Co-integration and Causal Linkages between Foreign Exchange Rate and Stock Prices in India

Dr. Mohd. Asif Khan[1]
Dr. Mohammad Athar Noor[2]
Dr. Mohd Motasim Ali Khan[3]

Abstract

The broad objective of this study is to analyse the long term relationship and short term dynamic inter-linkages between Indian stock prices and foreign exchange rate. This paper is based on 10 years' daily data i.e. from 1 Jan 2010 to 31 Dec 2019 of nominal exchange rates of US Dollar, Euro and daily closing values of Nifty 50. In this study, Augmented Dickey-Fuller (ADF) is applied to test stationarity of data and it is found stationary at first difference. Karl Pearson correlation test is used to find the correlating relationship between the variables and it is found that both the variables are not correlated significantly. Johansen's co-integration test is applied to determine the long-run equilibrium relationship between the variables which revealed that there exists co-integration relationship (long-term balance) between the exchange rate and stock prices in India. Granger causality test is employed to determine the causality and short-term relationship between the variables and the result revealed unidirectional causality running from exchange rate to stock prices, which indicates that the volatility that occurred in the exchange rate will cause volatility in stock prices.

Keywords: *co-integration, causality, exchange rates, investment, stock prices*

[1] *Associate Professor, Department of Commerce, AMU, Aligarh, UP, India*
[2] *Research Associate, Department of Commerce, AMU, Aligarh, UP, India*
[3] *Research Assistant, Department of Commerce, AMU, Aligarh, UP, India*

Introduction

The issue of whether stock prices and exchange rates are related or not has received considerable attention after the East Asian crisis. During the crisis, the countries affected saw turmoil in both currency and stock markets. If stock prices and exchange rates are related, and the causation runs from exchange rates to stock prices, then the crisis in the stock markets can be prevented by controlling the exchange rates. Also, developing countries can exploit such a link to attract/stimulate foreign portfolio investment in their own countries. Similarly, if the causation runs from stock prices to exchange rates, then authorities can focus on domestic economic policies to stabilize the stock market. If the two markets/prices are related, then investors can use this information to predict the behaviour of one market using the information of the other market. Thus, we analyse the long-run relationship and short-term dynamic inter-linkages between Indian stock prices and foreign exchange. US Dollar and Euro have been used as a proxy of foreign exchange.

The findings of the study can be applied and generalised to various transitioning and emerging economies. Private equity investors and mutual fund managers can take appropriate decisions regarding their investments. The key findings of the present study will also be helpful to policymakers and regulators. The long-run relationship between the exchange rate and Indian stock prices is found to be negative, which implies that the government should take proper measures to strengthen the Indian currency in order to ensure the performance of the Indian stock market.

Numerous international studies were conducted which examined the relationship between stock market prices and foreign exchange rate. Some important studies are as follows: Franck and Young (1972) was the first study that examined the relationship between stock prices and exchange rates. They use six different exchange rates and found no relationship between these two financial variables. Ajayi and Mougoue (1996) show that an increase in aggregate domestic stock price has a negative short-run effect on domestic currency value, but in the long run, increases in stock prices have a positive effect on domestic currency value. However, currency depreciation has a negative short-run effect on the stock market.

Clive W.J Granger, Bwo-Nung Huang and Chin Wei Yang (1998) examined the causality issue using Granger causality tests and Impulse response function for nine Asian countries. They used daily data for the period January 3, 1986 to November 14, 1997. The countries included in their study are: Hong Kong, Indonesia, Japan, South Korea, Malaysia, Philippines, Singapore, Thailand and Taiwan. For Japan and Thailand, they found that exchange rates lead stock prices with positive correlation. The data from Taiwan suggests stock prices lead exchange rates with negative correlation. No relationship was found for Singapore and bi-directional causality was discovered for the remaining countries. Ibrahim and Aziz (2003) employed co-integration analysis and vector autoregression modelling. Authors used monthly data from January 1977 to August 1998. They investigated the interactions between Malaysian equity market and four macroeconomic variables - real output, price level, money supply and exchange rate. Their results show that unstable interactions exist between stock prices and exchange rates during the crisis period. Additionally, they revealed their doubt about whether the Asian crisis had changed the relationships among variables.

