Dynamic Interactions between Commodity Market and Capital Market – Evidence from India

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Abstract

The present paper examines the relation between commodity market and capital market using 22 years monthly data for the period April, 1991 to March, 2013. Gold price represents commodity market and BSE Sensex is taken as proxy for capital market in India. The unit root test clarified that gold price and stock price were found to be integrated of order one using Augmented Dicky-Fuller test for unit root. The Granger causality test confirmed the presence of unidirectional causality which runs from gold price to stock price. It is established from the Johansen cointegration test that gold price and stock price are cointegrated, indicating an existence of long run equilibrium relationship between the two. VECM and wald test finally confirmed that there is a bi-directional relationship in the long-run between the two variables. We find a negative but low correlation between gold and sensex. Based on these results, we incline to suggest the favourable property of gold as an investment asset for the Indian emerging market. At least, gold provides a diversification and safe haven benefit to investors in the Indian market. The domestic Indian gold market tends to have resistance to heightened risk in the stock market as it preserves its low negative relation with stock market variations regardless of the market conditions.

Keywords: BSE Sensex, gold price, unit root test, granger causality test, cointegration test, VECM, Wald Test, impulse response function, variance decomposition.

Introduction

Globalisation in India has ushered in a sea of change in the financial architecture of the economy. Stock markets in India have experienced a tremendous growth in the market capitalisation along with a high economy growth in the last two decade since liberalisation. The activities in the financial markets in the contemporary scenario and their relationships with the other sectors of the economy have assumed significant importance. Generally it is well known that the capital market promotes economic growth and prosperity by providing an investment channel that contributes to attract domestic and foreign capital. The aggregate performance of capital market can be easily seen by its indices that represent the movement of stock prices being traded in capital market. However, over the past decades, the global financial markets have witnessed a string of financial crises. Aftermath of these crises felt in stock market too, which gives an image of excessive risk in stock market investment and bring back interest in gold as an alternative

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investment asset (Mansor, 2011). The global economic turmoil is likely to stimulate uncertainty in commodity market viz. gold price. Traditionally gold differs from other assets as it reacts positively to adverse market shocks. It is being observed that real gold value reached its historic high roughly in 1980, when the global economy faced the threat of stagflation due to oil crises in 1970s. Likewise, at the time the US subprime crisis intensified in September 2008, gold has responded with a surge in its value (Baur and McDermott, 2010). Moreover, there seems to be a strong belief that gold can provide protection, as a hedge or a safe haven, against this heightened risk in the financial markets. Baur and Lucey (2010) provided the first statistical test of when gold acts as a safe haven and when as a hedge. In order to distinguish a safe haven asset from a hedge and a diversifier asset, they explicitly define all three types as follows:

Hedge: *"A hedge is defined as an asset that is uncorrelated or negatively correlated with another asset or portfolio on average. A hedge does not have the (specific) property of reducing losses in times of market stress or turmoil since the asset could exhibit a positive correlation in such periods and a negative correlation in normal times with a negative correlation on average."*

Diversifier: *"A diversifier is defined as an asset that is positively (but not perfectly correlated) with another asset or portfolio on average. Similar to the hedge, the diversifier does not have the (specific) property of reducing losses in extreme adverse market conditions since the correlation property is only required to hold on average."*

Safe Haven: *"A safe haven is defined as an asset that is uncorrelated or negatively correlated with another asset or portfolio in times of market stress or turmoil."*

In the light of the above definition, we will explore the characteristics of gold in respect to Indian capital market. The capital market movement is represented by Bombay Stock Exchange benchmark index, Sensex and gold price representing the commodity market. Gold has been perceived as 'safe haven' especially during periods of financial and economic stress as it protects investor's wealth against financial turmoil. Hence, an asset with a stable real value or, at least a stable nominal value is an uncontroversial safe haven, as it allows its holder to resell it without loss at any time (Coudert & Raymond, 2010). Viewed from this aspect, gold possess almost all characteristics essential to be classified as a safe haven. When other investments are risky, people usually tend to invest in gold and when many start investing in gold, the price of gold increases. When other investments become safe, people disinvest from gold and enter into other investments resulting decline in demand of gold thereby decreasing price of gold. During the last decade, there is some empirical evidence that gold could be a hedge even against stocks, though only in the short run (Baur and Lucey, 2010). Further, connecting these two markets, viz. Capital and commodity market, it has been observed that whenever the capital market goes down, the gold prices go up indicating they move in an opposite direction. The demand for gold increases in a downturn economy, and consequently the value of gold also increases, thus, gold is a substitute investment avenue for Indian investors (Ray, 2013). In the context of commodities overwhelming financial assets, it is quite interesting to study the relationship between these two markets and to find out the role of gold as an investment venture in India.

