Dynamic Relationship between Stock Prices and Exchange Rates

(Evidence from India)

By

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Abstract

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This paper analyses the relationship between stock returns and Indian rupee-US Dollar Exchange Rates. Several statistical tests have been applied in order to study the behavior and dynamics of both the series. The paper also investigates the impact of both the time series on each other. The period for the study has been taken from January 2004 to July 2013 using daily closing indices. In this study, it was found that Stock returns as well as Exchange Rates were non-normally distributed. Through a unit root test, it was also established that both the time series, exchange rate and stock returns, were stationary at the level form itself. Also the correlation was found to be negative.

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Chapter 1

Introduction

The liberalization of foreign capital controls and adoption of a floating exchange rate rule in India have broadened the possibility of revising the relationship between exchange rates and stock prices. The former has released the possibility of international investment and the latter has increased the volatility of the foreign exchange market. Hence determining the relationship between stock prices and exchange rates has become crucial for the academicians, practitioners, investors and policy makers.

The stock market and foreign exchange markets are usually regarded as sensitive segments of the financial markets, as any policy change is directly reflected in these two markets. Meanwhile, a disturbance in either or both markets tends to raise anxiety among policy makers. In short, the two markets have tremendous policy implications. In addition to that, the dynamic correlation between both markets has preoccupied the minds of researchers, policy makers, along with analysts to carry out a thorough analysis of this relationship.

Although there is no straightforward theoretical relationship between stock prices and exchange rates, there is a multitude that plays a vital role in establishing the linkage between them. These include enterprise performance, dividends, stock prices of other countries, gross domestic product, exchange rates, interest rates, balance of payment, money supply, employment, etc. But according to the classic economic theory, stock prices and exchange rates can relate to each other by way of ‘flow oriented’ and

'portfolio balance' models. Flow oriented models, first discussed by Dornbusch and Fisher 1980, theorize that exchange rate movements cause movements in stock prices. This model is built on the macroeconomic view that because stock prices represent the discounted present value of a firm expected future cash flows, then any phenomenon that affects a firm's cash flow will be reflected in that firm's stock price if the market is efficient as the Efficient Market Hypothesis suggests. Movements in the exchange rate are one such phenomenon.

Other examples of the relationship between stock prices and exchange rates include "stock oriented models" or a portfolio balance approach. Stock-oriented models highlight the capital account as a main basis of exchange-rate dynamics whereas the portfolio-balance model is based on the theory that agents should allocate their wealth among domestic and foreign assets, including currencies, in their portfolio. Therefore, the exchange rate plays the role of matching the demand and supply of assets.

The logical reasoning from the undesirable effects of stock prices on exchange rates is the following. An appreciation in domestic stock prices leads individuals to demand more domestic assets. To buy more domestic assets, this can require them to sell foreign assets. As a result, there is an appreciation of the domestic currency due to an increased demand of domestic assets. The follow through of this is due to a growth in domestic asset prices and investors' wealth will lead them to increase their demand for money, which in turn raises domestic interest rates. A higher interest rate will in turn attract foreign capital, resulting in an appreciation of domestic currency.

The debate about the interaction between stock prices and exchange rates particularly commenced with the break-up of the Bretton Woods System. Since then there has been a large number of empirical studies to investigate the relationship between the variables. But researchers have found contradictory results regarding both the existence if any and the direction of the relationship. Some of the studies showed that there is a significant positive relationship between the variables, such as, Aggarwal (1981), Giovannini and Jorion (1987), and Roll (1992). But others counter, this argument and indicated a significant negative relationship between the variables, such as, Soenen and Hennigar (1988). While other studies find that there is no significant relationship between the variables, such as, Franck and Young (1972), Solnik (1987), Chow et al. (1997) and Bhattacharya and Mukherjee (2003), Bahmani-Oskooee and Sohrabian (1992), Nieh and Lee (2001). So in this area of finance literature there is no empirical agreement among the researchers regarding the interactions between stock prices and exchange rates. This justifies the need of more research in this area to contribute to the literature.

