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Analysing the impact of macroeconomic factors on gold prices in India

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Abstract

This research paper investigates the impact of various macroeconomic variables such as global crude oil prices, Indian inflation rate, Indian rupee vis-a-vis US dollar exchange rate and US gold prices on the gold prices prevailing in India by using ordinary least square (OLS) mechanism. The findings exhibit that the crude oil prices and inflation have significant positive impact on gold prices indicating that a hike in these variables contribute to rising gold prices in India. Likewise, a significant and positive association between gold price and Indian rupee exchange rate has been observed which signifies that a rise in domestic exchange rate vis-a-vis foreign currency (US dollar) that is, depreciation in Indian rupee tends to escalate the domestic country's gold prices. Further, an insignificant impact of US gold prices on gold prices in India has also been observed.

JEL Classification Codes: E31, E44, F15, F31.

Keywords: Gold prices, exchange rate, crude oil prices, inflation

Introduction

The precious yellow metal is blessed with beauty, strength, purity, success and traditional values. Prior to the introduction of fiat money, gold was used as a medium of exchange. Armed with these strengths, gold was considered as an auspicious metal and a source of an ideal investment in India. Furthermore, it has always been considered as a symbol of wealth and stability for Indian economy (Allese, 2008) ^[1]. Subsequently, India emerged as one of the leading importers and consumer of gold as a consequence of the rising domestic demand for the precious metal and both the physical and paper gold markets continued to flourish in value as well as in magnitude.

Gold became a valuable source since its price increased more quickly compared to other commodities. In addition, the metal contributes to diversification of portfolios through holding a balance between liquid and non-liquid assets. Since it qualifies easily for hedging purpose, gold serves as an essential aspect of an investment portfolio.

Since the Indian government liberalised the economy in the wake of the 1991 financial crisis, the country's gold market has experienced tremendous changes. As a consequence, the Indian market anticipated the advantages and applications of gold. However, in spite of the country's slow increase in wealth, the Indian gold market has consistently experienced remarkable growth rates. Due to the continuing rise in the price of gold and its extreme fluctuations in terms of elevated stock market volatility, investors find it difficult to decide whether to invest in gold. Owing to this reason, present study aims at exploring major drivers of gold prices prevailing in India. The paper attempts to examine the influence of global crude oil prices, Indian inflation rate, Indian rupee vis-a-vis US dollar exchange rate and gold prices prevailing in US.

Review of Literature

Several studies are available analysing the determinants as well as impact of gold prices fluctuations. A handful studies are being described chronologically as below:

Levin and Wright (2006) ^[4] evaluated the link between the price of gold and national price level prevailing in US over the period 1975 to 2006 and discovered a long run relationship between both the considered factors. The results disclosed that the price of gold rises by 1% corresponding to 1% hike in the US average price level.

Seshaiah *et al.* (2017) ^[7] investigated the influence of trade deficit, fiscal deficit, exchange rate, and oil prices on gold prices prevailing in India using monthly observations from 1994 to 2015. The analysis was based on Granger causality test, variance decomposition and

Johansen cointegration analysis. The results unveiled that around 93.4% of the volatility in gold prices can be explained by the gold itself while the impact of other factors considered on the fluctuation in gold prices under examination stayed negligible. In the context of the variations in crude oil prices, the gold price and trade deficit contribute 9.43% and 7.92%, respectively and in terms of the variations in the prices of exchange rate, both variables contribute 9.73% and 12.22%, respectively.

Beckmann *et al.* (2019) [2] explored the interactions between equities, bonds, currency rate and gold prices in Malaysia and unveiled the changing scenario of gold as a hedge and a safe haven throughout the global financial crisis in 2008. The study revealed a complex and dynamic association between uncertainty assessments and gold prices volatility spikes.

Sidana *et al.* (2021) [8] aimed at exploring the interactions between Indian gold price movements and the corresponding trends in US gold market based on 3157 observations of daily data series spanning March 2005 to December 2018. It has been observed that both the considered gold markets fail to establish any long-run association. However, a bidirectional causality between Indian and US gold prices has been found over the study period.

Nisarga and Marisetty (2023) [5] made an attempt to discover the key elements that have a major influence on gold prices prevailing in India. The study is based on few significant regressors such as changes in the BSE Sensex, fluctuations in the price of crude oil, changes in exchange rates, patterns in inflation and repo rates. The results exhibited a significant impact of all considered variables on Indian gold prices.

