

Dynamics of Macroeconomic Variables Affecting Price Innovation in Gold: A Relationship Analysis

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Macroeconomic variables indicate prosperity of any economy and they decide the destiny of investments. The macroeconomic variables influence price determination process in any economy. The uncertainty of macroeconomic variables affects stock and commodity market significantly causing volatility in the prices. In contemporary scenario, increase in oil demand depicts increased imports, and stronger inflation which, in turn, requires gold conservation. Volatilities and changes in macroeconomic variables are likely to have an impact on gold prices and vice-versa. Since gold is an important saving and investment instrument in India, it is expected that gold may be looked upon as alternative asset for those holding idle money and for speculative purposes. In past two decades, prices of gold have been rising and bursting out the technical's. It is not surprising that the gold prices move in synch because they are probably influenced by common macroeconomic fundamentals like, GDP, Growth Rate, Exchange Rate, Interest Rate, Inflation, Sensex, Index and Forex Reserves. As gold is one of prime financial assets which can be used as hedge against inflation, the close relationship between macroeconomic variables and gold prices are to be observed and analysed. The aim of this paper is to analyze the causal effects of macroeconomic variables on gold prices using unit root test, regression and granger causality test which will further specify the probability of change in the variables studied. Gold price will also be used as variable, to examine whether gold price contain any additional significant information about macroeconomic trends.

Keywords: Macroeconomic Variables; Gold Prices; Unit Root Test; Granger Causality Test.

Introduction

Gold, the precious metal, always commands the role of a monetary value holder and accumulator. It has been attractive since from ages for its producers, consumers, and investors across entire the globe. The gold price is a complex macroeconomic variable. Demand for gold is driven by various motives that are sensitive to macroeconomic conditions in different parts of the world and the world as a whole. Its dynamics is difficult to anticipate, predict and explain. In India, gold has immense value to the society in terms of jewellery making for ornamentation as well as a major vehicle of

wealth accumulation asset. According to Accounting for Fifth Annual Global Gold Consumption, India is the largest consumer of gold and almost all of India's gold demand is met by imports (Kannan and Dhal, 2008). Gold is an excellent source of long-term hedging against inflation rate. In the long term, and sometimes short-term gold price fluctuations are quite significant. Gold maintains its value in terms of real purchasing power. If the purchasing power of the currency falls, consecutively, inflation rate goes up and the price of gold rises. Gold has to manage its float with respect to deficit and other imports of related commodities from

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time to time. The different countries playing in the global gold market have to pay for the imported gold in terms of the currency of respective country (Frankel, 2011). Gold can neither be repudiated, nor its value undermined by inflation rate. It provides a strong and better hedge against declining currency as compared to any other commodity. Gold has been considered as desirable element in an investment portfolio. It holds its value even during inflation rate. Like any other country, in India, the monetary, fiscal and financial policy influence the economic growth, inflation rate, interest rates, exchange rate, stock market trends and asset prices, which serves as key drivers of gold demand (Razin and Rosefielde, 2011). The gold is partly used as domestic consumption and partly in disposing the deficit of payments.

The movement of gold price is highly sensitive to the changes in fundamentals of any economy and expectations about future prospects. Expectations are influenced by the micro and macro fundamentals which may be formed either rationally or adaptively on economic fundamentals, as well as by subjective factors which are sometimes unpredictable and also non-quantifiable (Sharma and Mahendru, 2010). The price of gold is determined by several factors. The common macroeconomic factors which may influence the gold prices are: growth rate, exchange rate, interest rate, inflation rate, NSE Index, BSE Sensex, foreign reserves, fiscal deficit, and gross domestic product (Bhattacharya and Mukharjee, 2002).

