International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2022, 12(3), 477-481.

The Effects of the Oil Price Shock on Inflation: The Case of Kazakhstan

Dinmukhamed Kelesbayev*, Kundyz Myrzabekkyzy, Artur Bolganbayev, Sabit Baimaganbetov

Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkestan, Kazakstan. *Email: dinmukhamed.kelesbayev@ayu.edu.kz

Received: 18 February 2022 **Accepted:** 10 May 2022 **DOI:** https://doi.org/10.32479/ijeep.13061

ABSTRACT

Increases in oil prices (OPs) cause inflation. Interest rates are expected to decrease as a result of the expansionary monetary policies of the central banks in response to the indirect effect of increasing OPs on inflation. Because an increase in OP creates an additional foreign currency inflow to Kazakhstan, this leads to the appreciation of its national currency tenge. Therefore, this study uses monthly Brent OP, Consumer Price Index (CPI), and Real Effective Exchange Rate (REER) values for the period 2015:M1–2021:M11 to investigate the effect of OP on inflation and real exchange rate in Kazakhstan. Analysis are performed using the Structural Vector Autoregression model. The results showed that while the REER mostly affects the OP, the CPI variable affects the REER.

Keywords: Oil Price, Structural Vector Autoregression, Inflation, Real Effective Exchange Rate, Kazakhstan
JEL Classifications: C22, C32, P44, Q43

1. INTRODUCTION

Inflation is defined as a rapid, continuous, and serious increase in the general level of prices, and is one of the most important economic problems. Although it is an undesirable phenomenon that creates significant economic and social costs, a moderate inflation level can contribute to the development of the economy by creating a stimulating effect. The reaction of a national economy to the inflation varies according to the rate of prices, the market mechanism, inflationary expectations, and the economic structures of the country. Deflation in developed countries is due to the focus on price stability as the primary objective of central bank monetary policies. Sustainable development and a low level of stable inflation are two of the main objectives of macroeconomic policymakers. Keynes, the world-renowned economist, preferred to regulate inflation through budget expenditures. Monetarists, on the other hand, see monetary impulses as the main regulator of the economy. This means that the focus should not be on short-term monetary policy, but rather on policies that strengthen the productive potential of an economy.

The main causes of inflation in Kazakhstan can be listed as the inefficiency of regulation methods, economic imbalances, the dominance of raw material orientation, and social and economic inequality between regions. In addition, the devaluation of Kazakhstan's national currency created a sharp decline in economic development and a sharp increase in the prices of imported goods. Other causes of inflation are the institutional environment, national budget deficit, low volume of exported goods, and finally, the FED's monetary policy. The FED's monetary policy has led to the complete dependence of the state, the exchange rate, and many other indicators on oil exports, which has led to an outflow of foreign investments.

This study aims to empirically examine the effect of oil prices (OPs) on the inflation rate using Kazakhstan data. OPs, which are the most important source of income for the economy of Kazakhstan, started to decrease in 2014 and this trend continued during the pandemic period. The structural vector autoregression (SVAR) approach is used to investigate the effect of inflation in Kazakhstan during this period. The article specifically aims to examine the effect of Brent crude OPs on the Consumer Price Index (CPI) and Real Effective Exchange Rate (REER). The reason behind this preference is that the national currency of Kazakhstan, the tenge, is mostly affected by OPs. Therefore, we used a 3-variable SVAR model with OP, CPI, and REER variables.

2. LITERATURE REVIEW

Garzon et al. (2022) analyzed the relationship between the euro/dollar exchange rate and OPs. Their results show that there is a positive relationship between the Euro/Dollar exchange rate and OPs. This is important for the selection of monetary policies to be implemented in the Euro Area during OP shocks.

Kelesbayev et al. (2022) analyzed the relationship between KASE stock market closing prices and OPs using monthly data from the period 2016 to 2021. They preferred Zivot Andrews unit root testing and VAR analysis methods. Their results show that Brent crude OPs have a positive effect on KASE stock market closing prices, while the real exchange rate has a negative effect. Therefore, changes in OPs affect the formation of stock prices.

