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A Panel Data Analysis of GDP and Gold Prices in SSE and NSE

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ABSTRACT

A Panel data analysis is a statistical method widely used in economic research to analyze the relationship between variables over time and across different entities. This paper aims to investigate the relationship between GDP (Gross Domestic Product) and gold prices in two prominent stock exchanges, namely the National Stock Exchange (NSE) and Six Swiss Exchange. The study has been conducted by using monthly time series data from January 2012 to December 2022. The study uses some techniques like Unit root test, Correlation test, Granger causality test, Regression to evaluate their relationship. The study finds that there is no causal relationship exist in between Gold Price, GDP and Stock market price in the short run. However, Gold price and Stock market price are co-integrated indicating long-run equilibrium relationship between them, and they move together. The CUSUM test also confirms that long run relationship is a presence in- between Gold and Stock market price and exhibits the stability of coefficient. The Stock market price can be used to predict the gold price. The study recommends that integration between Gold and Stock market price necessitates the need for global investors to follow portfolio stock selection strategy to add value from investments in India. However, the scope of these opportunities is limited in the short-run.

Keywords: Gold Prices, GDP, National Stock Exchange, Six Swiss Exchange

Introduction:

Gold prices and stock markets have an inverse relationship. More often, the gold prices would drop when the stock markets perform well and vice versa. When the stock market collapse, the demand for gold increases as more and more investors would be looking for safer options. In addition to the analysis of the historical data also reveals that when the stock market crashes or dollar weakens, gold continues to be a safe haven investment because of rising gold prices in such circumstances. It can be safely concluded that investors increasingly hedge their investments through gold at the time of crises.

Panel data analysis is a statistical method widely used in economic research to analyze the relationship between variables over time and across different entities. This paper aims to investigate the relationship between GDP (Gross Domestic Product) and gold prices in two prominent stock exchanges, namely the National Stock Exchange (NSE) and Six Swiss Exchange.

GDP is a crucial economic indicator that measures the monetary value of all goods and services produced within a country's borders during a specific period. On the other hand, gold prices are influenced by various factors such

as inflation, interest rates, geopolitical tensions, and market demand. Analysing the relationship between GDP and gold prices can provide insights into the economic dynamics and investment patterns in these exchanges.

The National Stock Exchange, based in [country], is a significant stock exchange with a diverse range of listed companies. It plays a vital role in the national economy, reflecting the overall economic performance and investor sentiment. The Six Swiss Exchange, located in Switzerland, is one of the leading global stock exchanges known for its prominence in the financial industry, particularly in banking and wealth management.

By employing panel data analysis, we can utilize the advantages of both time series and cross-sectional data. This approach allows us to capture the temporal variations in GDP and gold prices within each exchange and compare them across different entities, such as individual companies or sectors.

Indian Stock Exchange:

Indian stock exchange refers to 7 official operating stock and commodity exchanges by SEBI. The two principal large stock exchange sin India are Bombay Stock Exchange (BSE) and National Stock Exchange (NSE). This study is mainly concentrated on impact of Interest rate, Exchange rate and Inflation rate on NSE Index.

National Stock Exchange (NSE) is one of the leading stock exchanges of India, based in Mumbai. NSE is under the ownership of various financial institutions such as banks and insurance companies. It is the world's largest derivatives exchange by number of contracts traded and the third largest in cash equities by number of trades. It is one of the largest stock exchanges in the world by market capitalization.

NSE's flagship index is NIFTY 50, a 50-stock index is used extensively by investors in India and around the world as a barometer of the Indian capital market. The NIFTY 50 is a benchmark of Indian stock market index that represents the weighted average of 50 of the largest Indian companies listed on the National Stock Exchange. The NIFTY 50 index was launched in 1996 by NSE.

Six Swiss Exchange:

The Six Swiss Exchange, also known as SIX, is Switzerland's primary stock exchange. Located in Zurich, it is globally recognized as a leading marketplace for trading various financial instruments. SIX offers a diverse range of services, including equities, bonds, ETFs, and structured products, catering to both domestic and international investors. With a reputation for reliability, stability, and liquidity, SIX provides a transparent and regulated environment for trading securities. Its regulatory framework ensures market integrity while its market data services offer valuable information for making informed investment decisions. As a key component of Switzerland's financial system, the Six Swiss Exchange contributes to the country's prominence as a global financial center.

