Relationship amongst the Bullion, Forex, and Stock market in India

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The paper tries to understand the relationship amongst capital market, Forex, and Bullion markets. This paper tries to analyze the three markets by taking historical data of previous five years of Sensex, Forex, and Bullion markets. The objective of the study is to indicate the degree of relativity and degree of dependence of the markets among them, to predict the future trend of the markets, and to assess the market efficiency of all the three markets under study. For Capital market, closing price of Sensex each day has been considered. For Forex, spot price has been taken into consideration. For Bullion, AM price has been taken. This paper illustrates the research methodology that has been used viz. Grangers causality test and Co-integration test. From this paper it is found that capital market was highly volatile in last five years while Forex was least volatile. This paper illustrates correlation between the three markets and it is found that Bullion market and Capital market are directly proportional to each other while, Forex is inversely proportional to Capital and Bullion markets.

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Introduction

This paper investigates the nature of the causal relationship between stock prices and macroeconomic aggregates in the foreign sector in India. By applying the techniques of unit-root tests, co-integration and the long-run Granger non-causality test, the causal relationships among the BSE Sensitive Index, Forex, and Bullion markets.

Literature Survey

Grsoy, Cudi Tuncer and M.sl.mov, Al.vsat (1994) examines causality relationships between stock markets and economic growth based on the time series data compiled from 20 countries for the years 1981 through 1994. SimsÕ causality test based on Granger definition of causality was used. At first, panel data covering all countries over the entire analysis period were used to detect the direction of causation. Secondly, causal relations were investigated for each country, in isolation, using the respective time series data.

Brad Comincioli (1996) tries to evaluate the stock market as a leading economic indicator and explore causal relationships between stock prices and the economy. Their results indicated a "causal" relationship between the stock market and the economy. They found that while stock prices Granger-caused economic activity, no reverse causality was observed. Furthermore, we found that statistically significant lag lengths between fluctuations in the stock market and changes in the real economy are relatively short.

Basabi Bhattacharya and Jaydeep Mukherjee (2001) investigate the nature of the causal relationship between stock prices and macroeconomic aggregates in the foreign sector in India. By applying the

techniques of unit–root tests, co integration and the long–run Granger non–causality test recently proposed by Toda and Yamamoto (1995). They tested the causal relationships between the BSE Sensitive Index and the three macroeconomic variables, viz., exchange rate, foreign exchange reserves and value of trade balance using monthly data for the period 1990-91 to 2000-01. The results suggest that there is no causal linkage between stock prices and the three variables under consideration.

Umberto Triacca (2004) tries to find out relation between atmospheric concentration of carbon dioxide and global surface air temperature using Granger causality which in the end proves the inefficiency of Granger causality test to find relationship between the two.

Data & Methodology

Objective of the study

i. To study the degree of relativity and degree of dependence of the markets among them.

ii. To predict the future trend of the markets.

iii. To assess the market efficiency of all the three markets under study.

Scope of the study

The scope of the paper is to analyse the relationship among Bullion, Forex, and Stock market.

Research Methodology

The Granger Causality Test

Regression analysis deals with the dependence of one variable on other variables, it does not necessarily imply causation. In other words, the existence of a relationship between variables does not prove causality or the direction of influence. But in regressions involving time series data, the situation may be somewhat different because, as one author puts it,

". . . Time does not run backward. That is, if event A happens before event B, then it is possible that A is causing B. However, it is not possible that B is causing A. In other words, events in the past can cause events to happen today. Future events cannot. (Emphasis added.)" Quoted as in Damadoran.

This is the idea behind the Granger causality test. The econometrician Edward Leamer prefers the term precedence over causality. Francis Diebold prefers the term predictive causality. As he writes:

". . . the statement "y_i causes y_j" is just shorthand for the more precise, but longwinded, statement, "y_i contains useful information for predicting y_j (in the linear least squares sense), over and above the past histories of the other variables in the system." To save space, we simply say that y_i causes y_j". Qouted as in Damodaran.

To explain the Granger test, we will consider the often asked question in macroeconomics: Is it GDP that "causes" the money supply M (GDP → M) or is it the money supply M that causes GDP (M → GDP), where the arrow points to the direction of causality. The Granger causality test assumes that the information relevant to the prediction of the respective variables, GDP and M, is contained solely in the time series data on these variables. The test involves estimating the following pair of regressions:

$$\text{GDP } t = \sum_{i=1}^{n} \alpha_i M_{t-i} + \sum_{j=1}^{n} \beta_j \text{GDP}_{t-j} + u_{1t} \quad \text{----------Eq: 1}$$

$$M_t = \sum_{i=1}^{n} \lambda_i M_{t-i} + \sum_{j=1}^{n} \delta_j \text{GDP}_{t-j} + u_{2t} \quad \text{----------Eq: 2}$$

Where, it is assumed that the disturbances $u1t$ and $u2t$ are uncorrelated. In passing, note that, since we have two variables, we are dealing with **bilateral causality.** In the chapters on time series econometrics, we will extend this to multivariable causality through the technique of **vector autoregression (VAR).**

Equation (Eq: 1) postulates that current GDP is related to past values of itself as well as that of M, and (Eq: 2) postulates a similar behavior for M.

