Impact of exogenous variables (crude oil and gold) on stock returns volatility: A case of Karachi stock exchange

Usman Islam[1§] and **Safia Nosheen**[2]

[1]*The University of Lahore, Lahore, Pakistan*
[2]*University of Management and Technology, Lahore, Pakistan*
[§]*muhammad.usman@lbs.uol.edu.pk*

ABSTRACT

The purpose of this study is to understand the impact of gold and oil prices on the volatility of Karachi stock exchange (currently Pakistan Stock Exchange)-returns. In recent years, gold and crude oil have suffered significant changes, and most of the economies have been affected due to this change. This study primarily explores how much volatility is caused in Karachi stock exchange returns due to fluctuations in oil and gold prices. This study uses augmented dickey fuller test to check the stationarity of variables and ARCH and GARCH models with lag 1 to find the relationship between variables. The results of this study reveal that oil prices and domestic inflation significantly affect the market returns volatility, whereas gold price has no significant effect on the volatility of Karachi stock exchange-returns. Pakistan's market is a developing market; therefore it is not influenced by the Gold prices like other developed countries. This study uses 132 monthly observations for stock returns for a period ranging from 2005-2015. Oil is one of the largest imports of Pakistan and has a direct impact on Pakistan's economy. Therefore, results show a significant impact of oil prices in the volatility of Karachi stock exchange-returns.

Keywords:
ARMA, ARCH, GARCH, oil prices, gold prices, volatility.

INTRODUCTION

This study is conducted to identify the nature of Pakistan economy and its response to the oil prices fluctuations. Pakistan is a developing country and facing numerous crisis, especially terrorism threats since 2001, oil prices fluctuation, the incident of the world trade centre. News of bomb blast, target killing, political instability, foreign threats and corruptions are widespread. The stock market of Pakistan is very volatile as compare to the other Asian stock markets. In the last decade, tremendous fluctuations have been observed in Pakistan's biggest stock market Karachi stock exchange. Stock markets have a vital role in the growth of the country. Efficient capital market can enhance the growth of the economy.

The stock market provides a channel for investment, which plays an essential role to engage foreign and domestic investors. Performance of the stock market could be measured through index performance that is affected by many things like macroeconomic, social and political (Kibria et al., 2014). Pakistan stock market performance can be measured through KSE returns. In 2013, Karachi Stock market was declared second most revenue-generating a market. Figure 1 shows the Karachi stock exchange returns trend from Jan-91 to May-2014. Figure 1 shows abnormal growth in KSE returns from May-2009 to May-2014.

Figure 1: KSE Returns Trend

Consumer price index calculates the variation in the average price of a fixed basket of consumer goods. It has a significant impact on the economy. Increase in consumer prices index indicates inflation rate that reduces the purchasing power of consumers. The foreign exchange rate is the rate at which the currency of a country exchange for the currency of another country. Pakistan is an import-dominated country. When the currency of Pakistan is devalued against the US dollar, imports become expensive. Therefore, there is the unfavorable effect of currency devaluation on the economy of the country. Most countries like China increasing foreign reserves in the form of gold, so its demand is increasing. Pakistan is a significant importer of oil that is traded in dollars, so does the gold. Due to an imbalance in dollar prices cost of imports changes that have an extreme impact on the economy. The extreme impact might be positive or negative depending upon the direction of fluctuations. Therefore, gold prices have impact on Pakistan economy, and it is a universal macroeconomic variable.

Oil is one of the leading imports of Pakistan; for that reason, the prices of oil have a vital role in the Pakistan economy. Countries that import oil, their economy is affected by the fluctuation in oil prices. In the last years, oil prices

have been at the lowest rate in the last 20 years. In Pakistan most of the imports are inelastic by nature and the inelastic product is such a product that's demand is not affected by its prices like petroleum and another essential requirement of the country.

