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OIL AND GROWTH CHALLENGE IN KAZAKHSTAN

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Oil and Growth Challenge in Kazakhstan

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Abstract

CIS countries possess extensive natural resources and rely heavily on revenues from primary commodity exports, in particular petroleum and natural gas. We use Kazakhstan's dependence on revenues from the oil sector to demonstrate commodity producer vulnerability to external commodity price fluctuations. The goal of this paper is to examine the nature of the relationship between real GDP, fiscal revenues, real exchange rate, price level, and oil prices. We employ Bayesian approach to time series data for the period 2000–2015. We find evidence of significant effect of oil prices on Kazakhstani economy where one of the key channels playing a role in the effect of oil prices on real activity is related to the real effective exchange rate. Additionally, results of this research indicate that one possible channel for oil price shocks to affect the real exchange rate is through the upward pressure on domestic price level.

Keywords: GDP; Real Exchange Rate; Oil prices

JEL codes: E58, F31, F43, Q4

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Contents

Non-Technical Summary

Kazakhstan possesses extensive natural resources and relies heavily on revenues from the export of primary commodities, in particular petroleum and natural gas. Kazakhstan's dependence on revenues from the oil sector raises the possibility that the economy is vulnerable to external commodity price fluctuations.

According to the report of IMF[1], due to sharp decline in oil prices and expected contraction of Russia's economy, economic activity in Central Asia will continue to decelerate in 2015 and 2016. In Kazakhstan, the impact from lower oil prices and Russia's contraction is being amplified by a slowdown in domestic oil production as a result of delays in development of new oil fields. Moreover, a further decline in oil prices would weaken the fiscal balance of Kazakhstan. At the same time, Kazakhstani government is expected to use its large buffers to provide countercyclical stimulus to the economy over the near term through increases in infrastructure spending.

This research is undertaken in an attempt to shed the additional light on the nature of the relationship between oil prices and economic activity in Kazakhstan. There exists a large literature on the macroeconomic effects of oil price fluctuations. The nature of relationship between oil prices and economic growth is argued to be different for oil importing and oil exporting countries. As for the effect of oil prices on economic growth of oil producing countries, there is no universal answer to this issue.[2] It is argued that one transmission channel for oil prices to affect the economy of the country is through their effect on the exchange rate.[3] The aims of this research, therefore, are three-fold. First, we add to scarce empirical research on the effect of oil prices for Kazakhstani economy by investigating the importance of oil price for Kazakhstani output. Second, we examine the vulnerability of Kazakhstani

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[1] http://www.imf.org/external/pubs/ft/reo/2015/mcd/eng/pdf/cca0515.pdf

[2] Bjornland (2009) provides the 'transmission channels' of oil prices for macroeconomic behavior of oil exporting countries. She argues that for oil producing countries, higher oil prices may affect the economy in two ways: (1) through positive income and wealth effects and (2) through negative trade effects. Regarding the first channel, higher oil prices represent an immediate transfer of wealth from oil importers to oil exporters. As to the second channel, since the oil importing trading partners will suffer an oil induced recession, they will demand less export of traditional goods and services from the oil exporting countries which might have a negative effect on the oil exporting countries. The net effect of the two channels, positive wealth effect and negative trade effect trade effect, therefore, is ambigiuous.

[3] Literature on the natural resource curse phenomena (see for example Frankel, 2010) claims that upward swing in the world price of the export commodity causes a large real appreciation in the currency (taking the form of nominal currency appreciation if the country has a floating exchange rate or the form of money inflows and inflation if the country has a fixed exchange rate).

economy to Dutch disease by analyzing the effect of oil prices on Kazakhstani exchange rate. Third, we investigate whether oil price swings affect the fiscal situation in the country. To examine if and how oil price shocks influence the economic activity of Kazakhstan we employ Bayesian VAR framework to a New-Keynesian (inflation targeting) small open economy model.[4] Results are based on the inspection of the dynamics of key energy and macroeconomic variables as well as the insights from a Bayesian VAR model. We find evidence of significant effect of oil prices on Kazakhstani economy. It is found that one of the key channels playing a role in the effect of oil prices on real activity is related to the real effective exchange rate. Our finding that an increase in oil prices leads to appreciation of real exchange rate is consistent with the literature on oil exporting countries. The results of this study indicate that the impact of the oil price changes on output could be balanced by respective changes in the real exchange rate.

There are different channels for oil price shocks to result in appreciation of real exchange rate. Positive oil price shocks could result in appreciation of the real exchange rate through domestic pricing, or work through pro-cyclical fiscal policy. Results of this research indicate that one possible channel for oil price shocks to affect the real exchange rate is through the upward pressure on domestic price level.

From the economic policy perspective, Kazakhstan should continue to decrease its dependency on energy prices in the longer run through reform policies. In particular, given the important role of real exchange rate, the findings of this study give support to anti-inflation policies. These anti-inflationary policies could restrain the real appreciation of tenge and, hence, support output growth.

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[4] Svensson (2000) presents a relatively simple model of a small open economy, with some microfoundations, and with stylized, reasonably realistic relative lags for the different channels for the transmission of monetary policy: The direct exchange rate channel to the CPI has the shortest lag (for simplicity set to a zero lag), the aggregate demand channel's effect on the output gap has an intermediate lag (set to one period), and the aggregate demand and expectations channels on domestic inflation have the longest lag (set to two periods).

