Foreign Exchange, Gold, and Real Estate Markets in India : An Analysis of Return Volatility and Transmission

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Abstract

This empirical analysis endeavored to investigate the return volatility, covolatility, and the spillover impact of gold, real estate, and U.S. dollar in India. The generalized autoregressive conditional heteroskedasticity dynamic conditional correlation (GARCH - DCC) was used to reveal the return volatility and conditional correlation. The volatility spillover was examined by using the variance decomposition technique. The empirical outcome clearly revealed the presence of ARCH and GARCH effect on gold, realty, and U.S. dollar. Additionally, the results also manifested that the returns of these variables were not moving away from their means in the long run. On the other hand, the consequences of volatility spillover reported that real estate was the most dominating among all markets. This is so because returns on real estate had a significant contribution to the return volatility of the other markets. Finally, it was also found that return volatility of U.S. dollar was most affected as it was the net receiver of volatility, while return volatility of gold seemed to be neutral in the Indian financial market.

Keywords : gold, GARCH DCC, U.S. dollar volatility, spillover

JEL Classification Codes : E4, E5, G0, G1, G2

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In the current dynamic financial and monetary market, the economic crises have made the global financial and monetary markets to be highly volatile, which has raised serious concerns in the minds of investors who dreamed to make money through international diversification. The persistence of significant volatility in the stock markets has negatively affected the financial markets and the banking sector, which caused more distress in the real economy. The sophistication of the financial and monetary markets gave birth to many investment opportunities by diversification of investments into various instruments such as gold, leading currencies, as well as the property market. When the market becomes gloomy due to persistence of high level of volatility, then investors panic and they rush to find out the alternative markets to park their investments, and this leads to the transfer of investments from the stock market towards gold, tradable currency, and real estate. There are many empirical analyses that revealed that the gold prices showed an upward trend since a long time and this trend remained the same during the recession period (e.g., Bhunia & Das, 2012). The analysis of various agencies shows that the total yearly supply of gold worldwide plunged from 4037 tonnes in 2002 to 3380 tonnes in 2008. However, the demand of gold in India in 2017 was somewhere about 700 - 800 tonnes per annum. The volatility in the returns on gold impact investors significantly in India. Empirical investigation on the return volatility of gold has become very pertinent in the recent years (Tully & Lucey, 2007). Furthermore, today's versatile financial market investments have been expended from gold to other eminent instruments such as U.S. dollar as well as the

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property market. In recent days, foreign exchange investments have become the fastest emerging destination of investments among the investors as well as traders, and that is why foreign exchange has become the world's dominating financial market with the volume of transactions being larger than U.S. $1.5 trillion daily. In India, the U.S. dollar is considered as a safe destination of investments and a large amount of investments are done in the U.S. dollar. Apart from the U.S. dollar, the investments in real estate are always conceded to be safe destinations of investments and substantial amount of money is parked in the property market. The Indian real estate market is expected to touch U.S. $ 180 billion by 2020. The housing sector is expected to contribute around 11% percent to India's GDP by 2020 (India Brand Equity Foundation, 2019).

The above - mentioned financial assets such as gold, real estate, and U.S. dollar have significant contribution in the total investment of the Indian financial market. Volatility has become a relevant issue in the field of finance and monetary economics. Faster growing interlinkages between the international economies cause a spread of financial distress from one asset class to another in the same countries or among other nations. The analysis of many studies focused upon following the volatility of stock exchanges as well as foreign exchanges with the presumption of no potential outcomes of co-movement of volatility, while the observational investigations that centered on conceivable outcomes of co-movement of volatility overlooked taking consideration of return variability of gold, real estate, and U.S. dollar simultaneously. Many studies took into consideration return volatility of gold as well as U.S. dollar in isolation of other variables. On the other hand, a significant number of empirical analyses overlooked the real estate return volatility for their empirical analysis. Furthermore, it can be stated that the real estate market has always been ignored in the Indian context. Then again, a large portion of far-reaching exact examinations focused on Western economies, while none of the investigations centered on the Indian perspective.

Portfolio managers have tried to minimize the risk of returns through the diversification of the portfolio investments. However, in the current economic era, it is not an easy job, because the risk in return on assets might correlate with other assets. In a country like India, where most of the people desire to hold gold for the purpose of investment in place of other relevant investment assets such as real estate and foreign currencies, it has become very crucial to capture return co-volatility of portfolio investment together. There is a strong economic phenomenon as people invest their money in gold instead of real estate for earning good returns. Sometimes, people also look towards the U.S. dollar for investments. The endeavour of the present empirical investigation is to contribute to the existing wisdom related to the above theme. The current investigation strives to make a substantial few additions to the existing literature. First, it advances the existing literature by considering the current analysis considering the property market to understand the return volatility and spillover impact. Second, it also examines the three pertinent destinations of investment such as gold, real estate, and U.S. dollar simultaneously, while most of the literature on the above issue has given the importance to gold and stock markets for their analysis (Mishra, Das, & Mishra, 2010 ; Narang & Singh, 2012 ; Natchimuthu, Ram, & Angadi, 2017). Therefore, this analysis makes an addition by considering volatility of real estate, gold, and U.S. dollar, which have never been explored by earlier studies.

