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Abstract

The vibration of fuel prices in the energy market of Pakistan has sprung to huge extent. From the economic perspective of any nation's monetary uplifting, the government's view can be achieved via increasing the fuel/ energy prices but such measures always disturbs to discontented civilians of the same salaries who are liable to pay increased taxes. Daily prices of four major sources of energy including gasoline, diesel, kerosene and compressed natural gas (CNG) for the period of April 2006 to May 2011 have been investigated for checking the co-movements among them. Unit Root Test discloses that the prices are non-stationary at same order. While the Johansen Co-integration test shows that the prices of all the four energy products are co- integrated with each other. This is in contrast to the artificial situations as the Pakistani government exercises artificial pricing movements of specific oil over the other.

Keywords: Co-integration, Energy Market, Unit Root Test, Co-Integration Test

1. Introduction

The chief intent of the research work in this field is to ascertain the integration in energy market of Pakistan. In general oil, gas and hydro power is consider being the part of energy market. In this market there are several products available which are distinguished on the basis of their usage. Out of those many products available, petrol and diesel are considered to be the most important by- product as these two products are used for many different functions. It can be used at industrial level and it can be used by a common man as a fuel for his car or generator. Because of having this quality of multi usage the price variation in these two products is a major consideration of most of the population. And the general perception regarding the price variation in these products is that everyone expects that the change in prices of these two will have ultimate affects on economy as a whole. Many researchers worked on the relationship of oil prices and economic development. They encounter solid evidence that the variation in oil prices induce affect upon the emergence of economy, both in evolved as well as evolving countries.

By the very beginning the prices of petroleum products and other energy products are considered to be highly associated with each other. The constant relative price variation of these products made it a rule of thumb for the marketers'. But as the prices of petroleum products are raising in a very frequent manner that making it more complex to explain the association. As a result, the relationship between the prices in energy sector became the spotlight for researchers in the field of energy economics.

This work testament is to determine the relationship among the prices of energy market products and the impact of the frequent variation in prices on their relationship. The inflation rate is constantly increasing and this shows that prices of all the products available in the market are increasing day by day. But this research will highlight that these price variation are linked with each other or are moving individually, or they are following each other. If the prices are moving in a constant variation then it shows that market is integrated.

Aggregated variable such that prices, GNP, economic consumption, utilization, share prices, rising prices and additional macroeconomic indicators hold attribute of non-stationarity. Non- stationarity implies that a variable holds no definite propensity to turn back to a particular value or follow a linear orientation. To test hypothesis or to estimate relationship among such variables our data is needed to be transformed in to stationary data.

In 1980s, the relationships among specified aggregated variables are approximated through constructing and examination simultaneous equation models featuring the supposition that variables in these models are stationary. But these models were not well-grounded because time series data hold the attribute of non- stationarity and such data is indeterminable and can't be modeled or predicted. The final result received from employing non-stationary time series were perhaps illegitimate. In order to acquire authentic outcomes, the non-stationary data demands to be transformed into stationary data. Granger (1987) introduced the concept of co-integration model to study the non-stationary stochastic variables.

In 1987, according to Engle and Granger(1991, 1987) to examine the relationship between non-stationary time series variables the co integration technique has to be used. When the series have characteristic of non-stationarity in original but linear combination of the same series follows a specific trend and shows the characteristics of stationary then those series are stated to be co-integrated. Long-familiar co-integration studies include Johansen and Juselius (1990) and Hall, Anderson and Granger (1992).

Research has been done on energy market integration before 1990s (Asche, Osmundsen & Tveteras , 2002; Serletis,1994; Weiner,1991; Shaked & Sutton, 1982). But none of them have ever picked data from Pakistan to work about energy market integration. This may be because of the fact that Pakistani data is considered not as authentic then the data they used. So, to the best of my knowledge, this work is the only research piece of its type with the use of most authentic sources for data collection.

