Macroeconomic Determinants of Price Dynamics in the Indian Stock Market

Neeraj Kumar [1]
Deepika Goel [2]

Abstract

Purpose : The objective of this study was to analyze a long-term relationship between Indian stock prices and selected macroeconomic indicators. This paper investigated the long-term determinants of Indian stock prices, using monthly data from April 2005 to April 2024.

Methodology : The paper used Johansen's cointegration and vector error correction technique to investigate the short-run dynamic linkages among Indian stock prices and key macroeconomic indicators. Further, a dynamic analysis of the determinants using impulse response function (IRF), forecast error variance decomposition (FEVD), and Granger causality was also conducted.

Findings : The empirical results showed a significant long-term relationship (cointegration) between Indian stock market performance and macroeconomic indicators like the index of industrial production, inflation, money supply, interest rate, rupee-dollar exchange rate, net exports, and global financial market performance. The signs in the cointegrating vector were consistent with the theoretical understanding of the relationship among variables. The generalized variance decompositions suggested that the level of economic activity in the domestic economy, exchange rate movements, and the global financial environment were the most important determinants of the Indian stock market.

Practical Implications : Stock markets were a crucial part of a financial economy and played a phenomenal role in the growth and development of a nation. Markets worldwide have become more open and integrated. Hence, an economy's vulnerability to the global environment, including exogenous shocks and events, such as the 2008 global financial recession and the COVID-19 pandemic, had increased. It had become imperative to review the role of macroeconomic fundamentals in determining stock prices while accounting for such random events. The Indian stock market was sensitive to both domestic and global factors. Hence, targeting exchange rates and capital flows as policy variables was equally important as domestic fundamentals, such as economic activity.

Originality : This study included domestic and global factors as determinants of stock market prices. These findings had important policy implications as they might be crucial in the context of macroeconomic stabilization and adjustment programs.

Keywords : macroeconomic determinants, stock prices, VECM, Granger causality

JEL Classification Codes : C320, E44, G1

Paper Submission Date : March 5, 2024 ; Paper sent back for Revision : June 25, 2024 ; Paper Acceptance Date : July 10, 2024 ; Paper Published Online : September 14, 2024

[1] *Joint Director (Bilateral Cooperation),* Department of Economic Affairs, Ministry of Finance, Government of India, North Block, New Delhi. (Email : neeraj@econdse.org)

[2] *Associate Professor (Corresponding Author),* Aryabhatta College, University of Delhi, Benito Juarez Road, New Delhi - 110 021. (Email : deepika@aryabhattacollege.ac.in) ; ORCID iD : https://orcid.org/0000-0003-1823-2160

DOI : https://doi.org/10.17010/ijf/2024/v18i9/174457

Equity markets are one of the primary indicators of the strength and development of an economy. They channel funds from surplus to deficit sectors and facilitate financial intermediation. A well-functioning equity market boosts savings and allows for efficient allocation of funds. Stock markets are the most important source of raising funds for firms, companies, and business houses. Household wealth and consumption levels are also affected by stock prices. Therefore, researchers and policymakers, including regulators, keep a close eye on the behavior of stock markets.

Over time, both the market and regulator have reduced inefficiencies in the stock market, thereby making it more competitive. As a result, the stock market and other macro variables have become sensitive to each other. In addition, international linkages have increased due to more open stock markets worldwide. The elimination of traditional barriers and the advancement of technology are viewed as the cause of greater interlinkages in international financial markets.

In India, stock markets are fairly developed and can be compared to those of developed countries. India's evolving financial sector is becoming integrated with the global financial environment, and its monetary and financial sector policies are closely observed and compared with those of developed nations. Financial market integration has reduced gains from international portfolio diversification by making markets co-move more closely and enhancing spill-overs. The gains from international diversification are based on low correlations across international stock markets. So, the higher the correlations among stock markets (say, due to greater economic integration through liberalization, privatization, and globalization policies), the lower the benefits from global portfolio diversification and vice-versa.

Movements of stock prices are seen to depend on firm-specific factors; macroeconomic factors; monetary and fiscal policy announcements; domestic and international economic, social, or political events; market sentiments/expectations about the future economic growth trajectory of a company or a country; seasonal patterns/calendar anomalies; financial market integration, etc. Investment flows, in turn, are considered to be influenced by these factors. Also, markets are highly reactive to investment flows to and from all over the world.

Amid greater integration, the degree of vulnerability to the global environment, including exogenous shocks such as the 2008 global financial recession and the COVID-19 pandemic, has also increased. Such events have now become the new normal in the markets.

In this scenario, it has become imperative to review the role of macroeconomic fundamentals in determining asset prices while considering such random events. The paper examines the impact of fundamentals and exogenous forces on India's stock market. Specifically, the objectives of this study are twofold. First, to identify whether the macroeconomic variables (both domestic and global) have any relationship with Indian stock prices, given the new domestic and international economic scenarios. If so, what are the most significant factors, and the nature of their relationship?