This paper is structured as follows: section 1 gives a brief introduction of the subject matter. Section 2 presents the relation of gold price with respect to Indian capital market. Section 3 gives a brief review of existing literature. Section 4 discusses about the data and the econometric methodology adopted for the study. Section 5 presents the results of empirical studies. Summary conclusions are presented in Section 6.

Gold Price and the Indian Capital Market

Indian capital market has witnessed a major transformation and structural change during the past one decade as a result of ongoing financial sector reforms initiated by the Government of India since 1991 in the wake of policies of liberalization and globalization. Gupta (2002) has rightly pointed out that improving market efficiency, enhancing transparency, checking unfair trade practices and bringing the Indian capital market up to a certain international standard are some of the major objectives of these reforms. Financial markets and the variety of financial instruments have grown steadily in both volume and value in recent decades. This growth has raised the risks of the financial system and potentially established the need for a safe haven for investors (Baur and Lucey, 2010). International gold prices have risen with full intensity in the last few years, though there was one large correction in 2008. From July 2011 the pace of increase in gold prices has accelerated further and in the third quarter of 2011, gold prices rose much faster. The spurt in gold prices which occurred in 2011 took place in the background of worsening of financial and economic scenarios initially in the US, followed by the debt problems in the European Countries. The impact of the rise in international gold prices is reflected in its domestic prices as well. Despite the sharp recent price rise in India, demand for gold has sustained for a long time, not only as a component of safe savings but also due to its social and cultural importance. Therefore, movements in gold prices in India are of keen interest to all segments of the society including investors. Gold price has seen dramatic changes since independence in India. Over the last century and decade, the gold prices have fluctuated to a great extent. The period 2000-2011 signified the highest variation in gold prices. Post 1970, the gold price fluctuations increased manifold times compared to the previous time windows of analysis. Compared to 1960s, the fluctuations in gold prices increased by 872 times in the 2000s (Sujit, Kumar 2011).However, the continuous rise in the price of gold keeps the investors away from the yellow metal with its safe haven status climbing up. Even the expectation of forming a new government creates a bullish trends in the capital market, which is expected to do well in the coming days and this may force investors to shift money from the safe haven ‘gold’ to equity. Moreover, gold has not returned much in the previous few months and investors are looking for better opportunities to make a fruitful investment. This paper endeavour to shed light on the causal relation between the two major markets in India i.e. capital market and commodity market with the help of empirical evidence.

Literature review

The study on the relationship between stock price and macroeconomic variables has been done extensively. Researcher, Investors and policy makers are keen to know the effect of change in macroeconomic factors on stock price movement as these relationships are quite important in order to predict the movement of stock price and to have robust economy. Although, the paper concentrate on only commodity market i.e. the price of gold and its relation with stock price in India. Literatures available in the field of finance and economics are enormous. However, we have reviewed only few of them which are relevant and consulted for the preparation of this paper.

Gold is often termed as safe haven for the investors, the specific property of a safe haven asset is the nonpositive correlation with a portfolio in extreme market conditions as defined by ***Baur and Lucey (2010)***. In their study, they have also defined the nature of hedge and diversifier asset, which is already discussed in the introduction. They have employed GARCH model on daily prices of Morgan Stanley Capital International (MSCI) stock and bond indices and U.S. closing spot gold for the period starting from November 30, 1995 until November 30, 2005 and focus their study on the characteristics of gold for US, UK and German investors. They conclude that gold is a safe haven for stocks. However, gold is generally not a safe haven for bonds in any market. Gold only functions as a safe haven for a limited time, around 15 trading days. In the longer run, gold is not a safe haven, that is, investors that hold gold more than 15 trading days after an extreme negative shock lose money with their gold investment. This finding suggests that investors buy gold on days of extreme negative returns and sell it when market participants regain confidence and volatility is lower. Moreover, ***Capie, Mills and Wood (2005)*** analyze the role of gold as a hedge against the dollar, finding evidence of the exchange-rate hedging potential of gold. Other examples of studies that examine the financial characteristics of gold include ***Faugere and Van Erlach (2006), Lucey, Tully and Poti (2004)***. In another more extensive study by ***Baur and Mc Dermott (2010)*** where they have taken daily, weekly and monthly continuously compounded stock returns of a sub-set of the 53 constituents of a world index comprising the seven largest developed countries (G7), the largest emerging markets (BRIC countries) and Australia and Switzerland and also used regional indices such as North America, Latin America, Europe, EU, EMU and Emerging Markets covering a 30-year period from March 2, 1979 until March 2, 2009 and compared it with Gold Bullion in US$ per Troy ounce. Applying the same methodology as in their previous study (Baur and Lucey, 2010), they have found that the Gold is a strong hedge for all European markets and the US and also a safe haven in these markets. The strength of the safe haven effect varies across market conditions. Gold is generally a strong safe haven in very extreme market conditions for daily and weekly returns in European markets and the US. In contrast, gold is neither a hedge nor a safe haven for the BRIC countries, Australia, Canada and Japan. In contrast ***Jaiswal and Voronina (2011)***, in their thesis claimed that correlation between gold and stock returns varies across countries and economic sectors over time. They employed VAR model and verify the volatility spillover effects between gold and stock returns of BRIC countries during 2001 to 2010. They confirmed the role of gold as a hedge and safe haven in most of the sectors in Brazil, India and China during the time of the financial