Gold And Macroeconomic Variables

The new economic reforms, popularly known as LPG Model i.e., Liberalization, Privatization and Globalization aimed at making the Indian economy as fastest growing economy and globally competitive. In India, series of reforms were undertaken with respect to industrial, trade as well as financial sector aimed at making the economy more efficient. It has manifold usages, as jewellery and can also be considered as an important way to invest wealth, especially, in times of economic

uncertainty (Malik, 2012). Growth in Indian economy increases disposable income and simultaneously, demand for gold. The demand for gold is to store it as wealth. In rising inflation rate, money loses its value gradually and therefore, people tend to buy physical assets like, gold which will retain their value (Bhattacharya and Sivasubramaniam, 2003; Dhanbakayam and Sakthipriya, 2012).

Central banks usually keep some of their reserves in gold. If they decide to hold more reserves in gold, demand and price for gold rises. So, as an alternative to invest in a currency, investors may tend to buy gold. The level of US Government borrowing can have an impact on the price of gold. If markets feel the US debt is projected to get out of control, there is a greater chance that the dollar will devalue and dollar assets will fall. It means people may sell dollar assets, e.g., US treasury bills and buy gold (Elwell, 2012). Gold is often seen as an alternative to the stock market. Buying shares can give a higher return because investors receive dividends and possible growth in share capital. In times of economic turmoil or recession, the value of shares tends to fall. So, investors may sell shares and buy gold. Thus, fear over a recession tend to increase the value of gold as people move from more risky stock market to gold (Pettinger, 2011).

Rising gold prices can become self-fulfilling as investors pile capital into gold to take advantage of rising prices. The price of gold can be highly volatile. It is believed that there is gold bubble, when the economy returns to normal, people may feel gold is highly overvalued and people could see a fall in the price of gold like, the early 1980s (Bhansali, 2009). A change in supply could alter the price of gold. If there is a sharp increase in production, the price is likely to fall. However, the supply of gold is relatively stable. The fluctuations in price tend to relatively occur due to changes in demand. It can be estimated reliably that gold and macroeconomic variables are interdependent factors and complement each other as and when required (Pettinger, 2011).

Literature Review

In the post war period, the Dollar has been viewed as the dominant global currency. The dollar plays a key role in storing wealth and as medium of exchange. Many countries keep exchange fluctuation reserves in dollars. If people suspect that the dollar may be vulnerable, they may sell US dollar assets and look for something more secure, like, other currencies or gold (Kumar, 2005). It was investigated that there is relationship between the prices of gold and oil through the inflation rate channel and their interaction with the index of the US dollar for 1986 to 2011 found that, the impact of oil price on the gold price is not asymmetric but non-linear, which can be used to predict the gold price. Further research showed that there is a long-run relationship existing between the prices of oil and gold which imply that the oil price can be used to predict the gold price and gold can be used as a hedge against inflation rate (Le and Chang, 2011). A study was conducted using regression on changes in gold prices against the gold fund index returns lagged one month which yields a positive coefficient, suggesting that at least on a short-term basis the prices for gold related equities tend to lead bullion prices. Further, the impact of investor confidence, decision and speculation in gold was also undertaken, as there is a raise in economic confidence and good performance of high yield from bonds (Bartolomeo, 1993).

A study focused on bounds testing approach to co-integration, which tested the relationships between the prices of two strategic commodities i.e., oil and gold and the financial variables i.e., interest rates, exchange rates and stock prices of Japan, suggested the prices of gold and stock can help to form expectations of higher inflation rate over time. In short run gold stocks can be a better option and in long run gold as commodity can be a better source to hedge portfolio (Le and Chang, 2011). The gold price exhibited highly correlated behaviour with extreme outliers, such as a breakdown of governance, war, or disasters. These rising gold prices in particular, can be attributed at least in part to the announcement of the Central Bank and the event

had little direct relationship, if any at all, with the economic cycle, it was concluded that gold appears to be independent of cycles in contrast to other commodities, making it worth considering as a good portfolio diversifier (Lawrence, 2003).

