P-ISSN: 2709-6254	Journal of Development and Social Sciences	Oct-Dec 2022, Vol. 3, No. 4
O-ISSN:2709-6262	http://dx.doi.org/10.47205/jdss.2022(3-IV)52	[559-573]

JDSS Journal of Development and Social Sciences
www.jdss.org.pk

RESEARCH PAPER

Macro-Economic Consequences of Energy Price Shocks: Empirical Evidence of Pakistan

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ABSTRACT

This study examined the macro-economic consequences of energy price shocks in Pakistan. Energy prices take part an imperative role in the economic growth of Pakistan. The study objective to examines the influence of energy price shocks to the macroeconomic indicators. The reason of the study is to find out the impact of shocks of energy prices on macroeconomic indicators in Pakistan during 1980 to 2019. The analysis is carried out employing vector autoregressive (VAR) model. Impulse response functions results indicate that energy price shocks reduce the GDP. Overall findings for this study identify that high energy prices contain negative impact on GDP in Pakistan. The study implies that policy makers should develop, adopt, and initiate some imperatives to control the unanticipated volatility and movements in energy prices. The study highlights that policy should be designed to control the fluctuation in energy prices and to plan energy conservative policies that will motivate to discover the alternative energy sources to meet increasing energy demand in Pakistan and improve economic growth.

KEYWORDS Energy Price, GDP (per capita), Inflation Rate, Money Supply, Real Effective Exchange Rate

Introduction

The shocks of Energy Prices have been important resource of concern globally. On the other hand, due to the high dependency on imported oil, oil importing countries are most concerned. In developing countries such as Pakistan, macroeconomic stability is threatened by the fluctuation of OP through different countries. Sources of Energy are thought to be the lifeline of any economy not because it essential for life, but it is one of the most important strategic advantages for the socio-economic development (Saidi & Hammami 2015). Energy is essential for maintaining a consistent pace of economic growth. It also helps to sustain domestic, commercial, and commercial activities. Energy disturbances and deficiencies not only result in loss of economic development, but also unfavorably influence social attachment in the public, (Ministry of Finance 2015). Volatility in prices especially the recent price hikes turn attention of policy makers all over the world. This rise in energy prices adversely affects the economic growth of oil importing countries (Khan & Ahmed, 2011). A rise in energy prices causes cost of doing business to increase that can have impact on productivity and many other important economic parameters (Lescaroux & Mignon, 2008). The study also concludes that there is a negative influence of energy prices on macro-economic performance (Khan & Ahmed, 2011).

Due to its scarcity, most of the countries import crude oil to fulfill their current demand. According to Husain (2010) energy resources in countries are finite and not distributed equally. As oil abundant countries are very less in the world. This demand and supply gap force to higher energy price which not only affect the manufacturing side but also affect the agriculture side because the production of agriculture inputs like machinery and fertilizers energy prices severely effects by the prices. Energy prices also affect the overall demand for goods and, services. The reasons of shocks in prices are, firstly, great number of industries uses the fat as for primary input, as a result, cost of the production increases, industry production reduces, and OP increases. Secondly, due to the amendments to the TOT, Ops have grown, income transfers to the oil-exporting from oil –importing countries. Thus, the countries who import oil they get out of their real income. Finally, increment in OP, during higher prices of the products of petroleum and goods which are imported, impacts directly in lactation positively. Consequently, if rate of wage incurs in more top arrivals, to raise the interest rate, central bank id forced. On the other hand, since 19s of Pakistan, Pakistan has been the embassy of energy. In 1984, there was an import of about all petroleum. Particularly, in 8.8% annually growth.

During 1979-1984, Pakistan was one of the oil-importing countries. Pakistan signed an agreement of loan with the IMF at that time, after which, it was pointing by the IMF to sign of sustained enhancement in the economy of Pakistan. Nevertheless, according to the IMF, the economy of Pakistan was no longer in the danger or crises. To revisit and re-examine the influence of prices on Pakistan GDP, fluctuations in prices have prompted us. Pakistan depends heavily on imports of oil, as an emerging economy. Thus, when there is an excessive effect on OP, it reflects the (positive) performance of share markets. High (low) cost is represented by the high (low) price; changes in prices have effects on the earning of the organizations directly. Additionally, inflation will increase or decrease when price of energy prices will incur or decrease. Hence, this study is an attempt to find the influence of energy prices shocks on the financial system of Pakistan. This study would be helpful for the policy makers to comprehend the connection between the energy price shocks and economic performance and will assist them to acclimatize the correct policy mix that would help to make effective planning. This paper would be supportive in solving the energy price riddle formed for Pakistan economy. Current paper will serve as reference on shocks of energy prices and its connection with economic performance.

Literature Review

The interest of different practitioners was triggered by the first shock of oil in 1973/ 1974 into the prices and the nexus of the macro economy. As literature says, increment in inflation is caused by the higher prices of energy, and stock exchange also get panic thorough it (when suddenly change occurs) and growth of economy decreases which can call combine instability in monetary and financial trigger (Aliyu 2009). The affiliation between energy prices and growth of economy has established much importance in hypothetical and experiential research over the last two decades due to much importance of energy, because energy is vital ingredient in achieving the sustainable economic growth for every nation and it is a fourth pillar economy. Therefore, consequently increment in energy prices including oil prices, gas price, electricity price, crude oil price etc., have significant effect on economic growth and development of any nation. Both empirically and theoretically explored the role of energy and higher energy prices on economic growth and development, but not still found the any mechanism or transmission channel through which higher energy prices impact on aggregate economy especially in developing countries. Earliest the theoretical work on energy price and economic growth are done by Tatom, (1981), Asafu-Adjaye, (2000), and more recently Hamilton (2009).

Shahbaz et al., (2017) investigated that with domestic energy prices, Pakistan is exceedingly reliant on imported energy related to the worldwide energy prices thus making the economy of Pakistan weaker to energy price shocks. In recent papers, (e.g., Inoue, & Kilian, (2013), Mellado, 2014, Kilian, & Lee, (2014), various approaches had been used to check the impact of shocks of energy prices on growth for an economy. For G7 countries, by utilizing quarterly data, in co-integrated framework of VAR, for the period of 1980-2003, effect of OP on inflation and interest rate was checked. By increasing the rate of interest, it affected the real economy. To change in energy prices, the inflation is highly sensitive; therefore, Pakistan had witnessed a decline in the Inflation due to the plunge in the energy prices in Pakistan. During July-April 2014-15 the average value was 4.8%, which was the lowest Inflation Pakistan had experienced since 2003. State bank of Pakistan provided a chance by decrease in energy prices to diminishing the policy rate. The reduction in the exchange rate of Pakistan cause to strengthen the U.S. dollar which had e contribution to fall in imports.