Second, to investigate the patterns of short-run as well as long-run co-movements between Indian and the US stock markets to check whether stock prices in both the markets (BSE-Sensex and S&P 500[1]) are cointegrated, i.e., whether the two prices have a long-run or equilibrium relationship between them. With this, we examine the nature of the causal relationship between the two prices, controlling for other macroeconomic determinants and random events.

In this study, we focus on macroeconomic factors, such as real economic activity, capital flows, inflation, interest rates, exchange rates, money supply, etc., and the effects of major global events. Following a general to a specific approach, this paper investigates the co-movements and dynamic linkages among various stock market determinants, including foreign stock markets.

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[1] The S&P (Standard & Poor's) 500 index is widely considered the best single yardstick of the US stock market as well as the US economy.

By using a standard technique for establishing cointegrating relationship developed by Johansen and Juselius (1990, 1992), vector error-correction models (VECM), forecast error variance decomposition, and impulse response functions, the paper examines short-run and long-run relationships among Indian and US stock markets with other macroeconomic market forces. The VAR (vector autoregressive) technique is often criticized as it cannot capture potential long-run relations and suffers from misspecification bias. Johansen's VECM is a more appropriate framework than the standard vector autoregressive (VAR) technique.

The study uses the benchmark BSE Sensex index, which is a good proxy for the overall performance of the Indian stock market. From April 2005 to April 2024, Sensex saw a phenomenal journey from a nearly 6,000 level in 2005 to a high of 74,500 in April 2024. The period from January 2008 to March 2009 was the period of the global subprime crisis, while there was a sharp correction in the market due to the 2019 COVID-19 pandemic.

This paper is expected to make significant contributions to the existing literature. First, it comprehensively reviews and identifies key macroeconomic determinants of Indian stock prices. Available empirical literature either considers cross-country analysis of only stock market prices without taking into account domestic macro fundamentals or focuses on domestic fundaments only as the determinants of stock prices without considering the global environment. This paper investigates the determinants of Indian stock prices after accounting for global and domestic shocks.

Review of Literature

The two most influential theories on asset pricing are the capital asset pricing model (CAPM) and arbitrage pricing theory (APT). According to Sharpe (1964), CAPM, under certain assumptions, explains how asset prices are formed in the market and provides the framework for determining the equilibrium expected return for risky assets. It suggests that the expected return of a security is determined by β, which represents sensitivity to non-diversifiable risk (sometimes called systematic risk or market risk). On the other hand, APT, developed by Ross (1976), suggests that the return on any asset depends not only on risk-free interest rates and risk premiums but also on other forces. The assumptions of APT are less restrictive, making it a better alternative to CAPM[2]. APT is an explanatory model of security returns where each investor is assumed to hold a different portfolio with its particular array of βs rather than the identical market portfolio. In addition, the APT is generally considered a supply-side theory because its βs show the responsiveness or sensitivity of the underlying asset to multiple factors. The CAPM may be seen as a demand-side model as it uses market equilibrium, and its conclusions are based on the way each investor maximizes its utility function.

However, APT does not specify the factors affecting stock market returns. Hence, there is a need to find more theoretical explanations for modeling stock prices. The nature and number of determinants of stock market aggregate prices are likely to change with time and between countries and their economic environments. Therefore, the identification of factors is purely empirical. Using the approach based on APT, Chen et al. (1986) showed a systematic relationship between stock market returns and unexpected changes in inflation, GNP (indicated by IIP), investors' confidence, and unexpected shifts in the yield curve.

Several studies hypothesize a cointegrating relationship between macroeconomic variables and the stock market index. Ahmed (2008) investigated the short-run and long-run causal relationship of industrial production, exports, foreign direct investments, exchange rate, money supply, and interest rate with both Nifty and Sensex, using quarterly data from 1995 to 2007. The study used Johansen's procedure and the Toda and Yamamoto Granger (1995) Granger causality test to find the bivariate relationship between stock prices and key economic variables.

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[2] CAPM is also considered as a special case of APT.

Singh (2015) investigated the relationships between the Indian stock market index and macroeconomic variables, such as the industrial production index, wholesale price index, money supply, treasury bill rates, and exchange rates. Employing Johansen's cointegration technique, the paper found that the stock prices in India were positively related to the wholesale price index, money supply, and interest rate but negatively related to IIP and exchange rate from January 2007 to March 2014. Granger causality results revealed a bi-directional causality between the stock market index, exchange rate, and interest rate. Interest rates were found to Granger cause stock market indexes in both the short and long run. They also found that money supply caused stock prices only in the long run but not in the short run.

