Impact of Oil Price and Its Volatility on Stock Market Index in Pakistan: Bivariate EGARCH Model

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ABSTRACT

Oil is becoming as an important determinant which affects the macroeconomic activities and the stock market indices in unusual patterns among various parts of the globe particularly since the first oil crisis in 1973. Also Petroleum products are recognized to be the essential source of energy and power throughout the world and gaining substantial importance as a tool for endurance and security of developed nations. The research study targets to explore the impact of oil price and its volatility on Stock market index in Pakistan from the period 1991:M11 to 2014:M12. In this study we used the financial time series econometrics techniques; first applied the Box-Cox transformation on the data which suggested log transformation is required for all series. As data used will be monthly, Beaulieu and Miron (1992) seasonal unit root test is used if stationarity is present in the data. All variables hold unit root at zero frequency and become stationary at first difference. Further to confirm if co-integration relationship exists between the variables we have estimated Engle and Granger (1987) two-step method. And finally Bivariate EGARCH model is applied to scrutinize the impact of oil price volatility Stock market index. Bollerslev and Wooldridge (1992) proposed this model which is projected by using Maximum likelihood method. Hence the findings of Bivariate EGARCH model suggested the direct association between oil prices and Stock market Index. It means SPI is positively affected by oil prices. In case of Pakistan, asymmetric impact is positive but statistically insignificant at α=.05 (Level of significance). But in case of oil price volatility Bivariate EGARCH model, it is negative and statistically insignificant. The summation of Beta Coefficients of ARCH and GARCH suggests that the volatility shocks in the SPI have been highly continual and became extinct rather slowly in case of Pakistan.

Keywords: Oil prices, Volatility of oil prices, SPI, Box Cox Transformation, Beaulieu and Miron, Co-integration, Bivariate EGARCH, Pakistan.

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Note: This study is extracted from the M.Phil. Econometrics thesis of Abida Naurin.

1. Introduction

Oil prices has captured the attention of new investigators as a significant factor which have an effect on macroeconomic actions and the stock market indices in different ways over the globe particularly since 1973 when the first oil crisis occurred. Oil is measured as a most integral source of energy in the world and achieving substantial significance as a mean of urbanized countries' protection and continuous existence. According to Hamilton (1983), remarkable increase in the prices of crude oil resulted in the seven out of eight postwar downturns in the United States. Such conclusions and estimations have provided the base for the researchers to study oil as a significant determinant while assessing the economic activities in any country. Oil is the biggest need of every country that's why the alterations in oil prices affect the financial environment of industrial and developing states.

Consequently, stock market becomes less attractive due to higher interest rate that has to increase by policy makers due to pressure. The value of stocks declines due to the anticipation that interest rate to be higher and increase in oil costs decrease the cash flows of companies so the threat to stock market is the oil price flourishing. So, oil price change besides affecting production and utilization like other merchandise can also be source of change in behavior of depositors and stock prices.

Production cost includes oil as a major element .The development of a financial system is greatly dependent upon the rate of investment in the country. The function of stock market is to make available a platform which channelizes funds from excess to lacking units for fruitful investment. The movement in stock market causes the fluctuation in demand and supply of the underlying assets which represent the equity holding of the company by the investors. The price of stock denotes the present value of the potential cash flow streams of the company. In this context the presence of optimism in the market would lead to rise in stock prices, while on the other side the pessimistic thoughts would cause the decline in the stock index. Hence, the mentioned is the reason that the stock market can be considered as the index of the economy. Stock exchange is very important because it participate very animated role for the advancement of the financial sector for all the countries Siddiqui, (2014).

Pakistan has three major stock exchanges including (KSE) Karachi Stock Exchange, (ISEI) Islamabad Stock Exchange and (LSE) Lahore Stock Exchange. Karachi Stock Exchange has been considered for analysis as a true representative sample of the country's stock markets

.Because it plays vital role for the development of the country. Stock markets offer the platform where all investor are fully contributing not only local investor. Therefore, foreigner investors are investing the new business came to exist now it is positive sign for the development in the country.

The developed as well as developing economies are facing the problem of oil prices unpredictability. Linear model is used by the majority of the offered studies on this field. By relaying on the market arrangement or asymmetric market information this model ignores the nonlinear factors. Econometric analyses like co-integration and Granger causality test are applied to examine this issue. These techniques are not appropriate for proper results. Our study is important because, most of the relationship in the financial markets is non-linear in its behavior. The data frequency is low, thus using monthly data will give more consistent and efficient results. Hamilton (1983) was first who studied this relationship, while Jones and Kaul (1996) studied this effect on stock market. But still there is very little research to analyses the relationship and forecast it. A lot of researches are made for data of UK or USA or EU or developed or industrial countries while the studied on BRIC and GCC countries are also found. But only one or two paper discusses the relationship in Asian stock markets and that is also in panel data. This study is being conducted with the key purpose to cover this space in literature by using better technique of estimation of non-linear model. Increase and decrease in the oil prices do not have similar affect. Park and Ratti (2007) demonstrate in their study that decline in oil price has less influence on the economy than increase in its price. I have decided to explore the asymmetric effects of oil price changing on KSE-100 Index in Pakistan because of its practical importance. So there is a gap in literature that impact of oil price volatility on stock market index in Pakistan has not been studied and observed for said relationship.

The main objective of this study is to investigate the impact of oil price and its volatility on Stock market (KSE-100 Index) in Pakistan from the period 1991:M11 to 2014:M12. The other objective of the study is to examine the long run impact of oil price and its volatility on SPI. We also found the asymmetric effects of oil price in case of Pakistan.

This study is arranged as follows; section 2 demonstrates the salient features of Oil sector and Stock market in Pakistan. Section 3 describes literature review of previous studies at national and international level, followed by Econometric Methodology in section 4, results and discussion is discussed in section 5. Finally conclusion and policy recommendation is discussed in section 6.

2. Salient Features of Oil Sector and Stock Market in Pakistan

Geopolitical issues, OPEC and non OPEC supply commotion are the main reason behind the fluctuations in prices of oil. Initially the prices of oil were organized by US before the 1971 then this control was shifted to OPEC after a decade of its formation. OPEC had five members in 1960 after its formation but it has turned to six in1971.The world oil price was set $3.5/ barrel in 1972. The price of oil tripled in1974 in international market because many Arab oil exporting countries including Iran impediment on western countries and United States and shortened its production. This was happened when Egypt and Syria attacked Israel in1973 and United States and other western countries started supporting Israel. But afterward these price are remained smooth in between 1974-78.