Husaini and Lean (2021) stress that price stability is crucial for meaningful economic growth. This study examines the asymmetric effect of OP on the exchange rate and inflation in Indonesia, Malaysia, and Thailand. The study showed that, in these countries, an increase in OPs has a greater effect on the producer price index (PPI) compared to the CPI. However, the fall in OPs has had a significant impact on lowering both CPI and PPI in Thailand. In addition, an increase in the exchange rate (currency depreciation) causes an increase in both CPI and PPI.

Köse and Ünal (2021) analyzed the effects of OPs on inflation in Turkey, using the SVAR model, using monthly data from March 1988 to August 2019. Impulse-response functions showed that the response of OP and exchange rate to inflation is significant, especially in the first few months. Their results showed that it is important to follow stable economic policies, including monetary and fiscal policies, to hold inflation. Moreover, they found that OP is the most influential external factor on inflation and they stated that it should be taken into account when implementing other policies.

Bolganbayev et al. (2021) analyzed the effects of OPs on the macroeconomic indicators of the countries bordering the Caspian Sea by performing a panel data analysis on the quarterly data from the 2007 to 2020 period. This research used Peseran's (2007) panel unit root test and Westerlund's (2007) cointegration test. The results showed that OPs have a direct impact on economic growth.

Baimaganbetov et al. (2021) analyzed the effects of real OP shocks on Kazakhstan food inflation using the VAR model with the help of monthly data for the period 2004-2019. They first used the Zivot and Andrews (1992) unit root test and proved that food prices are I (1) according to the Zivot and Andrews (1992) test. In the next step, they performed a causality test and showed that there is bidirectional causality between OPs and food prices. The short-term effects of the variables were investigated using the VAR model. The results showed that crude OPs have an indirect effect on food prices.

Su et al. (2020) investigated the effect of OPs on inflation in the presence of geopolitical risk in Venezuela. Monthly data from January 2008 to August 2019 were used for the analysis. CPI has been used as the proxy of inflation and it has been determined that OP and inflation move together. Moreover, they showed that geopolitical risk plays an important role in influencing the OP. This study draws attention to the fact that Venezuela is highly dependent on oil revenues. Collapses in OPs can seriously exacerbate inflation. Therefore, it is emphasized that countries that are dependent on petroleum exports need political stability to reduce their geopolitical risks.

Tiwari et al. (2019) examined the relationship between OPs and the US CPI using data from January 1871 to June 2018. Their analysis showed that the OP inflation pass-through decreased over time. This relationship also varies between frequencies, showing that the OP-inflation pass-through is weaker in the short run as OPs lead the CPI.

Lacheheb and Sirag (2019) examined the relationship between the changes in OPs and the inflation rate in Algeria between 1970 and 2014. They used nonlinear autoregressive distributed lags. The estimated model showed a non-linear effect of OPs on inflation. Specifically, there is a significant relationship between the increase in OPs and the inflation rate, while there is no significant relationship between the decrease in OPs and inflation.

Malik et al. (2017) examined the effects of OP shocks on Pakistan's main macroeconomic variables with the help of the SVAR model using annual data for the period 1960–2014. The impulse-response analysis showed that OP shocks suppress the real gross domestic product and the real exchange rate depreciates. Moreover, OPs seem to have a positive effect on the long-term interest rates and inflation. Decomposition analysis of variance showed that OPs have a great impact on Pakistan's inflation rate.

Köse and Baimaganbetov (2015) analyzed the asymmetric effects of real OP shocks on industrial production, real exchange rate, and inflation in Kazakhstan during the 2000–2013 period with the help of the Structural VAR model. The results show that negative OP shocks have a greater impact on Kazakhstan's economic performance. In addition, the direct effect of oil shocks on the real exchange rate in Kazakhstan is limited. Also, there is no strong evidence for Dutch disease as positive shocks do not have a significant effect on the real exchange rate for Kazakhstan.

