

Association between Precious Metal Prices and UK Stock Market: The Case of FTSE 100 Index

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Abstract

Stock market of a country is highly sensitive to the both external and domestic factors, and precious metal prices i.e. gold, silver, platinum, and palladium is one of those factors. In the recent years, the fluctuations in precious metal prices gained the attention of many analysts, scholars, and academicians. This study examines the association between precious metal prices and London largest stock market FTSE 100 index. The current study uses monthly time series data covering the period of 2000-2016. Findings of this study reveal that there is a bivariate correlation exists among silver and gold, Platinum and gold and Platinum and silver, but no long run equilibrium exists among precious metal prices and UK stock market. Results of VAR model shows a significant and negative gold impact as well as platinum and palladium prices on FTSE 100 index in short run, while silver prices have no impact on UK stock market. Results of Granger Causality shows that all precious metal prices Granger Cause the FTSE 100 index in short run. Further, we apply impulse response function (IRF) after VAR model to observe the transmission dynamics of precious metal and stock market prices. Graphic results of impulse response function also tell us that silver prices have no effect of shock in the other variables prices. Considering the volatility dynamics of precious metals prices provides a guideline for rational investors for deciding how and where to invest during the times of low and high volatile regimes.

Keywords- Precious metals, UK stock market, Vector autoregressive model, Johansen Co Integration, Granger Causality, Impulse response function

Introduction

In times of financial crisis of 2008, precious metals have considered being alternative investments. In times of financial crisis, most of the investors in the past find precious metals as a safe haven (Opdyke,

2010). The study of precious metals market has focused on three different areas. These areas are future market manners and its relationship with spot markets, forecasting and investment prospects along with probable capital gains (Cargill & Rausser, 1975); (Goss, 1981); (Chu, 1978); (Heal & Barrow, 1980). Precious metals refer to the classification of metals that are considered to be rare and have economic value. The most popular precious metals that are used in industrial process and investments are Gold, Silver, Platinum, and Palladium. The markets in which investors make investments are determined by many factors such as current and future price movements of precious metals and interest rates. The top three countries that are utilizing gold are the USA, China, and India whereas major countries for gold productions are South Africa, USA, China and Australia (Shahzadi & Chohan, 2012).

The precious metals gained too much importance from the point of view of international investors and traders because of its recent rise prices and increased in economic uses. Their relationship has not only gained the attraction of the investors but also the attentions of the lay persons (Adrangi & Chatrath, 2002). Recently, precious prices are considered as moving together with stock prices. When global financial crisis starts, most of the stock markets crashed during the period of 2007- 2009. The investments in different commodities, oil, and precious metals have gained more popularity for investing activities all over the world. Many authors investigate the co-movements of commodity prices and provide further dependable evidence’s to the investors than consumer prices (Mahdavi & Zhou, 1997).The relationship between FTSE 100 index prices and precious metal prices over the years can be seen from Figure 1.

Figure 1: FTSE 100 index and precious metal prices (2000-2016)



Figure 1 shows the prices patterns of the index and precious metals over the years. FTSE 100 index is begun on 3 January 1984 at the base level of 1000. While, the index was dropped significantly during the financial crisis and after that, it recovers its performance on 8 February 2011. The index is reached at its peak 13 January 2017 with the highest closing value of 7337. The prices of the precious metals increased dramatically over the years. Such upward trends are due to many factors such as recent economic crisis, inflation anticipations and its greater demand by emerging markets (Lee & Lin, 2010). The prices of gold, platinum, and palladium have upward trend slightly downward trend due to financial crisis while silver prices show no significant effect. Gold and platinum have upward trend till 2008 and in 2008 it drops due to the crisis than after, in 2009 gold, platinum and palladium prices again increase. Financial crisis starts from the USA in September 2007 and spreads all over the world and almost every stock market is crashed due to this crisis. S&P 500 index drops almost 50% of its value in 2008 and Dow Jones drops almost 777.68 points¹. As results of these dramatic changes in the market of precious metals gained popularity among investors because these precious metals serves many things for the investors for instance; store of value and as a mean for expanding their risk (Adrangi, Chatrath, & Raffiee, 2003); (Lucey & Tully, 2006). Practically, the policy makers pay special attention to the commodity prices and their fluctuations. The central issue of world's economy is the volatility of commodity prices (Summit, 2009). Analyzing the linkage between the precious metal prices and the stock market is of particular interest of financial players (Jahan-Parvar, Wohar, & Vivian, 2011); (Choi & Hammoudeh, 2010).