To explain the finding, long struggle had been done by the theory of economics (Rotemberg, & Woodford, 1996, Finn, 2000). Arshad, & O'Kelly, (2019) investigated in their study that impact of global energy price shocks on the macro economy of China over the past two decades. They use oil prices for the proxy for the energy price. The findings showed that positive energy price shocks engender the statistically momentous increase the inflation and reduction in real GDP. So far, this section showed the discussion that there is existence of huge literature regarding to the influences of energy prices on GDP. However, Last couples of decades are focused by most of the literature. To provide the insights which was maybe absent in the contemporary data, Economist had been used increasingly, long run or historical evidence in the markets of energy. For example, on energy prices and transition, many of have focused (Kander & Stern, 2014, Nguyen, et al, 2019, Müller, et al, 2016). To analysis the statics', more recently, VAR model was used by the Nakajima, (2011) One of the advantages of using VAR is that, to identify the shocks, users must prescribe the assumption in the variable and can be atheist of the long run causality of the association. To the study, it is very important to endogeneity of the affiliation among energy prices and GDP.

Material and Methods

Data Description and Source

This study has been used annual time series data from 1980 to 2019. These variables GDP, Inflation, Interest rate, Money Supply, Real Exchange Rate and Energy Prices has taken for analysis. Pakistan Oil Prices used as proxy for the energy prices. All variables are taken for this study in the log-form. The data of Gross Domestic Product (per capita), Energy price, and real exchange rate, Rate of Interest, Rate of Inflation, and Supply of Money are taken from the Pakistan Economic Survey, State Bank of Pakistan (SBP), World Bank (WDI), and Statistics from International Financial (IFS).

Test of Unit Root

Unit root tests used to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary. Moreover, economic and finance theory often suggests the existence of long-run equilibrium relationships among nonstationary time series variables.

Criterion of Akaike Information (AIC)

It is very necessary to establish the suitable interval length, as the model of VAR is lagging sensitive. To fulfill this purpose, AIC is employed. The length of the interval chosen is that holds the minimum. **AIC=lC2ln (L) +2k1**

Total numbers of the parameter are represented by K, while the utmost value of the function of the probability for sample is represented by the L. for order 1, as the AIC criterion is least, for this study, model of VAR an interval length of 1 is engaged.

Selection of Lag Length

How many and which variable should be included in the model, this is the first step when we are using the VAR model. In addition, the mainly applicable lag length of the VAR model should be preferred. Bayesian criterion of information (BIC) or Criterion of Akaike

Information can be taken into the consideration to choose such criteria, which practitioners uses most of time, while deciding about lag length for study.

$$AIC_{(p)} = nlog\sigma^2 + 2p$$

$$BIC_{(p)} = nlog\sigma^2 + plog$$

To estimate the impact of energy price shock on macroeconomic variables, we estimate the following reduced form model. The model is based on Khan & Ahmed (2011).

$$\mathbf{Y_t} = \mathbf{A_0} + \mathbf{X_t B} + \mathbf{U_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (\mathbf{1})$$

Where (Y_t) denotes the vector of (n×1) endogenous variables and X_t are vector of (n×n) exogenous variable, U_t is the error term distributed with *i.e. N (0,* **o***)*

While Y_t is GDP per capita for nation at time, at the start of every period, across the countries, the conditional convergence is captured by it, is the vector of (nx1) endogenous variable and X_t are vectors (nxn) exogenous variable including Energy price, Real Effective Exchange Rate, Inflation, Money Supply, interest rate, Ut is the error term, distributed with.

Yt=$\breve{\alpha}_1 - \beta_{11}Y_{t-1} - \beta_{12}EP_t - \beta_{13}EP_{t-1} - \beta_{14}INT_t - \beta_{15}INT_{t-1} - \beta_{16}M1_t - \beta_{17}M1_{t-1} - \beta_{18}EXR_t - \beta_{19}EXR_{t-1} - \beta_{110}INF_t - \beta_{111}INF_{t-1}\varepsilon_{1t}$………………………………………………**(1)**

EP_t=$\breve{\alpha}_{20} - \beta_{21}Y_t - \beta_{22}Y_{t-1} - \beta_{23}EP_{t-1} - \beta_{24}INT_t - \beta_{25}INT_{t-1} - \beta_{26}M1_t - \beta_{27}M1_{t-1} - \beta_{28}EXR_t - \beta_{29}EXR_{t-1} - \beta_{210}INF_t - \beta_{211}INF_{t-1} - \varepsilon_{2t}$……………………………………… **(2)**

INT_t=$\breve{\alpha}_{30} - \beta_{31}Y_t - \beta_{32}Y_{t-1} - EP_t - \beta_{34}EP_{t-1} - \beta_{35}INT_{t-1} - \beta_{36}M1_t - \beta_{37}M1_{t-1} - \beta_{38}EXR_t - \beta_{39}EXR_{t-1} - \beta_{310}INF_t - \beta_{311}INF_{t-1} - \varepsilon_{3t}$ ……………………………………… **(3)**

$M1_t$=$\breve{\alpha}_{40} - \beta_{41}Y_t - \beta_{42}Y_{t-1} - \beta_{43}EP_t - \beta_{44}EP_{t-1} - \beta_{45}INT_t - \beta_{46}INT_{t-1} - \beta_{47}M1_{t-1} - \beta_{48}EXR_t - \beta_{49}EXR_{t-1} - \beta_{410}INF_t - \beta_{411}INF_{t-1} - \varepsilon_{4t}$……………………………………… **(4)**

EXR_t=$\breve{\alpha}_{50} - \beta_{51}Y_t - \beta_{52}Y_{t-1} - \beta_{53}EP_t$-$\beta_{54}EP_{t-1} - \beta_{55}INT_t - \beta_{56}INT_{t-1} - \beta_{57}M1_t$-$\beta_{58}M1_t - \beta_{59}EXR_{t-1} - \beta_{510}INF_t - \beta_{511}INF_{t-1} - \varepsilon_{5t}$……………………………………………………… **(5)**

INF_t=$\breve{\alpha}_{60} - \beta_{61}Y_t - \beta_{62}Y_{t-1} - \beta_{63}EP_t - \beta_{64}EP_{t-1} - \beta_{65}INT_t - \beta_{66}INT_{t-1} - \beta_{67}M1_t$-$\beta_{58}\beta_{68}M1_{t-1} - \beta_{68}EXR_t - \beta_{610}EXR_{t-1} - \beta_{611}INF_{t-1} - \varepsilon_{6t}$……………………………… **(6)**

