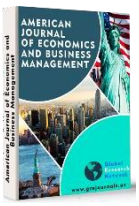

American Journal of Economics and Business Management

Vol. 7 Issue 3 | pp. 149-157 **| ISSN:** 2576-5973

Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

Cointegrating Relationship between Macroeconomic Predictors and Stock Prices in India

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Abstract:

The economic and sustainable growth of India is vital in the current era. The movement of the economic environment and capital market have an important role in the growth of our nation. The current study established the long-run and short-run relationship between the macroeconomic variables (i.e., gold prices, money supply, and foreign exchange reserve) and stock prices (i.e., S&P CNX Nifty Index) for the period from April 1995 to March 2023. By employing Johansen cointegration, it found that the GP, MS, and FER have a long-run relationship with stock prices i.e., NIFTY. Moreover, the VECM found short-run dynamics of the variables with one or two lags to meet the long-run equilibrium. This study will support the investors, managers and policy makers to make crucial decisions in this area.

Keywords: Cointegration, Macroeconomic Predictors, Stock Prices, VECM.

1. Introduction

Emerging economies' capital markets are expanding faster than developed nations. Recent years have seen a rise in foreign portfolio investments in emerging nations, where returns are more volatile than in developed nations (Abugri, 2008). The stock returns of developed and emerging nations, which are influenced by macroeconomic news, investors, and other stock market participants in the financial market, are a topic of continuous discussion.

The stock indexes' volatility is influenced by a number of institutional variables as well as changes in the economy's fundamentals. International factors have a significant influence on stock indices because of the interdependence of economies. Since domestic forces are the foundation of an economy, they cannot be disregarded. Researchers have consistently demonstrated a strong interest in examining the relationship between macro-variables and stock market values. Important economic factors that affect stock prices include foreign reserves, inflation, and exchange rates. Investors keep a close eye on the correlation between these characteristics and stock indices (Maghayereh, 2002). (Bhattacharya and Mukherjee, 2003) used unit root, cointegration, and long-run non-causality tests as analytical tools in their research of the Indian stock market from 1990 to 2000. The results indicated that there were no causal relationships between the stock prices and the selected variables—for example, the value of the gold price, money supply and foreign exchange reserves.

Citation: Mohanty , A. K. ., & Roy , D. A. K. . (2024). Cointegrating Relationship between Macroeconomic Predictors and Stock Prices in India. American Journal of Economics and Business Management, 7(3), 149–157. Retrieved from https://globalresearchnetwork.us/index.php/ajebm/article/view/2730

Received: 21 January 2024
Revised: 29 January 2024
Accepted: 20 February 2024
Published: 30 March 2024

On the other hand, there is theoretical support for the idea that macroeconomic factors influence stock prices. According to the macroeconomic school of thought, changes in macroeconomic variables have an impact on stock prices. The current price is equal to the discounted values of the cash flow, according to Ross's Asset Pricing Theory (APT) (1973, 1976), which reiterates the long-term correlation between macro-variables and stock prices (*Ross & Stephen, 1976)*. The pricing of financial assets and the assessment of price variance are done using the APT. According to the multifactor arbitrage pricing model, factor returns are consistent with the stochastic features of the returns. The factor-specific beta coefficient measures stock return sensitivity to economic conditions.

Cointegration is a statistical concept that deals with the long-term equilibrium relationship between two or more time series variables. In the context of macroeconomic predictors and stock prices, cointegration suggests that there exists a stable, long-run relationship between certain macroeconomic indicators and stock price movements. In the context of macroeconomic predictors and stock prices, cointegration suggests that certain macroeconomic factors influence stock prices over the long term. These factors could include variables like interest rates, inflation rates, GDP growth, exchange rates, gold prices, money supply, foreign exchange reserves, etc.

The current study focuses on how macroeconomic factors like gold prices, money supply, and foreign exchange reserves have influenced stock prices in India (Long & Hanh, 2019). Moreover, it is motivated to know the long-run as well as the short-run relationship between the macroeconomic predictors and stock prices in India.