crisis unlike Russia where gold and stocks go in the same direction. Investors in Russia do not opt for gold in time of uncertainty as investors do in China, India and Brazil. Moreover in normal time gold played a role of hedge which is uncorrelated or negatively correlated with stock. Even in India also, gold played a role of a hedge in almost every year and for every economic sector, except 2006, 2007, and 2010. Moreover in China, gold was positively correlated with almost every sector in 2005, which supports a role of diversifier, and other years it was a hedge for almost every industry. In an emerging market case like Malaysian stock market where ***Mansor (2011)*** studied the behaviour of stock returns of Kuala Lumpur composite index and price of gold. Applying GARCH-type models to daily gold and stock returns over the period August 2001 to March 2010, he found evidence indicating gold as a diversifier as relation between gold return and once-lagged stock return was significant positive. However, the coefficient of the once-lagged stock return in gold return equation is small and far from unit and their relation have not strengthened during times of consecutive days of market declines. He also found some evidence that gold return tends to break from its positive relation with stock market return following four consecutive stock market returns and suggested that as gold provides diversification benefit to investors in Malaysian market, it is a favourable alternative investment destination in Malaysian emerging market. Similar type of result found in the study of ***Smith (2001),*** who has explored the short-run and long-run relationship between the price of gold and stock prices in the developed economy of United States over the period from January 1991 to October 2001. He has used four gold prices comprising three gold prices set in London and one set in New York along with six stock price indices of varying coverage from US. The short-run correlation between returns on gold and returns on US stock price indices is small and negative and for some series and time periods insignificantly different from zero. Moreover, he does not find any long-run equilibrium relation between the gold price and US stock price indices in the cointegration test. He claimed to have only short-run relationships between gold price and stock price indices in US which is supported by Granger causality tests, where he found unidirectional causality from US stock returns to returns on the gold price.

The historical evidence on movements of gold price and stock price in Indian data indicates that when the stock market crashes or when the dollar weakens, gold continues to be a safe haven investment because gold prices rise in such circumstances ***(Gaur & Bansal, 2010)***. It is not a matter of bombshell that many investors, big and small have chosen to hedge their investments through gold at the time of crises as cited in Mishra, et al. (2010). Further exploring the relationship between gold price and stock market indices in India, ***Ray (2013)*** uses annual data for the period of 1990-91 to 2010-11 and examines the causal relationship between gold price and stock market indices with the help of Granger causality test. He found that the variables are cointegrated in the long-run. There is uni-directional causal relationship found in Granger causality test. He also observes that gold price and stock market moves in an opposite direction signifying gold as a hedge for the investors. Basically, when gold price goes down, people withdraw their investment from gold and invest the same in stock market which in turn increase the value of the stock market due to heavy investment. Similarly, when stock market goes down people tend to invest in gold resulting in fall in stock market indices, thus, gold is also playing a role of safe haven in India. Similar study of ***Narang and Singh (2012)*** where they used monthly

data of 10 years for the period 2002 to 2012 and found positive correlation between stock returns of sensex and gold price for the period 2002 to 2007. However, they claimed that due to economic crisis in USA in 2008 and 2011 this correlation seems to be fading and found no relation between them in cointegration test. Even there is no short-run causal relation found in his study from the result of Granger causality test. In the present paper, we take lead from these studies and examine the investment role of gold for an emerging economy like India and its relation with the stock market movement.

Objectives

As discussed in the review of literature that the gold price, which represents the commodity market, is often termed as a safe haven for the investors and also effect the movement of stock prices. Hence, it is imperative to verify the relationship between these two market viz. capital market and commodity market with sophisticated techniques. The paper explores the extent of linkages of sensex and gold prices using error correction model and cointegration technique with the 22 years monthly data. The objective of the study is to validate the relationship systematically and also to explore their causal relationship in long-run and short-run as well.

Data and Methodology

The present study is directed towards studying the short-run as well as long-run relationship between stock market indices and gold price in India.

Data Source

Relevant data of gold price and Bombay Stock Exchange Sensitivity index (BSE Sensex) are obtained from the official websites of Reserve Bank of India and Bombay Stock Exchange (BSE) respectively.

