# ASYMMETRIC EFFECT OF GOLD AND OIL PRICES ON STOCK MARKET PERFORMANCE IN PAKISTAN: NEW EVIDENCE FROM ASYMMETRIC ARDL COINTEGRATION

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## ABSTRACT

*The previous studies on stock market modelling in Pakistan context has assumed a linear relationship between stock market performance and its determinants. Most of the macroeconomic variables do not have linear properties, therefore considering asymmetric features of macroeconomic fundamentals, this study is a first attempt to explore the asymmetric impact of gold and oil prices on the stock market performance of Pakistan, covering the time period of 1990 – 2016. For the consideration of nonlinear, short-run and long-run associations between gold, oil prices and stock market performance, a novel approach of nonlinear ARDL or asymmetric ARDL is being used. The long-run parameters of the study affirm the asymmetric association between gold, oil prices and stock market performance, while short-run dynamics validate the asymmetric association between oil prices and stock market performance. Furthermore, negative and significant link between the exchange rate and the stock market was also found. The empirical outcomes propose that ignoring intrinsic asymmetries may lead to the misrepresentative implications in case of stock market performance. The achieved suggestion of asymmetries, both short and long-run dynamics could be of key prominence for more effective policy-making and to forecast the Pakistan Stock Market.*

*Keywords: Asymmetric Cointegration, Asymmetric ARDL, Oil Prices, Gold Prices, Pakistan Stock Market.*

## INTRODUCTION

Emerging economies have offered considerable opportunities to investors and stock market stakeholders to earn higher returns through

market capitalization. During the last couple of decades, a recent pattern of capital inflows and growth in trade volume is observed Kumar (2014). Furthermore, higher returns and other earning opportunities have attracted investors to invest in emerging markets to earn more, as compared to the developed capital markets such as the European and United States stock markets. Consequently, substantial inflows are expected to go into emerging stock markets from developed economies (Prasad et al. 2005). Stock prices in emerging economies, in terms of capital inflows and outflows, are more volatile and instable due to the good or bad news or occurrence of any other event around the globe. The global financial crises have also set in motion an upheaval in the global stock markets since last few decades (Ji & Fan, 2012). During the 2007-2008 crisis resulting from the subprime mortgage, the stock markets of Pakistan and other countries experienced disproportionate fluctuations and an adverse downturn in stock prices which eventually affected stock market performance (Bernanke, 2009).

In the past few decades, the relationship between exchange rate, oil prices, gold prices, economic growth and stock market performance has been studied in a linear setting (Okwuchukwu, 2015; Kanjilal & Ghosh, 2014; Shahbaz et al., 2014; Beckmann & Czudaj, 2013; Wang, Lee, & Thi, 2011). However, few studies are carried in a nonlinear fashion. Stock market performance is a reflection of an economy's macroeconomic drivers such as exchange rate, gold rate and oil prices. In developing economies, any good or bad news or event(s) significantly affect the macroeconomic drivers and their rates and prices (Raza et al., 2016). Furthermore, the stock market study is an enduring topic, which is discussed extensively with various other determinants such, Saeed Meo (2017), explored the relationship between the stock market and governance indicators.

Moreover, volatilities in oil prices, exchange rate and gold prices profoundly affect the stock prices and macroeconomic variables in most developed and emerging economies (Cologni & Manera, 2008; Gronwald, 2008; Kilian, 2008; Lardic & Mignon, 2008). Oil price volatilities, for example, affect differently (i.e. positively and negatively) on oil importing and exporting countries. For the importing economies, as oil prices decline, it gives rise to government expenditure, cost of production and a decrease in foreign reserves. For exporting economies, on the other hand, it results in decreased revenue than before oil prices actually decline. This

varied effect produces sudden shocks in stock prices. Hence, this encourages research practitioners to use nonlinear framework for volatile variables (Jiménez-Rodríguez & Sánchez, 2005).

Changes in exchange rates considerably affect stock prices in developing countries like Pakistan. Previously numerous models have been employed to see how the exchange rate affects stock markets in linear settings. Various researchers have used unconditional models (Chen et al., 2004; Di Iorio & Faff, 2001), while different researchers have used conditional models to investigate the effect of exchange rate on stock prices (Choi, Hiraki, & Takezawa, 1998; Ferson & Harvey, 1994). However, covariance among foreign exchange, market return and risk premium results in a positive or negative correlation between the said variables. Hau and Rey (2005), suggested that exchange rate and stock returns are negatively correlated because it adjusts the portfolio. Furthermore, the adverse effect of exchange rate volatilities and firm cash flows are also observed (Dumas, 1978; Shapiro, 1975). For this reason, studies on exchange rate volatilities in non-linear settings is required.

Because of the cultural and social significance of gold, women largely use gold in South Asia, especially in Pakistan and India. Investors keep gold in their portfolio because it provides hedge against extreme changes in the exchange rates, inflation, economic downturn, political turmoil and during poor performance of the stock markets ( Worthington & Pahlavani, 2007; Capie et al., 2005; Ghosh et al., 2004; Mahdavi & Zhou, 1997). In addition, the inclusion of gold in a portfolio can offer diversification benefits because it normalizes the volatilities in stock prices and increases overall portfolio return (Chua, Sick, & Woodward, 1990; Sherman, 1982). Therefore, gold prices are a major concern for the central bank and other stakeholders. Although, having hedge and diversification benefits, fluctuations in gold prices negatively affect the stock markets. The minor fluctuations in gold price make the situation secure for investments and vice versa (Baur, 2012; Tully & Lucey, 2007). Therefore, it is imperative for investors to understand the changing behavior of gold markets when adding it in the portfolio for hedge or diversification purpose (Ewing & Malik, 2013).

As discussed earlier, most studies have investigated the relationship between macroeconomic factors (i.e. gold and oil prices; interest, inflation and exchange rate) and the stock market performance in a linear setting.

