Indian Journal of Economics and Business
Vol. 21 No. 1 (January, 2022)

http://www.ashwinanokha.com/IJEB.php

Role of Petroleum Prices and Exchange Rate on Inflation in Pakistan's Economy: an ARDL Analysis

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Received: 10th September 2021
Revised: 20th November 2021
Accepted: 15th February 2022

Abstract: The main objective of most countries is to control the inflation rate because high inflation is harmful to any economy. To check the relationship between prices of petroleum and rate of exchange with inflation is the main objective of this study from the period of 1987 to 2019. Time series econometric model used in the study for estimation. The nonlinear autoregressive model was used to estimate the results. In long run, petroleum prices have a positive link with inflation, and the rate of exchange has a negative link with inflation and both are significant. But in the short run exchange rate is insignificant and positive relation with inflation.
Keywords: Petroleum Prices, Exchange Rate, Inflation, Money Supply

1- Introduction

The rise in prices of goods (food or non-food) items is called inflation. Inflation is not an increase in price level just one, two, or a few times but a persistent rise in inflation. Just a one-time rise in prices or due to some shocks prices increase is not considered inflation. When prices increase due to shock but not changed the rate of prices adjusts after some time it's not known as inflation. Inflation has two main causes, cost-push inflation, and demand-pull inflation. Cost-push inflation occurs when the cost of any

factor increase due to an increase in aggregate supply. Demand-pull inflation is when the economy grows too fast due to an increase in aggregate demand of the economy, inflation stable in Pakistan in 2003 which is occurred due to a crisis in 1998-99 and at 11 percent in 2005. (Moazam, M., & Kemal, M. A. (2016). Inflation in Pakistan: Money or Oil Prices (No. id: 11507).

Oil price rises are usually supposed to raise inflation and diminish economic growth. In inflation, oil prices positively impact the prices of commodities prepared with petroleum goods. Rises in oil prices can lower the source of other commodities since they raise the expenses of manufacturing them. The rise in the exchange price increases inflation. The rate of exchange is a vital macroeconomic variable in any economy because it retains international competitiveness (Jhingan, 2002). The significance of this variable can be known from the point that it does show its main role to trim down domestic price level (Mordi, 2006) but also has an opposing effect on global trade and capital flows (Abrams, 1980; Hilton, 1984).

2- Literature Review

LeBlanc, M., & Chinn, M. D. (2004) examined for the UK, US, Germany Japan, and France the impact of oil prices on inflation by using the Philips curve. Traditional Philips curve showed the nonlinear effects of oil prices on output. Results of the study showed that oil prices shock leads to inflation in Europe, Japan, and the United States. Traditionally in Europe, inflation is more sensitive less in the United States. If oil intensity will reduce then inflation effects can control. In the product market competition become low and consumers effects oil prices and wage. In 1970 economists debated that oil price shocks affect relative prices too.

Roeger, W. (2005) examined the short and long-run impact of oil price shocks inflation and output in Europe by using the DSGE model. Special stress is given to the effects of stagflation. If monetary policies react to the problem of inflation then inflation risk can control in the Euro area. The study also examined the issue of that short-run tradeoff between output and inflation with a country supply shock. In 1973-74 and 1979-80 economic activities become depressed and inflation becomes high in those days that situation is called stagflation. What types of shocks can control by monetary policies. This study analyzed how increases in oil prices affect macroeconomics determinants in the Euro area and how inflation and interest rate effects too.

Ito, T., & Sato, K. (2008) analyzed in East Asian countries how exchange rate changes impact on prices of imported goods. Countries who are are most pronounced in CPI face price shock like Indonesia. They examined using the vector autoregressive model offer a crucial insight into a crisis extension mechanism in rising market economies. When wearing and tear results in domesticated inflation, crisis becomes increased and the recovery process becomes difficult. Results of the study showed Indonesia's recovery process was low after the crisis because of high changes in exchange rates. In Indonesia, inflation at the domestic level leads to depression, and the balance sheet of the central bank affects it too.