Study period

The frequency of data is kept at monthly level and time span of study is 22 years taken from April, 1991 to March, 2013. The results from longer period of data are more precise and are better able to capture the dynamics between gold price movement and Sensex.

Sample Design

There are 264 observations. All the data are taken as logarithmic difference and thus symbolised as dsensex and dgold for BSE sensex and gold price respectively. Eviews 7.0 package has been used for arranging the data and implementation of econometric analysis.

Econometrics Methodology

The formal investigation has started with examining the stochastic properties of the variables used in the analysis. Therefore, the Augmented Dickey Fuller (ADF) unit root test has been done on the series to test the stationarity of the data and estimate the following equation:

$$\Delta (Y_t) = \alpha + \beta t + \square (Y_{t-1}) + \delta_1 \Delta (Y_{t-1}) + \ldots\ldots + \delta_{p-1} \Delta (Y_{t-p+1}) + €_t \ldots\ldots \quad (1)$$

Here, α is a constant, β is the coefficient of the trend term (t) and p is the lag order of the autoregressive process. Y_t denotes the endogenous variables (gold price and sensex). Here εt is

not white noise as in previous Dickey Fuller Tests. The purpose in adding the terms Δyt-1 is to allow for ARMA error processes. Next, we have applied Granger causality test in order to check the causality in short-run among the variables under study considering the following equation:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \beta_1 X_{t-1} + \beta_2 X_{t-2} + u_t$$

If $\beta_1 = \beta_2 = 0$, X does not Granger cause Y. If, on the other hand, any of the β coefficients is non-zero, then X does Granger cause Y. The null hypothesis that $\beta_1 = \beta_2 = 0$ can be tested by using the standard F-test of joint significance. It has been taken two period lags in the above equation though, in practice, the choice of the lag is arbitrary. Varying the lag length may lead to different result.

Further to check the long-run equilibrium relationship, the study has used Johansen Cointegration test to find out whether the variables are integrated or not. Once the number of cointegrated equations is found in cointegration test, we apply the VAR model to capture both the dynamic and interdependent relationships of the variables under study. As the variables included in the VAR model found to be cointegrated, we have used Vector Error Correction Model, which is a special type of restricted VAR to correct a disequilibrium that may shock the whole system. In VECM, the dynamics of both short-run and long-run adjustment is made to find out the causal factors that affect our variables i.e. sensex and gold price. The last step is to check the dynamic behaviour of the VAR model, which is done by two ways, Impulse response function (IRF) and variance decomposition, they are also considered as innovation accounting analysis. IRF brings a shock in residuals or innovations of each equation in the system VAR model that would affect on all endogenous variables. Consequently, variance decomposition breaks down the variance of the forecast error for each variable into components. Thus, each variable is explained as a linear combination of its own current innovations and lagged innovations of all the variables in the system. All the data are in log form.

Empirical Analysis

Descriptive Statistics

Table: 1

	LSENSEX	**LGOLD**
Mean	8.678482	8.868559
Median	8.363016	8.557370
Maximum	9.928623	10.36321
Minimum	7.118915	8.184053
Std. Dev.	0.741661	0.620796
Skewness	0.382256	1.105930
Kurtosis	1.798757	2.876481
Jarque-Bera	22.30209	53.98341
Probability	0.000014	0.000000
Sum	2291.119	2341.299
Sum Sq. Dev.	144.6662	101.3571
Observations	264	264

Descriptive statistics are used to illustrate the essential features of the data in a study. They present simple summaries about the illustration and the measures. It shows mean, median, standard deviation, skewness and kurtosis of the series along with cheeking normal distribution of the data.

More specifically, skewness is positive for both the variables indicating the flat tails on the right-hand side of the distribution comparably with the left-hand side indicating distribution deviated from normal distribution. The value of Kurtosis in both the variables is deviated from 3. Even the Jarque Bera test of normality has been applied on the frequency distribution. The p-value of the variables is less than 0.05 such that we reject the null hypothesis of the presence of normality in the frequency distribution. Thus, we can conclude that the distribution does not follow normal distribution.

Unit Root Test

Table: 2		
Augmented Dickey Fuller Unit Root Test		
	ADF level	**ADF first difference**
Lsensex	-2.366774	-14.43607
Lgold	-0.372086	-15.23891
Critical values		
1%	-3.993335	-3.993471
5%	-3.427004	-3.427070
10%	-3.136780	-3.136819

Stationary is employed through Augmented Dicky Fuller test and the results found that the ADF test is lower in both case than its theoretical value at level thus, the data contained unit root i.e. non-stationary at level but at first difference data becomes stationary as the ADF test is greater than its critical value. Data is stationery of same order i.e. 1(1) so we can run co-integration among these variables.

