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ESTIMATION OF LONG-RUN RELATIONSHIP OF INFLATION (CPI & WPI), AND OIL PRICES WITH KSE-100 INDEX: EVIDENCE FROM JOHANSEN MULTIVARIATE COINTEGRATION APPROACH

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Abstract. This research is an attempt to framework the applied strides to evaluate the long run relationship among commonly used inflation proxies induces such as, wholesale price index (WPI) and consumer price index (CPI), and crude oil price (COP) with KSE100 index returns. In this research we used monthly data for the time period from July 1995 to June 2016, and thus, in this way total 252 observations have been considered. Time series have been made stationary by applying ADF and PP tests at first difference. Johansen multivariate conintegration approach was used to test the long-term association amongst the considered macroeconomic variables. The results indicated that CPI and COP significantly affect KSE100 index returns that indicated CPI along with COP have foreseen power to impact KSE100 index. In contrary, the results of WPI and COP do not have long run relationship with KSE100 index in case of Pakistani economy. Results of variance decomposition exhibited that the index of LKSE100 was realistically rarer exogenous in connection to distinctive factors, as around 92.31% of its variation was explained due to its own specific shocks. It is concluded that CPI and COP can impact the KSE100 index returns. It is confirmed by the results of impulse response function that there is a positive and long run relationship between KSE100 returns and consumer price index (proxy of inflation) and international crude oil prices.

Keywords: inflation indices, consumer price index (CPI), wholesale price index (WPI), crude oil prices (COP), KSE 100 index, Johansen multivariate cointegration.

JEL Classification: C32, E31, E44, G12.

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Introduction

Stock indices and returns are always being a great interest for arguments, and association of stock indices with macroeconomic variables are the most examined subject for researches and financial experts around the globe. In our research, we tried to explain and scrutinize the association of KSE100 index returns with inflation (with CPI & WPI proxies) and international crude oil prices. It is generally seen that economic variables as macroeconomic variables T-bills, inflation, Foreign direct investments, interest rate, exchange rate, and money supply can impact the trade volume, returns, and volatilities of financial markets. The previous research studies indicated that there is no any set yardstick for prices and inflation, but in maximum studies wholesale price index (WPI) and consumer price index (CPI) have been used single or simultaneously both indices (e.g., Czapkiewicz, Stachowicz 2016; Abraham, Harrington 2016; Sibanda *et al.* 2015; etc.). Such inexact situation leads to consideration and discussion that whether in the long run; CPI and WPI act same or inversely, and also such discussion become very important while making the monetary policies for the central banks that point to inflation.

Oil prices and macroeconomic variables. Oil acts as an important role in economic development. Every country does not have plenty of such resources, so countries go for importing oil from other countries and face oil price volatility. As the oil is considered as highly demanded and depleting resource, so its price volatility can have effect on other variables as well such as, equity returns, exchange rate, inflation rate, and interest rate. Many studies have tested such relations for developed economies like US, Japan, UK, and Canada, and results of all these studies demonstrated that there is a definite impact of macroeconomic variables on equity returns (e.g., Wei, Guo 2016; Wasseja 2015; Hardouvelis 1987; Levine 2003; etc.). According to Levine and Zervos (1996), Chiarella and Gao (2004), and Hooker (2004) macroeconomic variables such as: FDIs, GDP, employment, productivity, inflation, and interest rate have explicit affect on stock markets returns. This is also clarified by Nejad *et al.* (2016), Broadstock *et al.* (2016) and Sadorsky (1999) and studied and established the association between stock returns and crude oil prices, where it was shown that that oil price volatility is determinant of equity returns.

Linkage of oil prices to stock returns. Huang *et al.* (1996) have studied and concluded the definite association between stock returns and crude oil prices, they further established the long run association amongst equity returns, GDP, oil prices and interest rate (e.g., Mardini, Ali 2016; Ghorbel, Souissi 2016; Hu *et al.* 2016; Beck, Levine 2004; etc.). Hence performance of stock market is considered as an instrument for country's economic growth. The increase in international crude oil prices also increase the company's expense and overall doing of business, which lead to decrease the cash flows and stock prices of company (e.g., Yurtkur *et al.* 2016; Ma *et al.* 2016; Driesprong *et al.* 2008; Pollet, Wilson 2010; etc.). According to Naifar and Dohaiman (2013) crude oil prices affect inflation and interest rate, which further impact the discount rate and this leads to affect the equity returns.

Linkage of inflation to stock returns. There are several proxies of inflation, in which consumer price index (CPI) is regarded as the most prominent, which essentially determines the health of the economic position of the country. The investors of stock exchange

look after the inflation rate as it may affect the investment and return and to see the risk and profit margin. As the inflation rate rises, the prices of all products in the market increase simultaneously. According to research studies, stock prices are inversely related to the inflation (e.g., Ratti, Vespignani 2016; Albulescu *et al.* 2016; Asprem 1989; Najand *et al.* 1992; etc.). Brandt and Wang's model (2003) suggested that inflation impacts the investor's risk averse and also needed yield on capital.

Objective and significance of research. The central objective of our research study is to ascertain the association between KSE100 index returns by taking care of inflation (with CPI & WPI proxies), and international crude oil prices. As in Pakistan, CPI is considered as inflation indicator, thus this study uses CPI for inflation indicator and WPI as wholesale index entailing of imported items allied to international market. This study comprises on 252 monthly observations for the time period from July 1995 to June 2016. The data has been collected from various sources like KSE website for stock indices, Yahoo Finance for crude oil prices, and Pakistan Bureau of Statistics for the CPI and WPI. Results of this study will help investors in making decisions with consideration of their investment portfolio for such notices.