2. Literature Review

A wide literature has utilized co-integration methods to inquire whether long-term counterbalance exists among prices. Peri and Baldi (2008) applied co-integration method to inquire the long-term relationship between market for biodiesel and vegetable oil in European Economic Community. For this study they

used weekly data from 2005 to 2007 and tried to find out the co-integration among rapeseed, soybean, and sunflower oil and biodiesel. They test level of integration by ADF tests, PP tests, and KPSS tests. Then they used Johansen approach to evaluate the presence of co-integration vector. The result of this study showed that out of the three vegetable oil prices only one, rapeseed oil, responded to be co-integrated with fossil oil prices and they showed the long run relationship.

The co-integration technique is applied on the prices of worldwide vegetable oil and petroleum by Yu, Bessler, and Fuller (2006). They used weekly observations of four edible oil prices and petroleum prices for the time period of January 1999 to March 2006. To determine the integration order for every individual series Augmented Dicker Fuller (ADF) test was used. Based on the unit root test results, Johansen (1988) maximum likehood procedure is used to investigate the co-integration among five price series. Results suggested that all prices are co-integrated and that the crude oil prices do not have a considerable impact on the variant of edible oil prices.

Another interesting study done on seemingly unrelated variables was by Subhani, Hasan, Mehar, & Osman (2011). This was one of the latest researches using the Johansen co-integration approach for analysis and the only research found with using the data from South Asian countries, so it has its own separate importance. Subhani et al. (2011) worked on stock markets of South Asian countries, which include Karachi Stock Exchange (Pakistan), Dhaka Stock Exchange (Bangladesh), Bombay Stock Exchange (India) and Nepal Stock Exchange (Nepal). He took daily share prices for all the four indices for last fifteen years for the period of May 1995 to May 2011 and to analyze this data he used Johansen co-integration analysis. Initially the ADF test was applied to investigate the unit root of each series. The ADF unit root test resulted that all of series had non-stationarity at the same level but at 1^{st} difference it is found that all series were stationary. Once the stationarity is found then co-integration can be applied to stock prices. Firstly the multivariate co-integration was applied on prices of all stock and then bivariate co-integration was applied to find co-integration between KSC 100 index with other stock prices i.e. BSC Sensex, DSE composite index, and NSE index. The first part of this research explored that all of these four stock markets are co-integrated as a whole. The second part of this research study about one on one relationship between these markets and the result showed that co-integration exists only between stock prices of Karachi Stock Exchange with the stock prices of Dhaka stock exchange, but not with Bombay stock exchange and Nepal stock exchange.

The relationship among the prices in energy sector is studied by various researchers. By using common ADF test and causality test integration in energy market of China was investigated by Hengyun, Oxley and Gibson (2007). In China certain policies are made with the aim to integrate their energy market. They used monthly prices of foursome energy fuels; including coal, gasoline, electricity and diesel. Ten years data (1995-2005) was gathered from thirty five major cities. The research found that gasoline and diesel are highly co-integrated as compare to coal and electricity market prices in China. Onour (2006) investigated short-run linkage between gas and petroleum prices in United States with the assistance of time-varying coefficient model and concluded his research with strong co-integration between two energy prices. Brown and Yucel (2007) used an error-correction model analyzed the steady association between natural gas prices and crude oil prices. Their research showed that the strong and stable relationship between the prices of two help to predict the future prices in energy market and acts as a rule of thumb. With that they also mentioned this in their study that gas prices could be drove out by other factors such as atmospheric condition, seasonality, natural gas reposition circumstances, and disturbances in natural gas yield.

Out of various studies conducted on prices in energy sector, many of them contradict with each other. Bachmeir and Griffin (2006) indicates that in spite of the fact that natural gas prices are showing strong and stable relationship with oil prices in recent years, but actually natural gas prices are dependent on oil price variations. Global oil market circumstances ascertain that the oil prices and natural gas prices align thereto by oil prices (Yucel & Guo, 1994). Serletis and Shahmoradi (2006) emphasized that price determination is dependent on demand and supply of the product. It is believed that the main factors that force the prices to fluctuate are recurrent effects and moment in time effects related with production and delivery of goods.

