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The Impact of Oil Prices on Inflation: The Case of Azerbaijan

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ABSTRACT

This paper investigates the relationship between inflation, oil prices and exchange rate in Azerbaijan using the vector error correction model (VECM) to the data ranging from 1995 to 2017. The results from cointegration method confirm the existence of a long-run relationship among the variables. Moreover, estimation results of VECM show that the oil prices and exchange rate have positive and statistically significant impact on inflation in the long-run. This implies that 1% increase in oil prices and exchange rate increases inflation by 0.58% and 1.81%, respectively. The results of the study also reveal that inflation is observed during the periods of both high and low oil prices, and the exchange rate acts as the transmission channel from oil prices to inflation.

Keywords: Inflation, Oil Price, Exchange Rate, Vector Error Correction Model, Azerbaijan
JEL Classifications: E31, Q4

1. INTRODUCTION

Economic situations of countries are being constantly shaped by globalization. In the last decades, the economies can be analyzed in two periods: Periods observed with high and low oil prices. Vast empirical studies suggest that there is a linear relationship between oil price fluctuations and economic growth (Hamilton, 1983; Papapetrou, 2001; Werner, 2005; Gbadebo, 2009). However, the sign and significance of this relationship depend on whether countries are oil exporters or importers. In the case of countries that import petroleum as raw material, oil price fluctuations change their production costs, the level of goods and services produced, and consequently affect main macroeconomic variables such as inflation and unemployment. The case is relatively different in oil-exporting countries such that oil price fluctuations exert both supply and demand shocks.

Response to positive shock:

- National economies of oil-rich countries depend largely on crude oil exports;
- Some of this revenue is saved in sovereign wealth funds (for future generations and to preserve macroeconomic stability during recessions associated with negative oil price shocks) and the remaining revenue is transferred to the state budget to stimulate economic diversification and growth;
- However, possibly due to structural sluggishness caused by misallocation and inefficient use of resources, and the booming oil industry and non-tradable sector, production (or tradable) sector shrinks and a low level of economic diversification is followed;
- Meanwhile, huge foreign currency inflow increases the value of a national currency and, as a result, goods and services in a domestic economy become relatively expensive than those in other countries. This in turn also hinders diversification and makes the economy vulnerable to oil price shocks;
- Therefore, having less diversified economies and weak financial sectors, oil-rich countries tend to peg their national currencies against foreign currencies, particularly the US dollar in order to ensure their economies against negative externalities;

- Because of the above-mentioned low production possibilities, these countries incline to import most consumer and industrial goods from other countries to satisfy domestic consumption. Hence, oil price shocks that affect production sectors and consumer prices in other countries also affect the economies of oil exporting countries;

Response to negative shock:

- Plummeting oil prices decrease oil revenue and foreign currency inflow, and as a result, the domestic currency loses its value. Currency devaluation is beneficial for the domestic economy by making its goods and services relatively cheaper than those in foreign countries and can promote export diversification. However, in the short run, because of present low economic diversification and sustained reliance on imports, oil-rich countries may experience inflation again.

From these points of view, we conclude and hypothesize that oil-rich countries may undergo inflation in both periods if their economies are less diversified. Therefore, oil-price transmission channels are assumed to be low economic diversification and fluctuations in exchange rates.

The aim of this study is to investigate the relationship between oil price fluctuations and inflation in the case of Azerbaijan. Azerbaijan is an oil-rich country, has passed the above-mentioned economic trajectory and faced similar challenges, and 46% of its budget is being financed through transfers from State Oil Fund of the Republic of Azerbaijan. During a spike in oil prices from 2000 to 2008, Azerbaijan experienced high oil rents constituting 42% of GDP and GDP growth reached its highest rate of 34.5% in 2006 (Figure 1). As it is difficult to sustain such a level for a long period, the rate dropped to 10.8% in 2008. It is also worth to highlight that Azerbaijan started to decrease its oil production in 2009-2010. During this period, GDP growth fell to 9.4% in 2009, 4.9% in 2010 and 0.07% in 2011. Nevertheless, during the highest oil prices observed in 2011-2013, the economy recovered, and the GDP growth rate reached 5.8% in 2013. The economy experienced another steep drop in oil prices the following year, and its GDP growth rate dropped to 2% in 2014, further dropped to −3.10% in 2016 and recovered by 0.10% in 2017 thanks to regulatory reform and stabilization policies[1].