Charles et al. (2011) made a study to investigate the relationship between stock prices and exchange rate movement in seven African countries including Tunisia. They used vector error correction model (VECM) co-integration and impulse response analysis to determine the long and short-run linkages between stock prices and exchange rates. Co-integration analyses indicate a long-run relationship between stock prices and the exchange rate in Tunisia, where exchange rate depreciation drives down stock prices. A short-run error-correction model also shows similar results. Lu Sui, Lijuan Sun (2016) aimed to examine the dynamic relationship between local stock market returns and exchange rates in the BRICS zone (Brazil, Russia, India, China, and South Africa). The authors were able to find significant effects between exchange rates and stock market returns by the VAR model, suggesting that exchange rate volatility can affect the performance of a firm or an industrial sector. Thus, an appropriate exchange rate can stabilize the stock market, especially during a financial crisis.

Indian studies that examined the relationship between stock prices and foreign exchange

Granger, et al., (2000) examined the relationship between stock prices and exchange rate during January 1986-June 1998 and found that stock prices in India and exchange rate did not reveal any recognizable pattern of causality between those time series. Apte (2001) investigated the relationship between volatility of the stock market and the nominal exchange rate of India by using the EGARCH specifications on the daily closing USD/INR exchange rate, BSE 30 (SENSEX) and NSE 50 (NIFTY) for the period 1991 to 2000. The study suggested that there appears to be a spill-over from the foreign exchange market to the stock market, but not the reverse. Muhammed and Rasheed (2002) explored the interaction between stock prices and exchange rates for four South Asian countries - Bangladesh, Sri Lanka, India and Pakistan. They performed a co-integration test, error correction modelling and a Granger causality test for the time span between January 1994 and December 2000. However, they found no association between the variables for Pakistan and India while bidirectional long-run causality in the Bangladesh and Sri Lanka data is observed. They concluded that the variables are unrelated in the short run for the countries that they selected.

Bhattacharya and Mukherjee (2003) investigated Indian markets using the data on stock prices and macroeconomic aggregates in the foreign sector, including exchange rate, and concluded that there is no significant relationship between stock prices and exchange rates. Rahman et al; (2009) examined the interactions between BSE stock prices and exchange rates during January 2003-June 2008 by using Granger causality test and found that there was no causal relationship between stock prices and exchange rate. Agrawal, Kumar Srivastav and Srivastava (2010) applied Granger causality test to examine the dynamics between Nifty returns and the Indian Rupee-USD exchange rates, using daily data for the period between October 2007 to March 2009. Their results support unidirectional causality running from stock returns to exchange rates with a negative correlation.

Razvan Stefanescu and Ramona Dumitriu (2013) explored the influence of variations in foreign exchange rates on the returns and volatility of stock prices in the Romanian capital market for the period January 2000-December 2012. They concluded that influence of variations in foreign exchange rates on returns depend on various factors like capital inflows, perceptions of impact of global crises on the national economy, etc. Sinha et al., (2015) studied the effect of exchange rate for the period January 2006-March 2012 on BSE Sensex index, BSE Oil & Gas sector index and BSE IT sector index by using least square regression model and found negative and insignificant interactions between foreign exchange rate and stock returns.

Joshipura and Peswani (2018) studied stocks listed on National Stock Exchange (NSE) for the period January 1995 to April 2017. It provides evidence that in the Indian equity market, low risk anomaly and value effect, both exist. The universe of value stocks delivers higher excess returns than the universe of growth stocks. Low risk anomaly enhances the performance of a portfolio consisting of value stocks. Bhattacharjee and Das (2020) investigated the effect of macroeconomic variables on the Indian stock market. The study uses monthly time series data covering the period April 2005 to December 2019 and employs the

ADF unit root test, Johansen co-integration test, VECM, and Granger causality for data analysis. The results show that the macroeconomic variables are co-integrated with the stock prices suggesting the presence of a long-run relationship. The pairwise Granger causality test indicates that the exchange rate, money supply, and short-term interest rate granger cause stock prices.

Research Gap

Though there are a number of studies regarding the relationship between stock prices and exchange rates of developed countries, there are very few studies conducted for developing countries. Likewise, in the context of the Indian economy, few studies in this direction are available. However, the issue has been gaining importance in recent years. In India, though stock market investment does not constitute a very significant portion of total household savings compared to other forms of financial assets, it may have a significant impact on exchange rate movement as FII investment has played a dominant role. The results, however, are tentative and there is a need to undertake in-depth research to address the issue.