Therefore, even though the exchange rate decrease, the government is forced to increase its imports and due to such volatility of the exchange rate, the cost of import increases. The meaning of the exchange rate volatility is the change in the exchange rate due to the rise and fall of the homeland currency as compared to the international standard currency of the world. Oil is one of the most precious natural resources in the world. The demand for oil is increasing as the population of the world is increasing. Whenever its supply disturbed, it has caused a problem for both developed as well as developing countries. The era of industrialization in the twentieth century the crude oil and its prices became vital indicators of economic activity. This economic development increases the energy demand and supply has increased dramatically. In October 1973 Israel-Arab war had triggered the media and the economists to focus on oil price surges when the Arab members of the organization oil-exporting countries imposed an oil embargo on industrialized countries. This restriction shows the severe impact on the developed countries.

Six years later a considerable drop in Iran's oil supply, a consequence of the 1979 Iranian Revolution, disrupted the oil market. The shortage of supply had entailed oil prices increase while just oversupply of oil dragged prices down as exemplified by Iraq's resumption of oil exportation in 1999 when UN instituted its Oil-Food program that has flooded the energy market. In the last decade, the demand for oil has tremendously increased due to the industrializations in some Asian countries, especially India and China have pushed oil prices up. Spill overs in oil wells and during oil hauling and speculation have also been some other reasons for increased oil prices. The importance of crude oil and its prices cause to impact in almost all the sector of the economy. There has been a dramatical fluctuation in the oil prices for the last few years — especially the prices of West Texas Intermediate and Brent which is the critical benchmarks of substantial crude oil. The price has crossed $30/barrel at the beginning of 2004-05.

LITERATURE REVIEW

Saleem (2012) studies the impact of terrorist blasts and attack news on the actual market return. This study used an old model "EGRACH" model of Engle and Ng (1992-93). Through this model, the impact of good and bad news is analyzed on the stock. The result shows that all such news has a very negative impact on the returns of almost every sector of the country, besides this such

news also increase the volatility of the stock market and a few big guns of the country utilized this news like a golden egg in their hand (Gul et al., 2013).

It is also believed that the return of Oil and Gas Development Companies and industry do not respond significantly to such news as compared to the rest of other sectors. International investors do not have confidence in the Pakistan market as compared to other Asian markets. Due to the incident of September 11 in New York, the whole world has suffered from a great depression. The impact of this incident was not only on that time, but it has very long-lasting. Many countries suffer from this and Pakistan was also one of these countries that have suffered from it. The Madrid and London bomb blast and a series of attack in 2004-05 in Pakistan create a very disappointing image of Pakistan in the international community (Tahir, 2012).

A strand of literature is available on the diversification of the existing portfolio, possible risk hedging and price discovery based on some financial instruments like future and options. Namita, Ruhi & Batra, (2013) studied the influence of future index on the volatility of the spot market on S&P CNX Nifty. To conduct this research, they used Bi-Variate E-GRACH technique. Their finding clearly shows a unidirectional relation between market return spillover of spot and futures markets. They analyzed that in the value of returns and riskiness spot markets control and dominate the future market. The descriptive statistics show the level 5% significance in their finding. According to the study, better knowledge regarding mean and variance dynamics of both market can give a better view of underlying risk, and it may also increase the risk management of the investor. Their finding was convenient for all the policymakers and potential investor. Robert A Connolly et al. (1998) exams the external markets equity returns and risk, concluded that riskiness existed between their linkages on the market of U.S., U.K. andJapan.

The size and nature of the effect depend entirely upon the nature of the news. A slight strong and positive direct relation do exist between the U.S.A. and U.K. markets, but it usually shows negative impacts on Japan's market (Connolly & Wang, 1998). The influence of bad or good news on the return's volatility has always been a core concern for investments houses. In the whole world, banks always play a very vital role in the financial decisions of every investor. The same matter was discussed by (Hendricks, Kempa & Pierdzioch, 2012). There is historic debate regarding does the news of dividend affect the market or not. There are many factors both internal as well as external that plays a vital role in the market returns as it is a macro-economic phenomenon, therefore, no hard and fast rule has been established so far concerning the effect of dividend announcement news on market returns. Khan, (2011) took the sample of 131 KSE listed company of the last ten-year data from 2001-2010. Correlation and Anova technique were used to analyze the collected data. The result showed that

there is relationship between macroeconomic variables and stock returns. Rohitha and Susantha (2007) conducted research on market return volatility. They discussed the macroeconomic variables and suggested that the explanation of market return variation is beyond anyone's reasonable explanation. The study concluded there is not only one factor that affects the market return besides these there are some others issues micro as well as a macro that plays a vital role in the fluctuation of the stock market return. Kibria et al., (2014) statically analyzed the impact of the news on some major markets like on the DIJA, S&P 500 and NASDAQ. By utilizing the ten-week data, they concluded that there exists an association between news and stock market return.

