International Journal of Social Sciences Bulletin

Volume 2, Issue 4, 2024

THE EFFECT OF FLUCTUATIONS IN FUEL PRICES ON INFLATION IN PAKISTAN

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Received	Revised	Accepted	Published
11 September, 2024	07 October, 2024	15 October, 2024	23 October, 2024

ABSTRACT

The impact of inconstancy in fuel costs on inflation in Pakistan was studied on the small level monthly time series data from June 2003 to August 2018. In addition, forecast of oil costs for the succeeding sixty months has been presented graphically along with which Granger causality test was also performed. The Impulse Response Function (IRF) determined the effect of fluctuations of fuel prices on inflation and Vector Autoregressive VAR model was used to forecast the fuel prices. The study depicted that fuel (diesel, kerosene, and petrol) prices could cause consumer price index (CPI) in Pakistan. The rise in Petrol prices turned out to be the major cause of inflation, whereas diesel and kerosene costs did not show that abundant result.

***Keywords**: Fuel Prices, Inflation, Impulse Response Function, Granger Causality, VAR, CPI.*

INTRODUCTION

Fuel is one in all the first sources of economy and therefore the most vital indicator of inflation measurement [1]. The fuel costs influence the economy and have displayed a direct impact on the general public, services and businesses without which an economy cannot progress for most the of sectors like transportation, services and industries etc. are based on fuel prices [2]. Likewise, economic growth decreases as inflation increases due to hike in fuel prices. The transportation cost, heating and manufacturing are indirectly affected while goods and services associated with petroleum products are directly affected by the rise in prices of fuel. The producers of products and services could pass the rise within the value of production to the customers by which the costs increase [3].

Inflation refers to the case in an economy wherever the overall costs of products and services increase with reference to time. The buying power of the customers' decreases once costs square measure increases for essential merchandise and services [4]. Consumer price index (CPI) is an indicator that is employed to measure the inflation on monthly basis; and the rise in inflation directly affects CPI. Once the costs of the commodities (like food, travelling, household items, bills, energy consumption and all everyday life accessories etc.) move upward, the getting power of currency decreases; this condition brings out unbalanced scenario within the economy [5]. The unemployment, increase in costs of products and services result in the inflation of economy [6].

The energy sector of Pakistan consists of crude oil, electricity, gas, and coal where fuel is the main source of energy. A nonstop increase within the energy consumption has been recorded in Pakistan. As an illustration, over the last twenty five years, the energy mix has taken place within the share of gas and oil consumption. In Pakistan, fuel costs are increasing day by day at the side of its consumption. Kiani [7] studied the impact of oil costs on Pakistan's economic growth using numerous macro-economic models. The time series data were analyzed to determine the relationship of gross domestic product (GDP) growth in Pakistan with sharp rise within the costs of oil for the past twenty years from 1990 to 2009. The oil prices showed a negative impact because of the sharp rise within the costs of oil with the real government expenditures and real output. The study unconcealed each economic policy and market costs expected to boost the real output and government expenditures.

Le and Chang [8] carried out the impact of oil worth changes on the stock exchange of rising and developed economies. Monthly data were collected from stock market of Japan, Singapore, South Korea and Malaysia for the period of January 1986 to February 2011. Variance decomposition test and generalized impulse response were accustomed to analyze the data. The results indicated that stock market responses to the shocks in oil prices vary across the market considerably. Positive responses of stock exchange were there for Japan, however, negative for Malaysia and verify unclear responses for South Korea and Singapore. Khan and Ahmad [9] studied the macroeconomic effects of worldwide shocks of food and oil worth to Pakistan's economy. Monthly time series data on food, oil costs, rate of inflation, real financial gain and nominal effective exchange rate were collected from January 1990 to July 2011. The study investigated the short run impact of food and oil costs on consumer worth inflation using Structural Vector Autoregressive analysis and Generalized Impulse Response analysis. The results unconcealed that inflation straightaway inflated by oil price's shocks and bit by bit prices increase with the food prices shocks. Additionally, exchange rate was observed as a dominant supply of variation in inflation.

