Mean and Variance Volatility Spillover from Commodity Market to Stock Market of Pakistan, China and India

Muhammad Adil
University Institute of Management Sciences, Arid University
madil4761@gmail.com

Anum Shafique
Lecturer, University Institute of Management Sciences, Arid University Rawalpindi
anum.shafique@uaar.edu.pk

Dr. Bushra Zulfiqar
Assistant Professor, Arid Agriculture University Rawalpindi
bushra.zulfiqar@uaar.edu.pk

Mehmood ul Hassan
Lecturer, Business Department AIOU
mehmmoulhasan@aiou.edu.pk

Abstract

The focus of this study is to understand the volatility and its spillover from Crude Oil and Gold Market to the stock markets of the countries selected. This is a univariate analysis where only one direction of volatility spillover has been examined. GJR GARCH Model has been used for the purpose of analysis. The findings of the study reveal that ARCH effect exists in the Oil and Gold Market but not in the Stock Markets Selected. Further, Mean Volatility do not exist but Variance equation shows volatility. And, no evidence of spillover was found in these stock markets.

Key words: Crude Oil, Gold Market, Stock Prices, GARCH, ARCH

Introduction

Stock market is affected by many economic factors such as crude oil prices, gold prices etc. (Awais, Ellahi, & Sher, 2019). In literature, very complex relationships among these factors were observed. It means that stock prices are more affected by these variables, i.e. crude oil prices, gold prices, and volatility of both. As Crude oil is one of the essential elements of an economy and considered as the driver of the economy (Ali & Kazmi, 2020). Thus Fluctuations in oil prices fundamentally affect business, yet additionally on trade markets and the overall economy. This influence on market exists due to the import of large quantity of oil to meet the daily requirements of different sectors of economies. Number of studies such as (Ansar & Asghar, 2013; Fatima & Bashir, 2014; Ji & Fan, 2012) has confirmed this argument.

Similarly, Bhunia et al. (2013) indentified several reasons for the vitality in gold prices in an economy. Gold prices of the country represent its healthy economy. While, Najaf et al. (2016) declared a strong relationship between the stock market and gold prices and express Gold as a risk-free investment. In addition, gold and inflation are positively correlated therefore gold is considered as a good hedge against inflation (Bampinas & Panagiotis, 2015). On the other hand, low volatility in gold prices leads to a safe investment environment (Baur, 2012). Therefore, Ciner et al. (2013) declared gold as diversified product for the portfolio due the low correlation with other assets which leads to reduce risk of the overall portfolio. On the other hand, fluctuations in gold prices can warn and expose investors to risks, which in turn stimulate investors' interest in understanding the stock market's response to fluctuations in gold prices.

Number of studies such as (Ali & Kazmi, 2020; Baur 2012; Ciner et al., 2013; Kanjilal & Ghosh, 2014; Najaf et al., 2016; Raza et al., 2016) have been carried out to check the impact of crude oil prices and gold prices on economies of the different emerging, and developed markets such as Europe and America, as they are the main producers of crude oil but is dearth of studies on Asian countries in the literature. Many empirical researches have analyzed and confirmed the association between oil and stock markets. For instance a study conducted by

Arfaoui and Rejeb (2017) aimed to examine the global perspective where the researchers studied oil, gold, US dollar and stock prices interdependencies. Similarly, Ansari and Sensarma (2019) studied the impact of US monetary policy, oil and gold prices on the stock markets of BRICS economies. The findings of the study reveal mixed results such as for gold, South Africa shows negative and Russia and Brazil shows positive impact. The current study conducted by Mensi et al. (2023) in Canada, Japan and USA and out of emerging markets BRICS economies. The findings of the study reveal co-movement between the crude oil and the stock markets has been intensified during the global financial crisis and covid-pandemic periods.

In emerging markets of Asian countries such as the stock markets of China, India and Pakistan represent dynamic landscape in the Asian region. Each country's stock market represents unique characteristics and complexities. India's stock market that is Bombay Stock Exchange and National Stock Exchange is known for its diversity and robust regulatory framework. China's stock market i.e. Shanghai and Shenzhen Stock exchanges are considered as a powerhouse in the global financial arena. China's stock exchanges have seen a rapid growth reflecting the huge economic expansion of the country. In contrast Pakistan's stock market i.e. PSX is operating in a developing economy. The challenges faced by the country such as geopolitical uncertainties and political turmoil have a huge impact on it. However, it has turned out to me resilient even in these tough times. The analysis of these markets with the Gold and Crude Oil interplay offer valuable insights into the regional economic dynamics as well as the cross market analysis. Due to fluctuation in oil and gold prices, the macroeconomic indicator does not remain constant. Hence the objective of this study is to understand the volatility and its spillover from Crude Oil and Gold Market to the stock markets of the countries i.e. Pakistan, Indian and Chinese Stock Markets.