2. Prior Studies

A portion of the body of existing literature has been examined in an effort to identify research gaps. (Mookerjee and Yu, 1997) used causality and cointegration tests to examine informational efficiency in the Singapore market. In relation to stock prices, the narrow and wide money supply, nominal exchange rates, and foreign currency reserves are examined. The impact of macroeconomic variables on the Nigerian stock market (Asaolu & Ogunmuyiwa, 2010**)** has investigated External Debt (ED), Inflation Rate (IR), Fiscal Deficit (FD), Exchange Rate (EX), Foreign Capital Inflow (FCI), Investment (INV), Industrial Output (INDO) and Inflation Rate (INF) as their independent variables and average share price as their dependent variable. By considering the Granger causality test, cointegration and error correction method, the study finds a weak association between the stock price and macroeconomic variables.

Employing the cointegration test and Granger causality test to check the long-run relationship between the variables while BVAR modeling for variance decomposition and impulse response function was used to check the short-run relationship between the variables (Ahmed, 2008**)** critically analyzed the impact of the aggregate economic variable on stock prices in India during the period from 1995 to 2007. The economic variables include an index of industrial production, export, foreign direct investment, money supply, exchange rate, and interest rate. The NSE Nifty and BSE Sensex are taken as the proxy of stock prices in India. The study found a different causal relationship between the macroeconomic variables with the BSE Sensex and NSE Nifty Index in India in the long run and also in the short run. The result also found that stock prices influence the economic activities in India except interest rate, which means interest rate seems to lead both stock indexes in India.

Considering the macroeconomic variables, including Interest Rate (IR), Exchange Rate (ER), Gross Domestic Product (GDP), Inflation Rate (INF), and Stock price, including the KSE 100 Index (Hunjra et al., 2014**)** have examined the variability of macroeconomic variables significantly influences the Stock Price during the period from January 2001 to

December 2011. The study has used ADF for Unit root, Cointegration Analysis and Granger causality to analyse the data set. The empirical result found that there is no significant relationship between the predicted variable and the explanatory variable. However, there is a significantly strong relationship between the variables. (Oskooee and Saha, 2015**)** Reviewed the prior articles to know the relationship between stock prices and exchange rates. By considering bivariate studies and the multi-variate models, the study found that the exchange rate has a significant relationship with stock price in the short run. However, very rare studies found it in the long run.

A few studies look into the effects of macroeconomic variables on gold prices. There is a moderate correlation between macroeconomic indicators and gold prices, according to data gathered over eight years from daily-based variable pricing (Oluyemi & Isaac, 2017; Jain & Biswal, 2016).

The volatility of macroeconomic variables on stock prices of the Nairobi Stock Exchange (Mumo, 2017**)**. Such study includes Inflation, Money supply, Exchange rate and Interest rate as independent variables and NSE Share Index as dependent variable for the period from 1998 to 2015. ADF and PP tests are used for unit root, Johansen Co-integration and VECM tests are used to analyze the data set. The analysis finds an equilibrium relationship between stock prices and macroeconomic variables. However, Inflation shows a negative insignificant relationship, but the exchange rate and Interest rate show a positive relationship. The impact of commodities and macroeconomic factors on stock market performance in Korea and Japan (Prieto & Lee, 2019) was analytically examined during the period from 1993 to 2017. By employing the Vector Error Correction Model (VECM), the study found that GDP growth, interest rate, exchange rate, oil price and gold price affect the Kospi in the short run. However, GDP growth, interest rate and gold price affect the Nikkei 225 in the short run. By using impulse response, we found each stock market has its shock, which declines from the short-run to the long run. Overall, the commodities and macroeconomic factors are the significant determinants of Korea and Japan's stock market performance during the study period.

All the variables that affect the price of gold have been categorized and grouped into three groups: the price of energy products, the financial markets, and the gold reserve. The findings showed that energy goods and gold reserves have favorable effects, whereas macroeconomic variables have a negative impact on gold prices due to the financial market (Long & Hanh, 2019).

