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Impact of Exchange Rate and Oil Prices on Inflation in Pakistan

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ABSTRACT

This study investigates the impact of Exchange Rate (Rupees Vs US $) and oil prices (Pak. Petroleum) and on the inflation rate in Pakistan by applying the Co-Integration technique to the monthly data for all the three series ranging from January 2004 to January 2019. Unit root testing results provide strong statistical evidence for each of the series to be non-stationary at the level and stationary at first difference. Co-integration testing results confirm the existence of Cointegration among the selected time series. Moreover, the empirical results of the regression of inflation on the exchange rate and oil price also lead to conclude that both the series have a strong statistical significant impact on inflation in Pakistan.

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1. Introduction

Inflation refers to the persistent increase in the prices of goods and a constant decrease in the value of money. Due to Inflation, the increase in prices of goods causes an increase in daily life expenditure and a decrease in the saving level. As a result, the investments decrease which disturbs any country's economic system. Under such a situation, inflation becomes an observable fact which leads to attracting the attention of researchers economists, and policymakers.

Many types of research in the literature show that oil prices highly influence the economy of any country so changes in oil prices is also a challenging task for policymakers, economists, and business holders for the last four decades. Fluctuations in inflation are related to the fluctuation in petroleum prices in the same directions. Because the oil used in daily life from transporting and home fueling to the production of many goods. An increase in the oil prices increases the cost of production which increases the consumer Price income(CPI) and an increase in inflation are likely to occur. Under such circumstances, it is very important to know the extent of the empirical relation between petroleum price changes and inflation for policymakers to conduct effective monetary policies. The business

holders and firm managers also set their pricing policies according to the inflation fluctuations so they also need to know the accurate this relation accurately.

The exchange rate between two currencies is referred to as the rate at which one country's currency is exchanged for another country's currency i.e. domestic and foreign currency. Devaluation of one currency means buy less foreign exchange with more domestic currency, as a result, imports become more expensive and exports become cheaper. The fluctuations in the rate of inflation in a country are related to the fluctuations in the value of its currency and the rates of foreign exchange with other countries. The effect of inflation on the value of a country's currency is more likely to be negative. Previous researches show that an increase in oil prices results in depreciation in the exchange rate (Rautava, 2004; Kutan and Wyzan, 2005; Chen and Chen, 2007; Ghosh, 2011). As consequence, both together have a significant influence on the inflation rate. So it is important to study the effect of exchange rate and oil prices on inflation.

2. Literature Review

Numerous research studies conducted to investigate the factor affecting inflation are available in the literature some of which are briefly described in this Section.

LeBlanc and Chin (2004) employed Augmented Philips Curve Parameter Estimates and Associated Statistics to analyze the impact of oil price changes on inflation for the Us, France UK, Japan, and Germany. They concluded that the increases in oil prices affect differently on inflation in different countries. The impact of high oil prices on Pakistan's economy has been examined by Kiani (2008). Aziz (2009) investigated the impact of real interest and rate real oil price on a real exchange rate for a monthly panel of 8 countries. The increase in petroleum price causes an increase in the Consumer price index (Arinze, 2011). Shaari, Hussain, and Abdullah (2012) applied VAR-VECM and Granger Causality models to the monthly data in Malaysia to investigate the effects of an oil price shock on inflation and derived the conclusion that the changes in the rate of crude oil price also changes the rate of inflation. Saleem and Ahmad (2015) applied the Johansen Co-integration method to explore the relationship between crude oil price and inflation investigated other determinants of inflation in Pakistan such as Money supply, exchange rate, and other taxes using time series data from 1979 to 2012.

Bala and Chin (2018) investigated the asymmetric impact of oil impacts of oil price changes on inflation in Algeria, Angola, Libya, and Nigeria considering three kinds of oil prices in each country by applying Autoregressive distributed lag (ARDL) dynamic panels. They concluded that the exchange rate and the gross domestic product (GDP) are positively related to inflation, while food production is negatively related to inflation. Iqbal and Razaq(2018) studied the association between the exchange of Pakistani Rupee per US dollar and crude oil prices using daily data from 2006-2013. They investigated the influence of oil prices on the exchange rate by applying asymmetric power autoregressive conditionally heteroscedastic model and reported high volatility persistency along with leverage effect. They also reported a positive association between both variables. Mukhtarov, Mahmadov, and Ahmedov (2019) studied the impact of oil price and exchange rate in Azerbaijan applying the vector error correction model (VECM) technique and found that the exchange rate and oil prices have a positive and statistically significant impact on inflation in the long-run.