Definitions of variables. We have used number of variables in this research, in this section we define these variables as follows:

Karachi stock exchange. Karachi stock exchange (KSE) was founded in September 18, 1947. It was the only exchange in Pakistan at that time. Karachi stock exchange was acknowledged "the best performing stock market of the World in 2002". In the month of July 2016 it regains the status of an emerging market. According to the Bloomberg, Karachi stock market was ranked 3rd amongst the best performing top 10 stock markets of the World in 2014. In January 11, 2016, Pakistan stock exchange was incorporated with Karachi stock exchange and two other bourses of Pakistan such as: Islamabad stock exchange (ISE) and Lahore stock exchange (LSE). KSE100 index is regarded as the premier equity market of Pakistan, and at the same time KSE100 index is one of the oldest equity markets of South Asia. KSE100 index comprises of total 654 listed companies at index with overall market capitalization of USD120.5 billion; KSE100 reached US$35 billion on July 30, 2011 and as on July 10, 2015, it reached US$72 billion market capitalization.

Inflation rate. Inflation rate shows level of prices for goods and services are raised i.e. currency purchasing power is failed. Burgess *et al.* (1994) defined inflation rate, as rate of fluctuations in average level of prices. The inflation rate is very much linked to consumer price index (CPI) that is an index of prices of goods used as demonstrative for whole national consumption form.

Consumer Price Index (CPI). The Consumer Price Index (CPI) is catalogue that measures the weighted average prices of set of consumer goods/services as food, medical or transport. CPI is measured by taking changes in prices of each item of set of goods/services and get average of them. So, CPI is used as determinant for inflation/deflation, and variations in CPI would show the prices variations with cost of living.

Wholesale price index (WPI). The wholesale price index (WPI) is the catalogue used to measure the price of set of wholesale goods. It is used as a central measure of inflation by some countries. In Pakistan, it is used to measure the price variations in manufactured goods/services, which are produced in the wholesale market during a required period.

Crude oil prices. Crude oil is a natural organic petroleum product that is composed of hydrocarbon deposits and other organic materials. The refined products of crude oil are diesel, gasoline, and other petrochemical products, which can be used in industrial usage. International crude oil prices are measured and quoted in barrels that are defined by Brent Blend, OPEC-BR and NMAX.

Figure 1 shows the trend of CPI, WPI (proxies of inflation) in Pakistan, KSE100 index and world crude oil prices (COP). The values are converted into natural Log that depicted the values and pattern in percent and could be derived a meaningful inference.

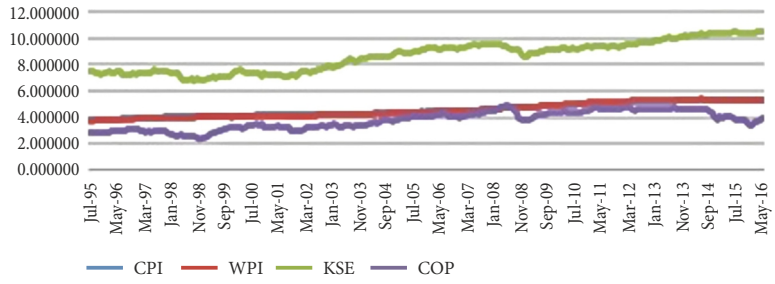

Fig. 1. Trends of CPI, WPI, KSE100 and COP
Source: Authors' calculations

The rest of the research study is ordered as: the Segment I comprises of the overviews regarding the pertinent previous literature on the linkage among oil prices, inflation, and important economic variables and capital markets. However, the Segment II contains on empirical framework and estimation techniques. Whereas, the Segment III talks about estimations and results. Finally, the last Segment comprises of discussions and conclusion.

1. Review of literature

Numerous theoretical and empirical literature has been pointed to examine the impact of exchange rate, global inflation, energy prices, international food inflation, world crude oil prices, domestic inflation, GDP, and interest rate on equity returns in different countries. The current review of literature showed a positive and significant association among international oil prices, inflation and their impact on equity prices.

Impact of oil prices shocks on stocks and inflation. There are many studies such as, Xu *et al.* (2014), Harvey *et al.* (2017), Abhyankar *et al.* (2013), Basher and Sadorsky (2006) determined the factors that push oil price shocks. Also Yurtkur *et al.* (2016) and Wang *et al.* (2013) explained that likely differences between the countries those either oil producing or oil importing and concluded that both experienced differently. Another study concluded that the importer of oil countries stock markets' returns has an impact of oil prices shocks but oil exporting countries do not have (Kilian, Park 2009). Oil is a major raw resource that is widely distributed in the economy. With concerned to oil price shocks, the oil importing countries got increment in CPI as oil price rises, the cost of goods also raises; thus produc-

tion is decreased. With oil price shock, American CPI fluctuates, hence affects the Global economy (e.g., Abraham, Harrington 2016; Sibanda *et al.* 2015; Lee *et al.* 2001; etc.). It is evident that higher prices of oil lead the higher cost of production, and eventually lower the overall production, which also lower the earnings of organizations (Enders, Jones 2016).