The effects of macroeconomic variables on the Turkish Stock Exchange indicated that interest rate, industrial production index, oil price, foreign exchange rate have a negative effect on ISE-100 Index returns, while money supply positively influence ISE-100 Index returns and Inflation rate and gold price do not appear to have any significant effect on ISE-100 Index returns (Büyüksalvarci, 2010). The long-run relationship between oil and gold spot and futures prices at various levels of maturity was examined and found that the relationship is rooted in investors using the gold market to hedge against inflation rate, which results from a shock in oil prices that leads to a rise in oil prices. Using co-integration test, it was found that gold and oil spot and futures markets were co-integrated and implies that investors do use the gold market as a hedge against inflation rate, and the oil market can be used to predict the gold market prices and vice versa with markets inefficiencies (Narayan, et al, 2010).

Objectives

- To study the Impact of Macroeconomic Variables on Gold Prices.
- To study the Cause and Effect Relationship between Macroeconomic Variables and Gold Prices.

Research Methodology

Research Questions

Do macroeconomic variables impact on gold prices?
Does there exist any interactive cause and effect relationship between macroeconomic variables and gold prices?

Hypothesis

H_{01} = There is no Impact of Macroeconomic Variables

on Gold Prices.

H_{02} = Macroeconomic Variables do not Granger Cause Gold.

Period of the Study

The research has been carried out for ten years ranging from the period 2002 to 2011 on quarterly basis i.e., March, June, September and December.

Scope of the Study

- The scope of the study was confined to the Macroeconomic Variables namely, growth rate, exchange rate, interest rate, inflation rate, NSE Index, BSE Sensex, foreign reserves, fiscal deficit, and gross domestic product.
- The study period have its own contemporary economic, political, and social situation and environment which might affect the prices of the scripts, thus, results are subject to overview of the situations and environment prevailing at that time.
- Heteroscedastic Values of market prices and rates of the Macroeconomic Variables were taken as base.

Time of the Study

The study is empirical in nature.

Part A

Type of Data & Data Source

The study undertook the secondary data for analysis. The quarterly values of growth rate, exchange rate, interest rate, inflation rate, NSE Index, BSE Sensex, foreign reserves, fiscal deficit, and gross domestic product were taken from various websites as www.bseindia.com, www.nseindia.com, www.indiabudget.nic.in, www.rbi.org.in, www.goldpricenetwork.com, etc.

Sample Design

The growth rate, exchange rate, interest rate, inflation rate, NSE Index, BSE Sensex, foreign reserves, fiscal deficit, and gross domestic product were considered as different variables explaining macroeconomic variables.

Tools For Analysis

Unit Root Test was applied to check the data stationarity. Further, to study the impact of macroeconomic variables on gold price, Regression Analysis and Granger Casualty Test were applied using Eviews.

Results & Interpretation

Unit Root Test

The Unit Root Test checks that the variables used in

Critical Value of Augmented Dickey Fuller Test (Level 0)						
Macro Economic Variables	Intercept					
	Lag	Critical Value	Prob.	1%	5%	10%
Growth Rate	0	-2.568032	0.1081	-3.61045	-2.93899	-2.60793
Exchange Rate	2	-2.685765	0.0860	-3.62102	-2.94343	-2.61026
Interest Rate	8	-3.544115	0.0133	-3.66166	-2.96041	-2.61916
Inflation Rate	5	-1.425113	0.5585	-3.63941	-2.95113	-2.6143
BSE Sensex	0	-4.455229	0.0010	-3.61045	-2.93899	-2.60793
NSE Index	0	-4.450788	0.0010	-3.61045	-2.93899	-2.60793
Forex Reserve	1	-0.422366	0.8951	-3.61559	-2.94115	-2.60907
Fiscal Deficit	6	-2.088521	0.2503	-3.64634	-2.95402	-2.61582
GDP	3	-2.479185	0.1288	-3.62678	-2.94584	-2.61153
Gold Prices	9	3.654203	1.0000	-3.67017	-2.96397	-2.62101

the study are stationary. Further, the test also determines the order of integration among the variables on the basis of lags. The ADF test was undertaken using trend,

intercept and trend and none cases. The results are given in the tables.

