Relationship between Stock Prices and Exchange Rates in India

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Abstract

The linkages between stock prices and exchange rates have been subjected to extensive research worldwide. This issue is also gaining importance in India especially in post liberalization period. In this context this article attempts to examine the relationship between stock prices and exchange rates in India using monthly data over a nine-year period from January 1999 to December 2007. The study employed the Engle–Granger two-step and Johansen co-integration tests as well as Grangers causality test. Both the Engle–Granger two-step and Johansen co-integration methods suggest that there is no long-run equilibrium relationship between these two financial variables. Granger causality tests find that there is no causality between stock prices and exchange rates. The results however are tentative and a further in depth research is required into the subject.

Key Words: Stock Prices, Exchange rates, Causation, Linkages, Time Series, Cointegration, Granger Causalty.

Introduction

The issue of whether stock prices and exchange rates are related or not has received considerable attention after the East Asian crisis of 1997. During the crisis the affected countries saw turmoil in both currency and stock markets. Traditionally both the markets have been regarded as sensitive segments of the financial market as the impact of any policy change gets quickly reflected in these two markets. At the same time, ruptures in either or both the markets tend to raise concern among policy makers, i.e., the two markets have tremendous policy implications. Therefore, the interaction between foreign exchange markets and stock markets has become more complex and important. In the context of Indian economy, very few relevant studies are available, though the issue of rupee appreciation against the US dollar has been gaining importance in recent years. In the beginning of the 1990s the Indian economy undertook some steps towards the liberalization and globalization of the financial sector of India, and this brought major changes in the financial system of the country.

During 1992, the liberalized exchange rate system introduced the convertibility of current account and, particularly since 1997, capital account is open for international investment. Apart from this, the advent of floating exchange rates, the development of 24-hour screen-based global trading, the increased use of national currency outside the country, and innovations in internationally traded financial products call for a re-examination of the relationship between the stock market and the foreign sector of the Indian economy. The analysis of the stock market has come to the fore because it is the most sensitive segment of the economy and is considered the barometer through which the country's exposure to the outer world is most readily felt. The present study is an Endeavour in this direction. Against this background, the present study discusses the dynamic linkages between the stock and foreign exchange market in the Indian context. The arguments for the linkage can be made at both micro and macro economic levels.

From the microeconomic level standpoint, the exchange rate is seen as influencing the value of domestic and multinational companies, and the research undertook in this area deals with the issue of domestic economies' exposure to exchange rate risk. Fluctuations in exchange rates can significantly have an effect on firm value, as they influence the terms of competition, the input and output prices, and the value of firm's assets and liabilities denominated in foreign currencies. Although firms with foreign operations, from exporting to international production, are more affected as compared to "pure" domestic firms, virtually no company can be considered as fully isolated from the effects of exchange rates changes. Consequently, all firms' prices may react sooner or later to changes in the exchange rates. Depending on the moment in time when exchange rates change, a company might face: (1) transaction exposure, that arises whenever the firm commits or is contractually

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bounded to make or receive a payment at a future date denominated in a foreign currency; (2) translation exposure, arising from the need to globally consolidate the financial reports of a multinational company from affiliates' reports denominated in various currencies; and (3) economic exposure, seen as the change in the firm's present value as result of changes in the value of the firm's expected future cash flows and cost of capital, induced by unexpected exchange rate changes.

At the macroeconomic level, the discussion has been centered on the relationship between aggregate stock price and floating value of exchange rates. As far as the theory on the relationship between stock prices and exchange rates at the macro level goes, there is no theoretical consensus on such relationship. The linkages between stock market performance and exchange rate behavior has long been debated in the economic literature.

This link is seen by models that focus on the current account (Flow Oriented Models, e.g. Dornbusch & Fisher, 1980) as well as those that focus on the asset market (Stock Oriented Models, e.g. Branson & Frankel, 1983), though in different ways.