Note that these regressions can be cast in growth forms, GDP and M, where a dot over a variable indicates its growth rate. We now distinguish four cases:

a. *Unidirectional causality from M to GDP* is indicated if the estimated coefficients on the lagged M in (Eq:1) are statistically different from zero as a group (i.e., $\Sigma \alpha_i \neq 0$) and the set of estimated coefficients on the lagged GDP in (Eq:2) is not statistically different from zero (i.e., $\Sigma \delta_j = 0$)

b. Conversely, *unidirectional causality from GDP to M* exists if the set of lagged M coefficients in (Eq:1) is not statistically different from zero (i.e., $\Sigma \alpha_i = 0$) and the set of the lagged GDP coefficients in (Eq:2) is statistically different from zero (i.e., $\Sigma \delta_j \neq 0$)

c. *Feedback,* or *bilateral causality,* is suggested when the sets of M and GDP coefficients are statistically significantly different from zero in both regressions.

d. Finally, *independence* is suggested when the sets of M and GDP coefficients are not statistically significant in both the regressions.

Since the future cannot predict the past, if variable X (Granger) causes variable Y, then changes in X should *precede* changes in Y. Therefore, in a regression of Y on other variables (including its own past values) if we include past or lagged values of X and it significantly improves the prediction of Y, then we can say that X (Granger) causes Y. A similar definition applies if Y (Granger) causes X.

The steps involved in implementing the Granger causality test as follows. We illustrate these steps with the GDP-money example given in Eq. (Eq: 1).

a. Regress current GDP on all lagged GDP terms and other variables, if any, but *do not* include the lagged M variables in this regression. This is the restricted regression. From this regression obtain the restricted residual sum of squares, RSS_R.

b. Now run the regression including the lagged M terms. In the language econometrics, this is the unrestricted regression. From this regression obtain the unrestricted residual sum of squares, RSS_{UR}.

c. The null hypothesis is $H0$: $\Sigma \alpha_i = 0$, that is, lagged M terms do not belong in the regression.

d. To test this hypothesis, we apply the F test given by (Eq:3), namely,

$$F = \frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)} \quad \text{----------Eq: 3}$$

Which follows the F distribution with m and $(n - k)$ df. In the present case m is equal to the number of lagged M terms and k is the number of parameters estimated in the unrestricted regression.

e. If the computed F value exceeds the critical F value at the chosen level of significance, we reject the null hypothesis, in which case the lagged M terms belong in the regression. This is another way of saying that M causes GDP.

f. Steps 1 to 5 can be repeated to test the model (Eq: 2), that is, whether GDP causes M.

Before we illustrate the Granger causality test, there are several things that need to be noted:

a. It is assumed that the two variables, GDP and M, are *stationary*. Sometimes taking the first differences of the variables makes them stationary, if they are not already stationary in the level form.

b. The number of lagged terms to be introduced in the causality tests is an important practical question. As in the case of the distributed lag models, we may have to use the *Akaike or Schwarz information criterion* to make the choice. But it should be added that the *direction of causality may depend critically on the number of lagged terms included.*

c. We have assumed that the error terms entering the causality test are uncorrelated. If this is not the case, appropriate transformation, may have to be taken.

d. Since our interest is in testing for causality, one need not present the estimated coefficients of models (Eq: 1) and (Eq: 2) explicitly (to save space); just the results of the F test given in (Eq: 3) will suffice.

Co-integration Test

The implication of non-stationary can lead to spurious regression when testing for Granger causality, unless a co-integrating vector is present. This makes the testing for a co-integration mandatory. If such a stationary linear combination exists, the non-stationary linear combination is called the co-integrating equation and may be interpreted as a long run equilibrium relationship among the variables. Since it is possible that co-integrating variable may derivate from their relationship on the short run, but their association would return in the long run. The test employed for determination of co-integration between the time series is Johansen's test. The existence of more than one co-integrating vector implies higher stability in the system.

The co-integration testing procedure suggested by Johansen to test the restrictions imposed by co-integration on the unrestricted VAR involving the series.