Research Questions

- Is there any spillover from Gold Market to Pakistan, Indian and Chinese Stock Markets?
- Is there any spillover from Oil Market to Pakistan, Indian and Chinese Stock Markets?

Research Objectives

- To investigate the spillover from Gold Market to Pakistan, Indian and Chinese Stock Markets?
- To examine spillover from Oil Market to Pakistan, Indian and Chinese Stock Markets?

Literature Review

Efficient Market Hypothesis (EMH) by Eugene Fama (1960) and Market Portfolio theory (Markowitz, 1991) provide the theoretical base for the underlying study. On one hand where EMH emphasizes the timely link between information and prices of stock. The fluctuations in the other markets may have a contagion effect on the stock markets. (Awais, Ullah, Sulehri, Thas Thaker, & Mohsin, 2022). Further, the investment opportunities in the other markets can provide investors opportunity to diversify their portfolio cross market. However, in order to optimize the benefits, it is necessary to understand the dynamics of relationship these markets offer.

Nadal et al. (2017) investigated time-shifting linkages between the crude oil market and the S&P500 stock market index. The researchers used DCC GARCH model to analyze the data. The findings of the study reveal that the connections exist between the returns of the crude oil and the stock markets. Moreover, Bein (2017) also studied the timing shifting linkages and the vulnerability transmission from oil market to the stock markets of Baltics and four European countries. The researcher also used DCC GARCH model to obtain results. The findings of the study reveal that the transfer of risk exists more in Baltic countries as compared to the European nations.

Awartani et al. (2018) used DCC-MIDAS model to find out the linkages between the oil prices and the stock markets of MENA (Middle East and North Africa) countries. The findings of the study show that an increase in oil prices leads to a reduction in the risk in the stock markets of Saudi Arabia. However, this increase in the oil price may cause other business sectors to become instable.

Another study conducted by Pandey et al. (2018) used the EGARCH model to examine linked between Gold and crude oil into BRICS' stock markets and found irregularity for fluctuation. Furthermore, this research also studied the extent to which the 2008 financial crisis affected the spillover of volatility. They concluded that spillover was significantly positive for both gold and crude oil volatility. BRICS stock market affected volatility in Crude Oil

and Gold prices. Likewise, Mokni and Youssef (2019) used copula model to study the dependence structure between crude oil and the GCC (gulf cooperation council) equity markets. The findings of the study show that positive relationship exists between the returns of both markets. Further, the equity market of Saudi Arabia show high level of persistent dependence with the oil prices. It further shows that there exists greater upper-tailedness as compared to the lower-tailedness in the markets selected, showing positive relationships in the extreme positive movements. Fina and Tourani-Rad (2019) studied the transmission of volatility from the crude oil market to stock returns in the US and Saudi Arabia using VAR method. The study showed that asymmetric pattern exists between the markets where the oil market fluctuations affect the stock market returns depending upon the direction of the movement.

Liu et al. (2019) revisit the relationship of worldwide crude oil costs with Chinese stock exchange returns. It has been deduced in the investigation that there is solid proof of respective transmission of mean and instability among Chinese stock market and worldwide benchmarks. Furthermore, high time-shifting relationship is seen between the thought about business sectors.

Wei et al. (2019) used non-linear limit co-integration to examine the impact of oil market fluctuations in the stock market of China. Their findings show a long-term relationship between the two markets. However, the disruption in this long-term relationship can be seen in 2008 and 2012. Jie (2019) show the linkage between the oil market and the Sino-US equity market during the trade war using BEKK and VAR Model. The study show no significant evidence of existence of spillover during this period. However, there are indications of weak risk transmission during the trade war period in the Chinese equity market.

Sinlapates et al. (2021) studied the volatility linkages between commodity and stock markets. The researchers selected the stock market of Thailand and Oil and Gold Market for the purpose of the study. The study employs BEKK GARCH model. The findings of the study reveal that volatility transmissions were different during different time periods. The study took financial crisis pre and post period to examine the volatility and spillover behavior. To sum, the above studies provide a comprehensive overview of the evolving research on the subject under study. It shows the intricate relationships between crude oil markets, global stock exchanges across various regions with different time periods and different methodologies.