The results of the current empirical analysis will provide a scientific benchmark for effective decision - making by investors as well as portfolio managers. The investors will be benefited by the results of this investigation. They can explore the information for effective management of international portfolio risk and currency risk planning. For finding conditional volatility in exchange rate returns and correlation dependency and interdependency, multivariate GARCH models have been used. The dynamic conditional correlations (DCC) model has become a dominant model in volatility transmission studies as it has the power to preserve the parsimony of univariate GARCH models of individual assets volatility like time-varying correlations, which makes it the most sophisticated and robust method of volatility modeling (Engle & Sheppard, 2001). It has clear computational advantages in that the number of parameters to be estimated in the correlation process is independent of the

number of series to be correlated, thus potentially very large correlation matrices can be estimated To calibrate the spillover impact of return volatility of gold, real estate, and foreign exchange, the vector autoregressive (VAR) model has been employed in the present study.

Review of Literature

The empirical analysis of Hillier, Draper, and Faff (2006) pointed out that precious metals such as gold, platinum, and silver had sufficient capability to cover risk at abnormal stock market volatility. Baur and Lucey (2010) also concluded the same attributes of gold after investigating the stock markets of U.S., United Kingdom, and Germany. Christie - David, Chaudhry, and Koch (2000) analyzed the impact of macroeconomic news on the return of precious metals such as gold and silver in the U.S. financial market. The outcome of the analysis revealed that macroeconomic announcements had a significant impact of the intraday volatility of gold prices. Gencer and Kilic (2014) concluded that previous volatility of the stock market significantly impacted the return volatility of gold in Turkey by applying the GARCH family model. On the other hand, Toraman, Başarır, and Bayramoglu (2011) investigated the conditional volatility of returns on gold in the U.S. market by exerting the M-GARCH model. The authors found that there was an inverse relationship between gold prices and exchange rate, and on the other hand, a positive relationship was found between gold and oil prices. Additionally, Gaur and Bansal (2010) confirmed that the crisis in stock markets led to a surge in gold prices. Furthermore, Smith (2002) investigated the short-run and long - run relationship between the stock market and gold prices. The empirical outcome clearly pointed out that there was a minor significant negative relation between stock indices and gold prices in the short and long time period. The results also showed the evidence of insignificant association between gold and stock market returns in the long-run. On the other hand, results also demonstrated a weak negative relationship in the short run time period. The study of Hammoudeh, Yuan, McAleer, and Thompson (2010) analyzed the return co-volatility in four precious metals like gold, silver, platinum, and palladium. The empirical results clearly pointed out that all these four metals had significantly short-run and long-run interdependencies to past news as well as past volatility. For this study, the authors applied the VARMA - GARCH model.

Bhowmik (2013) found that the stock market volatility had a negative nexus with the growth rate of India as a high volatility reduced the growth rate. The author applied simple GARCH as well as VAR model for this analysis. The empirical research of Arouri, Lahiani, and Nguyen (2013) investigated the linkage between the world gold prices and stock returns of the Chinese market. The empirical results of the investigation documented the existence of significant cross return volatility effects between gold prices and stock prices of the Chinese financial market. Moreover, the outcome also unearthed that the previous period returns of gold had a significant role in determining the dynamics of conditional return and volatility of the Chinese stock market for the period of the study. Gencer and Kilic (2014) scrutinized the conditional correlations and volatility links between gold, oil, and stock exchanges in Turkey by deploying the multivariate CCC M-GARCH model. The outcome showed the evidence that gold prices had a significant impact on portfolio management. Furthermore, the authors also found that a negative correlation existed between gold and other metals and commercial sectors. Kumar and Singh (2008) studied about the volatility in risk and return for gold and equity in India by exerting the GARCH mean model. The empirical outcome pointed out that there was a positive risk - return relationship among the variables. In addition, the outcome also revealed that the relation of Nifty and soybean was insignificant, while at the same time, it was significant in the case of gold. Suresh and George (2016) explored the consequences of market sentiment on return volatility of the Indian equity market. The outcome showed that the market sentiments had a significant impact on the return volatility of medium and small cap portfolios. Additionally, the results of the ARDL model demonstrated the long-term nexus between return volatility and irrational sentiments in the Indian perspective.

