Impact of Exchange rate Volatility on Stock Returns - An Empirical Study on Selected Small and Medium Enterprises (SMEs) in Indian Pharma Sector

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Abstract

This paper empirically investigates the relationship between stock returns and Indian rupee-US Dollar Exchange Rates. To study the relation between stock returns of pharma companies and exchange rate volatility,based on the availability of data and judgemental sampling, a sample of 20Small and Medium Enterprises(SMEs) in Indian pharma sector has been chosen. A number of statistical tests have been applied in order to study the behaviour and dynamics of both the series. Using monthly time series data, the empirical analyses has been carried out for the period 2005 to 2013. Various statistical techniques have been applied to determine the normality, stationarity, correlation, co-integration andheteroscedasticity between the two series i.e. stock returns and Indian rupee-US Dollar Exchange Rates.

Key words*: Co-integration, Correlation, Heteroscedasticity, Normality, Stationarity.*

Introduction

The recent fall in the exchange rate of the leading currencies raised renewed concerns among policy makers as well as investors in examining the nature and causes of such wailing decline. All emerging economy currencies depreciated abruptly against the US Dollar in the second-half of 2011 with the exchange rate of the Indian Rupee (INR) said to be the worst performing currency among them. Emerging market economies (EMEs) with a surplus or a small deficit in the current account were less hit than countries that have a sizeable deficit like India. Although the sharp fall and volatility in the exchange rate of the Indian rupee could be largely ascribed to macroeconomic factors, *inter alia*, current account deficit and capital outflows, wherein spill over effects stemming from other volatile markets due to differences in timing of trading activity, bid-ask spreads and risk perceptions cannot be ruled out. Furthermore, the recent severe fall in the exchange rate of the Indian rupee could also be attributed to the growing integration among the financial markets world over in which the confidence channel seems to have also played a significant role against the backdrop of the Eurozone sovereign debt crisis and the consequent external economic environment. In the past decades, there has been an exceptional increase in cross border transactions between countries in terms of goods and financial flows leading to growing integration of emerging markets with the developed one. This integration has been further powered by search for higher returns, risk diversification, cost effective and more efficient factors of production and expectation of global supremacy in the worldwide market place. An important result of these capital flows was its impact on linkages of global asset returns and spill over of volatility from one capital market to another. As a result, a financial crisis originating in a particular country/region, has extended geographically which included large and unexpected movements in the prices of various financial instruments, including foreign exchange rates (Dooley and Hutchinson, 2009; Melvin and Taylor, 2009; and Muller and Verschoor, 2009).

Volatility of returns is a vital subject for researchers in financial economics and analysts in financial markets. The prices of stocks and other assets depend on the expected volatility (covariance structure) of returns. Banks and other financial institutions carryout volatility assessments as a part of monitoring their risk exposure. Up until the 1980s, both researchers and practitioners in financial markets applied models in which volatility was assumed constant over time. Volatility may vary considerably over time: large (small) changes in returns are followed by large (small) changes. The modelling and forecasting of volatility are therefore essential for financial markets. Research on volatility models was initiated by Robert Engle who, in the early 1980s, developed a new concept that he termed autoregressive conditional heteroskedasticity, and acronymized ARCH. Since their advent, models built around this concept have become an instrumental tool for financial analysts, bankers and fund managers throughout the world. For two decades, Robert Engle has remained at the forefront of research on volatility modelling and made several outstanding contributions in this area.

Indian pharmaceutical industry will be third largest pharmaceuticals market by 2020. 20% of global exports in generics will be from India. Industry is expected to earn US$45 billion in revenue by 2020. US$ 200 billion projected to be spent on infrastructure by 2024. The country's pharmaceuticals industry accounts for about 2.4% of the global pharmaceutical industry by value and 10% by volume. Industry revenues are expected to expand at a CAGR of 12.1% during 2012-20 and reach US$45 billion. The healthcare sector in India is expected to grow to US$250 billion by 2020 from US$65 Billion currently. The generics market is expected to grow to US$26.1 billion by 2016 from US$ 11.3 billion in 2011.

Immense studies have been carried out on exchange rate volatility. However, in most of the studies macro-economic aspects have been discussed. Least attention has been put on specific export sectors and the performance of companies operating under these sectors. The effect of volatility on financials of the companies like revenue, operating profits, expenses, and share prices have been rarely discussed. The present study is an attempt to examine the relation between stock returns of selected multinational pharmaceuticals SMEs of India and exchange rate volatility. Applying monthly time series data this paper tries to empirical analyse how changes in exchange rates and stock prices are related to each other over the period 2005 to 2013. The organization of the paper is done as follows: Section 2 contains a brief literature review. Methodology and empirical results are presented in Section 3 and 4 respectively. Concluding remarks take place in Section 5.

