

# Gold Price, Stock Price and Exchange rate Nexus: The Case of India

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*The paper investigates the causal nexus between gold price, stock price and exchange rate in India through the Autoregressive Distributed Lag (ARDL) bounds testing approach and Granger Causality test. Using monthly time series data, the empirical analysis is carried out for the period from June 1990 to April 2014. Our analysis reveals that gold price and stock price tend to have long-run relationship with exchange rate in India. Besides, there is no evidence of stable long-run cointegration relationship among stock price and gold price in India. Our empirical findings also indicate that there exists no causality runs from gold price to stock price or vice versa in the short-run. It can be concluded that domestic gold price does not contain any significant information to forecast stock prices in India. The study findings are consistent with Kaliyamoorthy and Parithi (2012) where they found no evidence of causality between the gold price and stock price in India.*

*Keywords: Gold Price, Stock Market, Causality, Cointegration, India*

*JEL Classifications: G11, G12*

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## I. Introduction

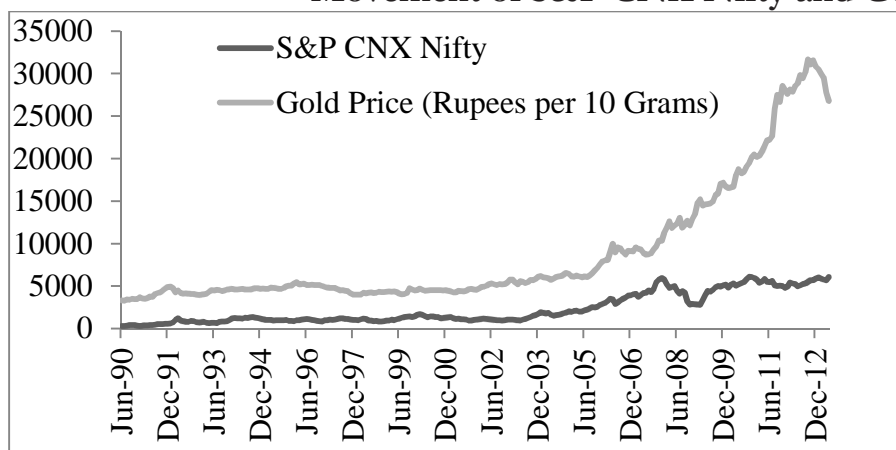
Gold is often considered a reliable investment avenue for any long term savings or investment portfolio. Investors always seek to protect their investment, and gold has acted as a reliable asset. Gold has always been considered as a commodity providing cushion against declining purchasing power of money, thus investment in gold is often made to thwart the impact of inflation and currency depreciation. It also serves as an alternative source of investment in the event of bearish or volatile stock market. As both gold and stock are often substitutes to each other, universally there exists a reverse relationship between gold and stock prices because as the prices of gold rises the investors start investing less in gold consequently falls in stock prices and vice versa. When an economy experiences slow down with falling stock market returns, the investors withdrew their funds from stocks and invest in gold until the economy revives. The evidence on movements of gold price and stock price in emerging economies like India 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 and Bansal, 2010).

The gradual rise in domestic gold price in India is owing to intense demand within the country. The security that gold offers as long as it is retained by Reserve Bank of India is the most pertinent reason that can be cited for huge demand acceleration within domestic market. Moreover, the gold can be converted into liquid cash at any time, even in times of crisis scenario like high global inflation or political turbulence. Gold has the generic ability in holding the character of an asset of last resort. World Economic History shows that countries have frequently used gold as security against loans when they have had difficulties with their Balance of Payments (Mishra et al. 2010).

Figure 1 clearly demonstrates the trend in the movement of S&P CNX Nifty and Gold price for the period June 1990 to May 2013. It appears they are moving in same direction but when market crashed in 2008,