Considering a VAR of order:

$$Y_t + A_1 Y_{t-1} + \text{-------} A_p Y_{t-p} + BX_t + \varepsilon_t \quad \text{----------Eq: 4}$$

Where Y_t is a K-vector of non-stationary variables, X_t is a d vector of deterministic variables and at is a vector of innovations. It can rewrite the VAR as

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} T_i \Delta Y_{t-1} + BX_t + \varepsilon_t \quad \text{----------Eq: 5}$$

Where $\Pi = \sum_{i-1}^{p} Ai - I$, $Ti = \sum_{j-1+1}^{p} Aj$

Granger's representations theorem asserts that if the coefficient matrix Π has reduced rank r<k, then there exists Kr matrixes and α & β each with rank r such that $\Pi = \alpha\beta'$ is stationary r is the number of co-integrating relations and each column is to the co-integrating vector. The elements of á are known as the adjustments parameter in the vector error the P matrix in an unrestricted form.

Johansens test the following possibilities

Series Y have no discriminant trends and the co integration equations do not have intercepts.

$$H_2(r): \Pi Y_{t-1} + BX_t = \alpha \beta' Y_{t-1} \quad \text{----------Eq: 6}$$

The likelihood Ratio Test Statistic:

$$Qr = -T \sum_{i-r-1}^{k} \log (1-\lambda i) \quad \text{----------Eq: 7}$$

For r=0, 1--------K-1 where λI is the i^{th} largest Eigen value. Qr is the so called trace statistics and is the test of H1 (r) against H1 (k).

Johansen also proposes an alternative LR test statistic, known as the maximum Eigen value statistics, which tests (r) against (r+1). The maximum Eigen value statistic can be computed from the statistic as

$$Q_{max} = - T \log (1-\lambda_{r+1}) = Q_r - Q_{r+1} \quad \text{----------Eq: 8}$$

Sources of data

Some data are secondary and some are computed. The secondary data are been taken from internet and computed data are derived from the historical data. Data are all been taken for research purpose with stick to ethical norms and regulation. Few data have been collected from magazines and business standard paper.

Limitation of study

- Time factors
- Unavailability of various data
- Changes of daily values

Analysis & Interpretation

This is a project where there is a need to understand if there is any relation between forex, bullion, and capital market in India. For this purpose interdependence method is used. The different methods are following:

Factor analysis

It a procedure that takes a large numbers of variables or objects and searches to see whether they have a small number of factors in common which account for their intercorrelation. Factor analysis has a number of possible applications

Table 1: Mean & Std. Deviation for Bullion, Forex, Sensex

	Mean	Std. Deviation	Analysis N
Bullion	.3764	2.46470	253
Currency	-.0723	.57393	253
Sensex	.8333	3.57682	253

Source Computed

Table 2: Correlation Matrix of Bullion, Forex, Sensex

		Bullion	Currency	Sensex
Correlation	Bullion.	1.000	-.0470	.035
	Currency.	-.047	1.000	-.071
	Sensex	.035	-.071	1.000
Sig. (1-tailed)	Bullion	1.000	.228	.287
	Currency	.228	1.000	.130
	Sensex	.287	.130	1.000

Source Computed
Determinant = 0.992

Table 3: Communalities of Bullion, Forex, Sensex

	Initial	Extraction
Bullion	.981	.266
Currency	.953	.441
Sensex	.977	.397

Source Computed
Extraction Method: Principal Component Analysis.

Table 5: Component Matrix of Bullion, Forex, Sensex

	Component
	1
Bullion	.515
Currency	-.664
Sensex	.630

Source Computed
Extraction Method: Principal Component Analysis.
Only one component was extracted from the above table.

Rotated Component Matrix
Since only one component was extracted. Therefore, the solution cannot be rotated.

Conclusion

In this paper five years data of capital market, Forex, and Bullion market have been taken and analyzed using SPSS version 10 and the results obtained explains the relationship amongst Sensex, Forex, and Bullion markets. In this analysis the default Eigen 'rule' was applied. Thus, only components with an Eigen value > 1 were extracted. There was no rotation. Because a reduced number of components are extracted the communalities are less than 1.

Only one component has Eigen values > 1, thus only one component is extracted that retain 36.8% of the total variation. Note that components 2 & 3 have Eigen values close to 1.

It is worth exploring the extraction of additional components because:

Table 4: Total Variance Explained

Initial Eigen values				Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.104	36.799	36.799	1.104	36.799	36.799
2	.969	32.285	69.084			
3	.927	30.916	100.000			

Source Computed
Extraction Method: Principal Component Analysis.

i. The default analysis retained only 36.8% of the variance and did not produce an interpretable solution.

ii. Components 2 & 3 have Eigen values close to 1.0, extracting them would retain 63.2% of the variance.

The analysis shows that Bullion and Sensex are directly proportional to each other but, Forex is inversely proportional to Bullion and Sensex i.e. when there is a bullish trend in Bullion there will be bullish trend in Sensex too. When there is a bearish trend in Bullion there will be bearish trend in Sensex too. On contrary to this, when there is a bullish trend in Forex there will be bearish trend in Sensex and Bullion.

Hence, it is found that these three markets viz. Bullion, Forex, Sensex are related and affect each other.

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