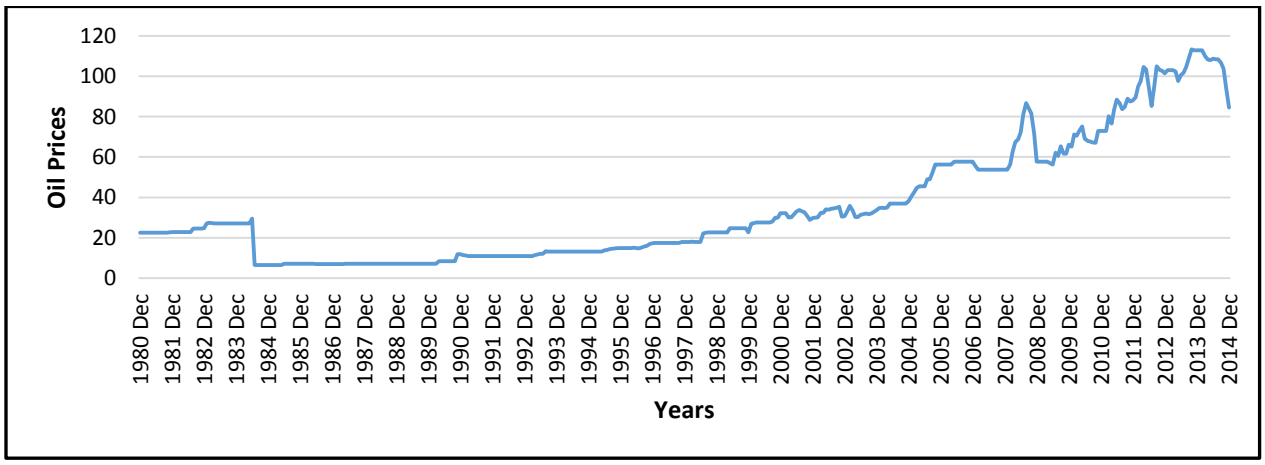
However after Iranian revolution the supply of oil again disturbed and in response prices increased again in 1979 but soon they have controlled their production. In 1980 Iraq assaulted Iran and price went up because of distraction in the production of both countries. However due to production of non OPEC and geopolitical stability price got stable in 1980's. Commonly it is experienced that oil prices in its market place went down yet in case of Saudi its income went upward due to oil extraction and domestic low price. In December 1986 OPEC had fixed an oil price at 18 $/container but that price was not prevailed for longer and soon decreased in the start of 1987. Due to supply shortage in 1990 Iraq-Kuwait war played an essential role to increased oil prices. After this war the oil price slow down noticeably till 1994 and meet the prices that was prevailed in 1973.

When Iraq attacked Kuwait price merely increased for short but for the rest of decade of 1990's it remained stable. In late 1990 the oil production was cut by OPEC due to supply shortage the prices of oil was greater than before in developed and developing nations. Later on the prices remain stable as the non OPEC countries increased their production especially Russia. Afterward prices are revived in 1998 because of supply shortage of oil OPEC and sustained it at the level of 1.72 million containers in April, 1999. Previously OPEC has try to allocate oil supply quota among its members in 1982-85 but it was failed to experienced due to opposition of its members particularly Saudi Arabia that shorten its supply as oil prices were too low. Again in mid-1986 a try was made to associate the oil prices with its oil market to stable prices at less the 10 dollar per container (Malik, 2007).

The oil war remain continue and US invaded Iraq in 2003 and prices of oil started increasing due to the growing demand for oil in developed and emerging economies and also production disturbance in Iraq and Venezuela. This price scrambling was demand driven and price reached at 97 US $ in 2008. When the oil demand increased in Asian countries in 2009 OPEC again decreased its supply that leads to shortage of 400,000 barrel/ day due to civil war in Libya. Because of this growing trend in demand in developing and developed nation the price of oil continued to increase afterward 2010 and never stops.

These shocks about oil prices depict that it have great impact on Stock Price Index of oil importing country (Pakistan) either directly and indirectly. With collaboration these external shocks Pakistan oil prices are also affected by the internal shocks due to various natural disasters and political conflicts prevailing within country. The earth quake of 2005 in northern areas of Pakistan badly affect its economy. Yet before that GDP was high and stable in 2004. Another natural disaster was and political conflicts prevailing within country. Another natural disaster was 2011 flood that ruins agriculture and infrastructure badly and tumbled down the economy as a whole. Such miscue leads to high import prices and create shortage of recourses due to high oil prices that is the one of the major input in almost all sectors economy. The oil prices trend is shown in figure 2.1.

Figure 2.1: Current Oil Prices in Pakistan (1980-2014)



Source: Monthly Statistical Bulletins of Pakistan.

3. REVIEW OF LITERATURE

There are many studies on the subject of energy price, especially in case of oil prices and stock market at International and national level.

Masih et al (2011), analyzed oil price volatility and stock market rise and fall in a rising market: Evidence from South Korea. To examine the stochastic properties and long run dynamics between the macro-economy, the stock markets, the instruments of monetary policy and the oil price fluctuations are the aims of this study. For this purpose, secondary data is used from May 1988 to Jan2005. By using the VECM model the examiners look into the impact of oil price changes and volatility on real stock returns, industrial production and interest rate. For further analysis, modern time series techniques in a co-integrating framework, Variance Decomposition and Impulse response function have also been employed. This study exposed that oil price movements significantly affect the stock market and the main channel of short run adjustment to long run equilibrium are real stock returns.

Bodenstein et al (2012), examined the how monetary policy makers should respond to oil price fluctuations and conclude that the best central bank policy response to oil price fluctuations depends on why the price of rudimentary oil has changed. For this purpose, multi-country DSGE model has been employed that is estimated by the method of maximum likelihood based on data for 1984-I through 2008-III quarterly. The major findings of this study are to explain that no two structural shocks justify the same monetary policy response and optimal monetary policy is well approximated by a policy rule that targets the output gap and attaches zero weight inflation. Further, find that oil trade greatly enhances the welfare gains from international monetary policy coordination.

Dhaoui and Kharief (2014) examined the practical relationship between oil price and stock market returns and unpredictability: confirmation from international developed markets for the period from January 1991 to September 2013 for eight developed countries. An EGARCH-M model has been used as an econometric method. The study concluded that oil price and stock market returns are strongly negatively connected in seven of the selected countries. Oil price changes have no significant effect on the stock market of Singapore. On the instability of returns, oil price changes have significant for six markets and no much effect on the others.

Le and Chang (2011) studied on “The impact of oil price fluctuations on stock markets in developed and emerging economies. The aim of this study was to examine the response of stock markets to oil price volatilities in Japan. Singapore, Korea and Malaysia by applying the generalized impulse response and variance decomposition analysis to the monthly data spanning

1986:01- 2011:02. The results show that response of stock market to oil price shocks diverge considerably across markets. The stock market showed negative response in Malaysia while positive in Japan but the signal in Korea and Singapore was blurred. Further the stock market ineffectiveness was find out, among others, seemed to have the slow reactions of the stock market to aggregate shocks such as oil price surges.