In India where the economy is still developing and capital markets are still in a vulnerable condition, according to our knowledge very few studies have been made so far to investigate the relationship between stock prices and exchange rates. Those that were conducted found conflicting results which encourages us to conduct the study to detect the relationship between the variables. Data used in this study include monthly average nominal exchange rates of the US dollar in terms of the Indian Rupee (INER), monthly closing values of the Bombay Stock Exchange index (INSP) for a period of January 2004 to July 2013.

The remainder of the paper is organized as follows. Chapter 2 provides literature review and Chapter 3 discusses the data and the appropriate time frame for the study and methodological issues. Chapter 4 provides empirical results and findings and a conclusion are given in Chapter 5.

Chapter 2

Literature Review

The price of individual stocks and the variations in rates of currency are subjects that have been extensively researched by such scholars as Franck and Young (1972). These authors employed six exchange rates and two samples of finance criteria to analyze their results. Aggarwal (1981), Soenen and Henniger (1988), witnessed the correlational relationship between two of the financial criteria. Aggarwal is the scholar who uncovered the following interesting facts. He concluded that the variations in both the exchange rates and stock prices, if one is stronger, then the other one is going to be stronger and if the other one is weaker, then the other one is going to also be a lot weaker, or less strong. However, not all scholars have agreed with the findings that Aggarwal came up with. This is important because whenever scholars disagree on such a fundamental issue. Soenen and Henniger, for instance, found a negative relationship between stock prices and exchange rates. What could account for this significant difference...two or three scholars coming to starkly opposite findings?

Solnik employed OLS regression analysis, and he came up with both positive and negative correlations between stock prices and exchange rates, depending on the time of the study. Also important was the type of stock that was under consideration, as well as the fact that there are economic cycles, and other sources of financial data that must be considered.

Other scholars have also contributed to this very important discussion. For example, Ma and Kao (1990) employed, not regression analysis, but instead an asset pricing model that shines new light on the dilemma. Their time period was between

the years 1983-1993 and based on what we have seen before, that should deliver different results. As it happens, this is true, but does not explain the full story. There are ambiguities that must be solved, and one is what type of economy is under discussion. If the country is importing, that will show different results than a country that is export oriented. The balance of trade is affected, whether a country is industrialized, developing, etc., also has a fundamental impact on stock prices. All of these criteria must be considered. Analyzing quantitative criteria under circumstances like this is markedly different from analyzing quantitative data. One deals with numbers, and one doesn't. Both can reveal a lot of useful and distinctive information, but qualitative data can also give us additional advantages, but along with its increased usefulness also comes increased complexity and ambiguity. These must be sorted out before we can make impactful results. Analysis of statistics can help with this procedure. How a market is structured impacts the correlation between stock market prices and exchange rates, and this is just one of many different factors, as we see in this paper.

Smith (1992) is another scholar who has weighed in on this particular discussion. Instead of using the OLS regression analysis model or an asset pricing model, but instead he employed a portfolio balancing model. As the name suggests, this analysis procedure has to deal with exchange rates and the impact had on them by a variety of factors to do with stock markets and their accompanying prices. His findings demonstrate that stock prices have a negative correlation with exchange rates, but equity value does offer a strong and positive correlation with exchange rates.

Taylor and Tonks (1988) did not use regression analysis, an asset pricing model or a portfolio model. Instead, he employed what is known as the Granger causality system or model. The findings of his study using this particular methodology were that because of the co-integration displayed the model. There was no correlation between exchange rates and the stock prices. One factor that is very important to factor into this equation is exchange control. That particular principle is vital to understand in this context due to the fact that when exchange control is lesser, then the correlation is correspondingly going to be decreased, also. Alternatively, when exchange control is greater, then the relationship between stock prices and exchange rates is accordingly going to also be greater. The literature displays the fact clearly that this is so, given the reality that in the United Kingdom co-integration was pursued after 1979, but not before. In other words, the indexes relating to the stock market were not integrated before the year 1979. That shows therefore less of a correlation between stock markets and exchange prices.