Waheed et al. [10] studied the impact of oil prices and lagged oil costs on firm-level stock returns. The volatility impact of oil costs and reactions on stock returns was conjointly studied. Annual panel data from 1998 to 2014 were taken from business records of SBP and EIA for non-financial 397 corporations which were classified in twelve industries. Using regression analysis, the study indicated that changes in oil costs displayed vital positive result on stock returns of firm, whereas lagged oil costs showed a significant negative result. Analysis showed same results for both business and firm. Study conducted that a positive signal within the stock market because of increasing prices of oil boost the stock returns on firm level in Pakistan. The positive shocks in the costs of oil considerably showed effect on stock returns as compared to negative shocks. The long run relationship, among the economic variables, studied within the past for the various times series data with style of form of approaches i.e. Sarwat et al. [11], Asghar and Naveed [12], Saleem and Ahmad [13], and Ansar and Asghar [14].

This study determines the connection between fuel costs and client price index in order to envision the causality of fuel costs on client price index; moreover, it, additionally, finds the result of fluctuations in fuel costs on inflation in Pakistan. Apart from that, it helps in foretelling the costs of fuel, kerosene oil and diesel for the next sixty months in Pakistan.

Materials and Methods

The monthly statistical data from a secondary source on numerous connected economic variables for the period of June-2003 to August-2018 were obtained from Pakistan Bureau of Statistics (PBS). In order to attain the analysis objectives, various statistical strategies like Johansen Co-Integration test, to verify the short-run relationship, and Granger Causality test were applied for investigating the relation between fuel costs and CPI. Variance autoregressive model was used to study the effect of fluctuations in fuel prices on inflation in Pakistan using Impulse Response Function (IRF) and also for forecasting the fuel prices in Pakistan.

Vector Auto-Regressive (VAR) Model

Vector autoregressive (VAR) model is the generalized form of auto regressive model. It is very useful technique in forecasting and studying the structural shocks effect. In this model, the variables should be endogenous in nature and will be extracted from historical data sets. Unlike regression analysis, this technique is applied when data are stationary. If the data were non-stationary at level, then it is integrated of different orders until it becomes stationary. The VAR model is illustrated as follows:

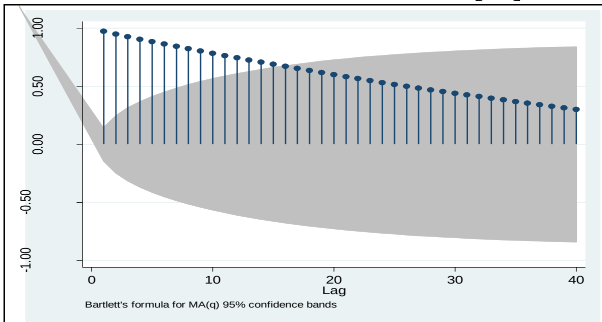
Let $Y_t = y_{1t}, y_{2t}, \dots, y_{nt}$ denotes a vector of order $n * 1$ for time series variables. By taking p-lagged values, the Vector Auto-Regressive (VAR(p)) model is as follows:

$$y_t = \alpha + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \dots + \beta_p y_{t-p} + \varepsilon_t$$

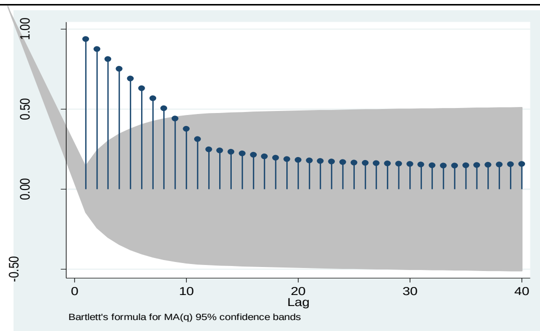
Where t= 1, …, T. Where β_i $i = 1,2,\dots,n$ is the coefficient matrix of order $n * n$ and ε_t is the error term of order $n * 1$ with constant mean and variance, and time invariant covariance matrix Σ. [15].

Results and Discussion

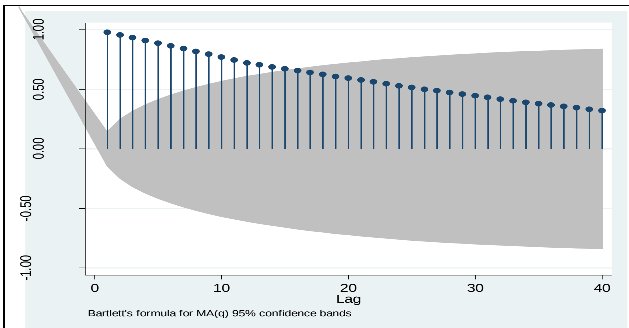
The econometric analysis began with checking the assumption of stationarity. The assumption of stationarity first check is graphically presented using correlogram. The following diagram illustrates the correlogram for the economic variables.