Thus, the contemporary variable to L.H.S of equation and solving we get,

$$\begin{bmatrix} 1, & \beta_{12.} & \beta_{13} & \beta_{14.} & \beta_{15,} & \beta_{16,} \\ .\beta_{21} & 1 & \beta_{23} & \beta_{24} & \beta_{25} & \beta_{26} \\ ,\beta_{32} & .\beta_{32} & 1 & \beta_{34} & \beta_{35} & \beta_{36} \\ ,\beta_{41} & ;\beta_{42} & \beta_{43} & 1 & \beta_{45} & \beta_{46} \\ .\beta_{51} & [\beta_{52} & \beta_{53} & \beta_{54} & 1 & \beta_{56} \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & 1 \end{bmatrix} \begin{bmatrix} Y_t \\ EP_t \\ INT_t \\ M1_t \\ EXR_t \\ INF_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \\ \beta_{40} \\ \beta_{50} \\ \beta_{60} \end{bmatrix} + \begin{bmatrix} 1 & \gamma_{12} & \gamma_{13} & \gamma_{14} & \gamma_{15} & \gamma_{16} \\ \gamma_{21} & 1 & \gamma_{23} & \gamma_{24} & \gamma_{25} & \gamma_{26} \\ \gamma_{31} & \gamma_{32} & 1 & \gamma_{34} & \gamma_{35} & \gamma_{36} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & 1 & \gamma_{45} & \gamma_{46} \\ \gamma_{51} & \gamma_{52} & \gamma_{53} & \gamma_{54} & 1 & \gamma_{56} \\ \gamma_{61} & \gamma_{62} & \gamma_{63} & \gamma_{64} & \gamma_{65} & 1 \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ EP_{t-1} \\ INT_{t-1} \\ M1_{t-1} \\ EXR_{t-1} \\ INF_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{1t} \\ \varepsilon_{1t} \\ \varepsilon_{1t} \\ \varepsilon_{1t} \\ \varepsilon_{1t} \end{bmatrix}$$

Equation (1) to (6) stipulates the primitive VAR (p) progression, where βi KxK matrices of factors, β is a K x 1 are vector of constants and is disturbance term. In this equation Y_t represents GDP Gross Domestic Product for a country at time while Y_{t-1} is the lag value of its own value and β_{10} is intercept. EP_t represents energy price for a country at a time while EP_{t-1} the lag value of its own value. β_{11} is slope and ER_t demonstrate the exchange rate while ER_{t-1} represent the lag value of its own value. In this equation INT_t is interest rate while INT_{t-1} is lag value of its own value. Here $M1_t$ shows the money supply and $M1_{t-1}$ is the lag value of its own value, INF_t is inflation rate for a country at a time while INF_{t-1} is the lag value of its own value. In this equation $e_{1t}$is disturbance term.

We assume that the error vectors must be zero mean, contemporaneously correlated, but not auto correlated.

By simplifying.

$$\begin{bmatrix} Y_t \\ ECON_t \\ INT_t \\ M1_t \\ EXR_t \\ INF_t \end{bmatrix} = \begin{bmatrix} 1 & \beta_{12} & ß_{13} & ß_{14} & ß_{15} & ß_{16} \\ \beta_{21} & 1 & ß_{23} & ß_{24} & ß_{25} & ß_{26} \\ ß_{32} & \beta_{32} & 1 & ß_{34} & ß_{35} & ß_{36} \\ ß_{41} & ß_{42} & ß_{43} & 1 & ß_{45} & ß_{46} \\ ß_{51} & ß_{52} & ß_{53} & ß_{54} & 1 & ß_{56} \\ ß_{61} & ß_{62} & ß_{63} & ß_{64} & ß_{65} & 1 \end{bmatrix}^{-1} \begin{bmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \\ \beta_{40} \\ \beta_{50} \\ \beta_{60} \end{bmatrix} +$$

$$\begin{bmatrix} 11 & ß_{12} & ß_{13} & \beta_{14} & \beta_{15} & \beta_{16} \\ ß_{21} & 1 & ß_{23} & \beta_{24} & \beta_{25} & \beta_{26} \\ ß_{32} & \beta_{32} & 1 & \beta_{34} & \beta_{35} & \beta_{36} \\ ß_{41} & ß_{42} & \beta_{43} & 1 & \beta_{45} & \beta_{46} \\ ß_{51} & ß_{52} & \beta_{53} & \beta_{54} & 1 & \beta_{56} \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & 1 \end{bmatrix}^{-1} \begin{bmatrix} 1 & \Upsilon_{12} & \Upsilon_{13} & \Upsilon_{14} & \Upsilon_{15} & \gamma_{16} \\ \Upsilon_{21} & 1 & \Upsilon_{23} & \Upsilon_{24} & \Upsilon_{25} & \gamma_{26} \\ \Upsilon_{31} & \Upsilon_{32} & 1 & \Upsilon_{34} & \Upsilon_{35} & \gamma_{36} \\ \Upsilon_{41} & \Upsilon_{42} & \Upsilon_{43} & 1 & \Upsilon_{45} & \gamma_{46} \\ \Upsilon_{51} & \Upsilon_{52} & \Upsilon_{53} & \Upsilon_{54} & 1 & \gamma_{56} \\ \Upsilon_{61} & \Upsilon_{62} & \Upsilon_{63} & \Upsilon_{64} & \Upsilon_{65} & 1 \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ ECON_{t-1} \\ INT_{t-1} \\ M1_{t-1} \\ EXR_{t-1} \\ INF_{t-1} \end{bmatrix} + \cdots$$

$$+ \begin{bmatrix} 1 & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} & \beta_{16} \\ ß_{21} & 1 & \beta_{23} & \beta_{24} & \beta_{25} & \beta_{26} \\ ß_{32} & \beta_{32} & 1 & \beta_{34} & \beta_{35} & \beta_{36} \\ ß_{41} & \beta_{42} & \beta_{43} & 1 & \beta_{45} & \beta_{46} \\ ß_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 & \beta_{56} \\ ß_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & 1 \end{bmatrix}^{-1} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{1t} \\ \varepsilon_{1t} \\ \varepsilon_{1t} \\ \varepsilon_{1t} \\ \varepsilon_{1t} \end{bmatrix}$$

Multiply both sides by β^{-1} we get

$$\beta^{-1}\beta M_t = \beta^{-1}\beta_o + \beta^{-1}\gamma M_{t-1} + \beta^{-1}\varepsilon_t$$

Suppose

$$\beta^{-1}\beta = A_o$$

$$\beta^{-1}\gamma = A_1$$

$$\beta^{-1}\varepsilon_t = u_t$$

The unrestricted VAR system can be written in a reduced form:

$$\mathbf{Y_t} = \mathbf{A_0} + \mathbf{X_t B} + \cdots + \mathbf{U_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(\mathbf{7})$$

Results And Discussion

Co-Integration Analysis

To ascertain that the regression of the non-stationary time series does not generate spurious regression, the study conducted the co-integration analysis.