However, in practice, these variables are subject to frequent fluctuations and exhibit nonlinear behavior which is ignored in previous studies. Anoruo (2011), explains that the fundamental limitation in a linear model is that it considers linear series whereas, they are nonlinear in practice. Moreover, the linear model fails to account short-run fluctuations and structural changes. Consequently, prior studies have provided mixed results, which propose that an increase in afore-mentioned variables may have a positive or sometimes negative effect on the stock market performance and vice versa. In order to fill the above-mentioned gaps and to get reliable results, this study will incorporate both short and long-run fluctuations and structural changes in the selected variables. The task will be completed using nonlinear ARDL suggested by Shin et al. (2014), that makes it possible to examine whether an increase or decrease in oil prices, gold prices, and exchange rate react in a different way (both in short-run and long-run) on the stock market. The basic benefit of using NARDL over linear model is that it enables underlying study variables to move along the different time periods. Furthermore, it provides error correction mechanism or a system which consider asymmetries in long-run co-integration. This permits asymmetric observations' response of oil prices, gold prices and exchange rate to both positive and negative fluctuations in stock market performance. The NARDL is thus, compatible in developing new structural analysis to retain the variables under study.

## LITERATURE REVIEW

The stock market is one of the major areas where people invest their capital to receive higher returns. However, what drives the stock market returns is a major concern for the research practitioners. Most of the studies on stock markets performance have been conducted using linear models and little attention has been given to non-linear models. As a result, these models have not provided reliable results. Currently, research on different issues using Nonlinear Autoregressive Distributed Lag Model (NARDL) is emerging and very effective to assess the relationship between different variables. Thus, shows the growing interest in the use of Nonlinear Autoregressive Distributed Lag Model (NARDL) around the globe.

Vacha and Barunik (2012), examined this phenomenon and found asymmetries in oil and stock prices, because of the rational economic agents with different level of risk and expectations. Arouri et al. (2015), reported that investors are usually risk aversive and they choose to invest in gold due to the minimum risk associated with it. The risk-aversive

behavior of investors has considerable implications for the stock market capitalization and performance. Secondly, the volatility or fluctuation in gold and oil prices also differs. The strength of gold to hold its value during a slump or sluggish growth compared to the value of oil provides an edge to investors to invest in the gold. Tiwari and Sahadudheen (2015), reported that investors are willing to invest in gold and oil due to their property of high liquidity and this is a safe option for them in the time of economic downturn or financial crisis. Goodman (1956), revealed that there are higher chances of loss of assets' value, including the investments in the stock market during inflationary pressure in the economy, while the gold usually holds its purchasing power.

Extensive literature is available that explains the frequent fluctuations in the gold prices and its potential negative impact on investment in the stock market. In the presence of low volatility, investment in gold is very instrumental and considered as a profitable option for portfolio diversification and hedging. Chen and Lin (2014), observed that central banks consider and retain gold as a secure asset to avoid the assets loss during an economic downturn. This nature of gold significantly reduces investment in stock markets. Kaufmann and Winters (1989), investigated the behavior of central bank during economic uncertainties and their inclination for investment in gold which affect the investment in the stock exchange. They suggest a positive nexus between gold investment and uncertainties which implies higher investment in gold by the central bank with a higher degree of uncertainties in the stock market. Baur (2012), found that frequent fluctuations in gold prices increase the investment inflow in the stock market. In other words, intense volatility in gold prices is negatively associated with the stock market investment. Investment in stock market declines with a lower fluctuation and volatility in gold prices. Ewing and Malik (2013), assessed this problem and reported that investigating the fluctuations and volatility in oil and gold market is very essential for investors to make hedging decisions. The investment in the stock market is highly responsive to the volatility in the gold market. Tully and Lucey (2007), reported that variables like gold and crude oil prices are very instrumental and investors are keen to understand stock market reactions on these variables. Similarly, Beckmann and Czudaj (2013), argued that besides the other factors, fluctuations in the gold and crude oil prices have major implications for investment and ultimately on the performance of stock markets. Furthermore, Maghyereh and Al-Kandari

(2007), observed that commodity prices show a nonlinear effect on stock markets. The stock markets in both emerging as well as developing economies are susceptible to oil and gold prices (Driesprong et al., 2008).

Considerable literature is available on the issue of nonlinear modelling approach in different countries, however, as far as our knowledge is concerned, no research is yet available in Pakistan. Asymmetric causal links between exchange rate, oil, gold prices and stock market are expected which provides the justification of this study and the use of NARDL model. The results of the studies on the nexus between gold prices, oil price and stock market performance in both developed as well as developing countries are largely heterogeneous. Jones and Kaul (1996), found a significant negative effect of oil prices on stock prices. Henriques and Sadorsky (2008), also reported that there exists a strong nexus between the variables. However, the results considerably vary from firm to firm depending on the size or capital share of the firm. Bekiros and Diks (2008), investigated oil prices nexus with future returns and found a nonlinear asymmetric relationship. According to the literature, all oil shocks are not similar. Kilian (2008), identified and explained numerous oil price shocks. These shocks are sometimes caused by supply-side shocks, demand-side shocks and production shocks. These different shocks to oil prices have different implications for investment in the stock markets. Kilian and Park (2009), revealed that investment in stock and its return in relation to changes in oil and gold prices varies across time and place. Hamilton (2009), explain that association between oil prices & investment in financial market hinges on origin and nature of the crisis. The results are either inconclusive or heterogeneous because different factors like shock to production, aggregate demand shock or shock to oil and gold prices due to uncertainty considerably affects financial investments.

This paper has considered an in-depth literature review and intends to report some important relationships among, exchange rate, gold prices and oil prices impact on stock market using NARDL, which is not reported previously in Pakistan. A Considerable number of economists tried to investigate the relationship among different variables of their interest using Nonlinear Autoregressive Distributed Lag model (NARDL). However, NARDL is rarely used to analyze stock market performance but is getting high attention in economics and finance literature (Meo et al., 2018; Fareed et al., 2018; Meo et al., 2018). The use of the nonlinear

autoregressive distributed lag model in our study will allow us to assess the impact of different variables in short-run and long-run. Literature involving data of time series has largely ignored the nonlinearity in oil and gold prices along with stock market performance. Disregarding nonlinearity in any time series variable has significant implications not only for the findings but for policy implications as well. Anoruo (2011), argued that fundamental weakness in linear modelling is the failure to apprehend the asymmetry in different time series variables.