Aggarwal and Khurana (2018) found that there was a long run nexus between the four stock markets such as Brazil, India, China, and Russia. On the other hand, causality outcomes revealed that there was a short term unidirectional causality running from Chinese, Brazilian, and Russian to the Indian stock market.The study conducted by Kishor and Singh (2014) in the area of stock return volatility in the BRICS nations found that the BRICS's stock markets, except for Brazilian and Chinese stock markets, were significantly affected by the news of the U.S. stock market (by using GARCH modeling). The empirical analysis of Mohammadi and Tan (2015) on the return and volatility spillovers across equity markets of Mainland China, Hong Kong, and the United States revealed the unidirectional return spillovers from the U.S. financial market to other major markets. The authors also concluded that no significant volatility spillover existed among the Hong Kong and various mainland Chinese markets. Natchimuthu, Ram, and Angadi (2017) investigated the existence of leverage effect on the gold price variability in Indian cities by exerting the PGARCH model. The outcome of the investigation revealed that there was an existence of volatility clustering of gold prices in Indian cities. Nikkinen, Sahlström, and Vähämaa (2006) explored the currency options on the euro, British pound, and Swiss franc exchange rates against the U.S. dollar to assess the return volatility relationship among these currencies. The empirical analysis showed the evidence that currency options had volatility expectations. The outcome also documented that euro's volatility expectations had a major impact on the GBP and CHF. The study of Mishra (2014) revealed that gold was one of the most preferable destinations of investment as well as the best substitute for the U.S. dollar.

Lakshmi (2013) tried to investigate the volatility of various sectoral indexes in India. The empirical outcome revealed that among the entire sectoral indexes, the realty sector volatility was the highest. There are an expanding number of studies that focused upon the volatility of foreign exchange of top dominating currencies in isolation of other financial investment instruments such as gold as well as property. Yadav (2016) examined the nexus between Nifty index returns in the Indian exchange rate in terms of U.S. dollar. The empirical outcome revealed that there was a tradeoff between the stock market returns and exchange rate. On the other hand, the degree of nexus was not very significant.

Numerous examinations have taken thought of examination of return instability of gold and also foreign exchange in segregation of different factors. On the other hand, none of the observational investigations gave space to the unpredictability of returns of the real estate markets for their experimental examination. Moreover, it can be expressed that the property market has dependably been disregarded in the Indian context. In this manner, the current observational investigation makes an expansion to the current aggregate wisdom of the above - mentioned theme in a few different ways. In the first place, it progresses the current writing by considering three applicable goals of speculation, for example, gold, real estate, and the U.S. dollar simultaneously. Second, this investigation considers the real estate sector to comprehend the return volatility and spillover impact as numerous studies on this topic have given significance to gold and securities exchange for their investigation (e.g., Narang & Singh, 2012 ; Natchimuthu et al., 2017 ; Mishra et al., 2010). In this manner, this examination expands the previous studies by considering the volatility of the realty sector, which has never been investigated in the previous analysis.

Data and Methodology

(1) Data Description : For the current empirical investigation, daily time - series data were gathered from the Bombay Stock Exchange (BSE Sensex), Federal Reserve Bank of St. Louis, as well as MCX database. The daily data consists of 10 years from June 2007 to May 2017 of all the variables. Additionally, the data of no trading days were not considered as done by previous empirical analysis for convenience. The realty index was utilized as a proxy for the real estate. The data of realty index were collected from the Bombay Stock Exchange database. On