Oskooe and Sohrabian (1992) have also had an opinion on this important discussion. Instead of the models discussed above, between the years 1973 and 1988, so a 15 year period, they found that in some cases there was correlation between stock market prices and exchange rates, but only under certain conditions. One of these important conditions is the economy. Another is whether the results are tested in a monthly or quarterly fashion. They discovered actually that there is a connection that is definite between stock market prices and exchange rates; however, it is not a long term, but rather a short-term one. And the connection or correlations goes both ways, and not just in one way.

Most interestingly, from the perspective of this paper, is what has happened in the context of India. Is it different from what has happened in the West? Let us look now. Abdalla and Murinde (1997) conducted a study, which had the following findings: In India, Korea, Pakistan and the Philippines, exchange rates have had a measurable effect on stock market prices, but not the other way around. In other words, the causality has occurred in one direction. There has not been an impact in these countries during the 1970s and '80s for exchange rates on stock market prices, or both ways, but just in the one direction of exchange rates on stock market prices. The bivariational model is what was used here, not regression analysis. Therefore, a finding can also be made to the effect that the kind of methodology used also has a definitive impact on the findings of a particular study.

Once we start talking about different countries, we will arrive at the conclusion that sometimes developing countries will be involved. Some issues that are discussed in theoretical papers are just that, theories. But this is an exception because whether or not there is a definite correlation or connection between stock prices and exchange rates has a strong impact on a nation's economy and because of that leaders of a nation have a responsibility to the citizens of each of their countries to be careful when planning financial reform or policies. If stock markets can be affected by exchange rates, and that is what this study shows, that has economic consequences, and leaders should consider such findings. That is the very practical merit of these studies. In a developed country, it does not matter so much. Of course, economic decisions are always important and vital, no matter how economically healthy a nation is, because no

country can afford to make one disastrous economic decision after another. However, it cannot really be denied that the developed countries in the West are much better off in a financial sense than the developing countries in the East, but still, no country can ignore the economy.

Two other scholars who have done a lot of research on the current topic include Pethe and Karnik (2000). They studied the effect of stock prices on exchange rates, in the context of the rupee. The period of time is always different when these scholars discuss this particular issue. In this case, they used the years 1992 to 1997 as a guide for their research. They did not use a regression analysis, portfolio model or any of the other methodological mechanisms outlined in this paper. Instead, they employed a co-integration model like was discussed already, but also a unit root test and along with it, an error correction model. Using this combination approach, these academics deduced that there was no definitive correlation or connection between stock market prices and exchange rates.

Karmarkar and Kawadia (2011) also contributed to this study. They used the methodology of coefficient determination and regression analysis. The conclusion was that there is an inverse relationship that is proportional between the stock price and exchange rate according to the Indian rupee. The period of time under consideration was one year, 2000. The information surrounding this year might be skewed because of the Y2K phenomenon, where people were worried about all computers crashing. That would affect things for several months afterward but that is my own theory and has nothing to do with the literature I studied of. It is just something I thought of. It also

shows again the difference between quarterly and monthly analysis, because a significant event would more strongly impact a monthly analysis than a quarterly one.

Bhattacharya et al (2002) have also discussed this issue. I discussed earlier the balance of trade that a country has, and the meaning of that term is something that Bhattacharya et al have used in their analysis, also. It is the balance of imports and exports for a country. It is more financially healthy for a country if they export more than they import because they usually have to pay a tariff or tax on what they import or bring into the country. And this means more money for their own country, which helps them to improve the standard of living for the people living in their country. Like I mentioned earlier, especially developing countries have to worry about the economic status of their nation because they are often in a position of jeopardy when it comes to financial health. This particular study shows that the relationship between exchange rates and stock market prices is non-existent or rather, that there is no direct correlation or connection between the two phenomena.