Impact of crude oil prices on stock returns. Now, many studies of economic and finance examine the association between equity returns, crude oil prices, and other macroeconomic variables, and concluded a significant positive relationship (e.g., Pinho, Madaleno 2016; Moosa 2015; etc.). The studies have congruent results for the association of crude oil prices and equity returns. Several research studies also concluded a negative association between equity returns and oil prices for developed economies (e.g., Harvey *et al.* 2017; Gopal, Munusamy 2016; Xu 2015; Balcilar *et al.* 2015; Cunado, Perez de Garcia 2014; Chen 2009; etc.). But with contrast to this, other studies found direct relationship between oil prices and equity returns also (e.g., Pönkä 2016; Mardini, Ali 2016; Gozgor *et al.* 2015; Sim, Zhou 2015; Sadorsky 1999; Abdalla *et al.* 2012; etc.). Nonetheless, Sarwar and Hussan (2016), Jammazi and Aloui (2010), Apergis and Miller (2009) concluded insignificant relationship between oil prices and equity returns. While finding for emerging countries is different as some studies suggested negative association between oil prices and equity prices especially in perspective of emerging markets (e.g., Raza *et al.* 2016; Najaf *et al.* 2016; Basher *et al.* 2012; Gupta, Modise 2013; etc.). Similarly, several studies found insignificant association between crude oil prices and stock returns of emerging equity markets (e.g., Gomes 2015; Kang, Ratti 2013; etc.).

Impact of oil prices on inflation and stock returns. The changes in crude oil prices affect the Inflation; Mork's (1989) determined the affects of oil prices on inflation rate and stock returns. Albulescu *et al.* (2016), Cunado and Perez de Gracia (2005), Fletcher (2000) showed that oil prices, stock exchange and inflation rate have significant positive relation with each other. Many studies showed that there is a positive affect of crude oil prices on inflation rate, CPI, stock market, and gold prices. So raise oil price pointers to inflation, decrease of production and productivity (e.g., Bec, Gaye 2016; Geise, Piłatowska 2015; etc.).

Impact of inflation and interest rate on stock returns. Consumer price index (CPI) is of the main catalogues for country's economic situation, as it determines the inflation rate for which investors of stock exchange are concerned because it affects their investment, return, profit margin and their evaluation of risk factors. According to the studies, if inflation rate escalated then simultaneously equity prices also rise, so, this phenomenon concluded a direct relationship (Wulfsberg 2016). However, some studies examined negative association between inflation rate and stock returns (e.g., Ratti, Vespignani 2016; Haugom *et al.* 2016; Jiang, Gu 2016; Albulescu *et al.* 2016; Mushtaq 2012; etc.). Numerous studies investigated the affects of interest and inflation rates on equity returns, and concluded that inflation and interest rate have an inverse association on stock returns (e.g., Gomes 2015; Sultonov 2015; Gilmore *et al.* 2015; etc.).

Several research studies have been taken place to get evidence from macroeconomic indicators as money supply, inflation and exchange rates towards stock returns and showed demonstrative power over it. Hu *et al.* (2016), Bondia *et al.* (2016), and George (2009) suggested that fundamental indicators' actions cannot describe stock price, and in reverse,

stock markets cannot describe fundamental indicators. But even then these macroeconomic variables and speculative bubbles can influence stock market movements or irrational behavior. Similarly, Popescu (2016), Ma *et al.* (2016), Guliman (2015), Binswanger (2000) suggested that fundamental macroeconomic indicators do not explain expected returns in developed or emerging stock markets.

2. Empirical framework

Model specification. Following equations show the theoretical framework in which the relationship between indicators and their affects on stock prices can be determined and that eventually lead to the final results i.e. positive or inverse impact of that indicator. However, the indicators have impact on stock prices in terms of results of the tests used.

$$\mathrm{LKSE}_t = \alpha_1 + \beta_1 \mathrm{LCPI}_t + \beta_2 \mathrm{LCOP}_t + \varepsilon; \tag{1}$$

$$\mathrm{LKSE}_t = \alpha_1 + \beta_1 \mathrm{LWPI}_t + \beta_2 \mathrm{LCOP}_t + \varepsilon; \tag{2}$$

where: LKSE = Log of Pakistan stock exchange (KSE100); LCPI = It is a natural log of consumer price index (CPI); LWPI = It is a natural log of wholesale prices index (WPI); LCOP = Log of crude oil prices (COP); t = time period; α = constant value, and ε = random error term.

Estimation technique. This study uses Johansen multivariate cointegration modeling as estimation technique. Following phases are used to analyze the cointegration. First of all, we have to check the order of integration for each variable, and after that we employ the multivariate conintegration analysis, then we employ the variance decomposition method to validate the multivariate cointegration results.

Unit root test. It is a technique to investigate the order of integration for each series under consideration. For this purpose, various methods have been developed, one of the widely used method is the Augmented Dickey-Fuller (ADF); this test requires rejecting the null hypothesis of unit root in comparison of alternative-hypothesis of stationarity (e.g., Dickey, Fuller 1979, 1981; etc.). Following regression equation shows common form of ADF test:

$$\Delta y_t = \alpha_o + \alpha_1 y_{t-1} + \sum_{i=1}^{n} \alpha \Delta y_t + e_t,$$

where: y = It is the data time series; t = It is the time period; Δ = 1st difference operator; n = number of lags; α_o = constant value; e = random error.

