Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 6 (2025)

Measuring the Impact of Petroleum Products on Inflation in Pakistan (1991-2012): A Statistical Approach

[1*]Qamruz Zaman, [2]Hasnat Ahmad, [3]Hassan Ali, [4]Muhammad Adil, [5]Shahid Iqbal

Article Details

Keywords: Inflation, High Speed Diesel, Time Series Analysis, Petroleum Product, Group

Qamruz Zaman*
Department of Statistics, University of Peshawar, Pakistan. Corresponding Author Email: cricsportsresearchgroup@gmail.com
Hasnat Ahmad
Economic Growth Officer, Sarhad Rural Support Programme (SRSP).
ahmadhasnat9@gmail.com
Hassan Ali
PhD scholar, Department of Economics; University of Peshawar.
alihassan.uop@gmail.com
Muhammad Adil
Pakistan Bureau of Statistics, Islamabad, Pakistan.
ayanqamar@gmail.com
Shahid Iqbal
Directorate of Advanced Studies, CDPM, IER University of Peshawar
shahidiqbalkhan@uop.edu.pk, siqbal@uop.edu.pk

ABSTRACT

This study focuses on finding the long run relationship between different income group based index numbers, i.e. lower, higher and combined/average income groups with that of petroleum products prices, namely petrol and high speed diesel(hsd), and estimation of an equation to investigate the effect of petrol and hsd prices on different income groups and to asses which income group is affected more by increase in prices of petrol or by hsd for the period 1991-2012.Different statistical tests were used to check the stationarity of the data. Correlogram, Augmented Dickey Fuller Test and Phillips-Perron test were used to assess the nature of stationarity after which Johansen's cointegration test is used to assess the long run equilibrium relation. The long run cointegration equation helps in assessing the strength of petrol and hsd on increasing the consumer price index for different income groups. After applying the test, it is found that for lower income group hsd causes more change in the index number than that of petrol prices while for higher income group families the case was reverse. Whereas for combined income group high speed diesel revealed more changes than that of petrol.

INTRODUCTION

Oil prices play vital role in the economic activity of every country specifically for oil importing countries. The two mostly dependable areas on oil are industries and transportation. In country like Pakistan, approximately 60% of energy is produced by Petroleum Products. Thus, it is of major interest for everybody to know the impact of oil prices on different important indicators of economy. One of the most important economic indicators which plays vital role in national policy matters is inflation, which is defined as the rise in the prices of a basket of goods over a period of time. The tool used to assess the inflation figure is Consumer Price Index (CPI). The percentage change in the CPI for one fiscal period over the other fiscal period is defined as inflation, e.g. if CPI for the period 2011-12, 2010-11 was 162.57 and 146.45, respectively then the percentage change, 11.01 is defined as inflation for the period 2011-12 (PBS, 2012). It is of interest to know that oil prices have a valuable weight in the compilation of CPI. Thus it is of significant importance to find out the impact of petroleum products on inflation figure.

The Pakistan Bureau of Statistics (PBS), previously known as Federal Bureau of Statistics, is responsible for collection, compilation and dissemination of Price Statistics. The three major price indices are:

(i) Consumer Price Index (CPI)

(ii) Sensitive Price Indicator (SPI)

(iii) Wholesale Price Index (WPI)

Consumer Price Index (CPI) is the most common measure of Inflation used worldwide to reflect any changes in the prices of basket of specified representative items, reflecting general patterns of common people's daily consumption. The first ever CPI published by PBS was compiled with base period as 1948-49 for industrial workers, for which the data was collected from the cities of Lahore, Karachi and Sialkot only. With the passage of time efforts have been made to improve the coverage of cities and items in the compilation of CPI. So for CPI is compiled on the basis of following base years; 1959-60, 1969-70, 1975-76, 1980-81,2000-01 and 2007-08 as base period.

CPI based on base period 2007-08 covers 40 urban centers of Pakistan comprising 76 markets and 5 income groups. The detail of income group is as under:

Q1: upto 8000/-

Q2: Rs. 8001/- to Rs. 12000/-

Q3: Rs. 12001/- to Rs.18000/-

Q4: Rs. 18001/- to Rs.35000/-

Q5: Above 35000/-

Whereas the combined income group measures the average of all income groups based index number.

CPI for the current base period, i.e. 2007-08, covers 487 items in the basket of goods and services, the items are selected based on family budget survey conducted in 2007-08. The basket of goods and services comprises of 12 major groups. The weights of commodity groups reveal that after Food group the most highly weighted groups are Housing, Water, Electricity, Gas and Other Fuels and Transportation with weights 34.84, 29.41 and 7.20 respectively.

This is why the study of petroleum products is of major importance for many researchers and policy makers.

The methodology used for the compilation of CPI is based on Laspeyres's formula as given below:

$$I_n = \frac{\sum (Pn/Po)\, x\, Wi}{\sum Wi}\, x\ 100$$

Where

I_n= CPI for the nth period

P_n= Price of an item in the in the nth period.

P_o= Price of an item in the base period.

Q_0= Quantity used in the based period.

W_i = Weight of the ith item in the base period = $\sum P_o$ x Q_o

$\sum W_i$= Total weight of all items.

Besides CPI, Pakistan Bureau of Statistics also compiles Wholesale PriceIndex and Sensitive Price Indicator. WPI is compiled on monthly basis whereas SPI is compiled on weekly basis and forwarded to different government departments for policy purposes.

WPI and SPI also uses the same formula of Laspeyers. WPI covers 463 items while SPI covers most essential 53 kitchen items.

The world in aggregate is in the grip of rising inflation. Pakistan is not an exception. The general CPI for the month of March, 2013 reached to 175.82 (with base period 2007-08=100), whereas the Transport Index approached to 189.11 for the same period (PBS, 2013). The inflation, if it crosses the double digit, is an index of a weak economy.

Aurangzeb and Haq (2012) stated "The inflation is caused by higher demand by consumers than the availability of consumer goods, large amount of liquidity in the banking system, devaluation and increased supply of currency notes, poor performance of agriculture sector, globally high oil prices, sources diverted towards ethanol fuel, as well as hoarding and smuggling. Heavy borrowing by the government also raises the inflation level. In sum, high inflation is said to be due to the "cost-push, demand-pull and supply reduction measures".

The rising prices of commodities, specifically of fuel, are adding to the economic difficulties of low income families. In addition, the devaluation of currency is increasing the level of poverty in the country. Power shortages have badly affected many industries. Thus, intelligent economic policies could help deal with the intensifying inflationary movement and improve the exaggerated sectors of the economy, specially manufacturing and agriculture.

MOTIVATION

Petroleum products play vital role in the economic activity of every country specifically for oil importing countries. Many of the researchers have studied the impact of oil prices on economy in combination with other variables like interest rate, house hold expenditure, crops etc. in different countries including Pakistan. But individual study on measuring the effect of petroleum products on Consumer Price Index (CPI) is not carried out in Pakistan. Thus there is a dire need to investigate the nature of relationship between petroleum products and inflation in the context of Pakistan.

OBJECTIVES OF THE STUDY

The main objectives of this study are:

- To assess relationship b/w Petroleum products and inflation by studying the impact of oil prices (Diesel, Petrol etc.) on Consumer Price Index/inflation in aggregate and individually/separately in Pakistan.
- To assess the effect of petroleum products on Lower and Combined Income groups/Quintiles separately to assess which income group is more vulnerable to this effect.

LITERATURE REVIEW

A number of the researchers from all parts of the globe worked on different aspects of economy and tried to find out the impact of different factors that contribute to the economic growth.

Jones and Khilji (1988) used the Granger direct test to evaluate the causal relationship between growth in money supply and inflation in Pakistan for the period from 1973 to 1985. The results of the test showed that money growth had a significant impact on inflation during the period considered and vice versa.

Abbas and Mitchell (2002) studied the impact of petroleum prices on the economy and the distributional price rise impact of petroleum products. They used modified input output approach to see the impact of petroleum prices on the economy in Australia. Their results indicated that hypothetical price increase would raise the CPI by 1.8%.

Cunado and Gracia (2005) studied the impact of oil price shocks on both economic activity and CPI for six Asian countries (Japan, Singapore, South Korea, Malaysia, Thailand and Philippines) over the period 1975–2002. The results suggested that oil prices have a significant effect on both economic activity and price indexes.