Many of the researchers linked the prices in energy sector with that of the growth of country. Adjaye (2000) analyzed the causative association between energy economic expenditure, energy department cost and profitable outgrowth of picked out evolving countries. The analysis encounters evidence of causality between energy expenditure and its cost to profitability outgrowth. The prediction was uni-directional Granger causality for Indonesia and India, for short-term and bi-directional Granger causality for Philippines and Thailand. The manifest for Pakistan as well discloses that electrical energy economic consumption affects economical development significantly. Research indicates the presence of bi-directional causality among economical development and economic use of petroleum products and no contributory association between natural gas economic use and economical development (Aqeel & Butt, 2001). Siddiqui (2004) also examines the relationship between economical development and energy economic consumption, by using data from Pakistan for the time period of 1971-2003. This study was different in three ways if compare it from the previous studies done by utilizing the same data. Early studies had ignored the impact of changes in sources other than energy on economic growth. However, in the study limited the primary factors of production and additional sources of economical development such as Labor Department, capital, human capital and exportations. Secondly, the energy consumption was used in commercial sector exclusively because of the fact that only commercially utilized energy contributes to economical growth and not the house hold. Thirdly, this study also covers the capital market analysis and tried to analyze the affect of capital formation on economical development. ADF and PP tests are selected and applied on level and difference to test stationarity of every series. The trend of causality was examined by using Granger Causality Test and the regression model is estimated by using Autoregressive Distributed Lag (ADL) model. The final result showed that outgrowth in stock market, commercially used electric energy consumption and petroleum products affects economical growth significantly.

3. Research Methodology

3.1 Data description

The data utilized in this empirical study represents day by day price for four energy fuels in Karachi- the largest city and the main financial centre of Pakistan. This study includes prices of four major fuel products i.e. gasoline, CNG, LDO and kerosene oil. The price data are collected by Oil and Gas Regulatory Authority (OGRA) for the period April 2006 to May 2011.

3.2 Econometrical frame work

Co-integration technique has been really popular instrument in applied economic study since its formulation. Co-integration is an econometric method to examine the co-movements among non-stationary time series variables. The series are said to be co-integrated if originally they are showing the characteristics of non-stationarity but a one-dimensional combination of them is stationary. To explore the co-integration among and between the fuel prices of Pakistan, first we have found out the non-stationarity and stationarity in the outlined series through ADF Test (1979) at level and 1^{st} difference respectively and after confirming the non stationarity in all outlined series at level, for studying and validating co-integration along with the mentioned fuel prices in energy market of Pakistan, Johansen Co-integration test was applied.

4. Findings

4.1 Findings of Unit Root Test

Table 1: Shocks in Light Diesel Oil, Gasoline, CNG and Kerosene Oil

Variables/Series	ADF Test with Intercept and Trend at same order		ADF Test with Intercept and Trend at 1st Difference	
	t-statistic	Prob	t-statistic	Prob
LDO	0.719474	0.9926	-43.62026	0.0001
Gasolin	-0.885617	0.7932	-42.71727	0.0000
kerosene Oil	0.029089	0.96	-42.77521	0.0000
CNG	-0.519853	0.8849	-41.87729	0.0000

MacKinnon Critical Value

1% level	-3.4337
5% level	2.86292
10% level	2.56755

The initiative measure in investigating co-integration is to quantify the existence of unit root for each individual series. For that reason, the Augmented Dickey Fuller (ADF) test helped in finding out whether the series has a unit root. Table 1 reported the findings of Unit Root Test at same and 1st difference. At the same order the t-statistic values for all the series are lower than the three MacKinnon critical values that represent the existence of unit root in the series and accept the null hypothesis for Unit Root Test i.e. Series is non-stationary. But it could be seen that at 1st difference all the series have t-statistic value greater than the critical values and it is found that all the series are stationary at 1st difference.