Phillips and Perron (1988) have also suggested the method for unit root test and given the following equation:

$$\Delta y_t = \alpha_o + \alpha_1 y_{t-1} + e_t.$$

The Johansen multivariate cointegration. This is based on cointegration equation by analyzing the presence of conintegration amongst the time series of identical order of integration. Basically main theme behind of this cointegration is that if **the data** time series (two or more) travel together in a precisely manner regardless of data series themselves are drifted in the long run then the difference between them is constant. As the difference

between series is constant so this can be defined as long-term equilibrium association (Hall, Henry 1989). Therefore, if there is absence of cointegration then the variable could not have any long-term association that means that they move indiscriminately walk away from one another (Dickey *et al.* 1991). We employed a test procedure, which was developed and proposed by Johansen and Juselius (1990), and Johansen (1991). The following equation consists of "y_t" as a vector for "n" number of stochastic variables and includes "p" lag vector autoregression (VAR) through Gaussian error as illustrated by Johansen (1991) modeling, and expressed as follows:

$$y_t = \mu + \Delta_1 y_{t-1} + \ldots + \Delta_p y_{t-p} + \varepsilon_t,$$

where: y_t = (nx1) vector of variables integrated of I(1) and I(2); ε_t = (nx1) vectors of shocks, now, the VAR equation can be written as follows:

$$\Delta y_t = \mu + \eta y_{t-1} + \sum_{i=1}^{n-1} \tau_t \Delta y_{t-1} + \varepsilon_t,$$

where: $\eta = \sum_{i=1}^{p} A_{i-1}$ and $\tau_t = \sum_{j=i+1}^{p} A_j$.

Johansen and Juselius (1990), Johansen (1988, 1995) have given two statistical models for finding the cointegration vectors, where the first test is known as, the Trace approximation (λ Trace) that investigates the null hypothesis as number of the trace test (λ trace), which analyzes the null-hypothesis as number of distinctive cointegrating vectors that would be equal or less than "p" opposed to general alternatives "$p = r$", and is calculated as:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_{r+1}),$$

where: T = number of usable observations; λ_{r+1} = Estimated Eigen-value from the matrix.

In Johansen and Juselius (1990) cointegration, the second test is called Max Eigen-value test (λ max), which can be computed by following equation:

$$\lambda_{\max}(r, r+1) = -T \ln\left(1 - \hat{\lambda}_{r+1}\right).$$

This is concerned to analyze the null hypothesis because there are "r" cointegrating vectors against of alternative hypothesis that is "r+1" cointegrating vector.

Variance decomposition analysis. Pesaran *et al.* (2001) suggested this analysis by defining the variance decomposition method, which involves only in one variable because of advance shocks decreasing in the compelling variables. In actuality the variance decomposition shows the extent of evidence in the autoregression where each variable provides to other variables. It shows, at what extent exogenous stuns to other variables elucidate the estimate error variance of each of the variable. The benefit of using this method as this procedure is free from ordering of variables.

VDA checks all the failures in accordance with variations in the values of macroeconomic factors in a specified time frame. The VDA shows that the taken variable might be elevated due to either its own shocks or the impact of other macroeconomic variables. Variance decomposition analysis is known as the best methodology to forecast the cumulative effects of shocks and its significant changes.

3. Estimation and results

Philips-Parron (PP) and Augmented Dickey-Fuller (ADF) techniques have been employed to examine the stationarity properties of the data time series, and Table 1 shows the results at level and first difference.

Philips-Parron (PP) and Augmented Dickey-Fuller Techniques (ADF). Firstly, Unit Root is used on series or log of data and all the series were non-constant, which defines that LKSE, LCPI, LWPI and LCOP possess unit-root at level, however at 1st difference all are stationary. Therefore, it can be summarized that the variables have gone through the procedure of I(1), as depicted by Table 1, hence, it is concluded that the null hypothesis has been rejected at 1% of unit root at first difference; therefore, all variables are incorporated of order one i.e. I(1) process.

Table 1. Stationarity tests result (Philips-Parron & Augmented Dickey-Fuller)

Unit Root Tests for stationarity at level and first difference						
Variables	Augmented Dickey-Fuller (ADF)			Philips-Parron (PP)		
	Level	Ist Diff	Prob.	Level	Ist Diff	Prob.
LKSE	0.093	–15.589	*	0.087	–15.589	*
LCOP	–1.698	–11.668	*	–1.660	–11.702	*
LCPI	0.232	–6.343	*	0.164	–13.890	*
LWPI	–0.302	–9.679	*	–0.423	–9.780	*

Note: *significant at 1% level. MacKinnon (1991) critical value (–3.461 – 1%) for rejection of hypothesis of unit root applied.

Source: Authors' estimation.

Graphical representation for stationarity. The Figure 2 shows that trend is stationary at first difference and the mean and variance is constant. If we look at the outcomes of PP and ADF techniques and graphs it is evident that the p-values of LKSE, LCOP, LCPI and LWPI are less than 1% having critical value of –3.461, which explores that data time series are stationary at first order or follow I(1) process.

VAR Lag (LKSE, LCPI & LCOP). For applying the Johansen (1991) cointegration method for long run relationship that is equation (1) and (2) it is needed to firstly analyze the lag length by evaluating VAR for both equations. Table 2 and Table 3 show these results. Table 2 shows the VAR lag as it is seen that the lag length in equation 1 model is 3. Thus Johansen cointegration method is applied through lag length 1, 2 for equation (1).

VAR Lag (LKSE, LCOP & LWPI). Table 3 shows the VAR lag as it is seen that the lag length in equation (2) model is 3 also. Thus Johansen cointegration method is applied through lag length 1, 2 for equations (2) as well.

Johansen multivariate cointegration test (long run). Cointegration is used when the non-stationary data time series has signified a long run relationship amongst the variables. But if there are two or more than two series are independently non stationary (and have to be integrated later of same order) and stationary linear combination exists – then we name it cointegration.