Empirical studies also provide contradictory evidence; for example, Ibrahim and Aziz (2003), Kim (2003) and Tian and Shiguang (2010) noted that there is essentially a long-term equilibrium relationship between stock price and exchange rate. On the other hand, Bahmani-Oskooee and Sohrabian (1992), Nieh and Leeb Chung (2001) and Smyth and Nandha (2003) argue that this relationship is merely short term. Mishra (2004) found that there is no causal relationship between returns on exchange rate and stock returns in India. A number of factors have influenced the results such as the methodologies used in these studies, the time period of the data and the context specific factors (countries' financial regulations and investor preferences and incentives). Due to these mixed results, there is need of an in-depth study to explore the real relationship between stock market and exchange rate by employing more sophisticated econometric tools. In this study, we attempt to explore the real relationship between the variables using latest 10-year data and advanced econometric tools.

Moreover, most studies took the US dollar as proxy for the foreign exchange; however, in this study, we take one more currency, the Euro, to study the impact of foreign exchange on stock prices at a wider level.

As far as methodology is concerned, most studies found causal linkages for the short term. They used Granger Causality econometric model. In this respect, our study is different as we also analyse long term relationship between both the variables using Johansen Co-integration econometric regression model. As per our best knowledge, there is no study in the Indian context which analyses lead and lag relationship between stock prices and foreign exchange. We have attempted to analyse this lead and lag relationship, if it occurs.

Thus, the above discussion gives rise to the following research questions:

1. Whether there exists long run relationship between stock prices and foreign exchange rate in India.
2. Whether there exist short term causal linkages between the two markets.

Data

We use 10 years' daily data i.e. from 1 Jan 2010 to 31 Dec 2019 of nominal exchange rates of US Dollar, Euro and daily closing values of Nifty 50, an index of Indian National Stock Exchange. US Dollar and Euro have been used as a proxy of foreign exchange. All the exchange rates are expressed in terms of local currency i.e. Indian rupee. We transform all the data series into natural log form to smooth the financial series.

Research Methodology

We use correlation test for measuring closeness of a linear relationship between variables. Then we conduct Unit Root Test since the stationary property of a series is the premise for other techniques. The co-integration test measures the relationships between Indian stock market and foreign exchange in the long run while Granger-causality is used to examine the short-term aspects. If co-integration is found, it means even if a set of variables are non-stationary, they never drift apart in the long run. In contrast, if they have a lack of co-integration, they have no long-run links.

Correlation Test

There are many possible measures of co-movement, and correlation is a standardized measure of closeness of a linear relationship between two variables. Correlation is computed into what is known as the correlation coefficient, which ranges between -1 and +1. Two variables that are perfectly positively correlated (a correlation coefficient of +1) move in tandem in the same direction, either up or down. In contrast, perfect negative correlation means that if one variable moves in one direction, the other variable that is perfectly negatively correlated will move by an equal amount in the opposite direction. Finding perfect positive or perfect negative correlations is rather unusual; most variables are correlated along the spectrum between more than -1 and less than 1. Two variables that have correlations coefficient of 0 are said to be uncorrelated. In terms of portfolio theory, the concept of correlation is useful if the returns of stock markets are negatively correlated, which stabilizes portfolio returns.

ADF Unit Root Test

Co-integration analysis requires that time series should be integrated of the same order. We will examine stationarity of time series by using unit root tests. We will employ Augmented Dickey-Fuller Test for the said purpose. The Augmented Dickey Fuller test examines the presence of a unit root in an autoregressive model. A simple AR (1) model is

$$\mathbf{y_t = \rho y_{t-1} + u_t,}$$

Where y_t is the variable of interest, t is the time index, ρ is a coefficient and u_t is the disturbance term. The regression model can be written as:

$$\mathbf{\Delta y_t = (\rho - 1) y_{t-1} + ut = \delta y_{t-1} + u_t,}$$

Where, Δ is the first difference operator. This model can be estimated and testing for a unit root is equivalent to testing δ = 0.