Literature Review

After the collapse of the Bretton woods system, exchange rates across the globe have fluctuated widely. Since then, there has been extensive debate about impact of exchange rate volatility on international trade. A significant amount of literature investigates the influence of exchange rate volatility on stock returns across various nations. Aggarwal(1981), Soenen and Hennigar (1988) in their studyreflected only the correlation between the two variables-exchange rates and stock returns. They explained that a change in the exchange rates would affect a firm's foreign operation and overall profits which would, in turn, affect its stock prices, depending on the multinational characteristics of the firm. On the contrary, a general downward movement of the stock market will motivate investors to seek for better returns elsewhere. This decreases the demand for money, pushing interest rates down, causing further outflow of funds and hence depreciating the currency. While the theoretical explanation was clear, empirical evidence was mixed. Maysami-Koh(2000), examined the impacts of the interest rate and exchange rate on the stock returns and revealed that the exchange rate and interest rate are the determinants in the stock prices. Oskooe and Sohrabian (1992) used Cointegration test for the first time and concluded bidirectional causality but no long term relationship between the two variables. Najang and Seifert(1992), employing GARCH framework for daily data from the U.S, Canada, the UK, Germany and Japan, showed that absolute differences in stock returns have positive effects on exchange rate volatility. Ajayi and Mougoué (1996)selected daily data from 1985 to 1991 for eight advance economic countries; employed error correction model and causality test and ultimately discovered that increase in aggregate domestic stock price has a negative short-run effect and a positive long-run effect on domestic currency value. On the other hand, currency depreciation has both negative short-run and long-run effect on the stock market. Abdalla and Murinde(1997) used data from 1985 to 1994, giving results for India, Korea and Pakistan that suggested exchange rates *Granger cause* stock prices. But, for the Philippines the stock prices lead the exchange rates Abhay Pethe and Ajit Karnik (2000) have investigated the inter – relationship between stock prices and important macroeconomic variables, viz., exchange rate of rupee vis - a -vis the dollar, prime lending rate, narrow money supply, and index of industrial production. The analysis and discussion are situated in the context of macroeconomic changes, especially in the financial sector, that have been taking place in India since the early 1990s. Agarwal (1997), Chakrabarti (2001) and Trivedi & Nair(2003), have shown that equity return has positive impact on FII. Ajayi et al (1998). explored the causal relations for seven advanced markets from 1985 to 1991 and eight Asian emerging markets from 1987 to 1991 and supported unidirectional causality in all the advanced economies but no consistent causal relations in the emerging economies. They elucidated the various results by the differences in the structure and characteristics of financial markets between these groups. Morley and Pentecost (2000) conducted a study on G-7 countries, finally stating that the reason for the lack of 7 strong relationships between exchange rates and stock prices may be due to the exchange controls that were in effect in the 1980s. Nieh and Lee I (2001)scrutinized the relationship between stock prices and exchange rates for G-7 countries for the period from October 1, 1993 to February 15, 1999.They don't found any significant long-run equilibrium relationship for each G-7 countries. Kim (2003)indicated that S&P's common stock price is negatively related to the exchange rate. Smyth and Nandha studied the relationship for Pakistan, India, Bangladesh and Sri Lanka over the period 1995-2001. Theyverified no long run relationship between variables. Unidirectional causality was seen running from exchange rates to stock prices for only India and Sri Lanka. Ibrahim and Aziz examined dynamic linkages between the variables for Malaysia, using monthly data over the period 1977-1998 and their results showed that exchange rate is negatively associated with the stock prices. Gordon & Gupta (2003) and Babu and Prabheesh (2007) found bidirectional causality and opined that foreign investors have the ability of playing like market makers given their volume of investments. Marey (2004) on the basis of a survey data observed that long term expectations are not only heterogeneous but are also not effectively described by the rational expectations. In his own research, Marey (2004) investigated the level of plausibility of standard exchange rate expectations mechanism which in an artificial economy are found to be favored by heterogeneous traders, the research concludes that adaptive expectations market exhibits more serial correlation because it bandwagons the expectations market. Secondly, the extrapolative expectations marketsometimes generates extreme returns and thus cannot be empirically plausible and finally, the regressive expectations market reproduces stylized facts of empirical quarterly exchange rates.