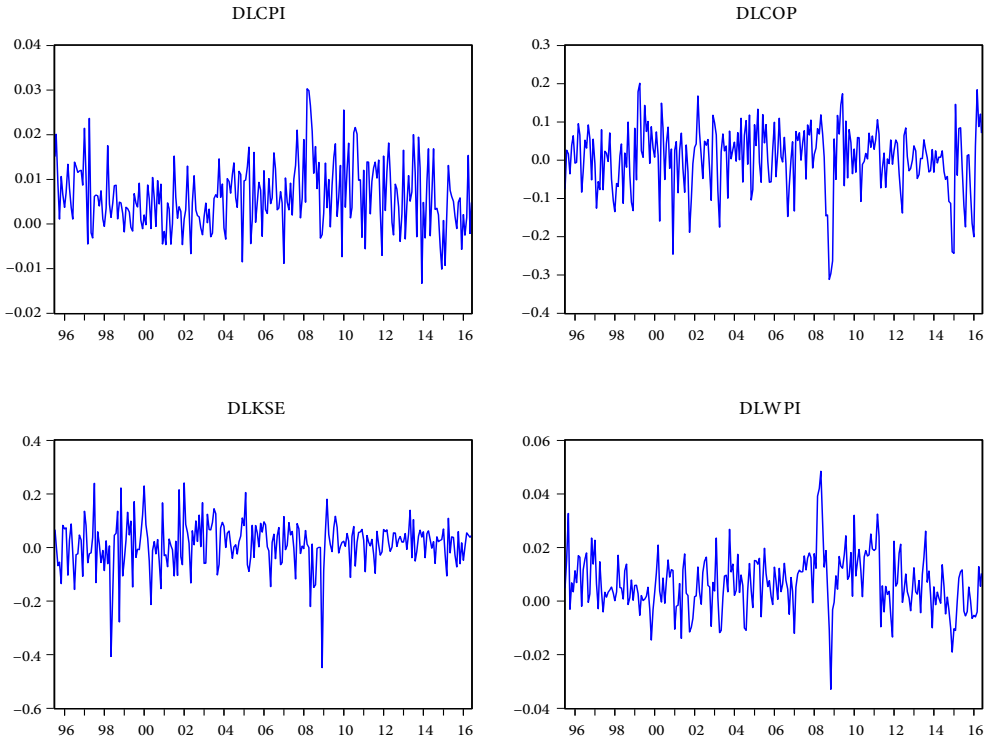

Fig. 2. Graph of 1st difference of all series
Source: Authors' calculations.

Table 2. VAR Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	–407.15	NA	0.01	3.36	3.40	3.38
1	1368.53	3493.13	0.00	–11.12	10.94709*	–11.05
2	1387.09	36.06	0.00	–11.20	–10.90	11.07626*
3	1401.24	27.13739*	2.64e-09*	11.23968*	–10.81	–11.07
4	1408.87	14.45	0.00	–11.23	–10.67	–11.00
5	1416.32	13.91	0.00	–11.22	–10.53	–10.94
6	1421.57	9.69	0.00	–11.19	–10.37	–10.86
7	1425.95	7.96	0.00	–11.15	–10.20	–10.77
8	1433.60	13.74	0.00	–11.14	–10.06	–10.70

Notes: *indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Swarz information criterion; HQ: Hannan-Quinn information criterion.
Source: Authors' estimation.

Table 3. VAR Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	–439.83	NA	0.01	3.63	3.67	3.65
1	1301.26	3425.10	0.00	–10.57	–10.40	–10.50
2	1337.38	70.17	0.00	–10.79	10.48903*	10.66880*
3	1346.53	17.54	4.13e-09*	10.79122*	–10.36	–10.62
4	1349.73	6.07	0.00	–10.74	–10.18	–10.52
5	1354.79	9.45	0.00	–10.71	–10.02	–10.43
6	1358.90	7.58	0.00	–10.67	–9.85	–10.34
7	1364.39	9.99	0.00	–10.64	–9.70	–10.26
8	1376.25	21.30006*	5E-09	–1E+01	–1E+01	–1E+01

Notes: *indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Swarz information criterion; HQ: Hannan-Quinn information criterion.
Source: Authors' estimation.

The Johansen test has two tests i.e. the trace statistics that examines the null hypothesis against the alternative hypothesis of "m" cointegrating vectors in a stationary data time series. There are "*r*" cointegrating vectors where $r = 0, 1...,$ m etc., and 2nd test is Max. Eigen-value that actually tests the null-hypothesis against the alternative that there is "*r*" cointegrating relation where it is "$r + 1$".

Cointegration (LKSE, LCPI & LCOP). Below Table 4 shows the outcomes of long run relation i.e. cointegration condition that methodology used by Johansen and Juselius (1990) for LKSE, LCPI and LCOP. The results show maximum eigenvalue statistic and trace statistics, which point to long run relation or one cointegration between CPI, KSE 100 index, and COP. Both tests have $p < 0.05$ and trace statistic > critical value of run relationship or one cointegration.

Cointegration (LKSE, LWPI & LCOP). Following Table 5 shows the outcome of existence of long run relation or cointegration condition for LKSE, LWPI and LCOP by using the method of Johansen and Juselius (1990). Here results show that maximum eigenvalue statistic and trace statistics have no long run relationship or no cointegration between WPI, KSE 100 index and COP as both tests have $p > 0.05$ and trace statistic < critical value.