3. Method and Methodology

In the current study to investigate the impact of oil prices and exchange rate on inflation, we have applied the Co-integration technique. First of all, the non-stationarity features of the individual variables have been checked informally using graphical representation and the correlograms of the

Autocorrelation function and partial autocorrelation function and Ljung & Box test proposed by Ljung & Box (1978). Formally, the stationarity of the selected series assessed by applying the Augmented Dickey-Fuller(ADF) unit root test proposed by Dickey and Fuller (1981) and Phillips –Perron(PP) unit root test by Phillips and Perron (1988). Both tests have been applied with No intercept, with intercept, and with trend and intercept. In case of the existence of unit root the same order, then run the regression equation of the form

$$Inf_t = \beta_0 + \beta_1 EX_t + \beta_2 PP_t + u_t$$

Where
Inf_t= Monthly inflation rate in term of CPI
EX_t = Monthly Exchange Rate in Pakistani Rupees / US $
PP_t =Prices of Pak Petroleum in Rupees/ Barrel
u_t = Error Term

The OLS method of estimation has been applied to estimate the parameters of the above equation and residuals of the fitted model will be obtained. The testing of the unit root of the residuals is carried through ADF and PP unit root test. The stationarity of the residuals of the fitted model leads to conclude that there is Cointegration among the selected variable. Afterward, the significance of the variables is checked to explain the impact of exchange rate and oil prices on inflation.

4. Results and Discussion

In this section, we present the data and the results based on the methodology discussed in the previous section. The EViews.9, Minitab,16, and Excel as the main statistical software have been employed for analysis purposes. We have proceeded as in Section 4.1 description about the data used in this study is given. Also, plots of the data, unit root testing descriptive statistics are given to highlight the general statistical feature of the inflation series, exchange rate series, and oil price series in Pakistan. In Section 4.2 the results based on model estimation and cointegration test are given.

4.1 Data

This study uses monthly time-series data of the three series: Monthly inflation rate based on the Pakistani Consumer Price index (CPI), the exchange rate of Pak rupees vs Us $, and oil prices (Pak Petroleum). The data on each series consists of 181 observations ranging from January 2004 to January 2019. Monthly Pak Petroleum data is measured in Pakistan Rupee per Barrel(Source: World Bank, www.indexmundi.com). The data on inflation rate has been collected from different annual Pakistan Economic Survey reports, Federal Bureau of Statistics Reports, Annual reports of State Bank Pakistan, and from the web page “www.tradingeconomics.com”. The data on the exchange rate is measured in Pak Rupees per also has been collected from “www.investing.com”.

Visual inspection of data provides a deep insight into its properties. We start our analysis by plotting the selected variables given in Figure 1 to Figure 3.

