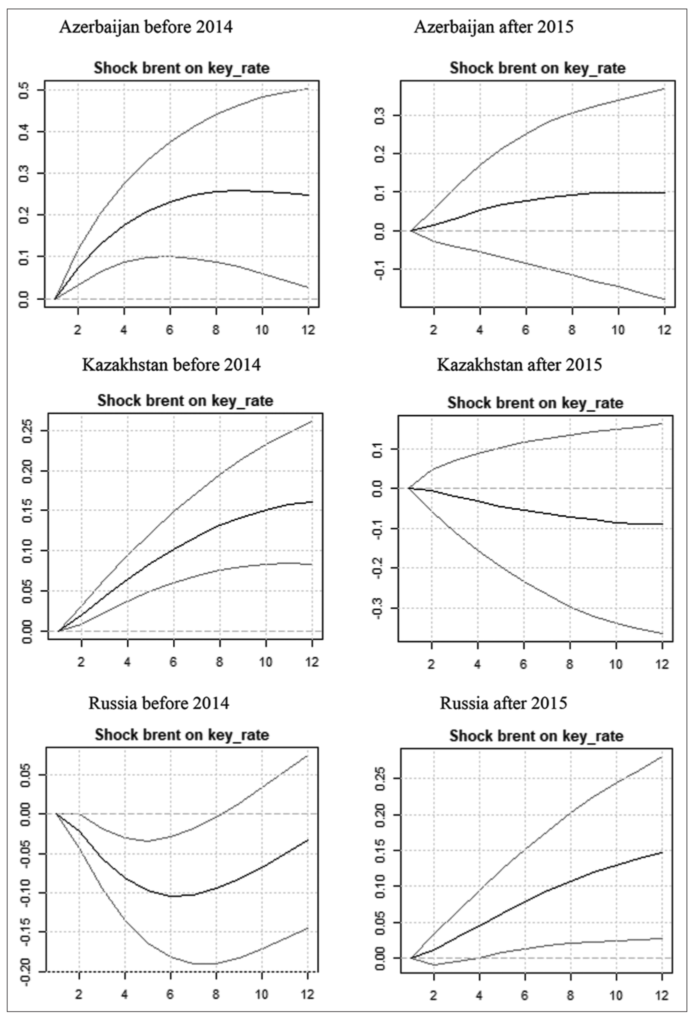


Figure 2: IRFs: Oil price shock on exchange rate

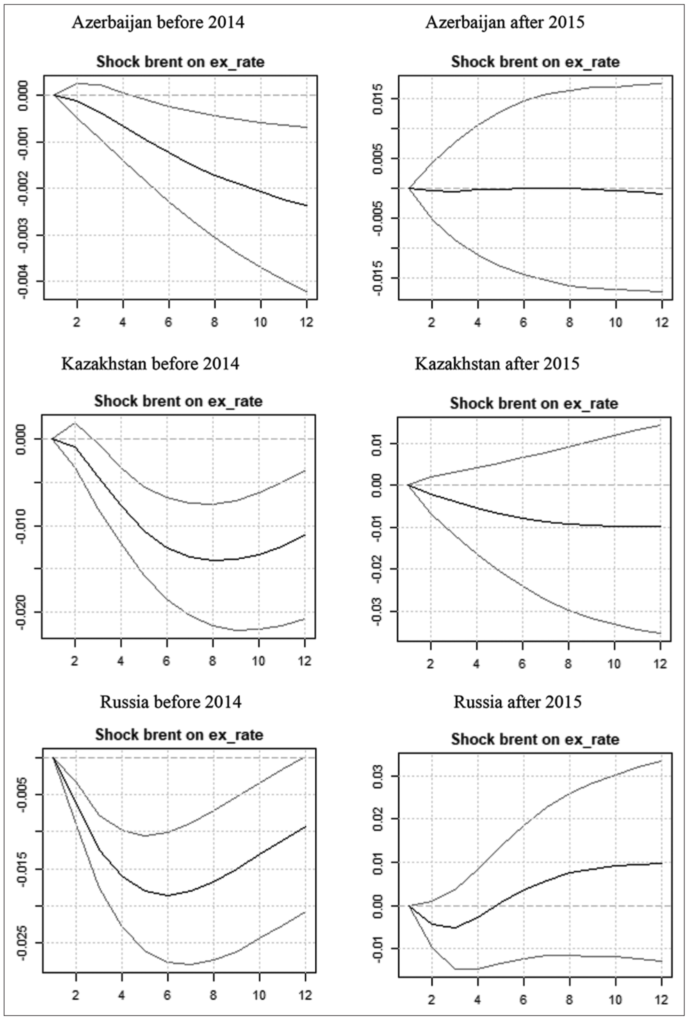
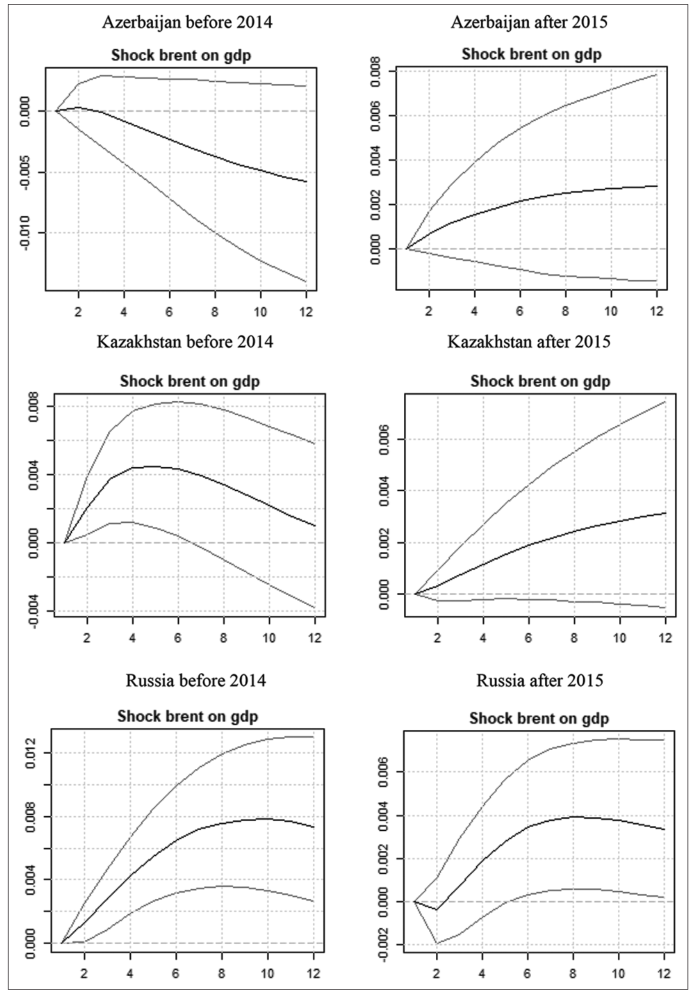


Figure 3: IRF: Oil price shock on GDP growth rate



rate for stabilization of national economy, and at the same time tried to use it as a tool for influencing the rate of economic growth.

The opposite situation is observed for Russia. The modelling shows that until 2014, the rate was used as a tool to stabilize the foreign exchange market during crisis periods – the rate was being increased when oil prices were falling, possibly to the detriment of growth, as well as an instrument to stimulate the economy during periods of high oil prices. Beginning from 2015 the key interest rate, on the contrary, actually became an instrument for stabilizing economic activity by stimulating economic growth during crisis periods. Against the background of a general slowdown in the Russian economy after 2014, the monetary authorities decreased the interest rate when oil prices were falling. It should be specially stressed that these findings are robust to the events of 2020.

Up to 2014 the IRFs for the exchange rate are generally similar to the IRFs for the key interest rate. The strongest sensitivity of exchange rate to oil prices movements is observed in Russia (Figure 2). In Kazakhstan the strength of this effect is weaker but still substantial. In Azerbaijan the effect is on the edge of significance. This difference is explained by a policy of a soft and more flexible exchange rate corridor followed by Russia until 2014. Compared to Azerbaijani manat and Kazakhstani tenge Russian ruble reacted to oil price shocks quicker. In Azerbaijan the exchange rate management regime was especially rigid and not all changes in oil prices found a response in the exchange rate of the national currency.

After 2015 the model doesn't find significant influence of oil price shocks on exchange rate dynamics in all three countries. In Azerbaijan since June 2017 the rate of the national currency has been strictly fixed to US dollar. In Kazakhstan and Russia, approximately at the same moment, various versions of budgetary rule were introduced with the purpose to decouple the exchange rate of the national currency and the economy as a whole from the fluctuations in oil prices. Factually, in 2–3 years after the official announcements on the transition to inflation targeting combined with the free floating exchange rate regime all three countries introduced special policy mechanisms that actually limited free floating and compensated for the volatility of external factors. Moreover, for Russia this period is also characterized by the impact of sanctions, what also distorted the statistical relationship between oil prices and the exchange rate of the national currency.