A financial time series is said to be integrated of one order, i.e., I (1), if it becomes stationary after differencing once. If two series are integrated of order one, they may have a linear combination that may be stationary without differencing. If the said condition fulfils, then these are called co-integrated.

Co-integration Test

Once we have determined that our series are integrated of the same order, we are ready to perform co-integration tests. Johansen-Juselius (JJ) (1990) test is used to find the co-integration vectors. It is based on the maximum likelihood estimation in a VAR model. If we have a set of g variables (g ≥ 2) which are integrated of first order I (1) and thought to be co-integrated, a VAR model with k lags containing these variables could be set up:

$$y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + \beta_k y_{t-k} + u_t$$

For Johansen test to be used, the above VAR needs to be transformed into a vector error correction model (VECM) of the following form:

$$\Delta y_t = \prod y_{t-k} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \ldots + \Gamma_{k-1} \Delta y_{t-(k-1)} + u_t$$

$$\text{where } \prod = (\sum_{i=1}^{k} \beta_i) - I_g \text{ and } \Gamma_i = (\sum_{j=1}^{i} \beta_j) - I_g$$

This VAR model contains g variables in first differenced form on the LHS, and k–1 lags of the dependent variables (differences) on the RHS, with a Γ coefficient matrix. As Johansen test can be affected by the lag length used in the VECM, it is important to select an optimal lag length.

Johansen test centres around an examination of the Π matrix. In equilibrium, all the Δy_{t-1} will be zero and assuming error terms, u_t, to be at its expected value of zero, we will have Γy_{t-k} =0. From this follows interpretation of Π as a long-run coefficient matrix. The test of co-integration between the variables is calculated by looking at the rank of the Π matrix through its Eigen values (characteristic roots). The number of Eigen values that are different from zero determines the rank of a matrix (Rec, 2009).

There are two test statistics for co-integration under Johansen methodology: trace statistic (λ_{trace}) and the Max-Eigen value statistic (λ_{max}). The test statistics are formulated in the following way:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{g}\ln(1+\hat{\lambda}_i) \text{ , and}$$

$$\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1})$$

Where *r* is the number of co-integrating vectors under the null hypothesis (*r*=0, 1, k-1), k represents number of variables in the system, T is the number of observations, and $\lambda_t\hat{}$ is the estimated value for the i^{th} ordered Eigen value (characteristic root) obtained from the estimated Π matrix. λ_{trace} is a joint test where the null hypothesis is that the number of co-integrating vectors is less than or equal to *r* against the alternative hypothesis that there are more than *r*. λ_{max} conducts separate tests on every Eigen value and the null hypothesis is that the number of co-integrating vectors is less than *r* against the alternative hypothesis that there is *r* + 1 (Rec, 2009).

Bivariate Co-integration Test

Bivariate Autoregressive process will indicate pair-wise co-integration in between the specified data set of series. This model will determine the level of long run relationship among two variables. This equation is used to know the long run effects of one variable on other variables for the specified study period.

$$Wt = K_0 + \sum_{i=1}^{n} K_i w_{t-i} + \sum_{i=1}^{n} \delta_i V_{t-i} + \varepsilon_t$$

$$U_t = L_0 + \sum_{i=1}^{n} L_i U_{t-i} + \sum_{i=1}^{n} f_i U_{t-i} + \varepsilon_t$$

W_t and U_t are the stationary series K_0 and L_0 constants

$$U_t = L_0 + \sum_{i=1}^{n} L_i U_{t-i} + \sum_{i=1}^{n} f_i U_{t-i} + \varepsilon_t$$

Granger Causality Analysis

According to representation of Granger theorem, if two variables are co-integrated, then there will be at least one direction or unidirectional granger causality must exist, which tends to the consequences to find the relationship by error correction model (ECM). Granger causality test is used to determine short term causality relation among variables and direction. So, employing pair-wise Granger causality test technique is helpful to identify each factor causal relationship. Lag is selected to get appropriate results which are user specified. If the time series variables are not stationary at I (0) and no co-integration exists among variables, then it would be converted by taking first difference I (1) and applied as follows:

$$Q_{prob}(W_{t+n} \mid \Theta_t = Q_{prob}(W_{t+n} \mid \omega_t)$$

Q prob is conditional probability, Θt information set at time t, on past values of W_{t+n} and ω_t information set containing values for both w_t and U_t for the t period. F test is considerable to testify the null hypothesis as follows:

$$F = \frac{RSSR - RSSUR/\ k\text{-}k0}{RSS/\ N\text{-}\ k}$$

If the F-Statistic exceeds the critical value at the selected level of significance, or p-value associated with the F=Statistic is less than 0.05, then the null hypothesis is rejected with reference to lagged variables relevant to regression. This will improve the causality or prediction relationship. Granger Causality model is proposed by C. W. J. Granger (1969) which is more predictive than causation. The test is used to determine the predictions of future based on past values.