The current study tries to find the following research questions:

- What is the relationship between Gold and UK stock market?
- What is the relationship between Silver and UK stock market?
- What is the relationship between Platinum and UK stock market?
- What is the relationship between Palladium and UK stock market?

Based on the above research questions, the aims of this study are as follows:

¹<https://www.thebalance.com/stock-market-crash-of-2008-3305535>

- To find the long-run or short-run relationship between Gold and FTSE 100 Index of UK stock market for the period of 2000 to 2016.
- To find the long-run or short-run relationship between Silver and FTSE 100 Index of UK stock market for the period of 2000 to 2016.
- To find the long-run or short-run relationship between Platinum and FTSE 100 Index of UK stock market for the period of 2000 to 2016.
- To find the long-run or short-run relationship between Palladium and FTSE 100 Index of UK stock market for the period of 2000 to 2016.

The main objective of this study is to find the relationship between precious metals and stock market of UK because it is well known that the prices of various natural resources is of high importance for both businesses and policy makers (J. T. Bernard, Khalaf, Kichian, & McMahan, 2008).

Literature Review

Most of the studies conducted in past are about to examining the relationship between stock markets and different types of macroeconomic variables. The main focus of these studies is to analysis the stock markets of developing countries by different factors (Fama & French, 1989); (Hamo, 1988); (Abdalla & Murinde, 1997); (Darrat & Dickens, 1999). These studies found industrial production, angle of the yield curve, risk premiums, money supply, inflation rate and interest rates has been the significant factors in explaining stock markets. The literature on precious metals has recently gained specific thoughtfulness from the academicians and researchers. These precious metals provide an avenue for investors to make a hedge to diversify their risks arising from stock markets. The financial disturbances, stock markets high volatility and widespread contagion becomes the main reasons that shift the investor's vision towards precious metals and other alternative investment instruments for diversifying their risks. Hence it is not astonishing that literature on the precious metals is one of the parts of evaluating price dynamics in the portfolio management. Different researchers conducted studies to find the

relationship of precious metals and macro economic factors (Heemskerk, 2001) and (Jonathan A Batten, Ciner, & Lucey, 2010).

There is vast literature available on the volatility spillover of the stock markets all over the world, yet the interaction between precious metals and stock markets has received far less attention. Taylor (1998) analyses the reactions of precious metals i.e., Gold, Silver and Platinum against the reactions of inflation. They tested the hypotheses that these precious metals act as long-run and short-run hedges against inflation. They concentrated their analysis on the period before 1939 and around the second OPEC oil shock in 1979. They found that there have been particular periods during the last 80 years when precious metals have been used as a short-run hedge against inflation, but they could not be used to hedge inflation around the first oil crisis during the last ten years. They found cointegration relationship between precious metal prices and the level of consumer price index with the help of a Vector Auto Regressive model, and concluded that the precious metals can be used as a long-run inflation hedge.

Similarly, Mills (2004) conducted a study by analyzing the behaviors of Gold prices from 1971 to 2002. They found that gold prices are characterized by short-run perseverance and scaling with a break point of 15 days. Further they found that the phenomenon of volatility prices scaling with long-run correlations is significant. J.-T. Bernard, Khalaf, Kichian, and McMahan (2005) examined the aluminum value arrangement with day by day, week by week and month to month frequencies. They utilized three econometric determinations that spread: I) arbitrary walk models with ARCH or GARCH impacts, ii) Poisson-based hop dispersion models with ARCH or GARCH impacts and iii) mean returning models that take into account vulnerability in balance cost. Their outcomes appeared that on account of high recurrence (every day and week by week) information, the mean-returning model with stochastic accommodation yield beats to an enormous degrees. Jonathan Andrew Batten and Lucey (2010) examined the volatility structure of gold, exchanging as a fates contract on the Chicago Board of Trade utilizing intraday (high recurrence) information from January 1999 to December 2005. They utilized GARCH displaying and the Garman Klass estimator. They discovered huge variations over the exchanging days predictable with microstructure

hypotheses, despite the fact that unpredictability is just somewhat emphatically connected with volume when estimated by tick count.