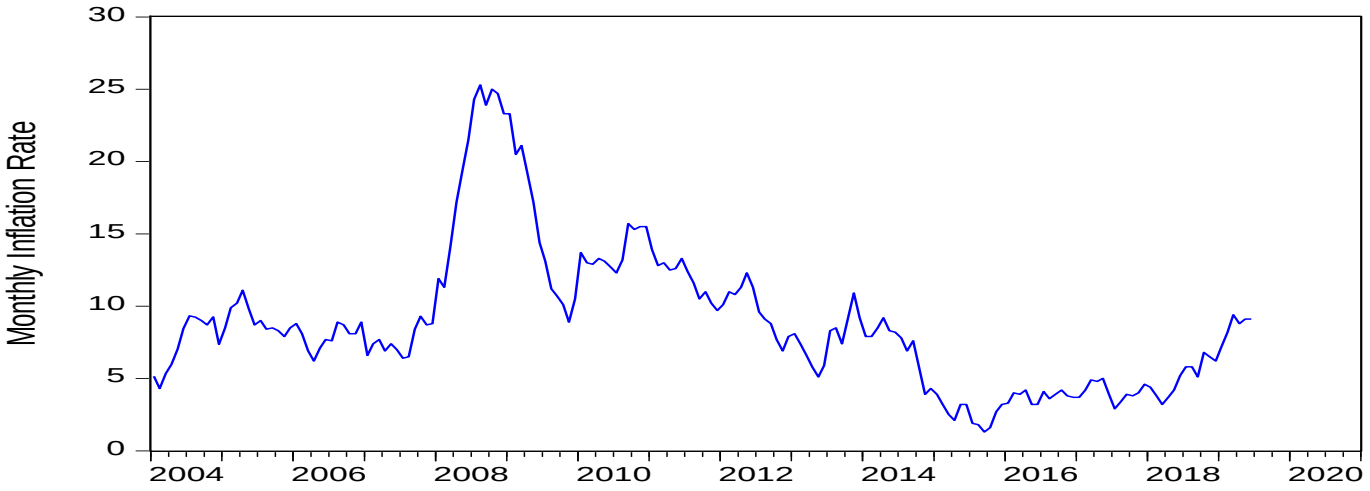


Figure 1: Monthly Inflation Rate in Pakistan

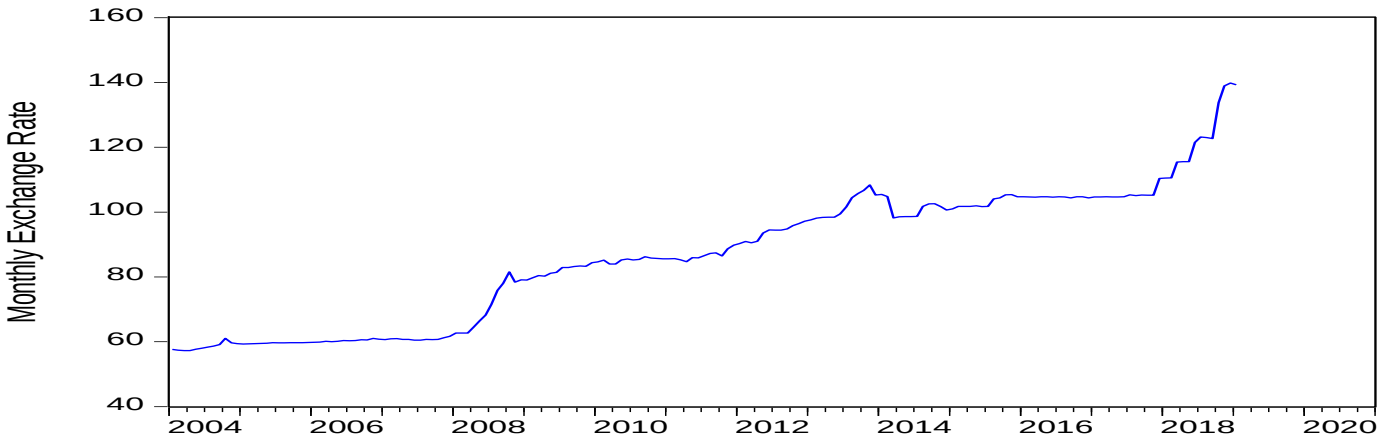


Figure 2: Monthly Exchange