Review of Literature

A general scanning of literature available in India from different published sources indicates that very few detailed studies have been conducted in India in the field of exchange rates in India, particularly in studying relationship between stock prices and exchange rates in India. However, many studies have been conducted abroad, particularly in the Western developed countries. However, these are not very relevant in Indian context. 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. Aggarwal (1981) explored the relationship between changes in the dollar exchange rates and change in indices of stock prices. He uses monthly U.S. stock price data and the effective exchange rate for the period 1974–1978. His results, which were based on simple regressions, showed that stock prices and the value of the U.S. dollar is positively related and this relationship is stronger in the short run than in the long run. Solnik (1987) employing OLS regression analysis on monthly and quarterly data from 1973 to 1983 for eight industrialized countries found a negative relationship between real domestic stock returns and real exchange rate movements. However, for monthly data over 1979-83, he observed a weak but positive relation between the two variables. Bahmani-Oskooee and Sohrabian (1992) analysed the long-run relationship between stock prices and exchange rates using co-integration as well as the casual relationship between the two by using Granger causality test. They employed monthly data on S&P 500 index and effective exchange rate for the period 1973–1988. They concluded that there is a bi-directional causality between the stock prices and effective exchange rate, at least in the short-run. The co-integration analysis reveals that there is no long-run relationship between these two variables. Rittenberg (1993) employed the Granger causality tests to examine the relationship between exchange rate changes and price level changes in Turkey. Since causality tests are sensitive to lag selection, therefore he employed three different specific methods for optimal lag selection [i.e., an arbitrarily selected, Hsiao method and the SMAR or subset model auto regression method of Kunst and Marin]. In all cases, he found that causality runs from price level change to exchange rate changes but there is no feedback causality from exchange rate to price level changes. Abdalla and Murinde (1997) applied co-integration approach to examine the long-run relation between stock price index and the real effective exchange rate for Pakistan, Korea, India and Philippines. They use month data from January 1985 to July 1994. Their study found no long-run relationship for Pakistan and Korea but did find a long-run relationship for India and Philippines. They also examine the issue of causation between stock prices and exchange rates. Using standard Granger causality tests they found a unidirectional causality from exchange rates to stock prices for both Pakistan and Korea.

Ong and Izan (1999) used Nonlinear Least Square method to examine the association between stock prices and exchange rates. They found that U.S. share price returns fully reflect information conveyed by movements in both the Japanese yen and the French France after four weeks. Their results, however, suggest a very weak relationship between the U.S equity market and exchange rates. They concluded that depreciation in a country's currency would cause its share market returns to rise, while an appreciation would have the opposite effect. Amare and Mohsin (2000) examine the long-run association between stock prices and exchange rates for nine Asian countries (Japan, Hong Kong, Taiwan, Singapore, Thailand, Malaysia, Korea, Indonesia, and Philippines). They use monthly data from January 1980 to June 1998 and employed co-integration technique. The long-run relationship between stock prices and exchange rates was found only for Singapore and Philippines. Granger, Huang and Yang (2000) examine the causality issue using Granger causality tests and Impulse response function for nine Asian countries. They use 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 leads stock prices with positive correlation. The data from Taiwan suggests stock prices leads exchange rates with negative correlation. No relationship was found for Singapore and bi directional causality was discovered for the remaining countries.

Pethe and Karnik (2000) investigated the interrelationships between stock prices and macro economic variables such as exchange rate of rupee vis-à-vis dollar, prime lending rate, narrow money supply, broad money supply and index of industrial production on the monthly data spanning from April 1992 to December 1997. By employing unit root test, co-integration and error correction models, the study found there was no long run stable relationship between stock prices, exchange rates, prime lending rate, narrow money supply, broad money supply and index of industrial production. Apte (2001) investigated the relationship between the 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 NIFTY-50 over the period 1991 to 2000. The study suggests that there appears to be a spillover from the foreign exchange market to the stock market but not the reverse.

Bhattacharya and Mukharjee (2002) studied the nature of causal relation between the stock market, exchange rate, foreign exchange reserves and value of trade balance in India from 1990: 4 to 2001: 3 by applying the co-integration and long-run Granger Non-causality tests. The study suggests that there is no causal linkage between stock prices and the three variables under consideration. Muhammad and Rasheed (2002) used monthly data from four South Asian countries, namely Pakistan, India, Bangladesh and Sri Lanka, and employed co-integration and error correction modeling approach to examine the long-run and short-run associations between stock prices and exchange rates for the period January 1994 to December 2000. Our results show no long-run and short-run associations between stock prices and exchange rates for Pakistan and India. No short-run association was also found for Bangladesh and Sri Lanka. However, there seems to be a bi-directional long-run causality between these variables for Bangladesh and Sri Lanka. The results suggest that in South Asian countries stock prices and exchange rates are unrelated (at least in the short run). Lean, Halim and Wong (2003) employed the co-integration and bivariate causality tests to explore the relationship between exchange rates and stock prices prevalent in the pre-Asian crisis, during Asian crisis and during 9/11-terrorist attack in the US periods on the seven Asian countries such as Hong Kong, Indonesia, Singapore, Malaysia, Korea, Philippines and Thailand badly hit by the Asian financial crisis. The study also included Japan for the control purpose. The empirical results of the study found that during the period before 1997 Asian financial crisis, all the countries except the Philippines and Malaysia experienced no evidence of Granger causality and no specific co-integration relationship between the exchange rates and stock prices. Causality, but not co-integration, between the capital and financial markets appears to become strong during the Asian financial crisis period and all the countries showed evidence of causality between the two markets. The study also found a surprising result that after the 9/11-terrorist attack, the causality relationship between the two markets turns back to normal as in the pre Asian crisis period, when in all the countries except Korea are found no linkages between exchange rates and stock prices. In addition, the study found that after the 9/11-terrorist attack, there is less co-integration relationship between exchange rates and stock prices.