1 Introduction

Kazakhstan possesses extensive natural resources and relies heavily on revenues from the export of primary commodities, in particular petroleum and natural gas. Starting 1999 the Kazakhstani economy was growing rapidly with average growth rate of nine percent annually with most of this growth attributed to the export of petroleum and natural gas. However, Kazakhstan's dependence on revenues from the oil sector raises the possibility that the economy is vulnerable to external commodity price fluctuations. The relationship is important in the region since a drop in world oil prices in the late 2008, followed by considerable rise of commodity prices since mid-2010 with oil prices (Brent) rising by about 40%, increases uncertainty on the oil revenue levels and, as a result, has the capability of destabilizing the entire region of Central Asia and Russia. As a result, in August 200 National Fund of Kazakhstan was created as a stabilization fund that ensures the economy of Kazakhstan is stable against the price swings of oil. This oil fund accumulates financial resources when oil prices exceed target level and dispense funds when prices fall below that level. There are several channels through which oil price shocks might destabilize Kazakhstani economy:

a. Shifts in the tax composition have further heightened the exposure of public finances to commodity price swings and raised the importance of the stabilization function provided by national oil fund.
b. Upward pressures on the exchange rate, resulting from vast oil earnings and FDI flows into the oil sector, might complicate monetary policy management.
c. The appreciation in the real exchange rate makes the development of the non-oil sector more difficult.

According to the report of IMF[5], due to sharp decline in oil prices and expected contraction of Russia's economy, economic activity in Central Asia will continue to decelerate in 2015. Table below presents some economic indicators for Kazakhstan provided by IMF.

Kazakhstan: Selected Economic Indicators

As of March 23, 2015 Average Projections

[5] http://www.imf.org/external/pubs/ft/reo/2015/mcd/eng/pdf/cca0515.pdf

	2000-10	2011	2012	2013	2014	2015	2016
Real GDP Growth (Annual change; percent)	8.5	7.5	5	6	4.3	2	3.1
Consumer Price Inflation (Year average; percent)	9	8.3	5.1	5.8	6.7	5.2	5.5
General Gov. Overall Fiscal Balance (Percent of GDP)	2.5	5.9	4.5	5	1.9	-3.3	-2
Current Account Balance (Percent of GDP)	-1.5	5.4	0.5	0.5	1.6	-4.1	-3.1

In Kazakhstan, the impact from lower oil prices and Russia's contraction is being amplified by a slowdown in domestic oil production as a result of delays in development of new oil fields. As a result, growth is projected to decline to 2 percent in 2015. Moreover, a further decline in oil prices would weaken the fiscal balance of Kazakhstan. At the same time, Kazakhstani government is expected to use its large buffers to provide countercyclical stimulus to the economy over the near term through increases in infrastructure spending. The countercyclical fiscal stance together with lower oil prices, have been contributing to a change in the fiscal balance from a surplus of about 1.9 percent in 2014 to a deficit close to 3.3 percent in 2015. The current account balance in Kazakhstan is expected to turn from a surplus of 1.6 percent of GDP in 2014 to a deficit of 4.1 percent in 2015, reflecting large oil export revenue losses. However, over the medium term, fiscal consolidation is needed to rebuild depleted buffers and adjust spending plans to the new regional and global economic context. The external pressures from the twin shocks of lower oil prices and Russia's slowdown, as well as ruble depreciation and dollar appreciation, suggest that greater exchange rate flexibility will be needed to absorb the shocks, retain competitiveness in the face of upward pressure on the real exchange rate, and prevent a drain on reserves.

All this raises the question to what extend the Kazakhstani economy is affected by dynamics of oil prices. There exists a large literature on the macroeconomic effects of oil price fluctuations. The nature of relationship between oil prices and economic growth is different for oil importing and oil exporting countries. According to the theory, given that crude is a basic production input, supply-side consequences of oil price hikes include a contraction in overall economic activity and inflation. Additionally, aggregate demand is expected to fall in oil importing countries and increase in oil exporting countries. Therefore, general conclusion of all studies conducted to evaluate the impact of oil prices on economic growth of oil-importing countries is that there is a negative correlation between increases in oil prices and the subsequent economic downturns in oil importing countries. As for the effect of oil prices on economic growth of oil producing countries, there is no universal answer to this issue.[6] In the light of that, it is not surprising that scarce existing empirical research on the effect of oil prices on Kazakhstani economic growth produced ambiguous results. While Korhonen and Mehrotra (2009) claim the positive relationship between increases in oil prices followed by higher economic activity in Kazakhstan, Gurvich et al. (2009) find no evidence of oil price importance for Kazakhstani output.

Furthermore, the relationship between oil prices and economic growth rate is argued to be asymmetric as it seems to differ in magnitude depending on hikes or declines in oil prices. This asymmetric effect of oil prices on GDP growth was first found for oil-importing countries as declines in oil prices had a smaller positive effects on economic activity than those predicted by linear model. Later, similar asymmetric relationship between oil prices and economic growth was found for oil-exporting countries. The only study that tested whether the impact of oil prices on economic activity of Kazakhstan is linear in nature was not able to reject the null hypothesis of linearity for Kazakhstan (Korhonen and Mehrotra, 2009). This research is undertaken in an attempt to shed the additional light on the nature of the relationship between oil prices and economic activity in Kazakhstan both in terms of sign and magnitude.

It is argued that one transmission channel for oil prices to affect the economy of the country is through their effect on the exchange rate.[7] Empirical research examining the effect of oil prices on real exchange rate has generally found that an increase in oil prices leads to an appreciation of the domestic currency. Though, estimates of Chen and Chen (2007) imply

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[6] Bjornland (2009) provides the 'transmission channels' of oil prices for macroeconomic behavior of oil exporting countries. She argues that for oil producing countries, higher oil prices may affect the economy in two ways: (1) through positive income and wealth effects and (2) through negative trade effects. Regarding the first channel, higher oil prices represent an immediate transfer of wealth from oil importers to oil exporters. As to the second channel, since the oil importing trading partners will suffer an oil induced recession, they will demand less export of traditional goods and services from the oil exporting countries which might have a negative effect on the oil exporting countries. The net effect of the two channels, positive wealth effect and negative trade effect trade effect, therefore, is ambigiuous.