As for the IRFs related to the GDP growth rate of three countries under consideration, until 2014 the situation in Azerbaijan was very different from that in Kazakhstan and Russia (Figure 3). In the latter two countries, a significant dependence of GDP growth rates on oil prices shocks is observed both before and after 2014. At the same time, after 2014 this dependence weakened significantly because of the introduction of the above-mentioned budget rule with the goal to decouple economic growth from external factors. In Azerbaijan after 2015 the absolutely synchronous with Kazakhstan and Russia dependence of the GDP growth rate on oil prices is observed. Moreover, even the peak IRFs values and periods of their fading practically coincide in three countries. At the same time, until 2014, the models did not reveal stable significant dependency of growth on oil price shocks.

In general, the modelling results suggest that, although all three countries formally announced the transition to a more or less free floating exchange rate policy at about the same time, this transition evolved under different initial conditions. In Russia to a great extent the transition was more prepared in a sense that internal financial market was comparatively more developed and monetary authorities possessed the variety of tools to implement a new policy regime. In Azerbaijan and Kazakhstan the transition turned out to be an irresistible force majeure.

Given the differences in the initial preparedness to follow the regime of (managed) free float the synchronicity of exit from this regime by three countries in 2017 was really astonishing. In Russia and Kazakhstan the free float was replaced and/or supplemented by national variants of budgetary rule. In essence the budgetary rules in both countries imply that the higher world oil price is the larger share of oil and gas export earning is mandatory sterilized in national sovereign funds. The accumulated hard currency reserves allow to support the exchange rate of national currencies. In Azerbaijan national currency was fixed at about 0.6 manat per US dollar. At the moment none of three countries follows the free floating exchange rate.

It can be argued that the main reason behind the abandonment of more or less free floating exchange rate regimes was an effect of the exchange rate pass through into inflation.

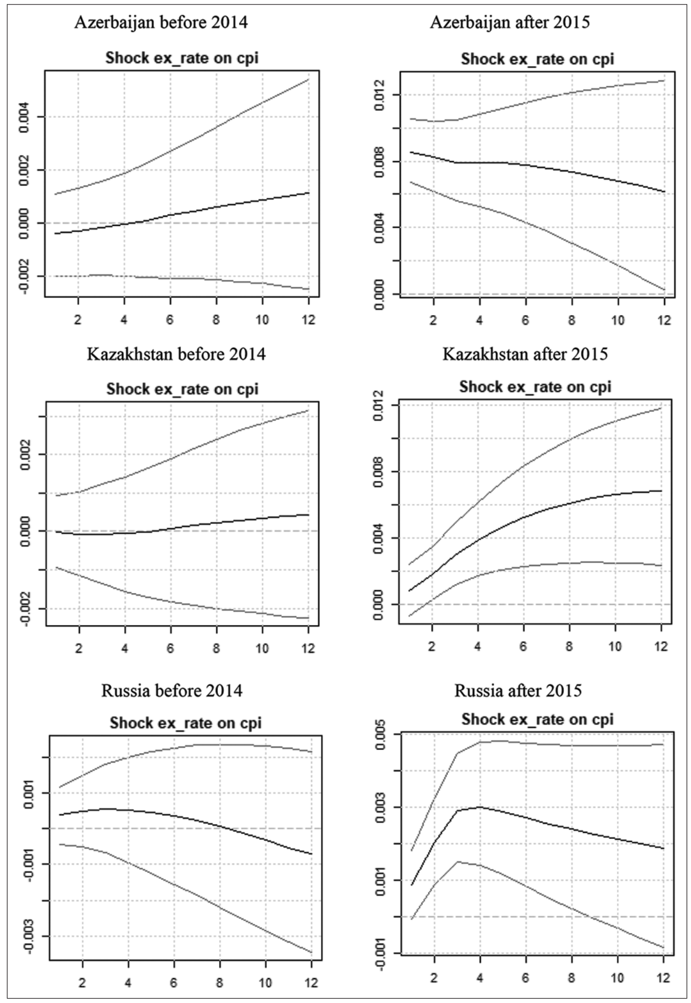
4.1.2. Exchange rate shocks and consumer inflation nexus

Up to 2014 all three economies in varying degree were in the phase of recovery growth. Inflation was primary determined by such non-monetary factors as structure of production costs as well as by the accumulated inertia inbuilt into constantly high inflationary expectations of economic agents. The most important is that a directly controlled or managed exchange rate was bringing relative stability into internal prices dynamics. Unsurprisingly in none of three countries the IRFs reveal significant influence of exchange rate shocks on consumer inflation (Figure 4).