Smyth and Nandha (2003) examined the relationship between exchange rates and stock prices in Bangladesh, India, Pakistan and Sri Lanka using daily data over a six-year period from 1995 to 2001. Both the Engle–Granger two-step and Johansen co-integration methods suggested that there is no long-run equilibrium relationship between these two financial variables in any of the four countries. Granger causality tests find that there is uni directional causality running from exchange rates to stock prices in India and Sri Lanka, but in Bangladesh and Pakistan exchange rates and stock prices are independent.

Stavarek (2004) investigated the nature of the causal relationship between stock prices and effective exchange rates in the four old EU member countries (Asia, France, Germany and the UK), four new EU member countries (Czech Republic, Hungary, Poland and Slovakia) and in the USA. Both the short term and long term causalities between these variables were explored using the monthly data. The study employed co-integration analysis, vector error correction modeling and standard Granger causality test to examine whether stock prices and exchange rates were related to each other or not and what kind of causality direction exists between them. The results of the study found much stronger causality in countries with developed capital and foreign exchange markets (old EU member countries and the USA) than in the new comers. The evidence also suggested more powerful long-run as well as short-run causal relations during the period 1993-2003 than during 1970-1992. Causalities seem to be predominantly unidirectional with the direction running from stock prices to exchange rates.

Hussain and Liew (2004) used Granger, Sim and Geweke causality tests, to investigate the causal relationship between the foreign exchange and stock exchange markets in Malaysia and Thailand during the turmoil of the 1997 Asian Currency Crisis. Daily composite stock indices, which reflect the overall stock markets performance and daily spot exchange rates of these two neighboring countries, are deployed in this study. They found a feedback causal relationship between exchange rate and stock price in Malaysia, whereas a unidirectional causal relationship running from exchange rate to stock price in Thailand. The stock markets of these countries are also found to be closely linked, with a feedback causal relationship between them. Mishra (2004) examined whether stock market and foreign exchange markets are related to each other or not in the context of India. The study employed Granger's causality test and Vector Auto Regression technique on monthly stock return, exchange rate, interest rate and demand for money for the period April 1992 to March 2002. The major findings of the study are (a) there exists a unidirectional causality between the exchange rate and interest rate and between the exchange rate return and demand for money; (b) there is no Granger's causality between the exchange rate return and stock return. Through Vector Auto Regression modeling, the study confirmed that though stock return, exchange rate return, the demand for money, and interest rate are related to each other but it lacks any consistent relationship. The forecast error variance decomposition further evidences that (a) the exchange rate return affects the demand for money, (b) the interest rate causes exchange rate return change (c) the exchange rate return affects the stock return.