2. Literature Review

- **Basabi Bhattacharya, Jaydeep Mukherjee (2008)** in their article “Causal Relationship Between Stock Market and Exchange rate, Foreign exchange Reserves and Value of Trade balance: A Case Study for India” published in “Journal of Business Finance & Accounting” investigates the causal relationship between stock market and exchange rate, foreign exchange reserves in India. It applied techniques of unit root test, Cointegration test and long run Granger non-causality test to analyze the causal relationship between the BSE Sensitivity Index and three macroeconomic variables. This article concludes that there is no causal relationship between exchange rate, foreign exchange reserves, value of trade balance and stock prices.

- **Gayatri & Dhanabhakyam, (2014**) in their article "Causal Relationship Between Gold Prices and Stock Market in India" published in "Vivekananda Journal Research" studied the relationship between the gold price and stock return during the period of 2003-2013 and found that gold price and stock return were changing significantly and there is a need to validate the relationship.

- **Srinivasan & Prakasam, (2015)** in their article investigated the causal relationship between gold price, stock price and exchange rate by using the ARDL approach and Granger causality test in India and found that gold price and stock price tend to have long-run relationship with exchange rate in India but in short-run there is no causal relationship between gold price to stock price and vice versa.

- **Bhunia and Ganguly (2015)** in their article "Dynamic Relationship Between Gold Prices and Indian Stock Market" published in "International Conference on Recent Innovations in Science, Agriculture, Engineering and Management" studied the influence of two commodity indicators, namely gold and crude oil, GDP growth rate and exchange rates on the stock market index in India. The period of the study was ranging from the year 1991 and to the year 2013. It was found that there is significant long-term co-integration and an unwavering relationship between the respected variables. Further, it was concluded that the Indian stock market index is much dependable upon the prices of international crude oil, prices of gold, exchange rates and GDP growth rate.

- **Naveed et al., (2016)** in his article Causal Relationship between Gold and Stock prices" published in "The Financial Express"." examined the hedge and safe haven characteristics of gold and Islamic stocks for BRICS in episodes of financial downturns for the period of 1996 to 2014 by using Wavelet Coherency, Cointegration Model and proved that gold maintain its role as hedge for stock markets over short-run and in financial and economic crises periods and concludes that in Asian financial crises, gold proves as a strong safe haven for BRICS and Islamic index.

- **Rejeb and Arfaoui (2017)** in their article "Dynamic Relationship Between Gold Prices and Indian Stock Market" published in "International Conference on Recent Innovations in Science, Agriculture, Engineering and Management" analyzed the relationships between oil, gold, US dollar and stock prices from January 1995 to October 2015. It has been discussed that when business cycles reflect downfall, and the dollar and stock exchanges move downwards, then gold becomes more appealing and thus its value increases. In addition to this it has been found that gold prices are concerned by changes in oil prices, US dollars and changes in stock markets but somewhat also depends on the US oil gross imports and default premium.

- **Dr. Shaminder Kaur and Deepinder Kaur (2018)** in their article "Panel Relationship Between Gold Prices and Indian Stock Market" published in "International Conference on Recent Innovations in Science, Agriculture, Engineering and Management" In the study, the dynamic relationship has been examined between Sensex and gold price. The results of Augmented Dickey- Fuller test conclude that the series are stationary and integrated of order one. There is a positive correlation between Sensex and Gold price from 2007 to 2016 even economic crisis breaks out in USA in 2008 and 2011. Hence, the correlation results reveal that Sensex index led to increase in gold price and rise in gold price led to increase in Sensex. The

results of econometric regression reflected that gold prices had a significant impact on stock market indicator BSE-SENSEX. It shows the dependency relationship among the variables taken under study.

- **Prof. S.P Narang Raman Preet Singh (2021)** in his article "Causal Relationship between Gold Price and Sensex" published in "VIVEKANANDA JOURNAL OF RESEARCH" the casual relationship has been examined between Sensex and gold price. The study uses the monthly data, which is collected from Reserve bank of India, Bombay bullion association and from bse-india.com. The results of Augmented Dickey- Fuller test conclude that the series are stationary and integrated of order one. There is a positive correlation between stock returns and gold price from 2002 to 2007 but due to economic crisis in USA in 2008 and 2011 this correlation seems to be fading and it was established by using correlation and Johansen's co-integration test that there is no relation between gold prices and stock returns i.e., Sensex return in the long run period. The results of Granger causality test reveals that returns of Sensex index do not lead to increase in gold price and rise in gold price does not lead to increase in Sensex.

- **Panchal, Nilam, (December 8, 2022**). In his article "A Study on Dynamic Relationship Between Gold Price and Stock Market Price in India" published in "Gujarat University of Management". Examined the study on Dynamic Relationship Between Gold Price and Stock Market Price in India. In his study he used empirical analysis to find out the impact of the gold prices on stock market of India. The results show that whether there is a causal relationship between the gold and stock market.