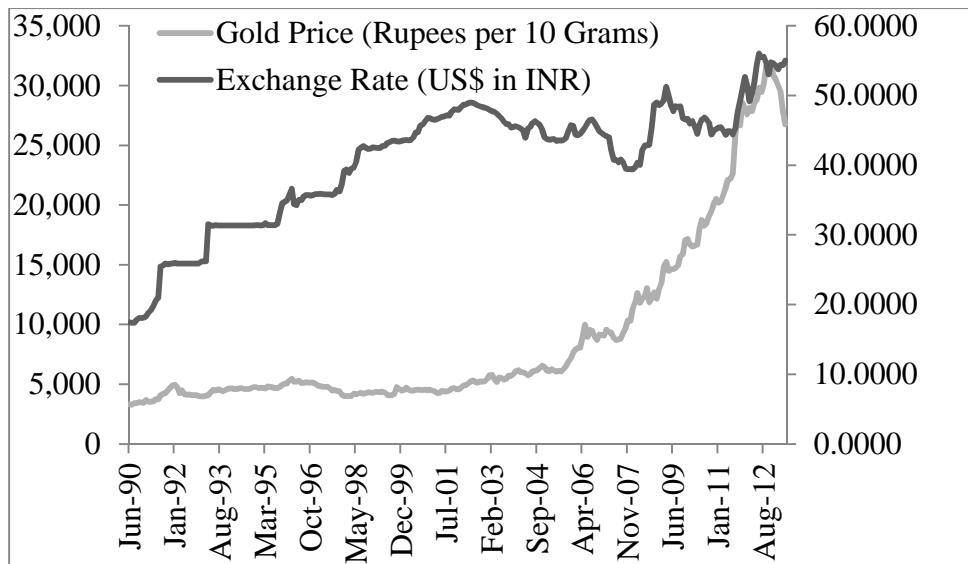
gold price were increasing at a steady rate and in the year 2012-13 when gold price was down the Nifty price started increasing. This implies that that when the stock market crashes, gold continues to be a safe haven investment because of rising gold prices in such circumstances. It can be safely concluded that investors increasingly hedge their investments through gold at the time of crises.

**Figure 1.**  
**Movement of S&P CNX Nifty and Gold price**



One of the important macroeconomic factors that influence the gold price is currency exchange rates. In the event of a devaluation of the currency, normally investors prefer to choose gold as a store of value. Such circumstances will result in an increase in the demand for gold and would leads to increase the price of gold. Besides, the weakening of the US dollar exchange rate will usually contribute to the rise in gold prices. As clear as can be seen from the Figure 2, the overall pattern of gold price in India is increasing steadily over time along with the depreciation of rupee against US dollar. This steady increment in gold price for the last decade stimulates us to examine whether gold can be used to hedge exchange rate fluctuation.

**Figure 2.**  
**Movement of Exchange Rate and Gold price**



Available empirical studies towards the relationship between gold prices, stock market returns and exchange rate provide contradictory results in the context of developed and emerging economies. For Example, studies conducted by Smith (2001) observed a meager connection stock exchange prices and gold price in the case of Hong Kong stock exchange, Japan, Australia, Germany, France and US stock exchange. Toraman et al. (2011) found high negative correlation between gold prices and US exchange rates. Nguyen et al. (2012) conducted study on seven countries including Japan, Singapore, UK, Indonesia, Malaysia, the Philippines, Thailand and United States and they revealed that the Indonesia, Japan, Malaysia and the Philippines market have relationship with the gold price. Shahzadi and Chohan (2012) examined the impact of gold prices on Karachi stock market indices and found a negative correlation between the two prices. Baig

et al. (2013) detected that the gold prices and KSE-100 return have no significant relationship in the long -run and short-un.

Kaliyamoorthy and Parithi (2012) studied the relationship between gold market and stock market prices in India and showed no relationship between gold prices and stock market indices. Moreover, Narang and Singh (2012) proved that there is no causality between the gold price and stock price in India. Mishra et al. (2010) studied the volatility of gold price and stock market in India and they found a long-run equilibrium relation between gold market prices and stock market. Sharma and Mahendra (2010) divulged that exchange rate and gold price influences the stock prices in India. Bhunia and Das (2012) proved the existence of comovement between stock prices and gold prices during the period financial crisis and thereafter in the Indian Context.

Recently, Patel (2013) and Ray (2013) investigated the causal relationship between stock market indices and gold price in India and they found that the Granger causality runs from gold price to stock price. Similarly, Sreekanth and Veni (2014) disclosed that the gold prices and NIFTY are cointegrated in the long run. Besides, they confirmed that the causality flows from gold prices to NIFTY in the short-run and long-run. Using the Toda and Yamamoto non-causality test, Mishra (2014) observed that both the prices have contained in themselves some information to predict each other. Bhunia and Pakira (2014) confirmed that Indian stock market is influenced by gold price and exchange rates in the long-run. Moreover, they showed bidirectional causal between gold price and exchange rates during the study period.