Azman-Saini, Habibullah, Law and Dayang-Affizzah (2006) examined causal between stock prices and exchange rates in Malaysia using a new Granger non-causality test proposed by Toda and Yamamoto based on a monthly sample from January 1993 to August 1998. The results show that there is a bi-directional causality for the pre-crisis period. Horobet and Ilie (2007) examined the interactions between the exchange rates and stock prices in Romania, after 1997, taking into account the change in the monetary regime occurred in 2005 – the shift towards inflation targeting. They used bivariate co-integration (both the Engle-Granger and the Johansen-Juselius methodology) and Granger causality tests and applied it on daily and monthly exchange rates and stock prices data collected over the 1999 to 2007 period. Three types of exchange rates were used: the nominal effective exchange rates of the Romanian leu, the bilateral nominal exchange rates of the leu against the US dollar and the euro, and the real effective exchange rates of the leu. In terms of stock prices, the BET and BET-C indices of the Bucharest Stock Exchange were used, denominated in the local currency. Doong and Lee (2008) examined the interaction between stock prices and exchange rates and investigated how the volatility of stock returns influences their correlation. They employed multivariate conditional correlation model with time-varying correlations, the STCC–EGARCH model proposed by Berben and Jansen and Silvennoinen and Teräsvirta. They used weekly data from Indonesia, Korea, Malaysia, Philippines, Taiwan, and Thailand from 2000 to 2008 to examine the linkage between stock market and foreign exchange market of six Asian emerging countries. It was found that there are significant price spillovers from stock returns to exchange rate changes for Indonesia, Korea, Malaysia, Thailand, and Taiwan. Furthermore, as the stock returns volatility increases, the correlations become higher in Asian emerging countries except the Philippines. Mishra and Paul (2008) examined the integration and efficiency of Indian stock and foreign exchange markets. The study employed Time series ordinary least square regression, Unit Root test, Grangers causality test, Vector Auto Regression techniques on monthly data of stock return and exchange rate return for the period spanning from February 1995 to March 2005.The major finding were as follows. Both the stock indices return (Rsensex and Rnifty) were near normal whereas exchange rate return is not normal and more peak. The stock return and exchange rate return were positively related. From the Granger's causality test, it was found that there is no causality for the return series of stock indices and exchange rate except return Nifty and return exchange rate. Weak form of market efficiency hypothesis was also corroborated for stock and foreign exchange markets.

Aydemir and Demirhan (2009) investigated the causal relationship between stock prices and exchange rates, using data from 23 February 2001 to 11 January 2008 about Turkey. In this study, national 100, services, financials, industrials, and technology indices were taken as stock price indices. The results of empirical study indicated that there was a bidirectional causal relationship between exchange rate and all stock market indices. While the negative causality exists from national 100, services, financials and industrials indices to exchange rate, there was a positive causal relationship from technology indices to exchange rate. On the other hand, negative causal relationship from exchange rate to all stock market indices was determined.

Objective of the study

The main objective of the present study is to examine the relationship between stock prices and exchange rates in India on the micro level. Particularly it aims to examine the long term relationship and also causality between these two variable by using co-integration and granger causality test

Hypothesis of the study

In order to achieve the research objective the following hypothesis are being tested in the study.

i.) There is no co-integration between stock prices and exchange rates in India.

ii.) There is no casual relationship between stock prices and exchange rates in India.

Data and Empirical Methodology

The study uses monthly data from January 1999 to December 2007 with the total of 108 observations. To represent exchange rate, exchange rate expressed in Indian rupee per U.S. dollar based on FEDAI indicative rates has been taken. National Stock Exchange's S&P CNX NIFTY index which is one of the most robust indices available for Indian stock market has been taken to represent stock prices. The data has been obtained from Handbook of Statistics on Indian Economy 2007-08 published by Reserve Bank of India. Following the literature all data series have been expressed in their natural logarithms. We denote the chosen stock price index and exchange rate by NSE and EX respectively, thus their logs are represented by log (NSE) and log (EX).

In order to examine the relationship between stock prices and exchange rates, the first step is to subject the underlying time series to stationarity tests in order to avoid the problems of spurious regressions which might arise if the time series are non-stationary. Many studies have lately shown that majority of time series variables are non-stationary or integrated of order 1. Thus, a unit root test should precede any empirical study employing such variables. There have been a variety of proposed methods for implementing stationarity test and principally Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test have been widely used in econometric literature. Also this study, as a first step, executes both unit root tests to investigate whether the time series of stock prices and exchange rates are stationary or not. In both these tests, the null hypothesis is that the time series is non stationary or it has a unit root.

In general, the ADF (1979) test consists of estimating the following regression:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t$$

Where ε_t is a pure white noise error term (the residuals are said to white noise when it possess zero mean, constant variance and no autocorrelation) and where $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc. The number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term in above equation is serially uncorrelated.

In ADF we test whether $\delta = 0$ i.e., there is a unit root- the time series is non stationary. If δ is significantly less than zero, the null hypothesis is rejected and implying a unit root exists. In other words if the computed absolute value of the test statistic exceeds critical values, we reject the hypothesis that $\delta = 0$, in which case the time series is stationary. On the other hand, if the computed absolute value of the test statistic does not exceed the critical value, we do not reject the null hypothesis, in which case the time series is non stationary.