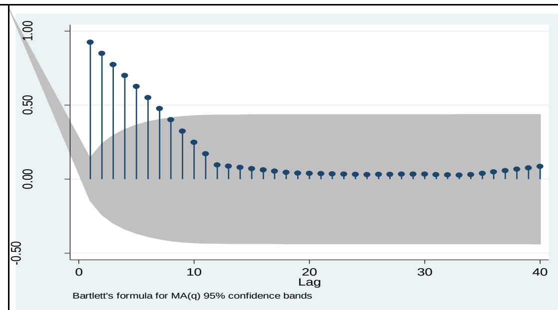
Correlogram for CPI



Correlogram for Diesel prices



Correlogram for Kerosene oil prices



Correlogram for Petrol prices

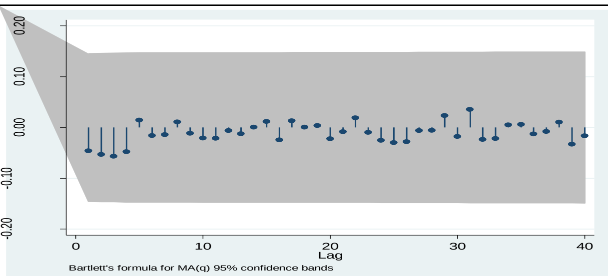
Figure 1: correlogram of time series variables at level.

The Figure indicates a correlogram of CPI, diesel costs, Kerosene, and petrol oil costs time series data from June 2003 to August 2018 at level. The speedy decline in the graph of Auto-Correlation Function (ACF) of all four series indicates that the CPI, diesel costs, Kerosene, and petrol oil prices are non-stationary in nature at level. In order to envision the stationarity through empirical observation, augmented dickey fuller (ADF) test of unit root test was performed. The subsequent table defines output of ADF for CPI and oil costs time series.

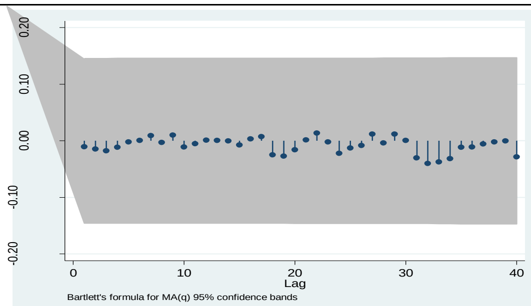
Table: Empirical Result of Augmented Dickey Fuller (ADF) Test

Time series	t-statistics	P-Value	Null Hypothesis	Status
CPI	-0.613510	0.863	Accept H_0	Non-stationary
Diesel	-0.286973	0.923	Accept H_0	Non-stationary
Kerosene	-0.883019	0.792	Accept H_0	Non-stationary
Petrol	-0.478314	0.891	Accept H_0	Non-stationary

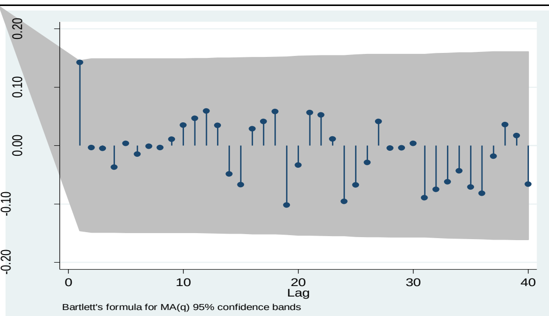
The above table indicates the results of ADF test for stationarity in the selected time series data because the p-value for each time series economic variable is more than 5-hitter level of significance defines that all the four time series variables area unit non-stationary in nature. To form the series stationary, first order distinction computed i.e. every time series economic variable integrated at order 1 i.e. I (1) and stationarity checked using both graphical and empirical approach i.e. ADF test. The subsequent correlogram is the graphical presentation of I (1) based on ACF.