Muhammad (2002) also conducted a study that is relevant to this discussion of exchange rates and stock prices. Earlier, I discussed the difference between short and long-term impacts of these two criteria. The countries that Muhammad discussed included India, but also Sri Lanka, Bangladesh and Pakistan. This time, the years 1994 to 2000 were the ones under discussion. Instead of a quarterly analysis, he conducted a monthly analysis. In addition, he studied a Granger causality test, as well the co-integration model. The conclusions drawn by Muhammad were that there was no correlation in the long term between stock market prices and exchange rates when we

are discussing India (or Pakistan). However, the situation is different in other countries. For instance, in Bangladesh and Sri Lanka, there is a relationship between exchange rate and stock prices, but it is not short term; instead, it is long term. In Sri Lanka, additional conclusions were drawn concerning the co-integration. The Granger causality test demonstrated the following: In Sri Lanka, there is a two-way correlation between exchange rates and stock prices.

These quick examples show clearly that there is no easy answer to the connection if any between stock prices and exchange rates. One of the most important is which country is under discussion. Even among developing countries, there is a wide range of differences between one country's relationship between stock prices and exchange rates.

Nath and Samanta (2003) also have weighed in on this discussion. Their findings were arrived at using the particular methodology of Granger causality. The period of time that they used to achieve their results and conclusions were between the years 1993 and 2002, and they published their study one year later. They found that there is no correlation between exchange rates and stock prices. They did find that there were a few exceptions based on government policies such as whether or not trade was more or less free. Therefore, not only elements within each country are important, but also their results can also help us to face the fact that relations between countries, especially in an economic sense, are also fundamentally important. Once again, there are many factors which affect the correlation between exchange rates and stock prices.

Mishra (2004) has also an opinion on these matters, and he wrote in the context of India, also. The methodology employed this time was the causality test of Granger, as well as regression analysis. Monthly results were used, not quarterly, which does affect the results, as we have seen before. The period studied was the year 1992 to 2002, so an entire decade of results was included in these two different types of analyses. The conclusion reached was that there was no correlation between stock prices and exchange rates.

Chapter 3

Data and Research Methodology

3.0 Sample

When figuring out the population that will be represented, one of the decisions that has to be made is where to get the information that will be used in the research. To ascertain the affect of stock prices on exchange rates, and vice versa, you go to the relevant stock exchange, which in this case is the Bombay Stock Exchange in India. Another important resource is the Yahoo Finance section, and it contains very reliable sources. This site is www.yahoofinance.com and the other useful one for my purposes is Oanda, the currency site, www.oanda.com/currency/historical-rates/.

The two main time periods were monthly and quarterly that were used in this paper. Monthly Stock returns have been calculated by taking the natural logarithm of monthly closing price, i.e. $r = \ln S(t)/S(t)\text{-}1$, where S(t) is the closing stock price of the t^{th} month. Similarly, natural logarithm of monthly exchange rates has been computed as $\ln E(t)/E(t)\text{-}1$. The values obtained are used for studying the relationship between stock prices and exchange rates. Line plots, so obtained, are shown in Figures A.1 and A.2 respectively in Appendix A.

There were various methodologies used in the formation of this paper: Regression analysis, the portfolio model, the Granger analysis, the bivariational model, the asset pricing model. The fact that there are different methodologies (and different time periods, quarterly and monthly) and different countries being studied, results vary

considerably, although in a lot of cases, it was found that there is no correlation, especially in the short run, between exchange rates and stock market prices.

3.1 Normality Test

The Jarque-Bera (JB) test (Gujarati, 2003) is used to test whether stock returns and exchange rates individually follow the normal probability distribution. The JB test of normality is an asymptotic, or large-sample, test. This test computes the skewness and kurtosis measures and uses the following test statistic:

$$JB = n [S2 /6 + (K-3)2 /24] \quad (3.1)$$

Here n = sample size, S = skewness coefficient, and K = kurtosis coefficient. For a normally distributed variable, S = 0 and K = 3. Therefore, the JB test of normality is a test of the joint hypothesis that S and K are 0 and 3 respectively.