From the existing literature, it can be clear that the relationship between gold price and stock price have been inconclusive, especially in the context of Indian economy. Gold in India witnessed boost in its prices with tumbling US Dollar and stock market on the backdrop of US Subprime crisis and subsequent euro zone crisis. The growing

investment in gold at the time of bearish stock market and falling gold price during the bullish stock market has drawn more attention since this transformational economic crisis began to unfold in 2008. The interdependence of gold price and stock price in India raises the empirical question whether gold price leads to stock price or vice versa. The verifying of this nexus will be immense helpful for the capital market regulators and investors to implement effective decision making strategies on investment and trading in gold and stock markets.

In this context, our study attempts to investigate the causal nexus between gold price, stock price and exchange rate in India for the period June 1990 to April 2014. The rest of the paper is organised as follows: Section II describes the data and methodology applied in the study. Section III provides the empirical results and discussion. Concluding remarks is depicted in the Section IV.

## **II. Methodology**

The Autoregressive Distributed Lag (ARDL) bounds testing approach has been employed in this paper to explore the causal nexus between gold price, stock price and exchange rate in India. The ARDL modeling approach was originally introduced by Pesaran and Shin (1999) and further extended by Pesaran et al (2001). This approach is based on the estimation of an Unrestricted Error Correction Model (UECM) which enjoys several advantages over the conventional type of cointegration techniques. First, it can be applied to a small sample size study Pesaran et al (2001) and therefore conducting bounds testing will be appropriate for the present study. Second, it estimates the short- and long-run components of the model simultaneously, removing problems associated with omitted variables and autocorrelation. Third, the standard Wald or F-statistics used in the bounds test has a non-standard distribution under the null hypothesis of no-cointegration relationship between the examined variables,

irrespective whether the underlying variables are  $I(0)$ ,  $I(1)$  or fractionally integrated. Fourth, this technique generally provides unbiased estimates of the long-run model and valid t-statistic even when some of the regressors are endogenous (Harris and Sollis, 2003). Inder (1993) and Pesaran and Pesaran (1997) have shown that the inclusion of the dynamics may correct the endogeneity bias. Fifth, the short as well as long-run parameters of the model could be estimated simultaneously. Sixth, once the orders of the lags in the ARDL model have been appropriately selected, we can estimate the cointegration relationship using a simple Ordinary Least Square (OLS) method. In view of the above advantages, ARDL-UECM used in the present study has the following form as expressed in equations (1-3):

$$\Delta nY_1 = \beta_0 + \sum_{i=1}^m \delta_1 \Delta nY_{1t-i} + \sum_{i=1}^n \delta_2 \Delta nY_{2t-i} + \sum_{i=1}^n \delta_3 \Delta nY_{3t-i} + \beta_1 InY_{1t-i} + \beta_2 InY_{2t-i} + \beta_3 InY_{3t-i} + \varepsilon_t \quad (1)$$

$$\Delta nY_2 = \beta_0 + \sum_{i=1}^m \delta_1 \Delta nY_{1t-i} + \sum_{i=1}^n \delta_2 \Delta nY_{2t-i} + \sum_{i=1}^p \delta_3 \Delta nY_{3t-i} + \beta_1 InY_{1t-i} + \beta_2 InY_{2t-i} + \beta_3 InY_{3t-i} + \varepsilon_t \quad (2)$$

$$\Delta nY_3 = \beta_0 + \sum_{i=1}^m \delta_1 \Delta nY_{1t-i} + \sum_{i=1}^n \delta_2 \Delta nY_{2t-i} + \sum_{i=1}^p \delta_3 \Delta nY_{3t-i} + \beta_1 InY_{1t-i} + \beta_2 InY_{2t-i} + \beta_3 InY_{3t-i} + \varepsilon_t \quad (3)$$

where,  $Y_1$ ,  $Y_2$  and  $Y_3$  represents selected variables for the study such as gold price (GOLD), stock price (STOCK) and exchange rate (EXRATE), respectively.  $t$  is the time dimension and  $\Delta$  denotes a first difference operator;  $\beta_0$  is an intercept and  $\varepsilon_t$  is a white noise error term.