Shahzadi and Chohan (2012) analyzed the Pakistani stock market by testing the relationship between KSE 100 index prices and gold prices for the period of 2006 to 2010. Whilst, unit root test, Granger Causality and Co Integration test were performed for testing the relationship. Results show that no Co Integration exists among gold prices and KSE 100 index. Further, Granger Causality test does not apply to the data set because Co Integration does not exist between variables of interest. Baur and Lucey (2010) conducted a study in US, UK, and Germany for finding the relationship among gold prices and stock markets. They found the gold as a safe haven in these countries after examining the negative shocks affecting the stock markets of these countries. The findings proposed that gold is considered as a verge for stocks in the UK and US markets.

On the basis of above literature review, in this study we find the relationship among FTSE100 index and precious metal prices for the period of 2000 to 2016. The research design is unique because in the UK there is no previous study exist that addresses the same issue. We analyze 16 years monthly prices of FTSE 100 and precious metals of UK market. Figure 1 shows the conceptual framework of our study based on the literature review.

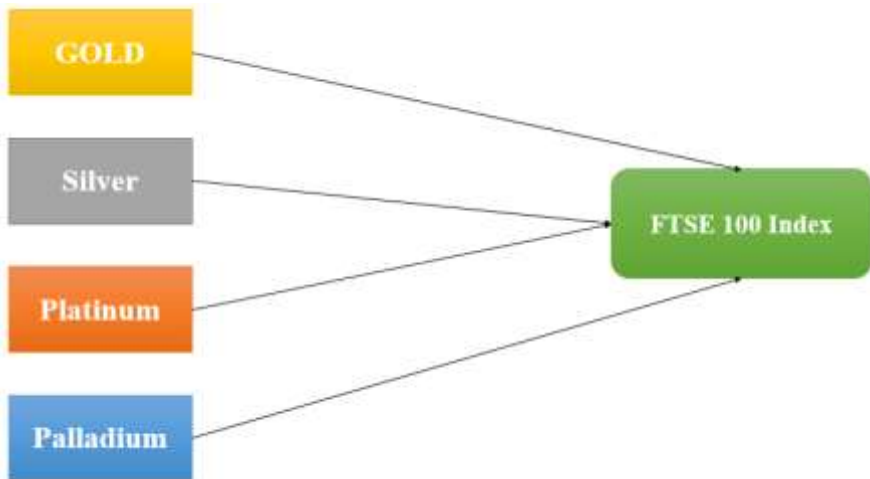


Figure 1: Conceptual framework of study

Methodology

United Kingdom is the target population for the current study. London Stock Exchange is the main stock exchange of UK with current market capitalization of 10.76bn GBP². Gold mining starts in Britain thousands of years ago. The discovery of precious metals and beautiful jewelry rings and wrought torcs and ornaments were often associated with the burial traditions of high-status gold industry throughout Prehistoric Britain. The Romans arrived in Britain and they took the production of precious metals on more professional approach³. This study uses FTSE 100 index of UK stock market for the purpose of analyzing the relationship. The rationale behind selecting FTSE 100 index is because is the largest index of UK stock market and has been widely used in similar studies.

Table 1 show that the average monthly FTSE 100 index has a mean value of 5617.4690 with a large variation of 868.3340. It reaches its maximum value at 7010.8200 and fall at the minimum value of 3639.5000. Similarly, the mean monthly prices of gold, silver, platinum, and palladium are 868.9870, 14.6786, 1122.4768 and 487.0706 with a standard deviation of 473.4612, 9.2074, 416.4586 and 221.9709 respectively.