Rate Pak. Rupees / US $

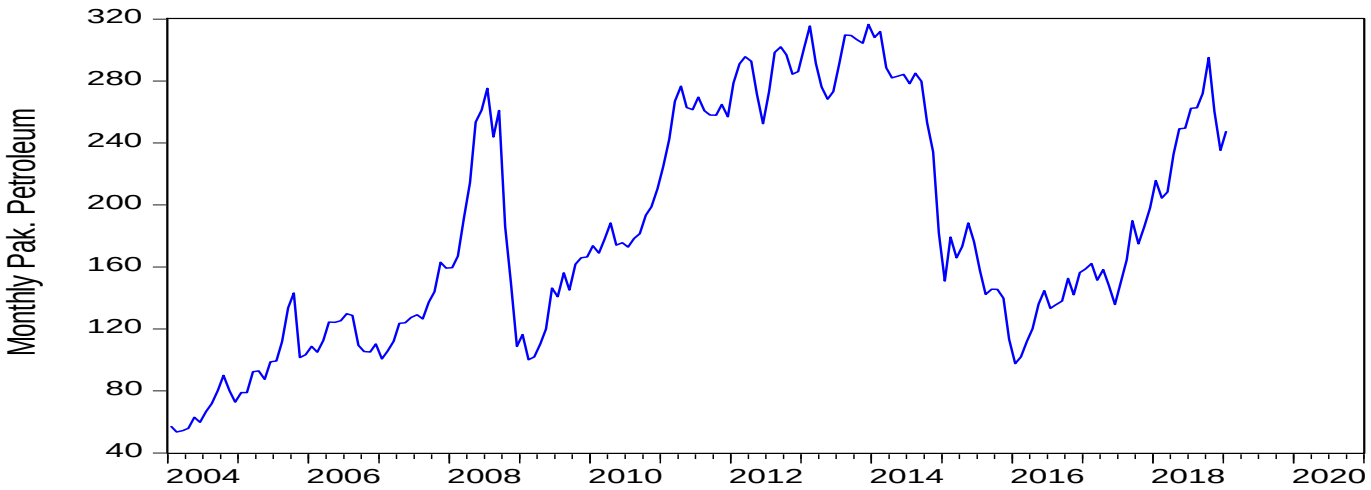


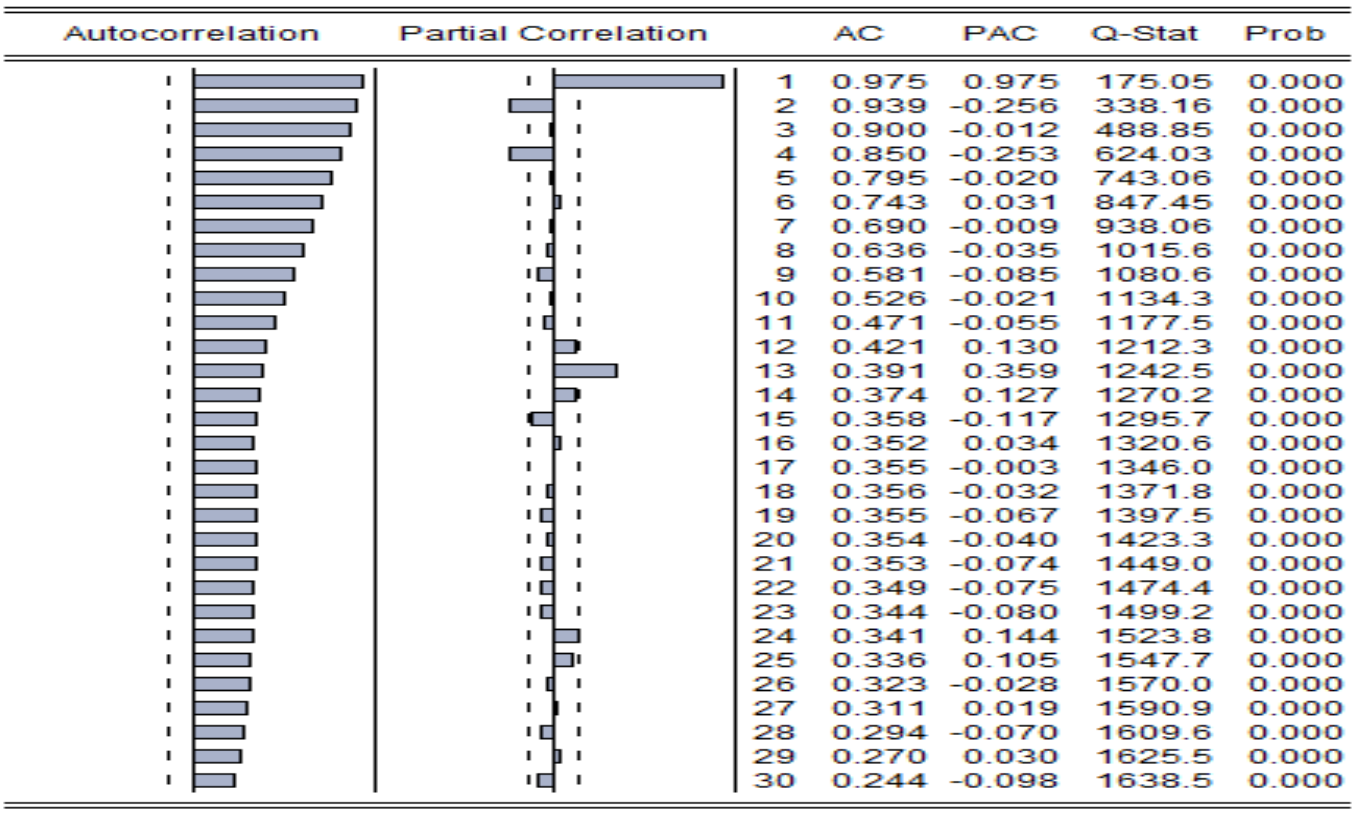
Figure 3: Monthly Prices of Pak Petroleum