Methodology

Daily closing prices were obtained for all the five markets (Two commodity markets i.e. Gold & Crude oil) and three financial markets (Pakistan, India, & China). The reason of selection of these three stock markets is to ensure the representation of diverse economic landscapes in the Asian region. India and China, particularly, are recognized as the emerging economies with substantial impacts on the global markets. On the other hand, Pakistan being a developing country provides a valuable contrast. Analysis of these diverse market dynamics will offer insights in the context of Gold, Oil and Stock market interactions. The duration of the data has been January 04, 2010 to December 30th 2019. Data for the financial markets and crude oil market was obtained from investing.com. In addition, Gold Market data was obtained from eia.gov. Returns for all series were calculated using the natural log function and dividing the opening price with the closing price in each series.

The mean equation used for the purpose of the study is as follows:

$Rt = \mu + \lambda iRt{-}1 + \varepsilon t$

The variance equation used for the purpose of the study is as follows:

$\sigma_t^2 = \omega + (\alpha + \gamma I_{t-1})\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$

Results and Discussion

Table 1: Unit Root Test

Serial Name	Stationarity
Pakistan	0.0001
China	0.0001
India	0.0001
Oil	0.0001
Gold	0.0101

Table 1 shows the result of unit root test. The null hypothesis of the unit root test tells about the presence of unit root in the series, indicating a non-stationarity in the time series. It is to be noted that if the p-value is less than 0.05, then we will reject this null hypothesis. Therefore, in the above results as the p-value is less than 0.05 in all the cases, we may infer that all the series in the underlying study i.e. both commodity and the financial markets show the stationarity at level.

Table 2: LM Test

Serial Name	Durbin-Watson stat	LM Test (Prob.)
Pakistan	2.000684	0.1763
China	1.998825	0.3787
India	2.000676	0.3787
Oil	1.999988	0.9800
Gold	2.073750	0.000

Durbin Watson values show about the situation of auto-correlation in the data. The values fall in the range between 1.7 to 2.3. As per the DB test, these values are in range suggesting no correlation between the terms, i.e. including gold and oil prices and the stock markets of the respective countries. In addition to this, the p-value of gold in the LM test is also less than 0.05. Thus, as a result we can accept the null hypothesis and may reject the alternative hypothesis.

Table 3 Heteroscedasticity Test: ARCH

Oil	F-statistic	54.42768	Prob. F(1,3534)	0.0000
Gold	F-statistic	51.45116	Prob. F(1,3534)	0.0000

ARCH test is pre-requisite for applying the GARCH method in order to check the volatility in the data. The p-value is the indicator for making decision regarding the presence of ARCH effect or not. The p-value for the series in the underlying study is less than 0.05 that shows the presence of ARCH effect in both the oil and the gold stock return series. It therefore, suggest the need to further analyze the potential spillover effects.

Table 4 Mean Equation from Oil to Stock Markets

Series	Variables	Coefficients	P-value
Pakistan	OIL (-1)	-0.004	0.933
China	OIL (-1)	-0.004	0.93
India	OIL (-1)	-0.004	0.933

Table 5 Variance Equation for Oil Market to Stock Markets

Series	Variables	Coefficients	P-value
Pakistan	Residue (-1)^2	0.15	0
	GARCH(-1)	0.6	0
	VSOP	0	1
China	Residue (-1)^2	0.15	0
	GARCH(-1)	0.6	0
	VSOC	0	1
India	Residue (-1)^2	0.15	0.001
	GARCH(-1)	0.6	0
	VSOI	0	1

The results of mean equation for all the three stock markets i.e. Pakistan, India and China show the absence of volatility in the oil returns. However, the variance equations show the presence of volatility, which can be clearly seen as the p-value is less than the threshold i.e. 0.05. In addition to this, the beta coefficient of GARCH (-1) shows 60% volatility in the oil market.

