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CAUSAL ANALYSIS OF STOCK PRICES AND MACROECONOMIC VARIABLES: EVIDENCE FROM INDIAN STOCK MARKET

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ABSTRACT

Macroeconomic factors play a major role in shaping the capital markets of both developed and developing countries. The present study has been undertaken to evaluate the causal relationships between the stock prices represented by the NIFTY 200 monthly closing index prices and macroeconomic variables namely inflation, money supply growth, interest rates, exchange rates and foreign institutional investments both for the short-run and the long-run. The autoregressive distributed lag (ARDL) model has been used in the study to determine the causal relationships between the selected macroeconomic variables and Indian stock prices from 2010 to 2020. The findings of the study indicate that in the long run, the macroeconomic variables have an insignificant impact on stock prices. In the short run, however, inflation and foreign portfolio investments have a positive impact on stock prices, while exchange rates have a negative impact on stock prices.

Contribution/Originality: Our study focuses on the NIFTY 200 index, which is an important but less frequently covered indicator of the Indian economy. Our study also makes use of the panel ARDL methodology, which is a less frequently used technique, to study the impact of macroeconomic variables on this particular index.

1. INTRODUCTION

By channelizing the transfer of funds from surplus sectors of the economy to the deficit sectors, the stock market plays a major role in developing the economy and the various industries in a country. The stock markets of emerging economies such as India tend to be more volatile compared to developed economies such as the US (Engle & Rangel, 2008). The equity markets of emerging economies such as India are affected by a magnitude of factors, which can be specific to a particular firm, an industry consisting of several firms, or maybe even the entire nation or region.

The Efficient Market Hypothesis, propounded by Fama (1970), states that current market prices incorporate the information brought about by the variation in different macroeconomic factors. Subsequent studies carried out by researchers on the Efficient Market Hypothesis have affirmed the influence of macroeconomic variables on stock prices (Fama & Schwert, 1977; Nelson, 1976). The Arbitrage Pricing Theory (APT), proposed by Ross (1976), provides a theoretical framework for linking macroeconomic variables and stock prices. The study by Chen, Roll, & Ross (1986) used the theoretical underpinnings of APT and determined the existence of a long-run relationship between stock prices and macroeconomic variables. Other studies covering the links between macroeconomic

variables and stock markets of different regions have found that stock market movement is correlated to varying degrees with the changes in the economic fundamentals (Cheung & Ng, 1998; Queku, Gyedu, & Carsamer, 2022). Since the equity markets of emerging economies are impacted by a multitude of factors, investors must evaluate the various potential economic factors at play and formulate their expectations accordingly about the stock markets. Investors can evaluate the stock market performance by utilizing a composite market index, such as the NIFTY 200, before committing funds for investment purposes. The market index serves as the basis for equity portfolio performance measurement and it also provides investors with the necessary insight to evaluate market trends taking place both in the past and in the present. For this study, the wholesale price index, growth rate of money supply, short-term interest rates, exchange rates, and foreign institutional investments are the regressor variables and their impact on stock prices is determined. Instead of tracking how each individual company share performs in an economy, a stock market index has been chosen, as it is more convenient to keep track of. The NIFTY 200 index prices have been selected as the dependent variable for this study. The NIFTY 200 index was chosen because it accounts for about 86.7% of the free float market capitalization and 84.6% of all traded value on the National Stock Exchange, making it a very representative measure of the Indian capital markets.

The structure for the remaining article is divided into five sections. Section 2 covers the review of literature and the formulation of hypotheses of the current topic; Section 3 deals with the objective of the current study; Section 4 covers the data and methodology used to obtain empirical results; Section 5 presents the results of the study and their interpretation through the application of statistical techniques; and Section 6 concludes the study.