## ECONOMETRIC MODELLING

Firstly, a linear equation is postulated to examine the nature of the relationship between exchange rate and stock market performance along with oil and gold prices,

$$LSP_t = \beta_0 + \beta_1(LEXR_t) + \beta_2(LOP_t) + \beta_3(LGP_t) + u_t \qquad (1)$$

In equation (1), LSP, LEXR, LOP, and LGP refer to the log of stock market performance, log of the exchange rate, log of oil prices, and log of gold prices respectively. Current literature assumes that positive and negative changes in oil prices and gold prices have a similar impact on stock market performance. Raza et al. (2016), explored that the negative and positive changes have asymmetric effects on stock market prices. The prime objective of this study is to explore asymmetric effect(s) of oil and gold prices on stock market performance in the context of Pakistan. Therefore, the nonlinear functional form of the model is derived as follows.

$$LSP_t = f(LEXR, LOP_t^+, LOP_t^-, LGP_t^+, LGP_t^-) \qquad (2)$$

Whereas, the general form of asymmetric ARDL will be as following.

$$LSP_t = \beta_1 + \beta_1(LEXR_t) + \beta_2(LOP_1^+) + \beta_3(LOP_1^-) + \beta_4(LGP_1^+) + \beta_5(LGP_1^-) + \varepsilon_t \ (3)$$

*Where LSP refers to stock prices, LOP$^+$ and LGP$^+$ denote the positive partial sum of oil prices and gold prices respectively. Whereas, LOP$_t^-$, LGP$_t^-$ refer to the negative partial sum of oil prices and gold prices respectively. While, $\beta_1, \beta_2, \beta_3, \beta_4$ and $\beta_5$ are the long-run coefficients to be estimated. $\varepsilon_t$ is the error term.*

There are five reasons for using nonlinear ARDL of (Shin, Yu, & Greenwood-Nimmo, 2014). Firstly, it permits co-integration modelling that could have been existed between the exchange rate, oil prices, gold prices and stock market performance. Secondly, nonlinear ARDL approach produces long-run and short-run effects of independent variables on the

dependent variable. Thirdly, stationary order restriction is needed to compute linkage between under-considered variables in traditional models like error correction models. Traditional models can only be applied if all the variables are integrated in the same order. On the other hand, NARDL can be applied either if all variables are purely stationary at I(0), I(1) or I(0) & (1) except I(2) (Bacha, & McMillan, 2017; Ibrahim, 2015; Ilyas et al., 2010). The fourth reason stresses that the NARDL performs well in a small sample size (Narayan, 2005; Ghatak & Siddiki, 2001; Pesaran et al., 2001; Romilly et al., 2001). Finally, the last benefit of nonlinear ARDL model is its quality to produce long-run and short-run asymmetric associations.

The specified Eq.1 only provides long-run coefficients of exogenous variables. While, for the short-run effects the Eq.1 is rewritten following the Pesaran et al.'s (2001) bounds testing approach under the error correction mechanism, as follows:

$$\Delta lsp_t = \gamma_0 + \sum_{k=1}^{m1} \gamma_{1k} \Delta lsp_{t-k} + \sum_{k=1}^{m2} \gamma_{2k} \Delta lexr_{t-k} \sum_{k=1}^{m3} \gamma_{3k} \Delta lop_{t-k} + + \sum_{k=1}^{m4} \gamma_{4k} \Delta lgp_{t-k}$$
$$+ \lambda_1 lsp_{t-1} + \lambda_2 lexr_{t-1} + \lambda_3 lop_{t-1} + \lambda_4 lgp_{t-1} + \mu_t \tag{4}$$

Specification (4) provides short and long-run effects under the error correction mechanism where, $\gamma_1, \gamma_2, \gamma_3, \gamma_4$ refer to short-run coefficients and $\lambda_1, \lambda_2, \lambda_3, \lambda_4$ denotes long-run coefficients of the model. However, for the validity of long-run coefficients, Pesaran et al. (2001), suggested using bounds test/F-test.

Furthermore, the specification (1) & (4) assume a symmetric effect of all exogenous variables on the dependent variable. While the prime intention of the current study is to check asymmetric effects of all the exogenous variables on the dependent variable, thus Shin et al.'s (2014) four steps of NARDL approach are followed. Firstly, the oil prices and gold prices are decomposed into their positive and negative partial sums. The decomposition regression is taken as $w_t = \lambda^+ + z_t^+ + \lambda^- z_t^- + \mu_t$ where $\lambda^+ +$ and $\lambda^-$ are associated in long-term and $z_t$ is a vector of regressors, decomposed as:

$$z_t = z_0 + z_t^+ + z_t^- \tag{5}$$

where, $z^+$ and $z^-$ are the independent variables, which are decomposed into a partial sum of negative and positive changes. The following Eq.6, 7, 8, & 9 are the partial sums of positive and negative changes in oil prices, exchange rate and gold prices.

$$lop^+ = \sum_{i=1}^{t} \Delta lop_i^+ = \sum_{i=1}^{t} \max (\Delta lop_i, 0) \qquad (6)$$

$$lop^- = \sum_{i=1}^{t} \Delta lop_i^- = \sum_{i=1}^{t} \min (\Delta lop_i, 0) \qquad (7)$$

$$lgp^+ = \sum_{i=1}^{t} \Delta lgp_i^+ = \sum_{i=1}^{t} \max (\Delta lgp_i, 0) \qquad (8)$$

$$lgp^- = \sum_{i=1}^{t} \Delta lgp_i^- = \sum_{i=1}^{t} \min (\Delta lgp_i, 0) \qquad (9)$$