Perera (2005) tried to measure the impact of fuel prices on inflation in Sri Lanka. The direct impact was measured through various components in the price indices that have a direct relationship with diesel prices. He used autoregressive distributed lag model and his results revealed that the indirect impact of changes in diesel prices on both Colombo Consumers' Price Index (CCPI) and Sri Lanka Consumers' Price Index (SLCPI) was much larger than the direct impact. Increase in diesel prices by 10 % would increase the monthly changes in CCPI by 1.21 % during the first month. In the case of SLCPI, the indirect impact of the same change in diesel price was 1.01 % with a lag of 2-3 months. He also applied co-integration tests and found that two variables were not significantly co-integrated to form a long-run permanent relationship.

Schimmelpfennig (2006) tried to forecast inflation in Pakistan based on money supply, credit to the private sector), an activity variable, the interest and the exchange rates, as well as the wheat support price as a supply-side factor. Their results revealed significant impact of money supply with a lag of one year.

According to technical report of State Bank of Pakistan (2008), Peshnani et al. revealed that for oil importing country like Pakistan, oil prices hike quickly entered into the domestic economy and exaggerated the energy shortage in Pakistan which caused increase in the general price level.

Malik (2008) investigated the challenges of high oil prices on the economy of Pakistan, as Pakistan is heavily dependant on imported fuels which is expected to increase causing inflationary pressure on the economy.

Cologni and Manera (2008) estimated a VAR model for G7 countries (i.e. Canada, France, Germany, Japan, Italy, UK and US) to see if changing oil prices for the last 20 years have been reflected in policy matters. They introduced long & short run relationships between oil prices, interest rate and inflation. Their Results suggested that, for most of the G7 countries considered, an unexpected oil price shock was followed by an increase in inflation rate and by a decline in output growth.

Syed (2010) measured the impact of changing oil prices and other macro-economic variables like consumption, government expenditures and average exchange rates, domestic investment, inflation and foreign direct investment on Gross Domestic Product (GDP) in the context of Pakistan's economy. The major findings of the study showed that oil prices and inflation have negative relationship with GDP.

Kiani(2011) studied the impact of high oil prices on the economic growth of Pakistan for the period 1990-2008 and found that increase in oil prices leads to inflation, budget deficit and puts downward pressure on exchange rates which as a result affects the consumption pattern of common man badly.

Baker (2011) studied the impact of fuel oil prices on inflation and found that oil prices were affecting more to the lower income group families as compare to higher income group. Study also revealed that fuel expenditure accounts for over twice the total budgets of low income consumers than that of better off consumers.

Alvarez et al. (2011) assessed the impact of oil price changes on Spanish and Euro area consumer price inflation and found that the inflationary effect of oil price changes in both economies was limited, even though crude oil price fluctuations were major driver of inflation variability. The impact on Spanish inflation was found to be somewhat higher than in the Euro area. In both economies, direct effects have increased in the last decade, reflecting the higher expenditure share of households on refined oil products.

Celik and Akgul (2011) studied the changes in fuel oil prices and their relationship with Consumer Price Index (CPI) in Turkey from 2005-2010 using Vector Error Correction model. Their results revealed that 1% rise in fuel oil prices increased CPI by 1.26% with an approximate one year lag.

Le and Chang, (2011) examined the response of stock markets to oil price volatilities in Japan, Singapore, Korea and Malaysia and used the generalized impulse response and variance decomposition analyses approach to the monthly data from 1986 – 2011. Their results suggest that the reaction of stock markets to oil price shocks varies significantly across markets.

Abdullah & Kalim (2012) tried to investigate the main factors contributing to food inflation based on Johansen's cointegration approach for the period 1972-2008, and revealed a long term relationship between inflation and factors like inflation expectations, money supply, percapita

GDP, support prices, food imports and food exports.

Ali, Ramzan, Razi and Bhatti (2012) investigated the effect of high speed diesel prices on food inflation in Pakistan and found a significant relationship between the two factors.

According to Economic Survey of Pakistan (2012), global spikes in commodities and fuel prices employed significance on domestic inflation. The report suggested that main factors contributing to the rise of non-food inflation was the upward fine-tuning of energy, gas and fuel prices. The ramble in fuel related items such as diesel, petrol, gas, CNG and power tariff rates pushed the production and transportation cost out of bed thereby accelerating inflation.

METHODOLOGY

This section will discuss various topics of econometric used for analysis of the time series data, together with description about the source of data to be used for the purpose of analysis.

DATA SOURCE

Data to be used for the study purpose will be obtained from Pakistan Bureau of Statistics (PBS) fiscal year monthly basis, starting from July, 1991 to June, 2012. Data will be collected for consumer price index (CPI) for lower, higher and combined income groups, and petroleum products which includes petrol and high speed diesel (hsd) prices.

STATISTICAL ANALYSIS

In this research, first of all the trend and nature of trend of data would be assessed with the help of correlogram. To see the effect of stationarity of the data a number of unit root tests are available. Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test would be used in this study to decide about the presence or absence of stationarity in the data. if the data is found to be non-stationary, then first difference of the given time series will be checked for stationarity. After the presence of non-stationarity, co-integration would be studied to assess if there exist any long run relationship between index number and petroleum products. After that cointegration regression equation will be used to see the significance of the coefficients in the long run and to see the significance of those coefficients in the regression model.

Statistical Software: Eviews Statistical Software will be used to assess the nature of relationship we are looking for in this study.

TIME SERIES DATA

Time series data have a significant role in econometrics theory. It is used to describe special issues and problems in econometrics. The term time series refers to the series of observation w.r.t time or the chronological arrangement of data. It is the series of observation on the variable collected or taken in different time points. The time series data is also called time based data and it can be observed over the regular or equal interval of time. For example it can be collected on daily basis, such as stock prices, weather report etc. It can be observed on weekly basis, e.g. as sensitive price indicator, money supply in market etc. The time series may be collected on monthly basis like unemployment rate, consumer price index etc. It can be quarterly time series like GDP, GNP etc. Or it can be annually like Inflation rate, Real interest rate, Nominal interest rate, government expenditure, government budget etc. In most of the situation the time series is quinquennially, i.e. observe after every 5 years like census of manufactures, or it can decennially i.e. observed after every 10 years like population census of Pakistan. (Gujrati, 2004)

TIME SERIES MODELING

One of the major assignments of the time series econometrician is to develop such a time series model or time based model which is simple in mathematical form and easy in interpretation and especially capable of forecasting the future value of the response and to draw a statistical inference about the economic theory related with that time series or time based data. In the beginning the time series methodology of the time series was just to decompose the time series data into different components like secular trends, cyclical trends, seasonal variation and irregular variation irrespective of the accuracy of the forecasting of time series. But with the passage of time the scenario changed and the basic approach of the time series, nowadays, is to forecast the future value of the time based data and test the validity of the economic theory with that time based data. Time series econometrics concerns with the estimation of the different equations that having stochastic trends, it is because of that most of the time series contains a natural stochastic trend and can be well estimated with the help of difference stochastic time series equation. The most common example of the difference time series is the random walk model hypothesis. It is the simplest form of the time series that helps in studying the day to day changes in the prices of the commodity or stocks having zero mean value. The simplest form of the random walk for a price of the commodity is

$$Y_{t+1} = Y_t + U_{t+1}$$

Where Y_t cab be the price of the commodity at time t and U_{t+1} is the error term at time t+1. The above time series models are also called autoregressive models. From statistical point of view and to draw statistical inference form the time series data, the means and the variance of the time series should not move with time i.e. time series must be stationary. If it is not stationary then we make it stationary through differencing (Enders, 2004). Following is the detail discussion of

Stationarity and non-Stationarity.

STATIONARITY

As the study is based on data in time series so the first thing is to inquire about the data for stationarity. If the assumptions of homoscedasticity, constant average are satisfied and the covariance is only related between the jumps of two consecutive points, the data follows stationarity pattern. Such time series is also known as weakly stationary or covariance stationary (Gujrati, 2004). Symbolically we can say that a time series is said to be covariance stationary at time point t and t-k, if

$$E\,(X_t) = E\,(X_{t-k}) = \mu$$

$$Var\,(X_t) = Var\,(X_{t-k}) = \sigma^2 > 0$$

$$Cov\,(X_t - X_{t-k}) = \gamma_k$$

The above equation indicates that the mean and variance of time series are constant and independent of time t whereas γ_k is the covariance between time point t and t-s. If a time series does not possess the above condition or characteristics then the time series is said to be non-stationary.

NON-STATIONARITY

A time series is said to be non-stationary if its mean and variance is the function of the time and its covariance depends upon the time point for which it is computed. The graph of the non-stationary time series shows upward movement or downward movement. When a time series is non-stationary in nature, then before modeling the time series data, it must be made stationary by taking its difference. Such a time series then called integrated time series or stationary time series.

TEST OF STATIONARITY

The following procedure will be used for checking the stationarity in time series data.