The Sensitivity of the Indonesian Islamic Stock Prices to Macroeconomic Variables by (WIDARJONO et al., 2021**)**. Their independent variables include Money Supply, Domestic Output, Exchange Rate and Federal Reserve rate. The dependent variable includes the Jakarta Islamic Index (JII). The study period varies from January 2000 to December 2019. By employing ADF and PP Test for unit root and NARDL (Non-linear ARDL), the result shows that The Jakarta Islamic Index asymmetrically responds to broad money supply and exchange rate but not to domestic output and Federal Reserve rate. A reduction in the money supply has a worse effect on Islamic stock prices as compared to an increase in the money supply. The Jakarta Islamic Index responds differently to depreciation and appreciation. The transmission of the exchange rate to Islamic stock prices occurs only for appreciation. Our study finds an absence of a transmission mechanism from the domestic output and the interest rate to Islamic stock prices.

The current study adds to the body of research that examines the connections between a number of macro-variables and the stock market. It examines the empirical research on the relationship between the other macroeconomic variables and the Indian stock market index. As one of the developing economies, India has drawn interest from academics, researchers, and investors worldwide who are eager to establish connections. Taking into account both short- and long-term relationships, investors might assess and diversify their portfolios.

3. Data and Research Methodology

3.1. Data

The current study establishes the long-run and short-run relationship between the movement of selected macroeconomic variables and stock prices in India. The monthly data of Gold Price (GP), Money Supply (MS), Foreign Exchange Reserve (FER), and Nifty CNX Index (NIFTY) have been taken for the period from April 1995 to March 2023. The data of considered variables has been collected from the RBI database and Yahoo Finance. After the collection of data, the variables are converted into natural logarithm form. The following (Table 1) are the variable's details:

Table 1: Variables Details

Variables	Definitions	Sources
Gold Price (GP)	The Average Price of Gold in Mumbai is collected, and the price is taken per 10-gram rate.	https://cimsdbie.rbi.org.in/BOE/OpenDocument/ 2306011537/OpenDocument/opendoc/open Document.jsp? logonSuccessful=true&shareId=1
Money Supply (MS)	The broad money supply (M3) is collected to check the influence of the movement on stock prices.	https://dbie.rbi.org.in/BOE/OpenDocument/ 2311211739/OpenDocument/opendoc/ openDocument. jsp?logonSuccessful =true&shareId=0
Foreign Exchange Reserve (FER)	Foreign Exchange Reserve is collected from the RBI (Handbook of Statistics) database.	https://cimsdbie.rbi.org.in/DBIE/#/dbie/reports/Statistics /External%20Sector/ Forex%20Reserve
S&P CNX Nifty Index (NIFTY)	The Nifty Index is taken as a proxy of stock prices in the study, which is collected from Yahoo Finance (Rupees per share).	https://finance.yahoo.com/quote/%5ENSEI/history? p=%5ENSEI

3.2. Methods

The analytical part started with descriptive statistics and Unit root tests to determine the behavior of the selected variables. To examine the long-run association between the Indian stock market price behavior and the movement of macroeconomic variables, the study employed Johansen cointegration. Moreover, to verify the short-run dynamics, it used the Vector Error Correction Model (VECM).

Johansen's Cointegration Test: A cointegration test requires that the stationarity of the variables be verified. We look at long-run relationships between the series if all the variables are integrated in the first order or the same order of integration. The two-step Engel and Granger (1986) test and Johansen's cointegration (1988) test are the two well-known techniques used for analysis. Johansen's test is applicable because there are more than two variables. The variables in this test are in their level form, meaning they are not stationary.

***Vector Error Correction Model (VECM)*:** The cointegration test is used when the series is determined to be stationary in the same order following the initial difference (I(1)). Variables are referred to as cointegrated when correlations between them are discovered. Although a long-term relationship between the variables has been established, a short-term duration may be in an equilibrium. Because of this, VECM is used to determine the long-term relationship between the variables by examining the existence of short-run disequilibrium and the rate of correction. The following is the model specified for VECM analysis:

$$\Delta \boldsymbol{NIFTY}_t = \boldsymbol{\delta} + \sum_{i=1}^{k-1} \boldsymbol{\alpha}_i \, \Delta \boldsymbol{NIFTY}_{t-i} + \sum_{j=1}^{k-1} \boldsymbol{\beta}_j \, \Delta \boldsymbol{GP}_{t-j} + \sum_{m=1}^{k-1} \boldsymbol{\gamma}_m \, \Delta \boldsymbol{MS}_{t-m} + \sum_{n=1}^{k-1} \boldsymbol{\delta}_n \, \Delta \boldsymbol{MS}_{t-n} + \boldsymbol{\eta}_1 \boldsymbol{ECT}_{t-1} + \boldsymbol{u}_{1t}$$