Figure 1 shows the graph of the monthly Inflation Rate in Pakistan showing the pattern of nonstationary series. We can also see that the inflation rate becomes rapidly high during 2007-2008

and then it declines and afterward show fluctuations.

Figure 2 shows the graph of monthly Exchange Rate Pak Rs Vs US$. It is clear from the Figure that the time series seems to be "trending" upward and showing Fluctuations leading to conclude that the series is nonstationary.

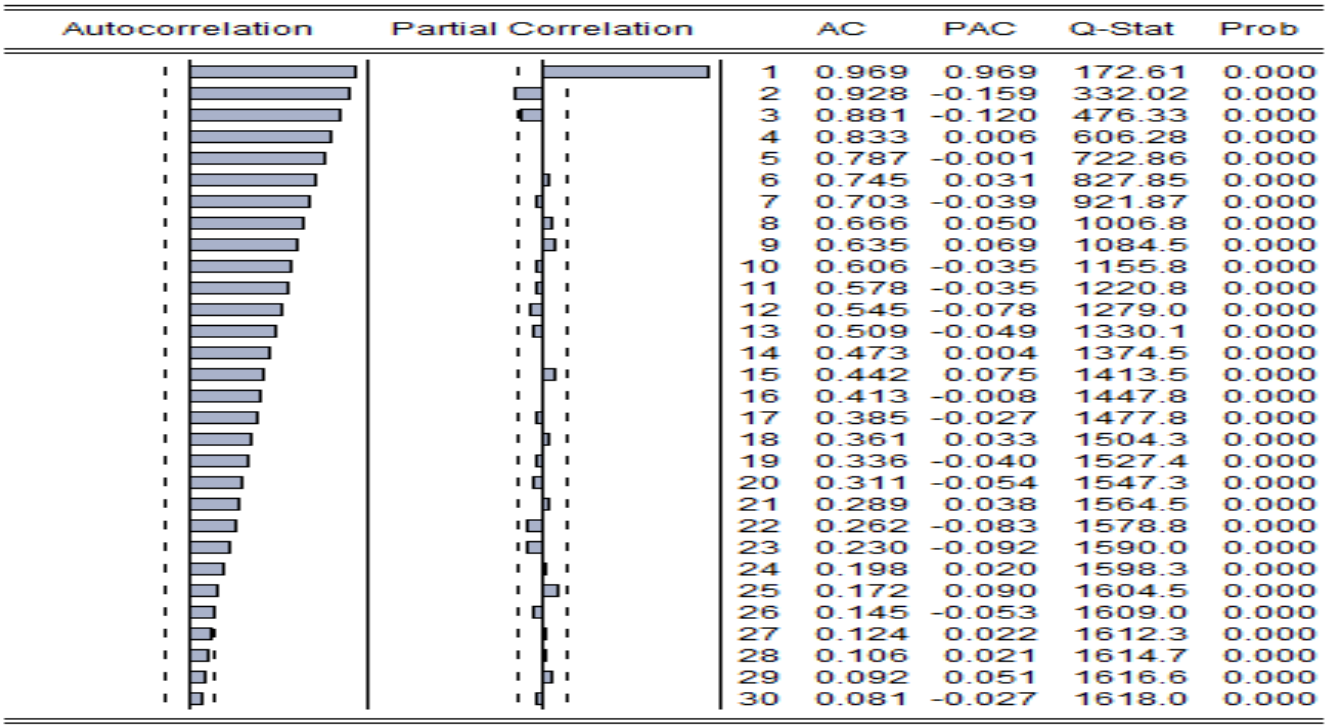
The pattern of monthly prices of Pak Petroleum shows many fluctuations upward and downward as obvious in Figure 3, revealing that the series is nonstationary.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.975	0.975	175.05	0.000
		2	0.939	-0.256	338.16	0.000
		3	0.900	-0.012	488.85	0.000
		4	0.850	-0.253	624.03	0.000
		5	0.795	-0.020	743.06	0.000
		6	0.743	0.031	847.45	0.000
		7	0.690	-0.009	938.06	0.000
		8	0.636	-0.035	1015.6	0.000
		9	0.581	-0.085	1080.6	0.000
		10	0.526	-0.021	1134.3	0.000
		11	0.471	-0.055	1177.5	0.000
		12	0.421	0.130	1212.3	0.000
		13	0.391	0.359	1242.5	0.000
		14	0.374	0.127	1270.2	0.000
		15	0.358	-0.117	1295.7	0.000
		16	0.352	0.034	1320.6	0.000
		17	0.355	-0.003	1346.0	0.000
		18	0.356	-0.032	1371.8	0.000
		19	0.355	-0.067	1397.5	0.000
		20	0.354	-0.040	1423.3	0.000
		21	0.353	-0.074	1449.0	0.000
		22	0.349	-0.075	1474.4	0.000
		23	0.344	-0.080	1499.2	0.000
		24	0.341	0.144	1523.8	0.000
		25	0.336	0.105	1547.7	0.000
		26	0.323	-0.028	1570.0	0.000
		27	0.311	0.019	1590.9	0.000
		28	0.294	-0.070	1609.6	0.000
		29	0.270	0.030	1625.5	0.000
		30	0.244	-0.098	1638.5	0.000