The first step in the ARDL bounds testing approach is to estimate equations (1-3) using ordinary least squares method in order to test for existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged level variables, i.e.,  $H_0: \beta_1 = \beta_2 = \beta_3 = 0$  against the alternative  $H_1: \beta_1 \neq$

$\beta_2 \neq \beta_3 \neq 0$ , which normalize on  $Y_1$  by  $F(Y_1/Y_2, Y_3)$ . Two sets of critical value bounds for the F-statistic are generated by Pesaran et al (2001). If the computed F-statistic falls below the lower bound critical value, the null hypothesis of no cointegration cannot be rejected. Contrary, if the computed F-statistic lies above the upper bound critical value; the null hypothesis is rejected, implying that there is a long-run cointegration relationship amongst the variables in the model. Nevertheless, if the calculated value falls within the bounds, inference is inconclusive. Similar testing procedure was followed to calculate the F-statistic when each of  $Y_2$  and  $Y_3$  appear as a dependent variable and other variables are considered as explanatory variables in the specification.

Once cointegration is established, we obtain the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. This is specified as follows:

$$\Delta Y_{1t} = \mu_1 + \gamma_1 z_{t-1} + \sum_{i=1}^{p-1} \theta_{1t} \Delta Y_{1t-i} + \sum_{i=1}^{p-1} \delta_{1t} \Delta Y_{2t-i} + \sum_{i=1}^{p-1} \xi_{1t} \Delta Y_{3t-i} + \varepsilon_{1t} \quad (4)$$

$$\Delta Y_{2t} = \mu_2 + \gamma_2 z_{t-1} + \sum_{i=1}^{p-1} \delta_{2t} \Delta Y_{2t-i} + \sum_{i=1}^{p-1} \theta_{2t} \Delta Y_{1t-i} + \sum_{i=1}^{p-1} \xi_{2t} \Delta Y_{3t-i} + \varepsilon_{1t} \quad (5)$$

$$\Delta Y_{3t} = \mu_3 + \gamma_3 z_{t-1} + \sum_{i=1}^{p-1} \xi_{3t} \Delta Y_{3t-i} + \sum_{i=1}^{p-1} \theta_{3t} \Delta Y_{1t-i} + \sum_{i=1}^{p-1} \delta_{3t} \Delta Y_{2t-i} + \varepsilon_{1t} \quad (6)$$

where  $\gamma' z_{t-1}$  is the error correction term derived from the cointegrating vector.  $\theta$ ,  $\delta$  and  $\xi$  are the short-run parameters to be estimated,  $p$  is the lag length, and  $\varepsilon_t$  are assumed to be stationary random processes with a mean of zero and constant variance.

For each equation in the error correction model, we employ short-term Granger causality to test whether endogenous variables can be treated as exogenous by the joint significance of the coefficients of each of the other lagged endogenous variables in that equation. The short-term significance of sum of the each lagged explanatory



variables ( $\theta$ 's,  $\delta$ 's and  $\xi$ 's) can be exposed either through joint F or Wald  $\chi^2$  test. Besides, the long-term causality is implied by the significance of the t-tests of the lagged error correction term ( $ECT_{t-1}$ ). However, the non-significance of both the t-statistics and joint F or Wald  $\chi^2$  tests in the error correction model indicates econometric exogeneity of the dependent variable. If there is no cointegration between the variables then the causality test should be carried out on a VAR in differenced data. It may be noted here that even in the absence of cointegration between the variables, the error correction model can still be estimated to test for short-run standard Granger causality (Bahmani and Payesteh, 1993). In this case, the error-correction term(s) should not be included in the model(s) for estimation purposes.

Finally, the study employed Variance Decomposition Analysis (VDA) and Impulse Response Functions (IRFs) to assess to what extent shocks to certain time-series variable are explained by other variables in the system. Variance decomposition analysis measures the proportions of forecast error variance in a variable that is explained by innovations (impulses) in it and by the other variables in the system. For example, it explains what proportions of the changes in a particular variable can be attributed to changes in the other lagged explanatory variables. In a statistical sense, if a variable explains most of its own shock, then it does not allow variances of other variables to contribute to it being explained and is therefore said to be relatively exogenous. Impulse response analysis traces out the responsiveness of the dependent variable in Vector Auto Regressive (VAR) framework to shocks to each of the other explanatory variables over the period of time. A shock to a variable in a VAR framework not only directly affects that variable, but also transmits its effect to all other endogenous variables in the system.