Where $k-1$stands for lag length are declined by 1, η_iIs the speed of adjustment parameter with a negative sign, ECT_t is the error correction term, and u_tIs called stochastic error terms.

4. Results and Discussion

Statistical properties of variables are checked before using any time series econometric models. Table 2 represents the summary statistics of the natural logarithm value of GP, MS, FER and NIFTY. The summary statistics measure the mean, minimum, maximum, standard deviation, and JB-test values of each variable. The mean, maximum, minimum, and standard deviation of lnNIFTY is 8.25, 9.84, 6.70, and 0.95, respectively. Again, the mean, maximum, minimum, and standard deviation of lnGP is 9.52, 10.95, 8.29, and 0.88, respectively. The mean, maximum, minimum, and standard deviation of lnMS is 15.27, 16.92, 13.24, and 1.10, respectively. Further, the mean, maximum, minimum, and standard deviation of lnFER is 13.67, 15.38, 11.19, and 1.23, respectively. Moreover, very important is the JB test, which reveals the normality of variables. The JB test of all the variables is significant, which means the variables are non-normal. Hence, we have to differentiate the data, and the differentiated data will be applicable to run the model.

Table 2: Summary Statistics of lnNifty, lnGP, lnMS, and lnFER

Variables Name	Mean	Max	Min	Std. Dev.	JB-Stat.
lnNIFTY	8.2498	9.8394	6.7066	0.9584	25.9283***(0.0000)
lnGP	9.5298	10.9598	8.2928	0.8845	33.9913***(0.0000)
LnMS	15.2777	16.9221	13.2401	1.1035	25.0323***(0.0000)
lnFER	13.6717	15.3834	11.1900	1.2376	27.7476***(0.0000)

Source: Authors' Computation by using EViews

4.1. Unit Root Test

The Augmented Dickey-Fuller (ADF) Test and the Phillips–Perron (PP) Test have been applied to check the stationarity of the lnNIFTY, lnGP, lnMS, and lnFER. Table 3 depicts the result of the unit root testing. In the case of each variable, the null hypothesis (series contains the unit root) is accepted at a level that confirms the presence of the unit root at the level. The ADF and PP tests are run once the variables are transformed into the first difference. The null hypothesis is firmly rejected, and it is shown that the variables are stationary at first difference. Another name for the series that is stationary at first difference is integrated at first order, or I (1). Next, the existence and sequence of integration between the component variables are tested using the Johansen Test. Every variable needs to be integrated in the same sequence in order to examine the cointegration property. The current investigation adheres to the same protocol as series I (1).

Table 3: Unit root test of lnNIFTY, lnGP, lnMS, and lnFER

Variables	ADF		PP		Order of Integration
	At Level	At first Difference	At Level	At first Difference	
lnNIFTY	-0.5333 (0.8814)	-18.0183*** (0.0000)	-0.5341 (0.8812)	-18.0185*** (0.0000)	I (1)
lnGP	-0.6473 (0.9908)	-16.2232*** (0.0000)	-0.5280 (0.9875)	-16.1840*** (0.0000)	I (1)
LnMS	2.3571 (0.1549)	3.2263** (0.0411)	1.4819 (0.0091)	17.5786*** (0.0000)	I (1)
lnFER	2.2671 (0.1834)	16.4660*** (0.0000)	1.1030 (0.0897)	16.5147*** (0.0000)	I (1)

Source: Authors' Computation by using EViews

Table 3 shows the unit root test by using ADF and PP test with at level and first difference. The result of ADF shows that all the selected variables are insignificant at level, which means the variables have unit roots at level (non-stationary) and are significant at first difference, which means the variables have no unit root at first difference. Similarly, the same result is found in the PP test. Hence, all the selected variables are non-stationary at

the level and stationary at the first difference, which fulfills the assumption of employing Johansen Cointegration.