4.2 Findings of Co-integration Test

Table 2: Bivariate Co-integration

Variables/Series	Log Lokelihood	T-Statistic
LDO & Gasoline	-3411.887	7.165501
LDO & Kerosene Oil	-1981.02	11.87118
LDO & CNG	-2143.853	6.545644

MacKinnon Critical Value

1% level	7.04
5% level	5.41

Table 3: Multivariate Co-integration

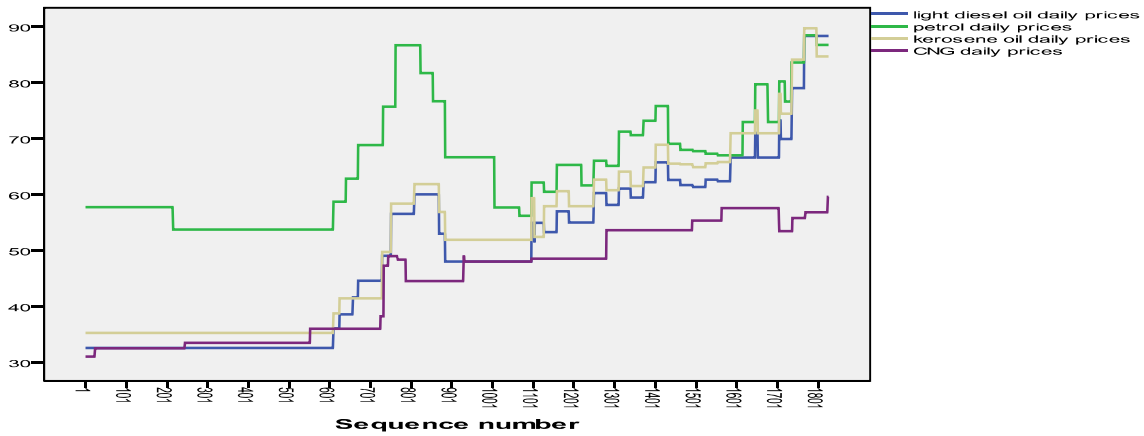
Variables/Series	Log Lokelihood	T-Statistic
LDO, Gasoline, Kerosene Oil & CNG	-4166.210	49.99707

MacKinnon Critical Value

1% level	48.46
5% level	47.21

Since, the presence of non-stationarity at similar sort in the series are observed, therefore, Johansen co-integration test is applied to investigate the co-integration. Table 2 representing the resultant of Johansen Bi-Variate Co-integration test that has executed on one on one basis. This table reported that there is the co-integrating equation was found important as the value of t-statistic is greater than MacKinnon critical value in all the three cases. Thus, it made us reject the hypothesis i.e. there is no co-integration in the pairs of outlined series. After investigating the co-integrating property between outlined series on one on one basis, the co-integration among all the series as the whole has been observed and is shown in table 3. Multivariate co-integration reports that at 1% the t-statistic values are greater than the MacKinnon critical value at 1% and 5% both; therefore, the null hypothesis gets rejected and concluded that all the four series studied here are co-integrated. This can also be seen through the diagram below that is generated on SPSS.This diagram is clearly explaining the relationship among the four data series. It can be seen that the prices of these fuel products are following each other from the start of the series till the end. Hence they are found to be co-integrated with each other.

Figure 1: Co-movements among Light Diesel Oil, Gasoline, CNG and Kerosene Oil



5. Conclusion

This research study concludes that the prices of the four energy products are co-integrated as a whole with each other but none of them have exclusive co-movement with any other. The prices of goods and services available in the economy is divided into various sections out of which a single basket named fuel and lightening was chosen and then further only four product prices are chosen randomly for this related research. The same econometric methodology can be applied on prices of products in the same basket and also with the prices in different baskets to study their relativity and variations. The increase in time period for which the data has been collected can also affect the results and probably may expose variation in results for every time and every product price we choose for study.

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