Asymmetric influence of oil and gold prices on Baltic and South Asian stock markets: Evidence from Johansen cointegration and ARDL approach

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The purpose of the undertaken research study is to examine the influence of crude oil and gold prices on the equity returns of Baltic and South Asian stock markets. The study comprises of daily data from January 1, 2010, to June 30, 2016. Nasdaq Baltic market (LOMXBBGI) data time series is stationary at level; however, rest of the data series became stationary at first difference by employing Philips-Perron and Augmented Dickey-Fuller approaches.

Results of Johansen cointegration illustrated an absence of the cointegration amongst the considered economic indicators, therefore; we could not establish the long haul association amidst the equity returns of Baltic and South Asian markets, and crude oil and gold prices. The outcomes of VEC Granger Causality/Block Exogeneity Wald approach suggested unidirectional causality from LCOP to LKSE100 and LGP to LKSE100. Hence, it has been established that there is no causal affiliation amongst the variables. However, it is further concluded from the results of ARDL approach that the LOMXBBGI has a significant short-term relationship in lag 1 and lag 2. Moreover, DLGP also showed a significant short-term relationship with LOMXBBGI at 10% significant level. However, LCOP does not have any affect on LOMXBBGI.

Key words: *crude oil prices, gold prices, stock markets, Johansen cointegration, ARDL approach*

Introduction

Stock indices and returns are always being a great interest for arguments, and association of stock indices with macroeconomic variables has always been debatable, and it is one of the most examined subjects for researchers and financial experts around the globe. This research measures and explores the relationship among oil, gold and stock returns with exceptional reference to Baltic and South Asian securities exchanges. Oil prices play a significant role in predicting prices in several industrial and entrepreneurial costs, which eventually pave the way to determine the stock prices. Oil prices also influence almost every sphere of economy one way or the other. Oil price become rationale fluctuation in earning capability of industrial and corporate concerns in an economy. More specifically the escalation in the prices of oil leads to decrease in an earning capability of business concerns and vice verse. Rational evidence supports the stochastic association between stock and oil prices in an economy as ascertained by the Hassan and Nasir (2008).

There are various elements responsible for influencing the oil, stock and gold prices, which substitutes each other from the investors' perspective, and exhibit price trends articulated as contrary to studies. Particularly, the gold is not local instrument rather it is a worldwide product. Thus, the change in gold prices affects other macroeconomic factors as well. The studies on this issue carried out by the several researchers such as Toraman et al. (2011) and concluded, as the gold prices are transacted in dollars, hence such prices are sensitive to most of the policy formulations, socio-politico turmoil in the USA and that change also causes fluctuations in oil prices. Similarly, there are numerous elements which influence stock returns, along with macroeconomic indicators: namely government borrowings, inflation and interest rates, the relationship between goods physically in and out, Forex valuation, currency circulation, oil prices, growth rates and gold prices (Cheung et al., 1998).

There is an obvious link between prices of crude oil and stock returns. It was also studied and found that there was a significant affirmative association between economic growth, interest rate, oil prices and equity returns (Hu et al., 2016). Thus, the contribution of the stock market is instrumental for nations' economic well-being. Any adjustment in prices of crude petroleum at local and global market causes the variation in the cost of doing modern business and value costs of the business concern (Ma et al., 2016). According to Naifar and

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Dohaiman (2013), crude oil prices affect inflation and interest rate, which further impact the discount rate and this leads to affect the equity returns.

The 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 very demanded and draining asset so its price instability can affect different factors also, for example, inflation, exchange rate, and securities exchange returns. Many studies have tested such relations for developed economies like the US, Japan, the UK, and Canada, and results of all these studies demonstrated that there is a definite impact of macroeconomic variables on equity returns (Wei and Guo, 2016). Broadstock et al. (2016) contemplated and built up the association amidst global oil prices and equity returns, and they demonstrated that the oil price instability is a major determinant of equity returns' volatility.

The purpose of this research study

A major goal of the undertaken research study is to investigate the influence of crude oil prices (COP) and gold rates on Baltic securities exchanges including Nasdaq Baltic (cross-national Baltic securities showcase), and South Asian stock markets like Pakistan and India. This analysis presumes to test the degree of the relationship among gold, crude oil costs and securities exchange returns by utilising Johansen cointegration, ARDL and Granger causality techniques. Another imperative point of the undertaken study is to scrutinise the causal association and directionality amidst the equity returns of South Asian and Baltic stock markets, and crude oil and gold prices. This is the first time two different geographical regions have been considered for the investigation of this kind of relationship.

Novelty and significance of the research

Novelty and Significance of this research are many folds because this is the first ever research, which has been done on two distinctive topographical regional money related markets and analyses the effect of unrefined petroleum (COP) and gold prices on these securities exchanges. Lithuania, Estonia, Latvia, Pakistan, and India are the developing economies, and these countries have significant importance in their regions. Another distinguished aspect of this research is the data and time-varying factor, we used recent daily data, and total 1617 observations (after adjustments) were recorded and analysed. Secondly, in recent years Baltic and South Asian stock indices have shown tremendous growth and performance. This phenomenal growth of these financial markets differentiates them from other regional stock markets; moreover, unparalleled changes have also been witnessed in crude oil, and gold prices worldwide. Thus, now, it has been a substance of great relevance and curiosity for researchers. This research is important for the investors who are willing to invest in these stock markets. There are different variables, which are affecting the stock returns, the oil prices, and gold prices are also main variables, so, this research gives a clear picture of relationships among these variables and is beneficial for the investors of both regions and foreign investors.

International gold trading markets

As per requirements of world financial markets, global financial bodies are replete with a multitude of gold exchanges. Presently, more than 40 markets of gold are instituting the international market structure around the world. Like worldwide gold markets as a nucleus, the domestic gold market is subsidiary. There are four leading global gold markets spread all over the world, such as the America gold market, the Zurich gold market, and London and Hong Kong markets. The London market prices hold sway over the prices of the gold market in the four corners of the world. In Pakistan, there is a commodity market widely known as Pakistan Mercantile Exchange (PMEX), which further includes trade items of gold and commodities of variant nature. Likewise, the multi-commodity and the national commodity and derivatives exchanges regulate the gold trading in India. Concerning Europe and world perspective, there is a small-scale gold market of minor importance in the shape of the Baltic market because there is no investment demand. Lately, the right set of circumstances, for investment in gold relating to market prices, has come into existence. By the time, the importance of the investment in gold jewellery purchase was realised. Besides, the liquidity of the investment gold is at a low ebb. While gold offering investment banks are hesitant to purchase them neither back nor give the required liquidity.

International crude oil prices

The current prices of many barrels of oil are gauged through crude oil prices, for example, Brent Blend or West Texas Intermediate. Occasionally, NMEX future and OPEC basket prices are stated as well. There are dissimilarities in oil prices of barrels based on the specific gravity or API and the content of sulphur of it as well as on its location evidenced in its proximity to tidewater and/or refineries. Untreated crude oil (Western Canadian Select-acid and weighty) is cheaper than WTI, which is lighter and sugary oil.

Nasdaq Baltic (OMXBBGI)

To expedite cross-border trade and lure regional intensified investment, the Baltic Market is being established by Nasdaq stock exchange with Tallinn, Riga, and Vilnius, which is tailored towards reducing differences among the three Baltic markets by sharing a harmonious trading system, rules and market acts. It minimises the expenses of cross-fringe exchanging within the Baltic region.

Nasdaq Vilnius (OMXV)

Lithuania possesses key securities market infrastructure operators, e.g. Nasdaq Vilnius and the Lithuanian Central Securities Depository, which facilitates market participants with transactions in securities, clearing and settling securities contacts, and list down the securities, as well as for the function of the principal public securities, and funded pension trust registered. Banks and brokerage houses are not allowed to deal in trade for Nasdaq Vilnius stock market. Standardized equity markets' operating rules are guiding principles of the exchange, as it is the self-regulating company with the authority of issuing and enforcing rules and regulations of its own.