Cologni, A., & Manera, M. (2008) examined that instant increases in the oil prices are broadly seen as an important subscriber to business cycle asymmetries. Due to increase the in oil prices in the world market economic activities of developed countries have become low. Some economists thought that this is due to an increment in energy prices, but some argued that it is due to the reaction of monetary policies which are developed to control inflation, which is occurred by rises in the oil prices. In this study, the VAR

model was used to the analyzed effect of oil prices on prices and production in several countries. In most countries interest rate effects due to shocks of the oil price are unexpected. Due to the increase of interest rate output become decrease.

Tang, W., Wu, L., & Zhang, Z. (2010) analyzed that oil prices shock and economic development have a positive relationship. Studies showed oil prices impact on economies of China. The changes in oil price hurt investment and output but have a positive effect on inflation and the rate of interest. Results showed that in the short-run effects output decrease but long-run effects investment increases. After that long-run effects dominate and keep for quite some time. When oil prices increase then investment and output become low and inflation or interest rate becomes high economic growth becomes low and the country faces depression.

Cunado, J., & de Gracia, F. P. (2014) analyzed that from 1975 to 2002 price of oil affect both consumer price indexes and economic activity in six countries of Asia. The result of the study showed that prices of oil have a substantial impact on both price indexes and economic activity while in the short-run effect is limited, in local currencies when prices changed then more consequential results occur. In World war, the second instant increase in prices of oil and other products of energy hit the world economies. Moreover, oil price affects employment rate, investment rate, the role of technology, or business cycle too. Oil prices affect macroeconomic variables. The tax structure is also a reason for the international change in oil prices in different countries. Prices of the oil depend on tax structure too.

Saleem, S., & Ahmad, K. (2015) analyzed that Pakistan's economy was also affected by shocks of crude oil prices but no attention was given to that effects. In this study relationship between oil prices changes and inflation is examined in Pakistan. The study also determined the other factors which lead to inflation. During the period 1979 to 2012 crude oil price shocks that affect the GDP of Pakistan are examined in this study with help of time series data. Johansen co-integration techniques were applied to study the short and long-run effects. Results showed that GDP has an indirect relationship with inflation and has a direct relationship with indirect taxes, interest rate, crude oil prices, exchange rate, and monetary supply. Studies suggest that substitutions of gas and oil should prefer.

Khan et al. (2021) studied the impact of oil prices on stock market development in Pakistan by using time series data from 1985 to 2017. The findings revealed that oil prices, remittance inflow, and foreign direct investment had a positively affected on the stock market and the exchange rate had a negative impact on the stock market. Qasim et al. (2021) study exchange rate and oil prices' impact on inflation by using time series data from January 2004 to January 2019. For estimation, the Cointegration technique is applied. The result revealed that exchange rate and oil prices had strongly affected inflation. The study of the dynamic impact of gold prices, oil prices and exchange rate on stock market performance by Ali et al. (2021). They used daily data of macro variables from 2003 to 2018. The study showed that there had no short run and long run relationship between variables. The change in oil prices, foreign exchange rate and gold prices had negatively affected on the stock market.

The study of Akbar et al. (2021) shed light on Nexus gold price, exchange rate, interest rate and oil price for monetary policy by using time series data from 1995 to 2016. For estimation, they applied the VAR model. The findings revealed that tight monetary policy had a significant impact on the exchange rate and raised gold prices. Duan et al. (2021) examined how geopolitical risk drives exchange rate and oil prices by using wavelet based analysis and used time series data from 2008 to 2019. The result showed that oil

prices and the exchange rate had a bidirectional causal relationship from 2017 to 2019. Venezuela had to reduce its oil dependence and reduce regional conflicts. The government had managed the exchange rate to achieve growth.

3- Methodology

3.1 Data Sources and Type

Data for the analysis was collected from World Development Bank and macrotrends.net. Variables that are used in the study are petroleum prices, exchange rate, gross fixed capital formation, inflation, and supply of money m2. Secondary data was used in the study. Data is used in the study is yearly based from the period of 1987 to 2019 which is 33 years of data and a Nonlinear autoregressive technique used for the analysis of data.