Correlation Analysis

Table: 3		
	DSENSEX	**DGOLD**
DSENSEX	1.000000	-0.092152
DGOLD	-0.092152	1.000000

Correlation analysis shows the linear association between the variables. From the correlation matrix, we can see that there is insignificant negative relation exist between sensex and gold price, which can give reason for gold as a safe haven investment.

Regression analysis

Hypothesis

H_0: Independent variable cannot influence dependent variable.

H_1: Independent variable influences the dependent variable.

Table: 4				
Dependent Variable: DSENSEX, Method: Least Square, Sample (adjusted): 1 263				
Included observations: 263 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012172	0.005316	2.289759	0.0228
DGOLD	-0.226028	0.151178	-1.495116	0.1361
R-squared	0.008492	Mean dependent var		0.010360
Adjusted R-squared	0.004693	S.D. dependent var		0.084134
S.E. of regression	0.083937	Akaike info criterion		-2.109936
Sum squared resid	1.838834	Schwarz criterion		-2.082772
Log likelihood	279.4566	Hannan-Quinn criter.		-2.099019
F-statistic	2.235372	Durbin-Watson stat		1.774612
Prob(F-statistic)	0.136092			

When the p-value is equal to less than 5% (0.05), reject null hypothesis and accept alternative. If p-value is more than 5%, then accept null hypothesis. R-squared and adjusted R-squared indicates the explanatory power of the models which is not good in the above regression result. The model explains only 0.8% of the variation in the dependent variable. As the adjusted R-square as well as R-Square statistic is very low, indicating that the explanatory variables gold is statistically insignificant to explain the variation in the dependent variable BSE Sensex. For that, we consider the estimated t-statistic. If the absolute value of the explanatory variables is less than 2, then we can say that the variable is insignificant. Here for the explanatory variables the absolute value of the t-statistic is less than 2 and the corresponding p-value is more than 0.05 thus, accepting Null hypothesis that the independent variables cannot influence the dependent variable. The overall model does not fit at all. It may be due to the fact that we have considered only one explanatory variable i.e. gold price although, there are other macroeconomic factors which influence the stock prices (sensex), the model can be better if we consider the other factors also. Moreover, this paper focuses on the relationship between gold price and sensex, thus, other macroeconomic factors are avoided.

Durbin-Watson Statistics

The Durbin-Watson is the most common test for autocorrelation and is based on the assumption that the structure is of first order. Since first order autocorrelation is most likely to appear in time series data, the test is very relevant. Generally all statistical software has the option of calculating it automatically. The value of Durbin-Watson ranges from 0 to 4. When the value is near 2, it indicates non-autocorrelation; Values approaching 0 indicate positive autocorrelation and values toward 4 indicate negative autocorrelation. The Durbin-Watson statistic (D-W Statistic) in the above result being less than 2 (1.774612) suggests that there is no auto-correlation among residuals.

Granger Causality Test

Granger causality analysis (GCA) is a method for investigating whether one time series can correctly forecast another (Granger, 1969). This method is based on multiple regression analysis to check the short-run causal relation among the variables.

Hypothesis

H_0: No Granger causality is there**.**

H_1: Granger causality is there.

Table: 5			
Pairwise Granger Causality Tests, Sample: 1 264, Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
DSENSEX does not Granger Cause DGOLD	261	0.02881	0.9716
DGOLD does not Granger Cause DSENSEX		3.30489	0.0383
If p < 0.05, reject H_0 at 5% significant level.			

From the p-value (p>0.05), it is clear that BSE Sensex does not granger cause gold price. On the other hand, gold price granger causes the BSE Sensex (p< 0.05). Hence, there prevails unidirectional relationship between the variables in short run which runs from gold price to sensex. In order to check their long-run relationship we will go for cointegration test and error correction model further.

Cointegration Test

Table: 6				
Sample (adjusted): 6 263, Included observations: 258 after adjustments				
Trend assumption: Linear deterministic trend				
Series: DGOLD DSENSEX				
Lags interval (in first differences): 1 to 4				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.188146	92.26700	15.49471	0.0000
At most 1 *	0.138594	38.49089	3.841466	0.0000
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.188146	53.77611	14.26460	0.0000
At most 1 *	0.138594	38.49089	3.841466	0.0000
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table - 6 demonstrates the result of the Johansen cointegration test, which is fairly different from the result of Granger causality test. The absolute value of the estimated trace statistic is greater than its tabulated value. Hence, the null hypothesis of no Cointegration is rejected at 5% level of significance. The same holds for the eigen-value as well. Hence, we further go for testing the null

hypothesis of all most one Cointegration relation between the variables. Here, also we reject the null hypothesis suggesting that there are two significant cointegrating vectors in the model. This implies that there are two common stochastic trends, indicating a degree of integration between the two markets. Now we use the cointegrating equations and go for applying Vector Error Correction Model (VECM).