Nasdaq Tallinn (OMXT)

Estonia has the only controlled securities market of secondary nature. It captivates investors attention. The listed companies have an aim for attracting the liquidity assets, and the intermediate investors, which are the members of the stock exchange can do transactions through the automated electronic trading mechanism. The Nasdaq Tallinn stock market regulates itself without intervention from external bodies by releasing and implementing the rules and regulations, which are in line with universally applicable methods of exchange operating procedures. Financial Supervisory Authority of Estonia authorises and oversees it. As back as April 2004, the Nasdaq Tallinn stock exchange has been a member of the Nordic-Baltic alliance.

Nasdaq Riga (OMXR)

Apart from single shareholder's companies with roughly 90 % of remaining shares, OMX Riga (OMXR) is an all-share file including of the considerable number of shares recorded on the fundamental and auxiliary records on the Riga Stock Exchange in Latvia. Nasdaq Riga exchange is the only financial market in Latvia, which is regulated. Equitably, winning status and adjustment are better shown on the Riga showcase. Base date is December 31, 1999, with an estimation of 100. Nasdaq Riga is a directing framework all alone with no outer intercession association went with the forces of issuing and authorising its own standards and controls in consonance with working trade methodology generally connected on the planet.

Pakistan Stock Exchange (PSX)

It was the 18th day of September 1947, when Karachi Stock Exchange came into existence. Pakistan had only that Stock market during that time. The market was perceived one of the best equity markets of Asia in 2002. The July of 2016 brought the news of getting back the status of developing the business sector. The July of 2016 brought the news of getting back the status of emerging market. Bloomberg has placed Karachi stock exchange at third rank among top 10 stock markets of the work during 2014. It was the 11th day of January 2016; Karachi stock exchange was renamed with Pakistan Stock exchange. Now the PSE (KSE100) is the blend of Lahore Stock exchange and Islamabad stock market. KSE100 is counted among the biggest stock markets in South Asia. Total 654 companies were listed in December 2009, and as on July 11, 2016, the total market capitalisation was US$120.5 billion; KSE100 reached US$35 billion on July 30, 2011, and as on July 10, 2015, it reached US$72 billion market capitalisation.

SENSEX

The Bombay stock trade is otherwise called the BSE 30 or just SENSEX. It is the head securities exchange of India, which is a developing and developing business sector of the area. SENSEX is free to float market-weighted equity market; sound organisations are listed in BSE 30 or SENSEX. Since it is index 30, therefore, 30 components companies, the most prestigious and most actively traded stocks, which are representatives of the overall industry and sectors of Indian economy. It was reported and issued, since January 1, 1986, SENSEX is known as the foundation of local value markets and beat of the Indian economy. The base estimation of 100 was determined on April 1, 1979, with 1978-79 as the base year. Dollex 30 was additionally propelled on July 25, 2001, which is connected to USD. As on April 21, 2011, the aggregate market capitalisation was approx. USD442 billion. However, the free float capitalisation was USD233 billion.

Substantiation from previous literature

Numbers of theoretical and empirical researches have been taken place to figure out the fluctuation of exchange rates, global inflation, gold prices, interest rates, World crude oil prices and GDP, and their impact on global financial stock markets. The present literature review tells positive and negative, significant and insignificant relation between international oil prices, gold prices and their impact on share prices.

Now numbers of economic and financial findings are available endorsing the significant link among equity returns, crude oil prices in international market, and other macroeconomic indicators (Pinho and Madaleno, 2016). The result of the research tells us to identify the relationship between equity returns and oil prices. Most of the study suggested that it has a negative association between equity returns and oil prices, especially in stable economies (Xu, 2015). However, on the contrary to this, other studies found a direct relation between equity returns and oil prices as well (Pönkä, 2016). Nonetheless, Apergis and Miller (2009) finished up the immaterial relationship between stock returns and unrefined petroleum costs (COP). The significances of the evaluations directed for developing economies is different, as some exploration discoveries proposed a backwards connect between stock returns and the costs of unrefined petroleum (COP). This has seen in developing markets (Raza et al., 2016; Basher et al., 2012).

Any adjustment in oil value impacts the inclination of inflation. Mork's (1989) concentrates the influence of oil prices on the inflation rate and equity returns. An abstract demonstrates that oil costs, inflation rate, and stock costs are essentially and decidedly connected with each other (Albulescu et al., 2017). Numerous studies have recognised that the positive and critical relationships exist among oil costs, CPI, gold costs and stock returns. Along these lines, raise oil value directs towards inflation, the decrease of production and efficiency (Geise and Piłatowska, 2015).

Sumner et al. (2010) tried to discover the mutual dependence of gold, stocks, and bonds by observing the gold returns and instabilities. As per this, gold is just supportive in predicting stock behavioural movements. Büyüksalvarcı (2010) concentrated the relationship among interest rate; CPI, oil costs, gold prices, conversion rate, money supply, and stock returns, they contrarily identified the relationship with the stock returns. Sharma and Mahendru (2010) researched the relationship between FOREX rates, gold costs and stock returns in the Indian setting and found the huge relationship between the factors of interest.

The long-term association among stock prices, gold and oil prices has been reported in Chinese, Japanese and German contexts, however, the U.S markets reported insensitive to the phenomenon (Wang et al., 2010). Shahzadi and Chohan (2011) concluded an inverse relationship amidst returns of KSE100, and crude oil and gold prices; their review obtained the information time frame from 2006 to 2010 month to month premise. The presence of no relationship between gold returns and stock returns has additionally recorded that research. Another research conducted by Kaliyamoorthy and Parithi (2012) concluded that stock returns and gold prices both are increasing, yet lingering securities exchange is not the aftereffect of increased rates of gold.

Nguyen et al. (2012) led the review on the relationship of securities exchanges and gold returns. They kept in mind the ultimate objective to achieve the goal of this review; the analysts picked the USA, UK, Thailand, Singapore, Malaysia, Japan, Philippine, and Indonesian securities exchanges as a subject of interest. As indicated by Moore (1990), there is a negative relationship amongst gold and securities exchange. It implies when securities exchanges declining then gold costs increment differently. It means when stock markets are declining then gold prices increase or the other way around. Lawrence (2003) found that gold earnings are indifferent to macroeconomic indicators. However, these are associated with the other financial assets, such as shares, debentures; this may be the cause of weak association between equity returns and gold prices. Baig et al. (2013) presumed that equity returns of KSE100 are not affected by the crude oil and gold prices, and both oil and gold rates are insusceptible to KSE100 returns. An exact finding reported that there was no massive relationship between stock costs and gold costs in the USA setting, however in short-run gold cost can altogether impact on stock returns (Smith, 2001). The discoveries of Blose and Shieh (1995) affirmed that prices of gold are presently inflation sensitive. According to Bhunia and Mukhuti (2013), gold prices do not have any causal relationship on equity returns of BSE and NSE in the case of India. They also established that there was no bidirectional causality existed amongst gold and securities exchange returns.

Material and methods

Data sources

Data Sources. For this analysis the daily data of gold price, crude oil prices, KSE100, SENSEX has been taken from January 1, 2010, to June 30, 2016, from Yahoo Finance website, and daily data of same time period for Nasdaq Baltic, Nasdaq Vilnius, Nasdaq Tallinn, Nasdaq Riga has been extracted from Nasdaq Baltic Statistics website.

Estimation techniques

The estimation methods utilised as a part of this research are natural log returns for the factors. The analysis was carried out through different statistical techniques such as descriptive statistics, ADF and Philips-Parron tests, Johansen cointegration and ARDL approach for the long run relationship, and VEC Granger or (BEWG), and Granger causality tests for the direction and causality purposes have been utilised.