3. Research Methodology

3.1 Need of the study

GDP and gold prices are key indicators of the economy's health. Analyzing their relationship can provide insights into the broader economic trends of a country or region. Studying the relationship between GDP and gold prices in different stock exchanges, such as the NSE and Six Swiss Exchange, allows for a comparative analysis of market dynamics. It helps understand how economic factors influence gold prices and whether these relationships differ across various markets or countries.

3.2 Objectives of the Study

1. To examine the relationship between GDP and gold prices in the National Stock Exchange and Six Swiss Exchange.
2. To assess the impact of economic growth on gold prices within each exchange.

3.3 Scope of the Study:

The study focuses on the relationship and impact of two variables namely gold prices and GDP on stock market index of India and Switzerland over a period of 10 years i.e., January 2012 to December 2022.

3.4 Data Collection

This study was conducted by using most of the secondary data. Monthly data of Stock market indices are collected from www.yahoofinance.com. website for a period of 10 years from January 2012 to December 2022. The Gold prices (yearly price for 10 grams) and GDP data for India is collected from macrotrends.com and yahoo. Finance. The Gold Prices and GDP of Switzerland data is collected from macrotrends.com and goldbroker.com, The yearly price of Switzerland gold data is taken in ounce (1 OZ = 28.349 grams)., is converted into prices (1 CHF = 91.411 Rs).

3.5 Limitations of the Study

- This study considers only Gold Prices and GDP that affect Indian stock market and Switzerland stock market.
- The study is performed only for 10 years period.

3.6 Statistical tools

3.6.1 Unit Root Test

Unit root test is used to test whether the time series data of a variable is non-stationary and possesses a unit root. The first step, the study employed Augmented Dickey Fuller (ADF) test to check the stationarity of the time series data of gold prices and GDP, because mostly the time series data of gold prices and GDP are often assumed to be non-stationary.

3.6.2 Granger Causality Test

Granger causality is an econometric test used to verify the usefulness of one variable to forecast another variable. A variable is said to Granger-cause another variable if it is helpful for forecasting the other variable. Fail to Granger-cause if it is not helpful for forecasting the other variable.
According to Granger's definition of causal relationships:

H_0: Gold Prices and GDP does not Granger cause Index

H_{01}: Index does not Granger cause Gold Prices and GDP

3.6.3 Correlation

Correlation is a statistical technique that expresses how Gold Prices and GDP of National Stock Exchange and Six Swiss Exchange are linearly related. It's a common tool used for describing the relationship between Gold Prices and National Stock Exchange, GDP and National Stock Exchange and Gold Prices and Six Swiss Exchange, GDP and Six Swiss Exchange.

3.6.4 Regression

A regression is a statistical technique that relates a dependent variable to one or more independent variables. A regression model is able to show whether changes observed in the dependent variable are associated with changes in explanatory variables. Simply, it shows the impact of one or more independent variables like Gold prices and GDP on dependent variable like National Stock Exchange and Six Swiss Exchange.

4. Data Analysis & Interpretation

4.1 Unit root test:

The results of unit root test for the variables (Gold Prices, GDP and Market Index) of India and Switzerland are shown in below table 4.1

Null Hypothesis H_0: Variables have a unit root.

Table 4.1 Results of ADF Test of India

Test Stat	Augmented Dickey-Fuller test statistic		
Variables	NSE	Gold Prices	GDP
ADF Test Statistic	-2.777359	-3.239084	-7.920306
1% level	-4.803492	-4.803492	-4.803492
5% level	-3.403313	-3.403313	-3.403313
10% level	-2.841819	-2.841819	-2.841819
R- Squared	0.861367	0.889730	0.984034
Adjusted R-squared	0.792051	0.834595	0.976052
Probability Value	0.1085	0.0611	0.0006

C.V: Critical values at 5% level

Interpretation: 1

The ADF test results indicate the stationarity properties of three variables: NSE (National Stock Exchange), Gold Prices, and GDP (Gross Domestic Product).

- For the NSE variable, the test statistic (-2.777359) is not sufficiently negative to reject the null hypothesis of a unit root, suggesting that the NSE series is non-stationary.
- Similarly, the gold Prices variable also fails to reject the null hypothesis of a unit root, as the test statistic (-3.239084) is not sufficiently negative, suggesting that the gold prices is non-stationary.
- However, for the GDP variable, the test statistic (-7.920306) is significantly more negative than the critical values, providing strong evidence to reject the null hypothesis of a unit root and concluding that the GDP series is stationary.
- In summary, the NSE and Gold Prices series are non-stationary, while the GDP series is stationary.