Goonatilake and Herath, 2007 studied the influence of financial ratios on stock volatility and empirically showed that there is a strong relationship between the financial ratios and stock returns. Qayyum and Anwar (2011) conduct the researcher to indicate the significance of the relation between the stock market and monetary policy. They applied Engle-Granger two steps procedure and the bivariate EGRACH methodology and conclude a powerful and prominent relationship between monetary policy and stock returns. Box-Jenkins modelling has been used in the literature to study the stock market phenomena.

Time series analysis is useful for many activities in capital markets, and price indices to get the beneficial outcomes. The participation of investors in the stock market can reasonably be increase if they may have clues about its future direction; this is the reason why the prediction of the stock market getting more interesting and valuable. The more predictable the stock market is, the more profitable it can be by way of investing and trading. The one, who can make this job of predictability happen-with consistency, can be most valuable and thereby profitable. Additionally, this prediction feature of the stock market not only benefits investors, but it may of immense value to regulators and policymakers who can impose corrective measures given their capacity to forecast (Alile, 1984). Habibullah, Ahmed and Karim (1999) lately for stakeholders like investors, businesspeople, stockbrokers, and speculators, prediction of expected stock prices has been a pain in the neck, the main hurdle. Because investors and investing significant chunks of money into the stock market day by day, their anxiousness, in predicting expected stock movements, is increasing too. Here, fundamentally, only one question is addressed: what is an appropriate time to buy, hold or sell a stock? Noticeably, the journey to pursue this primary question can never be addressed in a vacuum; the prediction is based upon one assumption investors usually take-historic data of stock price movements provides a basis, although in part, for predicting future trends. Of course, it could be valid to some extent, but not always. Ironically, time series in finance tend to become extremely hard for

forecasting or prediction purpose because of their two properties-noise and property of being non-stationary (Shaffer, 2000).

Financial time series are subject to changes concerning time and more considerable variability. Moreover, movements in the stock market are also influenced by a numerous macro-economic variable: political uncertainty; law and order situation; broader economic factors etc. Although the prediction of the stock market or individual stocks has mostly been studied all over the world, and on several capital markets-stock markets; yet few grey areas prevail. For instance, the challenges, related to the un-clarified nature of stock market prediction and its day to day use in stocks of institutional investors in an attempt to maximize returns, still need to be wrestled down (Harries, 1997). Moving average, exponential smoothing, time-series regression etc. are the most commonly used linear method. Among them, Autoregressive Integrated Moving Average (ARIMA) is the most renowned method (Box and Jenkins, 1976). Although it is assumed to be a linear method, it carries more flexibility by representing various versions of time series: Autoregressive (AR); Moving Average (MA); combined AR and MA series ARIMA.

Furthermore, the perfect linearity of stock market returns does not hold due to the lack of empirical support. For a similar reason, the residual variance among expected and actual returns is reasonably significant. Therefore, several academicians and analyst advocate that financial markets are inherently non-linear (Abhyankar, Copeland & Wong, 1997). The stock market prediction has also been made by using few parametric nonlinear models including Autoregressive Conditional Heteroskedasticity (ARCH) and General Autoregressive Conditional Heteroskedasticity (GARCH). However, the pre-specification of the nonlinear model is a condition that has to be met, and required by the majority of nonlinear statistical methods, ahead of doing any estimation of parameters.