The present study uses the monthly data on closing prices of S&P CNX Nifty of National Stock Exchange (NSE), average gold prices of Mumbai (measured in Rupees per 10 grams) and exchange rate (US\$ against INR). The necessary information for the study is collected from the National Stock Exchange database and Reserve Bank of India database for the period of June 1990 to April 2014. Stock market returns are calculated on the basis of first difference of log NSE S&P CNX Nifty closing price index series.

### **III. Results and Discussions**

As a preliminary step, it is necessary to examine the stationary property of time series data to determine the most appropriate econometric technique in order to avoid spurious results. The use of non-stationary variables in the time series analysis leads to misleading inferences (Libanio, 2005). We use the Augmented Dicker Fuller (ADF) test to check for the unit root in each variable and thereby determine the order of integration. The results of unit root test are presented in the Table 1. The results of ADF test with trend reveal that gold price and stock price are stationary at first differences, and exchange rate is stationary at levels. Besides, the ADF test with intercept and trend shows that stock price and exchange rate are stationary at levels and gold price is stationary at first differences. The ADF test results confirm that the variables having mixed order of integration, viz. either  $I(0)$  or  $I(1)$ , so the ARDL process is used.

**Table 1.**  
**Augmented Dickey-Fuller Test Results**

Variables	Intercept		Intercept & Trend	
	Level	First Difference	Level	First Difference
GOLD	1.299	-15.226*	-0.638	-15.361*
STOCK	-1.557	-12.118*	-3.119***	-12.108*
EXRATE	-3.540*	-13.812*	-3.540***	-14.020*

Note: \*(\*\*\*) – indicates significance at one and ten percent level, respectively.  
Optimal lag length is determined by the Schwarz Information Criterion (SIC).

Table 2 presents the result of ARDL Bounds F-test for Cointegration relationship based on equations (1-3). The appropriate lag length was selected on the basis of Schwarz Information Criterion (SIC) for the conditional ARDL-UECM.

**Table 2.**  
**ARDL Cointegration Bound Testing Approach**

Model Specification	F-statistics	Inference
$F_{\text{GOLD}}(\text{GOLD/STOCK, EXRATE})$	1.552	No Cointegration
$F_{\text{STOCK}}(\text{STOCK/GOLD, EXRATE})$	3.801	Inconclusive
$F_{\text{EXRATE}}(\text{EXRATE/STOCK, GOLD})$	4.904**	Cointegration

Note: \* indicates computed statistic falls above the upper bound value. Asymptotic critical value bounds are obtained from Pesaran et al. 2001, p. 300; Case III: Unrestricted intercept and no trend. Lower bound  $I(0) = 3.79$  and Upper bound  $I(1) = 4.85$  at five percent significance level.

The table result reveals that the computed F-statistic is obviously greater than the upper bound critical value of 3.79 at the five percent

significant level. Thus, the null hypothesis of no cointegration is rejected and exchange rate tends to have long-run relationship with gold price and stock price. Besides, the results confirm the absence of a level relationship (a long-run relationship) when gold price is a dependent variable regressed on stock price and exchange rate. Similarly, when stock price is the dependent variable, the calculated F-statistics is found to be lower than the upper critical bound value of five percent. This shows that there is no evidence of stable long-run cointegration relationship among stock price and gold price in India.

**Table 3.**  
**Granger Causality Test Results**

Dependent Variable	Short-Run Effect			Long-Run Effect
	Wald F statistics			t-statistics
	GOLD	STOCK	EXRATE	ECT(s)
GOLD	-	0.174 (0.676)	0.979 (0.322)	--
STOCK	1.654 (0.198)	-	0.0004 (0.983)	--
EXRATE	1.118 (0.290)	0.0069 (0.933)	-	-0.019* [-2.669]

Notes: \* indicate the significance at one percent level. Optimal lag length is determined by the Schwarz Information Criterion (SIC). Parenthesis ( ) and [ ] shows P-value and t-value, respectively.