CORRELOGRAM TEST

This approach also provides rough idea about Stationarity of time series by observing the correlogram of autocorrelation function. A correlogram is the simple approach based on autocorrelation function (ACF) of time based data. If the correlogram of the Auto Correlation Functions (ACF) tends to zero rather quickly at initial lags whereas for a non-stationary series the ACFs will show a linear decline. The ACF at lag k is denoted by ρ_k and defined as

ρ_k = Covariance at lag k / Variance

$$\rho_k = \gamma_k / \gamma_0$$

The ACF ρ_k is unit less measure and its range is from -1 to 1.

The plot of sample ρ_k verses k is known as correlogram. If correlogram of ACF of time based data tends to zero rather quickly at initial lags, the time series is said to be stationary, whereas for non-stationary time series data, the correlogram indicates a linear decline.

UNIT ROOT TEST

The unit root test is used in determining the trend and the nature of the time series i.e. Deterministic or stochastic. When a time series contains a unit root it tells us about the non-stationarity of the data. This is one of the widely popular tests of stationarity or non-stationarity over past several years.

If Y_t is a time series process then

$$Y_t = \rho Y_{t-1} + e_t \qquad -1 \leq \rho \leq 1$$

where e_t is white noise or error term at time point t.

When $\rho = 1$, then there is the problem of unit root in X_t i.e. the time series is non-stationary.

There are several methods available for testing the presence of unit root in time based data. For this analysis the Augmented Dikey-Fuller (ADF) and Phillips-Perron (PP) tests will be used to check presence of the unit root problem in the data and then discuss about the stationarity in time based data Y_t.

AUGMENTED DICKEY-FULLER TEST (ADF)

This is a formal econometric approach for detecting non stationarity in time based data developed by Dikey and Fuller in 1979. This is used to test the existence of unit root in the coefficient of lagged variables in a time based econometric models. If the coefficient of a lagged variable in an econometric model shows a value of one then this is an indication of unit root in the series.

To test the unit root in time based data, ADF test estimate the γ from the following models.

$$\Delta X_t = \gamma X_{t-1} + \alpha_2 \Delta X_{t-1} + \alpha_3 \Delta X_{t-2} + \ldots\ldots\ldots\ldots + \varepsilon_t \qquad \text{Random Walk.}$$

$$\Delta X_t = \alpha_o + \gamma X_{t-1} + \alpha_2 \Delta X_{t-1} + \alpha_3 \Delta X_{t-2} + \ldots\ldots\ldots\ldots + \varepsilon_t \qquad \text{Random Walk with Drift.}$$

$$\Delta X_t = \alpha_o + b_t + \gamma X_{t-1} + \alpha_2 \Delta X_{t-1} + \alpha_3 \Delta X_{t-2} + \ldots\ldots\ldots\ldots + \varepsilon_t \qquad \text{Random Walk with Drift and trend}$$

It is assumed that $X_0 = 0$ and $\varepsilon_t \sim$ iid N (0, 1)

In ADF the null hypothesis is defined as H_0: $\gamma = 0$. The decision rule for the ADF is as follow:

1. If the computed value of the test statistic of ADF test is greater than critical or tabulated

value, then we accept the null hypothesis and may conclude that there is unit root in time series i.e. the Y_t is not stationary.

2. On the other hand if the computed value of the test statistic of ADF is less than critical value, then we may reject the null hypothesis and conclude that there is no unit root in the time based data.

In case if we fail to reject null hypothesis then we take the difference of the time series data and test for unit root in the same way. However in most of the cases the difference of the time series is found to be stationary. Thus we can precede our analysis afterwards.

PHILLIPS-PERRON TEST

Phillips and Perron (1989) developed a testing procedure to test the unit root in time series when there is structural change at time period. Phillips-Perron proposed nonparametric transformation of τ from Ducky-Filler regression such that under the unit root null hypothesis, the distribution of the transform statistic i.e. z statistic will be DF distribution.

The regression model under the null hypothesis is

$$H_0: X_t = \alpha_0 + X_{t-1} + \mu_1 D_p + \varepsilon_t$$

Where the D_p is a dummy variable such that $D_p = 1$ if $t = \tau + 1$, otherwise zero.

Whereas the model under the alternative hypothesis is

$$H_1: X_t = \alpha_0 + \alpha_2 X_{t-1} + \mu_2 D_L + \varepsilon_t$$

Reject the null hypothesis of unit root if calculated value of t is less then critical value otherwise do not reject H_0

3.6 Cointegration

In order to view if any two or more time series of stochastic variables have a long run equilibrium relationship or not, cointegration is one of the appropriate technique. (Macri, 2006). In a situation when a non-stationary time series is differenced to make it stationary, the data is said to be integrated of order "d" and denoted as I (d). (Gujrati, 2004)

Suppose Yt and Xt are differenced one time i.e. I (1) process then

$$Yt = \beta 0 + \beta 1 Xt + et$$

Where et ~ I (0)

Then Yt and Xt are said to be cointegrated and the regression of y on x is called cointegration regression. Johansen's methodology for cointegration is the basic approaches used for testing cointegration.

Johansen's methodology takes its starting point in the vector autoregression (VAR) of order p given by

$$y_t = \mu + A_1 y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_t$$

Where yt is an n×1 vector of variables that are integrated of order one, commonly denoted I(1), and ε t is an n×1 vector of innovations. This VAR can be rewritten as

$$\Delta y_t = \mu + \prod y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta\ Y_{t-i} + \varepsilon_t$$

Where

$$\prod = \sum_{J=1}^{P} A_j \text{ -I and } \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

If the coefficient matrix ∏ has reduced rank r < n, then there exist n x r matrices α and β each with rank r such that ∏ = αβ′ and β′ , then Yt is stationary. Where r is the number of cointegrating relationships, the elements of α are known as the adjustment parameters in the vector error correction (VEC) model and each column of β is a cointegrating vector. Johansen developed two different approaches for testing the significance of cointegration i.e. trace statistics and maximum eigenvalue test.

TRACE STATISTIC

The trace statistic is defined as

$$\lambda \text{ trace } (r) = -T \sum \ln(1 - \lambda)$$

Where λ are the sample based values of the characteristic roots and also called Eigen values and T is the number of observations those are used. It tests the null hypothesis of r cointegration vectors against the alternative hypothesis of n cointegration vectors.

MAXIMUM EIGEN VALUE STATISTIC

The maximum Eigen value is defined as

$$\lambda \max (r, r+1) = -T \ln (1-\lambda\, r+1)$$

This approach of Johansen, tests the null hyp: of r cointegration vectors against alternative hyp: of r +1 cointegration vectors.

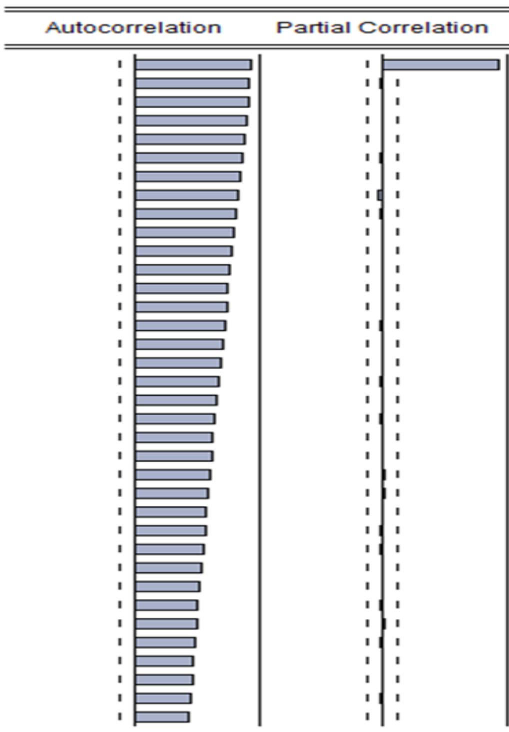
COINTEGRATING EQUATION:

In order to get an estimated equation, eviews software is used which by default selected, Fully Modified OLS (Phillips andHansen 1992) to provide optimal estimates of cointegrating regression. “Phillips and Hansen (1990) propose an estimator which employs a semi-parametric correction to eliminate the problems caused by the long run correlation between the cointegrating equation and stochastic regressors innovations. The resulting Fully Modified OLS (FMOLS) estimator is asymptotically unbiased and has fully efficient mixture normal asymptotics allowing for standard Wald tests using asymptotic Chi-square statistical inference".