2. REVIEW OF LITERATURE AND HYPOTHESES FORMULATION

2.1. Literature on Inflation, Industrial Production, Money Supply and Stock Prices

Fama & Schwert (1977) determined that stock prices are negatively related to inflation. Their findings were supported by the research done by Fama (1981); Geske & Roll (1983); Kaul (1990); Liu & Shrestha (2008) and Chandrashekar, Sakthivel, Sampath, & Chittedi (2018), who determined a negative relationship between stock returns and inflation. In contrast to findings of these studies, Abdullah & Hayworth (1993) demonstrated that US stock returns were positively related with inflation and money growth. Kumari (2011) found that there was no significant relationship between Indian stock returns and inflation. Hashemzadeh & Taylor (1988) found bi-directional causality between US stock prices and money supply. Researchers have determined that narrow money supply (M1) had a short- and long-run equilibrium relationship with stock prices, while broad money supply (M3) impacted stock returns only in the long run (Cheung & Ng, 1998; Fifield, Power, & Sinclair, 2002; Flannery & Protopapadakis, 2002; Mookerjee & Yu, 1997; Sahu & Pandey, 2020). Ibrahim & Yusoff (2001) determined that, in the short run, money supply positively affects Malaysian stock prices. In the long run, however, money supply negatively impacts stock prices. Adjasi (2009); Humpe & Macmillan (2009); Osamwonyi & Evbayiro-Osagie (2012) and Gupta & Reid (2013) determined that stock prices in their respective regions were influenced negatively by money supply. Wickremasinghe (2011) noted that narrow money (M1) influences the Sri Lankan stock prices for the long run only. Celebi & Hönig (2019) determined that during the periods of financial crisis, lagged values of broad money supply negatively impacted German stock prices, whereas lagged narrow money supply displayed a positive impact on stock prices. In the post-crisis period, however, narrow money supply showed a negligible impact on stock prices.

The following hypotheses have been formulated for research:

H_{0A}: Inflation has no significant impact on stock prices.

H_{0B}: Growth in money supply has no significant impact on stock prices.

2.2. Literature on Exchange Rates, Interest Rates and Stock Prices

Wasserfallen (1989) found that interest rates have an overall negative effect on the stock markets of Western European countries. These findings are supported by Mok (1993), who determined that there was sporadic

unidirectional and negative causality from Hong Kong stock prices to interest rates. They also determined a weak bi-directional and positive causality between the stock prices and the exchange rates. Similarly, Gjerde & Saettem (1999); Ibrahim (1999); Nasseh & Strauss (2000); Hondroyiannis & Papapetrou (2001); Al-Tamimi, Alwan, & Abdel Rahman (2011) and Khan, Teng, Pervaiz, & Chaudhary (2017) determined that interest rates have a negative influence on the stock prices of their respective regions. In contrast to other studies, Campbell & Ammer (1993) found that interest rates are not the principal driving force in determining stock returns. Erdem, Arslan, & Sema Erdem (2005) found that interest rates have a unidirectional and positive influence on the Istanbul stock price indexes with the exception of the services index. These findings are similar to Parab & Reddy (2020) and Chang, Bhutto, Turi, Hashmi, & Gohar (2021), who determined that interest rates have a positive impact on stock prices. Tsoukalas (2003) determined the presence of a strong causal relationship between the Cypriot stock prices and exchange rates. He reasoned that since import sector services play a vital role in the Cypriot economy, these sectors tend to be highly influenced by the exchange rates. Narayan (2009) determined that a positive relationship exists between the US dollar to Indian rupee exchange rate and Indian stock returns. Joshi & Giri (2015); Khan, Tantisantiwong, Fifield, & Power (2015) and Megaravalli & Sampagnaro (2018) determined that exchange rates have a positive influence on stock prices. In contrast to these findings, Bhattacharjee & Das (2020) and Irani, Athari, & Hadood (2021) determined that stock prices negatively react to the exchange rate.

The following hypotheses have been formulated for research:

H_{0C}: Short-term interest rates have no significant impact on stock prices.

H_{0D}: Exchange rates have no significant impact on stock prices.