3. DATA SET AND METHODOLOGY

In this study, the OP is defined as Brent OP per barrel in US dollars. The CPI is used as the proxy for inflation. The REER Index is the weighted average change of the Tenge exchange rate adjusted for changes in relative prices of Kazakhstan's main trading partners relative to the currency basket of 32 countries. An increase in the index means the appreciation of the national currency, while a decrease means its depreciation. The data used in this study are monthly data from the 2015 to 2021 period. CPI and REER Index data were obtained from the electronic data distribution system of the National Bank of Kazakhstan, and Brent OP data was obtained from the energy information administration.

The list of variables used in this study is as follows:
- OP: Brent OP
- CPI: CPI (2015 = 100)
- REER: REER Index (2015 = 100).

The general representation of an SVAR model based on VAR models, consisting of k endogenous variables (i.e., k-dimensional), with a maximum delay number p (i.e. in the order of p), is given in equation (1).

$$Ay_t = A_0 + A_1 y_{t-1} + \cdots + A_p y_{t-p} + B\varepsilon_t \quad (1)$$

Here, y_t represents the vector of (k × 1) dimensional variables, A_i (i = 1,.....p) (k × k) represents the coefficients matrix, A represents the coefficients matrix showing the simultaneous relationships between the variables, and εt represents the (k × 1) dimensional structural shocks vector. It is assumed that the endogenous variables are stationary, structural shocks are serially unrelated white noise processes.

Since the current values of the variables in SVAR models have simultaneous effects on other variables, it is not possible to make direct predictions from the model (1). Therefore, by multiplying both sides of the structural model by A^{-1}, the reduced VAR model shown in equation (2) is obtained:

$$y_t = \Gamma_0 + \Gamma_1 y_{t-1} + \cdots + \Gamma_p y_{t-p} + u_t \quad (2)$$

Here, $\Gamma_0 = A^{-1}A_0$, $\Gamma_1 = A^{-1}A_1$, $\Gamma_p = A^{-1}A_p$, and $u_t = A^{-1}\varepsilon$ represents the descriptions. Also, the reduced form error term u_t is an unobservable zero-mean white noise process with $k\,x\,1$ dimensions. The link between the structural shocks (ε_t) and the reduced shape error term (u_t) becomes interrelated in the system (3):

$$u_t = A^{-1}B\varepsilon_t \quad (3)$$

Moreover, the relationship between the variance-covariance matrices of u_t (observed) and ε_t (unobserved) is as follows:

$$\sum_u = A^{-1}BB'(A^{-1})' \quad (4)$$

The important point here is that the residual terms of the reduced-form model and the structural model shocks have become "combined." In other words, the residual terms of the discounted model are "mixed" with the simultaneous effects of indirect shocks on the variables. Although these composite shocks show the estimation errors of the variables, they do not have a structural explanation. In other words, residual terms and coefficients obtained from the reduced model do not reflect the true structural coefficients and shocks. According to Enders (1995), this combination of prediction errors is not important as long as only the prediction is concerned. However, if one desires to obtain impulse-response functions and variance decomposition to reveal the effects of shocks in each variable, structural shocks should be used. In this case, structural shocks should be decomposed. For this operation, it is necessary to impose $(k2 - k)/2$ constraints on the A and/or B matrices. Because the variance-covariance matrix of structural shocks consists of $(k2 + k)/2$ independent elements. If matrix A is the unit matrix, the number of constraints to be placed on non-zero elements of matrix B should not exceed $(k2 - k)/2$ for a fully defined system as the order condition requires. In this framework, two groups of constraints, namely short-term and long-term constraints, are applied to distinguish between the instantaneous or short-term relations between the variables and the long-term relations.

Table 1: Results of ADF unit root testing

Variables	ADF Test		First Difference	
	Statistics	Probability	Statistics	Probability
Oil prices	−3.007684	0.1375	−6.575754	0.0000
CPI	−1.257036	0.6451	−5.021682	0.0001
Reel effective exchange rate	−2.325117	0.1670	−8.421921	0.0000

The first application of short-run constraints was made by Sims (1980) and it is called Cholesky Decomposition. In this method, structural shocks enter the system in form of a lower triangular or recursive structure. Accordingly, while the first variable in the ranking is affected only by its own shocks, the second variable is affected by both itself and the shocks of the first variable, and finally, the last variable is affected by shocks belonging to other variables as well as its own shocks. However, in such a Wold Causal Chain structure, the action-response functions are extremely sensitive to the ordering of the variables. Because 6 different orders are possible in a three-variable system, and each order can significantly affect the results (Enders, 1995). Therefore, Bernanke (1986) and Sims (1986) suggested using a non-recursive structure.