Sandusky's (1999) study on the US economy also shows that oil price volatility shocks have asymmetric effects on the economy. By evaluating the desire response functions, he shows that movements in stock returns can be explained by movements in oil prices: after 1986, furthermore, larger portion of forecast error variance in real stock returns is explicated by the oil price movements than the interest rates. The results finally recommend that positive shocks to oil prices slow down real stock returns while shocks to real stock returns have positive impacts on interest rates and industrial production.

Jones and Kaul (1996) however report that the reaction of the United States and Canadian stock markets to oil price shocks can be completely enlighten on the basis of changes in the expected value of future real cash flows. This evidence is valid but is weaker for the UK and Japan.

Siddique (2014) conducted a study on "Oil price fluctuation and stock market performance-The case of Pakistan". The goal of this study is to investigate the impact of oil price fluctuation on the stock market performance in Pakistan and KSE-100 index has been considered for analysis as an accurate representative sample of the country's stock markets. The annual time series data has been used from 2003 to 2012 for analysis. In this study , first of all find the descriptive statistics of all the variables after that find the correlation matrix and then estimate the simply regression. This study concludes that an optimistic and statistically significant relationship exists between oil price and other explanatory variables and stock market performance in Pakistan.

Ansar and Asghar (2013) examined the impact of oil prices on the CPI and stock market (KSE-100 index). For this reason the pollsters by using the secondary data employed the multi regression method from January2007 to August2012. The study revealed that there is positive but not much stronger relationship among the oil prices, CPI and KSE-100 index. Jawad (2013) study the oil price volatility and its impact on economic growth in Pakistan. The object of this

study is to explore the impact of oil price volatility on the economic growth of Pakistan. For this the researcher estimated the linear regression by using the secondary data from 1973 to 2011.To check the stationary, unit root test i-e Augmented Dickey-Fuller Test has been employed. This study revealed that oil price volatility has immaterial impact on Gross Domestic Production.

Fatima and Bashir (2014) studied Oil price and stock market fluctuations: Emerging Markets(A comparative study of Pakistan and China) The foremost objective of this study has to look at the volatility of international oil prices and stock market of emerging markets of Asia so the evidence was taken from China and Pakistan. The data is used 1st January 1998 to 31st December 2013. The monthly data is used for Stock market, Brent oil prices, exchange rate and CPI of respective countries. Multivariate Co-integration Analysis has done along with Vector Error Correction Model. Firstly, OLS regression has been applied and then unit root test to check the stationarity of data. The results discovered that all the variables have integrated at first difference i.e. I(1). When variables became stationary a differencing then co-integration analysis, Granger causality test and VECM model applied for further analysis. The results revealed that oil prices negatively affected the stock markets in emerging markets such as these countries are oil importing countries. To end Impulse Response and Variance Decomposition that forecast the impact of oil on stock markets. Then asymmetric effects have been observed in the stock markets.

The above literatures have employed different methodologies to fulfill their different objectives. Some used panel data and some used time series data. Majority of the studies reveal that oil prices has positive impact on stock market. If we examine the ***literature review in context of Pakistan*** There are number of issue in the above studies, as there are used small data sets for the time series which can't fulfill the basic criteria of minimum data/observation selection of time series analysis e.g. Siddique (2014), Ansar and Asghar (2013) and Jawad (2013). Particularly financial data is skewed and leptokurtic in their behavior, which violate the assumption of normality. When data set is not normal and shows volatility in it then linear models are not suitable. For this, use volatility modeling; volatility of a series is generally measured by its conditional variance. Due to volatility clustering there is ARCH effect in the series because series is conditionally depends on its lags. To capture this effect didn't use the ARCH test. Mostly above studies used Augmented Dickey-Fuller Test to check the stationary of

monthly time series data while Beaulieu and Miron unit root test is appropriate for monthly time series. In the methodology, auto correlation exists so the suggested results are biased. So, there exists a gap in the literature. To solve all these problem mention above can be solve under the structure of non- linear models i.e. ARCH family, with the help of large data set.

4. METHODOLOGY

Nelson (1991) has developed the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model. Braun, *et al.* (1995), Kroner and Ng (1996, 1998), Henry and Sherma (1999) and Engle and Cho (1999) have extended Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model in bivariate version. Nelson (1991) argues that market information affects the conditional variances and this affection varies from information to information and to capture asymmetric adjustment margins effect he set up an EGARCH model. Engle and Ng (1993) recommends a standard measure to how news information can be incorporated in to the volatility estimates. In order to better estimation and scantest news information impact curves to the data, a number of new candidates for modeling time fluctuating volatility are introduced and compared. These models permit numerous types of asymmetry in the effect of news information on volatility. Yoo (1987) and lee (1994) say that the error-correction term is a critical component to describe the conditional mean of the co-integration variables. EC-GARCH model contain the error-correction term in the GARCH model which proposed by Lee (1994). Empirical results in Enders and Granger (1998) conclude that the asymmetric ECM could describe the long run equilibrium relation.

In this paper, we use the model extended with error correction term in the mean equation to establish the Bivariate EGARCH model. Further Engle and Granger (1987) two step method is used for the presence of cointegrating relationship between the variables. As a first step we estimated the long run equation and then apply unit root test on the residual from the cointegrating equation.

The Engle-Granger two step method for stock price index is

$$LSPI_t = \alpha + \beta LOP_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \textbf{(4.1a)}$$

$$\Delta\varepsilon_t = \rho\varepsilon_{t-1} + \beta_1\Delta\varepsilon_{t-1} + \beta_2\Delta\varepsilon_{t-2} + \ldots + \beta_p\Delta\varepsilon_{t-p} + \mu_t \quad \ldots \quad \textbf{(4.1b)}$$

Where $LSPI_t$ log of Stock price index is, LOP_t is log of oil price, ε_t is residual from cointegrating equation and μ_t is residual from the equation of unit root test which is supposed to be white noise.