Table 1
Test of Johansen Co-Integration

Johansen Co-Integration Test						
No. of CE(s),	None **	At most 1 **	At most 2 *	At most 3 *-	At most 4 *p	At most 5 *;
Eigen-value	0.917	0.694	0.622	0.554	0.237	7.200
Trace Statistic	183.365	103.604	65.677	34.502	8.663	0.000
Critical Value at 0.05	95.753	69.818	47.856	29.797	15.494	3.841
Prob.**	0.000	0.000	0.000	0.013	0.397	0.989

At the level 0.05, trace the test indicates 4 equations of co-integration
At the level 0.05, represents the rejection of the hypothesis*
*p-values of **MacKinnon-Haug-Michelis in 1999*

Unrestricted Co-integration Test Rank (Maximum Eigen value)						
No. of CE(s)	None	At most 1	At most 2	At most 3 *	At most 4 *	At most 5 *
Eigen-value	0.917	0.694	0.622	0.554	0.237	7.200
Max-Eigen-value	79.760	37.926	31.175	25.839	8.663	0.000
Critical Value at 0.05	40.077	33.876	27.584	21.131	14.264	3.841
Prob.**	0.000	0.015	0.016	0.010	0.315	0.989

At the level of 0.05, 4 equations of cointegration indicated by Max-eigen value
** Represents non acceptance of the hypothesis at the 0.05 level*
*p-values of the **MacKinnon-Haug-Michelis (1999)*

It can be understood from the Table that the system is integrated and does not generate a spurious regression. Individually the variables in the system have unit root but together the co-movement of the variables is not spurious. Thus, it can be concluded that the variables in the system have a stable long run equilibrium behavior and will not wander away from each other.

Unit Root Test

Table 2
Unit Root Test

Variables	At Level		At 1st Difference		Decision
	t-statistics	Prob	t-statistics	Prob	
GDP	-3.291	0.536	-3.836	0.006	I(1)

Inflation	-6.121	0.103	-5.916	0.000	I(1)
Interest rate	-5.210	0.006			I(0)
Money Supply	-6.221	0.327	-4.953	0.000	I(1)
Real Exchange Rate	-5.071	0.835	-4.823	0.000	I(1)
Energy Prices	-7.555	0.783	-4.598	0.0008	I(1)

It is showed by the Table 1 that the outcomes of unit root test indicate GDP, inflation, money supply, real exchange rate and energy prices at levels, but it is removed later than first differencing the data while interest rate are level stationary. This suggests that order of integration among the variable of the model is different and hence standard OLS and co-integration estimates are not appropriate to use. Thus, we shall use VAR and presence of unit root causes errors in estimation which are not generally removed even with addition of new data.

Impulse Response Functions

For the one variable to another variables, the shock effect of one standard deviation (SD) showed by the impulse response functions in the system, as a result, in empirical causal analysis, it is considered as an essential tool. The shocks of one variable when hit the system, the impact is transmitted to all other variables not only for the current time period but sometimes persist over the future horizon of forecast. The Impulse Response Functions sketches the collision of one-time shock of a variable to endogenous variables in the system over the forecast horizon.

Energy Price Shocks Effect

The function of Impulse Response for the energy price shocks (measured by the condition unpredictability or volatility) on GDP Per Capita, Real Effective Exchange Rate, Energy Price, Money Supply, Interest Rate, and Inflation Rate in the Table: For each variable the Impulse response functions is linked separately with unit shocks that are distinguished here. In response to a shock to Energy Prices, GDP response is initially positive for short run but in 2nd period it shows the negative response. According to the theory there is negative affiliation among the prices and demand, so as far as the energy prices increases the demand will be low, its impact on GDP will be negative, GDP will respond negatively, and this graph shows that it is. The 3rd graph demonstrates the response of inflation to a shock of energy price. The response of the interest rate, Money Supply, Real Effective Exchange Rate to energy price is also positive. The shock of energy prices produces a positive response in energy prices upon impact that then converges to equilibrium in fourth period. But for the shocks of energy prices in the system, the response of remaining variables remains stable over the entire forecast horizon.

Impulse Response function to Energy Price Shocks

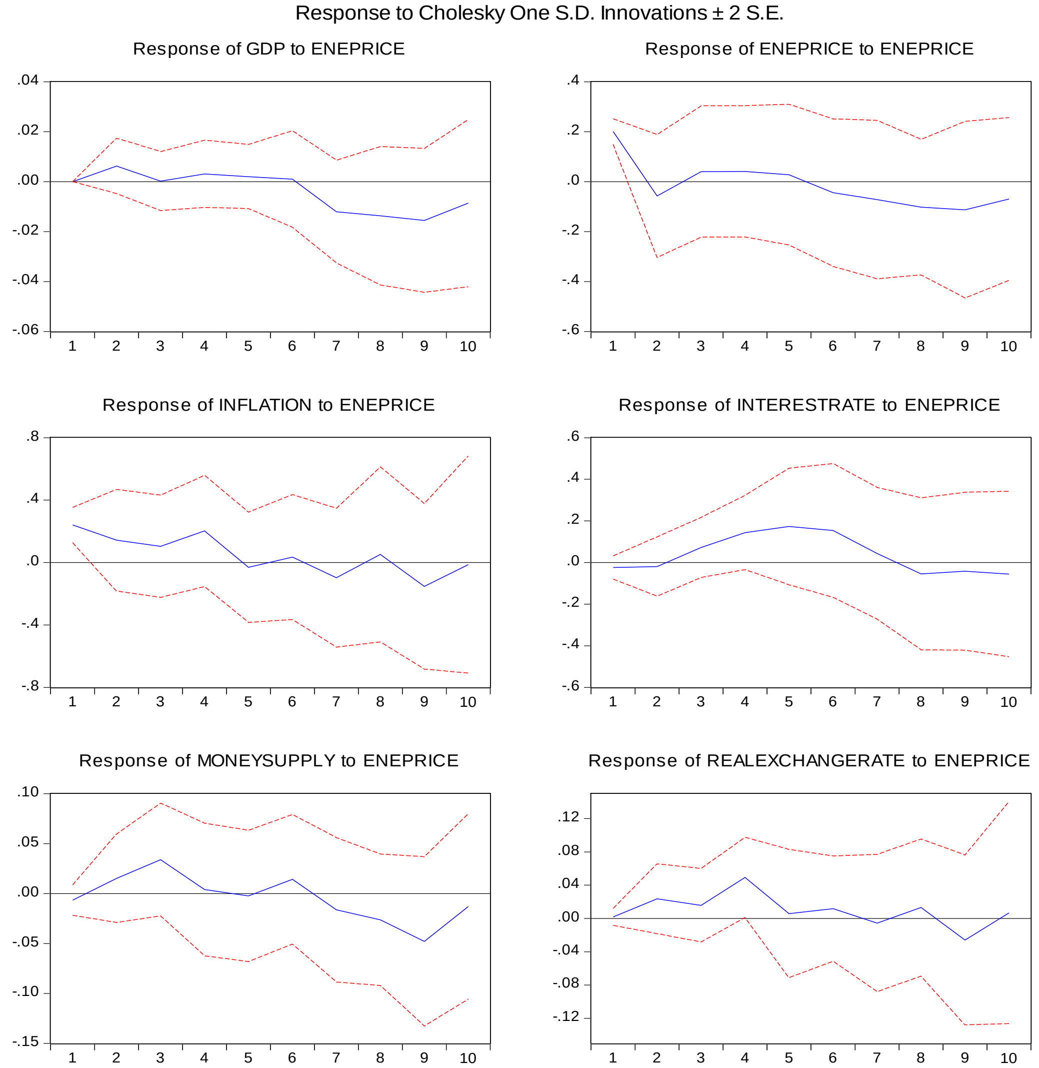

Figure 1: VAR Impulse response functions with intercept using annual data for 1980-2019

Inflation Rate Shock

GDP and Energy Price give reaction to Inflation rate negatively. Response of Inflation to its own shock generates positive response. In the view to the theory there is constructive association between inflation and money supply. The reaction of the Money Supply to Inflation rate is positive and response of GDP and energy prices shocks generate a negative response in Money Supply, where interest rate, money supply, exchange rate and own shocks generate positive response upon impact by Bini-Smaghi L. (1991). There is a negative correlation among GDP and Inflation for the case of Pakistan (Ayoub et al. 2011).