The country followed fixed exchange rate regime by 2014 (albeit managed because of slowly revaluation of the national currency), and due to sharp fall in oil revenue, Azerbaijan devalued its national currency Azerbaijani Manat in 2015 by 34% and adopted managed floating exchange rate regime. During the period of oil boom and fixed exchange rate regime, an increase in consumer prices was observed until 2008 (20.8%), over time dropped to 1.4% in 2014 and started to increase by 4% in 2015, 12.4% in 2016 and 13% in 2017 (Figure 1).

The contribution of the paper is that the channel from oil price to consumer price fluctuations is particularly evaluated in the case of Azerbaijan, which to the best of our knowledge has not been researched so far. Another contribution is that detailed policy implications are introduced based on the estimation results in order to mitigate the negative impacts of oil price fluctuations.

The rest of the paper is organized as follows: A literature review is provided in Section 2. Section 3 describes the data and defines methodology. Section 4 presents and discusses the results. Section 5 concludes and offers policy implications.

2. LITERATURE REVIEW

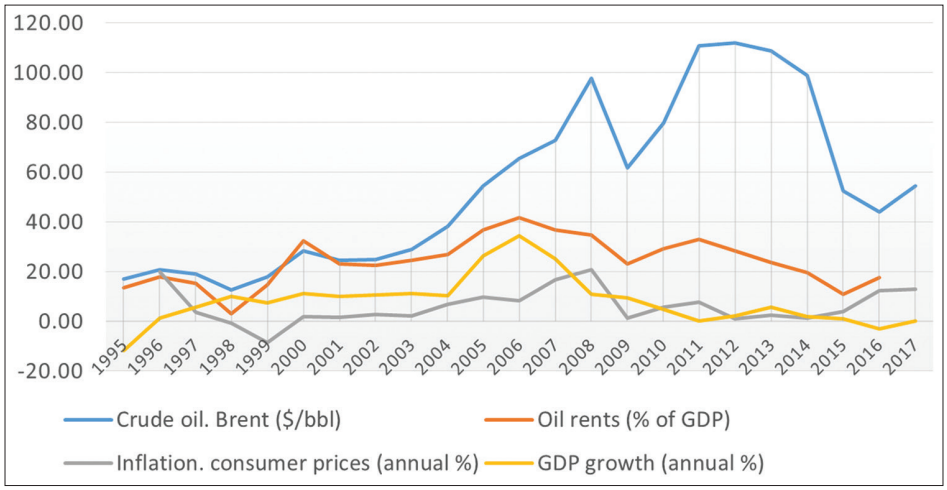
Effects of oil price fluctuations on inflation are comprehended theoretically and experientially. The effect depends on whether countries are consumers (importers) or producers (exporters) of oil. In this regard, we classify literature into two parts. Summary of corresponding empirical studies is presented in Table 1.

2.1. Oil Importing Countries

When oil price is high, companies prefer to reduce production rate due to high production costs. Similarly, oil price reduction

1 For more information on stabilization policies, see Strategic Roadmap on National Economy and Key Sectors of the Republic of Azerbaijan at https://ereforms.org/store//media/ekspert_yazilari/islahat%20icmali/mart/strateji%20yol%20x%C9%99rit%C9%99si%20-eng1.pdf

Figure 1: Macroeconomic indicators of Azerbaijan



Source: World Development Indicators, World Bank, 2018

decreases production cost and price level. However, it does not reduce price level of goods in price stickiness condition, as suppliers keep the price at a high level. From experiential view, there are various empirical studies that investigated the impact of oil price shocks on inflation (Mork, 1989; Mory, 1993; Burbidge and Harrison, 1984; Hamilton, 1996).