Figure 1. Return Series in India

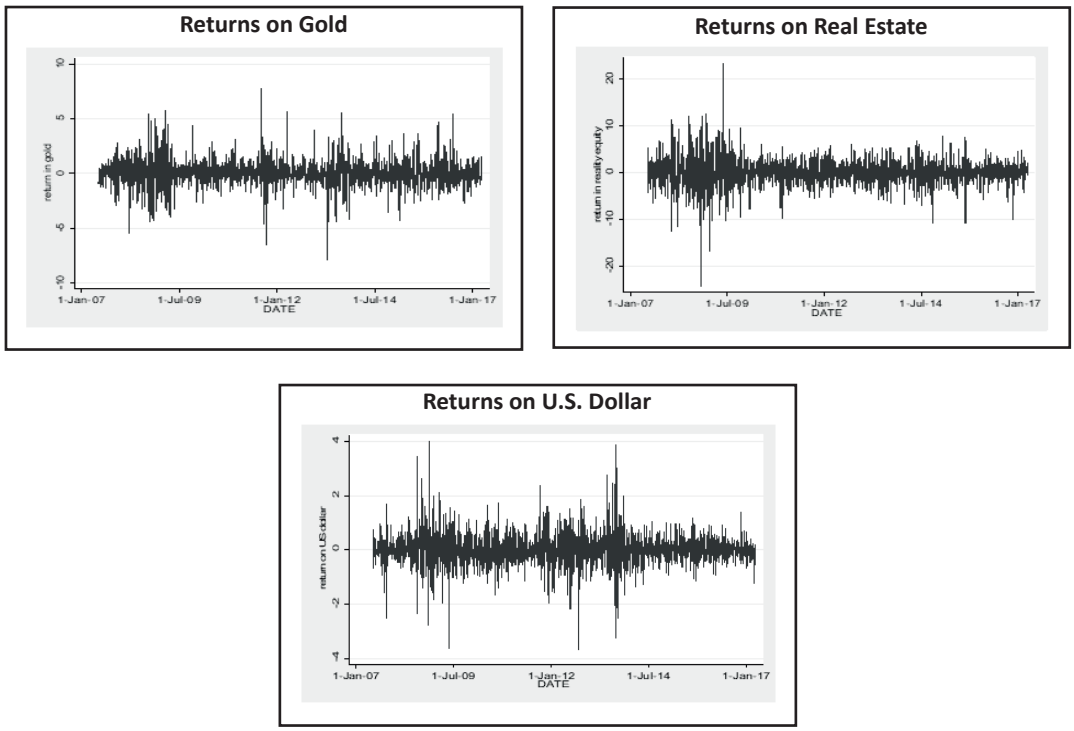


Table 1. Descriptive Statistics for Returns on Gold, Real Estate, and U.S. Dollar

	Returns on Gold	Returns on Real Estate	Return on U.S. Dollar($)
Mean	0.054	-0.017	0.0212
Standard Dev	1.113	2.82	0.56
Variance	1.23	7.9	0.3242
Kurtosis	8.93***	9.89**	9.72***
Skewness	0.11**	-0.11**	0.195**
Jarque - Bera	2670**	250.25**	2657.22**
Q Statistics	34.65***	58.19**	61.5**

Note. *** is significant at 1% and ** is significant at 5% critical value.

the other hand, the information about the U.S. dollar was collected from the Federal Reserve database. Finally, the data of gold prices were accumulated from Multi Commodity Exchange of India Ltd. (MCX) database. All the above data have been converted in their natural log form.

From the Table 1, it can be inferred that variation in the real estate market is high as compared to gold market and U.S. dollar (USD). On the other hand, the skewness of gold and USD is positive, which indicates that the tail is towards the mean, while the returns of real estate is tailed towards the mode as its value is negative. Furthermore, the outcome of Jarque - Bera test reveals that none of the variables is normally distributed. The null hypothesis of normality in distribution is rejected by the result of the J - B test. The *Q* statistics of Ljung - Box test shows that there is a serial correlation of residual of all the variables because it rejects the null hypothesis of no serial

Table 2. Unit Root Test of Data

Variables	ADF Test	Phillips - Perron Test
Gold	-25.35***	-26.65***
U.S. Dollar	-36.33***	-37.36***
Real Estate	-25.95***	-25.98***

Note. *** is significant at 1% and ** at 5% critical value.

correlation. The outcome indicates higher order serial correlation and non-linearity among the variables. These outcomes clearly indicate that the return volatility of these variables can be investigated by exerting the GARCH family model. Finally, the outcome also points out that the returns series of gold, real estate, and foreign exchange (USD) exhibit non - randomness and volatility clustering. It means that large movements are characterized by large changes and vice-versa.

The results of unit - root test show that every one of the factors is significant at the 1% level of significance. It implies that it dismisses the null hypothesis of unit root and every one of the variables considered for this empirical analysis is stationary at 1% level of significance (see Table 2).

(2) Methodology : The major objective of this paper is to examine conditional return volatility, correlation dependency and interdependency, and spillover impact of gold, realty, and foreign exchange investments with respect to the Indian financial markets. For finding the conditional volatility in return and correlation dependency and interdependency, multivariate GARCH models with alternative assumptions have been applied. For this study, GARCH DCC (dynamic conditional correlation) model has been applied, which was propounded by Engle and Sheppard (2001). The dynamic conditional correlations (DCC) model has become a dominant model in volatility transmission studies as it has the power to preserve the parsimony of univariate GARCH models of individual assets volatility like time-varying correlations which makes it the most sophisticated and robust method of volatility modeling (Engle & Sheppard, 2001). It has clear computational advantages in that the number of parameters to be estimated in the correlation process is independent of the number of series to be correlated ; thus, potentially very large correlation matrices can be estimated. For obtaining results for the spillover impact, the vector autoregressive (VAR) model has been applied. These investigation techniques are sufficient to examine conditional volatility interdependence as well as the existence of conditional correlations among the variables for the short and long span of time. Additionally, these can sufficiently reveal the volatility spillover impact over time.