Impulse Response to inflation rate

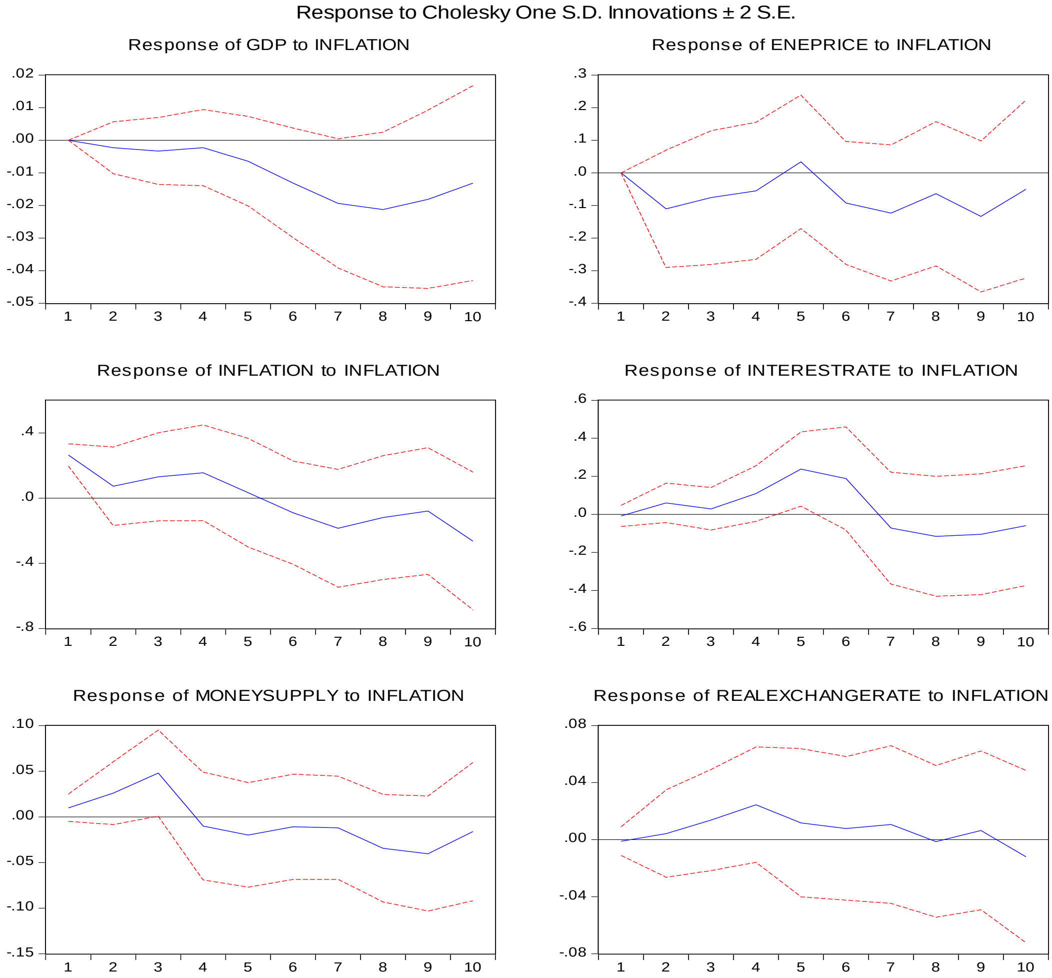

Figure 2: VAR Impulse response functions with intercept using annual data for 1980-2019

Money Supply shocks effect

The response of GDP for Money Supply is negative while produce a positive response in its own shock. The impact of other variables to Money Supply remains persistently positive over the entire forecast horizon and volatile, responsive around the equilibrium. The impact of money supply and interest rate does not decease over the entire forecast horizon as found by Bini-Smaghi, (1991) for the US economy. The impact of money supply and exchange rate shocks remain persistently positive over the entire forecast horizon. Energy prices generate negative response in Money Supply at early stage but not for long run, while shocks of interest rate, inflation rate, money supply and exchange rate produce a positive response.