Figure 4: Correlogram of AC and PAC of Inflation Rate, Q-Stat = Ljung Box Q statistics and Prob = p-value to test the Q-statistic

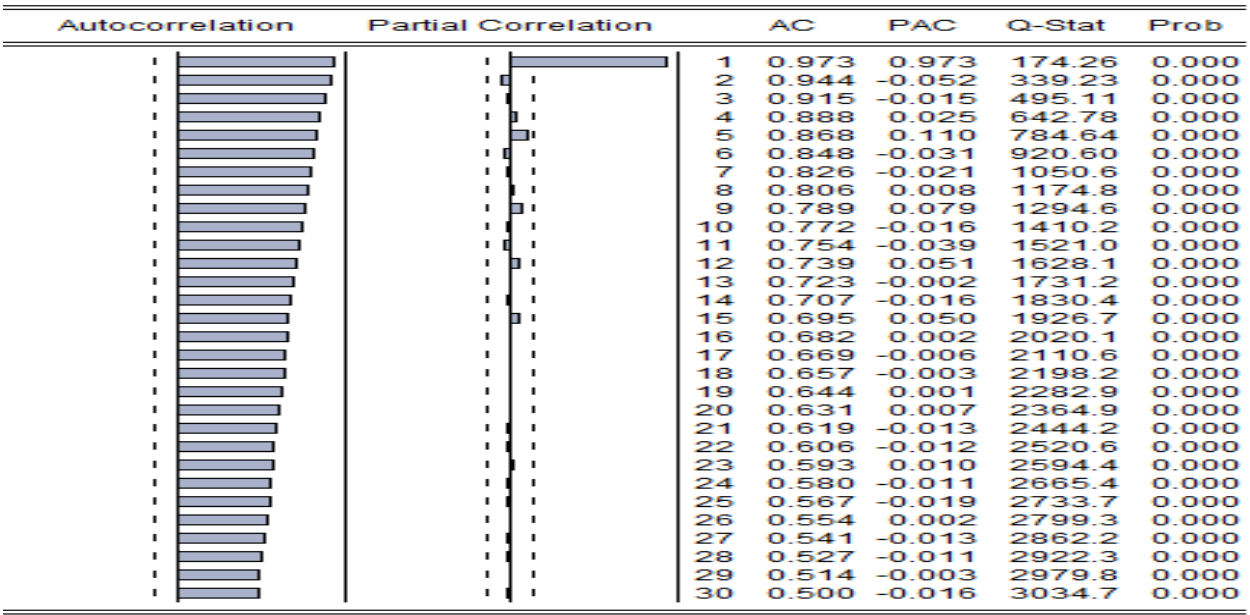
Figure 4 represents the correlogram of the series for the Pakistan inflation Rate. It is clear that the autocorrelation coefficients at the first few lags are very high then start decreasing and PACF is very high at lag 1. Overall, the behavior of the series is nonstationary. Q statistic is highly significant with P-value =0 at each lag indicating non-stationarity of the series.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.969	0.969	172.61	0.000
		2	0.928	-0.159	332.02	0.000
		3	0.881	-0.120	476.33	0.000
		4	0.833	0.006	606.28	0.000
		5	0.787	-0.001	722.86	0.000
		6	0.745	0.031	827.85	0.000
		7	0.703	-0.039	921.87	0.000
		8	0.666	0.050	1006.8	0.000
		9	0.635	0.069	1084.5	0.000
		10	0.606	-0.035	1155.8	0.000
		11	0.578	-0.035	1220.8	0.000
		12	0.545	-0.078	1279.0	0.000
		13	0.509	-0.049	1330.1	0.000
		14	0.473	0.004	1374.5	0.000
		15	0.442	0.075	1413.5	0.000
		16	0.413	-0.008	1447.8	0.000
		17	0.385	-0.027	1477.8	0.000
		18	0.361	0.033	1504.3	0.000
		19	0.336	-0.040	1527.4	0.000
		20	0.311	-0.054	1547.3	0.000
		21	0.289	0.038	1564.5	0.000
		22	0.262	-0.083	1578.8	0.000
		23	0.230	-0.092	1590.0	0.000
		24	0.198	0.020	1598.3	0.000
		25	0.172	0.090	1604.5	0.000
		26	0.145	-0.053	1609.0	0.000
		27	0.124	0.022	1612.3	0.000
		28	0.106	0.021	1614.7	0.000
		29	0.092	0.051	1616.6	0.000
		30	0.081	-0.027	1618.0	0.000