RESULTS AND DISCUSSION

GRAPHICAL PRESENTATION OF DATA

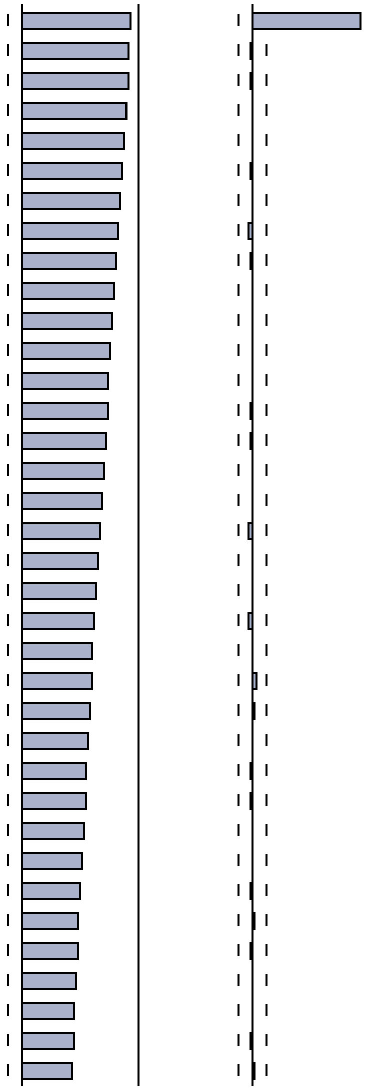
This section describes the graphical presentation of the data for the three indices series and two petroleum products for the period from july-1992 to June 2012. Correlogram approach is adopted to represent if there is any stationarity in the data. One of the problems in correlogram is to select appropriate lag length, but as I am using Eviews-8 statistical software, which automatically selects lag length. The lag length in the given graphical analysis at level is 36.



	AC	PAC	Q-Stat	Prob
1	0.982	0.982	246.14	0.000
2	0.965	-0.017	484.37	0.000
3	0.947	0.000	714.95	0.000
4	0.930	0.005	938.21	0.000
5	0.913	0.001	1154.4	0.000
6	0.897	-0.012	1363.6	0.000
7	0.880	0.004	1566.0	0.000
8	0.863	-0.027	1761.5	0.000
9	0.846	-0.012	1950.1	0.000
10	0.829	0.002	2132.1	0.000
11	0.813	-0.003	2307.6	0.000
12	0.797	0.001	2477.0	0.000
13	0.781	-0.004	2640.3	0.000
14	0.765	-0.004	2797.8	0.000
15	0.749	-0.013	2949.4	0.000
16	0.734	0.002	3095.4	0.000
17	0.718	0.001	3236.0	0.000
18	0.703	-0.023	3371.2	0.000
19	0.687	-0.003	3500.9	0.000
20	0.671	-0.020	3625.3	0.000
21	0.656	-0.006	3744.4	0.000
22	0.640	-0.005	3858.4	0.000
23	0.625	0.011	3967.7	0.000
24	0.611	0.009	4072.5	0.000
25	0.597	0.005	4173.1	0.000
26	0.583	-0.011	4269.6	0.000
27	0.569	-0.013	4361.8	0.000
28	0.556	0.006	4450.1	0.000
29	0.543	-0.000	4534.7	0.000
30	0.529	-0.009	4615.5	0.000
31	0.517	0.012	4692.9	0.000
32	0.504	-0.017	4766.9	0.000
33	0.492	-0.001	4837.6	0.000
34	0.479	-0.005	4905.0	0.000
35	0.467	-0.010	4969.2	0.000
36	0.455	0.005	5030.5	0.000

FIGURE 4.1: CORRELOGRAM FOR COMBINED INDEX NUMBER

The Autocorrelation Functions (ACFs) for Combined index number in figure 4.1 shows linear decline which indicates non stationarity in the combined income group for the period starting from July,1991 to June, 2012.

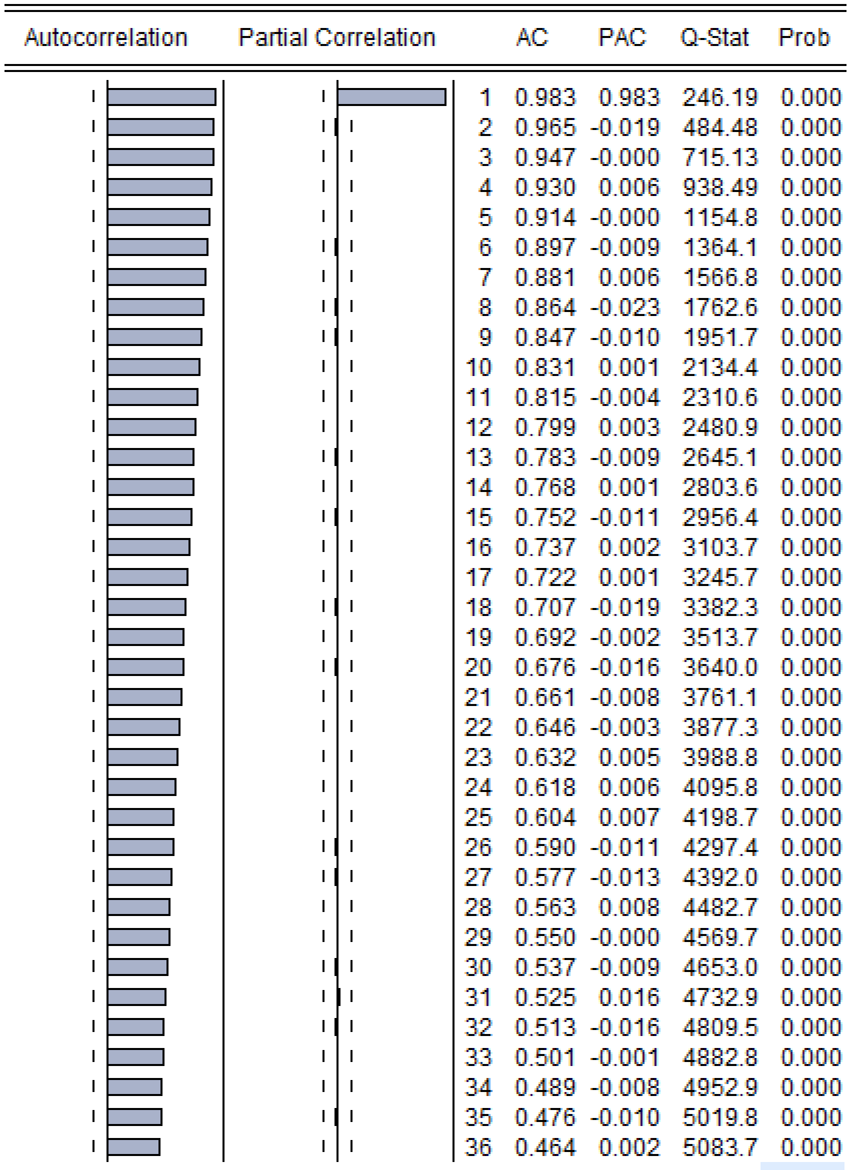


Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.983	0.983	246.44	0.000
		2	0.966	-0.014	485.30	0.000
		3	0.949	-0.010	716.66	0.000
		4	0.932	0.003	940.80	0.000
		5	0.916	0.005	1158.0	0.000
		6	0.899	-0.016	1368.3	0.000
		7	0.883	-0.001	1571.8	0.000
		8	0.865	-0.035	1768.3	0.000
		9	0.848	-0.014	1957.8	0.000
		10	0.831	0.004	2140.5	0.000
		11	0.815	0.003	2316.8	0.000
		12	0.798	-0.002	2486.8	0.000
		13	0.783	0.004	2650.8	0.000
		14	0.767	-0.014	2808.9	0.000
		15	0.750	-0.016	2961.0	0.000
		16	0.734	-0.001	3107.3	0.000
		17	0.719	-0.000	3248.0	0.000
		18	0.703	-0.030	3383.0	0.000
		19	0.686	-0.002	3512.5	0.000
		20	0.671	-0.002	3636.6	0.000
		21	0.654	-0.025	3755.2	0.000
		22	0.638	-0.006	3868.5	0.000
		23	0.623	0.026	3977.0	0.000
		24	0.609	0.016	4081.1	0.000
		25	0.595	0.003	4180.9	0.000
		26	0.581	-0.011	4276.6	0.000
		27	0.567	-0.018	4368.1	0.000
		28	0.553	0.004	4455.5	0.000
		29	0.540	0.002	4539.1	0.000
		30	0.526	-0.014	4618.9	0.000
		31	0.513	0.011	4695.3	0.000
		32	0.500	-0.018	4768.1	0.000
		33	0.487	0.002	4837.5	0.000
		34	0.475	-0.005	4903.6	0.000
		35	0.462	-0.009	4966.5	0.000
		36	0.450	0.009	5026.4	0.000

FIGURE 4.2: CORRELOGRAM FOR Q1 (LOWER INCOME GROUP) INDEX NO.