***Variance Decompositions Analysis*-D(LKSE), D(LCPI) & D(LCOP).** The results of Table 6, stipulate further validation of associations among the variables investigation. The findings of the variance decomposition analysis confirmed that the magnitude of the foresee error of distinct variable resultant of other variables. Therefore, we can establish that the VDA generates viability to pick the comparative connotation of each variable that creates fluctuation in unlike variables (Ratanapakorn, Sharma 2007). Results of the Table 6 established that LKSE100 index was reasonably rarer exogenous in associations to diverse factors, as around 92.31% of its variation was explained by its own shocks succeeding up to 10 months. However, other variables such as, LCPI (proxy of inflation) explained the variance projection of 3.797%, and LCOP elucidated variance of 3.889% independently for LKSE100 index.

Table 4. Cointegration condition for LKSE, LCPI & LCOP

Unrestricted cointegration rank test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.**
None*	0.1085	33.4262	29.7971	0.0183
At most 1	0.0190	4.8184	15.4947	0.8278
At most 2	0.0002	0.0485	3.8415	0.8256
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level *denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted cointegration rank test (Maximum Eigen-value)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen statistic	0.05 Critical value	Prob.**
None*	0.1085	28.6079	21.1316	0.0037
At most 1	0.0190	4.7698	14.2646	0.7706
At most 2	0.0002	0.0485	3.8415	0.8256
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level *denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Source: Authors' estimation.

Table 5. Cointegration condition for LKSE, LWPI & LCOP

Unrestricted cointegration rank test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.**
None*	0.0561	18.0157	29.7971	0.5649
At most 1	0.0145	3.6278	15.4947	0.9313
At most 2	0.0000	0.0030	3.8415	0.9543
Trace test indicates no cointegration at the 0.05 level *denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigevalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen statistic	0.05 Critical value	Prob.**
None	0.0561	14.3879	21.1316	0.3340
At most 1	0.0145	3.6248	14.2646	0.8967
At most 2	0.0000	0.0030	3.8415	0.9543
Max-eigenvalue test indicates no cointegration at the 0.05 level *denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Source: Authors' estimation.

Moreover, CPI shows KSE100 index by 3.80%, whereas, crude oil price contributes 3.89% to the KSE100 index and the outcomes are in line with the outcome of cointegration test results. Therefore, crude oil prices and CPI are the important macroeconomic factors, which contribute to KSE100 index in Pakistan even though crude oil is marginal at 3.89% and CPI is at 3.90%. Thus, it can be suggested that crude oil prices and inflation rate are used to forecast the Pakistani stock market returns.

Table 6. Variance Decomposition – D(LKSE), D(LCPI) & D(LCOP)

Variance Decomposition of D(LKSE)				
Period	S.E.	D(LKSE)	D(LCPI)	D(LCOP)
1	0.0867	100.0000	0.0000	0.0000
2	0.0873	98.6523	0.6701	0.6776
3	0.0899	92.9075	3.2820	3.8105
4	0.0901	92.9343	3.2672	3.7985
5	0.0903	92.8325	3.3631	3.8044
6	0.0905	92.3914	3.7555	3.8531
7	0.0905	92.3512	3.7751	3.8738
8	0.0905	92.3376	3.7777	3.8847
9	0.0905	92.3165	3.7971	3.8864
10	0.0905	92.3127	3.7975	3.8898
Variance Decomposition of D(LCPI)				
Period	S.E.	D(LKSE)	D(LCPI)	D(LCOP)
1	0.0069	0.1268	99.8732	0.0000
2	0.0072	0.3540	94.1389	5.5071
3	0.0073	1.0280	92.7295	6.2425
4	0.0075	1.1790	92.6955	6.1255
5	0.0075	1.1719	92.2892	6.5389
6	0.0075	1.1775	92.1401	6.6824
7	0.0076	1.1773	92.1332	6.6895
8	0.0076	1.1778	92.1062	6.7160
9	0.0076	1.1785	92.1008	6.7207
10	0.0076	1.1789	92.1005	6.7206
Variance Decomposition of D(LCOP)				
Period	S.E.	D(LKSE)	D(LCPI)	D(LCOP)
1	0.08214	0.56847	3.15770	96.27383
2	0.08522	0.95198	3.17640	95.87162
3	0.08657	2.86345	3.30570	93.83084
4	0.08740	2.82865	4.90078	92.27057
5	0.08759	2.82210	5.30109	91.87680
6	0.08765	2.81862	5.39653	91.78485
7	0.08775	2.81402	5.59268	91.59331
8	0.08779	2.81171	5.64368	91.54461
9	0.08780	2.81156	5.64995	91.53849
10	0.08781	2.81128	5.65833	91.53039
Cholesky Ordering: D(LKSE) D(LCPI) D(LCOP)				

Source: Authors' calculations.

***Variance Decompositions Analysis*-D(LKSE), D(LWPI) & D(LCOP).** Similarly, results of the Table 7 established that LKSE100 index was judiciously fewer exogenous in relations to varied variables, as around 92.691% of its variation was explained by its own shocks succeeding up to 10 months. However, other variables such as, LWPI (proxy of inflation) elucidated the variance projection of 1.811%, and LCOP clarified variance of 4.497% individually for LKSE100 index. The share of LWPI (proxy for inflation) is very minimal, and cannot be clarified for KSE100 index.