Jacob and Raphael (2019) explored various macroeconomic variables affecting the flow of foreign portfolio investment (FPI). The authors indicated that domestic stock market return was one of the significant determinants of FPI inflows. Radha and Gopinathan (2019) analyzed the long-run relationship between macroeconomic variables and selected banking sector stocks. Results revealed a significant positive relationship between bank rate, repo rate, and reverse repo rate, as well as the Indian stock market and banking sector stocks. Granger causality results showed strong causation between the variables and movements in the Nifty index and banks' share prices.

Pal and Garg (2019) analyzed the sensitivity of Indian stock indices to monetary and macroeconomic policy. They employed VAR, including the variables Sensex, 91-day T-bill rate, gross domestic product (GDP), wholesale price index (WPI), consumer price index (CPI), index of industrial production (IIP), and current account deficit (CAD), using monthly data for the Indian economy from 2004 to 2016. The findings indicated that monetary policy shocks had a greater impact on the stock market than other macroeconomic surprises.

Extensive research has been done on testing market efficiency since the 1960s. As per Fama's theory of the efficient market hypothesis (1970), the stock markets are efficient if they incorporate “all relevant information” available. Given the macroeconomic fundamentals, this helps produce the best possible forecasts (Danak & Patel, 2020). Karmakar and Inani (2019) used panel cointegration and panel VECM on Nifty spot and futures, 35 single stocks, and their respective futures. The authors concluded that the spot market was more efficient in price discovery for most size and sector panels.

Hiremath and Narayan (2016) examined the adaptive market hypothesis and determinants for the Indian stock markets and found that the Indian stock market was moving toward efficiency. The study found a positive and significant link between the Indian market's efficiency gap, international shocks, and domestic policy. Gahlot (2019) examined the effect of foreign and domestic institutional investors on the volatility of the Indian stock market. They observed that recent news did not significantly affect the stock market returns, so investors could develop better investment strategies by analyzing recent and historical news.

The all-pervasive reduction in stock prices in India during the global financial crisis was found to be linked with the greater integration of Indian stock markets with world markets, which caused quick transmission of shocks. Pandit (2015) identified determinants of the change in stock prices during the global financial crisis using data from 2,075 companies. Empirical results from this study showed that stock prices of companies with extensive foreign exposure (in terms of export intensity and a significant share of FIIs in investment), higher beta values (indicating higher risk levels), and higher book-to-market value (indicating lower stock market value) experienced fall in their stock prices. Firms with larger asset sizes acted as safety zones for investors during the crisis, and their stock prices increased.

In light of the available literature, the study proposes to analyze the macroeconomic determinants of the Indian stock market. The next section outlines some of the determinants and their expected signs.

Macroeconomic Variables

Interest Rate

The association between interest rate and stock price is well documented in the literature, though results vary. Studies like Asaolu and Ogunmuyiwa (2011), Ahmed (2008), Chen et al. (1986), Dickinson (2000), Maysami and Koh (2000), Mo et al. (2018), Pal and Garg (2019), Radha and Gopinathan (2019), Singh (2015), hypothesize a negative relationship between stock prices and interest rates. The authors argue that because most companies finance their capital equipment and inventories through borrowings, a drop in interest rates lowers borrowing costs and serves as an incentive for expansion, which will significantly impact the firm's future expected returns. This will increase prices that investors are willing to pay for the stock through expectations of higher future dividend payments. According to the dividend discount model,[3] the required rate of return and the share price are inversely related. Thus, returns on stocks are expected to decrease with the increase in the interest rate.

Money Supply

According to Hirota (2023), money supply affects stock prices positively. The amount of money in the economy determines whether equities are overpriced or underpriced. According to the monetary portfolio (MP) model, investors hold more money when the money supply increases. They adjust their portfolio by exchanging cash for different assets, like bonds and stocks. As a result, interest rates decline, and stock prices rise (Nagina, 2022; Vohra, 2016).

Economic Activity

Several studies consider the index of industrial production (IIP) indicator of economic activity due to the lack of monthly data on GDP. The present study also uses IIP as the proxy for the level of economic activity and expects a positive relationship between IIP and stock market prices. Increased industrial production boosts corporate earnings, leading to increased investment and higher stock values. Several studies (Chen et al., 1986; Maysami et al., 2004; Rahman & Uddin, 2009; Ratanapakorn & Sharma, 2007; Tripathi et al., 2016) have found a positive and significant relationship between IIP and stock prices.