The PP test developed by Phillips and Perron (1988) is similar to the ADF tests as discussed above. The asymptotic distribution of the PP test is the same as the ADF test statistic.

If the series under consideration turn out to be integrated in the same order, it is possible to proceed testing for co-integration relationships between the integrated variables. The concept of co-integration was first developed by Engle and Granger (1987), which discusses the case of variables that are integrated of order one and are included in a regression. We know that I (1) variables should be differenced before they are used in linear regressions in order to make them I (0), otherwise the regression is spurious. Engle and Granger advanced the idea that sometimes the regression of two I (1) variable might not be spurious, but meaningful, in case the two variables are cointegrated.

Generally, if two time series X_t and Y_t are integrated of order one [i.e. I (1)] then, in most of the cases, $Y_t - \beta X_t$ is also a I(1) process for any number β. Nevertheless, it is possible that for some $\beta \neq 0$, $Y_t - \beta X_t$ is not an I (1), but an I (0) process, with constant mean, constant variance and autocorrelation that depends only on the time distance between any two variables in the series, and it is asymptotically uncorrelated. If such β exists, the series Y_t and X_t are said to be cointegrated and β is called the cointegrating parameter. As a result, a regression of Y_t on X_t would be meaningful, not spurious. Economically speaking, co-integration of two variables indicates a long-term or equilibrium relationship between them, given by their stationary linear combination (called the cointegrating equation).

We test for the existence of co-integration between the stock prices and the exchange rates using two methodologies: the one developed by Engle and Granger (1987) and the other one by Johansen (1988) and Johansen and Juselius (1990). The Engle-Granger (EG) test is a two-step procedure involving (i) an OLS estimation of a pre-specified cointegrating regression and (ii) a unit root test of the residuals saved from the first step. The null hypothesis of no co-integration is rejected if it is found that the residuals are non-stationary. The EG test has some weaknesses. The test may be sensitive to which variable is used as a dependent or independent variable, which is problematic in the case of more than two variables. In our implementation, we experiment with all possible regressions of the variables. Moreover the test is widely noted to have low power. Perhaps a severe disadvantage of the test is that the critical values of the test are highly sensitive to sample sizes, since the test statistics have no well-defined limiting distribution.

The Johansen-Juselius procedure is based on the maximum likelihood estimation in a VAR model, and calculates two statistics – the trace statistic and the maximum Eigenvalue – in order to test for the presence of r cointegrating vectors. The trace statistic tests the null hypothesis that there are at most r cointegrating vectors against the hypothesis of r or more cointegrating vectors. The maximum Eigenvalue statistics tests for r cointegrating vectors against the hypothesis of r+1 cointegrating vectors. The Johansen-Juselius procedure considers all variables included in the co-integration test as being endogeneous and therefore it avoids the issue of cointegrating vector normalization on one of the variables or of imposing a unique cointegrating vector, as implied in the Engle-Granger test. Beside its ability to determine the number of cointegrating vectors, the Johansen-Juselius procedure is generally considered to have more power than the Engle-Granger test. For our analysis we compare the trace statistic with a critical value and if the test statistic is greater than the critical value, the hypothesis being tested is rejected.

To examine the issue of causation between the two variables, this paper makes use of method developed by Granger (1969). Formally, a time series Xt Granger-causes another time series Yt if series Yt can be predicted better by using past values of (Xt, Yt) than by using only the historical values of Yt. A general specification of the Granger causality test involves estimating the following pair of regressions:

$$\Delta Yt = \alpha 0 + \sum_{i=1}^{n} \alpha i\, \Delta Yt\text{-}i + \sum_{j=1}^{n} \beta j\, \Delta Xt\text{-}j + \mu t \quad (1)$$

$$\Delta Xt = \varphi 0 + \sum_{i=1}^{n} \varphi i\, \Delta Xt\text{-}i + \sum_{j=1}^{n} \Phi j\, \Delta Yt\text{-}j + \upsilon t \quad (2)$$

Where Δ is the difference operator, Yt and Xt are the variables to be tested, and ut and vt are mutually uncorrelated white noise errors, and t denotes the time period and 'i' an 'j' are number of lags.