Eryigit (2012) conducted research on the effect of oil price movements in the case of Turkey using weekly data from 2005 to 2008 and found out that oil price shocks have positive impacts on stock market. However, the shocks exerted negative impacts on interest rates and exchange rates. Using quarterly data from 1990 to 2011, Ozturk (2015) revealed positive impacts of oil price shocks on inflation in Turkey. Using quarterly data from 1987 to 2015, Rasasi and Yilmaz (2016) came to similar conclusion and highlighted that oil price increases affect inflation positively with a delay.

In studies conducted by Sibanda et al. (2015) for South Africa and by Malik (2017) for Pakistan on the effect of oil price fluctuations on inflation, positive relationship was determined.

Cologni and Manera (2008) conducted their research on the effect of oil price changes in G-7 countries, and found that oil prices impact inflation significantly, which in turn affects the real economy by raising the interest rates.

Similar results were obtained by Wu and Ni (2011) for the US for the period of 1995-2005. The authors investigated the relationship between oil prices, inflation, interest rates and money, and focused on possible reactions of monetary policies to external shocks. Their results revealed that oil price changes affect inflation in both symmetric and asymmetric models, and oil price changes Granger cause inflation. A similar study was carried out by Cavalcanti and Jalles (2013) in the case of the USA for Brazil, which had different path on oil import dependence rate such that

Table 1: Summary of similar empirical studies in the literature

Author (s)	Time period	Country	Method (s)	Result
Cologni and Manera (2008)	Quarterly, 1980-2003	G-7	VAR	They found that oil prices impact inflation significantly which in turn affects the real economy by raising the interest rates
Tang et al. (2010)	Monthly, 1998-2008	China	SVAR	Finds that a positive oil price shock has positive effects on inflation
Qianqian (2011)	Monthly, 1999-2008	China	VECM	Positive oil price shocks cause China's CPI to rise
Wu and Ni (2011)	Monthly, 1995-2005	U.S.	GCT	Firstly, the empirical results reveal that the GOIL will affect INF, and INF will affect GOIL in both symmetric and asymmetric models. Namely, the feedback effects exist between GOIL and INF. Oil prices Granger cause inflation
Eryigit (2012)	Weekly, 2005-2008	Turkey	VAR	Their analysis indicates that oil price shocks have positive impacts on stock market and negative impacts on both interest rates and exchange rates
Cavalcanti and Jalles (2013)	Quarterly, 1975–2008	U.S. and Brazil	SVAR	Oil prices have positive impact on inflation
Abounoori et al. (2014)	Monthly, 2003-2013	Iran	Dynamic ECT	The findings showed that the oil price pass-through into inflation in both short-and-long terms were positive and incomplete
Ozturk (2015)	Quarterly, 1990-2011	Turkey	VAR	Positive impacts of oil price shocks on inflation rate
Katircioglu et al. (2015)	Annual, 1980-2011	OECD countries	Panel CT	Results of this study reveal that the price of oil exerts statistically and negatively significant impacts on CPI, in the case of OECD countries in general
Sibanda et al. (2015)	Monthly, 2002-2013	South Africa	VAR	Both crude oil prices and the exchange rates have positive impacts on inflation expectations
Chen et al. (2015)	Quarterly, 1994-2012	China	SVAR	Suggest that the increase of China's price level results from oil price shocks
Rasasi and Yilmaz (2016)	Quarterly, 1987-2015	Turkey	SVEC	Authors found that oil price increases affect inflation positively with a delay
Zhao et al. (2016)	Annaul, 1990*2013	China	DSGE	China's economy experiences long-term inflation as a consequence of oil supply shocks
Malik et al. (2017)	Annual, 1960-2014	Pakistan	SVAR	The inflation rate rise as a result of a positive oil price shock
Trang (2017)	Quarterly, 2000-2015	Vietnam	VAR	Rise in oil prices would lead to higher inflation
Davari and Kamalian (2018)	Quarterly, 2003-2015	Iran	Non-linear ARDL	No significant relationship between oil-price growth and inflation rate, but significant relationship between the reduction in oil price and inflation
Bala and Chin (2018)	Annual, 1995-2014	Algeria, Angola, Libya, and Nigeria	ARDL dynamic panels	Oil price changes positively influences inflation