In the subsequent stage t in Eq.4 is supplanted by $LOP^+$, $LGP^+$ $LOP^-$ and $LGP^-$ variables. In this way, formulation of nonlinear ARDL (hereafter NARDL) is completed:

$$\Delta lsp_t = \theta + \sum_{k=1}^{P1} \theta_k \Delta lsp_{t-k} + \sum_{k=1}^{P2} \theta_k \Delta lexr_{t-k} + \sum_{k=1}^{P3} \theta_k \Delta lop^+_{t-k} + \sum_{k=1}^{P4} \theta_k \Delta lop^-_{t-k}$$
$$+ + \sum_{k=1}^{P5} \theta_k \Delta lgp^+_{t-k} + \sum_{k=1}^{P6} \theta_k \Delta lgp^-_{t-k} + \lambda_1 lsp_{t-1} + \lambda_2 lexr_{t-1} + \lambda_3 lop^+_{t-1}$$
$$+ \lambda_4 lop^-_{t-1} + \lambda_5 goldp^+_{t-1} + \lambda_6 golp^-_{t-1} + \mu_t \qquad (10)$$

Furthermore, Shin et al. (2014) also suggested that the Pesaran et al's. (2001), bounds testing approach is fully functional for equation (10). When we add the negative and positive partial sum of oil prices and gold prices in the model (4) it becomes nonlinear ARDL, while without negative and positive series of said variables it remains linear ARDL

## DATA AND EMPIRICAL RESULTS

### Data

The annual data, covering a time span of 1990-2016 has been used to examine the asymmetric effect of gold price, oil prices, and the exchange rate on stock market performance. Stock market performance (SP) is calculated as aggregate market capitalization. Gold prices (GP) are calculated as rupees per 10 grams of yearly average. The data on stock market performance and gold prices are taken from statistical supplements of the State Bank of Pakistan. Official Exchange Rate (EXR) is extracted from the World Bank database recognized as WDI (World Development Indicators). Oil prices (OP) are measured by spot crude prices and are taken from the world energy survey. All variables are taken in log arithmetic form to calculate elasticities and data normalization. The descriptive statistics are reported in Table 1. Mean of the exchange rate and oil prices are lesser than stock market performance and gold prices.

Exchange rate, oil and gold prices indicate that there is minimal variation in the data as compared to stock market performance. The Jarque-Bera test provides evidence of data normality since the probability magnitudes of all considered variables are greater than 1% level of significance (0.322334, 0.270322, 0.241057 and 0.200094 > 0.01) for stock market performance, exchange rate, gold and oil prices respectively.

Table 1. Descriptive Statistics

|  | LSP | LEXR | LGP | LOP |
|---|---|---|---|---|
| Mean | 5.550886 | 1.595459 | 3.775032 | 1.491427 |
| Median | 5.579616 | 1.674137 | 3.695961 | 1.433830 |
| Maximum | 6.880154 | 2.020233 | 4.451812 | 2.037741 |
| Minimum | 3.818424 | 0.995635 | 3.196176 | 1.086696 |
| Std. Dev. | 0.925794 | 0.309790 | 0.399257 | 0.301265 |
| Skewness | -0.226222 | -0.299548 | 0.384914 | 0.518269 |
| Kurtosis | 1.857699 | 1.823023 | 1.857927 | 1.965167 |
| Jarque-Bera | 2.264336 | 2.616286 | 2.845447 | 3.217938 |
| Probability | 0.322334 | 0.270322 | 0.241057 | 0.200094 |

**Unit Root Tests**

Traditional co-integration tests can only be applied if all the variables are integrated at the same order. However, NARDL can be applied if either all the variables are purely stationary at I(0), I(1) or I(0) & (1) except I(2) (Dhaoui & Bacha, 2017; Ibrahim, 2015; Ilyas et al., 2010). ADF, PP and KPSS tests are applied to ensure that all the considered variables are not I(2). The compiled results are reported in Table 2. The results of table 2 indicate that all the considered variables are non-stationary at the level I(0) while they became stationary at first order of integration I(I).

Table 2. Unit Root Tests Results

| Tests | LSP | LEXR | LOP | LGP |
|---|---|---|---|---|
| **ADF** | | | | |
| I(0) | -1.317418 | -2.578880 | -1.106281 | 0.034485 |
| I(I) | -5.615854* | -4.521955* | -5.702930* | -5.754789 |
| **PP** | | | | |
| I(0) | -1.318233 | -2.578880 | -1.194615 | 0.034485 |
| I(I) | -5.615104* | -4.486037* | -5.703180* | -5.760521* |
| **KPSS** | | | | |
| I(0) | 0.703699** | 0.705969** | 0.460442*** | 0.679180** |
| I(I) | 0.114372 | 0.387383 | 0.186966 | 0.133743 |

*, **and *** depict 1, 5 and 10 % significance level respectively.

Bounds tests are reported in Table 3. The F-statistics test indicates no co-integration in non-linear form of under considered series. Whereas, the error correction term is a useful way to establish a long-run relationship (Banerjee et al., 1998; Kremers et al.,1992).Thus, $t_{BDM}$ statistics are calculated to test the null hypothesis; on long-run relationship (proposed by Banerjee et al., 1998). The $t_{BDM}$ statistics affirmed the long-run relationship among the study variables.