Part B

Critical Value of Augmented Dickey Fuller Test (Level 0)						
Macro Economic Variables	Trend & Intercept					
	Lag	Critical Value	Prob.	1%	5%	10%
Growth Rate	5	-2.729735	0.2318	-4.25288	-3.54849	-3.20709
Exchange Rate	2	-2.502239	0.3253	-4.22682	-3.5366	-3.20032
Interest Rate	8	-3.430328	0.0656	-4.28458	-3.56288	-3.21527
Inflation Rate	7	-2.21116	0.4677	-4.27328	-3.55776	-3.21236
BSE Sensex	1	-4.907076	0.0017	-4.21913	-3.53308	-3.19831
NSE Index	1	-4.780387	0.0023	-4.21913	-3.53308	-3.19831
Forex Reserve	8	-3.190301	0.1048	-4.28458	-3.56288	-3.21527
Fiscal Deficit	5	-2.408447	0.3689	-4.25288	-3.54849	-3.20709
GDP	9	-4.523706	0.0059	-4.29673	-3.56838	-3.21838
Gold Prices	9	2.234975	1.0000	-4.29673	-3.56838	-3.21838

Part C

Critical Value of Augmented Dickey Fuller Test (Level 0)						
Macro Economic Variables	None					
	Lag	Critical Value	Prob.	1%	5%	10%
Growth Rate	5	0.300089	0.7668	-2.63473	-1.951	-1.61091
Exchange Rate	4	0.228142	0.7466	-2.63269	-1.95069	-1.61106
Interest Rate	1	0.162183	0.7276	-2.62724	-1.94986	-1.61147
Inflation Rate	5	0.195643	0.7369	-2.63473	-1.951	-1.61091
BSE Sensex	0	-4.137034	0.0001	-2.62561	-1.94961	-1.61159
NSE Index	0	-4.102127	0.0001	-2.62561	-1.94961	-1.61159
Forex Reserve	1	1.946734	0.9861	-2.62724	-1.94986	-1.61147
Fiscal Deficit	5	-0.528937	0.4802	-2.63473	-1.951	-1.61091
GDP	3	-1.252949	0.1894	-2.63076	-1.95039	-1.6112
Gold Prices	0	6.110196	1.0000	-2.62561	-1.94961	-1.61159

The results suggest that, the macro economic variables: gold prices, growth rate, exchange rate, interest rate, inflation rate, NSE Index, BSE Sensex, foreign reserves, fiscal deficit, and gross domestic product follow stationary trend as the respective critical value is

negative. The P value of BSE Sensex and NSE Index in all the three cases, are less than 0.05. It concludes that the two variables i.e., BSE Sensex and NSE Index are not stationary. The P values of remaining variables follow a stationary trend in all the three cases. All these

variables are stationary at varying lags as shown in above tables. The results can also be interpreted by way of comparing critical value with value at 1%, 5% and 10% level of significance. This also verifies that the variables are stationary at all the levels. The calculated values are negative and positive but, the interpretation does not consider negative signs and these

values are considered as absolute values. Except the two, rest other variables are stationary and as the critical value is smaller than the values at 1%, 5% and 10% level of significance, the variables are stationary and hold good for calculating Regression Analysis and Granger Test.

Regression Analysis

Part A

Variables	Coefficient	Std. Error	t-Statistic	Prob.
C (Constant)	-119619.1	24868.46	-4.810072	0
Exchange Rate	2023.742	456.1035	4.437024	0.0001
Fiscal Deficit	0.28232	0.084034	3.359595	0.0021
Forex Reserve	0.053952	0.006195	8.708731	0
GDP	-160.1541	132.0544	-1.212788	0.2347
Growth Rate	135.0514	592.4873	0.22794	0.8212
NSE Index	431.0128	309.1471	1.3942	0.1735
Inflation Rate	-1811.901	769.5286	-2.35456	0.0253
Interest Rate	4214.037	1176.883	3.580677	0.0012
BSE Sensex	-209.7586	299.5247	-0.700305	0.4891