After 2014, shift to new policy regime and its recurrent adjustments have led to establishing of the direct influence of exchange rate shocks on consumer inflation. Moreover, in Azerbaijan and Kazakhstan, the magnitude of these shocks at the peak levels was rather similar. In Russia the reaction of inflation to changes in the exchange rate is almost two folds weaker what is explained by a more diversified production structure, serving both consumer and industrial goods demand.

In sum crisis developments in 2014 – early 2015 forced all three countries in varying degree to loose the regulation of the foreign

Figure 4: IRF: Exchange rate shock on CPI



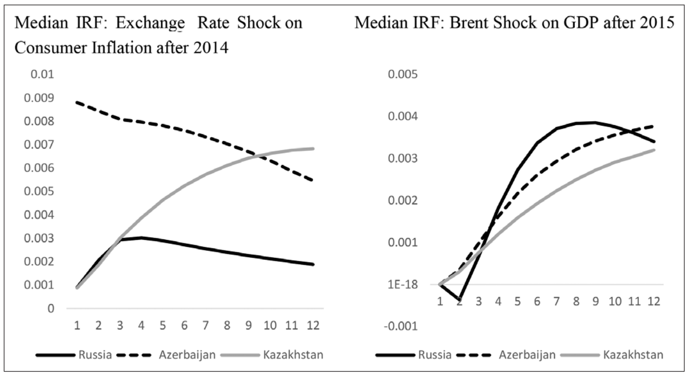
exchange market what in its turn led to a significant adjustment in the exchange rates of national currencies. Exactly during this period Azerbaijan, Kazakhstan and Russia followed very similar polices closely resembling typical cases of a free floating exchange rate regimes. The influence of the exchange rate on inflation reached its maximum. At certain moments the exchange rate was a decisive factor driving consumer prices growth, what is proved by the dispersion decomposition graphs. As a result, all three countries found themselves in a situation where the weakening of the exchange rate regulation, which had become a significant factor in inflation dynamics, led to the loss of control over inflation. Meanwhile at least Kazakhstan and Russia officially implemented the inflation targeting as a priority policy task. Moreover the authorities rapidly found out that the channel of interest rate proved to be less effective than expected for supporting economic growth.

As the result, economic policy in this format did not last long in all three countries. By 2017, all three countries had introduced various economic policy restrictions, from the budgetary rule in Kazakhstan and Russia to fixing of the exchange rate in Azerbaijan. These and related policy innovations moved them far from the declared policies of managing economic system via free floating exchange rate and interest rate channel. Even taking into account the significant difference in the initial conditions and in the variety of implemented policy measures, since the beginning of 2015 direct influence of oil prices movements on GDP growth ceased to exist (Figure 5). Also, in all three countries the link between the oil price and the exchange rate of the national currency has significantly weakened, but at the same time the link between the latter and inflation has increased due to a pass through effects.

4.1.3. Historical variance decomposition of inflation

It is relevant to analyze inflationary dynamics in the nexus of oil price, exchange rate, interest rate and GDP growth interrelated shocks. We use the BVAR analogue of a standard historical variance decomposition, which makes it possible to trace the degree of mutual influence of variables on each other.

Figure 5: Median IRFs after 2014



Using the cumulative FEVD analogs for each variable in the BVAR model (formulas 10 and 11 above) calculated in each point and corrected for changes in the variables themselves, one can get estimates of every variable modelled. Thus it is possible to trace degree of each variable influence on changes in all other variables.

The figures below show the results of such calculations identifying the contributions of individual factors to inflation process in the three countries. The decomposition of effects as of 2014 was calculated using the modelling results obtained for the period 2005–2013. As it has been stated already during 2014, in fact, a mixture of several economic policy regimes was observed. Nevertheless, we make such an adjustment for the purpose of greater clarity of the results of the decomposition.