Table 3. Bounds Tests Results

| Model | Test statistic | Upper bound | Lower bound | Remark |
|---|---|---|---|---|
| LSP/(LEXR, LOP, LGP) | F-stats =2.683422 | 3.67 | 2.79 | Inconclusive |
| LSP/(LEXR, LOP, LGP) | $t_{BDM}$ = -2.612968 | Critical value = 2.38[4] | Conclusive | |

*F stats indicate the null hypothesis = all coefficients equal to zero.*

The estimates of NARDL are reported in Table 4. General to specific approach is adopted to reach final NARDL estimation version. Whereas, insignificant independent variables were eliminated to enhance the estimation accuracy of the dynamic multiplier (Pesaran et al., 2001). We have applied Wald test to examine the long-run ($W_{LR, LGP}$ and $W_{LR, LOP}$) to test the symmetric hypothesis among negative and positive part of concerned variables to validate the suitability of NARDL. Symmetric hypothesis results are reported in Table 5. The results of the symmetric hypothesis accept the alternative hypothesis i.e. $\frac{\beta^+}{\rho} \neq \frac{\beta^-}{\rho}$ asymmetry between negative and positive part of the concerned variables. Furthermore, for the LGP part the long-run Wald test is found 2.284 (P-value = 0.143), whereas for the LOP part, it is found 11.5295 (P-value = 0.0023). Short-run dynamics exits only in case of oil prices. So, the short-run symmetric hypothesis is also tested, which is stated as $W_{SR, LOP}$: $\sum_{i=1}^{t} \Delta lop_i^+ = \sum_{i=1}^{t} \Delta lop_i^-$ . The results of the short-run symmetric hypothesis are also reported in Table 5. The Wald test for the LOP part in the short-run is 5.26 (P-value = 0.03). The aforementioned empirical findings provide further evidence that the linear model for the dynamics of gold and oil prices in Pakistan would be undoubtedly model misspecification.

Moreover, we come back towards long-run dynamics which are reported in Table 4. NARDL estimates validate gold prices as significant both positive (LGPPOSITVE) and negative (LGPNEGATIVE) long-run magnitudes. The estimated coefficients on LGPPOSITVE and LGPNEGATIVE are 1.64 and

[4]*The critical value at 2.5 % proposed by Banerjee et al. (1998).*

-2.98 respectively. Consequently, it may conclude that a 1% increase in gold prices results -2.98% declines in stock market performance while a 1% decrease in gold prices results in 1.64% decline in stock market performance but the negative component is statistically insignificant. The empirical findings suggest that positive changes are making greater effect than negative changes.

On the other side, oil prices are statistically significant in both positive (LOPPOSITVE) and negative (LOPNEGATIVE) components. The estimated coefficients on LOPPOSITVE and LOPNEGATIVE are 3.06 and -3.16 respectively. The impact size of the negative component of oil prices is greater than the positive component. The estimate can be interpreted as a 1% increase in oil prices, results, 3.06% increase in stock market performance while a 1% decrease in gold prices results in 3.16% increase in stock market performance. However, the response of stock market performance to exchange rate is statistically insignificant (-1.64 with P-value= 0.27) which suggest that the increase in the exchange rate will decrease in stock market performance. The results of the oil prices suggest that both are helpful to enhance the stock market performance for either positive or negative component of the concerned variables, while gold prices enhance stock market performance in the presence of the positive component only. The diagnostic tests are presented in Table 6.

Table 4. Dynamic Estimation of NARDL Results

| Dependent variable | D(LSP) | | | |
|---|---|---|---|---|
| **Impact variable** | **Co-efficient** | **Standard error** | **t-Statistic** | **Prob.** |
| C | 1.968150 | 0.650432 | 3.025910 | 0.0057 |
| LSP (-1) | -0.301155 | 0.115254 | -2.612968 | 0.0150 |
| LEXR (-1) | -0.496297 | 0.440218 | -1.127387 | 0.2703 |
| LGPPOSITVE (-1) | -0.897826 | 0.387028 | -2.319792 | 0.0288 |
| LGPNEGATIVE (-1) | 0.494599 | 0.942831 | 0.524589 | 0.6045 |
| LOPPOSITVE (-1) | 0.924441 | 0.302394 | 3.057075 | 0.0053 |
| LOPNEGATIVE (-1) | -0.953199 | 0.339726 | -2.805786 | 0.0096 |
| DLOPPPOSITVE (-1) | -1.148698 | 0.497242 | -2.310140 | 0.0294 |
| DLOPNEGATIVE (-1) | 0.581804 | 0.375022 | 1.551384 | 0.1334 |
| **Long-run impact** | | | | |
| *Lgp$^+$* | -2.98* | *Lop$^+$* | 3.06* | |
| *Lgp$^-$* | 1.64 | *Lop$^-$* | -3.16* | |
| **LEXR** | -1.64 | | | |

*L* shows long-run and subscript "+" and "–" depicts the positive and negative component, * shows 1% significance level.

Table 5. Symmetric Hypothesis

| Symmetric Hypothesis | | | | | |
|---|---|---|---|---|---|
| **Long-run** | **Wald Stats** | **Prob.** | **Short-run** | **Wald Stats** | **Prob.** |
| $W_{LR, \, LGP}$ | 2.284 | 0.143 | $W_{SR, \, LOP}$ | 5.26 | 0.03 |
| $W_{LR, \, LOP}$ | 11.5295 | 0.0023 | | | |

Long-run symmetric hypothesis: $\frac{-\beta_i^+}{\beta} \neq \frac{-\beta_i^-}{\beta}$ and $\sum_{i=1}^{l} \Delta lop_i^+ = \sum_{i=1}^{l} \Delta lop_i^-$ short-run symmetric hypothesis:

Table 6. Diagnostics Tests

| Diagnostics | | |
|---|---|---|
| $R^2$ | 0.40 | |
| DW-statistic | 2.17 | |
| **Diagnostic tests** | **Test stats** | **Prob.** |
| $X^2_{\text{Ramsey}}$ | 2.69 | 0.050 |
| $X^2_{\text{Normality}}$ | 0.68 | 0.71 |
| $X^2_{\text{Hetro}}$ | 0.97 | 0.47 |
| $X^2_{\text{Serial correlation}}$ | 1.44 | 0.25 |