[7] Literature on the natural resource curse phenomena (see for example Frankel, 2010) claims that upward swing in the world price of the export commodity causes a large real appreciation in the currency (taking the form of nominal currency appreciation if the country has a floating exchange rate or the form of money inflows and inflation if the country has a fixed exchange rate).

an opposite relationship suggesting that a rise in real oil prices leads to a depreciation of the real exchange rate in the long-run. These contradicting results might explain ambiguity of existing empirical research on the effect of oil prices on Kazakhstani exchange rate. While Korhonen and Mehrotra (2009) claim that the role of oil price shocks in explaining movement of real exchange rate is negligible, Kutan and Wyzan (2005) results indicate that changes in oil prices have significant effects on movements in the real exchange rate, particularly, oil price increase leads to appreciation of the real exchange rate. In a new contribution to the debate, we contest the existence of relationship between oil price changes and real exchange rate.

The aims of this research, therefore, are three-fold. First, we add to scarce empirical research on the effect of oil prices for Kazakhstani economy by investigating the importance of oil price for Kazakhstani output. Second, we examine the vulnerability of Kazakhstani economy to Dutch disease by analyzing the effect of oil prices on Kazakhstani exchange rate. Third, we investigate whether oil price swings affect the fiscal situation in the country.

The rest of the article is organized as following: Section 2 provides brief overview of existing literature, Section 3 introduces the theoretical framework, Section 4 describes the empirical model, Section 5 describes the data, Section 6 discusses the results, and Section 7 concludes.

2 Literature Review

The oil price - macroeconomic relationship is expected to be different in oil importing and in oil exporting countries. As a result, there are two strands of literature that focus on the effect of oil prices on economic activity of the country. One strand of literature investigates how oil prices influence economic activity of oil-importing countries. Bernanke et al. (1997), Hamilton (2003), Hamilton and Herrera (2004), Lee et al. (1995), Jimenez-Rodriguez and Sanchez (2005), Hsing (2009), Abeysinghe (2001), Raymond and Rich (1997), Ghosh et al. (2009) have all conducted studies in different time series and concluded that there is a negative correlation between increases in oil prices and the subsequent economic downturns in oil importing countries. Another strand of literature has, conversely, focused on oil producers and found that generally there is a positive relationship between increases in oil prices followed by higher economic activity for oil exporting countries. Bjornland (2009), Jimenez-Rodriguez and Sanchez (2005), Korhonen and Mehrotra (2009) find a positive effect of higher oil prices on the growth rate of Norway, Russia, Kazakhstan, Iran, and Venezuela, respectively. Additionally, Gurvich et al. (2009) showed that the price of oil has a significant effect on the economy of four out of the five oil producing countries (Norway, Russia, Iran, and Venezuela). And at the same time oil exporting countries like the United Kingdom and Canada have behaved more like oil importing countries, showing declining growth rates as a result of higher oil prices (Jimenez-Rodriguez and Sanchez, 2005). However, there are several recent studies that indicate that macroeconomic effects of oil prices have become less profound. Blanchard and Gali (2007) provide several reasons for a milder effects on inflation and economic activity of the recent increases in the price of oil.

This relationship between oil prices and economic growth rate is argued to be asymmetric as it seems to lose significance when the declines in oil prices occur. Moreover, asymmetric effect of oil prices on GDP growth is commonly found for oil-importing countries. Mork (1989), Hamilton (2003), Jimenez-Rodriguez and Sanchez (2005), Jimenez-Rodriguez (2009), Lardic and Mignon (2008), Yang and Lam (2008), Cologni and Manera (2009) find asymmetry between the responses to oil-price increases and decreases by the GDP growth, concluding that the decreases are not statistically significant. Bjornland (2009), Aliyu (2009), and Korhonen, Mehrotra (2009) contribute to this literature by finding asymmetric effects of oil price movements on GDP growth in oil-exporting countries, Norway, Nigeria, and Venezuela, respectively. Korhonen and Mehrotra (2009), however, were not able to reject the null hypothesis of linearity for Iran, Kazakhstan, and Russia.

The macroeconomic literature has identified several primary routes to the asymmetry between oil price changes and GDP responses. That includes the sectoral shifts hypothesis (costly rearrangement of factors across sectors that are affected differently by the oil price change); the demand composition route; and the investment pause effect (along the lines of the irreversible investment model, in which households and firms defer major purchases in the face of uncertainty). Ferderer (1996), Bernanke et al. (1997) have also found a significant relationship between oil price increases and counterinflationary policy responses.

As for the effect of oil prices on real exchange rate, Amano and Norden (1998), Huang and Guo (2007), Kutan and Wyzan (2005), Korhonen and Juurikkala (2009), Narayan et al. (2008) have found that an increase in oil prices leads to an appreciation of the domestic currency. However, Chen and Chen (2007) estimates suggest an opposite relationship that a rise in real oil prices leads to a depreciation of the real exchange rate in the long-run. Korhonen and Mehrotra (2009) have found that a positive shock to real oil prices leads to an appreciation of the real exchange rate only in Iran and Venezuela. In case of Kazakhstan and Russia, the role of oil price shocks in explaining movement of real exchange rate is found to be negligible.