The Bivariate EGARCH (*p, q*) model for the stock market consists of two equations such as:

$$\Delta lspi_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta lspi_{t-i} + \sum_{j=0}^{q} \beta_j \Delta lop_{t-j} + \sigma lop_{t-i}^2 + \gamma ecm_{t-1} + \varepsilon_t \quad \ldots\ldots \textbf{(4.2a)}$$

$$l(\sigma spi_t^2) = \alpha_0 + \delta_s l\, \sigma spi_{t-1}^2 + \theta_s zlspi_{t-1} + \beta_s\big(|zlspi_{t-1}| - E(|zlspi_{t-1}|)\big) + \sigma lop_{t-i}^2$$
$$+\theta_p zlop_{t-1} + \beta_P\big(|zlop_{t-1}| - E(|zlop_{t-1}|)\big) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(4.2b)}$$

Where; i = 1, 2….p and j = 0, 1….q $\varepsilon\, t|\Omega t\text{-}1 \sim N\,[0, (\sigma spit)^2]$

The variables used in the above equations are as follows:

$\Delta lspi_t$ = Returns on Stock Market

$l(\sigma spi_t^2)$= Variance of stock market returns

Δlop = Log difference of oil prices

σlop^2 = Variance of log of oil prices

γecm = Error correction term

ε_t = Random variable

The equation (4.2a) is conditional mean equation of returns on stock market ($\Delta lspi_t$). That is dynamic error correction model. The random variable (i.e., εt) is supposed to have zero mean and conditional variance. Later the second equation of the model (i.e., 4.2b) indicates the conditional variance of the stock market returns. This equation depends upon the lagged value of innovation of log SPI and the log of oil prices, lag of conditional variance of the stock market returns and the terms to detect asymmetric effect. The parameter θ_s shows last period forecast variance and β_s indicates news impact of stock market returns. While the parameters $\theta_p$and β_p shows the last period forecast variance and the asymmetric impact of oil price respectively in the conditional variance of stock market returns. Additional, the θ's permit asymmetry news impact from SPI. The estimated parameter of GARCH term that is δ_s shows persistence of volatility.

Data for this study is taken from the period of 1991-11 to 2014-12. The variables in this regard used are current oil prices and KSE-100 Index of Pakistan. Oil prices (OP)-oil (petroleum) prices monthly data of Pakistan is taken from the monthly statistical bulletins of

Pakistan. The sample period of KSE-100 Index taken from State Bank of Pakistan (SBP). Here is the description of econometric techniques that we will use in this study for our findings.

It is important to test the time series before building a model, if there is a need to transform the data. As transformation ensure proper functional form of the model. Before the estimation of univariate and multivariate models, it is necessary to transform the dependent and independent variables. Power family of transformation is modified by **"**Box and Cox**"** in 1964.Further modify the box-cox transformation by using the Geometric mean in the transformation. So we applied Box-Cox transformation in this study by using following formula:

$Y_t(\lambda) = (Y_t^{\lambda} - 1)/\lambda Y^{*\lambda-1}$ If $\lambda \neq 0$ ..... ***(4.3)***

$Y_t(\lambda) = Y^{*} ln\, Y_t$ if $\lambda = 0$ ..... ***(4.4)***

L (λ) = - T/2(1+LN2π + LN RSS/T) ..... ***(4.5)***

The maximum L (λ) value of λ will suggest the type of transformation of the series. Before estimation of Bivariate EGARCH model we have to check the stationary of the series. The test was developed by Beaulieu and Miron (1993) to test the seasonal and non-seasonal unit root (i.e. unit root at zero, biannual and annual frequency) in monthly time series. It extended to the Frances (1991) U.R Test by generating 12 series to detect the complex U.R separately. Beaulieu and Miron proposed the test of unit root in monthly data. The null hypothesis are

H0: $\pi_1 = \pi_2 ..... \pi_{12} = 0$

H_1*: At least one of them is not zero*

To test the unit root in monthly series Beaulieu and Miron suggest estimation of the following equation.

$$\Delta_{12} Y_t = \alpha + \beta T + \sum_{k=2}^{12} \beta_k D_{tk} + \sum_{k=1}^{12} \pi_k Y_{t-i,k} + \epsilon_t \quad \ldots \qquad \textbf{(4.6)}$$

The variables can be generated by following equations. Where $\mu_t = DT + DS = \delta + \beta_t + \Sigma \alpha_s D_{s,t}$

We have estimated the equation with OLS. And test for the serial autocorrelation of the residuals. For this we have used LM test at 1st and 12th lag. If the residuals are not white noise then we added lags of dependent variable until the error terms of the series is whiten. Hypothesis which is tested for this test varies between even and odd. First two coefficients .i.e. $\pi_1$and π_2 are tested individually using t-test and remaining are tested using F-test by applying the Wald Test. Roots in the monthly data are tested as follows.

- ✓ The zero frequency unit root ($\boldsymbol{\pi_1}$ = 0) and bi-annual frequency unit root ($\boldsymbol{\pi_6}$= 0) are tested using left sided t-statistics.
- ✓ While the complex roots are tested by using joint test (F-test).
- ✓ If all $\boldsymbol{\pi_i}$= 0, then we apply $(1-B^{12})$ filter.
- ✓ If $\boldsymbol{\pi_i} \neq 0$ data are stationary and use seasonal dummies.

In this study Engle and Granger Two- Step Method is used for cointegration. Engle and Granger (1987) offered the two step co-integration test also called as residual based test. But this test is not appropriate for more than two variables. This method is following as:

Step 1

While moving with the step 1 of Engle and Granger (1987) approach with regression of the variables, it is necessary to include variables expected to be co-integrated and have sustained shocks on the equilibrium. The variables that have sustained the shocks are termed as exogenous shocks and basically are included in the form of dummy variable. As a first step we will be estimated the long run equation and then apply unit root test on the residual from the co-integrating equation.

The Engle-Granger two-step method for price Stock price index can be performed as:

$$Yt = \alpha + \beta Xt + \varepsilon t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \textbf{(4.7)}$$

$$\Delta\varepsilon_t = \rho\varepsilon_{t-1} + \beta_1\Delta\varepsilon_{t-1} + \beta_2\Delta\varepsilon_{t-2} + \ldots + \beta_p\Delta\varepsilon_{t-p} + \mu_t \quad \ldots\ldots\ldots\ldots\ldots \quad \textbf{(4.8)}$$

$$\therefore \mu_t \sim N(0,\sigma^2)$$

Where Y_t = ($LSPI_t$) is log of stock price index respectively, X_t= (LOP_t) is log of oil price. ε_t is residual from co-integrating equation and μ_t is residual from the equation of unit root test which is assumed to be white noise. After obtaining the residual, order of integration is tested using a unit root test based on the nature of data and it is to check that if variables are integrated of order 1 .i.e. they are stationary at 1st difference, residual should be level stationary. The obtained residual is then tested for the hypothesis .i.e. null hypothesis of no cointegration against the alternative hypothesis of cointegration present.

Step 2

After testing for order of integration, short run dynamics are tested by taking into account both Yt and Xt in the difference form along with the error correction term .i.e. lagged form of the residual.