The Autocorrelation Functions (ACFs) for Quintile 1, i.e lower income group based index number in figure 4.2 shows linear decline which reveals non stationarity in the lower income group based index number for the period starting from July,1991 to June, 2012.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 6 (2025)



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.983	0.983	246.19	0.000
		2	0.965	-0.019	484.48	0.000
		3	0.947	-0.000	715.13	0.000
		4	0.930	0.006	938.49	0.000
		5	0.914	-0.000	1154.8	0.000
		6	0.897	-0.009	1364.1	0.000
		7	0.881	0.006	1566.8	0.000
		8	0.864	-0.023	1762.6	0.000
		9	0.847	-0.010	1951.7	0.000
		10	0.831	0.001	2134.4	0.000
		11	0.815	-0.004	2310.6	0.000
		12	0.799	0.003	2480.9	0.000
		13	0.783	-0.009	2645.1	0.000
		14	0.768	0.001	2803.6	0.000
		15	0.752	-0.011	2956.4	0.000
		16	0.737	0.002	3103.7	0.000
		17	0.722	0.001	3245.7	0.000
		18	0.707	-0.019	3382.3	0.000
		19	0.692	-0.002	3513.7	0.000
		20	0.676	-0.016	3640.0	0.000
		21	0.661	-0.008	3761.1	0.000
		22	0.646	-0.003	3877.3	0.000
		23	0.632	0.005	3988.8	0.000
		24	0.618	0.006	4095.8	0.000
		25	0.604	0.007	4198.7	0.000
		26	0.590	-0.011	4297.4	0.000
		27	0.577	-0.013	4392.0	0.000
		28	0.563	0.008	4482.7	0.000
		29	0.550	-0.000	4569.7	0.000
		30	0.537	-0.009	4653.0	0.000
		31	0.525	0.016	4732.9	0.000
		32	0.513	-0.016	4809.5	0.000
		33	0.501	-0.001	4882.8	0.000
		34	0.489	-0.008	4952.9	0.000
		35	0.476	-0.010	5019.8	0.000
		36	0.464	0.002	5083.7	0.000

FIGURE 4.3: CORRELOGRAM FOR Q5 (HIGHER INCOME GROUP) INDEX NUMBER

The Autocorrelation Functions (ACFs) for Quintile 5, i.e higher income group based index number in figure 4.3 shows linear decline which reveals non stationarity in the higher income group based index number for the period starting from July,1991 to June, 2012.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.982	0.982	245.67	0.000
		2	0.957	-0.176	480.09	0.000
		3	0.931	-0.011	703.06	0.000
		4	0.909	0.068	916.09	0.000
		5	0.888	0.037	1120.6	0.000
		6	0.871	0.034	1317.8	0.000
		7	0.853	-0.014	1507.9	0.000
		8	0.837	0.041	1691.8	0.000
		9	0.821	-0.013	1869.6	0.000
		10	0.808	0.073	2042.4	0.000
		11	0.795	-0.036	2210.2	0.000
		12	0.781	-0.011	2372.9	0.000
		13	0.766	-0.027	2529.9	0.000
		14	0.750	-0.003	2681.3	0.000
		15	0.737	0.062	2827.9	0.000
		16	0.727	0.059	2971.1	0.000
		17	0.717	-0.013	3111.2	0.000
		18	0.708	0.001	3248.4	0.000
		19	0.698	-0.016	3382.2	0.000
		20	0.687	-0.008	3512.5	0.000
		21	0.676	-0.000	3639.1	0.000
		22	0.666	0.034	3762.6	0.000
		23	0.656	-0.038	3882.8	0.000
		24	0.646	0.036	4000.1	0.000
		25	0.637	-0.007	4114.4	0.000
		26	0.626	-0.034	4225.4	0.000
		27	0.613	-0.053	4332.4	0.000
		28	0.601	0.022	4435.8	0.000
		29	0.590	0.016	4535.8	0.000
		30	0.581	0.023	4633.0	0.000
		31	0.573	0.064	4728.3	0.000
		32	0.567	-0.022	4821.7	0.000
		33	0.560	0.005	4913.2	0.000
		34	0.551	-0.048	5002.5	0.000
		35	0.541	-0.048	5088.8	0.000
		36	0.532	0.067	5172.6	0.000

FIGURE 4.4: CORRELOGRAM FOR PETROL

The Autocorrelation Functions (ACFs) for petrol prices in figure 4.4 shows linear decline which shows non stationarity in the petrol prices for the period starting from July,1991 to June, 2012.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.982	0.982	245.82	0.000
		2	0.961	-0.091	482.12	0.000
		3	0.939	-0.017	708.82	0.000
		4	0.919	0.022	926.63	0.000
		5	0.899	-0.006	1135.9	0.000
		6	0.880	0.018	1337.1	0.000
		7	0.861	-0.012	1530.6	0.000
		8	0.844	0.046	1717.3	0.000
		9	0.827	-0.019	1897.3	0.000
		10	0.810	-0.001	2070.8	0.000
		11	0.794	0.008	2238.0	0.000
		12	0.777	-0.034	2398.9	0.000
		13	0.759	-0.032	2553.0	0.000
		14	0.739	-0.044	2699.9	0.000
		15	0.721	0.030	2840.2	0.000
		16	0.707	0.111	2975.8	0.000
		17	0.694	-0.014	3106.9	0.000
		18	0.681	-0.018	3233.6	0.000
		19	0.667	-0.011	3355.8	0.000
		20	0.653	-0.018	3473.4	0.000
		21	0.638	-0.013	3586.3	0.000
		22	0.625	0.032	3695.2	0.000
		23	0.612	-0.022	3799.8	0.000
		24	0.599	0.013	3900.4	0.000
		25	0.586	0.008	3997.3	0.000
		26	0.571	-0.074	4089.8	0.000
		27	0.557	-0.005	4177.9	0.000
		28	0.543	0.012	4262.1	0.000
		29	0.530	0.009	4342.7	0.000
		30	0.517	-0.009	4419.7	0.000
		31	0.505	0.030	4493.4	0.000
		32	0.492	-0.024	4563.8	0.000
		33	0.480	0.019	4631.3	0.000
		34	0.468	-0.039	4695.6	0.000
		35	0.455	-0.035	4756.5	0.000
		36	0.443	0.039	4814.5	0.000

FIGURE 4.5: CORRELOGRAM FOR HSD

The Autocorrelation Functions (ACFs) for High Speed Diesel prices in figure 4.5 shows linear decline which shows non stationarity in theHSD prices for the period starting from July,1991 to June, 2012.

To overcome the problem of non stationarity, first difference of the given series is taken, which shows that all series converges to stationary time series.

An important step for all-time series analysis is to have a stationary series, but usually most of the economic series are found to be non-stationary. To overcome this problem of non stationarity, In most of the cases first difference of majority of series diverges to stationary series.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.149	0.149	5.6469	0.017
		2	0.102	0.081	8.2933	0.016
		3	0.150	0.128	14.085	0.003
		4	-0.012	-0.059	14.122	0.007
		5	0.027	0.014	14.314	0.014
		6	0.114	0.100	17.708	0.007
		7	0.146	0.134	23.292	0.002
		8	0.064	0.007	24.349	0.002
		9	0.137	0.086	29.259	0.001
		10	0.034	-0.027	29.567	0.001
		11	0.083	0.076	31.385	0.001
		12	0.280	0.247	52.213	0.000
		13	0.148	0.079	58.064	0.000
		14	0.071	-0.031	59.422	0.000
		15	0.075	-0.028	60.955	0.000
		16	0.079	0.062	62.657	0.000
		17	0.043	0.041	63.162	0.000
		18	0.159	0.102	70.054	0.000
		19	0.074	-0.055	71.568	0.000
		20	0.112	0.044	75.035	0.000
		21	0.151	0.071	81.297	0.000
		22	-0.028	-0.070	81.513	0.000
		23	0.063	0.010	82.601	0.000
		24	0.270	0.196	103.06	0.000
		25	0.184	0.099	112.62	0.000
		26	0.143	0.057	118.40	0.000
		27	0.106	-0.040	121.61	0.000
		28	0.017	-0.053	121.69	0.000
		29	-0.075	-0.110	123.31	0.000
		30	0.103	0.065	126.34	0.000
		31	-0.101	-0.209	129.28	0.000
		32	0.108	0.055	132.67	0.000
		33	0.121	-0.025	136.95	0.000
		34	-0.041	-0.054	137.43	0.000
		35	0.054	0.007	138.29	0.000
		36	0.147	0.045	144.69	0.000