Change in stock exchange indices

The natural log difference approach is used to compute Baltic and Asian stocks returns. To substantiate the objective following equation for Baltic and Asian stock indices have been applied:

$$Indices_{(t)} = \ln\left(C_t / C_{t-1}\right) \quad (1)$$

where: in Eq. (1) *Indices* (*t*) are the returns of the different equity stocks for the time '*t*'. '*C t*' and '*C t*-1' are the returns of Baltic and South Asian stock markets for the time "*t*" and '*t*-1' in a fitting way.

Change in gold prices (GP)

Gold prices are figured by using the natural log difference. The following equation has been used for gold prices returns.

$$GP_{(t)} = \ln\left(GP_t / GP_{t-1}\right) \quad (2)$$

where: in Eq. (2) *GP* (*t*) is the returns for the time '*t*'. '*GP t*' and '*GP t*-1' are the purposes of gold rates for the time "*t*" and '*t*-1' in a proper way.

Change in crude oil prices (COP)

Oil returns can be calculated by applying the natural log difference. The following equation has been used for crude oil returns.

$$COP_{(t)} = \ln\left(COP_t / COP_{t-1}\right) \quad (3)$$

where: in Eq. (3) *COP* (*t*) is the return of crude oil for the time '*t*'. '*COP t*' and '*COP t*-1' are the purposes of unrefined petroleum costs for the time "*t*" and '*t*-1' in a suitable way.

Unit root tests

Although several approaches are there in order to check the stationarity of data series, however, in the undertaken study, we have preferred two techniques, in which first is known as the Augmented Dickey-Filler (1981). The generalised equation form of the test is as follows:

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \sum_{i=1}^{n} \alpha \Delta y_t + e_t \quad (4)$$

where: in Eq. (4), '*y*' is a data series in time period '*t*', while, '*n*' known as the optimum number of lags, 'α_o' is referred for a constant value, whereas, the white noise error is regarded as '*e*' in Eq. (4).

Philips-Perron (1988) have proposed another robust test, which has additionally recommended strategy for the application of a unit root test that provided an accompanying condition:

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + e_t \quad (5)$$

where: in Eq. (5), '*y*' is a called the data series in time period '*t*', whereas, 'α_o' is regarded as a constant value. However, the white noise error is known as '*e*' in Eq. (5).

Johansen cointegration testing approach

This approach constructs cointegration between the series of similar order by creating a cointegration equation. The difference between the series, though trended is stationary. Because of constant difference between the two series, and it is feasible to describe the long-term stable relationship between two series. It demonstrates no long-run connection lies between the two measures. Precisely if 'y_t' is known as the vector for '*n*' numbers of stochastic elements. Subsequently, there will be the existence of 'p-lag' vectors autoregression besides the Gaussian error, and the mathematical equation can be expressed as follows:

$$\Delta y_t = \mu + \Delta_1 y_{t-1} + \ldots\ldots\ldots + \Delta_p y_{t-p} + \varepsilon_t \quad (6)$$

The referred to above condition "y_t" is the ($nx1$) vector for factors, the factors are incorporated of orders, as expressed follows:

$$\Delta y_t = \mu + \eta y_{t-1} + \sum_{i=1}^{n-1} \tau_t \Delta y_{t-1} + \varepsilon_t \quad (7)$$

where: in Eq. (7) $\eta = \sum_{i=1}^{p} A_{i-1}$ and $\tau_t = \sum_{j=i+1}^{p} A_j$

Johansen (1988) test is applied to single out the value of cointegration vectors. These tests aim to compute two-statistic investigations, namely trace test or λ-trace. The target of these tests is to check the invalid speculations, whether the no of a particular cointegrating vector is not exactly or equivalent to probability (p) in the correlation of unlimited option $p = r$. Presently, the condition of Trace test is as follows:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n}\ln\left(1-\hat{\lambda}_{r+1}\right) \tag{8}$$

where: in Eq. (8) 'T' denotes the number of usable observations, and λr+1 describes the measured eigenvalues from the matrix. Thus, the subsequent test is called as the max-eigenvalue test or simply the λ-max, and can be estimated in accordance with Eq. (9) as follows:

$$\lambda_{\max}(r, r+1) = -T\ln\left(1-\hat{\lambda}_{r+1}\right) \tag{9}$$

The above condition incorporates testing for the invalid speculation, whether there is "r" of cointegrating vectors in the correlation of option theory, which is (r+1) cointegrating vector.

Bound testing approach

The performance of bound testing methodology is built upon three endorsements. Pesaran et al. (2001) were the first who had acclaimed the application of ARDL approach for the evaluation of relationship levels. The reason behind the effectiveness is that, once the required order of ARDL has been met then the relationship can be assessed through OLS technique. Another very important characteristic of this bound testing is unique because it permits the mix of I(1) and I(0) factors as regressors. It means that the order of integration can be varied. Subsequently, the ARDL testing approach has the freedom not to rely on the specific distinguishing order of the data time series. Next, this procedure is fitted and suitable for a limited and finite data sample (Zaman et al., 2011).

The construction of vector autoregression (VAR) for order p, which proposed by the Pesaran et al. (2001) can be written as follows:

$$Z_t = \mu + \sum_{i=1}^{p}\beta_i z_{t-i} + \varepsilon_t \tag{10}$$

where: in Eq. (10), z is known as vectors of x and y, where y = is known as the reliant variable characterised as stock returns of OMXBBGI, 'x_t' is the vector grid which speaks to an arrangement of *COP* and *GP* in time pattern of 't'.

We additionally built up a VECM as expressed follows:

$$\Delta z_t = \mu + \alpha t + \lambda z_{t-1} + \sum_{i=1}^{p-i}\gamma_t \Delta y_{t-i} + \sum_{i=1}^{p-1}\gamma_t \Delta x_{t-i} + \varepsilon_t \tag{11}$$

where: in Eq. (11), 'Δ' referred to primary distance operative, however, the multiplier matrix λ for long run could be written as Eq. (12) as follows:

$$\lambda = \begin{bmatrix} \lambda_{YY}\lambda_{YX} \\ \lambda_{XY}\lambda_{XX} \end{bmatrix} \tag{12}$$

Since the transverse items of the matrix are unrestricted, thus the opted arrangement said to be I(1) or I(0). If $\lambda_{YY} = 0$, then Y is considered to be order 1 or I(1). Conversely, if $\lambda_{YY} < 0$, then Y is known as order zero or I(0). The Wald test (F-measurement) was calculated to show changes between the long-term affiliation and the interconnected factors. The Wald test could be utilised by setting limits on anticipated long-run coefficients (Zaman et al., 2011). Hence, the option and invalid speculations could be communicated as takes after:

$$H_0 = \beta_1 = \beta_2 = \beta_3 = 0$$

No evidence of any long-term association. However, in contrary, the alternative hypothesis could be as:

$$H_A \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq 0$$

There is a proof of a long-term affiliation. In the above estimation, the F-critical value is being compared to F-calculated.

Granger causality test

The Granger expression utters that, when two diverse research constructs are cointegrated, the presence of unidirectional causality is inescapable, and eventually the phenomenon leads to determine the association by using Error Correction Model (ECM), which followed by authentication of causation. The use of match savvy Granger causality test helps to single out the relationship of every component. As we are compelled to choose Lag to obtain appropriate results, therefore it has been kept in mind, in the event that the time arrangement are not stationary at I(0) and no cointegration existed among the factors then it is important to change by taking the first distinction at I(1) and following expression could be functional:

$$Q_{prob}\left(W_{t+n} \mid \Phi_t\right) = Q_{prob}\left(W_{t+n} \mid \omega_t\right) \quad (13)$$

where: in Eq. (13) Q_{prob}. is called a conditional probability, 'Φ_t' is known as information, which was fixed for the '*t*' time period, for historical values '*Wt+n*', and 'ω_t' regarded as the information set comprising values, and '*t + n*' is the period of time, the Eq. (13) is known as the unrestricted regression equation.