(i) The DCC - GARCH and Vector Autoregressive (VAR) Model : In the DCC model, the diagonal variable of H is modeled as GARCH models. The off-diagonal variables are modeled on non - linear functions of the diagonal terms :

$$H_{ij,t} = \partial_{ij,t} \sqrt{H_{ii,t} H_{jj,t}}$$

where, $\partial_{ij,t}$ follows a dynamic process, rather than being constrained as constant as in the CCC specification. Two additional coefficients, λ_1 and λ_2 are adjustment parameters that govern the evolution of the conditional correlations. They must be positive and sum to less than one. A test for the sum of these parameters equaling zero tests the DCC model against the special case of the CCC model.

$$Y = \zeta x_t + e_t$$

$$e_t = \sqrt{H_t} v_t$$

$$H_t = \sqrt{D_t}\, R_t \sqrt{D_t}$$

$$R_t = diag\,(Q_t)^{-1/2}\, Q_t\, (diag\,(Q_t)^{-1/2})$$

$$Q_t = (1-\lambda_1-\lambda_2)R + \lambda_1 e_{t-1} + \lambda_2\, Q_{t-1} \qquad (1)$$

where, D_t is a diagonal matrix of conditional variances, R is is a matrix of conditional quasi-correlations, and e_t is a vector of standardized residuals, $D_t^{-1/2} e_t$. R is a weighted average of the unconditional VCE of the standardized residuals and the unconditional mean of Q_t . All the flexible versions of the MGARCH models are estimated under a multivariate Gaussian *t* distribution as the normality assumption is rejected in most empirical applications.

(ii) VAR Model for Finding the Spillover Effect on the Variables :

$$y_t = \alpha + \sum_{i=1}^{n} \partial\, y_{t-i} + \varepsilon \qquad (2)$$

From the above VAR model, we can see that y_t depends upon the past lag of its past as well as the lag. α is constant term where ∂' s coefficients show the relationship. ε is white noise error term which is (*iid*). The variance decomposition can be ascertained once the above VAR model will be run to find out the spillover effect.

$$y_t = \sum_{i=1}^{n} \partial_i\, \varepsilon_{t-1} \qquad (3)$$

where, $t = 1, 2, 3 \ldots Z$ and ∂ is $N * N$ coefficient matrix and it follows a recursion of the form :

$$\partial_I = \theta_1\, \partial_{i-1} + \theta_2\, \partial_{i-2} + \times\times\times\theta_n\, \partial_{i-n}$$

and $\partial_0 = I_n$ and if $\partial_1 = 0$ for $i < 0$

H-step-ahead forecast error variance decomposition is computed as :

$$\beta_{ij}^{g}(H) = \frac{\sigma_{ii}^{-1} \sum_{h=0}^{H-1} (e_i \beta_h \sum e_j}{\sum_{h=0}^{H-1} e_i \beta_h \sum \beta h e_i}\ , \quad i, j = 1,2\ \ldots n \qquad (4)$$

where, $\sum$ is variance matrix for the error vector, σ_{ii} is the standard deviation of the epsilon term of *i*th variables, and *e* is a (n * 1) vector with 1 as the *i*th element and 0 otherwise. To obtain a unit sum of each row of the variance decomposition, each entry of the variance decomposition matrix is normalized so that construction of the decomposition including own shocks in each market is equal to one. According to the characteristics of generalized VAR, $\sum_{j=1}^{n} \beta_{ij}^{g}(H)$ is not equal to 1, and then each entry of the variance decomposition matrix is normalized by the row as follows :

$$\beta_{ij}^{g}(H) = \frac{\beta_{ij}^{g}(H)}{\sum_{j=1}^{n} \beta_{ij}^{g}}$$

Using these results, the spillover index is constructed as follows :

Total spillover index :

$$s^{g}(H) = \frac{\sum_{\substack{i,j=1 \\ i \neq j}}^{n} \beta_{ij}^{g}(H)}{\sum_{i,j=1}^{n} \beta_{ij}^{g}(H)} * 100 \qquad (5)$$

where, i = return in one market and j = return in other different market. The index measures the contributions from the spillovers of volatility shocks across returns of asset to the total forecast error variance.

Directional Spillovers :

The directional spillovers help us to recognize both magnitude and the direction of the spillover effect as the results of variance composition do not hinge on the sequence of the variables. The directional spillovers received by variable *i* from all other variables *j* are defined as :

$$s^{g}_{j \to i}(H) = \frac{\sum_{j=1}^{N} \beta^{g}_{ij}(H)}{\sum_{j=1}^{n} \beta^{g}_{ij}(H)} \quad i \neq j \quad *100 \qquad (6)$$

where, *i* = return of one market and *j* = return of other market. We can define the return spillover effects as indicated by the directional spillovers received by one country from other countries' markets.

Analysis and Results

(1) Return Comovement : This section demonstrates the outcome of GARCH DCC and the VAR techniques. First, the cross - correlations among the returns of gold, real estate, and foreign exchange (U.S. dollar) have been calculated.