In these models, which are referred to as SVAR models in the literature, the constraints are applied according to the economic theory and the order of the variables is not important. In this framework, three types of SVAR models can be mentioned, namely the A Model, B Model, and AB Model, according to the constraints applied to A and/or B matrices. In Model A, which was developed to model the relationships between directly observable variables, the focus is on autoregressive coefficients, and $(k2 - k)/2$ constraints are applied to matrix A while B is the unit matrix.

On the other hand, in Model B, which focuses on the effects of structural shocks, structural shocks are determined from directly reduced form residual terms, and a constraint is placed on the B matrix. In this model, where A is taken as the unit matrix, the number of constraints to be imposed is again $(k2 - k)/2$. Finally, in the EU Model, in which both the simultaneous relations between variables and the effects of structural shocks are handled together, constraints are imposed on both the A and B matrix. However, the number of constraints in this model is $k2 + (k2 - k)/2$ (Amisano and Giannini, 1997; Breitung et al., 2004; Lütkepohl, 2005).

Since the persistence of the effects of shocks in OPs on the CPI and real exchange rate is investigated in this study, the A and

Table 2: VAR lag order selection criteria

Lag	LogL	LR: sequential modified LR test statistic (each test at 5% level)	FPE: Final prediction error	AIC: Akaike information criterion	SC: Schwarz information criterion	HQ: Hannan-Quinn information criterion
0	597.2796	NA	3.03e-12	−18.00847	−17.90894*	−17.96914*
1	608.2632	20.63585	2.86e-12	−18.06858	−17.67046	−17.91127
2	620.0947	21.15334*	2.63e-12*	−18.15438*	−17.45768	−17.87908
3	624.2564	7.062260	3.05e-12	−18.00777	−17.01247	−17.61448
4	632.4894	13.22276	3.15e-12	−17.98453	−16.69064	−17.47325
5	636.6565	6.313689	3.70e-12	−17.83807	−16.24560	−17.20881
6	639.2088	3.635218	4.59e-12	−17.64269	−15.75163	−16.89544

B matrices of the long-term constrained SVAR model adopted following Enders (1955) can be shown as follows within the framework of the variables of this study:

$$\begin{bmatrix} 1 & 0 & 0 \\ a_{11} & 1 & 0 \\ a_{12} & a_{13} & 1 \end{bmatrix} \begin{bmatrix} e_t^{oil} \\ e_t^{cpi} \\ e_t^{reer} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 \\ 0 & b_{22} & 0 \\ 0 & 0 & b_{33} \end{bmatrix} x \begin{bmatrix} u_t^{oil} \\ u_t^{cpi} \\ u_t^{reer} \end{bmatrix} \quad (5)$$

Impulse-response functions are moving average coefficients that measure the response of a variable to a particular shock over time. The variance decomposition of prediction error determines the contribution of each shock to the prediction fluctuation (the deviation in the prediction error variance) after the p period. If the change in any shock type does not explain the error variance of the prediction of the y series at all, then the y series is external and acts independently of the other variable and the shocks of that variable (Enders, 1995: 311; Lütkepohl, 2005: 64).

4. ANALYSIS AND DISCUSSION

In this part of the study, stationarity analyzes, which are extremely important for time series analysis, are given. To test the stationarity, we used the unit root test, which is the most popular method in empirical studies.

If we analyze the results in Table 1, we can see the H_0 hypothesis of the ADF test is built on the existence of a unit root. The results of the ADF test statistics showed that all the variables in the model are stationary after their first differences are calculated. In other words, it is I(1).

The results in Table 2 show that the appropriate delay length is two (2) according to the Sequential Modified LR test statistic and Final Prediction Error Akaike Information Criterion. Therefore, the VAR model without autocorrelation is VAR(2).