2.3. Literature on Foreign Institutional Investments and Stock Prices

Brennan & Cao (1997) reported a positive effect of foreign institutional investment (FII) inflows on equity returns both in developed and emerging markets. These findings are supported by Choe, Kho, & Stulz (1999), who studied the impact of foreign investments on stock returns in South Korea and determined that there was positive impact from FIIs on the South Korean economy before the Asian financial crisis but not after the crisis. Lin & Chen (2006) studied the effect of qualified foreign institutional investors' (QFIIs) investment transactions on Taiwan's stock market.

They determined that high holdings stocks tended to perform significantly better compared to low holdings stocks. They also noted that QFIIs had a better investment performance during the post liberalization period compared to the pre-liberalization period. Similarly, Jain, Meena, & Mathur (2012); Mishra & Singh (2012); Joo & Mir (2014); Wadhwa (2015); Bayar (2017) and Jena, Tiwari, Hammoudeh, & Shahbaz (2020) found that FII inflows had a positive effect on equity returns in different equity markets. In contrast to the above findings, a negative effect of FII inflows on stock prices was reported by Singh & Weisse (1998). This is supported by the findings of Garg & Bodla (2011) and Arora (2016), who found that foreign institutional investments have a negative relationship with returns of the Indian stock market. Misra (2012) determined that monthly FII and stock price data did not indicate causality running from any direction.

However, when daily data was analyzed, it revealed that FII flows were guided by market returns in both bear and bull phases. Institutional investors were influential in determining stock returns only after the market crash of 2008 and did not appear to have any such impact before the crisis (Mukherjee & Roy, 2016). Vardhan & Sinha (2016) explained that foreign institutional investments are influenced mainly by the returns from the domestic equity market and by changes in the exchange rates.

Based on the above, the following hypothesis has been formulated for research:

H_{0E}: Foreign institutional investments have no significant impact on stock prices.

3. OBJECTIVE OF THE STUDY

The current study objective is to investigate the long-run and short-run causal relationships that may exist between the six explanatory macroeconomic variables and the dependent variable, which comprises the NIFTY 200 closing index prices, for the period April 2010 to April 2020.

4. DATA AND METHODOLOGY

The data consists of monthly time-series data of the variables, such as inflation, industrial production, treasury bill rate, growth in money supply, exchange rate and investments from foreign institutions, and NIFTY 200 Index prices covering a 10-year study period from April 2010 to April 2020. The data for the wholesale price index and the industrial production index were collected from the official government websites. The data for the implied yield from 91-day T-Bills, USD/INR exchange rates, and broad money supply (M3) were extracted from the Reserve Bank of India (RBI) website. Information related to foreign institutional investments was obtained from the Central Depository Services Ltd. (CDSL) website. The average monthly closing values of the NIFTY 200 Index were collected from the National Stock Exchange website and are used to represent the stock prices. The information regarding all these variables is given in Table 1.

It should also be noted that the variables for stock prices, wholesale price index and exchange rates were transformed into their respective natural logarithmic values. This is done to reduce the sharpness of the data and also to help with the measurement of the long-run and short-run elasticities. The other variables were left in the level format.

Table 1. Variables used in the study.

Dependent Variable	**Description of Data**	**Symbol**
Stock Prices	The average monthly closing prices of the NIFTY 200 Index were chosen for the study.	MP
Independent Variable	Description of Data	Symbol
Wholesale Price Index	The Wholesale Price Index indicates the average price change for goods and services in a region and is often used as a proxy for a country's level of inflation.	WPI
Growth Rate of Broad Money	This measures how the money supply in the country changes from period to period. It is represented as follows: GMS = ΔMS/MS0*100 ΔMS = change in the broad money supply from period t-1 to t. MS0 = initial broad money supply.	GMS
Exchange Rate	The USD/INR exchange rate is used in the study.	ER
Foreign Institutional Investment Ratio	The foreign institutional investment ratio is defined as follows: FIIR = FIIP/FIIS If FIIR > 1, this indicates inflow of FIIs, and if FIIR < 1, this indicates an outflow of FIIs FIIP = Monthly purchase of FIIs FIIS = Monthly sales of FIIs	FIIR
91-Day Treasury Bills Yield	A proxy to the domestic short-term interest rate.	TBY

Time series stationarity is important, especially when it comes to drawing meaningful inferences from the selected datasets. For this study, the augmented Dickey–Fuller (ADF) test was utilized to determine the time series data stationarity.