3.2 Unit Root Test (Stationary Test)

Empirical work based on time series data assumes that the underlying time series is stationary. Generally speaking a data series is said to be stationary if its mean and variance are constant (non-changing) over time and the value of covariance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance is calculated (Gujrati, 2003). A unit root test has been applied to check whether a series is stationary or not. Stationarity condition has been tested using Augmented Dickey Fuller (ADF) (Gujarati, 2003).

3.2.1 Augmented Dickey–Fuller (ADF) Test

Augmented Dickey-Fuller (ADF) test has been carried out which is the modified version of Dickey-Fuller (DF) test. ADF makes a parametric correction in the original DF test for higher-order correlation by assuming that the series follows AR (p) process. The ADF approach controls for higher-order correlation by adding lagged difference terms of the dependent variable to the right-hand side of the regression. The Augmented Dickey-Fuller test specification used here is as follows:

$$\Delta Y_t = b_0 + \beta\, Y_t\text{-}1 + \mu_1\, \Delta Y_t\text{-}1 + \mu_2\, \Delta Y_t\text{-}2 + \ldots. \quad + \mu_p\, \Delta Y_t\text{-}p + e_t \qquad (3.2)$$

Here Y_t represents the time series to be tested, b_0 is the intercept term, β is the coefficient of interest in the unit root test, μ_i is the parameter of the augmented lagged first difference of Y_t to represent the p^{th}-order autoregressive process, and e_t is the white noise error term.

Chapter 4

Empirical Results

As discussed in the research and methodology, the analysis of the data was conducted in three steps. First, a normality test was used on both the series to determine the nature of their distributions. Jarque-Bera statistics were computed for this purpose, which are shown in Table 4.1 along with statistics for the two series. Skewness value 0 and kurtosis value 3 indicate that the variables are normally distributed. The skewness coefficient, in excess of unity is taken to be fairly extreme (Chou, 1969). High or low kurtosis value indicates extreme leptokurtic or extreme platykurtic (Parkinson, 1987). From obtained statistics, it is evident that both the variables are non-normally distributed, as the Skewness values for Stock Returns and exchange rates are -0.59995563 and 0.82848 respectively and the kurtosis values are 5.010639 and 4.779425 respectively.

Second**,** having stated the non-normal distribution of the two variables, the question of stationarity of the two time series posed concerns. The simplest way to check for stationarity is to plot time series graph and observe the trends in mean, variance and autocorrelation. A time series is said to be stationary if its mean and variance are constant over time. The line plots for the two series (log normal value of relatives) are shown in Figures A.3 and A.4 respectively (See Appendix A). The mean and variance appear to be constant as the plot trends neither upward nor downward. At the same time, the vertical fluctuations also indicate that the variance, too, is not changing. This hints that stationarity in both the series in their level forms. Since in addition to visual inspection, formal econometric tests are also needed to unambiguously

decide the actual nature of time series, an ADF test was performed to check the stationarity of the time series. The results of ADF test are shown in Appendix B as Table B.2 (a) and (b). Linking the obtained ADF statistics for the two variables with the critical values for rejection of hypothesis of existence of unit root, it can be seen that the obtained statistics for stock returns and exchange rates fall behind the critical values even at 1% significance levels. Hence it can be concluded on the basis of ADF test statistics that stock returns and exchange rates, both, found to be stationary at level form.

Third, a correlation test was conducted between stock returns and exchange rates. This test can be seen as a first indication of the existence of interdependency among time series. Table B.3 shows the correlation coefficients between stock returns and exchange rates. From the derived results, it can be observed that the coefficient of correlation to be -0.4162, which is indicative of negative correlation between the two series. Thus, it can be stated that the two series are weakly correlated.