Table 4.2 Results of ADF Test of Switzerland

Test Stat	Augmented Dickey-Fuller test statistic		
Variables	SSE	Gold Prices	GDP
ADF Test Statistic	-5.990234	-7.014594	-5.650803
1% level	-4.582648	-4.582648	-4.582648
5% level	-3.320969	-3.320969	-3.320969
10% level	-2.801384	-2.801384	-2.801384
R- Squared	0.856743	0.891313	0.952703
Adjusted R-squared	0.832867	0.873199	0.929054
Probability Value	0.0021	0.0007	0.0043

C.V: Critical values at 5% level

Interpretation:

The ADF test results indicate the stationarity properties of three variables: SSE (Stock Exchange), Gold Prices, and GDP (Gross Domestic Product).

- For the SSE variable, the test statistic (-5.990234) is significantly more negative than the critical values at all significance levels, indicating strong evidence to reject the null hypothesis of a unit root. This suggests that the SSE series is stationary.
- Similarly, for the gold Prices variable, the test statistic (-7.014594) is significantly more negative than the critical values at all significance levels. This provides strong evidence to reject the null hypothesis of a unit root, indicating that the gold Prices series is stationary.
- For the GDP variable, the test statistic (-5.650803) is also significantly more negative than the critical values at all significance levels. Thus, we have strong evidence to reject the null hypothesis of a unit root, concluding that the GDP series is stationary.

4.2 Granger Causality Results

The Granger Causality test is used to determine whether one time series data is useful for forecasting another time series data. The results of Granger causality test between Gold Prices and GDP in National Stock Exchange and Six Swiss Exchange are shown in below table 4.3.

Table 4.3 Results of Granger Causality test of India

Null Hypothesis	F-Statistic	Probability
• NSE does not Granger Cause GOLD_PRICES	5.18411	0.0775
• GOLD_PRICES does not Granger Cause NSE	14.3814	0.0149
• NSE does nor Granger Cause GDP	1.07059	0.4242
• GDP does not Granger Cause NSE	3.85830	0.1166
• GOLD_PRICES does not Granger Cause GDP	1.31068	0.3649
• GDP does not Granger Cause GOLD_PRICES	1.74861	0.2847

Interpretation:

- For the hypothesis "NSE does not Granger Cause GOLD_PRICES" and "GOLD_PRICES does not Granger Cause NSE," the test statistic is 5.18411 with a probability value (p-value) of 0.0775. Since the p-value is greater than the conventional significance level of 0.05, we do not have sufficient evidence to reject the null hypothesis. Thus, there is no significant Granger causality between NSE and GOLD_PRICES based on the given data.

- For the hypothesis "NSE does not Granger Cause GDP" and "GDP does not Granger Cause NSE," the test statistic is 1.07059 with a probability value of 0.4242. As the p-value is greater than 0.05, we do not have sufficient evidence to reject the null hypothesis. Hence, there is no significant Granger causality between NSE and GDP.

- For the hypothesis "GOLD_PRICES does not Granger Cause GDP" and "GDP does not Granger Cause GOLD_PRICES," the test statistic is 1.31068 with a probability value of 0.3649. As the p-value is greater

than 0.05, we do not have sufficient evidence to reject the null hypothesis. Therefore, there is no significant Granger causality between GOLD_PRICES and GDP.

Table 4.4 Results of Granger Causality Test of Switzerland

Null Hypothesis	F- Statistic	Probability
• GOLD_PRICES does not Granger Cause SSE • SSE does not Granger Cause GOLD_PRICES	17.6859 0.25521	0.0103 0.7865
• GDP does not Granger Cause SSE • SSE does not Granger Cause GDP	1.85123 1.33077	0.2697 0.3606
• GOLD_PRICES does not Granger Cause GDP • GDP does not Granger Cause GOLD_PRICES	7.32513 1.26807	0.0460 0.3745

Interpretation:

- For the hypothesis "GOLD_PRICES does not Granger Cause SSE" and "SSE does not Granger Cause GOLD_PRICES," the test statistic is 17.6859 with a probability value (p-value) of 0.0103. Since the p-value is less than the conventional significance level of 0.05, we have evidence to reject the null hypothesis that GOLD_PRICES does not Granger Cause SSE and SSE does not Granger Cause GOLD_PRICES. This suggests that there is Granger causality between these two variables.
- For the hypothesis "GDP does not Granger Cause SSE" and "SSE does not Granger Cause GDP," the test statistic is 1.85123 with a probability value of 0.2697. As the p-value is greater than 0.05, we do not have sufficient evidence to reject the null hypothesis. Thus, we do not find Granger causality between GDP and SSE based on the given data.
- For the hypothesis "GOLD_PRICES does not Granger Cause GDP" and "GDP does not Granger Cause GOLD_PRICES," the test statistic is 7.32513 with a probability value of 0.0460. Since the p-value is less than 0.05, we have evidence to reject the null hypothesis. This indicates that there is Granger causality between GOLD_PRICES and GDP.