Legend: ARDL: Autoregressive distributed lags bounds testing, VECM: Vector error correction method. CT: Cointegration test, GCT: Granger causality test, ECT: Error correction model, DSGE: Dynamic stochastic general equilibrium, SVAR: Structural vector autoregression, VAR: Vector autoregression
OECD: The organisation for economic co-operation and development. INF: Inflation, CPI: Consumer price index, EC: Energy consumption

oil import dependency is higher in the USA than Brazil. The authors conclude that although inflation volatility was declining in the USA, oil price shocks still accounted for a larger fraction of the volatility. However, such shocks did not seem to have clear impact on output growth and accounted for a small fraction of the volatility of inflation and output growth.

However, inversely proportional dependence was revealed by Katircioglu et al. (2015) in the case of OECD countries. The authors analyzed the impact of oil price movements on macroeconomic performance and revealed that the price of oil exerts statistically negative impact on macroeconomic variables; GDP, unemployment rate and the Consumer Price Index. Katircioglu et al. (2015) concludes that the impact depends on to what extent the country's industry depends on oil. Such that, nowadays, more energy efficient vehicles are used, and renewable energy resources can be used as alternatives to oil.

2.2. Oil Producing (Exporting) Countries

Abounoori et al (2014) conducted research for the case of Iran and revealed positive impact of oil price on inflation in short and long terms. However, using seasonal data and non-linear ARDL, Davari and Kamalian (2018) concluded that there is no significant relationship between oil-price growth and inflation rate, but significant relationship between the reduction in oil price and inflation was observed. Furthermore, researches by Trang (2017) for Vietnam, and Bala and Chin (2018) for Algeria, Angola, Libya, and Nigeria suggested that a rise in oil prices would lead to higher inflation.

3. MODEL AND DATA

3.1. Data

Our study uses annual data over the period of 1995-2017 for the following variables: Brent crude oil price (OP), exchange rate (EXC), inflation rate (INF). All data set have been retrieved from World Development Indicators of World Bank (WB, 2018) and the International Financial Statistics database of the International Monetary Fund (IMF, 2018.) For the purpose of analysis, the OP is measured in U.S. dollars per barrel whereas the EXC is measured in national currency per US dollar. The inflation is measured in the consumer price index (2010=100). In empirical estimations, all the variables were used in logarithmic form.

3.2. Econometric Methodology

We examine the relationship between oil price, inflation rate and exchange rate by employing the cointegration and vector error correction model (VECM) framework in this study. First, we will check non-stationarity characteristics of variables. We will use the Augmented Dickey Fuller unit root (Dickey and Fuller, 1981, ADF) and Philips and Perron (Philips and Perron, 1998, PP) tests for this exercise.

Next, if the variables are integrated on the same order, then we can test whether they move together in the long-run, using a cointegration test. In order to be on the safe side, we will follow the latter option and hence, use the Johansen test (Johansen, 1988) as it is the only test that can produce proper results in the case where more than two variables are tested for cointegration. After confirming the presence of cointegration between the variables, we will apply the VECM method to investigate the long-run relationship among the variables.

The above-mentioned methods are widely used techniques in similar studies, we do not describe them but their detailed discussions are provided in Dickey and Fuller (1981), Philips and Perron (1998), Phillips and Hansen (1990), Johansen (1988) and Johansen and Juselius (1990), inter alia.

4. EMPIRICAL RESULTS AND DISCUSSION

First, we should check the stationarity properties of the used variables. As mentioned in the methodology section, for this purpose, we use ADF and PP unit root tests. Results of unit root tests are presented in Table 2. We find that the variables are non-stationary at their levels but they are stationary at first difference, being integrated of order one, I(1). We thus conclude that our variables are non-stationary in levels but stationary in their first differences. Our conclusion that the variables are I(1) allows us to proceed to the cointegration test.