Impulse Response to Money Supply

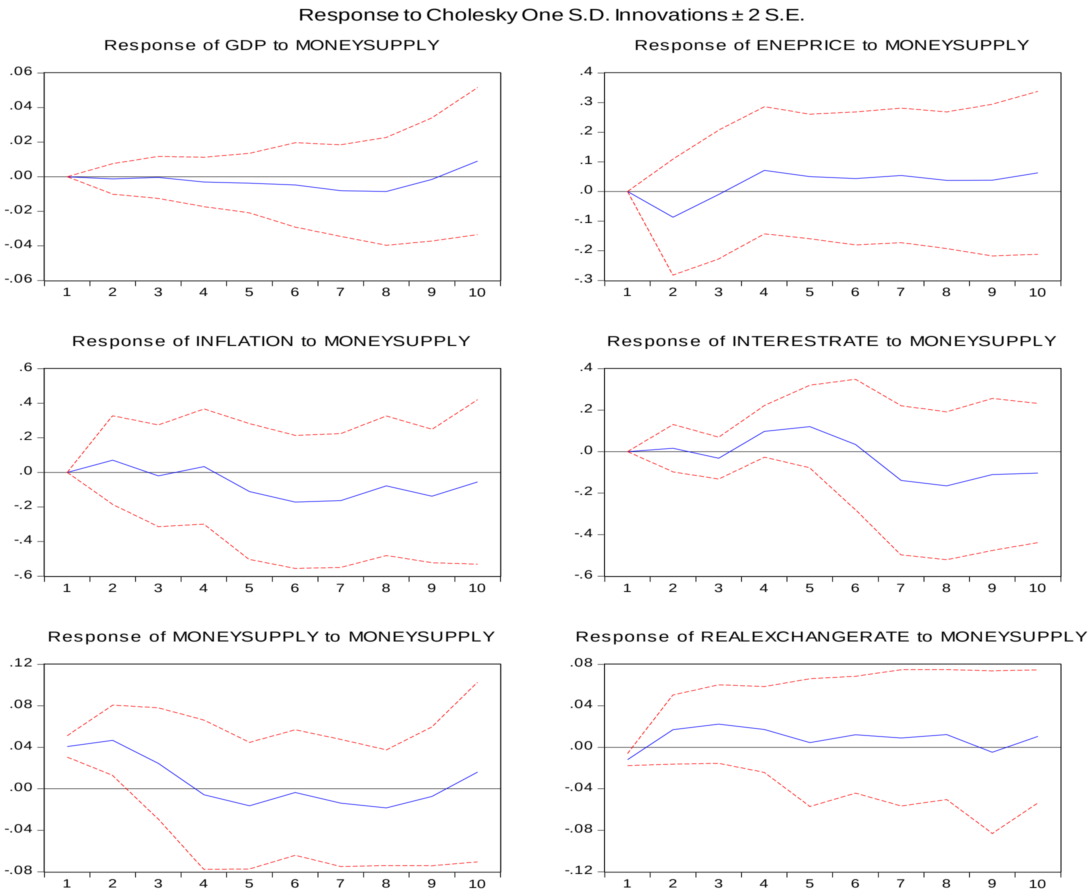

Figure 3: VAR Impulse response functions with intercept using annual data for 1980-2019

Influence of Real Effective Exchange Rate shocks

This graph shows that the impact of GDP shocks on exchange rate remain persistently positive over the complete forecast horizon and GDP shocks produce a stable response in Real Effective Exchange Rate over entire forecast horizon. Unanticipated movements in inflation rate and the figure shows that at the early stage the behavior of the variable have negative impact but gradually it gives stable response in Real Effective Exchange Rate, and it remains volatile around its origin not in short run but in long run which is reliable with the findings of De Castro & Garrote, (2015). Response of energy price to exchange rate is positive over entire forecast horizon. Energy prices and Exchange rate depress the overall performance of economy. In response of Money supply and its own shock the impact is responsive and around the equilibrium. The figure depicts the response of impulse for GDP to shocks on exchange rate over the future forecast horizon. The figure shows that at the early stage the behavior of the inflation rate has negative impact but gradually it gives stable response in exchange rate, and it remains volatile around its origin not in short run but in long run which is consistent with the findings of De Castro & Garrote, (2015).

Impulse Response to Real Exchange Rate

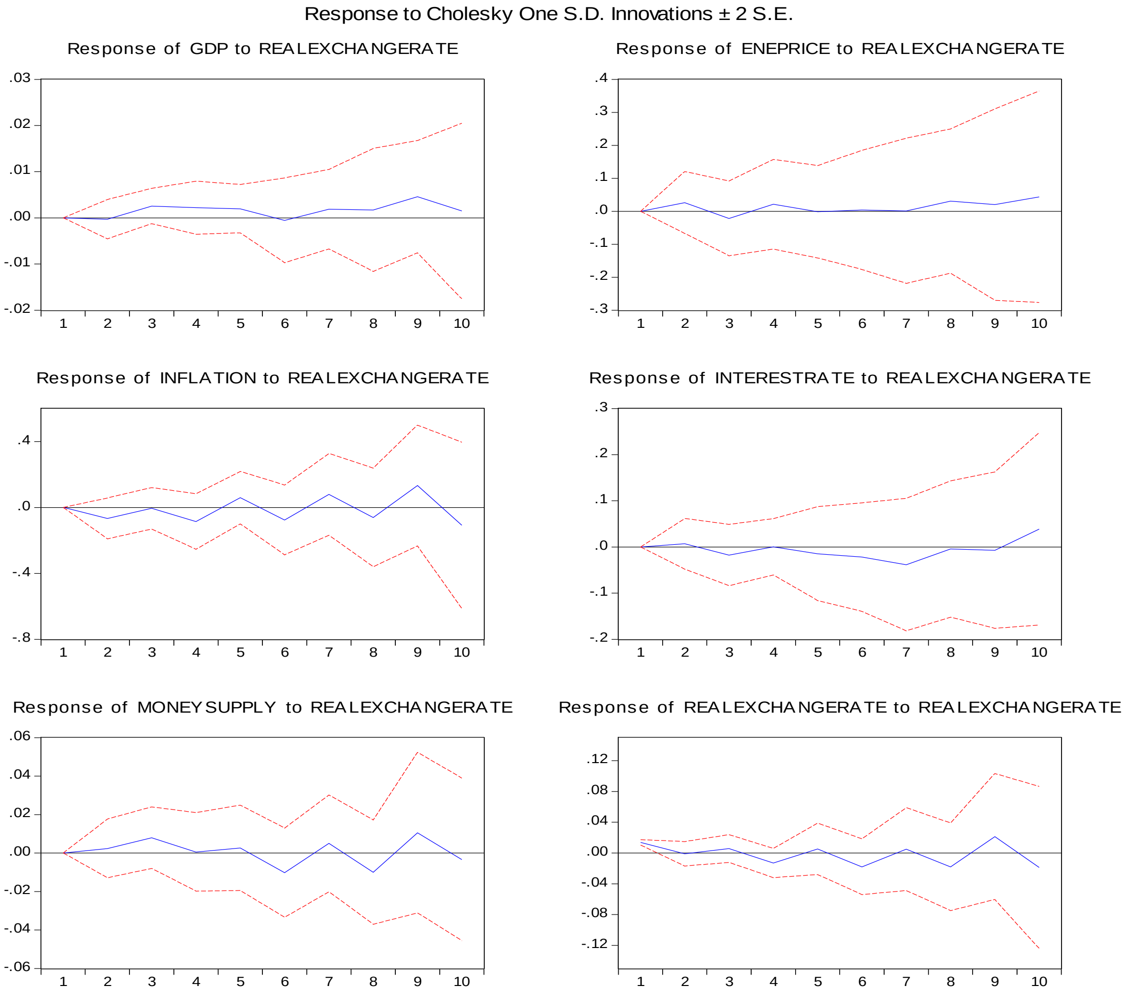

Figure 4: VAR Impulse response functions with intercept using annual data for 1980-2019

Impact of GDP shocks

Figure 5: Generalized the impulse response function to one S.D shocks for the changes in GDP. It should be noted that the axis which is horizontal shows the period in the figure. While the axis is in vertical explains the dependency level of variable to the variables which are independent for this study. Upon impact, there is a positive response of GDP to its own shock that then converges to equilibrium and remains stable. In response to a shock to GDP the energy prices increase initially and after the 5th period become stable while in response to own shock of GDP, GDP shows positive response. In rejoinder of inflation to GDP, inflation creates negative impact at the early stage but in 3rd period it generates positive response while the response of interest rate toward GDP, it shows positive response and remain around equilibrium, for some time period from 5th to 6th it has negative response but again it moves towards upward. In this graph Money supply response negatively at initial level but in 2nd period it generates positive response, volatile and around the equilibrium. It is contrary to the findings of Al-Shorgani, et al, (2015) that found negative contact of Oil prices on GDP growth.