Inflation

Pal and Garg (2019), Jacob and Raphael (2019), Singh (2015), Asaolu and Ogunmuyiwa (2011), Maysami and Koh (2000), Errunza and Hogan (1998), and Chen et al. (1986) explored the relationship between inflation and stock price levels. An increase in the inflation rate may lead to tightening economic policies, which increases the interest rates and hence reduces stock prices. The results of various empirical studies indicate a negative relationship between stock returns and multiple measures of expected and unexpected inflation. Based on the notion that money demand is procyclical, Fama (1981) claimed that an increase (decrease) in real activity is expected to coincide with a decrease (increase) in inflation. Participants in the stock market anticipate the changes in real activity, and stock prices appear to move inversely with inflation. Contrary to this literature, some studies, such as Ratanapakorn and Sharma (2007), find a positive relationship between stock price and inflation, which is also consistent with the belief that equity is a hedge against inflation.

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[3] Model used to determine the price at which security should sell based on the discounted value of estimated future dividend payments.

Exchange Rates

Jacob and Raphael (2019), Mo et al. (2018), Singh (2015), Asaolu and Ogunmuyiwa (2011), Gay Jr. (2016), Ahmed (2008), Dickinson (2000), and Maysami and Koh (2000) studied the association between exchange rate and stock prices. The relationship between prices in the stock market and the exchange rate can be in either direction, depending on the circumstances. If the demand for exports is sufficiently elastic, a depreciation of the Indian rupee will lead to an increase in the demand for India's exports, increasing cash flows in the country. This, in turn, will raise demand and, thus, the stock market prices. Hence, one can expect a positive correlation between stock market returns and changes in the exchange rate.

On the other hand, the depreciation of the local currency makes imports expensive relative to exports. Thus, the production costs of importing companies increase, reducing corporate earnings and stock prices. This happens because the costs cannot be passed on to the consumers because of the market's competitiveness. Hence, the impact of exchange rates on stock prices will be determined by the relative importance of the import and export sectors of the economy.

Net Exports

A positive relationship can be expected between net exports and stock prices via the effect of exports on domestic competitiveness. Higher exports imply higher earnings for exporters, which may lead to higher demand for shares by fueling share valuation. The relationship is documented in Pandit (2015), Asaolu and Ogunmuyiwa (2011), Ahmed (2008), and Maysami and Koh (2000). These studies consider exports as an important determinant of stock market prices.

Capital Flows

Capital flows and stock market prices are expected to be positively related to each other, but the direction of causality is a subject matter of empirical results. Generally, a bi-directional causality exists between capital inflows (in the form of FII or FDI) and stock market performance. Pandit (2015), Chakravarty and Mitra (2013), Hiremath and Narayan (2016), Asaolu and Ogunmuyiwa (2011), and Ahmed (2008) documented capital flows as one of the major determinants of stock prices.

Foreign Stock Prices

The globalized world has accelerated the integration of world financial markets. Price fluctuations in one market can spread easily and instantly to another market. Several studies examined co-movements across various stock markets. These studies are based on the relationship between co-movements of international stock prices and portfolio diversification benefits, on the premise that the higher the correlation among stock markets, the lower the benefits from global portfolio diversification and vice-versa. Meric et al. (2011), Aksoy et al. (2011), Modi et al. (2010), and Kaur (2004) found significant and positive linkages between the Indian and the US stock markets, where the direction of causality was observed from the US to India. These studies provided us with reasonable grounds to assert that the US stock market leads the Indian stock market.

To summarize, many studies identify macroeconomic factors affecting stock prices. One class of literature studies macroeconomic factors, such as GDP/GNP, money supply, interest rates, exports, inflation, exchange rates, etc., as factors determining stock market movements. Another set of studies focuses on co-movements and dynamic linkages among international markets. The present study focuses on the correlations among international markets, benefits from global portfolio diversification, and the domestic factors that can potentially affect stock market prices.

Empirical Framework

Based on the available literature, theoretical background, and empirical estimates, this paper churns out a set of plausible determinants of Indian stock prices. The paper analyzes the impact of economic activity, interest rate, money supply, inflation, exchange rate, capital flows, international trade performance, and global financial environment on the Indian stock market (See equation 1). Based on various theoretical and empirical studies, the expected signs of the determinants are summarized in Table 1.

Table 1. ***Expected Signs of the Variables with Stock Price Index***

Variables	*s&p*	*o*	*m*	π	*i*	*e*	*x*	*k*
Expected Signs	+	+	+	–	–	+/–	+/–	+

$$bsesx = f(o, i, \pi, m, e, k, x, s\&p) \qquad (1)$$

i.e.

$$bsesx_t = \alpha + \beta_1 o_t + \beta_2 i_t + \beta_3 \pi_t + \beta_4 m + \beta_5 e_t + \beta_6 k_t + \beta_7 x_t + \delta\, s\&p_t + \mu_t \qquad (2)$$

where,
bsesx = BSE-Sensex index (representing Indian stock prices),
o = level of economic activity,
i = interest rate,
π = inflation,
m = money supply,
e = exchange rate,
k = capital flows,
x = net exports,
s&p = S&P500 index (US stock price- representing global financial environment).