THEORETICAL FRAMEWORK

The theoretical framework is the structure that can hold or support a theory of a research study. The theoretical framework introduces and describes the theory that explains why the research problem under study exists. A theoretical framework is developed to focus on the relationships among the factors related to stock market volatility and the relationships within the stock market in the region that are related to contagion effects. The purpose of developing a conceptual framework is to helps the researcher to articulate hypotheses and to meaningfully analyze the interrelationship among the identification variables relevant to the topic.

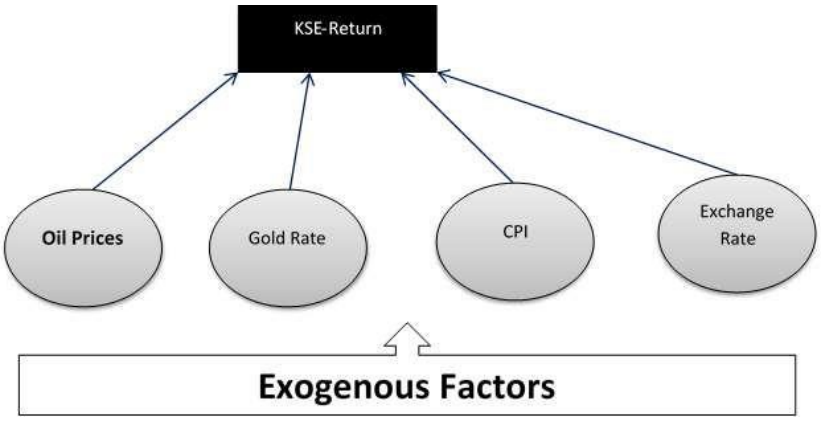

Figure 2: Proposed Model

As it is clear from the diagram 2 potential variables has been to understand their impacts on the KSE-returns. This study covers the impact of exogenous factors on the KSE returns.

As due to globalization international changes in such variables disturbed the balance of every economy. Therefore, these variables are chosen for the study. The study aims to understand the significance of these variables in term of stock returns. Moreover, to understand the nature and direction of the variations caused by these factors.

Research hypotheses

Hypothesis 1: *There is a relationship between KSE-100 index returns and the International Gold prices.*

Hypothesis 2: *There is a relationship between KSE-100 index returns and crude oil prices.*

Hypothesis 3: *There is a relationship between KSE-100 index returns and the domestic inflation rate.*

Hypothesis 4: *There is a relationship between KSE-100 index returns and the domestic exchange rate.*

METHODOLOGY

This is a pure time-series data study, and historical data has been collected from different resources. Monthly data for ten years of 2005-2015 has been used. The data of consumer price index is taken as proxy of inflation, crude oil prices per barrel for oil prices, and Pakistani rupee versus US dollar for the exchange rate. The data is collected from state bank of Pakistan and other sources.

Description of variables

Gold = The price of Gold in dollar per troy ounce

Oil = Price of crude oil in dollar per barrel

CPI = consumer price index

Exchange rate = Domestic currency concerning Dollar

ANALYSIS

The analysis started from the ADF test, and then ARMA test was conducted to check the lags

General Equations of ARMA

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=0}^{q} \beta_i \varepsilon_{t-i} + v_t$$

ARMA Equation

As based on the ic test the BIC value for a minimum for MA(1) model, therefore, the model equation suitable for this study will be as follow

$$y_t = \alpha_0 + \beta_1 \varepsilon_{t-1} + v_t$$

The first step in the analysis is to check either data is stationary or not as due to the assumption of ARCH family analysis stationary time series is compulsory. ADF model was used to evaluate these results. In the Table 1 results are shown multiple factors. First, the ADF test p-value is 0.000 that is significant at 1% it indicates that the series taken for analysis are stationary, and volatility analysis can be performed on that series.