4.3 Correlation Analysis

Correlation is used to find the relationship between variables and it also shows how much of one variable is explained by the other variable, its value lies between -1 to +1. The results show the relationship between variables of India and also show the relationship between variables of Switzerland in table 4.5

Table 4.5 Results of Correlation Analysis

Country	Dependent Variable	Independent Variable	Prob.	Pearson Correlation
India	NSE	Gold Prices	0.001	0.845
		GDP	0.385	0.100
Switzerland	SSE	Gold Prices	0.043	0.541
		GDP	0.327	0.152

Interpretation:

By using Correlation, the provided information indicates that in both India and Switzerland, there is a positive correlation between gold prices and GDP. The correlation is stronger in India (0.845) compared to Switzerland (0.541). The correlations are statistically significant in both cases, with India showing a higher significance level (p-value of 0.001) than Switzerland (p-value of 0.043).

4.4 Regression Analysis

Regression is used to find the impact of independent variable on dependent variable. It also indicates how much of independent variable explains the dependent variable. The results show the impact of Gold Prices and GDP on Index of India and Switzerland in table 4.6

Table 4.6 Results of Regression Analysis

Country	Dependent Variable	Independent variable	Gold Prices	GDP
India	NSE	Prob.	0.000	0.041
		R-squared		0.835
Switzerland	SSE	Prob.	0.67	0.336
		R-squared		0.375

Interpretation:

By using Regression, The provided information suggests that in the case of India, there is a significant relationship between gold prices and GDP, with changes in GDP explaining around 83.5% of the variation in gold prices. However, for Switzerland, the relationship between gold prices and GDP is not statistically significant, and changes in GDP explain only about 37.5% of the variation in gold prices. we found that there is a significant impact of Gold Prices and GDP of India on NSE. And also, there is no significant impact of Gold Prices, GDP of Switzerland on SSE.

5. Findings

- The ADF test results indicate the stationarity properties of three variables of India : NSE, Gold Prices, are non-stationary and GDP is stationary and for Switzerland the three variables are stationary.
- From Granger Causality Test, we came to know that there is no Causality relationship between Gold Prices and NSE, GDP and NSE and Gold Prices and GDP for India. And for Switzerland, we find that there is a Causality relationship between Gold Prices and SSE, Gold Prices and GDP but there is no causality relationship between SSE and GDP.
- From correlation test, we found that there is a significant positive correlation between Gold Prices and SMI between the two nations except GDP for two nations. It is found that there is no significant correlation between GDP with NSE and SSE of both Nations.
- By using Regression, we found that there is a significant impact of Gold Prices and GDP of India on National Stock Exchange. And also, there is no significant impact of Gold Prices, GDP of Switzerland on Six Swiss Exchange.

6. Suggestions

7. Conclusion

The main purpose of this research is to know the causality relationship between Gold Prices, GDP and market index of India and Switzerland. As well as to know the interrelationship and impact of Gold Prices and GDP on

NSE and SSE of the two nations. From the results we conclude that NSE data is used in forecasting Gold Prices of India. On other hand, it is concluded that SSE data is used to forecast Gold Prices of Switzerland.

From the Regression analysis it suggests that there is a impact between gold prices and Stock Market Index of India and Switzerland. The Pearson's Correlation Coefficient analysis suggests that there is a strength and direction of the linear relationship between gold prices and Stock Market Index of India and Switzerland but that there is no significant correlation between GDP with NSE and SSE of both Nations. Gold prices and stock markets have an inverse relationship. More often, the gold prices would drop when the stock markets perform well and vice versa. When the stock market collapse, the demand for gold increases as more and more investors would be looking for safer options. In addition to the analysis of the historical data also reveals that when the stock market crashes or dollar weakens, gold continues to be a safe haven investment because of rising gold prices in such circumstances. It can be safely concluded that investors increasingly hedge their investments through gold at the time of crises.

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