Impulse Response to GDP

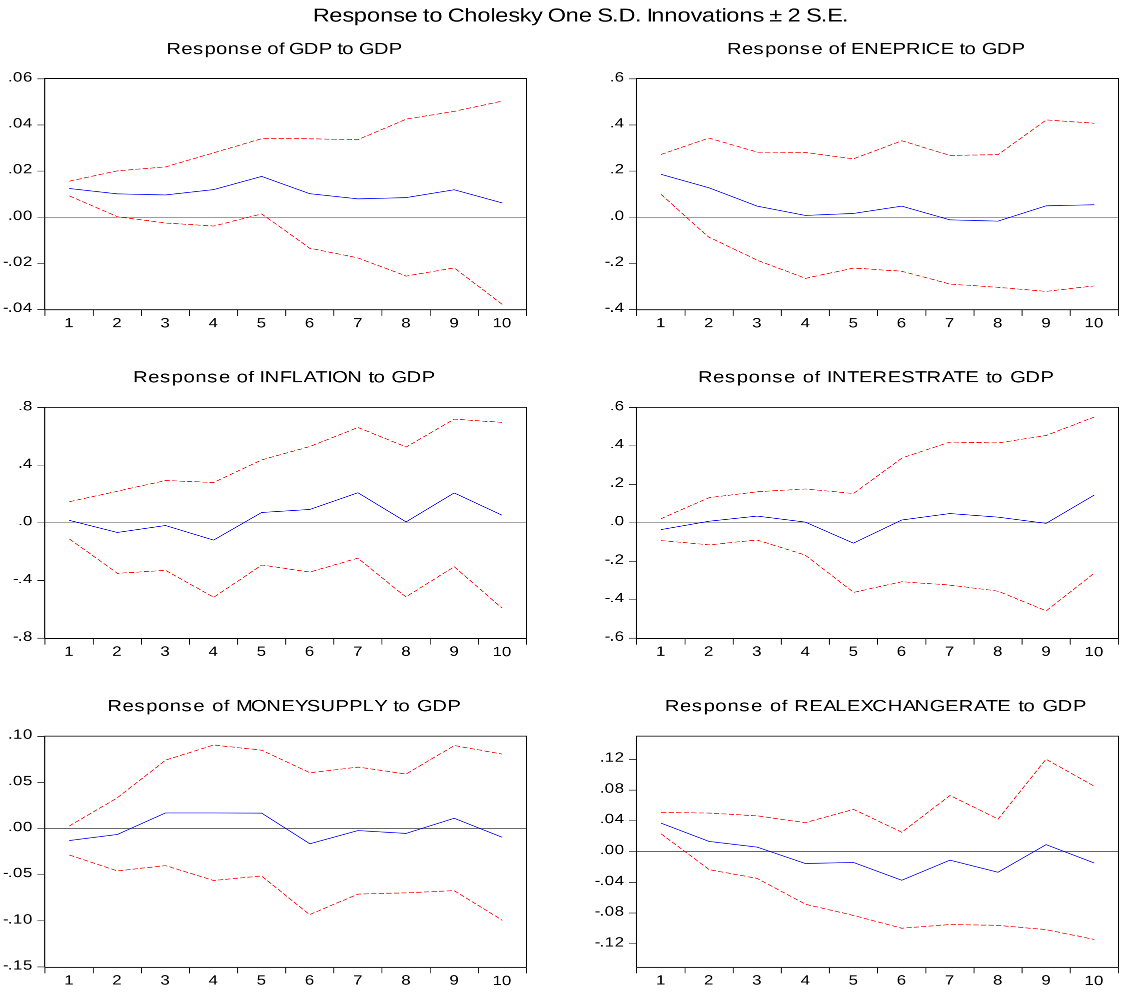

Figure 5: VAR Impulse response functions with intercept using annual data for 1980-2019

Effect of Interest rate shocks

The GDP shocks produce a stable response in interest rate over entire forecast horizon. This non-response of interest rate to GDP shocks initially indicates low responsiveness of investment expenditures translated into new investments. This is also found by Le Roux, & Ismail, (2004) for Australian Economy that faced the problems of capacity utilization of the existing manufacturing units and mismatch of the demand for consumer goods. But economy of Pakistan has different problems pertaining to energy crisis, lower level of capital and labor productivity and underdeveloped factor markets. GDP shock generates a negative response in interest rate upon impact that is adjust immediately in the following period but remains volatile over the forecast horizon around equilibrium. Inflation rate generates a negative response in interest rate and own shocks that are also volatile over the forecast horizon, and for rest of the shocks, interest rate remains responsive, volatile and around equilibrium.