Kutan and Wyzan (2005) examine the vulnerability of Kazakhstan to the Dutch disease by estimating a real exchange rate equation that incorporates oil prices. Their results indicate that changes in oil prices have significant effects on movements in the real exchange rate, particularly, oil price increase leads to appreciation of the real exchange rate. They also provide a plausible explanation of this result. According to Kutan and Wyzan (2005) an increase in the price of oil, which improves oil exporting country's terms-of-trade, would imply an increase in export revenues. This leads to an increased spending of all goods, which increases domestic prices relative to foreign prices, causing an increase in the real exchange rate.

Closer to our analysis, there are a number of papers looking at the effects of oil price on oil-producing countries. Rautava (2004) develops a VAR model to examine dynamics of Russian economy and shows that oil has played a significant role in movements of Russian GDP. Higher oil price leads to higher GDP, in both the short and long run. On the other hand, in the model, a higher oil price does not lead to a stronger real exchange rate, although the author conjectures that this may be because of the estimation strategy. For another major oil producer, Norway, Bjornland (2004), using a structural vector autoregressive framework, shows that an oil price shock stimulates the economy temporarily but has no significant long-run impact. The author finds no evidence to support the proposition that a major part of real exchange rate appreciation in Norway was driven by oil price shocks. Aliyu (2009) assesses the effects of oil price shocks on the real macroeconomic activity in Nigeria. He finds evidence of both linear and non-linear impact of oil price shocks on real GDP. In particular, asymmetric oil price increases in the non-linear models are found to have positive impact on real GDP growth of a larger magnitude than asymmetric oil price decreases adversely affects real GDP. Korhonen, Mehrotra (2009) assess the effects of oil price shocks on real exchange rates and output in four major energy-producing countries: Iran, Kazakhstan, Russia, and Venezuela. Using structural vector autoregressive models, they find that higher real oil prices are associated with higher output, however, they also find that supply shocks are the most important driver of real output in all four countries, possibly due to ongoing transition and catching-up. Authors find that oil shocks do not account for a large share of movements in the real exchange rate. They investigate possible non-linearity in the system by testing a smooth transition regression (STR) model and find no evidence of non-linearity.

As for the effect of oil prices on the Kazakhstani economy, there are few papers that address the issue. Korhonen, Mehrotra (2009) assess the effects of oil price shocks on real GDP and real exchange rate. They find a positive effect of oil prices on real GDP of Kazakhstan. Gurvich et al. (2009), on the other hand, have not found a significant effect of oil prices on real GDP of Kazakhstan. Regarding the influence of oil prices on real exchange rate, again results are not unanimous. Korhonen and Mehrotra (2009) have found that oil shocks do not account for a large share of movements in the real exchange rate. At the same time, Kutan and Wyzan (2005) results indicate that changes in oil prices have significant effects on movements in the real exchange rate. This heterogeneity of results raises a need for more empirical evidence on the effect of oil prices on economic performance of Kazakhstan.

3 Methodology

The main focus of the analysis is to examine if and how oil price shocks influence the economic activity of Kazakhstan. However, to allow for interaction between the identified shocks and monetary policy responses to shocks (the central bank that has an inflation target aims to counteract any effect these shocks might have on inflation), the choice of variables must reflect the theoretical set up of a New-Keynesian (inflation targeting) small open economy model.[8]

3. 1 *Theoretical Framework*

[8] Svensson (2000) presents a relatively simple model of a small open economy, with some microfoundations, and with stylized, reasonably realistic relative lags for the different channels for the transmission of monetary policy: The direct exchange rate channel to the CPI has the shortest lag (for simplicity set to a zero lag), the aggregate demand channel's effect on the output gap has an intermediate lag (set to one period), and the aggregate demand and expectations channels on domestic inflation have the longest lag (set to two periods).

Only the main features are presented below as detailed discussions of the model are already available in the literature. The real oil price o_t, aggregate demand d_t and supply s_t as well as money m_t, are each assumed to follow an autonomous stochastic process:[9]

$$
\begin{aligned}
o_t &= o_{t-1} + \varepsilon^o \\
s_t &= s_{t-1} + \varepsilon^s \\
d_t &= d_{t-1} + \varepsilon^d \\
m_t &= m_{t-1} + \varepsilon^m
\end{aligned}
\tag{1}
$$

The oil price is assumed to affect the supply of output which is determined by its own random walk process:

$$y_t = s_t + \gamma o_t \tag{2}$$

where γ stands for the inverse energy elasticity of output. Demand for output is assumed to follow the random walk process and be also affected by the real exchange rate e_t:

$$y_t^d = d_t + \phi e_t \tag{3}$$

Assuming equilibrium in the goods market leads to the following:

$$y_t^s = y_t^d = y \tag{4}$$

As transactions demand for real money is increasing in output and decreasing in the rate of interest it follows that:

$$m_t = p_t + \delta y_t - \lambda i_t \tag{5}$$

Finally, there is an interest parity condition:

$$i_t = E_t(e_t) \tag{6}$$

Solving equations (1)-(6) yields:

$$
\begin{aligned}
\Delta o_t &= \varepsilon_t^o \\
\Delta y_t &= \gamma \varepsilon_t^o + \varepsilon_t^s \\
\Delta e_t &= 1/\phi\left(\gamma \varepsilon_t^o + \varepsilon_t^s - \varepsilon_t^d\right)
\end{aligned}
\tag{7}
$$

Finally, using (5)-(7), we obtain the following expression for the change in price level:

$$\Delta p_t = \varepsilon_t^m + (-\delta + (\lambda/\phi))\varepsilon_t^s + (-\delta\gamma + (\lambda\gamma/\phi))\varepsilon_t^o - (\lambda/\phi)\varepsilon_t^d \tag{8}$$

From (7)-(8), it is obvious that the relationships between structural shocks can be expressed in a triangular order. Particularly, while oil price is affected solely by oil price shocks, the

[9] Korhonen and Mehrotra (2009) suggest that oil price enters the theoretical framework through the aggregate supply relation, and in the long run only oil price shocks are allowed to impact oil prices themselves.

price level is affected by all four structural shocks. Output is affected by both supply shocks and oil price shocks, while exchange rate is assumed to be affected by the real supply shocks, oil price shocks, and exchange rate.