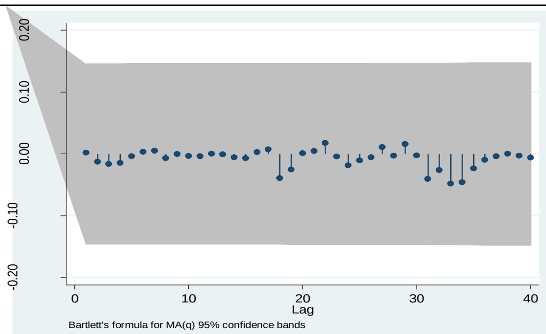
Correlogram for CPI at I (1)



Correlogram for Diesel prices at I (1)



Correlogram for Kerosene oil prices at I (1)



Correlogram for Petrol prices at I (1)

Figure 2: correlogram of time series variables at I (1).

The Figure on top indicates a correlogram of CPI, diesel costs, Kerosene, and petrol prices time series data from June 2003 to August 2018 at order of integration 1. The uniform behavior of time series in ACF on graph shows the stationarity altogether four series indicates that the CPI, diesel prices, Kerosene, and fuel oil costs are stationary in nature at I (1). To verify the stationarity through empirical observation, augmented dickey fuller (ADF) test of unit root test was performed. The subsequent table defines the output of the ADF above.

Table2: Empirical Result of Augmented Dickey Fuller (ADF) Test

Difference (D) Time series	t-statistics	P-Value	Null Hypothesis	Status
D.CPI	-13.97089	.000	Reject H_0	Stationary
D. Diesel	-13.48325	.000	Reject H_0	Stationary
D. Kerosene	-11.55660	.000	Reject H_0	Stationary
D. Petrol	-13.31386	.000	Reject H_0	Stationary

The above table indicates the result of ADF test for stationarity in the selected statistical information at integration order 1. Because the p-value for each time series economic variable is a smaller amount than five-hitter level of significance defines that all the four time series variables are stationary in nature of order 1. As all the time series economic variables square measure stationary at order 1 that fulfills the assumption of econometric analysis.

Selecting Optimal Lag Values

In order to fit a VAR model and to perform Johansen Co-integration test for the time series of fuels prices and CPI, we have to opt optimal lag values for the model.

Table3: Lag Selection Criteria for Co-Integration Test and VAR Model

Endogenous variables: CPI Diesel Kerosene Petrol						
Exogenous variables: C						
Lag	**Log L**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-3060.745	NA	2.34e+10	35.22695	35.29957	35.25641
1	-1933.531	2189.645	66365.45	22.45438	22.81749*	22.60168*
2	-1915.683	33.84978	64990.47	22.43313	23.08673	22.69827
3	-1896.380	35.72172	62616.01	22.39517	23.33925	22.77815
4	-1893.061	5.988411	72542.44	22.54093	23.77551	23.04175
5	**-1859.064**	**59.78747***	**59118.27***	**22.33407***	**23.85914**	**22.95273**
6	-1851.963	12.16275	65699.96	22.43635	24.25190	23.17285
7	-1846.293	9.449882	74320.11	22.55509	24.66113	23.40943
8	-1841.967	7.011232	85507.43	22.68927	25.08580	23.66145

Table three shows the acceptable selection of lag values by the standards of LR test statistic, Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criteria (SC), Hannan-Quinn Information Criteria (HQ). The minimum attainable value based on the criterion higher than optimal lags is on the fifth position. Therefore, the optimal lags 3 are 5 during this study for the model.

Johansen Co-Integration test

The assumption of Johansen co-integration test that all variables are integrated of the same order i.e. I (1). Johansen co-Integration test will let us know whether there is long or short-run relationship between the time series.

Table 4: Johansen Co-Integration for CPI and fuel prices

Series: CPI, Diesel, Kerosene, Petrol					
Lags interval (in first differences): 1 to 5					
Unrestricted Co-integration Rank Test (Trace)					
No. of Co-integrated equations (Hypothesized)	**Eigenvalue**	**Trace Statistic**	**5% Critical value**	**P. Value**	**Decision**
Equation.1	0.084	26.085	47.856	0.886	Accept H_0
Equation.2	0.041	10.508	29.797	0.971	Accept H_0
Equation.3	0.017	3.099	15.494	0.962	Accept H_0
Equation.4	0.000	0.058	3.841	0.809	Accept H_0
Trace test indicates no co-integration at the 0.05 level					
*** denotes rejection of the hypothesis at the 0.05 level**					

Table 4 shows that the variables enclosed for the “unrestricted co-integration Rank test (trace)” are fuel prices and CPI with lag values of one to five. Since the p-value of Trace statistic for each equation is greater than five percent, indicates the result as insignificant. This leads toward that all four equations in above cited table are not co-integration. In other words, Trace statistics indicates no co-integrated equations at 5-hitter level of significance. It is observed that there is a brief Run relationship between the fuel costs and CPI. The condition of no co-integrated equations between the variables for Vector Autoregressive (VAR) model is determined by the Johansen co-integration is determined. All the variables have no co-integration, and this means the short run relationship between the variables. As there is a short run relationship between the oil costs and the CPI, it leads toward the fitting of the VAR model.