VAR Impulse Response to Interest Rate

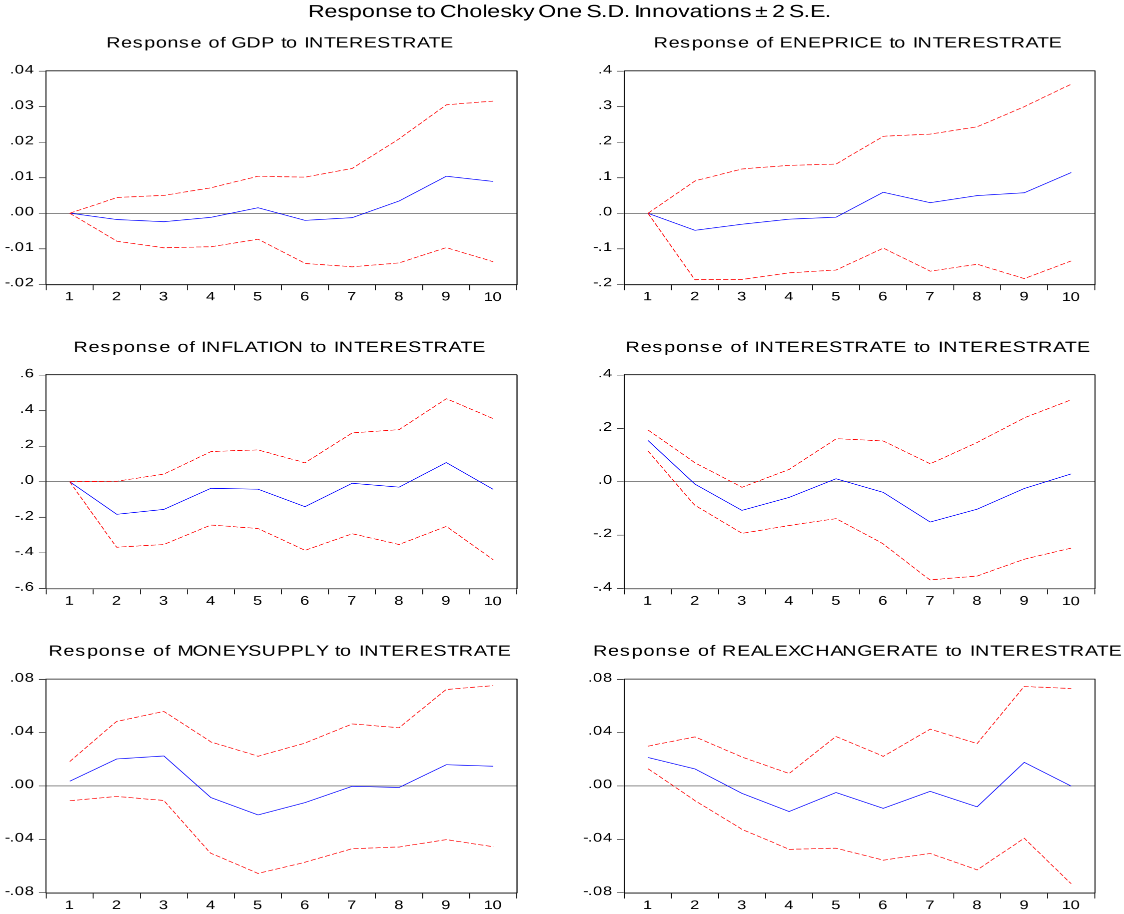

Figure 6: VAR Impulse response functions with intercept using annual data for 1980-2019

Conclusion

The study estimated the relationship between GDP (per capita), energy prices, interest rate, real effective exchange rate, money supply and inflation that have important macroeconomic implications not only in terms of performance of the economy but also in shaping the future growth patterns of developing economies like Pakistan. This study concludes: The VAR analysis revealed that shocks of energy prices and exchange rate have significant impact on performance of GDP, making this analysis relevant to understand the behavior of growth over the future time horizon. Unanticipated movements in exchange rate and energy prices depress the overall economy, and persistence of this impact can lead to recessionary impact on the GDP of Pakistan. The forecasted impact of these variables does not seem to die out in the short run, therefore, making it imperative for policy initiatives to control the unanticipated volatility and movements in exchange rate and energy prices.

Furthermore, the analysis found that energy prices shock not only adversely affect the performance of economy (GDP) but also causes an appreciation in exchange rate that remains persistent over a long term. This has multiple consequences on (GDP) economy not just in terms of trade – local and foreign – but also has important implications for monetary management by the central bank. On the other hand, the shocks of exchange rate do not have lasting effect on performance of (GDP) economy and inflation.

References

Aliyu, S. U. R. (2009). Real exchange rate misalignment: an application of behavioral equilibrium exchange rate (BEER) to Nigeria. *SSRN 1333642*.

Al-Shorgani, N. K. N., Shukor, H., Abdeshahian, P., Nazir, M. Y. M., Kalil, M. S., Hamid, A. A., & Yusoff, W. M. W. (2015). Process optimization of butanol production by Clostridium saccharoperbutylacetonicum N1-4 (ATCC 13564) using palm oil mill effluent in acetone–butanol–ethanol fermentation. *Biocatalysis and Agricultural Biotechnology, 4(2), 244-249.*

Arshad, M., & O'Kelly, B. (2019). Global status of wind power generation: theory, practice, and challenges. *International Journal of Green Energy, 16(14), 1073-1090.*

Asafu-Adjaye, J. (2000). The relationship between energy consumption, energy prices and economic growth: time series evidence from Asian developing countries. *Energy economics, 22(6), 615-625.*

Ayyoub, M., Chaudhry, I. S., & Farooq, F. (2011). Does Inflation Affect Economic Growth? The case of Pakistan. *Pakistan Journal of Social Sciences (PJSS), 31(1). pp. 51-64.*

Bini-Smaghi, L. (1991). Exchange rate variability and trade: why is it so difficult to find any empirical relationship?. *Applied economics, 23(5), 927-936.*

De Castro, F., & Garrote, D. (2015). The effects of fiscal shocks on the exchange rate in the EMU and differences with the USA. *Empirical Economics, 49(4), 1341-1365.*

Finn, M. G. (2000). Perfect competition and the effects of energy price increases on economic activity. *Journal of Money, Credit and banking, Vol. 32, No. 3, 400-416.*

Hamilton, J. D. (2009). Causes and Consequences of the Oil Shock of 2007-08 (No. w15002). *National Bureau of Economic Research.*

Husain, I. (2010). Electric and hybrid vehicles: design fundamentals. *CRC press.*

Inoue, A., & Kilian, L. (2013). Inference on impulse response functions in structural VAR models. *Journal of Econometrics, 177(1), 1-13.*

Kander, A., & Stern, D. I. (2014). Economic growth and the transition from traditional to modern energy in Sweden. *Energy Economics, 46, 56-65.*

Khan, M. A., & Ahmed, A. (2011). Macroeconomic effects of global food and oil price shocks to the Pakistan economy: a structural vector autoregressive (VAR) analysis. *The Pakistan Development Review, Vol. 50, No. 4, 491-511.*

Kilian, L., & Lee, T. K. (2014). Quantifying the speculative component in the real price of oil: The role of global oil inventories. *Journal of International Money and Finance, 42, 71-87.*

Le Roux, P., & Ismail, B. (2004). Modelling the impact of changes in the interest rates on the economy: An Austrian perspective. *South African Journal of Economic and Management Sciences, 7(1), 132-150.*

Lescaroux, F., & Mignon, V. (2008). On the influence of oil prices on economic activity and other macroeconomic and financial variables. *OPEC Energy Review, 32(4), 343-380.*

Mellado Jiménez, V., Borrachero, A. B., Brígido, M., Melo, L. V., Dávila Acedo, M., Conde Núñez, M., ... & Bermejo, M. L. (2014). Las emociones en la enseñanza de las ciencias. *Enseñanza de las Ciencias, 32(3), 0011-36.*

Ministry of Finance. (2015). Pakistan economic survey. *Finance Division, Government of Pakistan*

Müller, R. D., Seton, M., Zahirovic, S., Williams, S. E., Matthews, K. J., Wright, N. M., ... & Cannon, J. (2016). Ocean basin evolution and global-scale plate reorganization events since Pangea breakup. *Annual Review of Earth and Planetary Sciences, 44(1), 107-138.*

Nakajima, J. (2011). Time-varying parameter VAR model with stochastic volatility: An overview of methodology and empirical applications.

Nguyen, T. T., Hoang, V. N., Wilson, C., & Managi, S. (2019). Energy transition, poverty and inequality in Vietnam. *Energy Policy, 132, 536-548.*

Rotemberg, J. J., & Woodford, M. (1996). Imperfect competition and the effects of energy price increases on economic activity.

Saidi, K., & Hammami, S. (2015). The impact of CO2 emissions and economic growth on energy consumption in 58 countries. *Energy Reports, 1, 62-70.*

Shahbaz, M., Sarwar, S., Chen, W., & Malik, M. N. (2017). Dynamics of electricity consumption, oil price and economic growth: Global perspective. *Energy Policy, 108, 256-270.*

Tatom, J. (1981). Energy prices, economic performance and monetary policy. *Federal Reserve Bank of St. Louis Working Paper, 7.*