We now distinguish four cases:

1. Unidirectional causality from X to Y is indicated if the estimated coefficients on the lagged X in (1) are statistically different from zero as a group (i.e. $\sum \alpha i \neq 0$) and the set of estimated coefficients on the lagged Y in (2) is not statistically different from zero (i.e., $\sum \Phi j = 0$).
2. Conversely, unidirectional causality from Y to X exists if the set of lagged X coefficients in (1) is not statistically different from zero (i.e., $\sum \alpha i = 0$) and the set of the lagged GDP coefficients in (2) is statistically different from zero (i.e., $\sum \Phi j \neq 0$).

3. Feedback, or bilateral causality, is suggested when the sets of X and Y coefficients are statistically significantly different from zero in both regressions.

4. Finally, independence is suggested when the sets of X and Y coefficients are not statistically significant in both the regressions.

It may be mentioned that the standard Granger test as explained above is applicable to stationary series. In reality, however, underlying series may be non-stationary. In such cases, one has to transform the original series into stationary series and causality tests would be performed based on transformed-stationary series. Also if co-integration exists between the variables, then an error correction term is required to be included in equations (1) and (2) to examine the causality between the variables.

Empirical Results

For the purpose of our analysis both stock prices and

Fig. 1: Log of Stock Prices (Level Series)

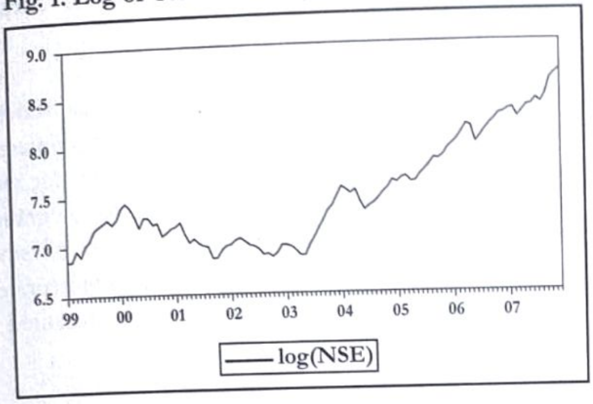


Fig. 2: Log of Exchange Rate (Level Series)

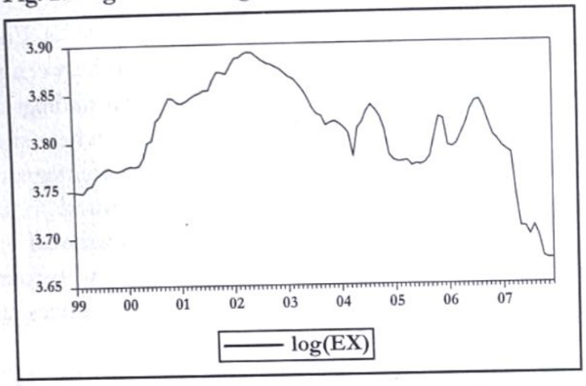


Table 1: Results of ADF and PP Unit Root Tests on Levels

Variable	ADF test statistics		PP test statistics	
	Constant and no trend	Constant and trend	Constant and no trend	Constant and trend
Log (NSE)	0.685130	-0.815856	0.892097	-0.598182
Log (EX)	-0.733606	-1.300557	-0.364287	-0.864001

Notes:

1. The lag length, for the ADF tests was chosen so as to minimize Schwarz Information Criterion (SIC) where the upper bound on the lag length of 12 was selected. The bandwidths for the Phillips–Perron test follow the Newey–West suggestion using Bartlett kernel.
2. The critical values for ADF unit root tests at 1% and 5% levels are -3.493129 and -2.888932 (without trend) and -4.046925 and -3.452764 (with trend) respectively.
3. The critical values for PP unit root tests at 1% and 5% levels are -3.492523 and -2.888669 (without trend) and -4.046072 and -3.452358 respectively.

exchange rate have been expressed in their natural logarithms. Figure 1 and Figure 2 represents graphs of both the variables in their log form.

As a first step in our analysis we check for the stationarity of both the time series namely, log (NSE) and log (EX) (where log represents natural logarithms) using ADF and PP tests as discussed in the previous section. Table 1 reports the ADF and PP test statistics with and without trend under the hypothesis of a unit root.