Table 1: Augmented Dickey Fuller Test

ROA		Coefficients	Std. Error	T	p>t
Constant		0.08	0.05	0.17	0.01**
Gold		0.00	0.00	0.66	0.50
Oil		-0.00	0.00	-0.13	0.89
CPI		-0.00	0.00	-3.14	0.00
Exchange rate		-0.00	0.00	-0.76	0.44
ARMA					
	MA				
	L1	0.0091711	0.107	0.09	0.93
Sigma		0.0733213	0.00	23.36	0.00**

Note: Number of Observations = 131; chi2 - wald = 11.67**; Prob>F = 0.0397**; Bayesian Information Criterion = -278.69; Dickey-Fuller test for unit root = 0.00***(5% critical Value = -2.578); * 10%, ** 5%, *** 1% level of significance

As it can be seen the p-value of the model that is 0.05 that indicates the model significance at 5%. The model chosen and shown in Table 1 is of moving the average-1 model. On conducting a series of analysis, it was evaluated that this data is more significant on the MA (1) model based on the Bayesian Information Criterion. The value of BIC shown at the end of Table 1 is the lowest of all the values judged in AR (1) and ARMA (1,1) models. The coefficient of analysis is minimal in magnitude, and the p-value of the coefficient decided only domestic inflation has a significant volatility impact on the KSE returns as compared to the rest of the variables.

GARCH analysis

The (GARCH) Process is an econometric term developed in 1982 by Robert F. Engle to describe an approach to estimate volatility in financial markets

ARCH and GARCH general Equations

$$h_t = a_0 + \sum_{i=1}^{q} a_i \varepsilon^2_{t-i} + \sum_{j=0}^{p} \gamma_j h_{t-j}$$

For this study there are 4 variables taken to understand the volatility impact, therefore, the equation for this study will be as follow

$$h_t = a_0 + \sum_{i=1}^{q} a_i \varepsilon^2_{t-i} + \sum_{j=0}^{p} \gamma_j h_{t-j} + \delta 1 Gold + \delta 3 Exchange\ rate + \delta 3 Oil + \delta 2 CPI + v_t$$

Table 2 shows the ARCH and GARCH impacts of volatility concerning the exogenous factors. From the Table first important finding of the GARCH analysis is the p-value of the model is 0.000 that is less than 0.05 that indicates the significance of the model at even 1%. The mean model p-value id above 0.05 that indicates the mean part of the model is not significant while elaborating the volatility impact of the selected variables on the KSE returns. Only the variance part is significant as per the analysis results. Out of 4 variables, 2 variables are significantly impacting the volatility in the KSE-returns that is domestic inflation rate measure in term of CPI and crude oil prices.

As both variables have a homogeneous and inter-related impact on the economy, firstly, oil is the most significant import of Pakistan. Therefore, the smallest change in the oil prices disturbed the balance of Pakistan's economy, and whole overall structure faces the impact of such changes. The increase in

the oil prices shifted the increase in domestic inflation as all the commodities suffer the change.

Table 2: ARACH and GARCH Analysis

ROA		Coefficients	Std. Error	T	P>t
Constant		0.06	0.04	1.38	0.167
Exchange rate		-0.00	0.00	-1.13	0.259
CPI		-0.00	0.00	-5.06	0.00***
OIL		0.00	0.00	2.1	0.05**
GOLD		0.00	0.00	0.74	0.46
ARMA					
	MA				
	L1	-0.087855	0.13	-0.66	0.51
ARCH					
	L1	0.1085415	0.08	1.33	0.18
GARCH					
	L1	0.8227332	0.15	5.47	0.00**
Constant		3.60E-04	4.32E-04	0.83	0.40

Note: Number of Observations = 131; chi2 - wald = 45.45***; Prob>F = 0.000***; L Jung – BOX Q statistics = 0.9641 (ref to Appendix); * 10%, ** 5%, *** 1% level of significance

The Table 2 also shows that the magnitude of the volatility caused by these variables is shallow. After conducting the analysis, we can see the mean is equal to zero as L Jung-BOX Q statistics is 0.96 more than 0.05. Besides this, the sign is also different for both of the significant variables.

CONCLUSION

The study shows quite different results for KSE-returns as compared to the literature of developed economies stocks returns. The KSE- stock returns are volatile but not as much as of the developed stocks like S & P 500 and NY index. The CPI is the most significant factor impacting the volatility of the KSE returns. The factors taken in the study are impacting the stock market, but the magnitude of their volatility is not material. This phenomenon can also be justified from the banking system that indicates that more developed the economy is the banking system is more sensitive to small change. Similarly, in the case of stock returns, then markets which are more developed are more volatile to these variables as compared to the other markets. The GARCH analysis shows volatility exists due to the exogenous variables in the stock market returns, but the individual variables do not show the significant volatile impact on stock returns. From the graph 1, a considerable fluctuation can be seen in a small region that indicates the impact of the global financial crisis.