As we can measure the unrestricted residual sum of the square by using the Eq. (13), and lagged values can be reduced for selected macroeconomic variables. The first difference is used to ascertain the restricted regression for getting the restricted sum of square. Ultimately, for the order I(1), we should keep 0 for entire values of *F*-test. From the Eq. (14), the null hypothesis could be tested:

$$F = \left(RSSR - RSSUR \big/ k - k_0\right) / \left(RSS \big/ N - k\right) \quad (14)$$

In the case that *F*-statistic values outperform the basic qualities at any chose level of importance or the *p*-esteem associated with *F*-statistic <0.05, then the invalid speculation must be rejected.

Estimation and results

Descriptive analysis

Table 1 exhibits the distinct investigation of gold, oil costs and stock returns. It shows that average stock returns of LSENSEX and LKSE100 over a day in given time period are 9.94 % and 9.85 % respectively. However, average stock returns of Baltic stock exchanges are as, LOMXBBGI is 6.30 %, LOMXV is 5.97 %, LOMXT is 6.59 %, and LOMXR is 6.06 %. Though, the normal returns in gold prices and crude oil prices over a day are 7.21 % and 4.36 % respectively. Moreover, Jarque-Bera (JB) test rejects normality in all data series. The maximum volatility was observed in stock returns of KSE100 during the period, and that was 0.4676, and followed by the returns of crude oil prices, i.e. 0.3281. The reason for high volatility in stock returns and growth in oil prices was due to high economic activities in the Baltic States, and South Asian countries, i.e. Pakistan and India during the selected time period. However, growth in gold prices was less volatile because in selected time period gold prices in international market remained stable in the long run.

Tab. 1. Descriptive analysis.

Statistics	**LSENSEX**	**LOMXV**	**LOMXT**	**LOMXR**	**LOMXBBG**	**LCOP**	**LGP**	**LKSE100**
Mean	9.9437	5.9678	6.5891	6.0569	6.3075	4.3589	7.2106	9.8518
Maximum	10.2983	6.2312	6.9193	6.4752	6.5807	4.7356	7.5436	10.5656
Minimum	9.6274	5.5333	6.0153	5.6878	5.7660	3.2661	6.9573	9.1302
Std. Dev.	0.1856	0.1751	0.1772	0.1573	0.1531	0.3281	0.1482	0.4676
Skewness	0.4117	-0.3022	-0.4119	1.0115	-0.6224	-1.3103	0.3842	-0.0181
Kurtosis	4.7415	5.0161	5.2382	6.9494	5.6352	6.6230	4.9216	4.3950
Jarque-Bera	152.39	89.85	84.82	336.43	113.35	488.88	118.14	173.65
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	1617	1617	1617	1617	1617	1617	1617	1617

Outcomes of Philips-Perron and Augmented Dickey-Fuller techniques

Table 2 indicated the outcomes of ADF and PP techniques that stock returns of KSE100, SENSEX, OMXV, OMXT, OMXR, gold price, and crude oil prices series have unit root at level, so it is transformed and checked at first difference where they got significant and becomes stationary, consequently these seven data series have been integrated of order one or simply I(1). This is imperative to note that the stock returns of OMXBBGI does not have unit root at a level and right now stationary, in this manner, the data time series of OMXBBGI has been integrated of order 0 or simply assumed I(0).

Tab. 2. Unit root tests for stationarity.

At Level						
	Augmented Dickey-Fuller Test			**Phillips-Perron test statistic**		
	Lags*	**ADF t-statistics**	**Probability**	**Bandwidth**	**Adj. t-Stat**	**Probability**
COP	0	-0.7132	0.8415	5	-0.6420	0.8587
GP	0	-1.7667	0.3974	5	-1.7124	0.4248
KSE100	0	-0.3841	0.9094	4	-0.4732	0.8938
OMXR	0	-0.9805	0.7621	17	-1.2341	0.6617
OMXV	0	-0.9566	0.7702	6	-1.0231	0.7470
OMXT	0	-2.7983	0.0587	7	-2.7603	0.0643
SEXSEX	0	-0.9773	0.7632	4	-1.0204	0.7479
OMXBBGI	0	-3.2845	0.0158	7	-3.1918	0.0207
At 1st diff						

	Lags	ADF t-statistics	Probability	Bandwidth	Adj. t-Stat	Probability
COP	0	-42.3746	0.0000	5	-42.3665	0.0000
GP	0	-41.3085	0.0000	5	-41.3519	0.0000
KSE100	0	-36.1020	0.0000	2	-36.1294	0.0000
OMXR	0	-46.6235	0.0001	16	-46.1277	0.0001
OMXV	0	-38.7225	0.0000	3	-38.7381	0.0000
OMXT	0	-37.0078	0.0000	5	-37.0587	0.0000
SEXSEX	0	-37.4702	0.0000	7	-37.4025	0.0000
OMXBBGI						

**: Lags selected automatically based on SCI with Max lags 24*
Conclusion: All variables are I (1), except OMXBBGI i.e. I(0)

Multivariate Johansen cointegration test results

This test is directed to assess the presence of cointegration and decides the nature of connection regarding a long haul or short-term association amidst equity returns of different stock markets, and changes in crude oil and gold prices. If the cointegration is not conceded, then it demonstrates that there has not been long-haul connection lies amongst the economic indicators. For a recognisable proof of various cointegrating vectors, two likelihood proportion tests were utilised; the first is known as the Trace approach, whereas, the second one is known as the maximum eigenvalues approach or λ-max.

Results of Multivariate Johansen cointegration for LKSE100

As stock returns of KSE100 index, gold prices, and crude oil prices data series have been integrated of order one or simply I(1), therefore, we employed Johansen cointegration technique. In order to find a lag length of LKSE100, LCOP, and LGP, we used Vector Error Correction method (VECM) that suggested the lags interval (in first difference) 1 to 2, 4 to 5 and 10 to 10.

Results of Table 3 showed that there does not have any long-run relationships among the gold and crude oil prices with stock returns of Pakistan stock exchange (KSE100). The outcomes additionally show that the cointegration is not there because both Trace test and λ-max test do not support the rejection of the null hypothesis of cointegration amongst the considered economic indicators. It is also evident from the results such as Trace statistic<critical value, and similarly, maximum eigenvalues<critical value, and p>0.05. These outcomes demonstrated the absence of cointegrating vectors; it is further recommended that there are no any normal stochastic patterns seen too. Subsequently, it is finally, established that there is no long haul association amidst equity returns of KSE100 and changes in crude oil and gold prices.

Tab. 3. Cointegration condition for LKSE100, LCOP & LGP.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05-Critical Value**	**Prob.****
None	0.005148	13.98016	29.79707	0.8417
At most 1	0.003395	5.690977	15.49471	0.7317
At most 2	0.000143	0.228894	3.841466	0.6323
Unrestricted Cointegration Rank Test (Max Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05-Critical Value**	**Prob.****
None	0.005148	8.28918	21.13162	0.8852
At most 1	0.003395	5.462083	14.2646	0.6827
At most 2	0.000143	0.228894	3.841466	0.6323

Both Trace and maximum eigenvalues approaches exhibited no cointegrating vectors at 5 % level
** indicates the null hypothesis rejection at 5 % level*
*** MacKinnon-Haug-Michelis (1999)-p-values*

Results of VEC Granger causality/Block Exogeneity Wald approach for KSE100

Findings of Table 4 suggested that there is no causal relationship exists between D(LKSE100), and D(LCOP) and D(LGP) since the corresponding probabilities are greater than 0.05 in all cases.

Tab. 4. VEC Granger Causality/Block Exogeneity Wald for KSE100.