Based upon the above review of literature, this study aims at empirical evaluation of the influence of significant macroeconomic factors on gold prices of India.

Objectives of the study

1. To identify if the considered macroeconomic factors have an impact on gold prices prevailing in India.
2. To investigate the linkage between Indian gold prices and considered drivers.

Data Description

This study aims at investigating the influence of considered macroeconomic factors on gold prices prevailing in India based on the monthly statistics over a period January 2001 to December 2022. The figures on Indian gold prices (GOLDP) are monthly average gold prices per 10 grams which has been taken as dependent variable and compiled from the website of Reserve Bank of India (RBI). The crude oil prices (OILP) are the spot prices in real terms measured in US dollar per barrel which has been obtained from the West Texas Intermediate (WTI) under the website of Federal Reserve bank of St. Louis. Further, consumer price index (CPI) has been used to represent domestic inflation. The exchange rate (EXR) considered is Indian rupee

exchange rate vis-à-vis US dollar and the price of gold in US (USGLP) is based on US dollar per troy ounce and retrieved from the website of Federal Reserve bank of St. Louis. All the factors are converted into logarithmic form to normalise the scale of data series.

Research Methodology

Stationarity Verification Tests

The study is based on time-series observations therefore, stationarity verification is the first and foremost condition before. The verification regarding the stationarity behaviour of considered datasets has been done using the ADF unit root tests. The analysis of stationarity of the series is based upon the following equations:

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{m=1}^n \beta_m \Delta Y_{t-m} + \mu_t \quad (1)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{m=1}^n \beta_m \Delta Y_{t-m} + \mu_t \quad (2)$$

where, Δ stands for first difference operator, α_0 is intercept or constant, Y_t is a time series, n denotes optimum lag length for dependent variables and μ_t is error term which is pure white noise.

OLS Regression Model

For evaluating the influence of undertaken macroeconomic factors on Indian gold prices, ordinary least squares (OLS) regression methodology has been used. Following is the specification of the model as expressed in equation (5):

$$Y_t = \beta_0 + \beta_1 \text{OILP} + \beta_2 \text{CPI} + \beta_3 \text{EXR} + \beta_4 \text{USGLP} + u_t \quad (3)$$

where, Y_t represents Gold Prices of India (GOLDP) i.e., dependent variable

OILP = International crude oil prices *viz.*, first explanatory variable.

CPI = Consumer price index

EXR = Indian rupee exchange rate vis-a-vis US dollar.

USGLP = US gold prices

β_0 = Intercept term

u_t = Disturbance term.

Analysis and Discussion

In an effort to explore the stationarity of considered time series, the analysis is being firstly performed using Augmented Dickey and Fuller (ADF) unit root test. The observations derived from ADF unit root test are reported in Table 1 which suggest that the considered time series data have a unit root problem at levels with intercept as well as with trend and intercept. However, the variables have been found stationary after taking their first difference and data series are integrated at I (1).

Table 1: Stationarity Tests through ADF unit Root Test

Data Series	Model Used	Data Level	p-value	Conclusion
GOLDP	Only Intercept	Level	0.654	Non- Stationary
		First Difference	0.000***	Stationary I(1)
	With Trend and Intercept	Level	0.895	Non- Stationary
		First Difference	0.000***	Stationary I(1)
OILP	Only Intercept	Level	0.160	Non- Stationary
		First Difference	0.000***	Stationary I(1)
	With Trend and Intercept	Level	0.176	Non- Stationary
		First Difference	0.000***	Stationary I(1)
CPI	Only Intercept	Level	0.178	Non- Stationary
		First Difference	0.000***	Stationary I(1)
	With Trend and Intercept	Level	0.323	Non- Stationary
		First Difference	0.000***	Stationary I(1)
EXR	Only Intercept	Level	0.090*	Stationary I(0)
		First Difference	0.000***	Stationary I(1)
	With Trend and Intercept	Level	0.744	Non- Stationary
		First Difference	0.000***	Stationary I(1)
USGLP	Only Intercept	Level	0.823	Non- Stationary
		First Difference	0.000***	Stationary I(1)
	With Trend and Intercept	Level	0.889	Non- Stationary
		First Difference	0.000***	Stationary I(1)

***, **, * shows 1%, 5% and 10% levels of significance, respectively.

Having confirmed the integration order, subsequently OLS approach has been applied.