Correlation Analysis

The correlation analysis is a basic and simple step to detect the direct relationship between the variables. It provides a preliminary verification for the presence of integration before other tests are conducted. It is a measure of how two random variables move in relation to each other. Table 1 presents correlation coefficients for close prices of Nifty 50, USD and EURO.

Table 1: Correlation Matrix

	NIFTY 50	USD	EURO
Nifty 50	1	0.162664	0.114382
USD	0.162664	1	0.788324
EURO	0.114382	0.788324	1

The correlation indices matrix in Table 1 show that Nifty 50 is not significantly correlated with USD as well as EURO which means variables are moving independently.

Table 2: ADF Unit Root Test

Variables	Augmented Dickey-Fuller Test Intercept with Trend			
	T Statistic		T Statistic	
	Level	Probability	1st Difference	Probability
L NIFTY 50	-0.887	0.792	-26.976	0
L USD	-1.119	0.710	-60.768	0
L EURO	-1.564	0.500	-61.888	0
Critical values of ADF test statistics for 1% and 5 % level of significance are -3.4385 and -2.86503 respectively.				

Table 2 shows the results of the Augmented Dickey-Fuller (ADF) test for the sample period. It reports that the log series of indices of blue chip companies are non-stationary at the level form as the absolute T statistic values are less than the absolute critical values at 1% and 5% level of significance. Moreover, p-values associated with their corresponding T-values are greater than 0.05. Hence, the null hypothesis of presence of a unit root in the series is accepted. However, they become stationary series in their first difference, as the absolute T statistic values are greater than the absolute critical values at 1% and 5% level of significance, rejecting the null hypothesis of a unit root. Thus, all of our data is integrated of order one i.e. I (1) as discussed in the Methodology section.

Bivariate Co-integration Analysis

We perform Johansen bivariate co-integration analysis to analyse the long run relationship between Nifty 50 and foreign exchange rate USD and EURO.

Table 3: Bivariate Co-integration Test for NIFTY 50 and USD

Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	Critical Value 0.05	Prob.**
None*	0.153	608.155	15.494	0.000
At most1	0.000	1.160	3.841	0.281
Trace test indicates no co-integration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 4: Bivariate Co-integration Test between NIFTY 50 and EURO

Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	Critical Value 0.05	Prob.**
None*	0.145	572.635	15.494	0.000
At most1	0.000	2.243	3.841	0.134
Trace test indicates no co-integration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 4 shows that the T-Statistic values are greater than the Critical value at 5% level of significance. Moreover, p-value is less than 0.05. We conclude that the variables are co-integrated with each other. As in case of USD, Nifty 50 has also long run relationship with EURO.

Granger Causality Test

Johansen co-integration analysis is able to determine whether the long-run relationship exists between two variables, whereas the Granger causality test helps in determining the short-term causation, although causation can run in both directions. According to representation theorem, if two variables are co-integrated, then Granger-causality must exist in at least one direction.

Table 5: Pair wise Granger Causality Analysis for pairs (NIFTY- USD) and (NIFTY- EURO)

Null Hypothesis:	F-Statistic	Prob.
USD does not Granger Cause NIFTY 50	93.239	8.E-22
NIFTY 50 does not Granger Cause USD	0.712	0.398
EURO does not Granger Cause NIFTY 50	44.819	2.E-11
NIFTY 50 does not Granger Cause EURO	0.165	0.684

Table 5 indicates the result of Pairwise Granger Causality test for (NIFTY- USD) and (NIFTY- EURO). We find that there is unidirectional casualty, running from USD, EURO to NIFTY as their corresponding p values are less than 0.05 which means that any change in USD and EURO affects stock prices of Nifty 50 in the short run. The result indicates that the variations that occur in the exchange rate will cause a variation in Indian stock prices. Therefore, USD and EURO work as a leading variable with reference to the Indian stock market.