Table 6 Mean Equation from Gold Market to Stock Markets

Series	Variables	Coefficients	P-value
Pakistan	Gold (-1)	0.174	0
China	Gold (-1)	0.104	0
India	Gold (-1)	0.117	0

Table 7 Variance Equation from Gold Market to Stock Markets

Series	Variables	Coefficients	P-value
Pakistan	Residue (-1)^2	0.302	0
	GARCH(-1)	-0.816	0
	VSOP	-0.011	0.831
China	Residue (-1)^2	0.52	0
	GARCH(-1)	-0.389	0
	VSOC	0.017	0.873
India	Residue (-1)^2	0.51	0
	GARCH(-1)	-0.418	0
	VSOI	0.008	0.89

The mean equations for all the stock markets show the presence of volatility in the gold returns. This conclusion (existence of volatility is reinforced by the variance equations as well). For the variance equations, p-values are also less than 0.05, showing the presence of volatility. Further, the beta coefficients of GARCH (-1) shows that there is a substantial negative volatility of approximately, -81.6% for Pakistan, -38.9% for China and -41.8% for India in the gold market. The negative direction of beta in this situation shows that any changes in the markets have adverse effects over the other.

It is to be notes that although volatility exists in the respective markets, the spillover effects cannot be seen, as evidenced by the greater p-values from the threshold that is 0.05. It shows that the gold market do not significantly affect the other markets discussed in the underlying study. It means that while the volatility exists in gold returns across regions, the adverse impact of this are contained within gold market itself and do not transmit to the other markets.

Discussion

The results for crude oil indicate lack of volatility in the mean equation for all the markets however, the variance equation shows the contradictory results. It means that the volatility does exists in the Crude oil returns. Further, as the p-values for spillover effect are all above 0.05, it shows no significance and therefore, no presence of spillover effect from the crude oil market to the stock market. The findings of the study are affirmed by Awartani et al. (2018) where the researchers used DCC-Midas in order to check the link among the oil costs and the MENA nations. Risk spillover from the oil market to MENA countries has shown weak linkages among the selected markets for the purpose of the study.

The volatility in the Gold returns across different time period show the dynamic nature of the Gold market. The results in the above in the form of negative beta coefficients show that changes in the Gold market have adverse impact on the markets. These results are supported by Awartani et al. (2018) where the researchers found weak relationship among these markets. Furthermore, the absence of spillover effect shows that Gold market volatility exists, it does not lead to a significant transmission of shocks to the stock markets. In addition, since gold is positively correlated with inflation, it is also a good hedge against inflation (Bampinas & Panagiotis, 2015). The reduced volatility of gold prices shows a safe investment environment (Baur, 2012)

Conclusion

This research provides insight into the volatility and spillover from oil and gold prices on the stock market of the selected countries. It was found that ARCH effect exists in Oil and Gold series. Further, mean volatility was not found but volatility in variance exists in the markets. Also, no evidence was found of spillover from Oil and Gold market to the selected stock markets.

The results of the study were opposed to those of the studies conducted by Wei et al. (2019) and Jie (2019) where the researchers found strong spillover effect from the commodity market to the selected stock markets. However, the findings of the underlying study compliments the findings of Awartani et al. (2018) where weak linkages of spillover resulted after the cross market analysis. The comparison highlights the importance of contextual factors. It means that the selection of markets in these studies are not same that can be a reason of difference in outcomes.

The study may not only assist the investors but also provide a vigilant caution to all the other stakeholders as well to consider the implications that may be caused by the other markets as well. Exploring other markets shall facilitate the investors to make a better portfolio. However, the understanding of the implications regarding the other markets is necessary. Lastly, there are many opportunities for the future researchers to explore these dynamics with further advance methodological approaches for instance Machine learning and other factors that aid to the volatility and spillover.

References

Ansar, I., & Asghar, N. (2013). The impact of oil prices on stock exchange and CPI in Pakistan. *IOSR journal of Business and Management*, *7*(6), 5.

Ansari, M. G., & Sensarma, R. (2019). US monetary policy, oil and gold prices: which has a greater impact on BRICS stock markets? *Economic Analysis and Policy*, *64*, 130-151.

Arfaoui, M., & Ben Rejeb, A. (2017). Oil, gold, US dollar and stock market interdependencies: a global analytical insight. *European Journal of Management and Business Economics*, *26*(3), 278-293.

Awais, M., Ellahi, N., & Sher, A. (2019). Effects of Remittances on Financial Development: A Time Series Analysis for Pakistan. *Global Regional Review*, *4*(4), 381-387.

Awais, M., Ullah, N., Sulehri, N. A., Thas Thaker, M. A. B. M., & Mohsin, M. (2022). Monitoring and Efficiency in Governance: A Measure for Sustainability in the Islamic Banking Industry. *Frontiers in Psychology*, *13*, 884532.