The results shown in table 1 indicate that both the log series are non-stationary as none of the test statistics is significant at 1% level of significance. Hence we accept the

Table 2: Results of ADF and PP Unit Root Tests on First Differences

Variable	ADF test statistics		PP test statistics	
	Constant and no trend	Constant and trend	Constant and no trend	Constant and trend
Log (NSE)	-8.149697	-8.302208	-8.133621	-8.250736
Log (EX)	-6.692537	-7.188572	-6.703553	-7.020406

Notes:

1. The lag length, for the ADF tests was chosen so as to minimize Schwarz Information Criterion (SIC) where the upper bound on the lag length of 12 was selected. The bandwidths for the Phillips–Perron test follow the Newey–West suggestion using Bartlett kernel.
2. The critical values for ADF unit root tests at 1% and 5% levels are -3.493129 and -2.888932 (without trend) and -4.046925 and -3.452764 (with trend) respectively.
3. The critical values for PP unit root tests at 1% and 5% are -3.493129 and -2.888932 (without trend) and -4.046925 and -3.452764 (with trend) respectively.

Fig. 3: Stock Prices Return Series (First Difference Series)

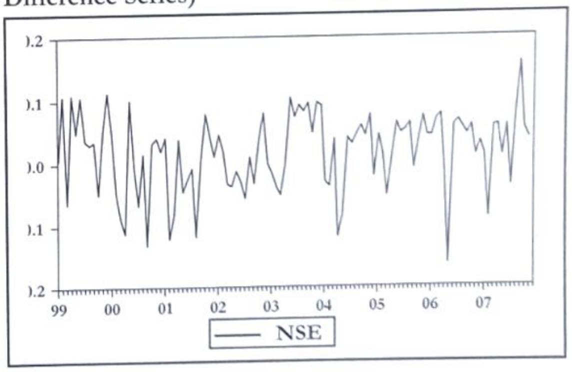
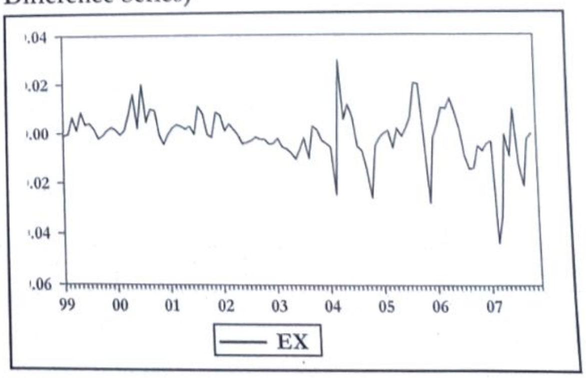


Fig. 4: Exchange Rate Return Series (First Difference Series)



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null hypothesis that these series are non stationary i.e. they contain a unit root. However, as shown in table 2, both the series, namely log (NSE) and log (EX) becomes stationary after taking their first differences. The null hypothesis that the return series are non stationary is rejected as the statistics are found significant at 1% level of significance. Thus these log-transformed series can be described as I (1) processes, indicating that their first-order differences (i.e. ΔLog (NSE) and ΔLog (EX), which actually represent return series here) are stationary. Plot of ΔLog (NSE) and ΔLog (EX) is shown in Figure 3 and Figure 4 respectively. Since both the series are integrated of the same order we apply co-integration tests to examine the long run relationship between these two variables. The Engle – Granger co integration test is used to check whether there are any statistically significant long run interlinkages

Table 3: Engle–Granger Co-integration Tests Between Stock Price and Exchange Rates (i.e., Between Log (NSE) and Log (EX))

Regression run	ADF test statistic for the residual series	PP test statistic for the residual series
Log (NSE) on Log (EX)	-2.498980 (1)	-2.345024 (4)
Log (EX) on Log (NSE)	-2.691094 (1)	-2.349950 (4)

Notes:

1. Figures in parentheses are lag lengths.
2. The critical values for ADF unit root tests at 1% and 5% levels are -3.4928 and -2.8887 respectively.
3. The critical values for PP unit root tests at 1% and 5% levels are -3.4922 and -2.8884and -2.5809 respectively.
4. The tests equations include constant and no trend. Higher lags were also considered but the results were same.

between the stock prices and exchange rates. This analysis helps in determining whether the regression of one time series on another is spurious or not. If the two time series are found to be cointegrated it means that they have a long run equilibrium relationship among them.

Unit root tests Unit root tests (Augmented Dickey Fuller test and Phillip Perron test) were applied on the residual series generated by regressing first stock prices on exchange rates and then exchange rates on stock prices. Table 3 presents the ADF and PP test statistics of residual series of both the regressions respectively.