The outcome of cross - correlation clearly reveals that the returns of gold and the real estate market are negatively correlated, and at the same time, the coefficient of correlation is very small (see Table 3). This finding is quite similar to the findings of many previous studies (see Smith, 2002 ; Toraman et al, 2011). On the other hand, returns of the real estate market and USD are negatively correlated. The coefficient of correlation seems to be significant in the Indian financial market. Additionally, the outcome demonstrates that there is a trade - off between the returns of the USD and the real estate market. This further indicates that if the returns on the USD increase, the returns on the real estate market decrease and vice-versa. As far as gold and USD are concerned, the results document that these two variables are positively correlated to each other, but the level of correlation is quite low, and this finding is further supported by the outcome of previous investigation (Gencer & Kilic, 2014). After revealing the outcome of cross correlation among the variables, the estimation of GARCH DCC is undertaken for obtaining a precise understanding of the return volatility co-movement of gold, realty, and USD in the Indian context.

Table 3. The Results of Cross-Correlation

	Gold Market	Real Estate Market	U.S. Dollar
Gold	1	-.0609**	0.0111***
Real Estate	-.0609**	1	-0.40344***
U. S. Dollar	0.0111***	-0.40344***	1

Note. *** is significant at 1% and ** at 5% critical value.

Table 4. The DCC Estimates of the Indian Financial Market

Variables	Statistical Value
α	0.005***
β	0.9873**
$\alpha + \beta$	0.9923***

Note. *** is significant at 1% and ** at 5% critical value.

The outcome clearly points out that α and β are statistically significant and the sum of them is less than one, which designates that the second comovement of gold, real estate, and USD is time-varying. Additionally, it can be realized that the sum of α and β is statistically significant and less than one, which glorifies the application of the DCC model for estimation of conditional volatility (see Table 4). Furthermore, to understand the nature of volatility and the behavior of each variable, the univariate GARCH estimation has been done and the same has been exhibited in the next section.

(2) ARCH and GARCH Effect : The ARCH and GARCH outcomes of all three variables show the evidence of ARCH and GARCH effect in the returns of gold, real estate, and USD in the Indian financial market. The sum of ARCH and GARCH is less than one as well as is significant at the 5% or 1% critical values. This stipulates that the return of all variables is not moving away from its mean in the long run and is persistent for a long time at the leaning process in the Indian financial market (Table 5).

The graphical representation of conditional variance reveals that return volatility of gold, real estate, and USD is very dynamic in nature in India (see Figure 2). It can be stated that the conditional variance of gold shows

Table 5. The Results of ARCH and GARCH

	ARCH(α)	GARCH(β)	α + β	STATUS
Gold	0.16***	0.80**	0.96**	Persists for a long time.
Real Estate	0.30***	0.619**	0.919**	Persists for a long time.
U.S. Dollar($)	0.216**	0.601**	0.817**	Persists for a long time.

Note. *** is significant at 1% and ** at 5% critical value.