Table 1: Descriptive statistics

	FTSE100	GOLD	SILVER	PLATINUM	PALLADIUM
Mean	5617.4690	868.9870	14.6786	1122.4768	487.0706
Median	5779.6400	851.9299	13.8242	1124.1998	455.7273
Standard Deviation	868.3340	473.4612	9.2074	416.4586	221.9709
Kurtosis	-0.7902	-1.3080	0.0759	-0.9546	-1.2841
Skewness	-0.4868	0.2184	0.8529	0.1379	0.1733
Range	3371.3200	1519.8977	37.8431	1628.2444	876.8545
Minimum	3639.5000	260.7500	4.1225	430.0714	163.1000
Maximum	7010.8200	1780.6477	41.9656	2058.3158	1039.9545
Observations	204	204	204	204	204

Table 2 gives the correlation matrix of all dependent and independent variables that we use in this study. There is a high positive correlation exists between FTSE 100 index and the prices of palladium. Other independent variables do not show significant correlation with FTSE 100 index. Similarly, correlation results show a positive high correlation between gold, silver and platinum and silver and platinum.

²<https://markets.ft.com/data/equities/tearsheet/summary?s=LSE:LSE> (March 20, 2017)

³<http://www.discoveryuk.com/goldrush/features/the-history-of-britains-gold/>

Table 2: Correlation matrix

	FTSE100	GOLD	SILVER	PLATINUM	PALLADIUM
FTSE100	1	—	—	—	—
GOLD	0.426**	1	—	—	—
SILVER	0.382**	0.443**	1	—	—
PLATINUM	0.351**	0.602**	0.246**	1	—
PALLADIUM	0.545**	0.574**	0.555**	0.347**	1

Note: Correlation is significant at 0.01 level (2-tailed)

The equation used to check the stationary of the data is as follows:

$$\Delta Y_t = \delta Y_{t-1} + a_t \quad (\text{No trend, no intercept}) \dots\dots\dots (1)$$

$$\Delta Y_t = \theta_0 + \delta Y_{t-1} + a_t \quad (\text{Intercept only}) \dots\dots\dots (2)$$

$$\Delta Y_t = \theta_0 + \theta_1 t + \delta Y_{t-1} + a_t \quad (\text{Trend and intercept}) \dots\dots\dots (3)$$

These equations are used to test the stationary of the data and all give same results. In the given equations above, Y is the variable which got unit root or not as well as the second equation with intercept only. Table 3 shows the results of Augmented Dickey–Fuller (ADF) of all variables of the interest. The results show that all variables got unit root or all are not stationary at level because absolute test statistics values are less than the critical values at 5%. The second part of the table shows all the variables on first difference. Here we can see after converting all the variables into first difference they become stationary.

Table 3: Unit root test

Variables	Augmented Dickey Fuller (Level)		Augmented Dickey Fuller (1st Difference)	
	Test statistic	5% critical value	Test statistic	5% critical value
FTSE100	-1.4100	-2.8830	-12.6380	-2.8830
GOLD	-1.0840	-2.8830	-11.3200	-2.8830
SILVER	-1.3140	-2.8830	-11.1700	-2.8830
PALATINUM	-1.7590	-2.8830	-9.7810	-2.8830
PALLADIUM	-1.2220	-2.8830	-10.5810	-2.8830

Table 4 presents the optimal lag selection results for our model. Results show that optimal lag for our analysis must be 2 because three

criteria’s goes in favor of lag 2 selection. According to ((Ivanov & Kilian, 2001) AIC criteria gives us more accurate results when our data is monthly, though the current study used monthly data.

Table 4: Optimal lag selection

Lags	FPE	AIC	HQIC	SBIC
0	8.9200	62.4477	62.4611	62.5102
1	1.7140	46.9587	47.1589	47.4535*
2	1.314*	46.6958*	47.0628*	47.6228
3	1.4140	46.7336	47.2675	48.0529
4	1.5140	46.8472	47.5480	48.5788

Table 5 shows the results of Johansen’s co integration test. For testing the Co Integration, Trace Statistics and Max-Eigen Statistics are used for FTSE 100 index and precious metals. The null hypothesis for Co Integration is “there is no Co Integration exists”.