Conclusion

Based on the results of research, we arrive at the following conclusions:

There is a co-integration relationship between the exchange rate and stock prices in India. This indicates that the exchange rate and stock prices in India have a relationship of balance and equality movement in the long run. In each period, the short term variable exchange rate and stock prices tend to mutually adjust to achieve its long-term equilibrium. Hence, for investment purposes, there is no portfolio diversification opportunity between the two markets. However, results of causality suggest that for short term period, there exist arbitrage opportunities for investors.

Moreover, there is unidirectional causal relationship between the exchange rate and stock prices in India, both short term and long term. This indicates that the variations that occur in the exchange rate will cause a variation in stock prices. If the exchange rate of the local currency strengthens, investors' interest to invest in Indian stock markets will rise, which, in turn, will result in rise in Indian stock indices.

Applicability and Generalizability

The findings of the study can be applied and generalised to various transitioning and emerging economies. Private equity investors and mutual fund managers can take appropriate decisions regarding their investments. The key findings of the present study will also be helpful to policymakers and regulators. The long-run relationship between the exchange rate and Indian stock prices is found to be negative, which implies that the government should take proper measures to strengthen the Indian currency in order to ensure the performance of the Indian stock market.

The understanding of the stock price-exchange rate relationship may prove helpful to foresee a crisis. Khalid and Kawai (2003) as well as Ito and Yuko (2004) among others, claim that the link between the stock and currency markets helped propagate the Asian Financial Crisis in 1997. It is believed that the sharp depreciation of the Thai baht triggered depreciation of other currencies in the region, which led to the collapse of the stock markets as well. Awareness about such a relationship between the two markets would trigger preventive action through different policies before the spread of a crisis.

This will benefit multinational corporations in managing their exposure to foreign contracts and exchange rate risk, thereby stabilizing their earnings. Currency is more often being included as an asset in the investment portfolios of different classes of investors such as FIIs, foreign investors, pension funds, banks, companies, and individual investors. Knowledge about the link between currency rates and other assets in a portfolio is vital for the performance of the fund. A better understanding of these movements of two markets enables them to make more informed investment and financing decisions. These investors can diversify their funds more efficiently which, in turn, can maximize their portfolio returns and minimise the risk.

References

- Abdalla, I. S., & Murinde, V. (1997). Exchange rate and stock price interactions in emerging financial markets: evidence on India, Korea, Pakistan and the Philippines. Applied Financial Economics, 7(1), 25-35.
- Aggarwal, R. (1981). 'Exchange rates and stock prices: A study of the US capital markets under floating exchange rates. Akron Business and Economic Review 12: 7-12.
- Agrawal, G., Srivastav, A. K., & Srivastava, A. (2010). A study of exchange rates movement and stock market volatility. International Journal of Business and Management, 5(12), 62-73.
- Ajayi, R. A., & Mougoué, M. (1996). On the dynamic relation between stock prices and exchange rates. Journal of Financial Research, 19(2), 193-207.
- Azman-Saini, W. N. W., Habibullah, M. S., Law, S. H., & Dayang-Afizzah, A. M. (2006). Stock prices, exchange rates and causality in Malaysia: A note. Munich Personal RePEc Archive, 653(3), 1-15.
- Bahmani-Oskooee, M., & Sohrabian, A. (1992). Stock prices and the effective exchange rate of the dollar. Applied Economics, 24(4), 459-464.
- Basher, S. A., Haug, A. A., & Sadorsky, P. (2012). Oil prices, exchange rates and emerging stock markets. Energy Economics, 34(1), 227-240.
- Bhattacharjee, Animesh, & Das, Joy. (2020). "Do Indian stock prices respond to domestic macroeconomic variables?" NMIMS Management Review XXXVIII, Issue 3, 55-71.
- Granger, C. W., Huang, B. N., & Yang, C. W. (2000). A bivariate causality between stock prices and exchange rates: evidence from recent Asian flu. The Quarterly Review of Economics and Finance, 40(3), 337-354.
- Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on co-integration with applications to the demand for money. Oxford Bulletin of Economics and Statistics, 52(2), 169-210.
- Joshipura, Mayank, & Peswani, Shilpa. (2018). "The Volatility Effect in Value and Growth Stocks: Evidence from India." NMIMS Management Review XXXVI, Issue 1, 46-62.
- Kim, K. H. (2003). Dollar exchange rate and stock price: evidence from multivariate co-integration and error correction model. Review of Financial Economics, 12(3), 301-313.
- Kutty, G. (2010). The relationship between exchange rates and stock prices: the case of Mexico. North American Journal of Finance and Banking Research, 4(4), 1-12.
- Muhammad, N., Rasheed, A., & Husain, F. (2002). Stock prices and exchange rates: are they related? Evidence from South Asian countries. The Pakistan Development Review, 41(4), 535-550.
- Nath, G. C., & Samanta, G. P. (2003). Dynamic relation between exchange rate and stock prices: a case for India. In 39th Annual Conference paper of Indian Econometric Society also published in NSE News February.
- Nieh, C. C., & Lee, C. F. (2001). Dynamic relationship between stock prices and exchange rates for G-7 countries. The Quarterly Review of Economics and Finance, 41(4), 477-490.
- Ong, L. L., & Izan, H. Y. (1999). Stocks and currencies: Are they related? Applied Financial Economics, 9(5), 523-532.
- Pan, M. S., Fok, R. C. W., & Liu, Y. A. (2007). Dynamic linkages between exchange rates and stock prices: Evidence from East Asian markets. International Review of Economics & Finance, 16(4), 503-520.
- Patel, S. A. (2013). Causal relationship between stock market indices and gold price: Evidence from India. IUP Journal of Applied Finance, 19(1), 99-109.