Dependent variable: D(LKSE100)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LCOP)	14.09227	5	0.0150
D(LGP)	6.783395	5	0.2373
All	21.71869	10	0.0166
Dependent variable: D(LCOP)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LKSE100)	2.920797	5	0.7122
D(LGP)	8.648206	5	0.1239
All	11.5083	10	0.3193
Dependent variable: D(LGP)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LKSE100)	17.15018	5	0.0042
D(LCOP)	1.774422	5	0.8794
All	19.14492	10	0.0385

** indicates, the null hypothesis rejection at 1 % level*

Results of Multivariate Johansen cointegration for LSENSEX

As stock returns of SENSEX index, gold prices, and crude oil prices data series have been integrated of order 1 or just I(1), therefore, we employed Johansen cointegration technique. In order to find a lag length of LSENSEX, LCOP, and LGP, we used Vector Error Correction method (VECM) that suggested the lags interval (in first difference) 1 to 1, 5 to 5 and 11 to 11.

Results of Table 5 showed that there does not have any long-run relationships among the gold and crude oil prices with stock returns of SENSEX index. The outcomes further show that the cointegration is not there because both Trace test and λ-max test suggested that the null hypothesis of no cointegration cannot be rejected, moreover, the results such as Trace statistic<critical value, and maximum eigen statistic<critical value, and p>0.05). These outcomes demonstrated the absence of critical cointegrating vectors. It is further recommended that there is having no any normal stochastic patterns seen too. Subsequently, it is concluded that there is no long haul association amidst equity return of SENSEX and changes in crude oil and gold prices in the case of India.

Tab. 5. Cointegration condition for LSENSEX, LCOP & LGP.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None	0.00598	16.20113	29.79707	0.6981
At most 1	0.003603	6.574557	15.49471	0.6276
At most 2	0.000487	0.781065	3.841466	0.3768
Unrestricted Cointegration Rank Test (Max Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None	0.00598	9.62657	21.13162	0.7789
At most 1	0.003603	5.793491	14.2646	0.6399
At most 2	0.000487	0.781065	3.841466	0.3768

Both Trace and maximum eigenvalues approaches exhibited no cointegrating vectors at 5 % level
** indicates the null hypothesis rejection at 5 % level*
*** MacKinnon-Haug-Michelis (1999)-p-values*

Results of VEC Granger causality/Block Exogeneity Wald approach for SENSEX

Findings of Table 6 suggested that there is no causal relationship exists between D(LSENSEX), and D(LCOP) and D(LGP) since the corresponding probabilities are greater than 0.05 in all cases.

Tab. 6. VEC Granger Causality/Block Exogeneity Wald for SENSEX.

Dependent variable: D(LSENSEX)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LCOP)	0.885197	3	0.829
D(LGP)	0.275495	3	0.9646
All	1.158138	6	0.9789
Dependent variable: D(LCOP)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LSENSEX)	1.302814	3	0.7285
D(LGP)	0.502994	3	0.9182
All	1.840527	6	0.9338
Dependent variable: D(LGP)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LSENSEX)	0.433195	3	0.9333
D(LCOP)	2.39402	3	0.4947
All	2.817964	6	0.8313

** indicates, the null hypothesis rejection at 1 % level*

Results of Multivariate Johansen cointegration for LOMXR

As stock returns of Nasdaq Riga stock exchange (OMXR), gold prices, and crude oil prices data series have been of order one or just I(1), thus, Johansen cointegration technique is suggested. In order to find the lag length for LOMXR, LCOP, and LGP, we used Vector Error Correction method (VECM) that suggested the lags interval (in first difference) 1 to 2 and 5 to 5.

Results of Table 7 exhibited that there does not have any long-run relationships among the gold and crude oil prices with stock returns of Nasdaq Riga stock exchange (OMXR) of Latvia. The outcomes additionally show that the cointegration is not there because both Trace test and λ-max test support the rejection of the null hypothesis of the non-existence of cointegration amongst the economic indicators. It is further substantiated by the results such as both Trace statistic, and maximum eigen statistic are less than the critical values, and $p>0.05$. These outcomes demonstrated that the critical cointegration had not existed between equity returns of OMXR and changes in crude oil and gold prices. It is further recommended that there is having no any normal stochastic patterns seen too. Subsequently, we concluded that there is no long haul association amidst equity returns of Nasdaq Riga stock exchange (OMXR) and changes in gold and oil prices.

Tab. 7. Cointegration condition for LOMXR, LCOP & LGP

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05-Critical Value**	**Prob.****
None	0.008136	18.69399	29.79707	0.5151
At most 1	0.002844	5.533471	15.49471	0.7498
At most 2	0.000587	0.945902	3.841466	0.3308
Unrestricted Cointegration Rank Test (Max Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05-Critical Value**	**Prob.****
None	0.008136	13.16052	21.13162	0.4376
At most 1	0.002844	4.587569	14.2646	0.7927
At most 2	0.000587	0.945902	3.841466	0.3308

Both Trace and maximum eigenvalues approaches exhibited no cointegrating vectors at 5 % level
** indicates the null hypothesis rejection at 5 % level*
*** MacKinnon-Haug-Michelis (1999)-p-values*

Results of VEC Granger causality/Block Exogeneity Wald approach for OMXR

Findings of Table 8 suggested that there is no causal relationship existed between D(LOMXR), and D(LCOP) and D(LGP) since the corresponding probabilities are greater than 0.05 in all cases.

Tab. 8. VEC Granger Causality/Block Exogeneity Wald for OMXR.

Dependent variable: D(LOMXR)			
Excluded	**Chi-sq**	**df**	**Prob.***
D(LCOP)	1.121159	3	0.7720
D(LGP)	3.765249	3	0.2880
All	4.738395	6	0.5778
Dependent variable: D(LCOP)			
Excluded	**Chi-sq**	**df**	**Prob.***
D(LOMXR)	0.541157	3	0.9098
D(LGP)	4.199823	3	0.2407
All	4.699962	6	0.5828
Dependent variable: D(LGP)			
Excluded	**Chi-sq**	**df**	**Prob.***
D(LOMXR)	1.533547	3	0.6745
D(LCOP)	2.010778	3	0.5702
All	3.546607	6	0.7378

** indicates, the null hypothesis rejection at 1 % level*

Results of Multivariate Johansen cointegration for LOMXT

As stock returns of Nasdaq Tallinn stock exchange (OMXT), gold prices, and crude oil prices data series have been of order one or just I(1), thus, Johansen cointegration technique is suggested. In order to find the lag length for LOMXT, LCOP, and LGP, we used Vector Error Correction method (VECM) that suggested the lags interval (in first difference) 1 to 1, 8 to 8 and 11 to 11.

Results of Table 9 showed that there does not have any long-run relationships among the gold and crude oil prices with stock returns of Nasdaq Tallinn stock exchange (OMXT) of Estonia. The outcomes additionally show that the cointegration is not there because both Trace test and λ-max test support the rejection of the null hypothesis of the non-existence of cointegration amongst the economic indicators. It is further substantiated by the results such as both Trace statistic, and maximum eigen statistic are less than the critical values, and p>0.05. These outcomes demonstrated that the critical cointegration had not existed between equity returns of OMXT and changes in crude oil and gold prices. It is further recommended that there is having no any normal stochastic patterns seen too. Subsequently, we concluded that there is no long haul association amidst equity returns of Nasdaq Tallinn stock exchange (OMXT) and changes in gold and oil prices.

Tab. 9. Cointegration condition for LOMXT, LCOP & LGP.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05-Critical Value**	**Prob.****
None	0.008444	18.1206	29.79707	0.5572
At most 1	0.002621	4.510656	15.49471	0.8584
At most 2	1.86E-04	0.298093	3.841466	0.5851
Unrestricted Cointegration Rank Test (Max Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05-Critical Value**	**Prob.****
None	0.008444	13.60994	21.13162	0.3979
At most 1	0.002621	4.212563	14.2646	0.8363
At most 2	1.86E-04	0.298093	3.841466	0.5851

Both Trace and maximum eigenvalues approaches exhibited no cointegrating vectors at 5 % level
** indicates the null hypothesis rejection at 5 % level*
*** MacKinnon-Haug-Michelis (1999)-p-values*

Results of VEC Granger causality/Block Exogeneity Wald approach for OMXT

Findings of Table 10 suggested that there is no causal relationship exists between D(LOMXT), and D(LCOP) and D(LGP) since the corresponding probabilities are greater than 0.05 in all all cases.