Methodology and Data

Unit Root Test and Cointegration Test

The methodology for the present study involves testing for the unit-roots first. The paper employs the Dickey-Fuller generalized least squares (DF-GLS) technique for testing the presence of unit roots. With nonstationary series, cointegration analysis can be used to examine whether there is any long-run relationship between the variables. Cointegration analysis becomes important for estimating error correction models (ECM). The concept of error correction explains the adjustment process between short-run disequilibrium and a desired long-run position. According to Engle and Granger (1987), if two variables are cointegrated, then an error correction data-generating mechanism exists, and vice versa. Because cointegrated variables do not drift apart over time, this idea provides insight into the long-run relationship between two variables and provides the basis for the test of cointegration.

The method of the cointegrating VAR can be shown by the autoregressive representation, as shown in Equation 3 below :

$$Y_t = A_0 + \sum_{j=1}^{p} A_j\, Y_{t-j} + \varepsilon_t \qquad (3)$$

where, Y_t is an n*1 vector of nonstationary $I(1)$ variables, A_0 is an n*1 vector of constants, p is the number of lags, A_j is an n*n matrix of coefficients, and ε_t is assumed to be an n*1 vector of Gaussian error terms.

To use Johansen's test, the above vector autoregressive process can be re-parameterized and turned into a vector error correction model of the form:

$$\Delta Y_t = A_0 + \sum_{j=1}^{p-1} \Gamma_j\, \Delta Y_{t-j} + \Pi\, Y_{t-p} + \varepsilon_t \qquad (4)$$

where,

$\Gamma_j = -\sum_{i=j+1}^{p} A_j$ and

$\Pi = -I + \sum_{i=j+1}^{p} A_j$

Δ is the difference operator, and I is an n*n identity matrix. The test for the number of characteristic roots insignificantly different from unity can be conducted using two statistics, namely, the trace and the maximum eigenvalue test.

Vector Error Correction Model (VECM)

If a cointegrating relationship exists among two or more variables, these variables are said to have a long-run equilibrium relationship. The cointegrating relationship, on its own, sheds no light on short-run dynamics. However, its existence indicates that some short-run forces must be responsible for keeping the relationship intact. Thus, it should be possible to construct a more comprehensive model that combines short-run and long-run dynamics. A standard means of accomplishing this is formulating an error correction model (ECM), which is particularly appropriate for models involving nonstationary processes.

Variance Decomposition

Variance decomposition divides the forecast error variance into components that can be assigned to each endogenous variable. Specifically, it allows for a split of the variance of variable *i*'s *n*-step ahead forecast errors, which is accounted for by variable *j* innovations in the VAR. The generalized variance decompositions are examined instead of the orthogonalized forecast error variance decompositions. The advantage of using the generalized version of variance decomposition is that orthogonalized variance decompositions depend on the ordering of the variables. The generalized error variance decompositions can add up to more or less than 100% depending on the strength of the covariances between the different errors.

Impulse Response Function

The impulse response function (IRF) measures the time profile of the shocks' effect on the future states of a dynamic system. It traces the effect of a one standard deviation change in exogenous variables on the current and future values of all the endogenous variables. Instead of the orthogonalized impulse responses, the generalized impulse responses are investigated as the latter does not depend on the ordering of the variables.

Granger Causality

Granger causality can also be tested using the VECM framework. For example, if two variables are cointegrated or share a common stochastic trend, Granger causality must exist in at least one direction. The Granger causality test also determines whether one variable can improve another's forecasting performance and, hence, the model's predictive ability.

Data

The present study uses monthly data of BSE-Sensex and S&P500 (US stock prices) along with other macroeconomic variables for the period starting from April 2005 to April 2024. The definitions of each variable used in this study are listed in Table 3. All the variables have been used in their natural logarithmic form except rates and ratios. Total capital flows (k) and net export (x) series have negative observations; hence, their logarithms are not defined.

Empirical Results

Tests for Non-Stationarity and Cointegration

Table 2 shows that stock prices in India and USA are positively correlated, having a high degree of correlation. Hence, this integration of domestic and global stock indices is further tested for using econometric techniques. As per unit root tests using the DF-GLS technique, all the variables except total capital flows are found to be nonstationary (at levels) and stationary at the first difference (see Table 4). In the case of the DF-GLS test, none of the null hypotheses of nonstationary variables get rejected because all the observed statistic values are less than the critical values in absolute terms (except total capital flows). Hence, the inference can be drawn that all the variables are $I(1)$, i.e., integrated of order one, while the total capital flows variable is $I(0)$.