Figures 6-8 show the influence of $brent_t$, $exch\_rate_t$, key_rate_t and gdp_t on consumer inflation cpi_t. For these calculations unlike previously 2014 was included into the first subperiod in order for greater clarity of the decomposition results. For all three countries the historical variance decomposition of consumer price inflation

Figure 6: Azerbaijan: Historical variance decomposition of CPI

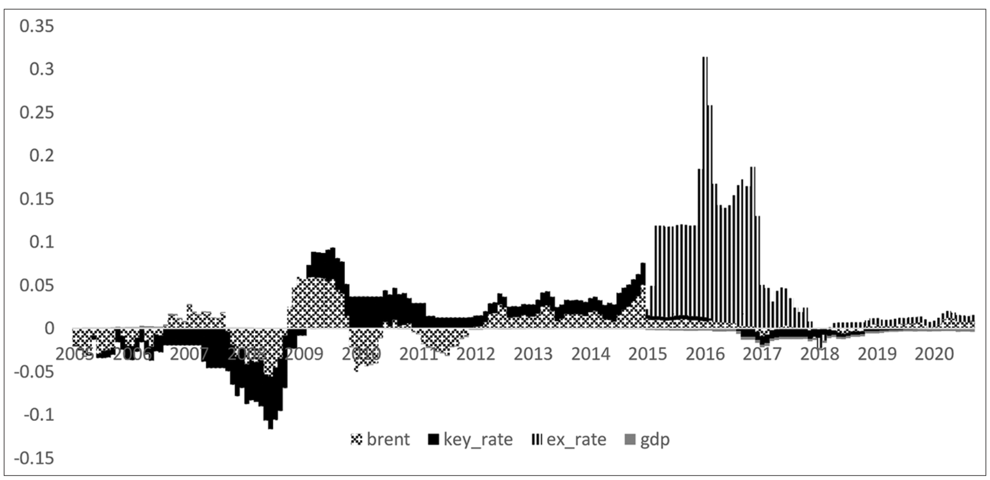


Figure 7: Kazakhstan: Historical variance decomposition of CPI

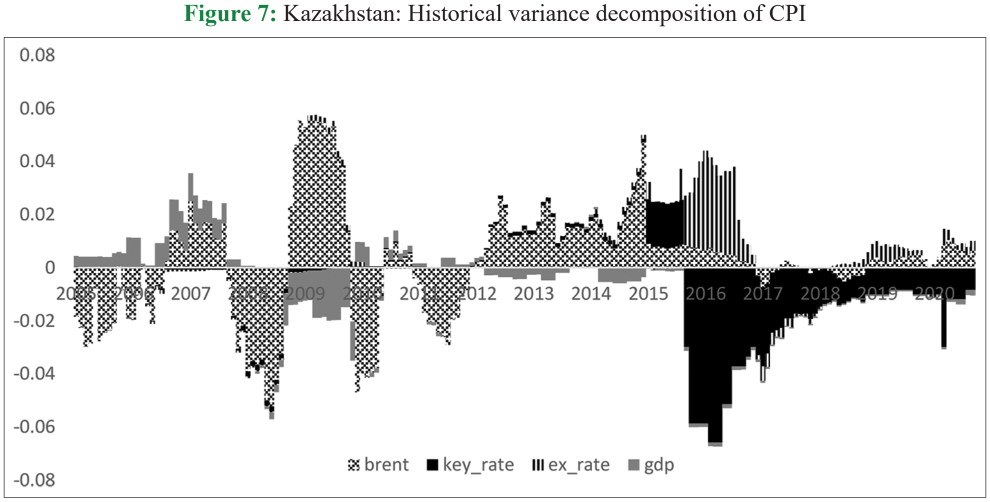
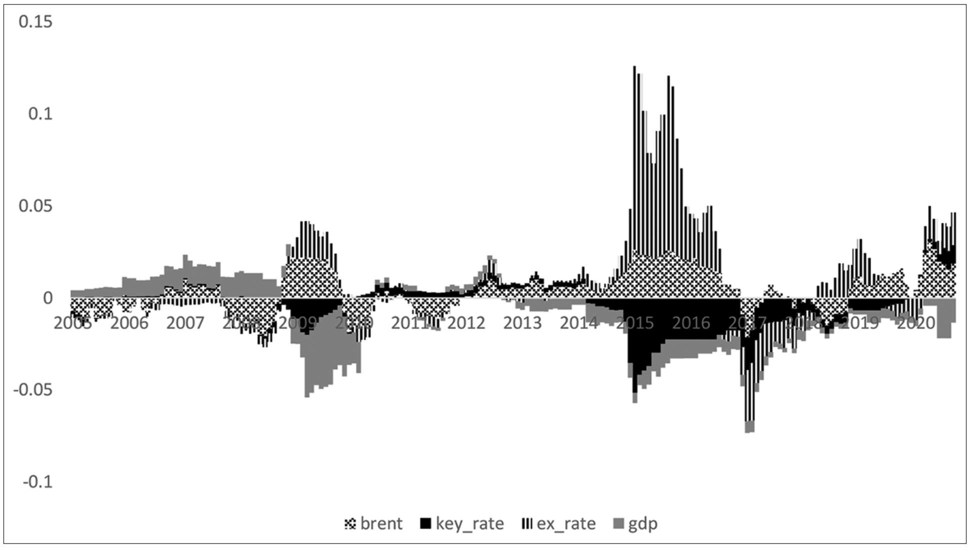