Griffin (2004) stated foreign flows are significant predictor of returns in Thailand, India, Korea, Taiwan and Doong et al. (2005) showed that these financial variables are not cointegrated. Bidirectional causality could be detected in Indonesia, Korea, Malaysia and Thailand and significantly negative relation between the stock returns and the contemporaneous change in the exchange rates for all countries except Thailand.Ozair(2006) and Vygodina(2006) worked with US data. Though Ozair detected no causal linkage and no Cointegration between these two financial variables, the latter claimed causality from large-cap stocks to exchange rates. Kurihara (2006) studied Japanese stock prices, U.S. stock prices, exchange rate, Japanese interest rate etc.(for a period of March 2001 to September 2005) anddisclosed that exchange rate and U.S. stock prices affected Japanese stock prices. Pan et al. (2007) employed data of seven East Asian countries over the period 1988 to 1998, proving bidirectional causal relation for Hong Kong before the 1997 Asian crises and unidirectional causal relation from exchange rates and stock prices for Japan, Malaysia, and Thailand and from stock prices to exchange rate for Korea and Singapore. During the Asian crises, only a causal relation from exchange rates to stock prices is seen for all countries except Malaysia. Erbaykal and Okuyan studied 13 developing economies, using different time periods and indicated causality relations for eight economies-unidirectional from stock price to exchange rates in the five of them and bidirectional for the remaining three. No causality was detected in Turkey; the reason of difference may be the time period used. Sevuktekin and Nargelecekenler (2006)observed bidirectional causality between the two financial variables in Turkey, using monthly data from 1986 to 2006. Takeshi(2008) showed unidirectional causality from stock returns to FII flows, irrelevant of the sample period in India whereas the reverse causality works only post 2003. Tsen (2011) articulated that the real exchange rate has been found to play an important role in the investment determination and the international trade systems as the appreciation of real exchange rate can lead to retarded exports, a change in the amount of debt payment that needs to be done and a growth of inflow of foreign direct investment. The economies overall can be impacted by the changes in the exchange rate. Wu et al (2012) studied the relationshipbetween the US dollar and the Stock Exchange Index. Their research focused on the Philippine Stock Exchange. According to the authors, such a research can actually help in guiding the government of countries to macro manage the investor returns on the stocks and thus in effect control the inflow of foreign direct investment into the country.

Data & Methodology

The present study is focused on studying the dynamics between stock returns volatility and exchange rates movement. Based on judgemental sampling and availability of data a sample of 20 multinational SMEs from India have been selected for this study. The frequency of data is kept at monthly level and time span of study is taken from 2005 to 2013. Data has been collected from BSE and Oanda.

Monthly stock returns have been calculated by taking the natural logarithm of the closing price relatives, i.e. r = ln P(t)/P(t-1) ,where P(t) is the closing price of the tth month. Similarly, natural logarithm of the exchange rate relatives have been computed as ln E(t)/E(t-1). The values so obtained have been employed for studying therelationship between stock returns and exchange rates.

To study empirically the behaviour of the two time series (Stock returns and Exchange rates) variables, following hypothesis are stated and tested:

Hypothesis 1: Stock returns and exchange rates are not normally distributed.

Hypothesis 2: Unit Root exists (i.e. non stationarity) in both the series.

Hypothesis 3: Correlation exists between the two variables-Stock returns and Exchange rates.

Hypothesis 4: Residuals are homoscedastic

Hypothesis 5: Two time series are cointegrated.

Following methods/tools are used to test the above hypotheses and subsequently draw inferences about the behaviour and dynamics of the two variables.

Normality

The classical *normal* linear regression model assumes that each $u_i$is distributed *normally* with

Mean: $E(u_i) = 0$

Variance: $E[u_i - E(u_i)]^2 = E(u_i^2) = \sigma^2$

cov (u_i, u_j): $E\{[(u_i - E(u_i)][u_j - E(u_j)]\} = E(u_i\, u_j) = 0 \quad i \neq j$

The assumptions given above can be more compactly stated as

$$u_i \sim N(0, \sigma^2)$$

where the symbol ∼ means *distributed as* and N stands for the *normal distribution,* the terms in the parentheses representing the two parameters of the normal distribution, namely, the mean and the variance. For **two normally distributed variables, zero covariance orcorrelation means independence of the two variables.** Therefore, with the normality assumption, means that *ui* and u_j are not only uncorrelated but are also independently distributed.

$$u_i \sim \text{NID}(0, \sigma^2)$$

where **NID** stands for *normally and independently distributed.*

The JB test of normality is an *asymptotic,* or large-sample, test. It is also based on the OLS residuals. This test first computes the **skewness** and **kurtosis** measures of the OLS residuals and uses the following test statistic:

$$\text{JB} = n\left[\frac{S^2}{6} + \frac{(K-3)^2}{24}\right]$$

where 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. In that case the value of the JB statistic is expected to be 0. Under the null hypothesis that the residuals are normally distributed, Jarque and Bera showed that *asymptotically (i.e., in large samples) the JB statistic follows the chi-square distribution with 2 df.* If the computed p value of the JB statistic in an application is sufficiently low, which will happen if the value of the statistic is very different from 0, one can reject the hypothesis that the residuals are normally distributed. But if the p value is reasonably high, which will happen if the value of the statistic is close to zero, we do not reject the normality assumption.