Table 7. Variance Decomposition – D(LKSE), D(LWPI) & D(LCOP)

Variance Decomposition of D(LKSE)				
Period	S.E.	D(LKSE)	D(LWPI)	D(LCOP)
1	0.0873	100.0000	0.0000	0.0000
2	0.0876	99.4675	0.0883	0.4442
3	0.0897	94.8220	0.7976	4.3804
4	0.0901	94.3304	1.2471	4.4225
5	0.0903	94.0777	1.4819	4.4404
6	0.0904	93.8292	1.6999	4.4709
7	0.0904	93.7333	1.7853	4.4814
8	0.0905	93.7026	1.8060	4.4914
9	0.0905	93.6937	1.8107	4.4956
10	0.0905	93.6911	1.8113	4.4975
Variance Decomposition of D(LWPI)				
Period	S.E.	D(LKSE)	D(LWPI)	D(LCOP)
1	0.0090	0.1410	99.8590	0.0000
2	0.0101	0.3160	94.6221	5.0620
3	0.0104	1.0999	93.0560	5.8441
4	0.0106	1.4355	92.4832	6.0813
5	0.0106	1.4630	92.0129	6.5241
6	0.0106	1.4698	91.8470	6.6833
7	0.0106	1.4738	91.8098	6.7163
8	0.0106	1.4743	91.8027	6.7230
9	0.0106	1.4742	91.8025	6.7233
10	0.0106	1.4742	91.8028	6.7230
Variance Decomposition of D(LCOP)				
Period	S.E.	D(LKSE)	D(LWPI)	D(LCOP)
1	0.08202	0.55134	10.79053	88.65813
2	0.08548	1.03228	12.54068	86.42704
3	0.08681	3.13141	12.32089	84.54769
4	0.08727	3.11562	12.81341	84.07097
5	0.08751	3.09967	13.23136	83.66897
6	0.08763	3.10818	13.44014	83.45168
7	0.08770	3.10504	13.56417	83.33078
8	0.08773	3.10653	13.61093	83.28254
9	0.08775	3.10676	13.62329	83.26995
10	0.08775	3.10731	13.62570	83.26699
Cholesky Ordering: D(LKSE) D(LWPI) D(LCOP)				

Source: Authors' calculations.

Impulse Response Function (IRF) – VAR (DLKSE, DLCPI, DLCOP). We also applied impulse response function to discover and explain the problem that how much rapidly, and how many times in one variable are transmitted into others. Figure 3, demonstrated the investigations of impulse response function, where reaction of series can be seen by considering that every series have one standard deviation shock. The Figure 3 shows the crude oil prices and CPI shocks to KSE100 returns and also assess the stock market return IRF to own shocks and CPI and crude oil price shocks. KSE100 index shows inverse relationship with its past on the long run according to results. Further it has inverse relationship in its response towards CPI shocks for first three periods and except the six periods CPI shows positive relationship in the long-term, and this result is consistent with the results of Johansen cointegration as discussed in earlier section. However, KSE100 shows positive relationship in response to the crude oil prices shocks for first three periods and for the long run crude oil price has positive relationship and here the results are in lined with Johansen cointegration estimation results.

Impulse Response Function (IRF) – VAR (DLKSE, DLWPI, DLCOP). Any response to any dynamic system with reaction to external alteration is called an impulse response, which is used to trigger the reaction of the dependent variables in the VAR towards each variable's shocks. Below Figure 4 represents such analysis of the impulse response of

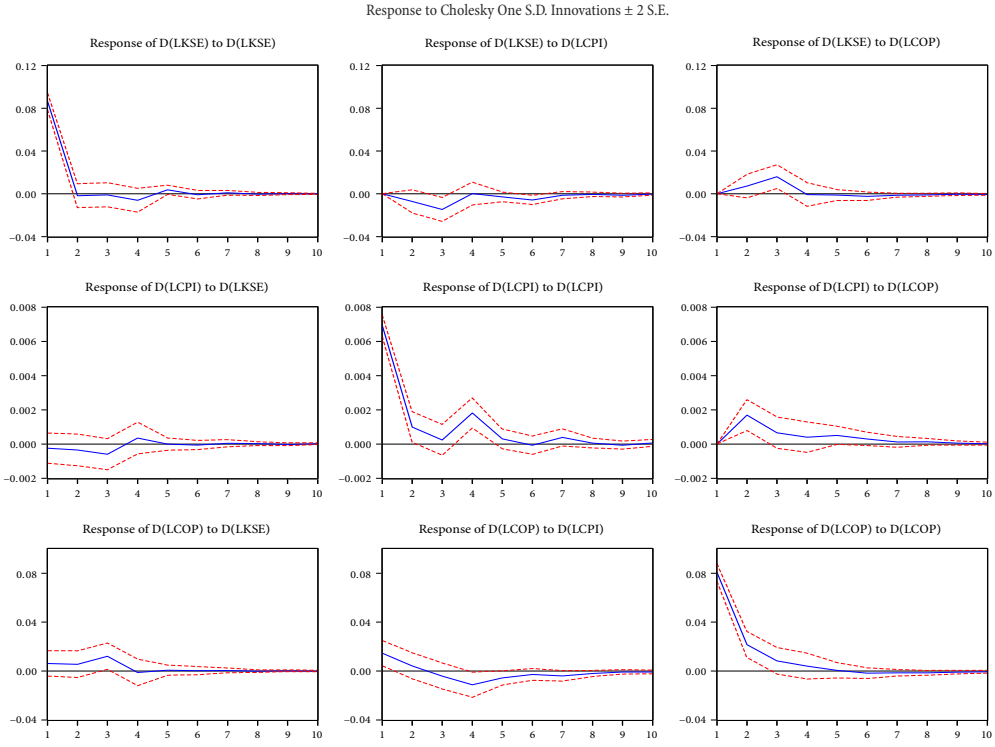

Fig. 3. Impulse Response Function – VAR (DLKSE, DLCPI, DLCOP)
Source: Authors' calculations.