Table 3 shows that the OP variable almost completely explains itself at the end of the 1st period. This shows that it is the most exogenous of the variables. In the 3rd period, approximately 3.78% of the variance of the OP variable is explained by the REER and 0.29% by the CPI. At the end of the 10th period, approximately 94% of the variance of the OP variable is explained by itself. When the other variables are examined, it is seen that approximately 5% of the variance of the OP variable is explained by the REER at the end of the 10th period. Therefore, variance decomposition findings reveal that at the end of the 10th period, the changes in OPs are mostly explained by the REER.

Table 4 findings show that at the end of the 1st period, approximately 13.07% of the REER variable is explained by OP. On the other hand, it can be said that the shocks occurring by the CPI variable do not affect the REER variable. At the end of the 10th period, approximately 79.44% of the variance of the REER variable is explained by himself. Thus, at the end of the

Table 3: Variance decomposition of oil price

Period	Standard Error	Oil Price	REER	CPI
1	0.128328	100.0000	0.000000	0.000000
2	0.133819	99.22349	0.767393	0.009120
3	0.137387	95.91880	3.786175	0.295029
4	0.139198	94.61434	5.038129	0.347533
5	0.139266	94.58164	5.058730	0.359631
6	0.139505	94.45612	5.184563	0.359315
7	0.139510	94.45212	5.186133	0.361750
8	0.139534	94.43887	5.199490	0.361639
9	0.139538	94.43671	5.201445	0.361843
10	0.139539	94.43589	5.202151	0.361958

Table 4: Variance decomposition of Reel effective exchange rate

Period	Standard Error	Oil Price	REER	CPI
1	0.013812	13.07780	86.92220	0.000000
2	0.014553	13.07664	82.25671	4.666646
3	0.014857	14.92912	80.27237	4.798506
4	0.014952	15.32268	79.73590	4.941419
5	0.014964	15.40300	79.64481	4.952184
6	0.014988	15.51636	79.48486	4.998780
7	0.014990	15.51248	79.45927	5.028252
8	0.014993	15.51590	79.44482	5.039279
9	0.014993	15.51536	79.44242	5.042220
10	0.014994	15.51656	79.43947	5.043971

Table 5: Variance decomposition of CPI

Period	Standard error	Oil price	REER	CPI
1	0.000887	2.733857	7.897548	89.36859
2	0.000927	2.598446	7.949186	89.45237
3	0.000976	2.840400	7.184998	89.97460
4	0.000991	3.151594	6.969034	89.87937
5	0.001001	3.173796	6.859413	89.96679
6	0.001005	3.160763	6.863005	89.97623
7	0.001007	3.161321	6.851615	89.98706
8	0.001008	3.169813	6.842439	89.98775
9	0.001008	3.173654	6.837465	89.98888
10	0.001008	3.174110	6.836071	89.98982

10th period, approximately 15.51% of the variance of the OP variable is explained by the REER. The explanatory power of the CPI is approximately 5.04%. Therefore, variance decomposition findings show that the REER changes are explained by OP and CPI at the end of the 10th period.

Table 5 findings show that at the end of the 1st period, approximately 7.89% of the CPI variable is explained by REER and 2.73% by the OP. The effects of other factors decrease over time and at the end of the 10th period, 89.9% of the changes are self-explained. This means that inflation is mostly affected by its own shocks and turns into a self-feeding circle after a while.

5. CONCLUSION

Historically, the emergence of money and money relations in societies can cause deterioration in prices. Disproportions in all areas of the economy resulted in higher prices and a decrease in the purchasing power of the population. This, in turn, leads to the problem of inflation and the poverty of the masses. In this study, OP and Kazakhstan's CPI and REER data are used. The price of oil, which is the most important source of income for the economy of Kazakhstan, started to decrease as of 2014 and this process continued during the pandemic. By looking at Kazakhstan's data for this period through the SVAR approach, we investigated how inflation was affected during the low OP period. In particular, the effect on Brent OP CPI and REER is examined.

The first stage of the study included stationarity analysis, which is extremely important for time series analysis. ADF unit root test is used to test the stationarity of variables. The results showed that, after their first difference, all the variables of the model are stationary. In the next step, the delay order for the VAR model is determined. The results showed that the appropriate lag length according to the Sequential Modified LR test statistic and Final Prediction Error, Akaike Information Criterion is two (2). Therefore, the VAR model without autocorrelation is VAR(2).