3.2 *Estimation Technique*

The main focus of the analysis is to examine if and how oil price shocks influence the economic activity of Kazakhstan. While the main emphasis is on real output and real exchange rate, the effect of oil prices on fiscal balance of Kazakhstan is also estimated. The research therefore uses following variables: real oil price (op_t), government revenues ($grev_t$), real GDP (gdp_t), real effective exchange rate against a basket of trading partners ($reer_t$), and inflation (π_t).

The inflation and domestic interest rates are expressed in levels as they are already measured as a ratio. Consistent with most recent vector autoregression studies, the remaining variables will be expressed in log levels (oil price, exchange rate, government revenues and GDP), so that a unit change can be interpreted as percentage.

Vector Autoregression models (VARs) are frequently used in the study of macroeconomic data. Let's consider vector autoregression model of order *p* (or simply, VAR (*p*)):

$$y_t = \sum_{i=1}^{p} \Phi_i y_{t-i} + Dz_t + u_t \tag{9}$$

where y_t is a ($n \times 1$) vector of endogenous variables, z_t is a $(d\times 1)$ vector of exogenous variables, Φ_i and D are ($n\times n$) and ($n\times d$) matrices of parameters respectively, and $u_t =(u_{1t}, u_{2t}, \ldots, u_{nt})'$ is the ($n\times 1$) generalization of a white noise process which is identically independently and normally distributed with variance-covariance matrix $\sum$.).

Vector Autoregressions models are among the most popular tools in economic forecasting. However, despite their popularity, the flexibility of VAR models entails the danger of over-parameterization which can lead to problematic predictions. Even medium-sized VARs (10-20 variables) have several hundred parameters to estimate. A generous parameterization means that unrestricted VARs are not operational alternatives to either standard macroeconometric models, where insignificant coefficients are purged out of the specification, or to parsimonious time series models since, with a limited number of degrees of freedom, estimates of VAR coefficients are imprecise and forecasts have large standard errors. Thus, classical estimation of models like (9) may result in imprecisely estimated relations that fit the data well only because of the large number of variables included.

Bayesian methods can solve these problems: they can make in-sample fitting less dramatic and improve out-of-sample performance. While Bayesian VAR (BVAR) were originally devised to improve macroeconomic forecasts, they have evolved dramatically and they are used now for a variety of purposes. A Bayesian approach to VAR estimation was firstly proposed by Litterman (1980) and it allows the use of prior beliefs on distribution of coefficients. It regards the true population structure as uncertain and takes this uncertainty into account in the form of a prior probability distribution over the model parameters. A statistical procedure is then used to revise these prior beliefs in light of the evidence in the data. This prior distribution then is updated by the information contained in the data.

Equation (9) could be rewritten in the following form:

$$Y_t = X_t\beta + \varepsilon_t \quad t = 1, \ldots T \tag{10}$$

where $X_t = (I_6 \otimes W_{t-1})$ is $n \times nk$, $W_{t-1} = (Y'_{t-1}, \ldots, Y'_{t-p}, z'_t)'$ is $k \times 1$ and $\beta = vec(B_1, B_2, \ldots, B_p, D)$ is $nk \times 1$. The unknown parameters of the model are β and Σ.

Estimation of (11) works as follows. The basic idea is to obtain posterior distribution of the parameters of the model. The posterior distribution is proportional to the product of the likelihood of the observed data and prior distribution of the parameters:

$$p(parameters|data) \propto p(data|parameters)p(parameters)$$

Given the probability density function of the data conditional on the parameters of the model

$$p(Y|\beta,\Sigma) \propto |\Sigma|^{-T/2} \exp\left\{-\frac{1}{2}\sum_t (Y_t - X_t\beta)'\Sigma^{-1}(Y_t - X_t\beta)\right\} \tag{11}$$

and a joint prior distribution of the parameters $p(\beta,\Sigma)$, the joint posterior distribution of the parameters conditional on the data is the following:

$$p(\beta,\Sigma|Y) \propto p(\beta,\Sigma)p(Y|\beta,\Sigma)$$

Many priors have been introduced in the literature, according to the specific economic problem, the sample data, and the way the parameters of the priors $p(\beta,\Sigma)$ are determined. Full Bayesian estimator of (11) requires specifying a prior distribution also for parameters of the prior $p(\beta,\Sigma)$ and then integrating them out of the posterior distribution $p(\beta,\Sigma|Y)$. However, these integrations sometimes could be very complicated or even impossible. In addition, some of priors must take some hyper-parameters as given. One solution is to substitute estimates of the hyperparameters directly into the formulas for the mean and variance of the posterior distributions of the parameters of interest.

Minnesota-Litterman prior is specified as a multivariate normal distribution for the coefficients of the autoregression and it makes large number of coefficients depend on a smaller vector of hyperparameters. If these are the objects estimated from the data, a better precision is expected because of the sheer dimensionality reduction (the noise to signal ratio is smaller; the number of data points per parameter increased), and out-of-sample forecasts can be improved. Even when the prior is false, in the sense that it does not reflect well sample information, this approach may reduce the MSE of the estimates. A number of authors have shown that VARs with a Minnesota prior produce superior forecasts to those of univariate ARIMA models or traditional multivariate simultaneous equations (Robertson and Tallman, 1999). Therefore, BVARs are routinely used for short-term macroeconomic forecasting in Central Banks and international institutions.