Figure 8: Russia: Historical variance decomposition of CPI



shows that after 2014 the contribution of exchange rate variance has significantly increased. In Kazakhstan and Russia such a dynamics is observed in parallel with deceasing contribution of the GDP variance, what once again confirms the earlier conclusion about signs of overheating of the economy before 2014. In Azerbaijan the changes look even more profound. Before 2014 the exchange rate practically didn't contribute to inflation, the latter was directly driven by fluctuations in oil prices. Beginning from 2015 inflation is driven by exchange rate and oil prices.

5. CONCLUSION

The analysis of the interrelationships of the main variables characterizing the economic policies of Azerbaijan, Kazakhstan and Russia showed that before 2014-2015 each of the three countries stuck to its own principles of monetary policy, implementing in practice one or other version of the managed exchange rate regime. In Russia the Central Bank, unlike its counterparts in Azerbaijan and Kazakhstan, used the key rate for stabilization of the exchange rate countercyclically to the movements in world oil prices. Azerbaijan stands out significantly among three countries as its economic growth during that period was delinked from world oil price dynamics. Kazakhstan occupied an intermediate position between the two: its interest rate policy was similar to that of Azerbaijan, but at the same time the oil price had a significant influence on GDP growth.

Until 2014 in all three countries the main factor contributing to the inflation dynamics was the price of oil. In Azerbaijan an additional contribution in similar direction was made by the key interest rate. In Kazakhstan and Russia inflation was also driven by GDP growth, reflecting the overheating of the economy. Besides, in Russia the exchange rate shocks significantly contributed to inflation.

In all three countries the crisis events of 2014-2015 became a powerful incentive for changes in economic policies regarding the exchange rate and inflation targeting. After 2015 the influence of devaluations of national currencies on inflationary dynamics has noticeably risen in Azerbaijan, Kazakhstan and Russia. Meantime, the effectiveness of inflation targeting policy (or its elements) turned out to be completely different. In Azerbaijan, inflation targeting tools actually failed, and monetary authorities has returned to a managed exchange rate regime. Implicitly that was a recognition that the trajectory of development of a small open economy is fully determined by the exogenous factors. In Kazakhstan, on the contrary, the effect of the shock from the devaluation of the national currency on inflation was offset by changes in the key interest rate. In this particular respect Kazakhstan can be qualified as a country with the "purest" inflation targeting regime. In Russia, changes in the key interest rate were also used to offset the inflationary effect of the devaluation of national currency. Nevertheless, in 2015–2016 the counter effect of the interest rate could not compensate even for the half of the negative shock produced by the devaluation. As the result in 2017 the authorities actually returned to a hybrid currency policy based not on the exchange rate corridor as before 2014, but on the budgetary rule, which allows to stabilize the foreign exchange market by accumulating hard currency reserves.

The floating exchange rate policy given the present structure of the economy has failed to solve the problem of weakening the influence of external factors on GDP and, at the same time, established a channel for the exchange rate to pass-through into inflation. Therefore, starting in 2017, all three countries introduced additional administrative and policy measures and mechanisms to ensure the stabilization of the foreign exchange market.

Generally, management of economic system via interest rate channel with parallel free floating of national currency is a mechanism of fine tuning effective for developed mature economies with the integrated real and financial sectors and with the established forward and backward linkages between economic policies and the economy. In post-Soviet oil exporting countries by the middle of the 2010-s the transition to a mature modern economy has not been completed. Therefore, the shift towards free floating exchange rate and inflationary targeting did not bring the expected results as it has happened for instance in Chile. (Morandé and Schmidt-Hebbel, 2000; Schmidt-Hebbel and Werner, 2002;

Schmidt-Hebbel and Tapia, 2002). Facing unexpected realities, the monetary authorities reversed the course.

One should also consider that the three countries belong to a group of small open commodity exporters heavily dependent on import of consumer, intermediate and capital goods. Economic growth in such economies crucially depends on exogenously given external factors. Possibilities to conduct independent and efficient policies regarding exchange rate and inflation are modest at best.

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