The Johansen (1988) cointegration test is popularly employed in academic research for determining long-run relationships between variables. The Johansen cointegration test, however, can be used only if all the variables are integrated of the same order. Most time series data, which are of an economic and financial nature, do not tend to be integrated of the same order. The autoregressive distributed lag (ARDL) model suggested by Pesaran, Shin, & Smith (2001) can be used to solve this particular problem. The ARDL model can be employed to study the relationships for

the different study variables, which may be integrated of order zero, order one or a combination of the two orders. However, it is not applicable when the variables are integrated of order two.

For the present study, the Nifty 200 average monthly index prices are considered to be the dependent variable. The wholesale price index (proxy for inflation), growth in money supply (GMS), 91-day treasury bill yields (proxy for short-term interest rates), exchange rates, and foreign institutional investment ratio are the regressor variables. The ARDL specification for the present study is expressed by the following equation:

$$\Delta \ln MP_t = \alpha_0 + \sum_{i=0}^{p} \alpha_1 \Delta \ln MP_{t-i} + \sum_{i=0}^{q1} \alpha_2 \Delta \ln WPI_{t-i} + \sum_{i=0}^{q2} \alpha_3 \Delta GMS_{t-i} + \sum_{i=0}^{q3} \alpha_4 \Delta TBY_{t-i} + \sum_{i=0}^{q4} \alpha_5 \Delta \ln ER_{t-i} + \sum_{i=0}^{q5} \alpha_6 \Delta FIIR_{t-i} + \delta_1 \ln MP_{t-1} + \delta_2 \ln WPI_{t-1} + \delta_3 GMS_{t-1} + \delta_4 TBY_{t-1} + \delta_5 \ln ER_{t-1} + \delta_6 FIIR_{t-1} + \varepsilon_t \quad (1)$$

In Equation 1, P is the optimal lag length for the dependent variable, q_1 to q_5 are the optimal lag lengths for the regressor variables, Δ is the first difference operators, α_1 to α_7 are the short-run coefficients, and δ_1 to δ_6 are the long-run coefficients for the model.

The Akaike information criterion (AIC) estimator is used to select the optimal variable lag length for the model used in the study.

The F-statistics from the bounds test are used to determine whether the variables under study are cointegrated in the long-run. Once the existence of a long-run relationships is established, the ARDL model has to be reparametrized in order to obtain the Unrestricted Error Correction Model (UECM), which is used to determine the short-run dynamics of the model.

The ARDL-UECM is expressed as follows:

$$\Delta \ln MP_t = \alpha_0 + \sum_{i=0}^{p} \Delta \ln MP_{t-i} + \sum_{i=0}^{q1} \Delta \ln WPI_{t-i} + \sum_{i=0}^{q2} \Delta GMS_{t-i} + \sum_{i=0}^{q3} \Delta TBY_{t-i} + \sum_{i=0}^{q4} \Delta \ln ER_{t-i} + \sum_{i=0}^{q5} \Delta FIIR_{t-i} + \lambda ECT_{t-1} + \upsilon_t \quad (2)$$

In Equation 2, the model residuals obtained by solving Equation 1 are represented by the error correction term (ECT). The speed of adjustment for the model is represented by λ. A positive λ value signifies that long-run equilibrium does not exist since the study variables are moving further apart in the short run. If λ is negative, it means that the variables are coming closer together in each period and will ultimately lead to long-run convergence. This implies that the relationships among the variables can only be determined when the λ value is negative and statistically significant.