Table 4: Johansen's Co-integration Test

Hypothesized No. of CE(s)	Likelihood ratio (trace statistic)	5 Percent Critical Value 1	Percent Critical Value
None	13.51200	19.96	24.60
At most 1	3.721642	9.24	12.97

It can be seen that the hypothesis that the residual series is non stationary is accepted. From the results it can be inferred that the stock prices are not integrated with exchange rates in the long run. We now employ Johansen co-integration test to examine whether or not the logarithms of stock prices and exchange rates for the country are cointegrated. The result of Johansen co-integration test is presented in Table 4.

L.R. rejects any co-integration at 5% significance level. The lags interval were taken to be 1 to 5.

Johansen's co-integration tests concludes same as Engle and Granger thus indicating no cointegartion between the two variables (log (NSE) and log (EX)). Such findings are in contrast with Abdalla and Murinde (1997) where stock prices and exchange rates were found to be cointegrated. However the results of this study are identical to the findings of Pethe and Karnik (2000), Muhammad and Rasheed (2002) and Smyth and Nanda (2003) who found that there was no cointegartion between stock prices and exchange rates in India.

Table 5: Granger Causality Test

Null Hypothesis	Lag 1	Lag 2	Lag 3
NSE does not Granger Cause EX	0.10380(0.74797)	0.04837(0.95281)	0.22991(0.87536)
EX does not Granger Cause NSE	0.09978(0.75274)	0.36701(0.69373)	0.31088(0.81747)

Notes: Figure in parenthesis represents probability values.

Table 6: Granger Causality Test

Null Hypothesis	Lag 4	Lag 5
NNSE does not Granger Cause EX	0.29479(0.88069)	0.27193(0.92739)
EX does not Granger Cause NSE	0.30172(0.87614)	0.22447(0.95107)

Notes: Figure in parenthesis represents probability values.

Since there is no cointegartion between stock prices and exchange rates, we can therefore apply the standard causality tests. However the causality test would be applied on the stationary series which in this case is the first difference series as represented by ΔLog (NSE) and ΔLog (EX). The null hypothesis under this test is that one variable does not granger cause the other. In our case stock prices does not causes exchange rates and vice-versa. The results of the standard Granger test are presented in Table 5 and Table 6. The lags are arbitrarily determined and the fixed at maximum of five.

The results in table 5 indicate that there is no causality in any direction between stock prices and exchange rates at any of the lags considered in the study. Thus, neither stock prices lead exchange rates or exchange rates lead stock prices. This finding is in contrast with Abdalla and Murinde (1997), Smyth and Nanda (2003) and Pethe and Karnik (2000) who found that exchange rates Granger cause stock prices in case of India. However the result of no bausality is similar with findings of Muhammad and Rasheed (2002).

Thus, stock prices and exchange rates prove to be independent variables with separate and independent development. The findings in the present study are consistent to the asset market approach that postulates weak or no association between stock prices and exchange rate. It contradicts to the Flow and Stock oriented models of exchange rate determination which states that a relationship exists between stock prices and exchange rates.

Summary and Conclusions

This study examined the relationship between the foreign exchange and stock markets for India by using monthly data over the period starting from January 1999 to December 2007, using co-integration and Granger causality tests. While the literature suggests the existence of significant interactions between the two markets for other countries but our empirical results show that these two markets are not interrelated in case of India.

The co-integration analysis using both Engle and Granger and Johansen method showed that there was no co-integration between the two variables thus indicating that there seems to be no long run relationship between the two variables. Neither the Granger causality test showed any evidence of causality between the two. Such findings are in contrast with flow and stock oriented models of exchange rate determination which postulate a relationship between stock prices and exchange rate. The results of present study show that the two markets are separate and independent and the movements in one market do not affect the other. Therefore, investors cannot use information obtained from one market (say stock market) to predict the behaviour of the other market. Theoretically, if there is any linkage between both of the variables then the crises can be averted either by managing exchange rate or by adopting indigenous policies to stable the stock market. Moreover the investors can utilize this relationship between stock prices and exchange rate to predict the behavior of these variables.

These findings are however taken to be tentative as we have seen in the recent past (in 2008) that the inflow of foreign money in Indian stock markets had led to an appreciation of the domestic currency thus supporting the stock or stock oriented model of exchange rate determination. Therefore there is a need to undertake an in-depth research to address the issue.

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