Brown et al. (1975), recommended CUSUM (cumulative sum) and CUSUMSQ (the cumulative sum of squares) tests to validate long-run coefficient's stability. Figure "A" depicts that plots of CUSUM and CUSUMSQ statistics are inside the critical bounds at 5 % significance level. This concludes that all estimated coefficients are stable.
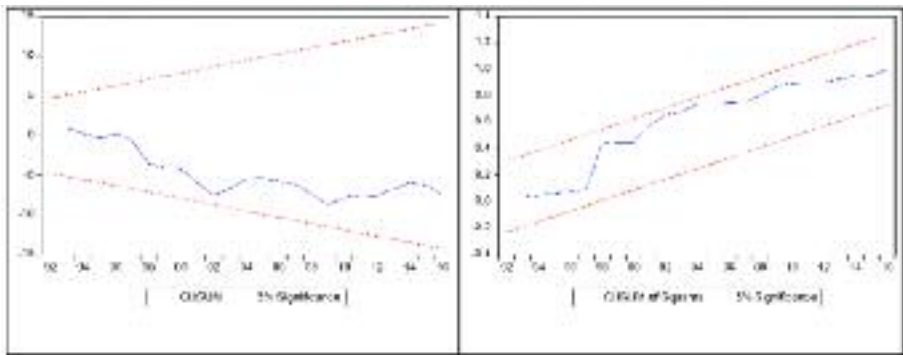


*Figure A. Plot of CUSUM and CUSUMSQ*

## SUMMARY AND CONCLUSION

This paper explored the dynamics among gold prices, oil prices and stock market performance, using Pakistan annual data. The time series data covers the time span from 1990 to 2016 and takes into account the exchange rate, gold prices, stock market performance and oil prices. The

empirical outcomes of the study contribute to prior literature by utilizing an asymmetric ARDL approach recently developed by Shin et al. (2014), which provides both possible asymmetric short and long-run dynamics. The empirical estimates affirm the asymmetric association between gold, oil prices and stock market performance. In the short-run dynamics, estimates indicate a significant asymmetric effect of oil prices.

Moreover, this investigation suggests that ignoring intrinsic asymmetries may lead to the misrepresentative implication in the case of stock market performance. The achieved suggestion of asymmetry could be of key prominence for more effective policy-making and forecasting in the Pakistan stock markets. For future research perspective, our paper results provide hints of possible dimensions. Firstly, the short and long-run asymmetry arise in the oil prices and creates increment on stock market performance, which is statistically significantly related to the stock market, thus it likely points out market forces in the Pakistan stock market. Therefore, policymakers may pay consideration directly to stock market forces and powers. Secondly, this investigation can further be organized with high-frequency data set to get more reliable policy implications.

# APPENDIX

## Why Nonlinearities /Asymmetries?

Ramos, Veiga, and Wang (2012), suggested that because of the change in oil prices, stock markets' behavior is asymmetric. The companies can transfer the burden of price increase to customers due to the fact that the company has monopolistic power in the industry or the demand does not change in response to increase in prices (Ramos & Veiga, 2013). Both facts explain the reason that why an increase in oil prices affects more than the decrease in the stock return of the oil and gas industry. The literature on the nexus between stock prices and exchange rate suggests a linear effect. It proposes that an increase or decrease in exchange rate affect symmetrically on stock prices. When believing a positive nexus, an increase in local currency destroys stock prices of the country, whereas a decrease in currency may augment stock prices at the same time with almost similar magnitude. However, in reality, this may not always be correct because technically speaking, considering the magnitude and signs both increase and decrease in the exchange rate should affect differently on stock prices. An asymmetry may appear in two shapes i.e. magnitude and sign. On one hand, asymmetry in magnitude implies that various industries and countries react differently to a degree of change in exchange rates. On the other hand, asymmetry in sign entails that industries and countries respond differently (i.e. positively or negatively) towards increase or decrease in exchange rates.

For a company, for instance, when a country's currency appreciates, it leads to a decrease in raw materials imported from abroad. As a result, firms' production costs decrease and profits increase, which eventually lead to an increase in stock prices. Similarly, when a country's currency depreciates, input costs increase and results in the decrease in stock prices. For the purpose of maintaining market share, the companies, however, can keep the same prices of their goods either by bearing the increased cost burden through cutting their profit margins or by increasing prices as a part of increased input costs, thereby, shifting some burden to the customer and retaining the market share. Moreover, there also exists an asymmetric relationship between gold and stock prices (Akgül, Bildirici, & Özdemir, 2015; Choudhry, Hassan, & Shabi, 2015). We suggest two key rationales for a nonlinear association between variables. Second, structural breaks, as well as asymmetric behavior resulting from bankruptcy or major credit incidents, are kind of non-linearities which frequently affect the dynamics of the market, specifically when sample period includes financial crisis such as the global crisis of 2007 and 2008 (Raza et al., 2016).

## REFERENCES

Akgül, I., Bildirici, M., & Özdemir, S. (2015). Evaluating the Nonlinear Linkage between Gold Prices and Stock Market Index Using Markov-Switching Bayesian VAR Models. *Procedia - Social and Behavioral Sciences*, *210*, 408-415.

Anoruo, E. (2011). Testing for Linear and Nonlinear Causality between Crude Oil Price Changes and Stock Market Returns. *International Journal of Economic Sciences & Applied Research*, *4*(3), 75-92.

Arouri, M. E. H., Lahiani, A., & Nguyen, D. K. (2015). World gold prices and stock returns in China: insights for hedging and diversification strategies. *Economic Modelling*, *44*, 273-282.

Banerjee, A., Dolado, J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in a single-equation framework. *Journal of time series analysis*, *19*(3), 267-283. https://doi.org/10.1111/1467-9892.00091

Baur, D. (2012). Asymmetric volatility in the gold market. *The Journal of Alternative Investments*, *14*(4), 26-38. https://doi.org/10.3905/jai.2012.14.4.026

Beckmann, J., & Czudaj, R. (2013). Gold as an inflation hedge in a time-varying coefficient framework. *The North American Journal of Economics and Finance*, *24*, 208-222. https://doi.org/10.1016/J.NAJEF.2012.10.007

Bekiros, S. D., & Diks, C. G. (2008). The relationship between crude oil spot and futures prices: Cointegration, linear and nonlinear causality. *Energy Economics*, *30*(5), 2673-2685.