The reliability and stability of the ARDL-ECM results are verified by performing diagnostic and stability tests. The presence of serial correlation in the residuals is determined using the Breusch–Godfrey serial correlation Lagrange multiplier (LM) test. The problem of heteroscedasticity in the error terms is verified using the White test and the autoregressive conditional heteroscedasticity (ARCH) test. The Jarque–Bera (J–B) test is used to determine the normality of the residuals, the Ramsey RESET test is used to determine the model specification accuracy, and the cumulative sum of the recursive residuals (CUSUM) plot was used to determine model stability.

5. ANALYSIS AND INTERPRETATION

Descriptive statistics present the data in a suitable manner, which allows for better interpretation and understanding of the chosen data set. Table 2 shows the mean, maximum, minimum, and standard deviation values for all the variables considered for the study.

The results from Table 2 show a low value of standard deviation for both the dependent variable as well as the regressor variables. This indicates that the data are clustered around the mean, leading to low variability of the data. Table A1 shows a very high degree of correlation between the wholesale price index and exchange rates, which

suggests that multicollinearity might be a problem. However, Table A2 confirms that multicollinearity does not affect the study greatly as all of the explanatory variables have a variance inflation factor score of less than 10.

Table 2. Descriptive statistics (level variables).

Variable	Mean	Max.	Min.	Std. Dev.
lnMP	8.281	8.750	7.780	0.303
lnWPI	4.701	4.820	4.490	0.082
GMS	0.937	3.250	-2.040	0.765
TBY	7.203	11.430	3.610	1.350
lnER	4.098	4.330	3.790	0.151
FIIR	0.551	1.540	-0.990	0.969

It is important to identify the integration order for the different time series data to mitigate the chances of obtaining spurious results when applying different econometric techniques. The augmented Dickey–Fuller test was used to check whether the time series data had a unit root under the assumption of 'constant and linear trend'.

Table 3 presents the level and first difference results of the augmented Dickey–Fuller (ADF) stationarity test. The ADF test results indicate that the foreign institutional investment ratio (FIIR) and interest rates (TBY) are stationary at level series at a significance level of 1% and 5%, respectively. This indicates that foreign institutional investments and interest rates are integrated of the order I(0). At a significance level of 1%, stock prices (MP), inflation (WPI), money supply growth (GMS) and exchange rates (ER) are stationary at the first difference. This indicates that stock prices, inflation, money supply growth and exchange rates are integrated of the order I(1).

Table 3. Augmented Dickey–Fuller (ADF) stationarity test results.

Variable	ADF Test		Order of Integration
	Level	First Difference	
MP	-1.4917 (0.8273)	-9.4257* (0.0000)	I(1)
WPI	-2.3159 (0.4218)	-8.2159* (0.0000)	I(1)
GMS	-2.1557 (0.5089)	-8.3156* (0.0000)	I(1)
TBY	-4.034** (0.0101)	-8.8931* (0.0000)	I(0)
ER	-2.40168 (0.3768)	-8.2846* (0.0000)	I(1)
FIIR	-8.3636* (0.0000)	-13.1098* (0.0000)	I(0)

Notes: ( ) MacKinnon one-sided *p*-values; * Significant at 1%; ** Significant at 5%.

The results from Table 3 indicate that the variables are integrated of orders zero (I(0)) or one (I(1)), but not two (I(2)). This implies that the Johansen's test of cointegration cannot be applied in the study. Also, the vector error correction model cannot be used to determine the causal relationships between the equity prices and explanatory variables. To circumvent these problems, the autoregressive distributed lag (ARDL) model and the unrestricted error correction model are utilized to determine the relationships between the equity prices and the different macroeconomic variables.For the study, the ARDL bounds test is employed to uncover whether any relationships between the variables exist in the long run. The results of the F-Bounds test of cointegration between the variables are presented in Table 4.