Figure 5: Correlogram of Pak. Petroleum.

Figure 5 shows the correlogram of the series for Pak. Petroleum. ACF PACF cut off at lag one revealing the pattern of nonstationary time series.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.973	0.973	174.26	0.000
		2	0.944	-0.052	339.23	0.000
		3	0.915	-0.015	495.11	0.000
		4	0.888	0.025	642.78	0.000
		5	0.868	0.110	784.64	0.000
		6	0.848	-0.031	920.60	0.000
		7	0.826	-0.021	1050.6	0.000
		8	0.806	0.008	1174.8	0.000
		9	0.789	0.079	1294.6	0.000
		10	0.772	-0.016	1410.2	0.000
		11	0.754	-0.039	1521.0	0.000
		12	0.739	0.051	1628.1	0.000
		13	0.723	-0.002	1731.2	0.000
		14	0.707	-0.016	1830.4	0.000
		15	0.695	0.050	1926.7	0.000
		16	0.682	0.002	2020.1	0.000
		17	0.669	-0.006	2110.6	0.000
		18	0.657	-0.003	2198.2	0.000
		19	0.644	0.001	2282.9	0.000
		20	0.631	0.007	2364.9	0.000
		21	0.619	-0.013	2444.2	0.000
		22	0.606	-0.012	2520.6	0.000
		23	0.593	0.010	2594.4	0.000
		24	0.580	-0.011	2665.4	0.000
		25	0.567	-0.019	2733.7	0.000
		26	0.554	0.002	2799.3	0.000
		27	0.541	-0.013	2862.2	0.000
		28	0.527	-0.011	2922.3	0.000
		29	0.514	-0.003	2979.8	0.000
		30	0.500	-0.016	3034.7	0.000

Figure 6: Correlogram of the Exchange rate

Figure 6 also depicts the pattern of nonstationarity of the exchange rate series. Formally the stationarity of all variables has been tested by applying ADF and PP unit root tests with no intercept, with intercept, and with both the intercept and trend for all the three variables. The results reported in Table 1, exhibits that the null hypothesis of the existence of unit root at level is accepted with strong statistical evidence(p-value is greater than 0.05) for all the three series according to both the tests

employing that all the series are nonstationary.