Bernanke, B. (2009). *Asia and the global financial crisis: a speech at the Federal Reserve Bank of San Francisco's Conference on Asia and the Global Financial Crisis, Santa Barbara, California, October 19, 2009* (No. 481). Board of Governors of the Federal Reserve System (US).

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society. Series B (Methodological)*, 149-192. https://doi.org/10.2307/2984889

Capie, F., Mills, T. C., & Wood, G. (2005). Gold as a hedge against the dollar. *Journal of International Financial Markets, Institutions and Money*, *15*(4), 343-352. https://doi.org/10.1016/J.INTFIN.2004.07.002

Chen, A. S., & Lin, J. W. (2014). The relation between gold and stocks: an analysis of severe bear markets. *Applied Economics Letters*, *21*(3), 158-170. https://doi.org/10.1080/13504851.2013.844321

Chen, J., Naylor, M., & Lu, X. (2004). Some insights into the foreign exchange pricing puzzle: Evidence from a small open economy. *Pacific-Basin Finance Journal*, *12*(1), 41-64. https://doi.org/10.1016/S0927-538X(03)00020-9

Choi, J. J., Hiraki, T., & Takezawa, N. (1998). Is foreign exchange risk priced in the Japanese stock market?. *Journal of Financial and Quantitative Analysis*, *33*(3), 361-382. https://doi.org/10.2307/2331100

Choudhry, T., Hassan, S. S., & Shabi, S. (2015). Relationship between gold and stock markets during the global financial crisis: Evidence from nonlinear causality tests. *International Review of Financial Analysis*, *41*, 247-256. https://doi.org/10.1016/J.IRFA.2015.03.011

Chua, J. H., Sick, G., & Woodward, R. S. (1990). Diversifying with gold stocks. *Financial Analysts Journal*, *46*(4), 76-79. https://doi.org/10.2469/faj.v46.n4.76

Cologni, A., & Manera, M. (2008). Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries. *Energy economics*, *30*(3), 856-888. https://doi.org/10.1016/J.ENECO.2006.11.001

Di Iorio, A., & Faff, R. (2001). A test of the stability of exchange rate risk: Evidence from the Australian equities market. *Global Finance Journal*, *12*(2), 179-203. https://doi.org/10.1016/S1044-0283(01)00027-8

Dhaoui, A., & Bacha, S. (2017). Investor emotional biases and trading volume's asymmetric response: A non-linear ARDL approach tested in S&P500 stock market. *Cogent Economics & Finance*, *5*(1), 1274225. https://doi.org/10.1080/23322039.2016.1274225

Driesprong, G., Jacobsen, B., & Maat, B. (2008). Striking oil: another puzzle?. *Journal of Financial Economics*, *89*(2), 307-327. https://doi.org/10.1016/J.JFINECO.2007.07.008

Dumas, B. (1978). The theory of the trading firm revisited. *The Journal of Finance*, *33*(3), 1019-1030. https://doi.org/10.1111/j.1540-6261.1978.tb02041.x

Ewing, B. T., & Malik, F. (2013). Volatility transmission between gold and oil futures under structural breaks. *International Review of Economics & Finance*, *25*, 113-121. https://doi.org/10.1016/J.IREF.2012.06.008

Fareed, Z., Meo, M. S., Zulfiqar, B., Shahzad, F., & Wang, N. (2018). Nexus of tourism, terrorism, and economic growth in Thailand: new evidence from asymmetric ARDL cointegration approach. *Asia Pacific Journal of Tourism Research*, *23*(12), 1129-1141.

Ferson, W. E., & Harvey, C. R. (1994). *Sources of risk and expected returns in global equity markets* (No. w4622). National Bureau of Economic Research.

Ghatak, S., & Siddiki, J. U. (2001). The use of the ARDL approach in estimating virtual exchange rates in India. *Journal of Applied statistics*, *28*(5), 573-583. https://doi.org/10.1080/02664760120047906

Ghosh, D., Levin, E. J., Macmillan, P., & Wright, R. E. (2004). Gold as an inflation hedge?. *Studies in Economics and Finance*, *22*(1), 1-25. https://doi.org/10.1108/eb043380

Goodman, B. (1956). The price of gold and international liquidity. *The Journal of Finance*, *11*(1), 15-28.https://doi.org/10.1111/j.1540-6261.1956.tb00683.x

Gronwald, M. (2008). Large oil shocks and the US economy: Infrequent incidents with large effects. *The Energy Journal*, 151-171. https://doi.org/10.2307/41323148

Hamilton, J. D. (2009). *Causes and Consequences of the Oil Shock of 2007-08* (No. w15002). National Bureau of Economic Research. https://doi.org/10.3386/w15002

Hau, H., & Rey, H. (2005). Exchange rates, equity prices, and capital flows. *The Review of Financial Studies*, *19*(1), 273-317. https://doi.org/10.1093/rfs/hhj008

Henriques, I., & Sadorsky, P. (2008). Oil prices and the stock prices of

alternative energy companies. *Energy Economics*, *30*(3), 998-1010. https://doi.org/10.1016/J.ENECO.2007.11.001

Ibrahim, M. H. (2015). Oil and food prices in Malaysia: a nonlinear ARDL analysis. *Agricultural and Food Economics*, *3*(1), 2. https://doi.org/10.1186/s40100-014-0020-3

Ilyas, M., Ahmad, H. K., Afzal, M., & Mahmood, T. (2010). Determinants of manufacturing value added in Pakistan: An application of bounds testing approach to cointegration. *Pakistan Economic and Social Review*, 209-223. https://doi.org/10.2307/25825362

Ji, Q., & Fan, Y. (2012). How does oil price volatility affect non-energy commodity markets?. *Applied Energy*, *89*(1), 273-280. https://doi.org/10.1016/J.APENERGY.2011.07.038

Jiménez-Rodríguez*, R., & Sánchez, M. (2005). Oil price shocks and real GDP growth: empirical evidence for some OECD countries. *Applied economics*, *37*(2), 201-228. https://doi.org/10.1080/0003684042000281561

Jones, C. M., & Kaul, G. (1996). Oil and the stock markets. *The journal of Finance*, *51*(2), 463-491.