The F-statistic values from Table 4 are shown to be greater than the upper bounds (I(1)) values, indicating that the null hypothesis of the cointegration test, which states that the variables are not cointegrated, is rejected at the 1% level of significance. This implies that the macroeconomic variables and the stock prices might share a long-run relationship.

Table 4. Results of the cointegration test (F-Bounds Test).

Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	5.7704*	10%	1.81	2.93
		5%	2.14	3.34
		2.5%	2.44	3.71
		1%	2.82	4.21

Notes: * Indicates statistical significance at 1%.

The results from the cointegration test suggest that long-run relationships might exist between the explanatory variables and the dependent variable. Next, the long-run elasticities of the macroeconomic variables need to be determined. The long-run elasticities show how the dependent variable (stock prices) reacts to the dynamism caused by the different regressor variables.

Table 5 displays the long-run coefficients for the regressor variables used in the ARDL model. The appropriate lag lengths chosen for the different economic variables are based on the Akaike information criterion.

Table 5. Estimated long-run coefficients using the ARDL approach.

Dependent Variable: lnMP				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
lnWPI	0.2635	1.0440	0.2524	0.8012
GMS	-0.0875	0.1012	-0.8644	0.3892
TBY	-0.0431	0.0655	-0.6575	0.5122
lnER	1.8054	1.1221	1.6089	0.1105
FIIR	0.3509	0.2133	1.6456	0.1027

The wholesale price index, which is a proxy for inflation, exchange rate and the foreign institutional investment ratio, have a positive but insignificant effect on the equity prices. On the other hand, money supply growth and the treasury bill yield, which are proxies for short-term interest rates, have a negative and insignificant effect on the equity prices. Thus, the results from Table 5 indicate that none of the regressor variables has a significant long-run relationship with the equity prices.

Table 6 shows the short-run elasticities for the ARDL model. Generally, in time series data, the long-run relationship between the variables tends to be stable, while the short-run relationships may be in disequilibrium.

In order to establish long-run equilibrium between the dependent variable and the regressor variables, it is important to observe a negative and statistically significant value for the error correction term. The error correction term helps determine the speed at which the dependent variable will achieve equilibrium in the long run. From Table 6, it can be observed that the error correction term is negative and statistically significant. This indicates that the previous period's disequilibrium will be corrected at a speed of adjustment of 5.78% to restore long-run equilibrium.

Table 6. Estimated short-run coefficients for selected ARDL model.

Variable	Coefficient	SE	t-statistic	Prob.
ΔlnWPI	0.7890	0.3811	2.0703**	0.0409
ΔGMS	-0.0011	0.0032	-0.3371	0.7367
ΔTBY	-0.0044	0.0059	-0.7413	0.4602
ΔlnER	-1.0086	0.1892	-5.3315*	0.0000
ΔFIIR	0.0122	0.0030	4.0421*	0.0001
ECT (-1)	-0.0578	0.0255	-2.2684**	0.0253
R-squared			0.5083	
Adjusted R-squared			0.4527	
F-statistic			9.1328	
Prob(F-statistic)			0.0000	

Notes: * and ** indicate statistical significance at 1% and 5%, respectively.

The results in Table 6 indicate that inflation, which is proxied by the wholesale price index (WPI), is significant at the 5% level of significance and has a positive slope coefficient. This implies that the null hypothesis (H_{0A}) of inflation having no effect on stock prices is rejected since inflation actually has a positive impact on the Indian capital markets in the short run. This finding is similar to Bhattarai & Joshi (2009), who determined a unidirectional positive relationship from inflation to Nepalese stock prices in the short run. Similarly, Hosseini, Ahmad, & Lai (2011) found that inflation had a positive impact on both Indian and Chinese stock prices. Also, Alam (2017) found that inflation and industrial production have a positive and significant influence on the Nifty and Sensex stock prices.