Table 1: Unit Root Tests at Level

Variables	ADF			PP		
	No Intercept	**Intercept**	**Intercept+ trend**	**No Intercept**	**Intercept**	**Intercept+ trend**
Inflation Rate	-1.14007 (0.2310)	-2.47619 (0.1230)	-2.54257 (0.3075)	-0.92988 (0.3125)	-2.11530 (0.2390)	-2.54257 (0.3075)
Pak Petroleum	-0.05795 (0.6622)	-2.09131 (0.2485)	-2.15763 (0.5098)	-0.04755 (0.6657)	-2.01185 (0.2816)	-2.08313 (0.5513)
Exchange Rate	3.36908 (0.9998)	1.28593 (0.9986)	-1.03952 (0.9348)	3.30476 (0.9998)	1.21486 (0.9982)	-1.28933 (0.8873)

Note Values of Test Statistics along with p- values in ( ).

Similarly, the results of unit root tests at the first difference reported in Table 2 provide strong evidence of the rejection of the null hypothesis of the existence of unit root confirming the stationarity of all the series. Hence all the selected series are integrated of order one at the level and order zero at first difference.

Table 2: Unit Root Test at First Difference

Variables	Augmented Dickey-Fuller (ADF)			Phillips Perron (PP)		
	No Intercept	**Intercept**	**Intercept+ trend**	**No Intercept**	**Intercept**	**Intercept+ trend**
Inflation Rate	-5.291895 (0000)	-5.265527 (0000)	-5.265527 (0001)	-10.87828 (0000)	-10.85501 (0000)	-10.85018 (0000)
Pak Petroleum	-10.70095 (0000)	-10.71614 (0000)	-10.70101 (0000)	-10.75772 (0000)	-10.77212 (0000)	-10.75704 (0000)
Exchange Rate	-10.04366 (0000)	-10.56051 (0000)	-10.92669 (0000)	-10.62362 (0000)	-11.01423 (0000)	-11.14266 (0000)

- **Values of Test Statistics along with p- values in ( )**

4.2 Cointegration Testing

We have observed in the previous Subsection, that the selected series, Inflation Rate, Exchange Rate, and Pak Petroleum series are integrated of order one individually. Now we have proceeded further and to assess the existence of Cointegration, we have firstly regressed the Inflation rate on the Exchange rate and Pak Petroleum and estimated the residuals.

Table 3: Estimated Regression of Inflation on Exchange rate and Pak petroleum

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.43373	1.39180	11.80756	0.0000
EX_t	-0.15626	0.01918	-8.145742	0.0000
PP_t	0.03251	0.00527	6.16440	0.0000

Table 3 shows the results of the estimated coefficients, their std. Errors, t- statistics are reported of this regression equation. It is obvious that the fitted regression is

$$Inf_t = 16.43373 - 0.15626EX_t + 0.03251PP_t$$

The results obtained by applying the ADF and PP unit root tests on the estimated residuals of the above equation are reported in Table.4.

Table 4: Unit Root testing of Residuals

	ADF test		**PP Test**	
Variable	**t-Statistic**	**Prob.**	**t-Statistic**	**Prob.**
Residual	-2.854749	0.0045	-2.520942	0.0117

These results lead to conclude that the residuals series is stationary. This employed that the variables are cointegrated. Moreover, the regression results reported in Table 3 provide strong statistical evidence of the significance of the coefficients for both the Pak Petroleum and exchange rate confirming that fluctuations in both the variables also affect the movement of inflation in Pakistan. It is also obvious that the increase in the prices of petroleum increase the inflation rate. Our finding is consistent with the literature(Ozturk 2015; Malik et al. 2017; Rasasi and Yilmaz, 2016; Mukhtarov et al., 2019).

5. Conclusion

This study has been conducted to investigate the impact of oil prices (Pak. Petroleum) and Exchange Rate Pak. Rs Vs US$ on consumer price Inflation in Pakistan. Monthly data for all three series are used in this study covering the period from January 2004 to January 2019. The graphical representation of all the series and correlograms of ACF, PACF depicted that all the three series are nonstationary at the level. the applications of ADF and PP unit root tests to all three series lead to conclude that these series are non-stationary at the level and stationary at first difference. To test the Co- Integration, the inflation rate is regressed on Pak Petroleum and exchange rate using the OLS technique. Further, the residuals of this regression are obtained and found stationary at a level confirming that the inflation rate, exchange rate, and prices of Pak. Petroleum in Pakistan is Co.integreted. Moreover, the results for the estimated regression coefficients provide strong evidence that the increasing trend in oil prices also increases the inflation rate. Furthermore, the movement in the exchange rate also affects the inflation rate in Pakistan.

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