Litterman (1986) specifies his priors by appealing to three statistical regularities of macroeconomic time series data:[10] (1) the trending behavior of most macroeconomic time series, (2) the fact that more recent values of a series usually contain more information on current values of the series relative to past values, and (3) past values of variable contain more information on the variable rather than past values of other variables. These regularities are specified by assigning a probability distributions to parameters in such a way that: (1) the mean of the coefficients assigned to all lags except the first one equals to zero, (2) the variance of the coefficients depends inversely on the number of lags, (3) the coefficients of variable *j* in equation *i* are assigned a lower prior variance than those of variable *i*. All these requirements are usually expressed in the form of hyper-parameters, say $\Pi \equiv (\pi_1, \pi_2, \ldots, \pi_H)$

[10] See Ciccarelli and Rebucci (2003) for more details.

. Usually, π_1 controls the value of the mean of the first own lag coefficient, π_2 controls the variance of the own lags, π_3 controls the variance of other lags, π_4 controls the speed of decreasing of the variance as the number of lags increases, π_5 controls the variance of exogenous part, and π_6 controls the degree of prior uncertainty.

Changes in the hyperparameters which lead to smaller (larger) variances of coefficients will be referred to as tightening (loosening) the prior. Thus, in the limit, as the prior is tightened around its mean. Consider θ_t the coefficient vector obtained by stacking up all the coefficients of the vector autoregression. The initial vector θ_1 is given a multivariate normal prior density function with mean $\bar{\theta}$. The covariance matrix of the prior, denoted Σ_1, is generated as a function, F, of the vector of prior parameters π. Thus, at time 1, we have

$$\Sigma_1 = F(\pi) \tag{12}$$

$$\theta_1 \sim N(\bar{\theta}, \Sigma_1) \tag{13}$$

Denoting $\theta^l{}_{i,j}$ the coefficient on lag l, of the j variable in equation i, in the case of the general Minnesota priors we have the following variance of the prior distribution:

$$\operatorname{var} \theta^l{}_{i,j} = \begin{cases} \pi_6 \pi_2 / l^{\pi_4} & \textit{for the } i^{th} \textit{ lagged endogeneous variable} \\ \left(\pi_6 \pi_3 / l^{\pi_4}\right) \sigma_{ii} / \sigma_{jj} & \textit{for the } j^{th} \textit{ lagged endogeneous variable} \\ \pi_6 \pi_5 \sigma_{ii} & \textit{for exogeneous variable} \end{cases} \tag{14}$$

Here π_6 controls the overall prior tightness, π_2 controls the tightness of own lags, π_3 controls the tightness of own lags relative to the tightness of lags of other variables in the equation,

π_4 controls the lag decay in the prior variance with $l = 1, \ldots, p$ denoting the variable's lag, π_5 controls the degree of uncertainty on the coefficients of the exogenous variables. Here σ_{ii}/σ_{jj} is a correction for the scale of series i compared with series j. Such adjustment is necessary to account for the fact that the series are measured in different units and have different degrees of variability (the coefficient of a variable that exhibits large fluctuations in the equation of a variable with moderate fluctuations will have a small prior variance). In general, σ_i is estimated from the standard deviation of the residuals from a p-lag univariate autoregression. Finally, the mean vector is specified as $\bar{\theta} = (0, \ldots, 0, \pi_1, 0, \ldots, 0)$ where π_1 represents the prior mean of coefficient on the first lag.

4 Data

We use quarterly data from the first quarter of 2000 to the last quarter of 2014 to estimate the Bayesian VAR model that includes Kazakhstani GDP, the fiscal revenues, the real effective exchange rate, interest rate, inflation rate as endogenous variables and international oil prices as exogenous variable. The period from 2000 to 2014 is used, which is generally assumed to be a relative stable monetary policy regime in Kazakhstan. Using an earlier starting period would have made it difficult to identify one policy regime. Before their respective financial crises - in August 1998 for Russia and April 1999 for Kazakhstan - both Russia and Kazakhstan used the nominal exchange rate as the nominal anchor - a common practice in transition economies (Korhonen and Mehrotra, 2009). However, fiscal policy in Russia was not compatible with a fixed exchange rate, and eventually the rouble was allowed to float. To keep export competitiveness, Kazakhstan was forced to follow the same practice.

After abandoning the fixed exchange rate regime, Kazakhstan have chosen a policy where the central bank and government agree on inflation targets (Monetary Policy Guidelines, National Bank of Kazakhstan) but there is also a publicly announced ceiling for appreciation of the real exchange rate. In addition, since interbank markets do not yet function very efficiently, the Central Bank of Kazakhstan´s main policy tool continues to be foreign currency intervention. The exchange rate against the US dollar was very stable between 2000 and 2004, after which it has been allowed to appreciate slightly.

Recent efforts by the Kazakhstan Central Bank to manage the Tenge to a trading band and restore fiscal probity have begun to redress the flawed approach of providing unconstrained and expensive downside structural support, to the extent that there is 2009/10 and 2014/2015 evidence that the government was buying up USD in the domestic market in an attempt to prevent Tenge appreciation and volatility. These factors have led to a situation where the Tenge’s exchange rate has sometimes been rather tightly managed. Therefore, Kazakhstan could be said to manage its exchange rate fairly tightly, even though it was not officially pursuing a policy of fixed exchange rates. Situation on the foreign exchange market was changed dramatically in August 2015 when Kazakhstani Central Bank let domestic currency to float.

5 Empirical results

This section provides analysis of the empirical results for the linear model described in the previous section. Firstly, we run the unit root tests using the ADF and the PP techniques. Then we carry out the Wald tests for the joint significance of the oil price coefficients in the model. Finally, we analyse the impulse functions and the accumulated responses and error variance decompositions.