To apply the Johansen cointegration test, all variables to be included to run the model must be $I(1)$. So, k, *crdum* (dummy used for global financial crisis), and *cordum* (dummy used for Covid-19 pandemic) are taken as $I(0)$ exogenous variables in the model. For the model given in equation 1, both the maximum eigenvalue and trace test statistics reject the null hypothesis that there is no cointegration between the variables but do not reject the

Table 2. ***Correlation Matrix***

Estimated Correlation Matrix of Variables									
	bsesx	***e***	***o***	***m***	***i***	***k***	***x***	***s&p***	π
bsesx	1.00								
e	0.90	1.00							
o	0.90	0.77	1.00						
m	0.97	0.97	0.86	1.00					
I	–0.42	–0.43	–0.34	–0.45	1.00				
k	0.06	0.01	0.04	0.05	–0.05	1.00			
x	–0.66	–0.56	–0.62	–0.63	–0.05	–0.03	1.00		
s&p	0.98	0.90	0.87	0.96	–0.49	0.02	–0.57	1.00	
π	–0.06	–0.25	0.04	–0.14	0.18	–0.17	–0.22	–0.05	1.00

Table 3. ***Data Definitions and Sources***

Variable	Definition	Source
bsesx	BSE SENSEX index: A free-float market-weighted stock market index of 30 well-established and financially sound companies listed on the Bombay Stock Exchange, November 1995 = 100.	www.bseindia.com
s&p	S&P 500 index (USA) (average values of every month, November 1995 = 1,000). The S&P 500 index is based on the market capitalizations of 500 large companies with common stocks listed on the NYSE or NASDAQ.	www.ceicdata.com
m	The broad measure of money supply in India (M3).	www. data.rbi.org.in
o	Index of industrial production of India seasonally adjusted using Census X12.	www.mospi.nic.in
π	WPI-based Inflation: The wholesale price index is a monthly index that measures changes in prices of goods before the retail level.	www.mospi.nic.in
e	Indian rupee/US dollar spot exchange rate.	www. data.rbi.org.in
k	Total capital flows are defined by the sum of two components - FDI and FII.	www. data.rbi.org.in, and www.nsdl.co.in
x	India's total exports net of imports.	www. data.rbi.org.in
i	10-year government bond benchmark yield.	www. data.rbi.org.in
CRDum	The 2008 global financial recession dummy takes a value of 1 from December 2007 to March 2009, 0 otherwise.	
CorDum	2020 COVID'2019 dummy, which takes a value of 1 for February 2020 and March 2020, 0 otherwise.	

Table 4. ***Unit Root Test***

Elliott-Rothenberg-Stock DF-GLS test statistic
(Lag length by AIC, Trend, and intercept included in the equation)

Variable	DF-GLS Statistic		Inference
	At level	At First difference	
bsesx	–1.979649	–4.507929	*I*(1)
s&p	–1.555275	–13.56096	*I*(1)
o	–2.709562	–13.12718	*I*(1)
π	–1.817130	–3.446494	*I*(1)
I	–2.562614	–9.336519	*I*(1)
m	–1.764348	–4.008345	*I*(1)
e	–2.410579	–13.97878	*I*(1)
x	–3.180618	–11.97693	*I*(1)
k	–10.0111	–	*I*(0)

Note. Cointegration with unrestricted intercepts and no trends in the VAR (Order = 2).

List of variables included in the cointegrating vector: *bsesx*, *s&p*, *o*, π, *i*, *m*, *e*, *x*.

List of unrestricted deterministic variables included in the VAR: *k CRDUM* (2008 crisis dummy) *CORDUM* (2020 COVID dummy).

hypothesis that there is one cointegrating relationship between the variables at a 5% significance level (see Tables 5 and 6).

Table 5. *Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix*

Null	Alternative	Statistic	95% Critical Value
r = 0	*r* = 1	56.5976	46.09
r <= 1	*r* = 2	35.2218	39.8500
r <= 2	*r* = 3	31.9180	33.8700
r <= 3	*r* = 4	23.5428	27.75
r <= 4	*r* = 5	14.9872	21.07
r <= 5	*r* = 6	2.3002	14.35

Table 6. *Cointegration LR Test Based on Trace of the Stochastic Matrix*

Null	Alternative	Statistic	95% Critical Value
r = 0	*r* >= 1	169.9748	122.78
r <= 1	*r* >= 2	113.3773	92.42
r <= 2	*r* >= 3	62.7482	68.06
r <= 3	*r* >= 4	40.8302	46.44
r <= 4	*r* >= 5	17.2874	28.42
r <= 5	*r* = 6	2.3002	14.35

Table 7. *Cointegrating Vector (Normalized Values)*

Model: bsesx = *f* (*s&p, o, m, i, π, e, x, k*)

(*k* is *I*(0) variable)

bsesx	***s&p***	***o***	***π***	***m***	***i***	***e***	***x***
	0.0805	2.6229	–0.0097	0.0995	–0.0380	0.1843	0.0044

The cointegrating vector (normalized with respect to *bsesx*) is reported (Table 7). It suggests that *bsesx* is positively cointegrated with the S&P500 index, index of industrial production, money supply, net exports, and exchange rate and negatively cointegrated with WPI inflation and interest rate. These signs are theoretically plausible and conform to the discussion about the impact of different macroeconomic variables on stock prices in this paper. The values in the cointegrating vector show long-term elasticities (Maysami & Koh, 2000).