Figure 2. Conditional Variance

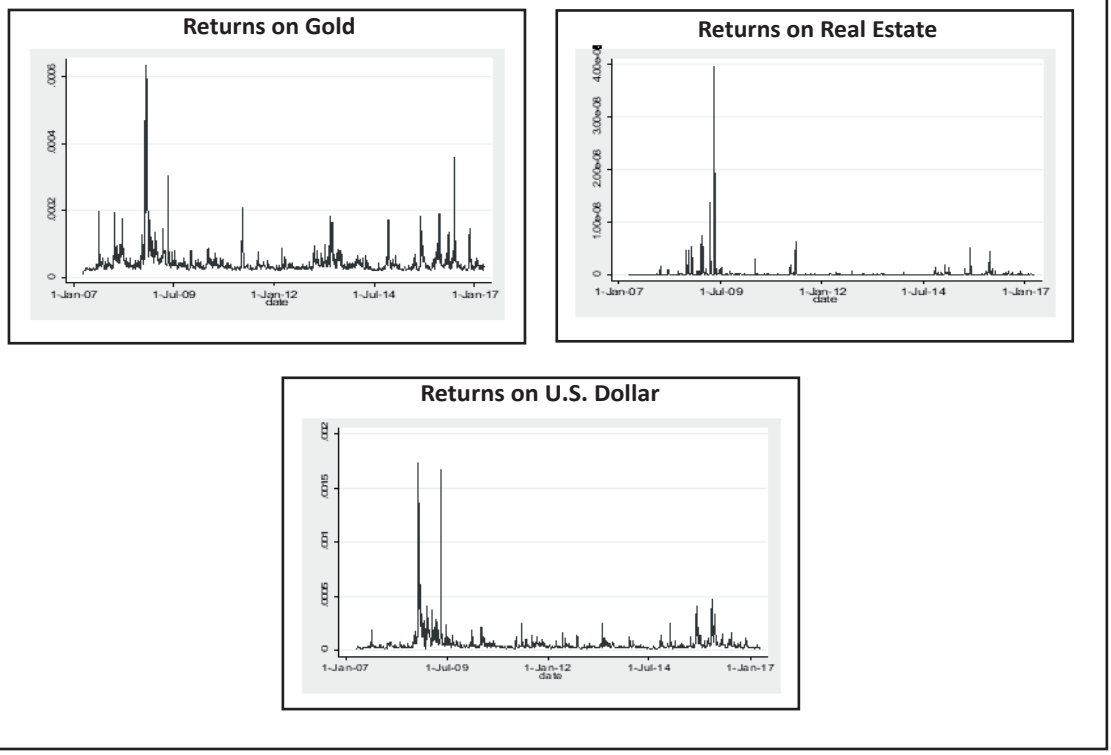


Figure 3. Dynamic Conditional Correlation

evidence of high volatility between the period of 2007 to 2008 and it dips from the beginning of 2009. The return volatility of gold again starts to surge at the beginning of 2016. The outcome of conditional volatility documents that the return volatility of real estate is low as compared with the other variables. It can further be noticed that the volatility of real estate also picks at the beginning of 2009 and after that period, it starts to plunge at a lower level. Finally, the outcome also reveals that the return volatility of USD remains at a high level between the period of 2007 to 2008 and it starts to plunge from the beginning of 2009 in India.

The outcome of dynamic conditional correlation clearly documents that the conditional correlation between gold and real estate seems to be negative (Figure 3). This relationship becomes more opposite until the mid of 2009. After 2009, it can be seen that their relationship starts moving towards positive and shows a rising trend. It can further be stated that there is an inverse relationship between returns of gold and real estate for the study period in the Indian financial market. As far as the returns of gold and USD are concerned, it can be inferred that the relationship between these two variables seems to be volatile. The correlation between gold and USD surges to the high level in the year 2016 and reaches a negative level at the beginning of 2017. On the other hand, as far as returns of USD and real estate are concerned, it can be surmised that there exists a continuous trend of ups and downs between these variables in India.

(3) Volatility Spillover : In this section, the net return volatility spillover of gold, real estate, and USD has been explained with reference to the Indian financial market. For exploring the net volatility spillover, the vector autoregressive approach (VAR) has been exerted and variance decomposition of the above-mentioned variables has been enumerated. Before citing the results, it is essential to explain the rows and columns of the spillover table (Table 6). The rows of the Table 6 reveal that a certain fraction of the total volatility of a variable has been

Table 6. The Results of Volatility Spillover

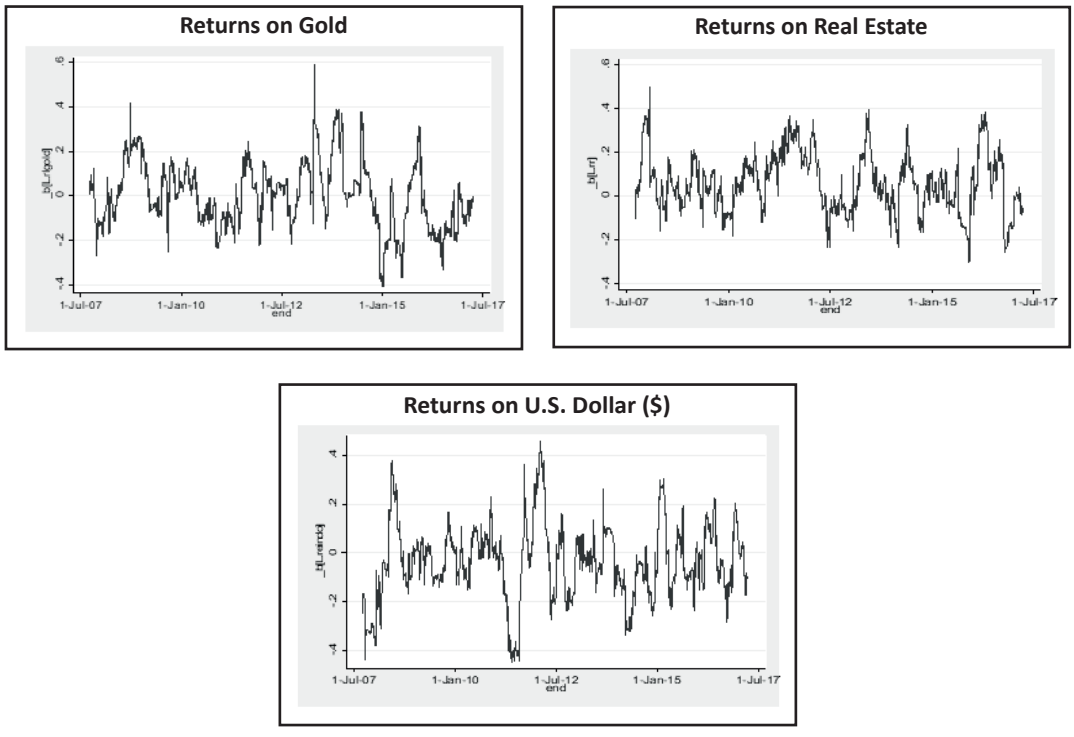
	From			
To	**Gold**	**Real Estate**	**U.S. Dollar**	***Contribution from Other***
Gold	99.63	0.34	0.03	0.37
Real Estate	0.23	97.27	2.50	2.73
U.S. Dollar	0.11	17.04	82.85	17.15
Contribution to Other	0.34	17.38	2.53	
Contribution including own	99.97	114.65	85.38	
Net Spillover Effect	-(0.03)	14.65	-(14.62)	

Note. The VAR lag length of order 1 was selected by the HIC Criterion.

explained by the other variable and the columns of the table show the percentage of the volatility of other variables. The last row of the table reveals the total net spillover impact of each variable and also explores whether the variable is a shock transmitter or shock observer in the Indian financial market.