Awartani, B., Javed, F., Maghyereh, A., & Virk, N. (2018). Time-varying transmission between oil and equities in the MENA region: New evidence from DCC-MIDAS analyses. *Review of development finance*, *8*(2), 116-126.)

Bampinas, G., & Panagiotidis, T. (2015). On the relationship between oil and gold before and after financial crisis: linear, nonlinear and time-varying causality testing. *Studies in Nonlinear Dynamics & Econometrics*, *19*(5), 657-668.

Baur, D. G., & Lucey, B. M. (2010). Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold. *Financial review*, *45*(2), 217-229.

Baur, D. G., & McDermott, T. K. (2010). Is gold a safe haven? International evidence. *Journal of Banking & Finance*, *34*(8), 1886-1898.

Bein, M. (2017). Time-varying co-movement and volatility transmission between the oil price and stock markets in the Baltics and four European countries. *Engineering Economics*, *28*(5), 482-493.

Bhunia, A., & Das, A. (2012). Association between gold prices and stock market returns: Empirical evidence from NSE. *Journal of Exclusive Management Science*, *1*(2), 1-7.

Ciner, C., Gurdgiev, C., & Lucey, B. M. (2013). Hedges and safe havens: An examination of stocks, bonds, gold, oil and exchange rates. *International Review of Financial Analysis*, *29*, 202-211.

Fama, E. F. (1960). Efficient market hypothesis. *Diss. PhD Thesis, Ph. D. dissertation*.

Fatima, T., & Bashir, A. (2014). Oil price and stock market fluctuations: Emerging markets (A comparative study of Pakistan and China). *International Review of Management and Business Research*, *3*(4), 1958.

Finta, M. A., Frijns, B., & Tourani-Rad, A. (2019). Volatility spillovers among oil and stock markets in the US and Saudi Arabia. *Applied Economics*, *51*(4), 329-345.

Ji, Q., & Fan, Y. (2012). How does oil price volatility affect non-energy commodity markets? *Applied Energy*, *89*(1), 273-280.

Jie, J. (2019, December). Study on the Linkage between International Crude Oil Price and Sino-US Stock Market against the Backdrop of Trade War. In *2019 International Conference on Economic Management and Cultural Industry (ICEMCI 2019)* (pp. 1044-1049). Atlantis Press.

Kazmi, S. A. R. (2020). *Impact of Crude Oil Market on the South Asian Equity Markets: Copula Approach* (Doctoral dissertation, Doctoral dissertation).

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.

Liu, Z., Ding, Z., Zhai, P., Lv, T., Wu, J. S., & Zhang, K. (2019). Revisiting the integration of China into the world crude oil market: the role of structural breaks. *Frontiers in Energy Research, 7*, 146.

Markowitz, H. M. (1991). Foundations of portfolio theory. *The journal of finance, 46*(2), 469-477.

Mensi, W., Rehman, M. U., Al-Yahyaee, K. H., & Vo, X. V. (2023). Frequency dependence between oil futures and international stock markets and the role of gold, bonds, and uncertainty indices: Evidence from partial and multivariate wavelet approaches. *Resources Policy, 80*, 103161.

Mokni, K., & Youssef, M. (2019). Measuring persistence of dependence between crude oil prices and GCC stock markets: A copula approach. *The Quarterly Review of Economics and Finance*, *72*, 14-33.

Nadal, R., Szklo, A., & Lucena, A. (2017). Time-varying impacts of demand and supply oil shocks on correlations between crude oil prices and stock markets indices. *Research in International Business and Finance, 42*(C): 1011-1020

Najafabadi, A. T. P., Qazvini, M., & Ofoghi, R. (2020). The impact of oil and gold prices shock on Tehran stock exchange: a copula approach. arXiv preprint *arXiv:2001.11275*.

Pandey, V. (2018). Volatility spillover from crude oil and gold to BRICS equity markets. *Journal of Economic Studies, 45*(2), 426-440.

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.

Sinlapates, P., Romklang, N., &Chancharat, S. (2021). Volatility linkages among the returns of oil, gold, and stock market: Evidence from Thailand. *Asia-Pacific Journal of Science and Technology*, *26*(04).

Wei, Y., Qin, S., Li, X., Zhu, S., & Wei, G. (2019). Oil price fluctuation, stock market and macroeconomic fundamentals: Evidence from China before and after the financial crisis. *Finance Research Letters, 30*(C): 23-29.