The growth in money supply has a negative but insignificant impact on the equity prices in the short run. This implies that the null hypothesis (H_{0B}) of money supply growth having no effect on stock prices fails to be rejected. Overall, money supply growth has no significant impact on the equity prices for both the long run and short run. The findings are supported by Ahmed (2008), who determined that money supply had insignificant causal links with Indian stock prices.

Similarly, the short-term interest rates, proxied by the 91-day treasury bill yield, have a negative but insignificant impact on the equity prices in the short run. This implies that the null hypothesis (H_{0C}) of short-term interest rates having no effect on stock prices fails to be rejected. Overall, short-term interest rates have no significant impact on the equity prices for both the long run and short run. The findings are line with Chirchir (2014) and Hussainey & Khanh (2009), who found that there is no significant causal relationship between interest rates and Kenyan and Vietnamese share prices, respectively.

The US dollar to Indian Rupee exchange rate was found to be significant at the 1% level of significance and has a negative coefficient of 1.0086. This indicates that an increase in US dollar vis-à-vis the Indian rupee by 1% will lead to a decrease in stock prices by 1%. This also implies that the null hypothesis (H_{0D}) of exchange rates having no effect on stock prices is rejected. This finding is in line with Fedorova & Pankratov (2010), who determined via the EGARCH model that the Russian stock exchange prices are negatively influenced by the US dollar exchange rate. Similarly, Ho & Odhiambo (2019) used the ARDL model to determine that exchange rates had a negative impact on the Hong Kong stock prices throughout the study period. Also, Bhattacharjee & Das (2020) determined that the Indian stock market negatively reacted to the US dollar to Indian rupee exchange rate both in the long run and the short run.

The foreign institutional investment ratio exhibited a positive and significant relationship with the equity prices at the 1% level of significance. This indicates that an increase in foreign institutional investments by one unit leads to an increase of 1.22% in the equity prices. This also implies that the null hypothesis (H_{0E}) of foreign institutional investments having no significant impact on stock prices is rejected. This finding is in line with Sureshm & Prabheesh (2008); Jain et al. (2012) and Shabbir & Muhammad (2019), who uncovered positive relationships between stock market returns and foreign institutional investments.

The results of the different diagnostic tests are presented in Table A3. The results of the Breusch–Godfrey Lagrange multiplier test for autocorrelation revealed that there is no serial correlation in the model. The results of the White and ARCH tests revealed that the error terms did not suffer from a heteroscedasticity problem and were independent of the regressor values. The results of the Jarque–Bera test indicate that the model residuals were normally distributed. The statistically insignificant F-statistic values for the Ramsey's RESET test revealed that the current model specification was correct. Finally, the CUSUM squares plot displayed in Figure 1 revealed that the ARDL-UEC model was stable and that the derivations of the long-run and short-run coefficients were correct.

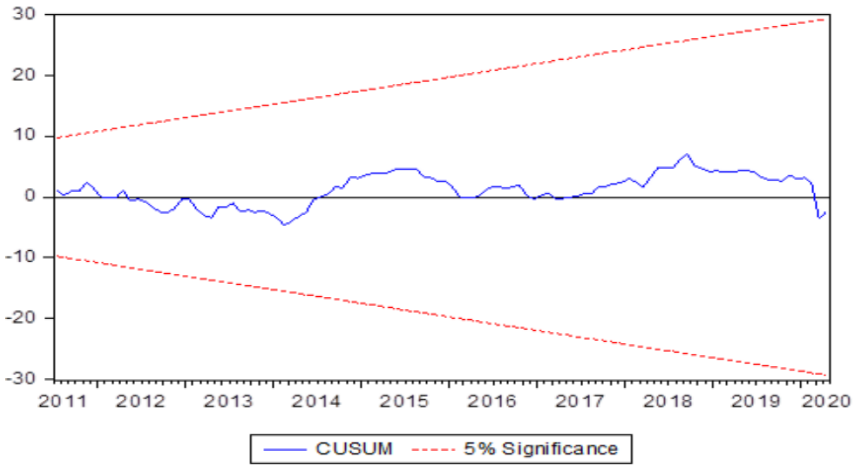

Figure 1. CUSUM test of model specification.