In the last stage, SVAR analysis was performed. The findings showed that approximately 94% of the variance of the OP is explained by itself and 5% by the REER. On the other hand, approximately 79.44% of the variance of the REER is explained by itself and 15.51% by the OP variable. Finally, we saw that the effect of other factors on the CPI decreases over time, and 89.9% of the changes are explained by itself and 6.83% by the REER. We can conclude that the most effective variable on the OP is the REER and the CPI affects the REERs.

REFERENCES

Amisano, G., Giannini, C. (1997), Topics in Structural VAR Econometrics. 2nd ed. Berlin, Germany: Springer-Verlag.

Baimaganbetov, S., Kelesbayev, D., Baibosynova, G., Yermankulova, R., Dandayeva, B. (2021), The impact of oil prices on the food inflation in Kazakhstan. International Journal of Energy Economics and Policy, 11(3), 73-79.

Bernanke, B. (1986), An Alternative Explanations of Money-Income Correlation. NBER Working Papers, No: 1842.

Bolganbayev, A., Myrzabekkyzy, K., Baimaganbetov, S., Kelesbayev, D. (2021), The effect of oil prices on the economic growth of oil exporting countries bordering the caspian sea: Panel data analysis. International Journal of Energy Economics and Policy, 11(6), 432-437.

Breitung, J., Brüggemann, R., Lütkepohl, H. (2004), Structural vector autoregressive modeling and impulse responses. In: Applied Time Series Econometrics. United States: Wiley. p159-196.

Enders, W. (1995), Applied Econometric Time Serie. New York: John Wiley & Sons.

Garzon, A.J., Hierro, L.A., Recio, H., Angel, L. (2022), Inflation, oil prices and exchange rates. The Euro's dampening effect. Journal of Policy Modeling, 44(1), 130-146.

Husaini, D.H., Lean, H.H. (2021), Asymmetric impact of oil price and exchange rate on disaggregation price inflation. Resources Policy, 73, 102175.

Kelesbayev, D., Myrzabekkyzy, K., Bolganbayev, A., Baimaganbetov, S. (2022), The impact of oil prices on the stock market and real exchange rate: The case of Kazakhstan. International Journal of Energy Economics and Policy, 12(1), 163-168.

Köse, N., Baimaganbetov, S. (2015), The asymmetric impact of oil price shocks on Kazakhstan macroeconomic dynamics: A structural vector autoregression approach. International Journal of Energy Economics and Policy, 5(4), 1058-1064.

Köse, N., Ünal, E. (2021), The effects of the oil price and oil price volatility on inflation in Turkey. Energy, 226, 120392.

Lacheheb, M., Sirag, A. (2019), Oil price and inflation in Algeria: A nonlinear ARDL approach. The Quarterly Review of Economics and Finance, 73, 217-222.

Lütkepohl, H. (2005), A New Introduction to Multiple Time Series Analysis. Berlin, Germany: Springer-Verlag.

Malik, K., Ajmal, H., Zahid, M.U. (2017), Oil price shock and its impact on the macroeconomic variables of Pakistan: A structural vector autoregressive approach. International Journal of Energy Economics and Policy, 7(5), 83-92.

Sims, C. (1980), Macroeconomics and reality. Econometrica, 48(1), 1-48.

Sims, C. (1986), Are forecasting models usable for policy analysis. In: Federal Reserve Bank of Minneapolis Quarterly Review. Germany: Winter. p3-16.

Su, C.W., Khan, K., Tao, R., Umar, M. (2020), A review of resource curse burden on inflation in Venezuela. Energy, 204, 117925.

Tiwari, A.K., Cunado, J., Hatemi, J.A., Gupta, R. (2019), Oil price-inflation pass-through in the United States over 1871 to 2018: A wavelet coherency analysis. Structural Change and Economic Dynamics, 50, 51-55.

Zivot, E., Andrews, D. (1992), Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. Journal of Business and Economic Statistics, 10(3), 251-270.