FIGURE 4.6: CORRELOGRAM AFTER 1ST DIFFERENCE OF COMBINED INDEX

The spikes in the Autocorrelation function after taking first difference of combined income group based index number in figure 4.6shows tendency of the pikes towards center, which indicates stationarity in the data set for combined income group based index number for the period starting from July, 1991 to June, 2012.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 6 (2025)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.157	0.157	6.2478	0.012
		2	0.039	0.015	6.6414	0.036
		3	0.141	0.135	11.698	0.008
		4	-0.078	-0.125	13.245	0.010
		5	-0.033	-0.006	13.526	0.019
		6	0.057	0.049	14.372	0.026
		7	0.093	0.112	16.618	0.020
		8	0.050	0.014	17.276	0.027
		9	0.089	0.059	19.338	0.022
		10	0.038	-0.007	19.709	0.032
		11	0.094	0.109	22.055	0.024
		12	0.257	0.234	39.618	0.000
		13	0.227	0.184	53.360	0.000
		14	0.043	-0.048	53.854	0.000
		15	0.025	-0.044	54.028	0.000
		16	0.056	0.055	54.864	0.000
		17	-0.001	0.058	54.864	0.000
		18	0.105	0.106	57.847	0.000
		19	0.035	-0.082	58.187	0.000
		20	0.082	0.021	60.029	0.000
		21	0.053	-0.022	60.812	0.000
		22	-0.024	-0.019	60.978	0.000
		23	0.109	0.082	64.277	0.000
		24	0.246	0.176	81.273	0.000
		25	0.183	0.049	90.679	0.000
		26	0.195	0.118	101.37	0.000
		27	0.069	-0.021	102.72	0.000
		28	-0.095	-0.105	105.28	0.000
		29	0.038	0.046	105.69	0.000
		30	0.063	0.063	106.82	0.000
		31	-0.128	-0.206	111.55	0.000
		32	0.076	-0.002	113.21	0.000
		33	0.070	-0.040	114.63	0.000
		34	-0.073	-0.055	116.19	0.000
		35	0.044	-0.012	116.75	0.000
		36	0.204	0.078	129.05	0.000

FIGURE 4.7: CORRELOGRAM AFTER 1ST DIFFERENCE OF Q1 INDEX

The spikes in the Autocorrelation function after taking first difference of Q1, i.e lower income group based index number in figure 4.7shows tendency of the pikes towards center, which indicates stationarity in the data set for quintile 1 or lower income group based index number for the period starting from July, 1991 to June, 2012.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.129	0.129	4.1979	0.040
		2	0.104	0.089	6.9699	0.031
		3	0.164	0.144	13.830	0.003
		4	0.010	-0.035	13.855	0.008
		5	0.062	0.040	14.853	0.011
		6	0.149	0.123	20.646	0.002
		7	0.154	0.129	26.806	0.000
		8	0.059	-0.004	27.707	0.001
		9	0.155	0.099	33.990	0.000
		10	0.019	-0.045	34.087	0.000
		11	0.077	0.059	35.640	0.000
		12	0.248	0.199	52.031	0.000
		13	0.113	0.052	55.459	0.000
		14	0.063	-0.030	56.532	0.000
		15	0.097	0.004	59.072	0.000
		16	0.080	0.046	60.781	0.000
		17	0.059	0.035	61.724	0.000
		18	0.204	0.127	73.075	0.000
		19	0.078	-0.031	74.753	0.000
		20	0.097	0.031	77.361	0.000
		21	0.186	0.100	86.876	0.000
		22	-0.028	-0.078	87.091	0.000
		23	0.026	-0.035	87.282	0.000
		24	0.273	0.200	108.17	0.000
		25	0.137	0.061	113.45	0.000
		26	0.117	0.043	117.28	0.000
		27	0.122	-0.027	121.50	0.000
		28	0.015	-0.049	121.56	0.000
		29	-0.068	-0.120	122.87	0.000
		30	0.118	0.042	126.84	0.000
		31	-0.091	-0.195	129.23	0.000
		32	0.099	0.071	132.09	0.000
		33	0.137	0.003	137.59	0.000
		34	-0.021	-0.029	137.73	0.000
		35	0.073	0.046	139.29	0.000
		36	0.090	-0.020	141.69	0.000

FIGURE 4.8: CORRELOGRAM AFTER 1ST DIFFERENCE OF Q5 INDEX

The spikes in the Autocorrelation function after taking first difference of Q5, i.e higher income group based index number in figure 4.8shows tendency of the pikes towards center, which indicates stationarity in the data set for quintile 5 or higher income group based index number for the period starting from July, 1991 to June, 2012.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 6 (2025)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.201	0.201	10.213	0.001
		2	0.079	0.041	11.821	0.003
		3	-0.042	-0.068	12.269	0.007
		4	-0.212	-0.203	23.774	0.000
		5	-0.042	0.046	24.226	0.000
		6	0.015	0.047	24.281	0.000
		7	-0.157	-0.203	30.705	0.000
		8	-0.086	-0.080	32.642	0.000
		9	-0.156	-0.104	38.989	0.000
		10	0.034	0.115	39.299	0.000
		11	0.065	-0.022	40.426	0.000
		12	0.008	-0.077	40.443	0.000
		13	-0.014	-0.054	40.497	0.000
		14	-0.099	-0.076	43.100	0.000
		15	-0.064	-0.023	44.197	0.000
		16	0.067	0.026	45.427	0.000
		17	-0.050	-0.108	46.109	0.000
		18	0.100	0.088	48.848	0.000
		19	0.060	0.049	49.840	0.000
		20	0.012	-0.005	49.879	0.000
		21	0.091	0.015	52.178	0.000
		22	0.048	0.028	52.815	0.000
		23	-0.128	-0.144	57.349	0.000
		24	0.020	0.059	57.462	0.000
		25	0.006	0.096	57.471	0.000
		26	-0.020	-0.049	57.579	0.000
		27	0.022	-0.014	57.718	0.001
		28	-0.024	0.009	57.884	0.001
		29	-0.187	-0.178	67.888	0.000
		30	-0.032	0.013	68.183	0.000
		31	-0.071	-0.061	69.639	0.000
		32	0.152	0.179	76.377	0.000
		33	0.114	0.048	80.137	0.000
		34	0.104	0.060	83.322	0.000
		35	0.016	-0.035	83.397	0.000
		36	-0.022	-0.015	83.541	0.000

FIGURE 4.9: CORRELOGRAM AFTER 1ST DIFFERENCE OF PETROL

The spikes in the Autocorrelation function after taking first difference of petrol prices in figure 4.9shows tendency of the pikes towards center, which indicates stationarity in the data set for petrol prices for the period starting from July, 1991 to June, 2012.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 3, Issue 6 (2025)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.140	0.140	4.9805	0.026
		2	0.063	0.045	6.0084	0.050
		3	0.004	-0.011	6.0117	0.111
		4	-0.132	-0.137	10.506	0.033
		5	0.098	0.139	12.974	0.024
		6	-0.037	-0.058	13.327	0.038
		7	-0.070	-0.073	14.591	0.042
		8	-0.025	-0.020	14.758	0.064
		9	0.027	0.083	14.952	0.092
		10	-0.097	-0.149	17.442	0.065
		11	0.105	0.138	20.364	0.041
		12	0.051	0.039	21.064	0.049
		13	0.039	0.029	21.467	0.064
		14	-0.005	-0.092	21.474	0.090
		15	-0.082	0.006	23.292	0.078
		16	0.186	0.204	32.616	0.008
		17	0.026	-0.047	32.801	0.012
		18	0.025	-0.016	32.970	0.017
		19	0.063	0.108	34.049	0.018
		20	0.035	0.070	34.381	0.024
		21	0.081	-0.001	36.185	0.021
		22	0.051	0.045	36.918	0.024
		23	-0.074	-0.045	38.429	0.023
		24	-0.005	0.004	38.438	0.031
		25	0.116	0.112	42.231	0.017
		26	-0.077	-0.042	43.894	0.016
		27	0.050	0.007	44.611	0.018
		28	-0.016	-0.016	44.688	0.024
		29	-0.153	-0.147	51.354	0.006
		30	0.038	0.050	51.762	0.008
		31	0.001	0.070	51.762	0.011
		32	0.192	0.159	62.457	0.001
		33	0.157	0.024	69.610	0.000
		34	0.147	0.177	75.953	0.000
		35	0.023	-0.024	76.109	0.000
		36	0.011	-0.026	76.145	0.000

FIGURE 4.10: CORRELOGRAM AFTER 1ST DIFFERENCE OF HSD

The spikes in the Autocorrelation function after taking first difference of high speed diesel prices in figure 4.10shows tendency of the pikes towards center, which indicates stationarity in the data set for HSD prices for the period starting from July, 1991 to June, 2012.