6. CONCLUSION AND DISCUSSION

The determination of which factors influence the stock prices the most is a matter of keen interest for various scholars in the field of finance. Early research concerning stock price determinants is limited because the stock price predictors were modeled in isolation from the macroeconomic factors. The early 1990s saw more and more countries embracing the free-market economy and macroeconomic factors became more prevalent in shaping the development of equity markets in various countries. The economies of these countries saw a great deal of liberalization and were more likely to be impacted by the macroeconomic factors. Keeping the changing economic conditions in mind, more and more researchers began to incorporate various macroeconomic factors into their modeling of various stock markets. With the above context in mind, the present study was undertaken to evaluate the causal relationships between the stock prices represented by the NIFTY 200 monthly closing index prices and the different macroeconomic variables, namely inflation, money supply growth, interest rates, exchange rates and foreign institutional investments, both for the short run and the long run.

The ARDL F-bounds cointegration test was utilized in the study because the different time series variables were shown to be integrated of different orders. The results from the cointegration test suggest that long-run relationships may exist between stock prices and the economic variables. The UECM was set up to establish long-run causality between the variables. The error correction term for the current model was observed to be negative and statistically significant. This shows that any disequilibrium occurring in the short-run gets corrected to restore long-run equilibrium.

The long-run elasticity analysis indicated that none of the macroeconomic regressor variables had a significant impact on stock prices during the period under study.

The results from the error correction model indicate that inflation and foreign portfolio investments have a positive impact on the Indian capital markets in the short run only. Exchange rates between the US Dollar and the Indian Rupee have a negative short-run impact on equity prices. Money supply growth and interest rates had no significant impact on Indian stock prices in both the short run and long run.

The research findings can help formulate certain implications. First, policy makers can use the findings from the study to get a better understanding of the different relationships between the macroeconomic variables and the stock prices and formulate policies accordingly. Policies focusing on keeping inflation under control and encouraging foreign institutional investments in the NIFTY 200 companies should be pursued, as the findings of the study revealed that these factors have a positive relationship with stock prices in the short term. Also, policies relating to keeping the US Dollar to Indian Rupee exchange rate in check should be followed as the exchange rates have been shown to have a negative impact on share prices in the short run. Second, the study results will allow prospective

investors to make long-term and short-term investment decisions when it comes to investing in stock indices, such as the NIFTY 200, given the constantly changing macroeconomic environment.

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APPENDIX

Table A1. Correlation matrix.

Variable	MP	WPI	IIP	GMS	TB	ER	FIIR
MP	1						
WPI	0.762**	1					
IIP	0.711**	0.589**	1				
GMS	-0.183*	-0.185*	-0.262**	1			
TB	-0.574**	-0.123	-0.239**	0.034	1		
ER	0.816**	0.908**	0.588**	-0.220*	-0.299**	1	
FIIR	-0.133	-0.083	-0.027	0.153	0.152	-0.202*	1

Notes: ** Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level.

Table A2. Variance inflation factor table.

Variable	VIF
ER	7.76
WPI	6.93
TB	1.28
FIIR	1.12
GMS	1.07
Mean VIF	3.63

Table A3. Diagnostic test results.

Diagnostic Test	Test Name	Test Statistic	Value	Prob.
Serial Correlation	Breusch–Godfrey LM test	Chi-square statistic	1.015	0.3136
Heteroskedasticity	White test	Chi-square statistic	97.60	0.0566
	ARCH test	F-statistic	0.2182	0.8043
Normality Test	Jarque–Bera Test	J-B statistic	2.1809	0.3361
Model Specification	Ramsey's RESET test	F-statistic	0.1338	0.7152