To apply the Johansen procedure, the optimal lag number should first be chosen. A vector auto regressive (VAR) model was initially specified with the endogenous variables of INF, OP and EXC. The details of this test are presented in Table 3. Both lag selection criteria and lag exclusion tests statistics propose that a lag of order three is optimal.

Panels A through D in Table 4 report that the VAR has worthy features as it is stable, the residuals do not demonstrate serial correlation and heteroscedasticity issue and they are normally distributed. The Johansen cointegration test results are presented in Panels E and F of Table 4.

Both the trace and the max-eigenvalue test statistics indicate one cointegration relationship among the variables. Therefore, we conclude that there is a cointegrating relationship among the variables.

Finally, we estimate coefficients of the long-run relationship between inflation, oil price and exchange rate using VECM method. VECM results are reported in Table 5.

Table 2: Results of unit root tests

Variables	The ADF test				The PP test	
	Level	k	First difference	k	Level	First difference
INF	−0.1302	0	−3.2297**	0	−0.1302	−3.2297**
OP	−1.3953	0	−4.2440***	0	−1.4525	−4.2024***
EXC	−1.9369	2	−3.1519**	0	−1.4556	−3.1717**

ADF and PP denote the Augmented Dickey-Fuller and Phillips-Perron tests respectively. Maximum lag order is set to two and optimal lag order (k) is selected based on Schwarz criterion in the ADF test; ***.** and *Indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels respectively; The critical values are taken from MacKinnon (1996) for the ADF and PP tests respectively

Table 3: Lag interval tests

Lag length		Information criteria				
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−13.61685	NA	0.001107	1.705813	2.002029	1.780311
1	34.80532	75.79123	3.66e-05	−1.722202	−0.981662	−1.535958
2	67.73680	42.95410	4.90e-06	−3.803200	−2.618336	−3.505210
3	94.30154	27.71973*	1.25e-06*	−5.330569*	−3.701381*	−4.920833*

*Indicates lag order selected by the criterion, 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

Table 4: VAR residual diagnostics, stability and cointegration tests results

Panel A: LM test for serial correlation[a]			Panel E: Johansen cointegration rank test (trace)[e]				
Lags	LM-Statistic	P value	Null hypothesis	Eigen value	Trace statistics	0.05 Critical value	P value
1	15.003	0.0908	None*	0.714244	37.65514	29.79707	0.0051
2	15.920	0.0686	At most 1	0.247170	8.844973	15.49471	0.3799
3	5.7016	0.7694	At most 2	0.095749	2.314910	3.841466	0.1281
4	8.4284	0.4916					
Panel B: Normality test[b]			**Panel F: Johansen cointegration rank test (Maximum Eigenvalue)[f]**				
Statistic	X^2	d.f. P value	Null hypothesis	Eigen value	Max-Eigen statistic	0.05 Criticial value	P value
Jarque-Bera	2.7993	6 0.833	None*	0.714244	28.81016	21.13162	0.0034
			At most 1	0.247170	6.530063	14.26460	0.5461
			At most 2	0.095749	2.314910	3.841466	0.1281
Panel C: Test for heteroscedasticity[c]							
White	X^2	d.f. P value					
Statistic	122.74	114 0.271					
Panel D: Test for stability[d]							
Modulus	Root						
0.9865	0.8073-0.5669i						
0.9865	0.8073+0.5669i						
0.6289	0.0141-0.6288i						
0.6289	0.0141+0.6288i						

[a]The null of the LM Test is no serial correlation in residuals at lag of h[th] order; [b]The Normality Test is the Urzua (1997) system normality test, for this test the null states multivariate normality of residuals; [c]The null for White Heteroscedasticity Test claims that there is no cross terms heteroscedasticity in the residuals; [d]VAR stability test results conclude that all roots of characteristic polynomial are inside of the unit circle; χ^2 stands for the Chi-square distribution; d.f.: Degree of freedom