4- Results and Discussion

This chapter examined the link between petroleum prices, rate of exchange, money supply, gross fixed capital formation, and GDP deflator by using the annual data from 1987 to 2019. For estimation of results E-views 9 software has been used. Econometric and descriptive analysis include in this chapter. The descriptive analysis was used to represent the interest of variables and to perform the overall trend. Graphs and tables were used to represent the model. In the econometric analysis diagnostic test and the stationary test has been tested which is necessary for the model. After the significance of necessary tests like co-integration and stationary test the nonlinear autoregressive distribution lag model has been used. The discussion and interpretation are established on the results of the model after the process of estimation.

4.1 Descriptive Analysis of the Data

The descriptive statistic explores the data that are provided such as median, average, mean, maximum value, minimum value, skewness, standard deviation, and kurtosis. Values of the variable are shown in the tables that are taken in the model such as GDP DF, GFCF, M2,OPYC, and REXC.

Table 1: Descriptive Estimation 1987-2019:

	GDP DF	GFCF	M2	OPYO	REXC
Mean	9.155220	3.439454	48.45829	42.81545	110.5357
Median	7.749247	4.291846	48.10007	31.97000	107.4728
Maximum	24.89115	19.90114	59.17200	102.9600	142.5901
Minimum	0.400236	-7.705551	38.59470	12.42000	95.26953
Std. Dev.	5.679843	6.433176	6.458130	28.50181	12.39725
Skewness	1.000478	0.319930	0.125617	0.903892	0.747903

Kurtosis	3.602178	3.102793	1.907276	2.482038	3.076046
Jarque-Bera	6.003865	0.577481	1.728600	4.862506	3.084425
Probability	0.049691	0.749207	0.421346	0.087927	0.213907
Sum	302.1223	113.5020	1599.124	1412.910	3647.677
Sum Sq. Dev.	1032.340	1324.344	1334.638	25995.30	4918.138

Source: Author's calculation

The table showed that in Pakistan the Gdp df stood an average of 9.1552 percent. Gdp df increased from 0.400236 percent and go to the maximum level of 24.89115 percent. The value of kurtosis and skewness is 3.602178 and 1.000478. The value 3.602178 showed that gdp df is normally distributed. The gross fixed capital formation average is 3.439454 gfcf increased from the value of -7.705551 and goes to the maximum level at the point of 19.90114. The value of skewness and kurtosis are 0.319930 and 3.102793. The value of skewness kurtosis and jarque-Bera showed that the gfcf is normally distributed. The money supply average is 48.45829 M2 increased from the value of 38.59470 percent and go to the maximum level at the point 59.17200 percent. The value of skewness and kurtosis are 0.125617 and 1.907276. The value of skewness kurtosis and jarque-Bera showed that the money supply is normally distributed. The oil prices average is 42.81545 opyo increased from the value of 12.42000 and go to the maximum level at the point 102.9600. The value of skewness and kurtosis are 0.903892 and 2.482038. The value of skewness kurtosis and jarque-Bera showed that the oil prices are normally distributed. The real exchange rate average is 110.5357 rexc increased from the value of 95.26953 and goes to the maximum level at point 142.5901. The value of skewness and kurtosis are 0.747903 and 3.076046. The value of skewness kurtosis and jarque-Bera showed that rexc is normally distributed.

4.2 Stationary of the data

Dickey and Fuller (1981) introduced the "Augmented Dickey Fuller" test that is used to check the stationary of variables.

Table 2: Augmented Dickey Fuller Test

	AT LEVEL		AT 1st DIFFERENCE	
Variables	Intercept	intercept & trend	intercept	intercept & trend Rank
GDP DF	-4.579111	-4.806461	-7.122917	-7.155516
GFCF	-3.861999	-3.876936	-7.584192	-7.450373
M2	-0.827243	-2.847609	-4.796719	-4.703338
PP	-1.869924	-2.429855	-7.739422	-7.643954

REXC	-2.842065	-1.702932	-5.062479	-6.045976

Source: Authors' calculations based on software, E-Views

The table shows unit root for gross domestic product deflator (GDP DF), gross fixed capital formation (GFCF), money supply (M2), petroleum prices (PP) and real exchange rate (REXC) are presented here. Among the above mentioned variables GDP DF stationer at the level and one percent, GFCF stationer at the level and one percent, M2 stationer at the first difference and one percent and real exchange rate also stationer at the first difference and one percent.