Tab. 10. VEC Granger Causality/Block Exogeneity Wald for OMXT.

Dependent variable: D(LOMXT)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LCOP)	2.962623	3	0.3974
D(LGP)	0.936112	3	0.8167
All	4.15912	6	0.6552
Dependent variable: D(LCOP)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LOMXT)	2.193857	3	0.5332
D(LGP)	0.57415	3	0.9023
All	2.777747	6	0.8362
Dependent variable: D(LGP)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LOMXT)	4.861086	3	0.1823
D(LCOP)	3.06984	3	0.381
All	8.114693	6	0.2298

** indicates, the null hypothesis rejection at 1 % level*

Results of Multivariate Johansen cointegration for LOMXV

As stock returns of Nasdaq Vilnius stock exchange (OMXV), gold prices, and crude oil prices data series have been of order one or just I(1), thus, Johansen cointegration technique is suggested. In order to find the lag length for LOMXV, LCOP, and LGP, we used Vector Error Correction method (VECM) that suggested the lags interval (in first difference) 1 to 1, 3 to 3, 5 to 5 and 7 to 7.

Results of Table 11 showed that there does not have any long-run relationships among the gold and crude oil prices with stock returns of Nasdaq Vilnius stock exchange (OMXV). The outcomes additionally show that the cointegration is not there because both Trace test and λ-max test support the rejection of the null hypothesis of the non-existence of cointegration amongst the economic indicators. It is further substantiated by the results such as both Trace statistic, and maximum eigen statistic are less than the critical values, and $p>0.05$. These outcomes demonstrated that the critical cointegration had not existed between equity returns of OMXV and changes in crude oil and gold prices. It is further recommended that there is having no any normal stochastic patterns seen too. Subsequently, we concluded that there is no long haul association amidst equity returns of Nasdaq Vilnius stock exchange (OMXV) and changes in gold and oil prices.

Tab. 11. Cointegration condition for LOMXV, LCOP & LGP.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05-Critical Value**	**Prob.****
None	0.004481	13.78134	29.79707	0.5752
At most 1	0.003438	6.555705	15.49471	0.8674
At most 2	0.00063	1.014024	3.841466	0.5652
Unrestricted Cointegration Rank Test (Max Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05-Critical Value**	**Prob.****
None	0.004481	7.22563	21.13162	0.3899
At most 1	0.003438	5.541682	14.2646	0.8573
At most 2	0.00063	1.014024	3.841466	0.5771

Both Trace and maximum eigenvalues approaches exhibited no cointegrating vectors at 5 % level
** indicates the null hypothesis rejection at 5 % level*
*** MacKinnon-Haug-Michelis (1999)-p-values*

Results of VEC Granger causality/Block Exogeneity Wald technique for OMXV

Outcomes of Table 12 suggested that there are no traces of causal relationship between D(LOMXV), and D(LCOP) and D(LGP) since *p*-value is greater than 0.05 in all cases.

Tab. 12. VEC Granger Causality/Block Exogeneity Wald for OMXV.

Dependent variable: D(LOMXV)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LCOP)	7.505466	4	0.1115
D(LGP)	8.264028	4	0.0824
All	13.81997	8	0.0866
Dependent variable: D(LCOP)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LOMXV)	3.462154	4	0.4837
D(LGP)	2.29198	4	0.6822
All	5.697482	8	0.6811
Dependent variable: D(LGP)			
Excluded	**Chi-sq**	**Df**	**Prob.***
D(LOMXV)	4.426153	4	0.3514
D(LCOP)	1.39138	4	0.8457
All	5.963889	8	0.6513

** indicates, the null hypothesis rejection at 1 % level*

ARDL modelling approach for OMXBBGI

As stock returns of Nasdaq OMXBBGI data series have been integrated of order 0 or simply I(0), however, the gold prices and crude oil prices data series have been integrated of order one or I(1). Therefore, in the scenario when the order of integration is different of considered economic indicators then the Johansen cointegration technique cannot be employed, thus, we used ARDL modelling approach for OMXBBGI, and crude oil and gold prices.

ARDL cointegration and short-term relationship

According to the results of ARDL estimations, Table 13 showed that the LOMXBBGI has a significant short-term relationship in lag 1 and lag 2 at 5 % and 10 % level of significance, moreover, DLGP also showed a significant short-term relationship at 10 % significant level. However, results of DLCOP showed no short-term association neither at 5 % nor 10 % level of significance among the variables.

Tab. 13. ARDL Cointegrating and short Run relationship

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
LOMXBBGI(-1)	1.0565	0.02487	42.47935	0.0000
LOMXBBGI(-2)	-0.0607	0.024798	-2.446013	0.0146
DLCOP	0.0075	0.009712	0.77234	0.4400
DLGP	-0.0311	0.018251	-1.702519	0.0889
C	0.0269	0.008215	3.268493	0.0011
R-squared	0.997258	Mean dependent var		6.308201
Adjusted R-squared	0.997251	S.D. dependent var		0.151983
S.E. of regression	0.007968	Akaike info criterion		-6.823608
Sum squared resid	0.102224	Schwarz criterion		-6.80693
Log-likelihood	5515.064	Hannan-Quinn criterion		-6.817418
F-statistic	146390.1	Durbin-Watson stat		2.004583
Prob(F-statistic)	0			

**Note: p-values and any subsequent tests do not account for model selection*

ARDL bound test

Table 14 of ARDL bounds test shows the computed value of *F*-statistics, which has compared with the critical value bonds as per the following null hypothesis: H0: Null Hypothesis: No long-run relationships exist. This hypothesis is tested through the critical value bounds at 10 %, 5 %, 2.5 % and 1 % significance level, which given in Table 12.

Tab. 14. ARDL Bounds Test.

Test Statistic	**Value**	**K**
F-statistic	3.612021	2

As indicated by Table 15, *F*-statistic (3.6120) is less than the critical values for upper bond, and also less than the 5% level of significance for a lower bond. Accordingly, the invalid theory of no long-run relationship is

accepted. However, the null hypothesis (H_0) is rejected at 10 percent significance level. Hence, it is demonstrated a long haul association amidst Nasdaq OMXBBGI and changes in gold and crude oil prices.

Tab. 15. Critical value bounds.

Significance	Lower Bound	Upper Bound
10%	3.17	4.14
5.0%	3.79	4.85
2.5%	4.41	5.52
1.0%	5.15	6.36

ARDL Cointegration and Long-term relationship

Table 16 exhibited the findings of long-run ARDL estimation. Findings of CointEq(-1) indicate the significant relationship in a long-term, and this is already ascertained in the above-bound testing table that there is long-term association at 10 %. However, the results of D(DLCOP) and D(DLGP) do not have any long-term cointegration at 5 % or 10 % level of significance as demonstrated by the ARDL estimations.

Tab. 16. ARDL Cointegrating and Long Run.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOMXBBGI(-1))	0.079805	0.024798	3.218192	0.0013
D(DLCOP)	0.013531	0.009712	1.393232	0.1637
D(DLGP)	0.019868	0.018251	1.088589	0.2765
CointEq(-1)	-0.003843	0.001302	-2.952054	0.0032

Outcomes of Granger causality approach

We employed pair-wise Granger causality approach for identifying causal association amidst each factor, and the results of Granger casualty further validated the outcomes of VEC Granger/Block Exogeneity Wald technique. Since we have to select Lag in order to get proper results that are user counted. It is also noted; from Table 17 and Table 18 that there was no causality existed among changes in crude oil and gold prices, and equity prices of the Baltic and South Asian markets at lag 1 and lag 2, but there has causality existed from crude oil prices to KSE100 returns and KSE100 to gold prices in lag 1 as shown in Table 17. Granger causality also existed in lag 2 from crude oil prices to KSE100 returns, and gold prices to KSE100, and OMXBBGI to gold prices as shown in Table 18. It is essential to grasp the idea that any change in one variable does not mean to bring change in another variable. It is a fact that causality is basically inevitable for movement in time series.