Table 5: Johansen Cointegration test

Maximum rank	Eigenvalue	Trace statistics	5% Critical value
0	—	53.6356*	68.5200
1	0.1061	30.9862	47.2100
2	0.0518	20.2333	29.6800
3	0.0476	10..3801	15.4100
4	0.0342	3.3487	3.7600
5	0.0164	—	—

Maximum rank	Eigenvalue	Max-Eigen statistics	5% Critical value
0	—	22.6493	33.4600
1	0.1061	10.7530	27.0700
2	0.0518	9.8532	20.9700
3	0.0476	7.0315	14.0700
4	0.0342	3.3480	3.7600
5	0.0164	—	—

Vector autoregressive (VAR) model

The results show that previous prices gold is significant at 5% critical level and negatively related with the FTSE 100 index in the short run. The lag 2 platinum and palladium prices are also significant at 5% level and negatively related to FTSE 100 index prices in the short run. Furthermore, silver prices show no impact on FTSE 100 index prices in the short run.

Table 6: Vector autoregressive model results

Variables	Coefficients	Std. Err.	Z value	Prob.
CONSTANT	168.4826	97.3655	1.7300	0.084*
FTSE100 L1	0.9981	0.0700	14.2600	0.000***
FTSE100 L2	-0.0253	0.0710	-0.3600	0.7210
GOLD L1	-1.6263	0.5254	-3.1000	0.002***
GOLD L2	1.7553	0.5198	3.3800	0.001***
SILVER L1	15.9971	14.4550	1.1100	0.2680
SILVER L2	-16.4040	14.1274	-1.1600	0.2640
PLATINIUM L1	0.4240	0.2440	1.7400	0.082*
PLATINIUM L2	-0.4773	0.2436	-1.9600	0.050**
PALLADIUM L1	0.6651	0.3551	1.8700	0.061*
PALLADIUM L2	-0.7766	0.3512	-2.2100	0.027**
No. of observations	202			
AIC	46.7440			
HQIC	47.1088			
SBIC	47.6415			
Note:				
* Statistically significant at 1%				
** Statistically significant at 5%				
*** Statistically significant at 10%				

Granger Causality test

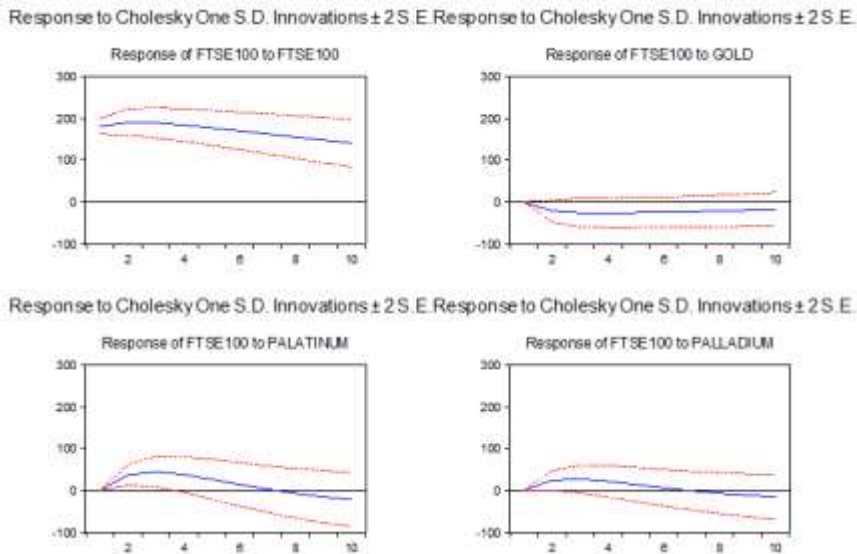
Table 7 shows the results of Granger Causality test of this study. The null hypothesis under this test is “there is no Granger Cause among variables”. We can see that gold is significant at 1% critical level it means we reject null hypothesis and we can say that gold does Granger cause FTSE 100 index, whereas FTSE 100 index p value is > 5% it means FTSE 100 index does not Granger Cause gold. The Palladium's p value is significant at 10% and it shows that palladium does Granger Cause FTSE 100 index and FTSE 100 index also Granger Cause palladium. While all other precious metals such as silver and platinum does not cause FTSE 100 index and FTSE 100 index also does not cause them. Finally, the overall results of the Granger Causality test for precious metals jointly shows a significant p value at 1%, it means all precious metals jointly Granger Cause FTSE 100 index in short run.