- Phylaktis, K., & Ravazzolo, F. (2005). Stock prices and exchange rate dynamics. Journal of International Money and Finance, 24(7), 1031-1053.
- Rahman, M. L., & Uddin, J. (2009). Dynamic relationship between stock prices and exchange rates: evidence from three South Asian countries. International Business Research, 2(2), 167-174.
- Singhal, S. (2012). An Analytical Study on Indian Currency Rupee Depreciation against the US Dollar and Its Economic Impact. ArthPrabhand: A Journal of Economics and Management, 1(1), 74-83.
- Sinha, P., & Kohli, D. (2015). Modeling exchange rate dynamics in India using stock market indices and macroeconomic variables. Amity Global Business Review, 1(1), 5-18.
- Stavarek, D. (2004). Linkages between stock prices and exchange rates in the EU and the United States. Czech Journal of Economics and Finance, 55(4), 141-161.
- Tabak, B. M. (2006). The dynamic relationship between stock prices and exchange rates: Evidence for Brazil. International Journal of Theoretical and Applied Finance, 9(8), 1377-1396.
- Yau, H. Y., & Nieh, C. C. (2006). Interrelationships among stock prices of Taiwan and Japan and NTD/Yen exchange rate. Journal of Asian Economics, 17(3), 535-552.
- Zhao, H. (2010). Dynamic relationship between exchange rate and stock price: Evidence from China. Research in International Business and Finance, 24(2), 103-112.

Mohd. Asif Khan *is a Senior Associate Professor in the Department of Commerce, Aligarh Muslim University, Aligarh, and holds Ph.D. in the area of Entrepreneurship. He has teaching as well as administration experience of 29 years. Khan is deeply involved in teaching, training, mentoring and research activities. Khan has published many papers in national and international journals, and has participated in various conferences, both nationally and internationally. He has also written several books. He can be reached at asif.com.amu@gmail.com.*

Mohammad Athar Noor *is a Research Associate in the department of Commerce, Aligarh Muslim University, Aligarh. He holds Ph.D. and Post Doctorate in the area of Finance. He has teaching experience of 2 years and is also involved in research activities. He has published many papers in the area of Investment (particularly Stock Market) and Tourism in national and international journals, and participated in various conferences. He can be reached at mohdatharnoor@gmail.com.*

Mohd Motasim Ali Khan *is a Research Assistant in the Department of Commerce, Aligarh Muslim University, Aligarh. Khan holds Ph.D. and Post Doctorate in the area of Tourism. He has teaching experience of 3 years and is also involved in research activities. He has published many papers in the areas of Tourism and Finance in national and international journals, and participated in various conferences. He can be reached at khanmughees@gmail.com.*