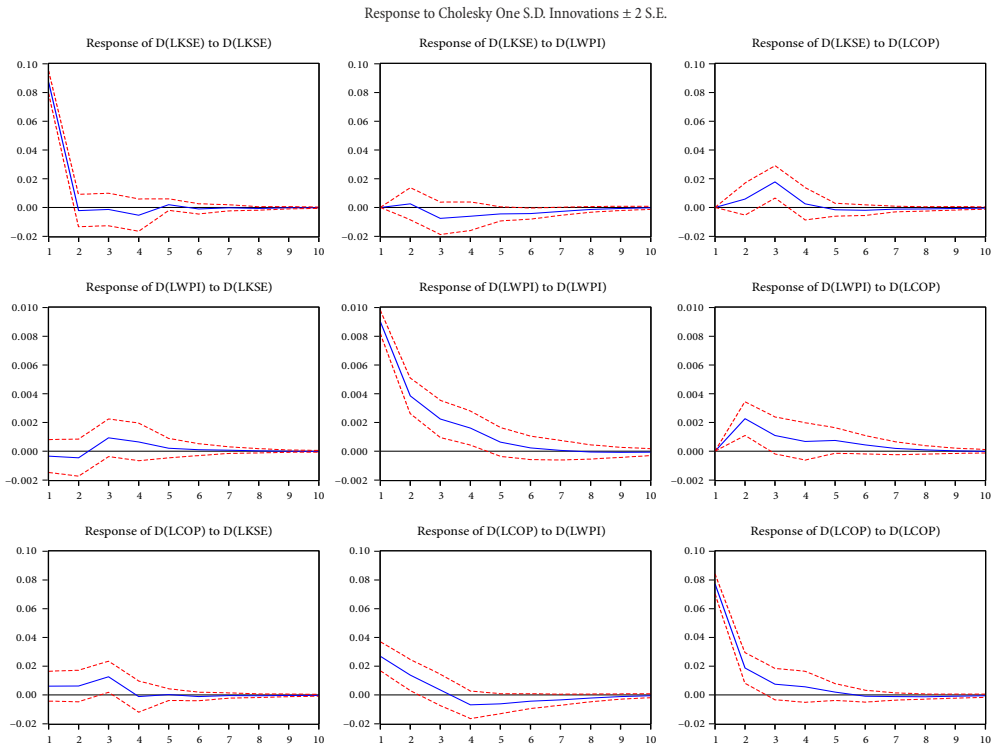

Fig. 4. Impulse Response Function – VAR (DLKSE, DLWPI, DLCOP)
Source: Authors' calculations.

KSE100 index in contrast to its own stuns and crude oil prices and wholesale price index shocks, where it can be seen from the result that on the long run KSE100 index has inverse relationship with its past. It is further suggested that there is negative relationship in its response to wholesale price index shocks during the period and same is the case with its response to international crude prices in long-term excluding first three periods because it has shown positive association in short-run and shown negativity from 5 to 7 periods and the positive relation in the long run up to 10 period and here the results are in line with Johansen cointegration estimation results.

Discussions and Conclusion

Discussions. As the aim of the research was to examine the association among KSE100 index returns, international oil prices and inflation in Pakistan for the period from July 1995 to June 2016. Thus, it is concluded from the outcomes that crude oil prices and CPI contribute to estimate KSE100 index by using CPI as inflation pointer, and one cointegration among the variables is examined, but when considering WPI as inflation indicator or pointer then no cointegration relation was observed, and demonstrated that there is no long-term relationship existed between KSE100 and WPI. The results of this research study

also demonstrated that crude oil prices have a significant affect on stock returns, which are consistent with previous research studies (e.g., Mardini, Ali 2016; Ghorbel, Souissi 2016; Hu *et al.* 2016; Pinho, Madaleno 2016; Moosa 2015; etc.). According to the results of our study, it further shows CPI (proxy of inflation rate) has a significant affect on equity returns, and previous studies also suggested if inflation rate escalated then simultaneously equity prices also rise, so, this phenomenon concluded a direct relationship (Wulfsberg 2016). However, some studies examined negative association between inflation rate and stock returns (e.g., Ratti, Vespignani 2016; Haugom *et al.* 2016; Jiang, Gu 2016; Albulescu *et al.* 2016; Mushtaq 2012; etc.). Several studies investigated the affects of interest rate and inflation rate on equity returns, and concluded that inflation and interest rate have an inverse association on stock returns (e.g., Gomes 2015; Sultonov 2015; Gilmore *et al.* 2015; etc.).

Conclusion. Finally, the results of this paper concluded that CPI and COP significantly affect KSE 100 index returns that elaborates the COP and CPI both together are strong variables to estimate or forecast the KSE100 index returns. However, WPI with COP have shown none of any long-term association with KSE100 index in case of Pakistani economy. Results and findings of variance decomposition analysis (VDA) demonstrated that the LKSE 100 index was moderately fewer exogenous in connection to different variables, because approximately 92.312 percent of its fluctuation was explained by its own particular stuns following up to 10 months. Therefore, overall it can be concluded that consumer price index (CPI) and crude oil prices (COP) are significant macroeconomic variables, which impact the Pakistan stock market returns (KSE100) but both are marginal at 3.90% (CPI) and 3.89% (COP). It is also concluded, in terms of stock market index impulse response function with its own shocks and consumer price index and crude oil prices shocks, it is observed that KSE100 index has negative association through its past on long-term basis, moreover, it has a positive relationship in the long run. It is further concluded that its response to CPI shocks and with COP has positive relationship in a long-term; these outcomes are consistent to the outcome of long run Johansen cointegration estimation as calculated in the earlier section.

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