ANALYSIS AND RESULTS

First of all Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests is used to assess the nature of stationarity. After this Johansen cointegration test is used to see the presence or absence of cointegration between different indices and petroleum products.

UNIT ROOT TEST

Based on Eviews statistical software, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used to check unit root in the given series of indices and petroleum products, which by default selected the the lag length of 15 for ADF test.

ADF AND PP TESTS

Due to the nature of the data, intercept and trend level is used for ADF and PP test.

TABLE4.1: UNIT ROOT TEST FOR STATIONARITY IN COMBINED INDEX NUMBER

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10 %	Result
ADF	2.536228	-3.99504	-3.42783	-3.137268	Non-Stationary
PP	3.007294				Non-Stationary

Table 4.1 shows that we can not reject the said hypothesis that the combined index number has a unit root based on both test statistics values calculated from ADF and PP test. It means that there exist a unit root which implies that the combined index number series is non-stationary at 1,5 and 10% level significance, respectively.

TABLE4.2: UNIT ROOT TEST FOR STATIONARITY IN Q1(LOWER INCOME GROUP) INDEX NUMBER

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10 %	Result
ADF	1.627932	-3.99504	-3.42783	-3.137268	Non-Stationary
PP	2.003275				Non-Stationary

Table4.2 shows that we cannot reject the said hypothesis that the lower income group based index number has a unit root based on both test statistics values i.e. ADF and PP test. It means that there exist a unit root which implies that the lower income group based index number series is non-stationary at 1,5 and 10% level of significance, respectively.

TABLE4.3: UNIT ROOT TEST FOR STATIONARITY IN Q5 (HIGHER INCOME GROUP) INDEX NUMBER

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10 %	Result
ADF	2.705567	-3.99504	-3.42783	-3.137268	Non-Stationary

PP	3.326911				Non-Stationary

Table 4.3 shows that we cannot reject the said hypothesis that the higher income group based index number has a unit root based on both test statistics values i.e. ADF and PP test. It means that there exist a unit root which implies that the higher income group based index number series is non-stationary at 1,5 and 10% level of significance, respectively.

TABLE4.4: UNIT ROOT TEST FOR STATIONARITY IN PETROL PRICES

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10 %	Result
ADF	-2.959442	-3.995189	-3.427902	-3.13731	Non-Stationary
PP	-2.430828				Non-Stationary

Table 4.4 shows that we cannot reject the said hypothesis that the petrol prices have a unit root based on both test statistics values i.e. ADF and PP test. It means that there exist a unit root which implies that the petrol prices series is non-stationary at 1,5 and 10% level of significance, respectively.

TABLE4.5: UNIT ROOT TEST FOR STATIONARITY IN HIGH-SPEED DIESEL PRICE

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10 %	Result
ADF	-0.03446	-3.99504	-3.42783	-3.137268	Non-Stationary
PP	0.254732				Non-Stationary

Table 4.5 shows that we cannot reject the said hypothesis that the high-speed diesel prices have a unit root based on both test statistics values i.e. ADF and PP test. It means that there exist a unit root which implies that the high-speed diesel prices series is non-stationary at 1,5 and 10% level of significance, respectively.

TABLE 4.6: UNIT ROOT TEST FOR STATIONARITY OF COMBINED INDEX NUMBER AFTER 1ST DIFFERENCE

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10%	Result
ADF	-14.71396	-3.995189	-3.427902	-3.13731	Stationary
PP	-14.73979				Stationary

Table 4.6 shows that after taking the first difference of combined index number, we reject the said hypothesis that the combined index number has a unit root based on both test statistics, i.e. ADF and PP test. It means that there does not exist a unit root which implies that the combined index number series is stationary at 1,5 and 10% level of significance, respectively.

TABLE 4.7: UNIT ROOT TEST FOR STATIONARITY OF LOWER INCOME GROUP BASED INDEX NUMBER AFTER 1ST DIFFERENCE

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10 %	Result
ADF	-14.28298	-3.995189	-3.427902	-3.13731	Stationary
PP	-14.21045				Stationary

Table 4.7 shows that after taking the first difference of lower income group based index number, we reject the said hypothesis that the lower income group based index number has a unit root based on both test statistics, i.e. ADF and PP test. It means that there does not exist a unit root which implies that the lower income group based index number series is stationary at 1,5 and 10% level of significance, respectively.

TABLE 4.8: UNIT ROOT TEST FOR STATIONARITY OF HIGHER INCOME GROUP BASED INDEX NUMBER AFTER 1ST DIFFERENCE

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10 %	Result
ADF	-15.15503	-3.995189	-3.427902	-3.13731	Stationary
PP	-15.15555				Stationary

Table 4.8 shows that after taking the first difference of higher income group based index number, we reject the said hypothesis that the higher income group based index number has a unit root based on both test statistics, i.e. ADF and PP test. It means that there does not exist a unit root which implies that the higher income group based index number series is stationary at 1,5 and 10% level of significance, respectively.

TABLE 4.9: UNIT ROOT TEST FOR STATIONARITY OF PETROL PRICES AFTER 1ST DIFFERENCE

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10 %	Result
ADF	-12.09057	-3.995189	-3.427902	-3.13731	Stationary

PP	-11.39025	Stationary

Table 4.9 shows that after taking the first difference of petrol prices, we reject the said hypothesis that the petrol prices has unit root based on both test statistics, i.e. ADF and PP test. It means that there does not exist a unit root which implies that the petrol prices series is stationary at 1,5 and 10% level of significance, respectively.

TABLE 4.10: UNIT ROOT TEST FOR STATIONARITY OF HIGH SPEED DIESEL PRICES AFTER 1ST DIFFERENCE

Test	Test Statistic value	C.V at 1%	C.V at 5%	C.V at 10 %	Result
ADF	-13.70992	-3.995189	-3.427902	-3.13731	Stationary
PP	-13.56908				Stationary

Table 4.10 shows that after taking the first difference of high speed diesl (hsd)prices, we reject the said hypothesis that the high speed diesel prices has unit root based on both test statistics, i.e. ADF and PP test. It means that there does not exist a unit root which implies that the high speed diesel prices series is stationary at 1,5 and 10% level of significance, respectively.

JOHANSEN TEST OF COINTEGRATION

It is important to decide in advance about the lag length for Johansen test of cointegration, but since I used Eviews 8 statistical software which automatically selects suitable lag length. I perform Johansen test of cointegration for incdex numbers and petroleum products. As I am using three levels of indices based on income groups, i.e, lower income group, higher income group and combined(average) income group, therefore I will apply separately three tests of cointegration. The Johansen test uses two methods, λ *trace* and λ max statistic to find cointegration between variables. Thus I obtain both the statistics values and decide about the cointegration.

TABLE 4.11: JOHANSON COINTEGRATION TEST FOR (COMBINED INDEX NUMBER AND PETROL, HSD)

TRACE AND EIGEN VALUE STATISTICS					
Statistics	**Null Hypothesis**	**Alt. Hypothesis**	**Eigen value**	**Trace Statistic**	**C.V at 5%**
λ trace	r = 0	r > 0	0.163993	64.94187	29.79707
	r = 1	r > 1	0.060943	20.69977	15.49471

Statistic	r = 2	r > 2	0.020708	5.16865	3.841466
λ max Statistic	r = 0	r > 0	0.163993	44.24211	21.13162
	r = 1	r > 1	0.060943	15.53111	14.2646
	r = 2	r > 2	0.020708	5.16865	3.841466

The above table reveals the rejection of null hypothesis based on both test statistic values at 5% level of significance about no cointegration of no (r=0), one (r=1) and two (r=2) variables and thus it may be concluded that there exist a long run relationship between all three variables, namely combined index number, petrol and high speed diesel (hsd).

TABLE 4.12: JOHANSON COINTEGRATION TEST FOR (Q1(LOWER INCOME GROUP) INDEX NUMBER AND PETROL,HSD)

TRACE AND EIGEN VALUE STATISTICS					
Statistics	**Null Hypothesis**	**Alt. Hypothesis**	**Eigen value**	**Trace Statistic**	**C.V at 5%**
λ trace Statistic	r = 0	r > 0	0.114412	49.95611	29.79707
	r = 1	r > 1	0.060392	19.94474	15.49471
	r = 2	r > 2	0.018286	4.558497	3.841466
λ max Statistic	r = 0	r > 0	0.114412	30.01137	21.13162
	r = 1	r > 1	0.060392	15.38624	14.2646
	r = 2	r > 2	0.018286	4.558497	3.841466

The above table reveals the same conclusion as was done previously. The result reveals rejection of null hypothesis based on both test statistic values at 5% level of significance about no cointegration of no (r=0), one (r=1) and two (r=2) variables and thus it may be concluded that there exist a long run relationship between all three variables, namely Q1 (lower income group) index number, petrol and high speed diesel (hsd).