Table 2: Estimated OLS parameters for Gold Prices of India and its Drivers

Data Series	Coefficient	Standard Error	t-Statistic	P-value
Intercept	4.986	0.134	45.07	0.000
OILP	0.129***	0.026	4.007	0.003
CPI	0.675*	0.152	1.983	0.057
EXR	0.213**	0.151	2.295	0.029
USGLP	-0.006	0.022	-0.290	0.767
R-squared	0.662	AIC		1.132
Adj. R-squared	0.654	SBC		1.185
F-statistic	55.03	HQC		1.134
Prob.(F-stats.)	0.000	Durbin-Watson (DW) value		1.895

***, **, * shows 1%, 5% and 10% levels of significance, respectively.

The OLS equation to predict the value of Indian gold prices from considered macroeconomic factors can be stated as follow:

$$\text{GOLDP} = 5.486 - 0.129 \cdot \text{OILP} + 0.675 \cdot \text{CPI} + 0.213 \cdot \text{EXR} + u_t \quad (4)$$

Table 2 exhibits the derived regression results which explain the impact of macroeconomic factors taken into account on gold prices prevailing in India. The findings reveal that the crude oil prices (OILP) and inflation (CPI) show significant positive coefficients, indicating that a hike in these variables contribute to rising gold prices in India, which is as expected. The reason being that high values for these variables increase the need for an inflation hedge, which would likely increase the demand for gold and this would in turn raise the price of gold in domestic economy. Likewise, a significant and positive relationship between gold price and Indian rupee exchange rate (EXR) has been observed which signifies that a rise in domestic exchange rate vis-a-vis foreign currency (US dollar) that is, depreciation in Indian rupee tends to escalate the domestic country's gold prices. Further, an insignificant impact of US gold prices

(USGLP) on gold prices in India has also been observed. Besides, the explanatory factor included in the regression model was found to explain 65% (Adjusted R²: 0.654) of the variations in Indian gold prices. In addition, the Durbin-Watson statistic is close to 2 which signifies the absence of autocorrelation in model. The highly significant F-statistic is a good indicator of the overall significance of the model.

A few residual diagnostic tests, aimed at assessment of the robustness of the derived OLS model have been presented in Table 3. These tests include the Jarque-Bera test for normality, the Breusch-Pagan-Godfrey Heteroskedasticity test, Breusch-Godfrey Serial Correlation LM test and Ramsey RESET test.

Table 3: Diagnostic tests results

Diagnostic Test	F-statistics	p-value
Normality Test (Jarque-Bera)	0.150	0.948
Breusch-Godfrey Serial Correlation LM Test	0.203	0.371
Breusch-Pagan-Godfrey Heteroskedasticity Test	0.362	0.774
Ramsey RESET Test	0.231	0.632

The results of residual diagnostic tests as presented in Table 3 confirm the robustness of the OLS regression model. The derived model is a good fit since the p-value is higher than 0.05 in each of the four cases.

Conclusion

The present study aimed at scrutinising the impact of macroeconomic factors taken into account on gold prices prevailing in India using monthly information over the period January 2001 to December 2022. The results based on ordinary least-square (OLS) regression procedure provide empirical evidence that a hike in crude oil prices (OILP) and inflation (CPI) leads to increase in the Indian gold prices as highlighted by the positive and significant coefficients of both the explanatory variables. The reason being that high values of these variables increase the need for an inflation hedge, which would increase the demand for gold and this would in turn raise the price of gold in domestic economy. Likewise, a significant and positive

relationship between gold price and exchange rate (EXR) has been observed which implies that a rise in domestic exchange rate vis-a-vis US dollar that is, the depreciation in Indian rupee tends to heighten the gold prices prevailing in domestic economy. Further, an insignificant impact of US gold prices (USGLP) on gold prices in India has also been observed from the derived results. Besides, the explanatory factor included in the regression model are capable of explaining 65% of the variations in Indian gold prices. The estimated model obtains a good-fit and its robustness is also confirmed by means of residual diagnostic tests.

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