The coefficient of lag values of the CPI and fuel oil (Diesel, fuel oil and Petrol) costs have positive and

Vector Autoregressive (VAR) Model

The VAR model is extremely helpful in prognostication and for the time series have short run relationship. The causality and shocks in time-based variable and its others were investigated by the VAR model. The VAR (5) indicates that the model includes 5 lag values from each variable.

$$\mathbf{CPI = 9.691 + 0.847\ CPI(-1) + 0.036\ CPI(-2) - 0.018\ CPI(-3) - 0.040\ CPI(-4) + 0.132\ CPI(-5) + 0.114\ Diesel(-1) - 0.294\ Diesel(-2) + 0.013\ Diesel(-3) + 0.340\ Diesel(-4) + 0.033\ Diesel(-5) - 0.553 Kereosene(-1) + 0.205 Kerosene(-2) + 0.545\ Kerosene(-3) - 0.465\ Kerosene(-4) + 0.221\ Kerosene(-5) + 0.032\ Petrol(-1) + 0.230\ Petrol(-2) - 0.160\ Petrol(-3) - 0.209\ Petrol(-4) - 0.071\ Petrol(-5)}$$

negative impact on CPI; it means that fuel costs have influence on CPI over the chosen period of your time.

Stability of the model

The stability of econometric model determined by unit circle for model stability. The following figure illustrates the stability unit root circle.

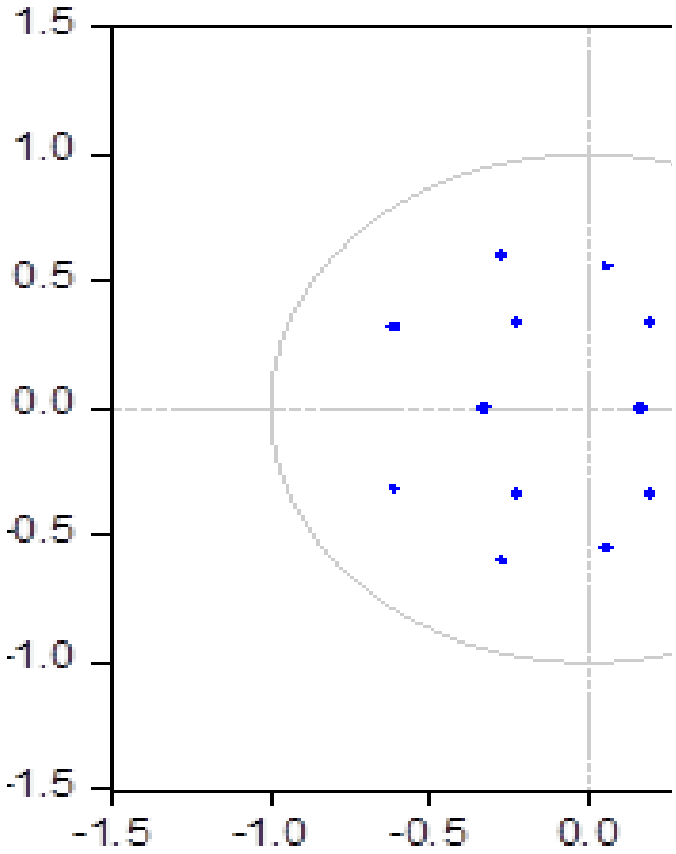


Figure 3: Unit Circle for Stability of the Model

As all the roots have the modulus less than one and lies within the unit circle in the above unit root circle which leads toward the stability of model.