The cointegrating equation (Normalised with respect to the Indian stock price index) can be written as:

$$bsesx_t = 0.0805\, s\&p_t + 2.6229\, o_t - 0.0097\, \pi_t + 0.0995 m_t - 0.0380\, i_t + 0.1843\, e_t + 0.0044\, x_t \qquad (5)$$

In addition, one must confirm whether this long-run cointegrating relationship is stable. One way to do this is by using an error correction model (ECM). So, the next step is to find a stable and significant error correction mechanism. Since we are only interested in the impact of macro forces on Indian stock prices, we will construct an error correction model keeping only Indian stock price (BSE-Sensex) as the dependent variable on OLS-based ECM.

Error Correction Model

As shown in Table 8, the error correction term is negative, less than one, and significant. The sign and magnitude

Table 8. ***Error Correction Model***

ECM for variable *bsesx* estimated by OLS based on cointegrating VAR(2). The dependent variable is *dbsesx.*			
Regressor	**Coefficient**	**Standard Error**	***T*-Ratio[Prob]**
Intercept	–0.43544	0.097332	–4.4737[0.000]
dLBSE1	–0.11661	0.079502	–1.4667[0.144]
dLSP5001	–0.047780	0.10489	–0.45550[0.649]
dWPI1	–0.0055776	0.0033761	–1.6521[0.100]
dYGSEC11	0.0079618	0.0097932	0.81300[0.417]
dLIIPD1	–0.12027	0.068171	–1.7642[0.079]
dLER1	–0.17207	0.19440	–0.88515[0.377]
dLM31	0.35142	0.34787	1.0102[0.314]
dTB11	0.00019	0.00111	0.17518[0.861]
ecm1(–1)	–0.085756	0.019445	–4.4101[0.000]
TKF1	0.0061763	0.00107	5.7660[0.000]
CRDUM	–0.082192	0.014961	–5.4937[0.000]
CORDUM	–0.16258	0.038634	–4.2083[0.000]

of the error correction term indicate a stable error (or a short-term shock) that eventually converges to the long-run equilibrium whenever there is a deviation from the short-run equilibrium level. Both the dummies were also found to be highly significant and had a negative impact on stock market returns.

Generalized Variance Decompositions and Impulse Response Functions

This paper conducts a transfer analysis to investigate the relative importance of the impact of each of these variables on the Indian stock market. The dynamic interactions of various shocks are examined using the impulse response functions and variance decompositions. Variance decomposition analysis measures the proportion of the forecast error variance in the BSE-Sensex explained by shocks given to its determinants, such as the S&P500 index, inflation, interest rate, rupee-dollar exchange rate, and export-given capital flows.

Table 9 provides the variance decompositions in percentage terms for 1, 6, 12, 18, and 24 months. At a forecast horizon of 24 months, about 49% of the forecast error variance in BSE-Sensex remains unexplained with its momentum. This may be seen as the non-systematic and purely random variations in the BSE-Sensex index. Results show that the index of industrial production, global financial environment, exchange rate, and net exports are the three most important determinants of the Indian stock market. The determinants of the Indian stock market

Table 9. ***Generalized Error Variance Decomposition***

Horizon	***bsesx***	***s&p***	π	***i***	***o***	***e***
1	65.79	16.87	0.28	0.25	1.81	14.99
6	56.22	13.73	1.15	0.36	15.31	13.22
12	51.55	12.75	1.41	0.42	22.02	11.85
18	49.76	12.39	1.50	0.45	24.58	11.32
24	48.87	12.22	1.55	0.46	25.85	11.05

Table 10. *Granger Causality Test*

Model: *bsesx* = *f* (*s&p, o, m, i,* π*, e, x, k*)			
Null	**Lags**	**CHSQ(2)**	**Inference**
$bsesx_t$ is not Granger, Granger caused by $s\&p_t$	1	29.01[0.000]	Reject null hypothesis
$bsesx_t$ is not Granger, Granger caused by o_t	1	19.55[0.000]	Reject null hypothesis
$bsesx_t$ is not Granger, Granger caused by m_t	1	21.69[0.000]	Reject null hypothesis
$bsesx_t$ is not Granger, Granger caused by i_t	1	19.78[0.000]	Reject null hypothesis
$bsesx_t$ is not Granger, Granger caused by π_t	1	21.17[0.000]	Reject null hypothesis
$bsesx_t$ is not Granger, Granger caused by e_t	1	20.05[0.000]	Reject null hypothesis
$bsesx_t$ is not Granger, Granger caused by x_t	1	19.45[0.000]	Reject null hypothesis
$bsesx_t$ is not Granger, Granger caused by k_t	1	5.667[0.000]*	Reject null hypothesis

Note. *t- statistics from the error correction model.

in descending order of importance could be—the index of industrial production, global financial environment, exchange rate, inflation, and interest rates. Hence, investors and policymakers must keep a close eye on exchange rate movements and the US stock market index to track the performance of the Indian stock market because these are the most important determinants of Indian stock markets.