Chapter 5

Conclusion

This research empirically studies the dynamic relationship between stock prices and exchange rates, in terms of the extent of interdependency. The total values of data were converted to log normal forms and checked for normality. Jarque-Bera test yielded statistics that affirmed the non-normal distribution of both the variables. This raised questions on the stationarity of the two series. Hence subsequently, stationarity of the two series was checked with ADF test and the results showed stationarity at level forms for both the series. Then, the coefficient of correlation between the two variables was computed, which indicated the negative correlation between them.

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Appendix

Figure A.1

Figure A.2

Figure A.3

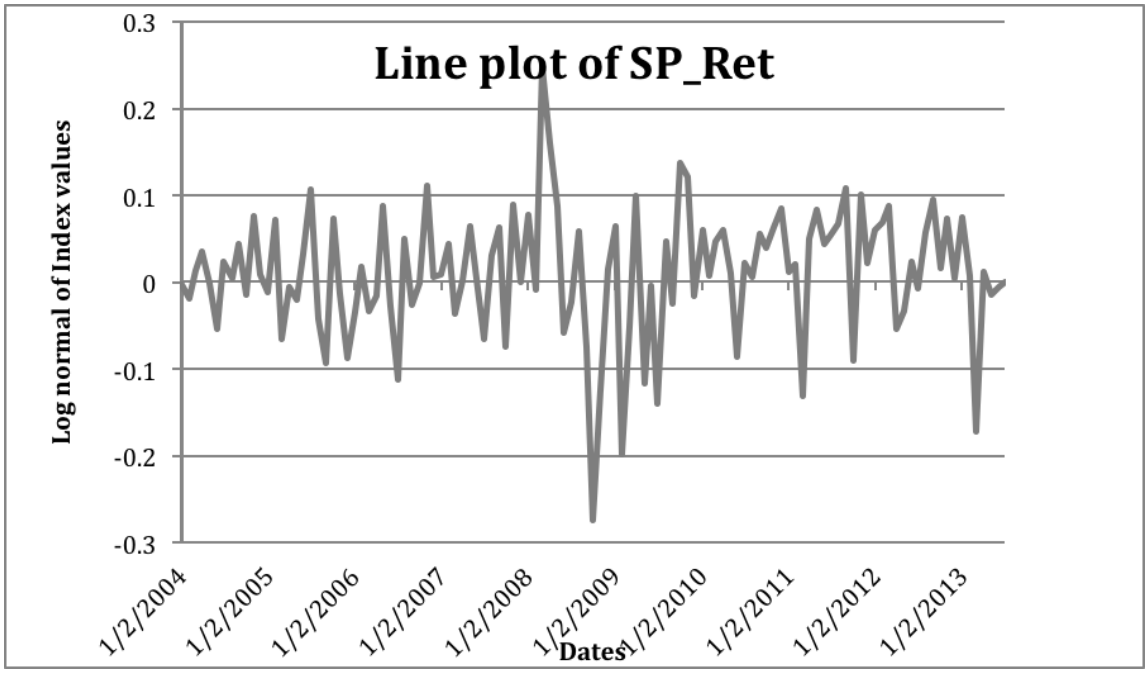
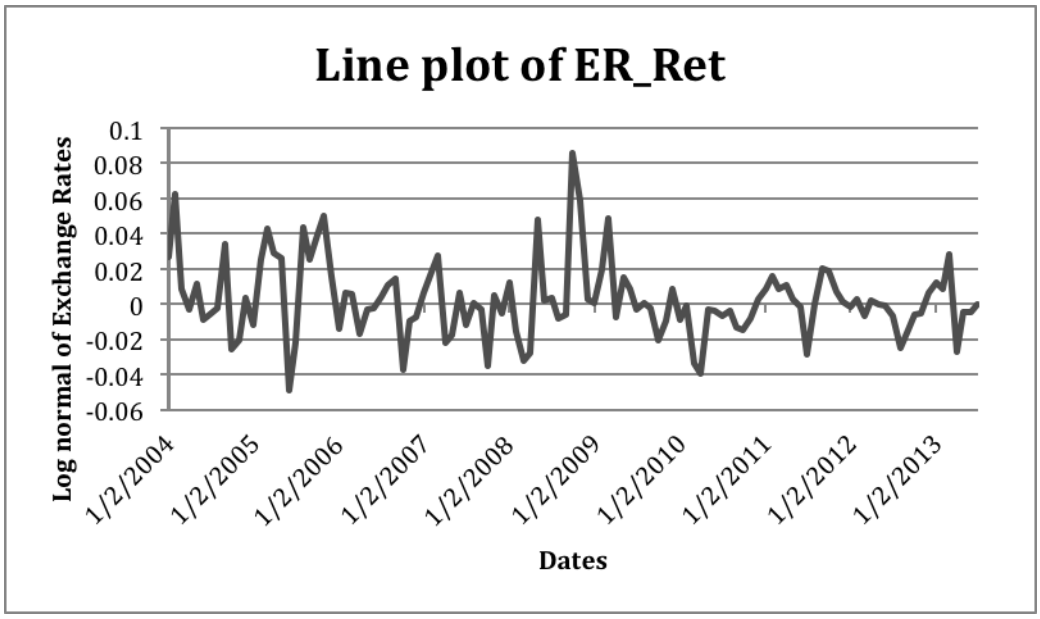