$\Delta Yt = \alpha + \beta 1 \Delta Xt + \beta 2 \varepsilon t{-}1$ **… ………………………………….. *(4.9)***

Where $\varepsilon t{-}1\ is\ Yt{-}1$.

It is important to note in this case that variables in the two steps mentioned above are stationary. The univariate ARIMA model is used to filter series before going into deeper estimation techniques. To determine the order of ARIMA we use correlogram for first difference of LSPI and LOP series. EGARCH Model is presented by Nelson (1991). According to Nelson this model addressed with the asymmetric effect and relaxed the restriction of non-negativity and also captures the effect of news on volatility better than GARCH model. Braun, *et al.* (1995), Kroner and Ng (1996, 1998), Henry and Sherma (1999) and Engle and Cho (1999) have extended Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model in bivariate version. This model is estimated by the Maximum Likelihood Method offered by Bollerslev and Wooldridge (1992). The desired model fulfills the number of diagnostic tests. For example, Godfrey Lagrange Multiplier (LM) (1978) test is applied to test the null hypothesis of serial correlation in the residual term of error correction model. Further Engle's (1982) LM test is used to detect the autocorrelation conditional heteroscedasticity (ARCH) in the residuals to confirm that there is constant variance in the residual series. Test of normality Jarque Bera (JB) test is applied to check the normality of the residual of the model.

5. RESULTS AND DISCUSSION

First Box-Cox transformation is applied on all variables to check for what type of transformation of the series is required. This suggested log transformation is required for all three variables. After that to detect unit root we applied Beaulieu and Miron monthly seasonal unit root test. According to this test we test stationarity both for seasonal and non- seasonal using t-test for seasonal unit root detection, while Wald test for the existence of non-seasonal unit root. We found all variables of integrated of order (1) and become stationary at first difference.

Table 1 presented the result for unit root test using Bealieu and Miron seasonal unit root test. The model is with constant, seasonal dummy and trend. The numbers of observation after adjustments are 406 for monthly data. In order to check the critical values these observations should be in years i.e. 406/12 = 34 ≈ 30 because the π table considers yearly observations, α = 0.05 and S = 12 for monthly data. Within this procedure after the application of Breusch Godfrey Serial Correlation LM test, at both level and difference form which are presented in Table 1,

above show that at 1st and 12th lag chi-square calculated value is smaller as compare to that of tabulated value. So according to the decision rule of Breusch Godfrey-LM test do not reject the null hypothesis and concluded that there is no problem of autocorrelation at the 1st and 12th lag on level and difference Regressions. Hence residuals are said to be white noised in this regard.

The result of the Table 1 shows that all the hypothesis are rejected showing that there is no unit root present, but the problem lies with the 1st value of the test statistic LOP and LKSE are -2.56 and -2.01 respectively. This result indicate that in the case of $t{:}\pi 1$ calculated values are exceeding the tabulated value which is -3.32, so null hypothesis of unit root is said to be accepted and concluding that series are non-stationary at level. After transforming the variables using first difference filter, all the variables, i.e. Oil Price and KSE-100 Index are found to be stationary at first difference in the presence of intercept, seasonal dummy/dummies and trend are found to be significant. From the Table-1 shows that estimated value of $t{:}\pi 1$ of log difference of OP and KSE are less then tabulated or critical values. So null hypothesis of unit root is not accepted. Similarly in the case of seasonal unit root as F-statistic calculated value is greater than critical or tabulated value, so null hypothesis of unit root in this case also stays rejected. Hence it is concluded here that all series are stationary at non-seasonal and seasonal unit roots.

Table 1: Bealieu and Miron Seasonal Unit Root Test

Hypotheses	**LKSE**	Δ_1 ***LKSE***	**LOP**	Δ_1***LOP***
Specifications	**C, d, t**	**C, d, t**	**C, d, t**	**C, d, t**
$t{:}\pi_1 = 0$	**-2.01**	-4.78	**-2.56**	-6.06
$t{:}\pi_2 = 0$	-4.45	-4.67	-5.62	-5.56
$F{:}\pi_3 = \pi_4 = 0$	20.90	21.88	40.18	35.17
$F{:}\pi_5 = \pi_6 = 0$	25.49	25.98	39.27	34.58
$F{:}\pi_7 = \pi_8 = 0$	27.41	25.46	38.23	33.73
$F{:}\pi_9 = \pi_{10} = 0$	28.57	27.30	34.86	31.33
$F{:}\pi_{11} = \pi_{12} = 0$	35.68	32.36	40.42	35.18
Test of Autocorrelation LM-Test				
$\chi^2_{(1)}$	0.8174	0.5878	0.5434	0.8972
$\chi^2_{(12)}$	12.5878	0.3745	2.3545	1.0000

Note:*Critical values at 5 percent significance level using Frances and Hobijin (1997) .

5.1. Dynamic Analysis for KSE-100 Index and Oil Prices

The existence of a long run relationship between KSE-100 index and oil price is examined by using Engle-Granger (1987) two step method. This step leads to conclude whether an error correction term have to contain in the EGARCH model or not. As a first step KSE-100 index is regressed on Oil prices. The results are presented below (t-statistics in parentheses).

$$LSPIt = 7.0893 + 0.0137\,\mathrm{T} - 0.1877LOPt \quad \ldots \quad \textbf{(5.1)}$$

(10.99) (5.45) (-0.67)

R-squared 0.82 F-statistic 656.68 ADF –1.87 (–3.81)

In the second step, we tested the existence of cointegration between the two variables is tested by applying the Dickey Fuller test of unit root on the residual found from long run equation (5.2) of stock price index. The DF unit root is tested at level or without differencing the data set.

The Engle-Granger's critical value at five percent level of significance is (-3.81). Thus the results show that presence of unit root in the residual series. In other words these two series are not cointegrated for the period under analysis. Which concludes that Bivariate EGARCH model will be estimated without error correction term in the conditional mean equations.

The serial correlation LM test is applied on the 1st lag and 12th lag $\chi 2$ calculated values are smaller as compare to $\chi 2$ tabulate values which are 0.8341 and 19.6334 respectively. So according to the decision rule of BG-LM test do not reject the null hypothesis and concluded that there is no problem of autocorrelation. Hence residuals are said to be white noised in this regard. If the problem of serial correlation exist then Dickey Fuller test converted in Augmented Dickey Fuller test, otherwise it is Dickey Fuller test.

5.2. ARCH Analysis

The study has been used techniques of financial time series econometrics. First the time series properties of data is examined. Particularly financial data is skewed and leptokurtic in their behavior, which violate the assumption of normality.