4.2. Long-run Analysis

Johansen cointegration is used to verify the long-run relationship between the selected macroeconomic variables and stock prices.

Johansen Cointegration

Table 4 shows two cointegrations, i.e., the first cointegration includes GP and MS to NIFTY, and the second cointegration includes GP, MS, and FER to NIFTY. In the first equation, one cointegrating equation was found both in λ-Trace and λ-Max at a 5% level of significance, and the LR estimates found that GP has an insignificant negative relationship with NIFTY in the long run. In contrast, the MS is insignificant and positively correlated with NIFTY in the long run. Similarly, in the second cointegration, the equation was found to have one cointegrating equation at a 5% level of significance in both λ-Trace and λ-Max, and the LR estimates find that GP has a significant negative relationship with NIFTY in long-run. In contrast, the MS and FER have a significant positive relationship with NIFTY in the long run. Here, the second equation is selected for short-run dynamics (VECM) and long-run relationships.

Table 4: Johansen Cointegration of lnNifty, lnGP, lnMS, & lnFER

LnNIFTY, lnGP, lnMS					
	Hypothesis		**Eigen Value**	**λ-Trace**	**λ-Max**
	H_0	**H_1**			
VAR-4	$r = 0$	$r = 1$	0.0879	49.2985**(0.0102)	29.9052**(0.0137)
	$r \leq 1$	$r = 2$	0.0423	19.3933(0.2582)	14.0706(0.2495))
	$r \leq 2$	$r = 3$	0.0162	5.3226(0.5507)	5.3226(0.5507)
LR Estimates	*lnNIFTY = - 0.4106lnGP + 0.9094lnMS + 0.0069t* ***(-1.06) (1.22) (0.87)***				
LnNIFTY, lnGP, lnMS, lnFER					
VAR-4	$r = 0$	$r = 1$	0.0949	71.9229***(0.0090)	32.4001**(0.0462)
	$r \leq 1$	$r = 2$	0.0548	39.5227(0.1049)	18.3333(0.3522)
	$r \leq 2$	$r = 3$	0.0341	21.1893(0.1716)	11.3080(0.4821)
	$r \leq 3$	$r = 4$	0.0299	9.8812(0.1327)	9.8812(0.1327)
LR Estimates	*lnNIFTY = - 0.7297lnGP** + 2.4617lnMS** +0.4892lnFER** + 0.00065t* ***(-2.13) (2.45) (1.93) (0.05)***				

Source: Authors' Computation by using EViews

4.3. Short-run Analysis

The Vector Error Correction Model (VECM) is used to know the short-run dynamics between the selected macroeconomic variables and stock prices.

Vector Error Correction Model (VECM)

The short-run dynamics (i.e., in Table 5) of lnNIFTY, lnGP, lnMS, and lnFER (as dependent) are estimated by using the Vector Error Correction Model (VECM). The error correction coefficient indicates how quickly the model will make modifications to return to equilibrium after any shocks. The coefficient values of lnNIFTY and MS are significant and positive, which indicates that the short-run dynamics are convergent with long-run equilibrium, whereas lnFER is insignificant and positive. However, lnGP is significantly negative, which suggests that the short-run dynamics are convergent with long-run equilibrium. The lnGP has a significant negative relationship with lnNIFTY at the second difference. In contrast, lnMS and lnFER have a positive relationship with lnNIFTY at the second and first differences, respectively, in the short run. The model incorporates two dummy variables (i.e., a dummy of GFC and COVID-19), which have a significant positive and significant negative relationship, respectively, with the lnNIFTY in the short run.