The Granger causality test is employed to estimate the equations (4) and (5) without inclusion of error correction terms to examine the short-run causal nexus between the variables under consideration. For equation (6), the error-correction term is considered for the estimation in the presence of cointegrating relationship. The results of Granger Causality test are presented in Table 3. The optimal lag length is determined by the Schwarz Information Criterion (SIC). The results of Wald F statistic based on Granger causality test confirm that stock

price, gold price and exchange rate are independent of each other in the short-run. Also, it is evident from the test results that estimated t statistic for the error correction coefficient has negative and significant at one percent level, ensuring the disequilibrium in exchange rate from the previous period's shock converges back to the long-run equilibrium in the current period. It shows the speed of adjustment towards long run adjustment is very slow. From the empirical findings of Granger causality test, it can be inferred that there exists no causality runs from gold price to stock price or vice versa in the short-run and long-run.

The results of Variance Decomposition Analysis for the selected variables viz. gold price, stock price and exchange rate over a 20-months horizon are presented in Table 4. The table result shows that gold price variable was 99 percent explained by its own shock over the 20 months horizon. The gold price accounts for only about 0.32 and 0.06 percent of the shock explained by exchange rate and stock price, respectively. The shock explained by changes in gold price and stock price on exchange rate is only about 3.15 and 0.18 percent during the entire 20 months horizon, respectively. Besides, the stock price accounts for only about 0.63 and 4.36 percent of the shock explained by gold price and exchange rate, respectively. By and large, the results of variance decomposition analysis suggest that gold price, stock price and exchange rate are independent of each other. This finding is consistent with the results obtained from the Granger causality test above.

**Table 4.**  
**Variance Decomposition Analysis**

Variance Decomposition of GOLD				
Period	S.E.	GOLD	EXRATE	STOCK
1	0.0343	100.00	0.0000	0.0000
2	0.0345	99.635	0.3061	0.0580
3	0.0345	99.615	0.3222	0.0621
4	0.0345	99.614	0.3227	0.0623
5	0.0345	99.614	0.3227	0.0623
10	0.0345	99.614	0.3227	0.0623
15	0.0345	99.614	0.3227	0.0623
20	0.0345	99.614	0.3227	0.0623
Variance Decomposition of EXRATE				
1	0.0220	3.2115	96.788	0.0000
2	0.0224	3.1586	96.696	0.1447
3	0.0224	3.1581	96.665	0.1767
4	0.0224	3.1583	96.660	0.1807
5	0.0224	3.1584	96.660	0.1812
10	0.0224	3.1584	96.660	0.1812
15	0.0224	3.1584	96.660	0.1812
20	0.0224	3.1584	96.660	0.1812
Variance Decomposition of STOCK				
1	0.0700	0.0067	4.3562	95.637
2	0.0732	0.5512	4.3461	95.102
3	0.0735	0.6240	4.3624	95.013
4	0.0736	0.6311	4.3653	95.003
5	0.0736	0.6317	4.3656	95.002
10	0.0736	0.6317	4.3657	95.002
15	0.0736	0.6317	4.3657	95.002
20	0.0736	0.6317	4.3657	95.002

The impulse response functions (IRFs) in Appendix 1 illustrate the responses of the endogenous variables to an initial shock of one standard deviation in gold price, stock price and exchange rate. The IRFs appear to be consistent with the results obtained from the Variance Decomposition Analysis (VDA) discussed above.

#### **IV. Conclusion**

The paper investigates the causal nexus between gold price, stock price and exchange rate in India through the Autoregressive Distributed Lag (ARDL) bounds testing approach and Granger Causality test. Using monthly time series data, the empirical analysis is carried out for the period from June 1990 to April 2014. Our analysis reveals that gold price and stock price tend to have long-run relationship with exchange rate in India. Besides, there is no evidence of stable long-run cointegration relationship among stock price and gold price in India. Our empirical findings also indicate that there exists no causality runs from gold price to stock price or vice versa in the short-run. It can be concluded that domestic gold price does not contain any significant information to forecast stock prices in India. The study findings are consistent with Kaliyamoorthy and Parithi (2012) where they found no evidence of causality between the gold price and stock price in India.

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