The plots of actual series has drawn to observe the pattern of series and present in the Figures 5.1 and 5.2.These graphs show actual series of (OP and KSE.100 Index), on monthly data. These graphs show that series are non-stationary because series are not fluctuate around the

zero mean level. So graphs also show the problem of autocorrelation as well as of heteroscedasticity. All the three graphs also show increasing trend of the data. So, our model become random walk model with drift and trend.

Figure 5.1: Current oil prices of Pakistan

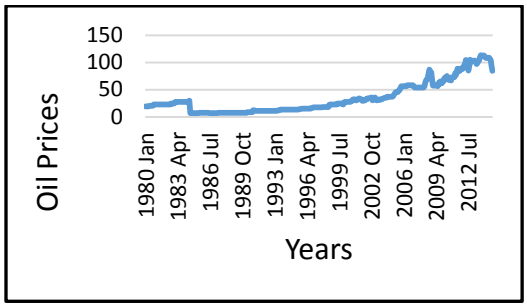


Figure 5.2: KSE-100 Index

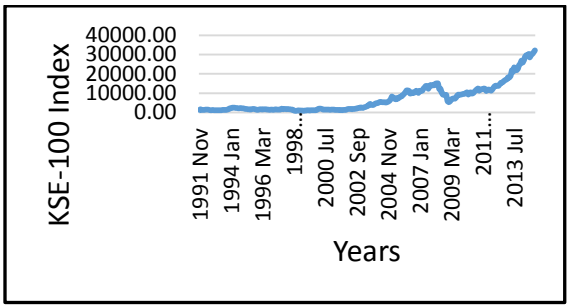


Figure 5.3: Volatility in Current oil price of Pakistan

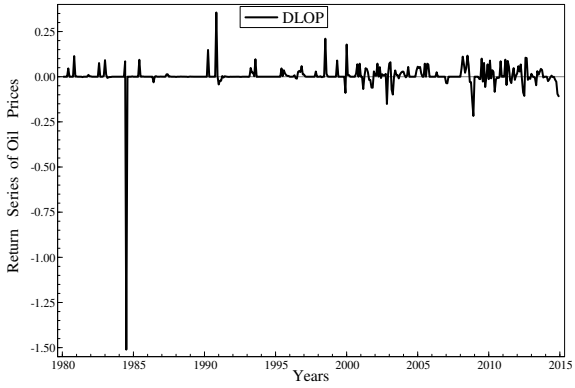


Figure 5.4:Volatility in Stock Price Returns

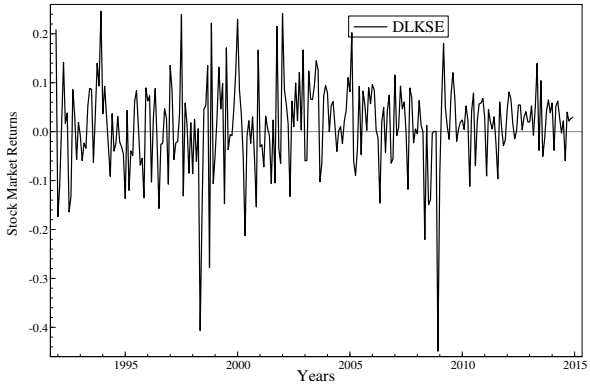


Figure 5.5: Distribution of Return on oil price of Pakistan

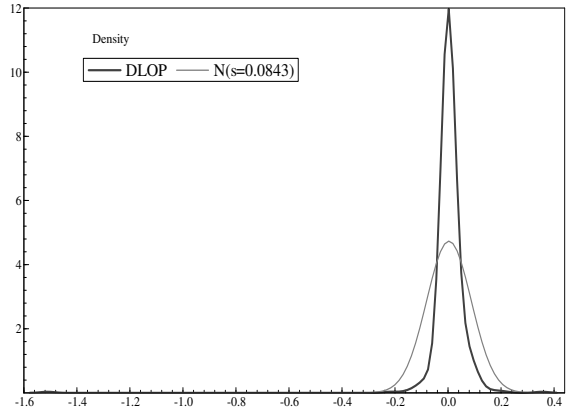
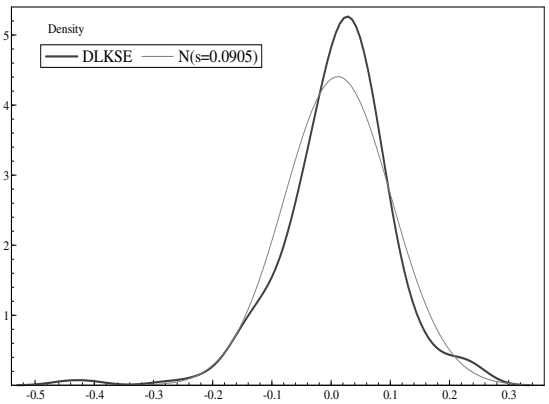


Figure 5.6: Distribution of Return on KSE-100 Index



Through figures 5.3 and 5.4 it can be noted that series are stationary because mean reversion behavior. But spread is not same. Volatility clustering is here which defines heteroscedasticity. There is prolonged period of low volatility and high volatility. In this regard we can say that periods of high volatility tend to be followed by periods of high volatility and periods of low volatility are followed by periods of low volatility. This suggest that, there is autocorrelation problem. So we call it ARCH effect. Because series conditionally depends on its lags.

Above Figures 5.5 and 5.6 show that distribution is like leptokurtic. These show that probability of extreme values is higher than normal. So, these are left skewed .It means that distinct players are active with different preferences in same market. The heavy tails show that the probability of extreme values are high. There is fluctuation in the data. Series are subject to leptokurtic.

5.3. Engle's ARCH Heteroscedasticity Test for return series of KSE and OP

In order to examine the ARCH effect we estimated the regression by OLS and obtain residuals μ_t. Then we applied ARCH LM test on the estimated residuals. The estimated results are given as following;

$$\Delta lkse_t = \underset{(1.77)}{0.0097} + \underset{(1.72)}{0.2232}\,\Delta lop_t \quad \ldots \qquad \textbf{(5.2)}$$

The absence of ARCH components is the null hypothesis, $\alpha_i = 0$ for all$i = 0,1, \ldots n$. The presence of ARCH components is alternative hypothesis, at least one of the estimated coefficients must be significant. The test statistic NR^2 follows χ^2 distribution with q degrees of freedom. Chi-square tabulated value is less than the estimated value of NR^2 then we reject the null hypothesis and conclude that there is an ARCH effect.