REFERENCES

Abhyankar, A., Copeland, L. S., & Wong, W. (1997). Uncovering nonlinear structure in real-time stock-market indexes: the S&P 500, the DAX, the Nikkei 225, and the FTSE-100. *Journal of Business & Economic Statistics*, *15*(1), 1-14.

Alile, H. I. (1984). The Nigerian Stock Exchange: Historical perspective, operations and contributions to economic development. *Central Bank of Nigeria Bullion, Silver Jubilee edition*, *2*, 65-69.

Box, G. E., & Jenkins, G. M. (1976). Time series analysis: Forecasting and control San Francisco. *Calif: Holden-Day*.

Connolly, R. A., & Wang, F. A. (1998, November). Economic news and stock market linkages: Evidence from the US, UK and Japan. In *Proceedings of the Second Joint Central Bank Research Conference on Risk Management and Systemic Risk*, Vol. 1, 211-240.

Goonatilake, R., & Herath, S. (2007). The volatility of the stock market and news. *International Research Journal of Finance and Economics*, *3*(11), 53-65.

Gul, S., Khan, M. T., Saif, N., Rehman, S. U., & Roohullah, S. (2013). Stock market reaction to political events (Evidence from Pakistan). *Journal of Economics and Sustainable Development*, *4*(1), 165-174.

Habibullah, M., Ahmed, A. U., & Karim, Z. (1999). Assessment of foodgrain production loss due to climate induced enhanced soil salinity. In *Vulnerability and adaptation to climate change for Bangladesh* (pp. 55-70). Springer, Dordrecht.

Harries, A. D., Parry, C., Nyong'onya, M., Graham, S. M., Daley, H. M., Maher, D., Salaniponi, F.M., & Nyangulu, D.S. (1997). The pattern of tuberculosis in Queen Elizabeth Central Hospital, Blantyre, Malawi: 1986–1995. *The International Journal of Tuberculosis and Lung Disease*, *1*(4), 346-351.

Hendricks, T. W., Kempa, B., & Pierdzioch, C. (2012). Do banks' buy and sell recommendations influence stock market volatility? Evidence from the German DAX30. *The European Journal of Finance*, *18*(1), 29-39.

Khan, A. A., & Khan, K. (2011). Dividend policy and stock prices–A case of KSE-100 index companies. *Cell*, *321*, 4028246.

Kibria, U., Mehmood, Y., Kamran, M., Arshad, M. U., Perveen, R., & Sajid, M. (2014). The impact of macroeconomic variables on stock market

returns: a case of Pakistan. *Research Journal of Management Sciences, 3*(8), 1-7.

Namita, R., Ruhi, K., & Batra, G. (2013). Futures Trading and its impact on Volatility of Indian Stock Market. *Asian Journal of Finance and Accounting, 5*(1), 289-305.

Qayyum, A., & Anwar, S. (2011). Impact of monetary policy on the volatility of stock market in Pakistan. *International Journal of Business and Social Science, 2*(11), 18-24.

Goonatilake, R., & Herath, S. (2007). The volatility of the stock market and news. *International Research Journal of Finance and Economics*, *3*(11), 53-65.

Shaffer, M. A., Okereke, E., Esterhai Jr, J. L., Elliott, M. A., Walter, G. A., Yim, S. H., & Vandenborne, K. (2000). Effects of immobilization on plantar-flexion torque, fatigue resistance, and functional ability following an ankle fracture. *Physical Therapy*, *80*(8), 769-780.

Tahir Suleman, M. (2012). Stock market reaction to terrorist attacks: Empirical evidence from a front line state. *Australasian Accounting, Business and Finance Journal*, *6*(1), 97-110.

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica: Journal of the Econometric Society*, 987-1007.