Table 7: Granger Causality test

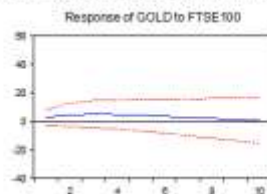
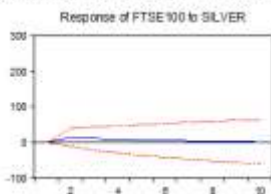
Null hypothesis:	Observations	F-statistic	Prob.
GOLD does not Granger cause FTSE100	202	13.7130	0.0010
FTSE100 does not cause GOLD	202	0.1140	0.9450
SILVER does not Granger cause FTSE100	202	1.3503	0.5090
FTSE100 does not cause SILVER	202	1.4330	0.4880
PALATINUM does not Granger cause FTSE100	202	4.1873	0.1230
FTSE100 does not cause PALATINUM	202	1.4548	0.4830
PALLADIUM does not Granger cause FTSE100	202	5.5063	0.0640
FTSE100 does not cause PALLADIUM	202	4.9710	0.0830
All precious matels does not cause FTSE100	202	26.5970	0.0010

Impulse response function (IRF) results show in Figure 2, describes that if we give one standard deviation positive shock to FTSE 100 index and all precious metals prices, then how they react in the future. We can see that FTSE 100 index prices will increase initially and then tends to decrease slightly during ten months from now. The gold prices will decrease till next three months and then becomes stable. Similarly, the platinum and palladium prices will increase till month three and then becomes decreases. The silver price bears no significant effect from shock in FTSE 100 index prices shock. Furthermore, all precious metal prices will be affected by the shock in the prices of one and other except platinum to gold and silver to platinum.

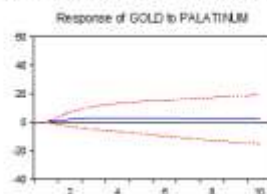
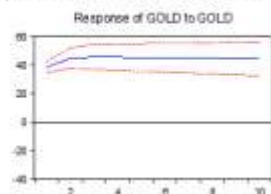
Figure 2: Impulse response function