The outcome of volatility spillover reveals that in the Indian financial market, out of the total return volatility of gold, 99.63% is explained by itself while 0.34% and 0.03% of the volatility of gold is explained by the return volatility of real estate as well as USD (Table 6). With respect to real estate, the outcome sufficiently documents that out of the total return volatility of real estate, 97.27% is explained by itself, while 0.23% and 2.50% is explained by gold and USD, respectively. Out of the total return volatility of USD, 82.85% of the total variability

Figure 4. Net Volatility Spillover, Rolling Windows



of return is explained by itself and 0.34% and 17.38% variability is explained by gold and real estate, respectively. On the basis of the above results, it can be surmised that the real estate market dominates among these three markets, this is because it has the highest contribution of volatility of other variables, while the USD seems to be the most affected variable, and this outcome is further supported by Mishra (2014). As far as gold is concerned, it seems to be neutral in the Indian financial market.

The Figure 4 exhibits the net volatility spillover, rolling windows for 200 days of gold, real estate, and USD in the Indian financial market. It can be noticed that among all the variables, the gold market seems to be neutral, it means that it does not affect the volatility of other assets as well as it is not influenced by other variables. The return of real estate is a net contributor of volatility. The outcome further reveals that in the Indian financial market, the real estate index has the capability to transmit the volatility to other assets such as gold and USD. It has the maximum contribution to the U.S. dollar volatility. Lastly, it can also be surmised that the USD is the highest receiver of volatility from other variables such as real estate and gold in India.

Conclusion and Implications

It has already been explained that there is an increasing amount of literature centered around the volatility of the U.S. dollar with top dominating currencies such as British pound, euro, and so forth in isolation of other financial investment instruments such as gold and real estate. Many studies have taken consideration of return volatility of gold and the U.S. dollar in isolation of other essential variables. On the other hand, none of the empirical studies endeavored to examine the return volatility of real estate, gold, and U.S. dollar simultaneously for their analysis. Additionally, it can be stated that the real estate market has always been ignored in the Indian context.

This analysis examines conditional volatility between gold, U.S. dollar, as well real estate investment returns and correlation dependency and interdependency as well as their spillover impact with respect to the Indian financial market. The relevant empirical insights from the current investigation can be summarized as follows. First of all, on the basis of cross-correlation results, it has been observed that there is a tradeoff between the returns of U.S. dollar and the real estate market. With respect to gold and USD, it can be surmised that these two variables are positively correlated to each other, but the level of correlation is quite low. Secondly, on the basis of volatility modelling, it can be inferred that the volatility of all the variables in the Indian financial markets seems identical. This is so, because the combined value of ARCH and GARCH effect of all the variables is less than one and is significant, which reveals that the return of all the variables is not moving away from its mean in the long run and is persistent for a long time at the leaning process. Finally, on the basis of consequences of volatility spillover, it can be concluded that the real estate market dominates among all these three variables ; this is because it has the highest contribution on the return volatility of the other variables such as gold and USD. Moreover, the empirical outcome also documents that returns on USD in the Indian market seems to be the most affected as it is the net receiver of volatility. With respect to gold, it is clear that it is neutral in the Indian financial market, which neither transmits the volatility nor receives it from other variables.

The results suggest that investors who are willing to invest in USD, they must have information about what is going on in the realty index in India. This is so because according to the current analysis, the U.S. dollar receives most of the volatility from the real estate market, which implies that if there is any fluctuation happening in the real estate market, this would affect the U.S. dollar returns in India. On the other hand, the results also document that the returns of the real estate market are not affected by any of the two markets such as gold and USD ; so, it would be a good idea to invest in the realty market for those investors who do not have any prior experience about the U.S. dollar as well as the gold market. As far as investments in gold are concerned, it seems to be a neutral investment opportunity.

Limitations of the Study and Scope for Future Research

Although the results are promising, but the current analysis has several limitations. First, this study considers only the Indian financial market. So, further analysis can be done by inclusion of more financial markets together for making the analysis more robust. This paper analyzes the spillover impact of one variable on other, but at the same time, it does not comment about the way through which the shock is transmitted from one market to the other market, while there is a possibility of finding the channel of shock transmission by using the SVAR approach.

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