Vector Error Correction Model (VECM)

Table: 7		
Vector Error Correction Estimates, Sample (adjusted): 4 263		
Included observations: 260 after adjustments		
Error Correction:	D(DSENSEX)	D(DGOLD)
CointEq1	-0.791139	0.152629
	(0.08680)	(0.03829)
	[-9.11473]	[3.98577]
D(DSENSEX(-1))	-0.069300	-0.119894
	(0.07607)	(0.03356)
	[-0.91103]	[-3.57256]
D(DSENSEX(-2))	0.013085	-0.080115
	(0.05955)	(0.02627)
	[0.21972]	[-3.04928]
D(DGOLD(-1))	-0.797615	-0.495477
	(0.14653)	(0.06465)
	[-5.44347]	[-7.66457]
D(DGOLD(-2))	-0.268210	-0.358571
	(0.13344)	(0.05887)
	[-2.00995]	[-6.09072]
C	-0.001077	-0.000510
	(0.00517)	(0.00228)
	[-0.20846]	[-0.22396]
R-squared	0.451954	0.383530
Adj. R-squared	0.441166	0.371395
Sum sq. resids	1.761796	0.342919
S.E. equation	0.083284	0.036743
F-statistic	41.89294	31.60471

The intercept of the cointegrating relation is negative (approx equal to zero) and significant (absolute t-value> 2). This implies that the error term adjusts itself to move into the long run equilibrium. The speed of adjustment can be found out from the estimated coefficient of the error correction term. It is here, -0.79 in the first equation which means that the speed of adjustment is 79%. There exists long run relationship among the variables. Also the one- period lagged value as well as two period lagged value of the BSE Sensex can statistically significantly explain the variation in the current period gold price which is clear from the estimated t-statistic. Also the one-period lagged value as well as two-period lagged value of the gold price can statistically significantly explain the variation in the current period BSE Sensex. However, in the second

equation of the VECM, though the t-statistic of the estimated coefficient of the error correction is greater than two, yet the coefficient is non-negative. This implies that the error term does not adjust itself to move into the long run equilibrium. Both the models are not statistically significant which is clear from the corresponding Adjusted R^2 statistics which are 0.44 and 0.37 respectively. This implies that 44 percent of the variation in the explained variable in Model I have been explained by all the explanatory variables taken together and 37 percent of the variation in the explained variable in Model II has been explained by the explanatory variables.
The following VECM equation is formed by applying OLS method:

D(DSENSEX) = C(1)*(DSENSEX(-1) - 1.27985071679*DGOLD(-1) - 0.00012635679463) + C(2)*D(DSENSEX(-1)) + C(3)*D(DSENSEX(-2)) + C(4)*D(DGOLD(-1)) + C(5)*D(DGOLD(-2)) + C(6)

D(DGOLD) = C(7)*(DSENSEX(-1) - 1.27985071679*DGOLD(-1) - 0.00012635679463) + C(8)*D(DSENSEX(-1)) + C(9)*D(DSENSEX(-2)) + C(10)*D(DGOLD(-1)) + C(11)*D(DGOLD(-2)) + C(12).

In the above equations, C(1) and C(7) are the coefficient of the error correction terms in the two models. For long run adjustment of the variables, it has to be negative and statistically significant. C(2), C(3), C(4) and C(5) are the coefficients showing short run impact of the explanatory variables on the explained variable in Model I. C(6) is the intercept term in the first model. Similarly, C(8), C(9), C(10) and C(11) are the coefficients showing the short run impact of the explanatory variables on explained variables in model II. Now, we can find out the joint significance of both the period lagged values of a particular explanatory variable on the explained variable by applying Wald Test.

Ordinary Least Square (OLS) Results are summarised as follows:

Table: 8

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.152629	0.038294	3.985766	0.0001
C(2)	-0.119894	0.033560	-3.572557	0.0004
C(3)	-0.080115	0.026273	-3.049284	0.0025
C(4)	-0.495477	0.064645	-7.664572	0.0000
C(5)	-0.358571	0.058872	-6.090718	0.0000
C(6)	-0.000510	0.002279	-0.223957	0.8230
R-squared	0.024808	Mean dependent var		0.009406
Adjusted R-squared	0.005612	S.D. dependent var		0.083194
S.E. of regression	0.082960	Akaike info criterion		-2.118108
Sum squared resid	1.748124	Schwarz criterion		-2.035938
Log likelihood	281.3540	Hannan-Quinn criteria		-2.085074
F-statistic	1.292318	Durbin-Watson stat		1.954673
Prob(F-statistic)	0.267618			