Granger Causality Test

The granger causality test helps to derive the causality relationship between CPI and fuel prices. The following table defines the output of Var Granger Causality test between the CPI and Fuel oil prices

Table 5: Granger causality test for CPI

VAR Granger Causality/Block Exogeneity Wald Tests			
Dependent variable: CPI			
Independent variables	**Chi-square values**	**DF**	**P. Value**
Diesel	11.270	5	0.038
Kerosene	16.303	5	0.006
Petrol	14.187	5	0.009

International Journal of Social Sciences Bulletin
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Table 5 presents the output of Granger Causality Test. The p-value for all fuel oil time series are statistically significant at 5% indicating fuel oil prices i.e. prices of diesel, kerosene oil and petrol jointly caused the CPI for the period of June 2003 to August 2018. Granger Causality Test conspicuously explains that the time series Kerosene oil, diesel, and petrol prices can cause CPI. The fluctuations in the fuel oil prices affect the inflation in Pakistan. To determine effect of fuel price fluctuation on CPI, Impulse Response Function was generated by VAR model. The impulse response function by Cholesky degrees of freedom method will show the shock in one variable and its effect on the other variable. In the following Figure 3, the blue line shows the impulse response function while red lines show 95% confidence interval. The impulse response function will always lie between the red lines. The figure depicts that shocks of fuel prices on inflation defining that diesel and kerosene prices have negative to positive impact on inflation, it slowly affects the inflation in Pakistan. While petrol prices have a positive impact on inflation, it sharply affects the inflation in Pakistan.