5.1 Unit root test

We conduct tests for stationarity of the series using Augmented Dickey Fuller (ADF) and Phillips and Perron (PP) tests as follows:

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2\, trend + \sum \beta_j \Delta y_{t-j} + \mu_t$$

The main motivation behind tests for unit roots is to see whether shocks to a series have permanent or transitory effects. A unit root in a time series variable implies that the mean and the variance are not constant over time, and the covariance between any two values of the series depends on the actual times at which the variables are observed. This implies that a shock to the variable takes it away from its equilibrium and the series, thus, establishes a new equilibrium. This means that a shock to the variable has a permanent effect on it. When the mean, variance and covariance of a variable are constant, shocks will not lead to a permanent change in equilibrium. Following a shock, the variable will change course; however, after a short period of time it will return to its pre-shock equilibrium. The estimation results are presented in Table 1. The appropriate lag level applied in the unit root test follows the SIC criterion.

Table 1. Unit Root Tests

Variable	ADF	PP
GDP	-0.93***	-0.82***

GOVREV	-0.98***	-1.31***
REER	-0.53***	-0.81***
INFLATION	-2.16***	-3.8***
OIL PRICE	-4.50***	-1.61***

Note: (**,***) indicate significance at 10, 5, and 1 percent respectively.
Lag length was chosen in line with the Schwarz information criterion.

Table 1 results show that all variables are stationary at levels. Meaning, the hypothesis of unit root could be rejected at some percent level.

5.2 *Estimation Results*

Quarterly time series data are sometimes influenced by seasonal and calendar effects. To eliminate the effect of seasonality, the seasonally adjusted time series should be used for estimation purposes. Table 2 provides results of model estimation for seasonally adjusted data. According to the results in Table 2, all variables are in line with expectations and comply with economic theory.

Table 2. Results of Model Estimation for Seasonally Adjusted Time Series

	GOVREV	GDP	REER	INFLATION
GOVREV(-1)	0.064	0.007	0.007	-1.028
GOVREV(-2)	0.033	0.001	-0.0006	-0.487
GDP(-1)	1.344*	0.688***	-0.078	-3.762
GDP(-2)	0.205	0.189***	-0.024	1.053
REER(-1)	-0.022	-0.027	0.292***	1.442
REER(-2)	0.140	-0.003	0.050	0.060
INFLATION(-1)	-0.008	-0.0007	0.0007	0.556***
INFLATION(-2)	0.002	-0.0002	9.13E-05	0.060
OIL PRICE	-0.126	0.046***	-0.048	6.796***
OIL PRICE (-1)	0.545**	-0.037	0.057	-1.851
OIL PRICE (-2)	0.067	0.024	0.107***	-0.933
C	9.627**	0.781**	3.218**	42.549
Adj. R-squared	0.96	0.99	0.86	0.71

Results show that most of variables are affected by either current or past prices of oil suggesting that oil prices have significant impact on country's performance. Particularly, 1 percent increase in current oil prices raises economic growth by 0.05 percent. It will also affect price level in a country and lead to inflation of 6.8 percent. Other variables take time to react to changes in oil prices. Specifically, government revenues mostly depend on oil price in last quarter. Real exchange rate is last to react to oil price changes, one percent increase in oil prices two quarters back brings increase in real exchange rate of 0.1 percent. Upward pressures of oil prices on the exchange rate result in lower economic activity that is experienced in a next quarter after increase in oil prices.

5.3 *Impulse response functions and accumulated responses*

To examine the effects of oil prices on Kazakhstani economy impulse-response functions are employed.

We can derive the specification for the impulse response function that describes the response of $y_{i,t+s}$ to a one-time impulse in y_{jt}, where all other variables are held constant. The matrix φ in Equation (9) can be described as follows:

$$\frac{\partial y_{i,t+s}}{\varepsilon_t'} = \varphi \tag{15}$$

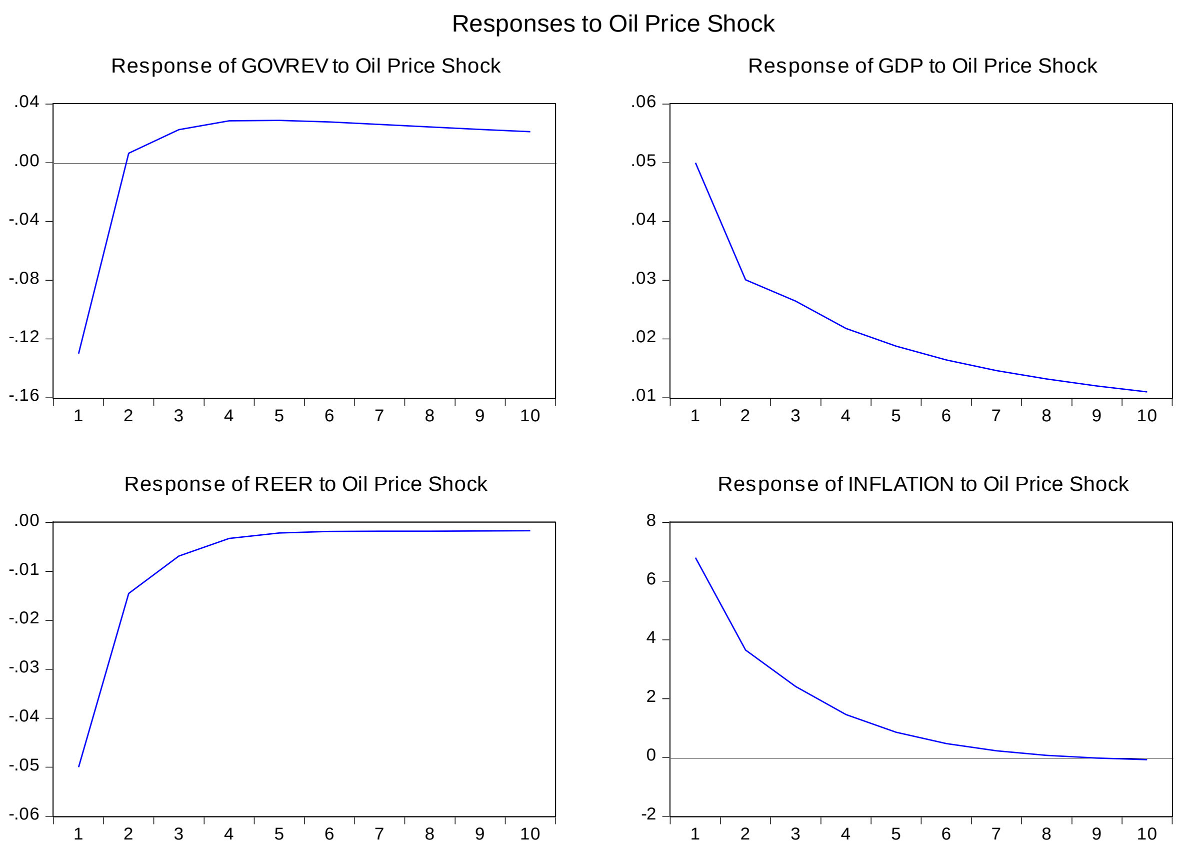
Equation (15) shows that the row *i* column *j* element of φ gives the outcome of a one-unit increase in the *j*th variable's innovation at date *t* (ε_{jt}) for the value of the *i*th variable at time *t*+*s* ($y_{i,t+s}$), holding all other innovations, at all time periods, constant. A plot of the row *i*, column *j* element of φ, $\partial y_{i,t+s}/\partial \varepsilon_{jt}$ as a function of *s* is the impulse response function. In essence, the impulse response function describes the response of $y_{i,t+s}$ to a one-time impulse in y_{jt} with all other variables held constant.

The level of GDP increases as a result of an oil price shock. This is expected, as a positive shock to oil price represents a positive supply shock for a major oil-producing economy. It induces an increase in incomes and wealth and supports consumption, given a constant propensity to consumption from income and wealth.

The impulse responses from the orthogonalized functions as presented in Figure 1 reveal that real GDP in Kazakhstan is positively affected by oil price shocks reaching about 0.5 percent in one three months following the oil price shock. However, in the long run the effect of oil price innovation on real GDP of Kazakhstan diminishes and asymptotically gets to zero after three years following the shock.

Assessing the real exchange rate responses to oil price innovations is another important channel for understanding the impact of oil price shock on the overall macroeconomy. We also examine the effect of oil price shock on the level of real exchange rate. Since Kazakhstan is the oil producing country, Kazakhstani real exchange rate appreciates when higher oil prices lead to higher inflow of foreign exchange into the economy. Although this may sound good for the economy, it, however, has serious implications on real economic activities and the foreign scene due to the heavy reliance of the economy on foreign inputs. Generally, results- that in the medium and long terms oil price innovations in Kazakhstan result in real exchange rate appreciation- are consistent with the theory.

Figure 1. Impulse Responses to One Percent in Oil Prices



Positive oil price shocks could result in appreciation of the real exchange rate through domestic pricing, when an increase in income and wealth of population puts an upward pressure on domestic prices, especially through the increased demand for non-tradable goods. It might also work through pro-cyclical fiscal policy.[11] Therefore, we investigate possible channels through which increase in oil prices leads to an appreciation of real exchange rate, using impulse responses of price level and fiscal budget to oil price shocks.

Positive oil price shocks result in higher price level, one percent increase in oil prices brings up an inflation of around 6 percent. Over time the effect of oil price shock diminishes and asymptotically gets to zero. As for the effect of oil price shocks on fiscal budget, immediate effect of oil shocks on fiscal budget is negative, reflecting the counter-cyclical fiscal policy. However, after 0.5 year country improves its fiscal stance through accumulation of fiscal surpluses.

6. Conclusions

There is one active strand of literature that examines the relationship between real GDP and oil prices. Recent hikes and drops in oil prices have made this topic attractive for policy making. The existent literature, while in large part on developed countries, has established a strong influence of oil prices on the macroeconomy. In this paper, we examined how sensitive Kazakhstani economic activity and fiscal policy to changes in international oil prices.

We find evidence of significant effect of oil prices on Kazakhstani economy. It is found that one of the key channels playing a role in the effect of oil prices on real activity is related to the real effective exchange rate. Our finding that an increase in oil prices leads to appreciation of real exchange rate is consistent with the literature on oil exporting countries. The results of this study indicate that the impact of the oil price changes on output could be balanced by respective changes in the real exchange rate.

There are different channels for oil price shocks to result in appreciation of real exchange rate. Oil price shocks could result in appreciation of the real exchange rate through domestic pricing, or work through pro-cyclical fiscal policy. Results of this

[11] Korhonen and Mehrotra (2009) provide different channels for oil price shocks to affect the real exchange rate.

research indicate that one possible channel for oil price shocks to affect the real exchange rate is through the upward pressure on domestic price level.

From the economic policy perspective, Kazakhstan should continue to decrease its dependency on energy prices in the longer run through reform policies. In particular, given the important role of real exchange rate, the findings of this study give support to anti-inflation policies. These anti-inflationary policies could restrain the real appreciation of tenge and, hence, support output growth.

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