Part B

R-squared	0.930524	Mean Dependent Variable	34064.46
Adjusted R-squared	0.909682	S.D. Dependent Variable	19559.33
S.E. of Regression	5878.163	Akaike Info Criterion	20.40819
Sum squared Residual	1.04E+09	Schwarz Criterion	20.83041
Log likelihood	-398.1639	Hannan-Quinn Criterion	20.56086
F-statistic	44.64518	Durbin-Watson Statistics	1.22761
Probability (F-statistic)	0		

The analysis suggests that, all the variables are good fitted for study as the value of R² is 93.05%. This also means that, the data of the macroeconomic variables used for study are of very high reliability. The P values of GDP, growth rate, BSE Sensex and NSE Index individually have a higher value than 0.05. Thus, these variables have least impact on the behaviour of gold pricing. Independent variables like, exchange rate, fiscal deficit, forex reserves, inflation rate and interest rate have P values lesser than 0.05 which means that these

independent variables strongly influence dependent variable and effect the gold prices at large. Lastly, the probability (F-statistic) of consolidate regressed values are less than 0.05, i.e., 0 which means that all the variables jointly affect gold pricing positively or negatively.

Granger Causality Test

The granger causality test concludes firstly, that the null hypothesis in cases of gold does not granger cause

Null Hypothesis	Lags	Observations	F Statistics	Prob.	Accept/Reject
Gold does not Granger Cause Growth Rate	2	38	0.32739	0.7231	Rejected
Growth Rate does not Granger Cause Gold	2	38	0.03135	0.9692	Rejected
Gold does not Granger Cause Exchange Rate	3	37	3.5063	0.0272	Accepted
Exchange Rate does not Granger Cause Gold	3	37	0.93986	0.4337	Rejected
Gold does not Granger Cause Interest Rate	1	39	2.7861	0.1038	Rejected
Interest Rate does not Granger Cause Gold	1	39	5.50843	0.0245	Accepted
Gold does not Granger Cause Inflation rate	12	28	0.4142	0.8827	Rejected
Inflation rate does not Granger Cause Gold	12	28	16.22	0.021	Accepted
Gold does not Granger Cause BSE Sensex	11	29	3.9225	0.0491	Accepted
BSE Sensex does not Granger Cause Gold	11	29	0.4541	0.8783	Rejected
Gold does not Granger Cause NSE Index	11	29	6.362	0.0168	Accepted
NSE Index does not Granger Cause Gold	11	29	0.67334	0.736	Rejected
Gold does not Granger Cause Forex Reserve	9	31	2.8624	0.0469	Accepted
Forex Reserve does not Granger Cause Gold	9	31	0.82799	0.5345	Rejected
Gold does not Granger Cause Fiscal Deficit	3	37	3.2237	0.0364	Accepted
Fiscal Deficit does not Granger Cause Gold	3	37	2.1786	0.1112	Rejected
Gold does not Granger Cause GDP	2	38	0.4662	0.6315	Rejected
GDP does not Granger Cause Gold	2	38	0.22239	0.8018	Rejected

growth rate, and growth rate does not granger cause gold are rejected at lag 2 as p value is more than 0.05 stating that there exists a bidirectional causality of gold with growth rate. Secondly, it is derived that, gold granger cause interest rate, inflation rate, at varying lags 1 and 12 respectively, rejecting null hypothesis.

Thirdly, it is derived that, gold does not granger cause exchange rate, BSE Sensex, NSE Index, Forex Reserve and Fiscal Deficit at varying lags 3, 11, 11, 9 and 3 respectively, accepting null hypothesis. Fourthly, Interest rate, inflation rate, do not granger cause gold, accepting null hypothesis at lag 1 and 12 respectively. Fifthly,

Exchange Rate, BSE Sensex, NSE Index, forex reserve and fiscal deficit do granger cause gold individually rejecting null hypothesis at lags 3, 11, 11, 9 and 3 respectively. Sixthly, the test concludes, that the null hypothesis in case of gold does not granger cause GDP, and GDP does not granger cause gold are rejected at lag 2 as P value is more than 0.05 stating that there exists a bidirectional causality of gold with GDP.