Table 5: Long-run coefficients from the VECM method

Regressor	Coefficient	Standard error	t-statistics
OP	0.58***	0.06	8.48
Exc	1.81***	0.36	4.97
Panel B: Residuals diagnostics tests results and speed of adjustment coefficient			
SoA	−0.1755 [0.0007]		
LM_{SC}	3.8775 [0.9193]		
χ^2_{HETR}	104.75 [0.1369]		
JB_N	1.3366 [0.9696]		

Dependent variable is INFt; ***.** and * show significance levels at 1%, 5% and 10%; Probabilities are in brackets; SoA: Speed of adjustment; LM_{SC}: Lagrange multiplier statistic of serial correlation test; χ^2_{HETR}: Chi-squared statistic for heteroscedasticity test; JB_N: Jarque-Bera statistic for testing normality; In VECM, Jarque-Bera statistic was taken from the option of Orthogonalization: Residual correlation (Doornik-Hansen). VECM: Vector error correction model

As it can be seen from the Table 5, the long-run coefficients from the VECM technique are statistically significant. Additionally, the residuals of the estimated specifications successfully pass the residuals diagnostics tests, which is another indication of the robustness of the estimation results.

The long-run coefficients are given in Table 5. Results show that OP has a positive and statistically significant impact on inflation at 1% level. The results reveal that inflation responses by 0.58% increase to a 1% increase in Brent crude oil price. Having positive and significance impact of oil price, our finding is consistent with the results of Tang et al. (2010) for China, Cavalcanti and Jalles (2013), U.S. and Brazil, Sibanda et al. (2015) for South Africa, Malik et al. (2017) Pakistan, Rasasi and Yilmaz (2016) for Turkey, Ozturk (2015) for Turkey. The impact of exchange rate on inflation is also found to be positive and statistically significant at 1% level. This shows that a 1% increase in exchange rate (depreciation of the national currency) results in 1.81% increase in inflation. This implies that an increase in exchange rate raises inflation.

In addition, Table 5 shows that the error correction term coefficient is negative and statistically significant at the 1% confidence level. This value indicates that any deviation from the short-run disequilibrium among the variables is corrected to return to the long-run equilibrium level within more than a year.

5. CONCLUSION

The study investigates the impact of oil price and exchange rate on inflation. After testing variables for a unit root, the results showed their stationarity at first differenced form, hence the variables can be tested for a common long-run trend. Johansen trace and maximum eigenvalue tests concluded one cointegration relationship among the variables. This implies that there is a long run relationship between inflation, oil price and exchange rate in Azerbaijan. The VECM approach is used to estimate the long run relationship among these variables. Estimation results show that oil price and exchange rate increase inflation in the long-run, namely, a 1% increase in

oil price and exchange rate increases inflation by 0.58% and 1.81%, respectively.

During the period of the fixed exchange rate regime with the revalued national currency, an increase in consumer price index comoved with increasing oil prices until 2008. The estimation result also implies that low inflation could also be expected if oil prices were lower during the fixed exchange rate regime. Indeed, low oil prices and decreased inflation comovement were also observed in 1996-1998, 2000-2001, 2008-2009, and 2011-2014. This is the case for an oil-dependent and less diversified economy, which is vulnerable to positive or negative external shocks. The less diversified economy tends to import most consumer and industrial goods from other countries to satisfy domestic demand. Therefore, changes in oil prices that affect the economies of foreign countries affect the economies of oil exporting countries proportionally.

This vulnerability is also attested by the result obtained for the impact of exchange rate such that the sharp drop in oil prices in 2014 caused devaluation of the national currency by 34% in 2015 and 48% in 2016 and also triggered inflation. In this regard, the exchange rate captures the role of the transmission channel from oil prices to inflation. Results of both explanatory variables reveal that a less diversified economy undergoes inflation during the period of high and low oil prices. Therefore, a resource dependent country should accelerate reforms on economic diversification to mitigate social and economic costs associated with external shocks. In this regard, preserving macroeconomic stability, particularly exchange rate and price stability, will increase confidence in the national currency, stimulate domestic and foreign investments, and promote sustainable economic development.

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