Tab. 17. Pairwise Granger Causality Test at Lag 1.

Null Hypothesis:	Obs.	F-Statistic	Prob.
DLKSE100 does not Granger Cause DLCOP	1615	0.4193	0.5174
DLCOP does not Granger Cause DLKSE100		5.8466	0.0157
DLOMXBBGI does not Granger Cause DLCOP	1615	0.4806	0.4882
DLCOP does not Granger Cause DLOMXBBGI		0.5541	0.4568
DLOMXR does not Granger Cause DLCOP	1615	0.1366	0.7118
DLCOP does not Granger Cause DLOMXR		0.0123	0.9116
DLOMXT does not Granger Cause DLCOP	1615	0.6068	0.4361
DLCOP does not Granger Cause DLOMXT		0.2450	0.6207
DLOMXV does not Granger Cause DLCOP	1615	0.7534	0.3855
DLCOP does not Granger Cause DLOMXV		0.3965	0.5290
DLSENSEX does not Granger Cause DLCOP	1615	0.0086	0.9262
DLCOP does not Granger Cause DLSENSEX		0.0095	0.9224
DLKSE100 does not Granger Cause DLGP	1615	2.7564	0.0971
DLGP does not Granger Cause DLKSE100		0.3786	0.5385
DLOMXBBGI does not Granger Cause DLGP	1615	1.6418	0.2003
DLGP does not Granger Cause DLOMXBBGI		0.0130	0.9093
DLOMXR does not Granger Cause DLGP	1615	0.2798	0.5969
DLGP does not Granger Cause DLOMXR		0.3511	0.5536
DLOMXT does not Granger Cause DLGP	1615	0.6457	0.4218
DLGP does not Granger Cause DLOMXT		0.6819	0.4091
DLOMXV does not Granger Cause DLGP	1615	0.0894	0.7650
DLGP does not Granger Cause DLOMXV		0.4044	0.5249
DLSENSEX does not Granger Cause DLGP	1615	0.2741	0.6007
DLGP does not Granger Cause DLSENSEX		0.0036	0.9520

Tab. 18. Pairwise Granger Causality Test at Lag 2.

Null Hypothesis:	Obs.	F-Statistic	Prob.
DLKSE100 does not Granger Cause DLCOP	1614	0.2922	0.7467
DLCOP does not Granger Cause DLKSE100		3.8502	0.0215
DLOMXBBGI does not Granger Cause DLCOP	1614	0.3959	0.6731
DLCOP does not Granger Cause DLOMXBBGI		0.6717	0.5110
DLOMXR does not Granger Cause DLCOP	1614	0.1925	0.8249
DLCOP does not Granger Cause DLOMXR		0.3050	0.7372
DLOMXT does not Granger Cause DLCOP	1614	1.0393	0.3540
DLCOP does not Granger Cause DLOMXT		0.7132	0.4902
DLOMXV does not Granger Cause DLCOP	1614	0.4145	0.6607
DLCOP does not Granger Cause DLOMXV		0.2133	0.8079
DLSENSEX does not Granger Cause DLCOP	1614	0.0315	0.9690
DLCOP does not Granger Cause DLSENSEX		0.1059	0.8995
DLKSE100 does not Granger Cause DLGP	1614	1.6276	0.1967
DLGP does not Granger Cause DLKSE100		2.6501	0.0710
DLOMXBBGI does not Granger Cause DLGP	1614	3.0098	0.0496
DLGP does not Granger Cause DLOMXBBGI		0.0150	0.9851
DLOMXR does not Granger Cause DLGP	1614	0.1650	0.8479
DLGP does not Granger Cause DLOMXR		0.4417	0.6430
DLOMXT does not Granger Cause DLGP	1614	0.6552	0.5195
DLGP does not Granger Cause DLOMXT		0.3888	0.6780
DLOMXV does not Granger Cause DLGP	1614	0.4325	0.6490
DLGP does not Granger Cause DLOMXV		1.3737	0.2535
DLSENSEX does not Granger Cause DLGP	1614	0.3261	0.7218
DLGP does not Granger Cause DLSENSEX		0.0115	0.9886

Discussion

The results of the study demonstrated the high returns in KSE100 and SENSEX with higher volatility as compared to the Baltic stock markets, since the Baltic stock markets are relatively small. However, both SENSEX and KSE100 fall into emerging markets classification. Thus the South Asian markets are performing much better as compared to the Baltic markets. The results of KSE100 and SENSEX are consistent with the previous studies (Hu et al., 2016; Raza et al., 2016; Basher et al., 2012; Sharma and Mahendru, 2010; Nguyen et al., 2012). Outcomes of our research also confirmed the association amongst the equity returns and gold and oil prices, these results also validated the previous literature concerning to the relationship of equity markets, and gold and crude oil prices in different financial markets of the World (Wei and Guo, 2016; Albulescu et al., 2017; Pinho and Madaleno, 2016; Pönkä, 2016).

Results of Multivariate Johansen cointegration illustrated the absence of the cointegration amongst the economic indicator. Thus, the results indicated no traces of a long haul association between Baltic and south Asian stock prices, crude oil prices and gold prices. Thus, these results are consistent with previous literature that also established the same findings (Ma et al., 2016; Xu, 2015; Apergis and Miller, 2009; Lawrence, 2003; Baig et al., 2013). Finally, VEC Granger Causality/Block Exogeneity Wald suggested unidirectional causality from crude oil prices to KSE100 and gold prices KSE100. These results in line with the previous literature that also demonstrated the one-way causation from crude oil prices to equity prices, and gold prices to equity prices (Büyüksalvarcı, 2010; Shahzadi and Chohan, 2011; Basher et al., 2012; Geise and Piłatowska, 2015).

It is finally concluded from this study that crude oil prices and gold prices do not have the long haul association with the Baltic and South Asian stock markets. However, the short-term relationship has been observed among the Baltic and South Asian financial markets, and crude oil and gold prices in the considered time period. Previous literature also validated the results of our research and confirmed the only short-term association between stock prices and crude oil and gold prices (Moore, 1990; Apergis and Miller, 2009; Lawrence, 2003; Sumner et al., 2010; Smith, 2001; Baig et al. (2013).

Conclusion

The results of this research concluded that there are high returns in KSE100 and SENSEX indices as compared to the Baltic stock markets but at the cost of higher volatility. The standard deviation in case of stock returns and growth in oil prices show that the selected time series are highly volatile as compared to growth in gold prices. The reason for high volatility in stock returns and growth in oil prices was due to high economic

activities in the Baltic States, i.e. Lithuania, Latvia, and Estonia, and South Asian countries (Pakistan and India). However, growth in gold prices was less volatile because in selected time period gold prices in international market remained stable in the long run. Results of Multivariate Johansen cointegration illustrated the absence of the cointegration amongst the economic indicator. Thus, the results indicated no traces of a long haul association between Baltic and south Asian stock prices, crude oil prices and gold prices. Finally, VEC Granger Causality/Block Exogeneity Wald suggested unidirectional causality from LCOP to LKSE100 and LGP to LKSE100. It is concluded from the outcomes that the long haul association does not exist amidst Baltic and South Asian stock markets and change in gold and oil prices. However, it is concluded from the results of ARDL approach; the long haul relationship existed between LOMXBBGI, and LCOP, and LGP at 10 percent significance level. It is also concluded from the results that there is no directional causality existed among LOMXBBGI, LCOP, and LGP as suggested by Granger casualty approach. Results of Granger casualty also validated the GCBEW results and showed the unidirectional causation from LCOP to LKSE100, and LGP to LKSE100 in lag 1 and lag 2, respectively. It is finally concluded from this study that crude oil prices and gold prices do not have the long haul association with the Baltic and South Asian stock markets. However, the short-term relationship has been observed among the Baltic and South Asian financial markets, and crude oil and gold prices in the considered time period.