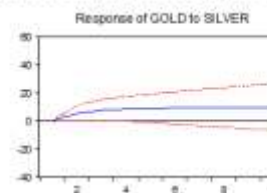
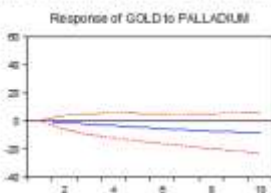
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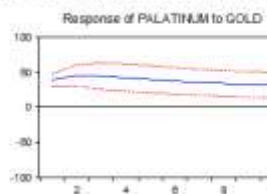
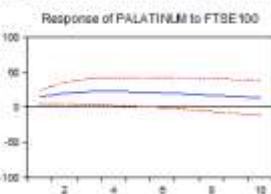
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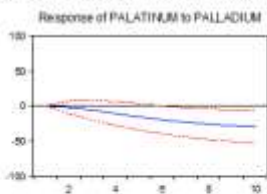
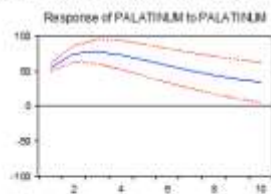
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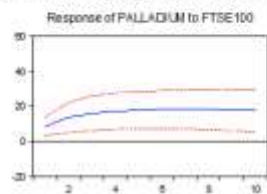
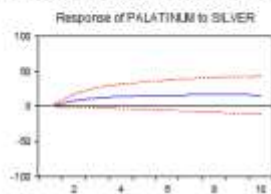
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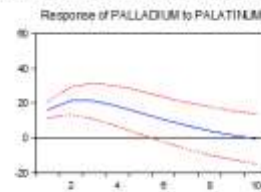
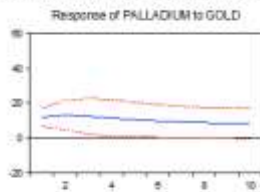
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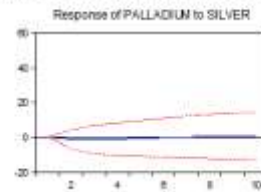
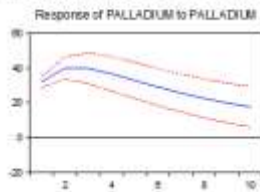
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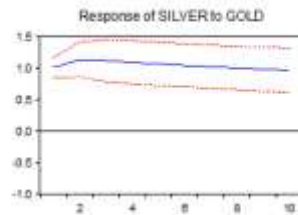
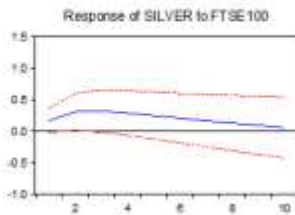
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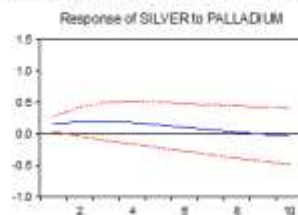
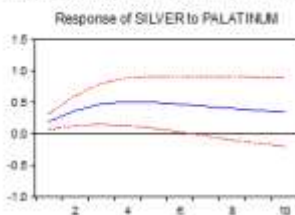
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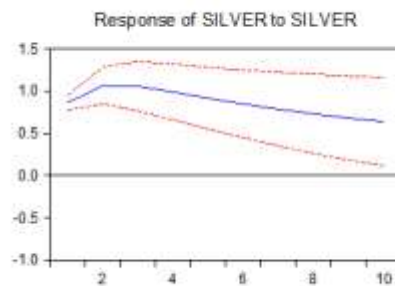
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Conclusion and Policy Implications

The results show that there is no long run association ship among FTSE 100 index and precious metal prices in the UK. The results of Johansen Co Integration test suggest that there is no long term relationship among these variables in UK market. These findings are consistent with (Bashiri, 2011) and (Shahzadi & Chohan, 2012).The VAR model results suggest that gold, platinum and palladium prices have a significant and negative impact on FTSE 100 index prices in short run, these findings are consistent with (Baryshevsky, 2004) and (Smith, 2001), while silver prices have no impact on UK stock market. The Granger Causality test results show that all precious metal prices Granger Cause the FTSE 100 index in short run. Furthermore, the impulse response function suggests the future price movements of the variables after giving one standard deviation shock to one another. The UK stock market is a form of weak efficient which is not an efficient market, and when a market is not efficient we can forecast the future price patterns on the basis of past available data (Timmermann & Granger, 2004). The impulse response function results also tell us that silver prices have no effect of shock from other variables prices.

This study gives the guidelines to the investors to invest in precious metals or invest in stock market. As results indicate the negative relationship between stock prices and gold, platinum and palladium, which shows the guideline to the current investors that if the stock markets got crashed again they can, think to invest in precious metals on the basis of past experience. This study is also helpful for researchers for finding the relationships between the stock markets and precious metals.

This study has a limitation, firstly the sample data is from UK market for 16 years from 2000-2016, it cannot capture the financial crisis and major changes in the economy before 2000, so results are limited for the given time span and could not be generalized to another time frame and another country. Secondly, the monthly average prices are used to find the relationships between variables, the prices not captured the day to day fluctuations in the prices since these are the average monthly prices. This study opens the avenue for the future researchers i.e., they can find out the relationship of the precious metals with stock markets of largest exporting and importing countries of the world or further their relationships between pre and post financial crisis can be analyzed.

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