Further, impulse response functions (IRF) determine the time the dependent variable takes to stabilize after a disturbance caused by one standard deviation shock in any of the endogenous variables. For example, IRF for the effect of a shock in US stock prices on Indian stock prices reveals that the latter takes around three months to revert to its normal momentum after a disturbance caused by one standard shock in US stock prices. Similarly, one can interpret other impulse response functions in the same manner[4]. All the impulse response functions suggest that the Indian stock price reverts to its natural momentum within three to four months. Lastly, the results on Granger causality (see Table 10) show that all determinants significantly Granger cause the Indian stock market prices and also provide a justification for them to be included in the model.

Conclusion

This paper investigates the long-term determinants of Indian stock prices using monthly data from April 2005 to April 2024. Johansen's cointegration and vector error correction techniques are employed to avoid potential misspecification biases arising from standard OLS and conventional autoregressive techniques. The study also investigates the patterns of short-run dynamic linkages among Indian stock prices and key macroeconomic indicators (including US stock market movements). It examines the nature of causal relationships among variables using standard time series techniques like the error correction model, impulse response functions, forecast error variance decompositions, and Granger causality.

The empirical results show a significant long-term equilibrium relationship (cointegration) between Indian stock market performance and industrial production, inflation, interest rate, rupee-dollar exchange rate, net exports, money supply, total capital flows, and global financial market performance. The signs in the cointegrating vector are consistent with a theoretical understanding of the relationship among variables. Estimates of the error correction model (ECM) show that the estimated long-run relation is stable and significant. The results of generalized variance decompositions suggest that domestic industrial production, exchange rate movements, and the global financial environment are the most important determinants of the Indian stock market. This

[4] IRF is not presented here for brevity. The results can be produced by the authors upon request.

suggests that both domestic and global factors play a significant role in affecting the Indian stock market prices. Policymakers and other stakeholders may need to consider these macroeconomic fundamentals and the global financial environment when formulating policies and strategies. The study's findings may have important policy implications because they could be crucial for areas such as the design of stabilization and adjustment programs. This research may prove to be significant in explaining and possibly forecasting the direction of Indian stock market prices with respect to internal and external shocks.

Limitations of the Study and the Way Forward

This study was conducted to analyze the determinants of the stock market in the Indian economy for the period from April 2005 to April 2024. The period was chosen to accommodate the missing observations for some of the variables in the historical past. Since stock markets are affected by international and domestic events, the use of empirical models developed for forecasting purposes is challenging and would have to be evaluated for the efficacy and accuracy of stock market forecasting.

Authors' Contribution

Mr. Neeraj Kumar conceived the idea and developed the empirical model to undertake the empirical study. Mr. Neeraj Kumar and Dr. Deepika Goel surveyed the literature to arrive at the final variables that could be included in the model. Dr. Deepika Goel collected the data and carried out empirical estimations to fulfill the research objective. The econometric estimations were done using Eview 12 and Microfit 5.0. Mr. Neeraj Kumar and Dr. Deepika Goel finally compiled the material together and produced the draft of the work.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter, or materials discussed in this manuscript.

Funding Acknowledgement

The authors received no financial support for the research, authorship, and/or for the publication of this article.

Acknowledgement

The authors wish to thank Prof. Pami Dua, Former Director and Senior Professor at the Delhi School of Economics, for her valuable insights and guidance for the work.

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About the Authors

Mr. Neeraj Kumar, a member of the Indian Economic Service (2013 batch), is currently Joint Director at the Ministry of Finance. He handles sovereign debt issues, negotiating within the G20 Common Framework and the Paris Club. Neeraj also manages high-level bilateral dialogues and previously contributed to significant securities market reforms. He holds an M.Phil in Economics from the Delhi School of Economics.

Dr. Deepika Goel is currently teaching as an Associate Professor at the Department of Economics at Aryabhatta College, University of Delhi. She has 25 years of experience teaching undergraduate courses at the University of Delhi. She completed her M.A., M.Phil., and Doctorate from the Department of Economics at the Delhi School of Economics. Her area of research involves macroeconometrics, time series, and forecasting.