Table: 9				
	Coefficient	Std. Error	t-Statistic	Prob.
C(7)	0.152629	0.038294	3.985766	0.0001
C(8)	-0.119894	0.033560	-3.572557	0.0004
C(9)	-0.080115	0.026273	-3.049284	0.0025
C(10)	-0.495477	0.064645	-7.664572	0.0000
C(11)	-0.358571	0.058872	-6.090718	0.0000
C(12)	-0.000510	0.002279	-0.223957	0.8230
R-squared	0.383530	Mean dependent var		-0.000385
Adjusted R-squared	0.371395	S.D. dependent var		0.046344
S.E. of regression	0.036743	Akaike info criterion		-3.746913
Sum squared resid	0.342919	Schwarz criterion		-3.664743
Log likelihood	493.0986	Hannan-Quinn criter.		-3.713879
F-statistic	31.60471	Durbin-Watson stat		2.137294
Prob(F-statistic)	0.000000			

WALD TEST

Table: 12			
Test Statistic	Value	df	Probability
F-statistic	6.907625	(2, 254)	0.0012
Chi-square	13.81525	2	0.0010
Null Hypothesis: C(8)=C(9)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(8)		-0.119894	0.033560
C(9)		-0.080115	0.026273
Restrictions are linear in coefficients.			

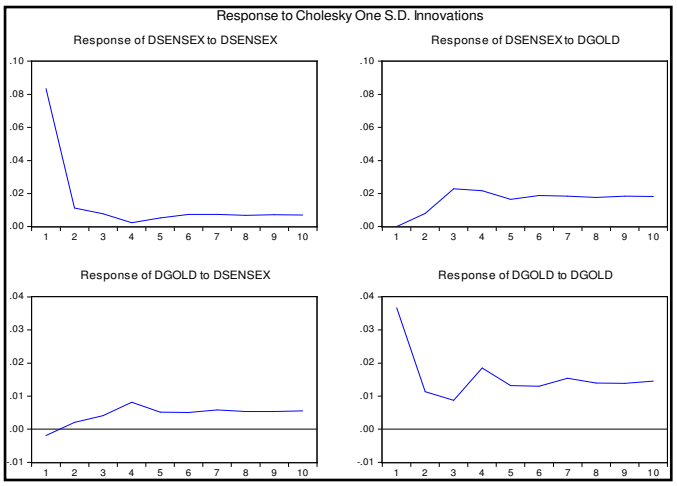
Table: 11			
Test Statistic	Value	df	Probability
F-statistic	15.43737	(2, 254)	0.0000
Chi-square	30.87474	2	0.0000
Null Hypothesis: C(4)=C(5)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(4)		-0.797615	0.146527
C(5)		-0.268210	0.133441
Restrictions are linear in coefficients.			

Table: 10			
Test Statistic	Value	df	Probability
F-statistic	0.938900	(2, 254)	0.3924
Chi-square	1.877800	2	0.3911
Null Hypothesis: C(2) =C(3)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		-0.069300	0.076068
C(3)		0.013085	0.059552
Restrictions are linear in coefficients.			

Table: 13			
Test Statistic	Value	df	Probability
F-statistic	32.03700	(2, 254)	0.0000
Chi-square	64.07401	2	0.0000
Null Hypothesis: C(10)=C(11)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(10)		-0.495477	0.064645
C(11)		-0.358571	0.058872
Restrictions are linear in coefficients.			

The results of the Wald Test claim that both the period lagged values of Sensex jointly insignificant to explain variation in the present value of Sensex. The p-values for both the statistic is greater than 0.05 such that we accept the null hypothesis of joint insignificance of the lagged values of Sensex. However, for all other coefficients, both the period lagged values of a particular explanatory variable statistically significant variation in the corresponding explained variables, Sensex and Gold Price. The p-values of F-statistic and Chi-Square Statistic suggest that the null hypothesis is rejected at 5% level of significance. This test is applied to make short run decision only.

Impulse Response Function



Impulse response function is a shock to a VAR system. It identifies the responsiveness of the dependent variables (endogenous variables) in the VAR when a shock is put to the error term. Impulse response analysis is another way of inspecting and evaluating the impact of shocks cross-section. While persistence measures focus on the long-run properties of shocks, impulse response traces the evolutionary path of the impact over time. A unit shock is applied to the residuals of the variable and observes its effects on the VAR system. In the figure 1, the impulses responses of Sensex to gold price and vice versa are shown for the period of ten months. In the first figure, the response or reaction of Sensex to Sensex is given. If we give a shock of one standard deviation to Sensex, then the Sensex is going to react to its own shock. The result show that it is responding in positive but gradually going down, however, it is not equal to zero. In the next figure, the response of sensex to gold price is given. However, responses of sensex start with negative to positive but after five months, the responses is quite stable, the same results hold for gold price response to sensex, which we can see in the next figure. The response of gold price is negative in the first month, then till three months it gradually increases then after five months the response is stagnant. The last figure shows the response of gold to its own shock. The result is same as the first one, where gold is responding in positive but gradually going down and then stable after seven months.