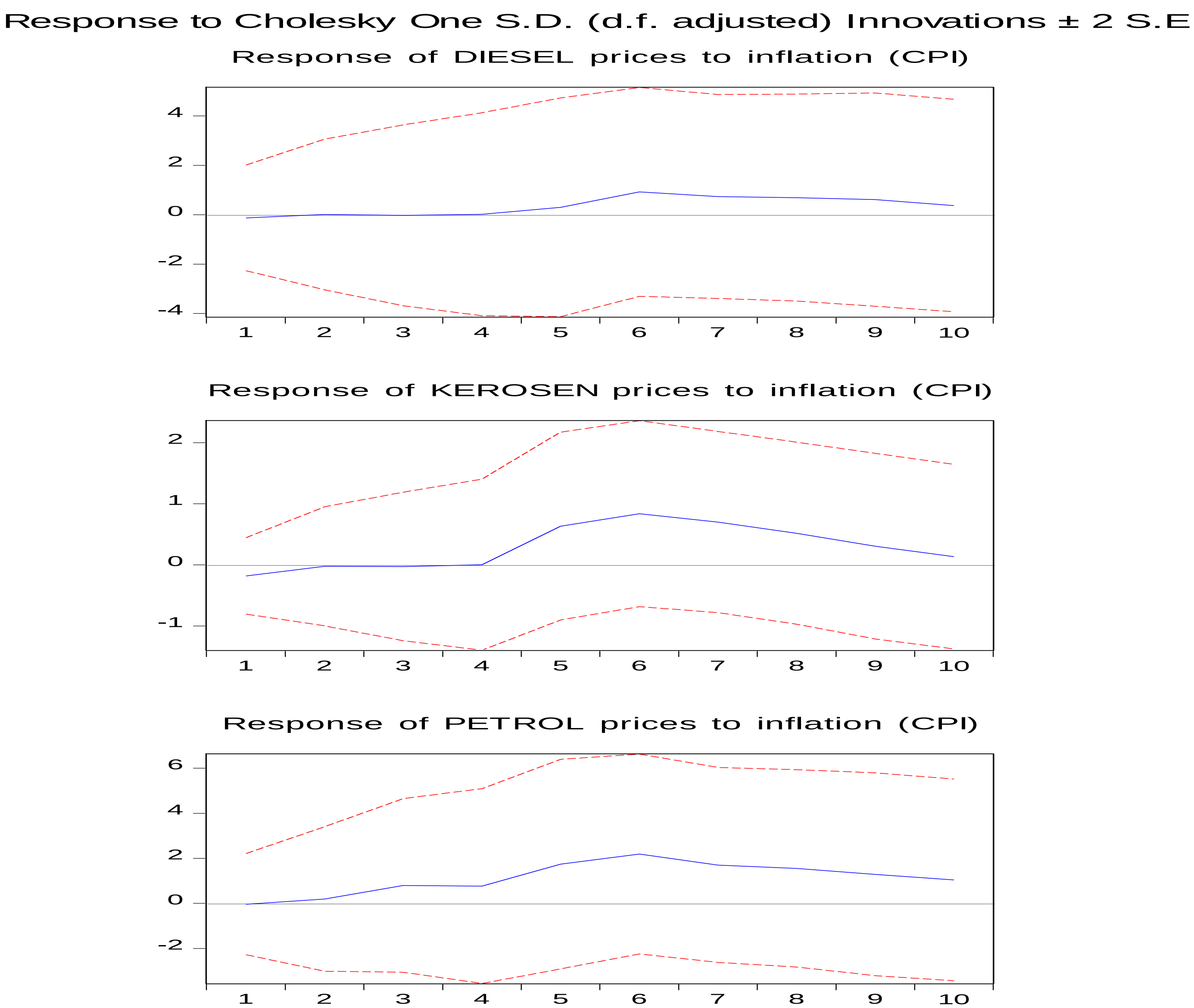

Figure 4: Graphs of Impulse Response Function

DISCUSSION

The objective of this study was to find out the relationship between fuel prices and CPI in Pakistan. The causality of fuel prices on CPI, the fluctuations in fuel prices on inflation and the forecasting of fuel prices in Pakistan were meticulously analyzed; and monthly time series data were used in this study for the period of June 2003 to August 2018. The time series variables used in this study are the fuel prices (Kerosene, Diesel and Petrol) and Consumer Price Index (CPI). All the time series are non-stationary at level, and series observed stationary at integration of order one. The stationarity for time series was checked graphically by correlogram and empirically by ADF test.

Akaike Information Criteria (AIC) decided to use 5 optimal lags in the study. According to the standards of Johansen co-integration test, the variables are all integrated of the same order. Short run relationship was found between the fuel costs and CPI by Johansen co-integration test, and conjointly decided to use Vector Autoregressive model for further analysis and foretelling. The test causality take a look at on granger (5) model accustomed to study the relation of fuel costs on CPI. It was derived by the granger causality test that the variables kerosene costs, diesel prices and fuel costs can cause the CPI.

The impact of fluctuations in fuel (kerosene, diesel and petrol) costs on inflation (CPI) in Islamic Republic of Pakistan was studied by the Impulse response function generated by VAR (5) Model using the Cholesky degrees of freedom technique with one standard deviation shock. The results unconcealed that the shock in diesel costs have asymmetric impact in the short run on inflation (CPI) and observed a negative to positive impact of diesel costs on inflation in Pakistan. A shock of kerosene prices has uneven impact in the short run on inflation and determined a negative to positive impact from diesel costs on inflation. The shock in petrol prices have a symmetric impact in the short run on inflation and observed a positive impact on inflation in Pakistan from petrol costs. It is concluded that diesel and kerosene costs have negative to positive impact on inflation; it slowly affects the inflation either positively or negatively. Whereas gasoline costs have directly affected the CPI and have a positive impact on inflation in Pakistan.

The VAR (5) model used to forecast the prices of diesel, gasoline and kerosene for the following sixty months in Pakistan. The graphical illustration of forecasted values indicated an increasing trend in the prices of diesel, petrol and kerosene for following sixty months as compared to the present costs. Diesel prices are going to be ranging from 258 Pakistani rupees and will unceasingly increase up to 281 PKR with reference to time. Petrol costs will be starting from 258 PKR and can unceasingly increase with relation to time. At the end of sixtieth month, the gasoline costs are going to be 280 PKR. The graph of forecasted costs of kerosene ranging from 129 PKR can unceasingly agitate to one hundred forty PKR at the end of sixtieth month.

CONCLUSION

The current study includes fuel (kerosene, fuel and diesel) prices and CPI; the result shows that all the statistic variables are non-stationary at level and becomes stationary when initial order difference using ADF check. The Johansen co-integration check indicates that there is a short-run relationship between fuel costs and CPI. VAR Model with five optimal lags chosen by Akiake Information Criteria (AIC) was used for analysis and forecasting. The VAR (5) model is a stable and smart model, as there is no serial correlation, no heteroscedasticity in the residuals and residuals are commonly distributed. Through granger causality test, it is discovered that fuel costs can cause the CPI. The Impulse Response Function (IRF) determines the result of fluctuations in fuel costs on inflation in Pakistan. The increase in petrol costs chiefly cause inflation, whereas diesel and kerosene costs do not have that much result on inflation in Pakistan. VAR (5) model forecasts fuel costs for consequent 60-months which shows the rise in fuel (diesel, kerosene and petrol) costs with reference to time.

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