4.3 Cointegration Analysis (The Bound Test)

The Cointegration technique is used to check the long run relationship between variables.

Table 3: Co-Integration Results

Equation	F-Statistics	Upper-bound value	Results
GDPDF GFCF M2 PP REXC exists	13.05075	*3.23*	Co-integration

Source: author's estimation

The long run co-integration may be existing between variables, according to granger (1987) and Engle on data series. Pesaran et al. (2001) suggest f-statistics can determine the long run co-integration. The table illustrates the value of f-statistics is 13.05075 which is greater than the value of the upper bound is 3.23 results show that there are exist a long run co-integration.

Table 4: Correlation Matrix

Covariance Correlation	GDP DF	GFCF	M2	PP	REXC
GDP DF	31.28302 1.000000				
GFCF	-6.652271 -0.187747	40.13165 1.000000			
M2	-9.495910 -0.266967	9.732244 0.241571	40.44359 1.000000		
PP	10.60399 0.067550	-0.095491 0.000537	109.6015 0.614047	787. 7364 1.000000	
REXC	-14.72576 -0.215665	12.25499 0.158462	-21.89900 -0.282069	-163.2428 -0.476431	149.0345 1.000000

Source: Author's estimation

The gdp df has a negative correlation with gfcf, m2, and rexc and a positive correlation with petroleum prices. The variable gfcf has a positive correlation with gdp df, m2, rexc and negatively correlated with

petroleum prices. M2 positively correlated with petroleum prices and negatively correlated with rexc. Petroleum prices negatively correlated with rexc.

Table 5: Short-Run Estimation of NARDL Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDPDF(-1))	0.5588	0.1455	3.8395	0.0027
D(GFCF_POS)	0.3029	0.1773	1.7079	0.1157
D(GFCF_NEG)	-1.0157	0.2700	-3.7609	0.0031
D(M2_POS)	-0.9325	0.5221	-1.7859	0.1017
D(M2_POS(-1))	0.9161	0.6891	1.3294	0.2106
D(M2_NEG)	-1.5995	0.4724	-3.3857	0.0061
D(M2_NEG(-1))	-0.9773	0.5921	-1.6506	0.1270
D(PP)	0.0664	0.0416	1.5953	0.1389
D(PP(-1))	0.0478	0.0399	1.1958	0.2569
D(REXC)	0.1665	0.1579	1.0548	0.3141
D(REXC(-1))	0.1780	0.1490	1.194743	0.2573
CointEq(-1)	-2.2407	0.2622	-8.545041	0.0000

Cointeq = GDPDF – (0.5699*GFCF_POS -0.7401*GFCF_NEG - 2.2437

*M2_POS + 0.6569*M2_NEG + 0.0334*PP -0.1511*REXC + 21.7881)

In the short run, some variables are significant and some variables are insignificant. But the long run tells us the clear results because in the short run the time period is too small that's why variations find in the results. Short run results elaborate that gfcf positive has an insignificant effect on inflation and has a

direct relationship. Negative gfcf has a significant and inverse relationship with inflation. And lag of gfcf is also a significant and direct relationship in Pakistan. Money supply positive and lag value of money supply positive has insignificant effect and m2 positive has direct relation and lag value of m2 positive has indirect relation with inflation. Money supply negative has an insignificant effect and lag value of m2 has a significant effect and both have an inverse relationship with inflation. Petroleum prices (PP) have an insignificant effect and positive relation with inflation. The real exchange rate has an insignificant and positive effect on inflation while a lag value of rexc also has the same effect.

Table 6: Long-Run Estimation of NARDL

Variables	Coefficient	Std.Error	t-statistic	Prob.
GFCF-POS	0.5698	0.108689	5.24315	0.0003
GFCF-NEG	-0.7400	0.1523	-4.8573	0.0005
M2-POS	-2.2437	0.3657	-6.1350	0.0001
M2-NEG	0.6587	0.1294	5.0728	0.0004
PP	0.0333	0.0174	1.9089	0.0827
REXC	-0.1510	0.0393	-3.8420	0.0027
C	21.7880	5.0023	4.3555	0.0011

The table explains the results of long run nonlinear ARDL. GFCF is significant under the probability of 0.0003 at 5 percent. A one percent increase in positive gross fixed capital formation means a 0.5698 percent increase in inflation. While a one percent decrease in the negative gross fixed capital formation leads to a -0.740082 percent increase in inflation. As Ahortor, C. R., & Adenutsi, D. E. (2009).stated in his study that capital accumulation and inflation have a negative effect. This shows a negative relationship with inflation which is significant at 0.0005.