To determine the order of ARIMA we use correlogram for first difference of LOP and LKSE series. These correlogram show the order of ARIMA for all of them. We used 20 lag lengths and 95 percent confidence interval for visual inspection. By visual inspection we have found that there is problem of autocorrelation in series. Because these correlogram are showing that many spikes lie outside its confidence interval except Dlop which are present in the following figures:

Figure 5.7: ACF of Dlop

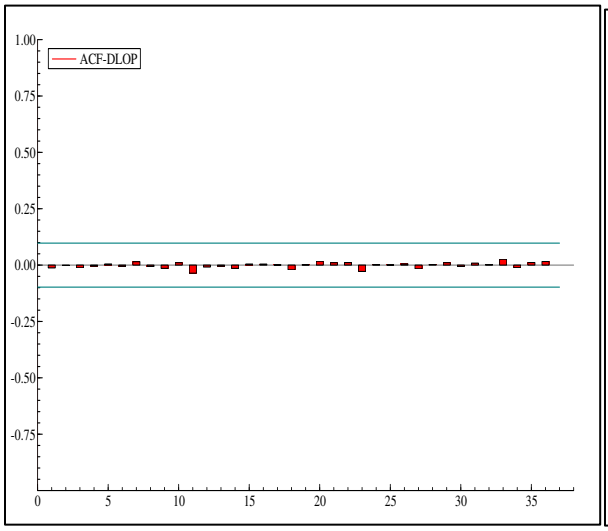


Figure 5.8: PACF of Dlop

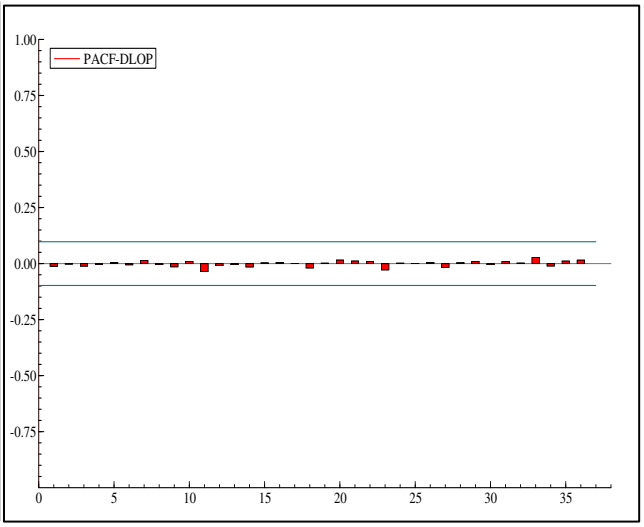


Figure 5.9: ACF of Dlkse

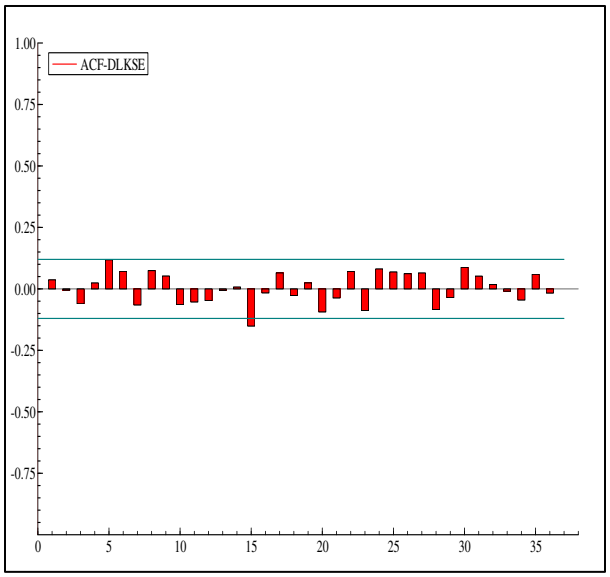
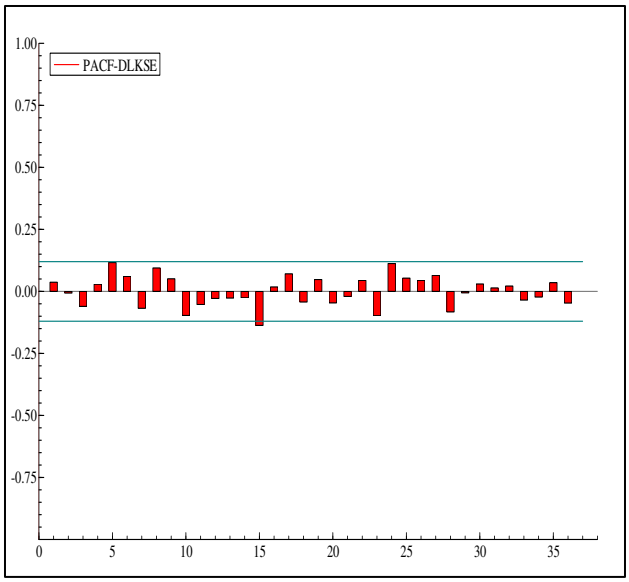


Figure 5.10: PACF of Dlkse



5.3. The impact of oil price on SPI bivariate E-GARCH model:

This study applies ARIMA BIVARIATE EGARCH (1, 1) model to investigate the impact of oil price on SPI from the period 1991:M11 to 2014:M12. SPI and oil prices contain unit root at zero frequency and become stationary at first difference. This model is estimated by

the Maximum Likelihood Method introduced by Bollerslev and Wooldridge (1992). The results are presented below (t-statistics in parentheses).

$$\Delta lspi_t = 0.0260 + 0.5070\,\Delta lspi_{t-5} + 0.4091\,\Delta lspi_{t-15} - 0.4586\varepsilon_{t-5} - 0.5187\,\varepsilon_{t-15} + 0.1150\,\Delta lop_{t-1} \quad \ldots \quad \textbf{(5.3a)}$$

(3.5531) (3.6391) (3.0816) (-3.3597) (-3.8224) (1.2633)

$$(\sigma spi_t^2) = -6.6749 - 0.3111\; l\,\sigma spi_{t-1}^2 + 0.013451 zlspi_{t-1} + 0.274067\,(|zlspi_{t-1}| - (|zlspi_{t-1}|)) \quad \ldots \quad \textbf{(5.3 b)}$$

(-2.2635) (-0.5130) (0.0837) (1.1217)

Diagnostic tests:

ARCH LM Test $\chi^2_{(1)}$= 0.124168 Test of Normality, Jarque.Bera $\chi^2_{(2)}$= 268.77

Autocorrelation Test Q-Statat 1st Lag $\chi^2_{(1)}$ = 0.1260, at 12th Lag $\chi^2_{(12)}$= 15.41

All the diagnostic tests are satisfied the criterion at the 5% level of significance except the Jarque-Bera test. Conclude that our ARIMA Bivariate EGARCH (1, 1) model has no serial correlation, no ARCH effect but with non-normal residual. All the estimators of the model are consistent and significant at the 5% level of significance.