TABLE 4.13: JOHANSON COINTEGRATION TEST FOR (Q5 (HIGHER INCOME GROUP) INDEX NUMBER AND PETROL, HSD)

TRACE AND EIGEN VALUE STATISTICS					
Statistics	**Null Hypothesis**	**Alt. Hypothesis**	**Eigen value**	**Trace Statistic**	**C.V at 5%**
λ trace	r = 0	r > 0	0.188307	72.58029	29.79707
	r = 1	r > 1	0.063302	21.04783	15.49471

Statistic	r = 2	r > 2	0.019625	4.895541	3.841466
λ max Statistic	r = 0	r > 0	0.188307	51.53246	21.13162
	r = 1	r > 1	0.063302	16.15229	14.2646
	r = 2	r > 2	0.019625	4.895541	3.841466

The above table reveals similar conclusion as was done previously. The result reveals rejection of null hypothesis based on both test statistic values at 5% level of significance about no cointegration of no (r=0), one (r=1) and two (r=2) variables and thus it may be concluded that there exist a long run relationship between all three variables, namely Q5 (higher income group) index number, petrol and high speed diesel (hsd).

COINTEGRATING EQUATION

Next objective of the study is to see which income group is more vulnerable to the changes in petroleum products.

For this purpose long run cointegration regression is used, which yielded the following estimated equations.

In the given equations Index numbers are regressed on petroleum products prices.

The first Cointegration regression equation represents Q5 regressed on the prices of petrol and HSD as given below:

$$Q5 = 30.7263 + 0.7716*PETROL + 0.6435*HSD$$

It reflects that if petrol price is increased by one rupee, then higher income group index (Q5) will increase 0.7716 times, where as if High Speed Diesel price increases by one rupee, then it will cause an increase of 0.6435 times in the index of higher income group. Thus it can be visualized that petrol causes more change in the index for higher income group than that of HSD. This is also, as generally higher income group families rely more on private transportation which uses petrol as a source for driving the vehicles.

Contrary to the above estimated equation the results for lower income group are reverse. The index number for Quintile1 that is, the index number based on lower income group when regressed on petrol prices and high speed diesel generated the following results:

$Q1 = 31.9558 + 0.6303*PETROL + 0.7867*HSD$

It reflects that if petrol price is increased by one rupee, then lower income group index (Q1) will increase 0.6303 times, where as if High Speed Diesel price increases by one rupee, then it will cause an increase of 0.7867 times in the index of lower income group. Thus it can be visualized that HSD causes more change in the index for lower income group than that of petrol.

This is because of a general fact that, lower income group families rely mostly on public transportation as a source for their traveling.

Whereas if combined income group based index number is regressed on the prices of petrol and HSD, gives the following results:

$$\text{Combined} = 32.2141 + 0.6963 * \text{PETROL} + 0.7029 * \text{HSD}$$

It reflects that if petrol price is increased by one rupee, then combined income group index will increase 0.6969 times, where as if High Speed Diesel price increases by one rupee, then it will cause an increase of 0.7029 times in the index of combined income group. Thus, it can be visualized that HSD causes more change in the index for combined income group than that of petrol.

CONCLUSION

The main aim of the study is to find out the long run relationship between consumer price index for lower, higher and combined income group with that of the prices of petrol and high speed diesel. For the said purpose monthly data was collected from PBS for 20 years. The data was analyzed with the help of correlogram and unit root tests, which suggested presence of unit root, while the first difference of the available series revealed stationarity. ADF and PP tests were used to assess the presence of stationarity. After confirming for non-stationarity, Johansen's cointegration test was used to see the long run equilibrium relationship between consumer price index and petroleum products which revealed significant relationship between the variables of interest. After this cointegration regression equation was used to assess the strength of each variable on consumer price index. The results for lower income group suggested higher impact of hsd prices on index number than that of petrol prices, while the case was totally opposite in higher income group, which showed that petrol prices were more affecting increase in consumer price index for higher income group families than that of hsd prices. The case of combined income group showed that overall hsd prices were causing more increase in the combined income group than that of petrol prices.

REFERENCES

Abbas, V., & Mitchel W. F. (2002). Assessing the Impact of Change in Petroleum Priceson Inflation and Household Expenditures in Australia. *Australian Economic Review, 35*(2), 122-132.

Alvarez, L. J., Hurtado, S., Sanchez, I., & Thomas, C. (2011).The impact of oil price changes on Spanish and euro area consumer price inflation. *Economic Modelling 28* (1-2), 422-431.

Aurangzeb, & Haq, A.U., (2012). Determinants of Inflation in Pakistan. *Universal Journal of Management and Social Sciences, 2* (4), 89-96.

Abdullah, M., & Kalim, R. (2012). Empirical Analysis of Food Price Inflation in Pakistan. *World Applied Sciences Journal, 16*(7), 933-939.

Ali, S. A., Ramzan, M., Razi, A., & Bhatti, A. G. (2012). Impact of oil prices On food inflation in Pakistan. *Interdisciplinary Journal of Contemporary Research in Business, 3*(11), 123-140.

Baker, W. (2011). *Fuel price inflation and low income consumers.* London: Consumer Focus.

Çelik, T., & Akgül, B. (2011). Changes in fuel oil prices in Turkey: An estimation of the inflation effect using VAR analysis. *East-west Journal of Economics and Business, 14*(2), 11-21.

Cologni A., & Manera M. (2008). Oil Prices, Inflation and Interest Rates in a Structural Cointegrated VAR Model for the G-7 Countries. Energy Economics.30(3), 856-888. doi: http://dx.doi.org/10.1016/j.eneco.2006.11.001

Cunado, J., & Gracia, F. P. D. (2005). Oil prices, economic activity and inflation: Evidence for some Asian countries. *The Quarterly Review of Economics and Finance, 45*, 65-83.

Dickey D. A. and Fuller W. A. (1979): Distribution of the estimators for autoregressive time Series with a unit root, *Journal of the American Statistical Association, 74*, 427-431.

Damodar, N.Gujarati. (2004). *Basic Econometrics*, (4th ed.) pp. 792-865

Johansen S (1988) : Statistical analysis of cointegration vectors, *Journal of economic dynamics and control, 12* , 54-231

Jones, J. D., & Khilji, N. M. (1988). Money Growth, Inflation, and Causality(EmpiricalEvidence for Pakistan, 1973-1985). *The Pakistan Development Review, XXVII*(1), 45-58.

Le, T.-H., & Chang, Y. (2011). The impact of oil price fluctuations on stock markets in developed and emerging economies. (pp. 1-36). Depocen.

Malik, A. (2008, February 20). How Pakistan is coping with the Challenge of High Oil Prices. Islamabad, Pakistan. Retrieved from http://mpra.ub.uni-muenchen.de/8256/

Phillips P.C.B. and Perron P. (1988) : Testing for a Unit Root in Time Series Regression , *Biometrika, 75*, 335–346

Pakistan Economic Survey (2012). Government of Pakistan, Ministry of Finance.

Pakistan Bureau of Statistics (2012). Government of Pakistan, Ministry of Economic Affairs and Statistics Division.

Perera, W.T.K., (2005). The Impact of Petroleum Prices on Inflation in Sri Lanka. *Staff Studies,* *35*(1-2), 107-127.

Schimmelpfennig, M. S. (2006). Inflation in Pakistan. *The Pakistan Development Review* , 185–202.

State Bank of Pakistan. (2008). *Fuel price trends, an analytical review.* Retrieved from State Bank of Pakistan web site: http://www.sbp.org.pk/departments/ihfd/OilPriceAnalysis-30-Aug-08.pdf

Shah, I., & Waleed, M. (2010). *The Fisher Equation, Belgium before and after Euro currency.* Lund: Department of Statistics School of Economics and Management Lund University Sweden.

Syed, N.I., (2010). Measuring the Impact of Changing Oil Prices and other Macro Economic Variables on GDP in the Context of Pakistan's Economy. *International Research Journal of Finance and Economics*, (52), 40-49.

Phillips, Peter C B, 1995. Fully Modified Least Squares and Vector Autoregression, *Econometrica, Econometric Society*, vol. 63(5), pages 1023-78.