Variance Decomposition

Variance decomposition provides a different method of depicting the system dynamics. Impulse response functions trace the effects of a shock to an endogenous variable on the variables in the VAR. By contrast, variance decomposition decomposes variation in an endogenous variable into

the component shocks to the endogenous variables in the VAR. The variance decomposition gives information about the relative importance of each random innovation to the variables in the VAR.

Table: 14			
Variance Decomposition of DSENSEX:			
Period	S.E.	DSENSEX	DGOLD
1	0.083284	100.0000	0.000000
2	0.084404	99.12704	0.872963
3	0.087824	92.35674	7.643255
4	0.090471	87.10228	12.89772
5	0.092113	84.36010	15.63990
6	0.094296	81.11368	18.88632
7	0.096376	78.25086	21.74914
8	0.098227	75.82562	24.17438
9	0.100192	73.38251	26.61749
10	0.102096	71.14304	28.85696
Variance Decomposition of DGOLD:			
Period	S.E.	DSENSEX	DGOLD
1	0.036743	0.278655	99.72134
2	0.038514	0.558524	99.44148
3	0.039713	1.576534	98.42347
4	0.044574	4.660376	95.33962
5	0.046784	5.444047	94.55595
6	0.048825	6.080789	93.91921
7	0.051552	6.752975	93.24703
8	0.053680	7.212590	92.78741
9	0.055717	7.629948	92.37005
10	0.057858	8.014972	91.98503
Cholesky Ordering: DSENSEX DGOLD			

In particular, table – 14 shows the results of variance decomposition of BSE Sensex and gold price in the VAR system, the following could be inferred:

In the second month 99.127% of the variability in the BSE Sensex fluctuations is explained by its own innovations. The proportion decreases for the following months (to 81.11 % after 6 months), while the disturbances of the gold price also explain some percentage of the variability of BSE Sensex. Although, after three months the percentage of variability is increasing gradually. The second part of the table depicts the variance decomposition of gold price in VAR system. In the first month 99.72% of the variability in the gold price fluctuations is explained by its own innovations, however, the proportion decreases in the following month. The disturbances of the sensex explain very minor proportion of the gold price.

Conclusion

Stock markets are highly volatile market as the stock prices are changed every day by the market, which causes a problem to the investors who want to play safe. Even the continuous series of financial crises that erupted in different parts of the world in last two decades, make the capital market highly risky investment venture, as a result investors are more keen to go for alternative investment opportunity and gold is very suitable as an alternative investment asset. In light of this, we examine the relation between gold and stock prices and investigate whether it changes during times of consecutive negative market returns for an emerging market, India. The present paper makes an effort to understand the dynamics of capital market and commodity markets thus, the impact of gold price on stock market indices along with their short-run and long-run causal relationship. The primary purpose of the study was to understand short run sensitivity of stock market to changes in gold price. The reason for this is because in India, investments in stock markets are short term and most of investors liquidate their stocks within year. VECM analysis was conducted which signify that gold price have significant impact on stock market returns. To begin with, the data are checked for normality. Application of Jarque-Bera test yielded that the variables under study are not normally distributed. This posed questions on the stationarity of the two series. Hence subsequently, stationarity of the two series were checked with ADF unit root test and the results showed stationarity at difference forms for both the series. Then, correlation between the two variables was computed, which indicated slight negative correlation between them. This made way for determining the direction of influence of each other among the variables. Hence, Granger Causality test was applied to the two variables, which proved unidirectional causality running from gold price to BSE Sensex, that is, a rise in gold price caused a decline in the stock market return but the converse was not found to be true in short-run. However, from cointegration test, it is found that the two variables are cointegrated which established their long-run relationship. Moreover, we have found an adjustment of the error term to reach the long-run equilibrium in the Vector Error Correction Model. The speed of adjustment from the short run disequilibrium to long-run equilibrium is 79 percent that means the model adjusts very fast to reach the long run equilibrium which is confirmed by the OLS of the VECM. One-period lagged value as well as two period lagged value of the BSE Sensex can statistically significantly explain the variation in the current period gold price. Also the one-period lagged value as well as two-period lagged value of the gold price can statistically significantly explain the variation in the current period BSE Sensex. The study observed that the past figure of stock price can explain the movement of gold price. Even the gold price movement causes the vibes in stock market movement in the long-run.

Based on these results, we incline to suggest the favourable property of gold as an investment asset for the Indian emerging market. At least, gold provides a diversification and safe haven benefit to investors in the Indian market. The domestic Indian gold market tends to have resistance to heightened risk in the stock market as it preserves its low negative relation with stock market variations regardless of the market conditions.

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