The equation (5.3a) is conditional mean equation of simple Bivariate EGARCH model. Which reveals that change in SPI is not only affected significantly by its lag but change in oil prices also plays a significant role in determining the stock price index. We have found positive relationship between oil prices and SPI. It means SPI is positively affected by oil prices. Thus any increase in the change in oil prices, indicating increases the change in stock price index.

The equation (5.3b) is conditional variance equation of oil price volatility Bivariate EGARCH model. News effect SPI asymmetrically that captures by parameter θ_s.The size effect of news reinforce by negative innovation while it is partially effected by a positive innovation. In our case of Pakistan this have positive value and statistically insignificant at the 5% level of significance. It means there is no impact of oil price news on SPI. The relative importance formula for positive and negative news was introduced by Yang and Doong (2004) i.e. $|-1+\theta_s$

$\left|\right.$ / (1+θ_s). According to them it also measure the differential impact between current conditional variance and own innovation of market. This ratio for Pakistan is 0.97 in our analysis calculated by above formula.

Generally for the persistent in the volatility shocks is captured by sum of ARCH and GARCH coefficients. That is near to one (0.97) which also validates in case of Pakistan. Although these volatility shocks of SPI are very persistent in our case but they are vanished out overtime.

5.4. The impact of oil price volatility on SPI bivariate E-GARCH model

This study applies ARIMA BIVARIATE EGARCH (1, 1) model is to investigate the impact of oil price volatility on SPI from the period 1991:M11 to 2014:M12. This model is estimated by the Maximum Likelihood Method offered by Bollerslev and Wooldridge (1992).The results are presented below (t-statistics in parentheses).

$$\Delta lspi_t = -0.012794 + 0.606826\Delta lspi_{t-15} - 0.182637\ \Delta lspi_{t-24} + 0.64645\ \varepsilon_{t-5} - 0.71169\varepsilon_{t-15}$$
(-0.718) (7.161) (-2.512) (1.635) (-9.391)

$$+0.279524\ \varepsilon_{t-24} + 0.125475\ \sigma lop_{t-1}^2 \quad \textbf{…} \quad \textbf{(5.4a)}$$
(3.845) (1.973)

$$l(\sigma spi_t^2) = -0.098952 + 0.991717 l\ \sigma spi_{t-1}^2 - 0.05048 zlspi_{t-1} +$$
(-0.925) (56.03) (-1.107)

$$0.063116\ (|zlspi_{t-1}| - (|zlspi_{t-1}|)) \quad \textbf{…} \quad \textbf{(5.4b)}$$
(0.775)

Diagnostic tests:

ARCH LM Test $\chi^2_{(1)}$= (0.000826) Test of Normality, Jarque Bera$\chi^2_{(2)}$ = (274.24)

Autocorrelation Test Q-Stat at 1st Lag $\chi^2_{(1)}$= (0.0008), at 12th Lag$\chi^2_{(12)}$ = (17.75)

All the diagnostic tests are satisfied the criterion at the 5% level of significance except the Jarque Bera test. Conclude that our ARIMA Bivariate EGARCH (1, 1) model has no serial correlation, no ARCH effect but with non-normal residual. But still all the estimators of the model are consistent and significant at the 5% level of significance.

The equation (5.4a) is conditional mean equation of the impact of oil price volatility on change in SPI Bivariate EGARCH model. Which reveals that change in SPI is not only affected significantly by its lag but oil price volatility also plays an important role to determine the SPI. The nonnegative estimates of conditional variance validates exponential leverage effect rather quadratic.

The equation (5.4b) is conditional variance equation of oil price volatility Bivariate EGARCH model. News effect on SPI is asymmetrically that captures by parameter θ_s.The size effect of news reinforce by negative innovation while it is partially effected by a positive innovation. In our case of Pakistan it has negative value and statistically insignificant. It means there is no impact of oil price news on SPI. The relative importance formula for positive and negative news was introduced by Yang and Doong (2004) i.e. $|-1+\theta_s|/(1+\theta_s)$. According to them it also measure the differential impact between current conditional variance and own innovation of market.

Generally for the persistent in the volatility shocks is captured by sum of ARCH and GARCH coefficients. That is one which also validates in case of Pakistan. Although these volatility shocks of SPI are very persistent in our case but they are vanished out overtime.

6. Conclusion and Policy Recommendations

Since many years Pakistan is suffering from oil related problems. Because Pakistan is found to be the major dependent on oil and related products. That is why, it has to spend huge amount while importing it. According to this point of view, the impact of oil price and its volatility on Stock market has been analyzed in this study. While some studies have conducted to examine the impact of energy prices specially oil prices on inflation and other macroeconomics variables but still there is no study has examined the impact of oil price volatility on Stock market. In Pakistan, we can see that limited studies were done regarding to this topic. So there is a gap in literature that impact of oil price volatility on stock market index in Pakistan has not studied and observed for said relationship. In this study we used the financial time series econometrics techniques. First applied the Box-Cox transformation on the data. Which suggested log transformation is required for all series. As data used will be monthly, Beaulieu and Miron (1992) seasonal unit root test is applied here to test stationarity of the data. All variables contain unit root at zero frequency and become stationary at first difference. Further to test for the presence of co-integration relationship between the variables we have estimated Engle and

Granger (1987) two-step method. And finally Bivariate EGARCH model is used to investigate the impact of oil price volatility on Stock market index. EGARCH Model is presented by Nelson (1991). According to Nelson this model addressed with the asymmetric effect and relaxed the restriction of non-negativity and also captures the effect of news on volatility better than GARCH model. This model is estimated by using Maximum Likelihood Method proposed by Bollerslev and Woolridge (1992).

We have found positive relationship between oil prices and Stock market Index. It means SPI is positively affected by oil prices. In case of Pakistan, asymmetric impact is positive but statistically insignificant at the 5% level of significance. But in the case of oil price volatility Bivariate EGARCH model, it is negative and statistically insignificant. It means there is no impact of oil price news on SPI. This study concludes that SPI is positively and significantly affected by oil price volatility. The sum of ARCH and GARCH coefficients validate these volatility shocks of SPI are very persistent in our case but they are vanished out overtime.

There are some main points which could be take into consideration from the policy perspective. These steps are based on the above discussion of results and testing for relationship between Oil Prices and Stock market. According to this study, Stock market is positively affected by oil prices. If oil prices are stable then stock market are also stable. Being an oil importing country, First government can get advantage by increasing their strategic oil reserves and protect themselves from the risk of supply shortage. Secondly, government would be made alternative fuels like Coal, natural gas and renewable energy. In order to minimize the oil price fluctuations which have an adverse impact on our national economy government would improve dialogue with oil exporting countries.

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