Figure A.4



Appendix B

Table B.1 Descriptive Statistics

	Stock Returns	Exchange Rates
Observations	114	114
Mean	0.010726	0.0024184
Maximum	0.2488511	0.0861316
Minimum	-0.2729919	-0.049313
Std. Deviation	0.0740887	0.0218284
Skewness	-0.5995563	0.82848
Kurtosis	5.010639	4.779425
Result	Not Normal	Not Normal

Table B.2 Results of Augmented Dickey Fuller Test

(a) ADF on Stock Return Series

```
. reg dSPret mdate  SP_ret_1 dSP_ret_2 dSP_ret_3

      Source |       SS       df       MS              Number of obs =     111
-------------+------------------------------           F(  4,   106) =   22.64
       Model |  .516051436     4  .129012859            Prob > F      =  0.0000
    Residual |  .604038182   106  .005698473            R-squared     =  0.4607
-------------+------------------------------           Adj R-squared =  0.4404
       Total |  1.12008962   110  .010182633            Root MSE      =  .07549

------------------------------------------------------------------------------
      dSPret |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       mdate |  -6.58e-06   7.42e-06    -0.89   0.378    -.0000213    8.14e-06
    SP_ret_1 |  -.8586121   .1587988    -5.41   0.000    -1.173446    -.543778
   dSP_ret_2 |  -.0498051   .1305781    -0.38   0.704    -.3086889    .2090786
   dSP_ret_3 |  -.0838115   .0966709    -0.87   0.388    -.2754709    .1078479
       _cons |   .1270152   .1330904     0.95   0.342    -.1368496    .3908799
```

(b) ADF on Exchange Rates Series

```
. reg  mdate dERret ER_ret_1 ER_ret_2 ER_ret_3
```

Source	SS	df	MS		
Model	5139625.31	4	1284906.33		
Residual	100436998	106	947518.851		
Total	105576623	110	959787.486		

Number of obs	111
F(4, 106)	1.36
Prob > F	0.2542
R-squared	0.0487
Adj R-squared	0.0128
Root MSE	973.41

mdate	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dERret	5337.152	4489.222	1.19	0.237	-3563.168	14237.47
ER_ret_1	17238.79	7497.359	2.30	0.023	2374.543	32103.03
ER_ret_2	-7519.635	5555.463	-1.35	0.179	-18533.88	3494.61
ER_ret_3	-4740.219	4615.219	-1.03	0.307	-13890.34	4409.901
_cons	17829.59	93.81419	190.05	0.000	17643.59	18015.58

Table B.3 Correlation Coefficients Matrix

```
. correlate SP_Ret ER_Ret
(obs=114)
```

	SP_Ret	ER_Ret
SP_Ret	1.0000	
ER_Ret	-0.4162	1.0000