Discussion

As per regression analysis, GDP, inflation and BSE Sensex negatively determines the gold prices where as exchange rate, fiscal deficit, forex reserve, growth rate NSE Index and interest rate determines gold prices positively. It indicates that, lesser amount of GDP is invested into gold and in case of inflation due to less saving available less gold is purchased. Rise in BSE Sensex indicates the higher flow of capital to share market in comparison to gold market indicating the potential of Indian companies leaving more accepted capital appreciation. Whereas, exchange rate increase fixes gold prices higher indicating strength of dollar. Increase in fiscal deficit causes higher gold prices indicating a loop that money generated out of fiscal deficit is invested into gold. Forex reserve increase indicates that, economy is doing well so people invest in gold. Higher growth rate leaves more chances of capital generation and its investment into gold. Positive affect of NSE Index probably reflects the effect of futures trading in commodity more which further shape the gold prices. Higher interest rate causes higher gold prices are probably due to, non availability of sufficient capital into debt market stating lag impact on gold prices. It indicates that, due to more buying in gold in anticipation of further price hike leaving lesser capital available to debt market.

As per granger analysis, as growth rate and GDP are affecting gold prices and gold prices are also affecting growth rate and GDP. This relationship shows that gold is the commodity and an investment vehicle that affects

and gets affected by growth rate and GDP. So government is to look into the matter of gold prices. To ensure proper inflow of the gold that too in accounted manner i.e., to say import duty should not be increased or should be so minimum that unaccounted inflow of gold become costlier. Because proper inflow of gold will lead to higher growth rate and GDP and consequently growth rate and GDP will affect the gold price mechanism. It is to note that gold prices does not affect exchange rate, BSE Sensex, NSE Index forex reserve and fiscal deficit, probably it is due to exchange rate determination is more depending on external factors. BSE Sensex and NSE Index are not affected by gold price that determines the independency and maturity of Indian capital market. Stating that, switching of the funds in the two markets is not so easy.

Forex reserve and fiscal deficit are also not affected by gold prices denotes that these are the two variables more depending upon governmental efforts and parties involved in gold price determination are private. Indirectly it also indicates that, government is not taking active participation in gold market. Forex reserve are not affected by gold price determination it shows that lesser forex is utilized in gold imports or correspondingly forex reserves are increasing for other reasons than gold. Gold does cause interest rate and inflation is probably due to the reason that gold is more intended to earn capital appreciation and appreciation can be liquidated immediately making funds and chances available to shift into debt market and vice versa. It shows the integration of the two markets. Gold does cause inflation is probably due to gold buying behaviour compelling more money in the market stating the priority and interest of the investor preference gold over other investment in case of inflation that is what the basic characteristic of gold is i.e., in case of inflation value of gold increases and value of commodity decreases confirming more worth of gold in comparison to other commodities and currencies.

Conclusion

The present paper makes a modest attempt to explore the causal relationship between gold prices and macroeconomic variables in the Indian economy. The study primarily revolved around two major questions first, do macroeconomic variables impact on gold prices? Answer to this question is that, exchange rate, fiscal deficit, forex reserve inflation rate are independently affecting gold prices at large but, growth rate, GDP, BSE Sensex and NSE Index are having a very low impact on gold prices independently and collectively all these variables determines gold prices. Secondly, does there exists any interactive cause and effect relationship between macroeconomic variables and gold prices? Answer to this question is that, gold does not cause and effect exchange rate, BSE Sensex, NSE Index, forex reserves and fiscal deficit but gold does affect interest rate and inflation and vice versa. There exists a bidirectional relationship with growth rate and GDP in terms of gold pricing.

Suggestions

Investors can take benefit of the results and discussions in their investment strategies considering external and internal environment of the country. Government should take an advantage of the study fixing import duties and fighting against black economy and inflation control. Gold price mechanism should be monitored by the government.

Implications

Gold works as a commodity for consumption and investment. Gold prices reflect growth rate and status of GDP. Gold can be used as an instrument against inflation.

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