Table 5: Vector Error Correction Model (VECM) of lnNifty, lnGP, lnMS, & lnFER

Error Correction:	D(LNNIFTY)	D(LNGP)	D(LNMS)	D(LNFER)
CointEq1	0.0153***	-0.0061**	0.0041***	0.0033
	[3.0312]	[-2.1008]	[4.9400]	[1.6260]
D(LNNIFTY(-1))	0.0095	-0.0081	0.0038	0.0595***
	[0.1689]	[-0.2913]	[0.4794]	[2.9896]
D(LNNIFTY(-2))	0.1427***	-0.0714**	0.0183**	0.0260
	[2.4947]	[-2.5229]	[2.2875]	[1.2880]
D(LNGP(-1))	-0.0023	0.0894	0.0132	-0.0642
	[-0.0200]	[1.5530]	[0.8084]	[-1.5601]
D(LNGP(-2))	-0.3178***	-0.0654	0.0414**	0.0339
	[-2.7491]	[-1.1428]	[2.5375]	[0.8294]
D(LNMS(-1))	1.2670***	0.2635	-0.0392	0.1318
	[3.2190]	[1.3519]	[-0.7056]	[0.9474]
D(LNMS(-2))	0.2703	-0.0087	-0.0631	0.1391
	[0.6870]	[-0.0450]	[-1.1359]	[1.0003]
D(LNFER(-1))	-0.0693	0.1495*	0.0391*	0.1118*
	[-0.4215]	[1.8367]	[1.6883]	[1.9235]
D(LNFER(-2))	5.2600***	-0.0164	-0.0438*	0.0049
	[-3.3000]	[-0.2068]	[-1.9261]	[0.0875]
C	0.0083	0.0024	0.0121***	0.0077***
	[1.1249]	[0.6713]	[11.5954]	[2.9570]
DGFC	0.0726***	0.0179**	0.0216	-0.0043
	[3.0000]	[2.3867]	[1.0286]	[-0.1699]
DCOVID	-0.0314**	-0.0195	-0.0734**	-0.0132
	[-2.3259]	[-1.4233]	[-2.3302]	[-0.5198]
R-squared	0.3118	0.1446	0.1009	0.0777
Adj. R-squared	0.3164	0.1173	0.0752	0.0513
Sum sq. resids	1.4195	0.3478	0.0282	0.1774
S.E. equation	0.0671	0.0332	0.0094	0.0237
F-statistic	0.4185	1.6348	3.9296	2.9496
Log likelihood	421.7903	650.3159	1058.068	759.7336
Akaike AIC	-2.5340	-3.9404	-6.4496	-4.6137
Schwarz SC	-2.4176	-3.8239	-6.3332	-4.4973
Mean dependent	0.0088	0.0072	0.0112	0.0128
S.D. dependent	0.0665	0.0335	0.0098	0.0243

Source: Source: Authors' Computation by using EViews

*, **, *** implies significant at 10%, 5%, & 1% respectively, & t-statistics in '[]'.

5. Conclusion and Recommendations

The analytical contemplation on the relationship between macroeconomic variables (i.e., gold price, money supply, and foreign exchange rate) and stock prices (i.e., Nifty Index). The Johansen cointegration analysis found one cointegrating relationship between the variables along with the long-run relationship between the macroeconomic variables and stock prices. Gold price is significantly and negatively influencing the Indian stock price in the long run. In contrast, money supply and foreign exchange reserves are significantly and positively influencing Indian stock prices in the long run. The short-run dynamics also found that all the variables are significant either at one lag or two lag, which means the variables have the short-run dynamics to meet the long-run equilibrium.

Overall, we concluded that the selected macroeconomic variables (i.e., gold prices, broad money supply, and foreign exchange reserve) have both short-run as well as long-run relationships between the variables.

The relationships between gold prices and stock prices in a way that promotes financial stability, investor confidence, and sustainable economic growth. Maintain a transparent and rules-based monetary policy framework, with clear communication of policy

objectives and decisions. Continuously monitor economic indicators, inflation expectations, and financial market conditions to adjust monetary policy settings as needed. Continuously assess reserve adequacy metrics and adjust reserve levels as needed to maintain confidence in the currency and support financial stability. This study emerges as an opportunity to research the area by considering other important macroeconomic variables along with other stocks.

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