References

Albulescu, C.T., Aubin, C., Goyeau, D.: Stock prices, inflation and inflation uncertainty in the U.S.: testing the long-run relationship considering Dow Jones sector indexes. *Applied Economics, Vol. 49, No. 18, 2017, pp. 1–14.*

Apergis, N., Miller, S.M.: Do structural oil-market shocks affect stock prices? *Energy Economics, Vol. 31, No. 4, 2009, pp. 569–575.*

Baig, M.M., Shahbaz, M., Imran, M., Jabbar, M., Ain, Q.U.: Relationship between Gold & Oil Price and Stock Market Returns. *Acta Universitatisdanubius, Vol. 9, No. 5, 2013, pp. 28–39.*

Basher, S.A., Haug, A.A., Sadorsky, P.: Oil prices, exchange rates and emerging stock markets. *Energy Economics, Vol. 34, No. 1, 2012, pp. 227–240*.

Bhunia, A., Mukhuti, S.: The Impact of domestic Gold Price on stock Price Indices–An empirical study of Indian Stock Exchanges. *Universal Journal of Marketing and Business Research, Vol. 2, No. 2, 2013, pp. 35–43.*

Blose, L.E., Shieh, J.C.P.: The Impact of Gold Price on the value of Gold Mining Stock. *Review of Financial Economics, Vol. 4, No. 2, 1995, pp. 125–139.*

Broadstock, D.C., Fan, Y., Ji, Q., Zhang, D.: Shocks and Stocks: A Bottom-up Assessment of the Relationship Between Oil Prices, Gasoline Prices and the Returns of Chinese Firms. *The Energy Journal, Vol. 37, No. 1, 2016*.

Büyüksalvarcı, A.: The Effects of Macroeconomics Variables on Stock Returns: Evidence from Turkey. *European Journal of Social Sciences, Vol. 14, No. 3, 2010, pp. 404–416.*

Dickey, D.A., Fuller, W.A.: Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica, Vol. 49, No. 4, 1981, pp. 1057–1072*.

Geise, A., Piłatowska, M.: Oil Prices, Production and Inflation in the Selected EU Countries: Threshold Cointegration Approach. *Dynamic Econometric Models, Vol. 14, 2015, pp. 71*.

Hassan, A., Nasir, Z.M.: Macroeconomic Factors and Equity Prices: An Empirical Investigation by Using ARDL Approach. The Pakistan Development Review, *Vol. 47, No. (4 Part II Winter), 2008, pp. 501–513.*

Hu, J.W.S., Hu, Y.C., Chien, J.: Elucidating the Relationship among EUA Spot Price, Brent Oil Price and Three European Stock Indices. *Universal Journal of Accounting and Finance, Vol. 4, No. 2, 2016, pp. 53–72*.

Cheung, Y.W., Lilian, K.N.: International evidence on the stock market and aggregate economic activity. *Journal of Empirical Finance, Vol. 5, No. 3, 1998, pp. 281–296.*

Johansen, S.: Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control, Vol. 12, No. (2-3), 1988, pp. 231–254*.

Kaliyamoorthy, D.S., Parithi, M.S.: Relationship of Gold Market and Stock Market: An Analysis. *International journal of Business and Management Tomorrow, Vol. 2, No. 6, 2012, pp. 1–6.*

Lawrence, C.: Why is Gold Different from other Assets? An empirical investigation. *World Gold Council, London, March, 2003.*

Ma, Z., Xu, R., Dong, X.: World oil prices and agricultural commodity prices: The evidence from China. *Agricultural Economics (Zemědělská ekonomika), Vol. 61, No. 12, 2016, pp. 564–576.*

Moore, G.H.: Gold Prices and a Leading Index of Inflation. *Challenge, Vol. 33, No. 4, 1990, pp. 52–56.*

Mork, K.A.: Oil and the Macro Economy When Prices Go Up and Down: An Extension of Hamilton's Results. *Journal of Political Economy, Vol. 97, No. 3, 1989, pp. 740–744*.

Naifar, N., Al Dohaiman, M.S.: Nonlinear analysis among crude oil prices, stock markets' return and macroeconomic variables. *International Review of Economics & Finance, Vol. 27, 2013, pp. 416–431*.

Nguyen, C., Komorníková, M., Komorník, J., Bhatti, I.: New Evidence on Asymmetric Movement Between Gold Prices and Stock Markets with Mixed–copula Analysis. *World Finance and Banking Symposium, Shanghai, China, December, 17–18, 2012*.

Pesaran, M.H., Shin, Y., Smith, R.J.: Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, Vol. 16, No. 3, 2001, pp. 289–326*.

Phillips, P.C.B., Perron, P.: 1988. Testing for a Unit Root in Time Series Regression. *Biometrika, Vol. 75, No. 2, 1988, pp. 335–346.*

Pinho, C., Madaleno, M.: Oil prices and stock returns: nonlinear links across sectors. *Portuguese Economic Journal, Vol. 15, No. 2, 2016, pp. 79–97*.

Pönkä, H.: Real oil prices and the international sign predictability of stock returns. *Finance Research Letters, Vol. 17, 2016, pp. 79–87*.

Raza, N., Shahzad, S.J.H., Tiwari, A.K., Shahbaz, M.: Asymmetric impact of gold, oil prices and their volatilities on stock prices of emerging markets. *Resources Policy, Vol. 49, 2016, pp. 290–301*.

Shahzadi, H., Chohan, M.N.: Impact of Gold Price on Stock Exchange: A Case Study of Pakistan, *3rd SAICON International Conference on Management, Business Ethics and Economics (ICMBEE), Institute of Information Technology, Lahore, Pakistan, 28–29 December 2011.*

Sharma, G.D., Mahendru, M.: Impact of Macro–Economic Variables on Stock Prices in India. *Global Journal of Management and Business Research, Vol. 10, No. 7, 2010, pp. 19–26*.

Smith, G.: The Price of Gold and Stock Price Indices for the United States, *November, 2001*. http://www.spdrgoldshares.com/media/GLD/file/Gold%26USStockIndicesDEC200120fina.pdf

Sumner, S., Johnson, R., Soenen, L.: Spillover effects between gold, Stock and bonds. *Journal of CENTRUM Cathedra: The Business and Economics Research Journal, Vol. 3, No. 2, 2010, pp. 106–120*.

Toraman, C., Başarir, Ç., Bayramoğlu, M.: Determination of Factors Affecting the Price of Gold: A Study of MGARCH Model. *Business and Economics Research Journal, Vol. 2, No. 4, 2011, pp. 37–50.*

Wang, M.L., Wang, C.P., Huang, T.Y.: Relationships among oil price, gold price, exchange rate and international stock markets. *International Research Journal of Finance and Economics, Vol. 47, 2010, pp. 82–91*.

Wei, Y., Guo, X.: An empirical analysis of the relationship between oil prices and the Chinese macro-economy, *Energy Economics, Vol. 56, 2016, pp. 88–100*.

Xu, B.: Oil prices and UK industry-level stock returns. *Applied Economics, Vol. 47, No. 25, 2015, pp. 2608–2627*.

Zaman, K., Khan, M.M., Ahmad, M., Khilji, B.A.: Growth, Employment, Exports and Wagner's Law: Evidence from Pakistan's Agriculture Sector (1960-2009). *International Journal of Rural Management, Vol. 7. No. (1-2), 2011, pp. 27–41*.