Kanjilal, K., & Ghosh, S. (2014). Income and price elasticity of gold import demand in India: Empirical evidence from threshold and ARDL bounds test cointegration. *Resources Policy*, *41*, 135-142.

Kaufmann, T. D., & Winters, R. A. (1989). The price of gold: A simple model. *Resources Policy*, *15*(4), 309-313.

Kilian, L. (2008). Exogenous oil supply shocks: how big are they and how much do they matter for the US economy?. *The Review of Economics and Statistics*, *90*(2), 216-240. https://doi.org/10.1162/rest.90.2.216

Kilian, L., & Park, C. (2009). The impact of oil price shocks on the US stock market. *International Economic Review*, *50*(4), 1267-1287. https://doi.org/10.1111/j.1468-2354.2009.00568.x

Kremers, J. J., Ericsson, N. R., & Dolado, J. J. (1992). The power of cointegration tests. *Oxford bulletin of economics and statistics*, *54*(3), 325-348. https://doi.org/10.1111/j.1468-0084.1992.tb00005.x

Kumar, D. (2014). Return and volatility transmission between gold and stock sectors: Application of portfolio management and hedging effectiveness. *IIMB Management Review*, *26*(1), 5-16. https://doi.org/10.1016/J.IIMB.2013.12.002

Lardic, S., & Mignon, V. (2008). Oil prices and economic activity: An asymmetric cointegration approach. *Energy Economics*, *30*(3), 847-855.

Maghyereh, A., & Al-Kandari, A. (2007). Oil prices and stock markets in GCC countries: new evidence from nonlinear cointegration analysis. *Managerial Finance*, *33*(7), 449-460. https://doi.org/10.1108/03074350710753735

Mahdavi, S., & Zhou, S. (1997). Gold and commodity prices as leading indicators of inflation: Tests of long-run relationship and predictive performance. *Journal of Economics and Business*, *49*(5), 475-489. https://doi.org/10.1016/S0148-6195(97)00034-9

Meo, M. S., Chowdhury, M. A. F., Shaikh, G. M., Ali, M., & Masood Sheikh, S. (2018). Asymmetric impact of oil prices, exchange rate, and inflation on tourism demand in Pakistan: new evidence from nonlinear ARDL. *Asia Pacific Journal of Tourism Research*, *23*(4), 408-422.

Meo, M. S., Khan, V. J., Ibrahim, T. O., Khan, S., Ali, S., & Noor, K. (2018). Asymmetric impact of inflation and unemployment on poverty in Pakistan: new evidence from asymmetric ARDL cointegration. *Asia Pacific Journal of Social Work and Development*, 1-16.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied economics*, *37*(17), 1979-1990.

Okwuchukwu, O. (2015). Exchange rate volatility, stock market performance and foreign direct investment in Nigeria. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, *5*(2), 172-184.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Prasad, E., Rogoff, Prasad, E., Rogoff, K., Wei, S. J., & Kose, M. A. (2005). Effects of financial globalization on developing countries: some

empirical evidence. In *India's and China's recent experience with reform and growth* (pp. 201-228). Palgrave Macmillan, London.

Ramos, S. B., & Veiga, H. (2013). Oil price asymmetric effects: Answering the puzzle in international stock markets. *Energy Economics*, *38*, 136-145.

Ramos, S. B., Veiga, H., & Wang, C. W. (2012). Asymmetric long-run effects in the oil industry (No. ws120502). *Universidad Carlos III de Madrid.* Departamento de Estadística.

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

Romilly, P., Song, H., & Liu, X. (2001). Car ownership and use in Britain: a comparison of the empirical results of alternative cointegration estimation methods and forecasts. *Applied economics*, *33*(14), 1803-1818.

Saeed Meo, M. (2017). Impact of Political Stability, Government Effectiveness and Corruption on Stock Markets of South Asia. *JPUHS*, *30*(1), 230–242.

Shahbaz, M., Tahir, M. I., Ali, I., & Rehman, I. U. (2014). Is gold investment a hedge against inflation in Pakistan? A co-integration and causality analysis in the presence of structural breaks. *The North American Journal of Economics and Finance*, *28*, 190-205.

Shapiro, A. C. (1975). Exchange rate changes, inflation, and the value of the multinational corporation. *The Journal of Finance*, *30*(2), 485-502. https://doi.org/10.1111/j.1540-6261.1975.tb01824.x

Sherman, E. J. (1982). Gold: a conservative, prudent diversifier. *The Journal of Portfolio Management*, *8*(3), 21-27.982). Gold. *The Journal of Portfolio Management*, *8*(3), 21-27.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In *Festschrift in Honor of Peter Schmidt* (pp. 281-314). Springer, New York, NY. https://doi.org/10.1007/978-1-4899-8008-3_9

Tiwari, A. K., & Sahadudheen, I. (2015). Understanding the nexus between oil and gold. *Resources Policy*, *46*, 85-91. https://doi.org/10.1016/J.RESOURPOL.2015.09.003

Tully, E., & Lucey, B. M. (2007). A power GARCH examination of the gold market. *Research in International Business and Finance*, *21*(2), 316-325. https://doi.org/10.1016/J.RIBAF.2006.07.001

Vacha, L., & Barunik, J. (2012). Co-movement of energy commodities revisited: Evidence from wavelet coherence analysis. *Energy Economics*, *34*(1), 241-247. https://doi.org/10.1016/J.ENECO.2011.10.007

Wang, K.M., Leeb, Y.M., & NguyenThic, T.-B. (2011). Time and place where gold acts as an inflation hedge: An application of long-run and short-run threshold model. *Economic Modelling*, *28*(3), 806–819.

Worthington, A. C., & Pahlavani, M. (2007). Gold investment as an inflationary hedge: Cointegration evidence with allowance for endogenous structural breaks. *Applied Financial Economics Letters*, *3*(4), 259-262.