Money supply under the probability of 0.0001 is at 5 percent. A 1% increase in the positive supply of money means a -2.2437% reduction in inflation. As Cao, T. (2015). The paradox of Inflation stated in his study due to the paradox of inflation m2 and inflation has an indirect relationship. While a 1% decrease in the negative supply of money leads to a 0.6568 percent decrease in inflation. This shows a positive relationship with inflation it is significant at 0.0004.

Petroleum prices (Opyo) are significant under the probability of 0.827 at 5 percent. One dollar increase in oil prices means a 0.0333 percent increase in inflation. Rexc is significant under the probability of 0.0027 at 5 percent. A 1% raises in the real rate of exchange means a -0.1510 percent reduction in inflation.

Table 7: Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.196871	Prob. F(2,26)	0.8225
Obs*R-squared	0.492293	Prob. Chi-Square(2)	0.7818

There is no autocorrelation in the model

Table 8: Heteroscedasticity Test:

Heteroscedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	2.257388	Prob. F(4,28)	0.0882
Obs*R-squared	8.046957	Prob. Chi-Square(4)	0.0899
Scaled explained SS	6.824992	Prob. Chi-Square(4)	0.1454

There is no heteroscedasticity in the model because the model is not significant at the 5 percent level.

4.4 Cusum analysis

CUSUM analysis is used to check the stability of variables in long run.

Figure 1: CUSUM

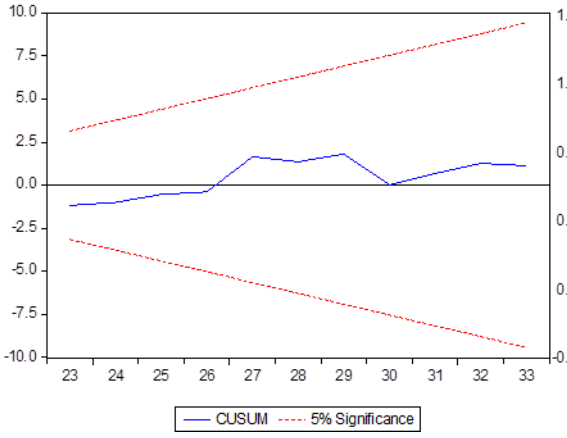
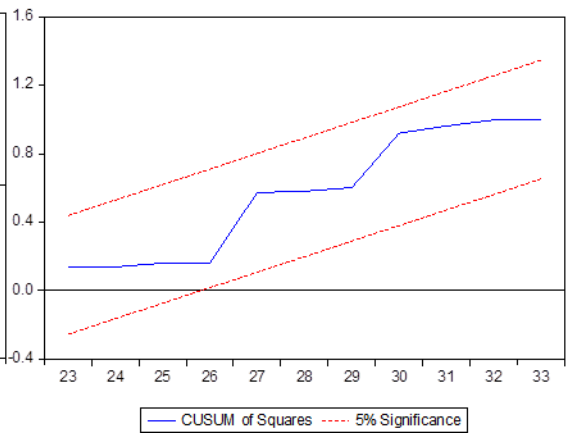


Figure 2: CUSUM SQUARE



The above figure shows that variables are stable because the blue line is in between the red lines.

5- Conclusion

Due to the rise in oil prices, prices of other goods made with oil become increase that's why oil prices directly cause to increase in inflation. This study attempted to study the effect of prices of oil and rate of

exchange on inflation from the period 1987 to 2019 and results showed that fluctuations of oil prices have positive effects on inflation and rate of exchange has negative relation in long run. The model was estimated to be qualifying the serial correlation, normality and standard diagnostic tests for heteroskedasticity. Furthermore, CUSUM and CUSUM square established that all the coefficients in the model are stable oil prices have a direct relationship with inflation while the exchange rate has an indirect relationship. Gfcf and money supply affects inflation both positively and negatively.

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