Stationarity

A stochastic process is said to be covariance stationary if:

(i) $E\{X(t)\} = \mu$ for all t;

(ii) Var$\{X(t)\} < \infty$ for all t; and

(iii) Cov$\{X(t), X(t+j)\} = \gamma j$ for all t and j.

This is sometimes referred to as weekly stationary, or simply stationary. Such stationary processes have finite mean, variance and covariance that do not depend on the time t, and the covariance depends only on the interval j. A strictly stationary process has met the above conditions (i) and (iii), and been extended to higher moments or orders. It states that the random vectors $\{X(t1), X(t2), \ldots X(tn)\}$ and $\{X(t1+j), X(t2+j), \ldots X(tn+j)\}$ have the same joint distribution. In other words, the joint distribution depends only on the interval j but not the time t. That is, the joint probability density $p\{x(t), x(t + \tau 1), ..x(t + \tau n)\}$, where $\tau i = ti - -ti-1$, depends only on the intervals $\tau 1 , \cdots \tau n$ but not t itself. A second-order stationary process is not exactly covariance stationary as it is not required to meet condition (ii). Therefore, a process can be strictly stationary while being not covariance stationary, and vice versa.

In the terminology of time series analysis, if a time series is stationary it is said to be integrated of order zero, or I (0) for short. If a time series needs the difference operation once to achieve stationarity, it is an I (1) series; and a time series is I (n) if it is to be differenced for n times to achieve stationarity. An I (0) time series has no roots on or inside the unit circle but an I (1) or higher-order integrated time series contains roots on or inside the unit circle. So, examining stationarity is equivalent to testing for the existence of unit roots in the time series.**The basic Dickey–Fuller (DF) test (Dickey and Fuller, 1979, 1981**) **is to examine whether ρ < 1**. The null hypothesis is that there is a unit root in yt , or H0 : θ = 0, against the alternative H1 : θ < 0, or there is no unit root in yt . The DF test procedure emerged since under the null hypothesis the conventional t-distribution does not apply. So whether θ < 0 or not cannot be confirmed by the conventional t-statistic for the θ estimate. Indeed, what the Dickey–Fuller procedure gives us is a set of critical values developed to deal with the non-standard distribution issue, which are derived through simulation.

Cointegration

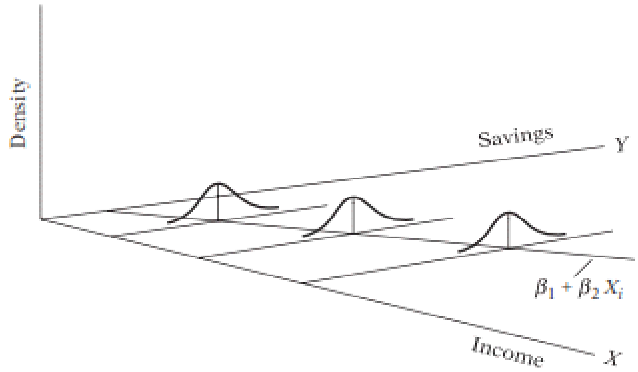
Cointegration is one of the most important developments in time series econometrics in the last quarter century. A group of non-stationary I (1) time series is said to have Cointegration relationships if a certain linear combination of these time series is stationary. There are two major approaches to testing for Cointegration, the Engle–Granger two step method (Engle and Granger, 1987) and the Johansen procedure (Johansen, 1988, 1991; Johansen and Juselius, 1990). In addition, procedures for panel Cointegration (Kao and Chiang, 1998; Moon and Phillips, 1999; Pedroni, 1999) have been recently developed, in the same spirit of panel unit roots and to address similar issues found in unit root tests. Since most panel Cointegration tests employ the same estimation methods of or make minor adjustments in relation to the asymptotic theory of non-stationary panel data, they are not to be discussed in this chapter. The Engle–Granger method involves firstly running regression of one variable on another, and secondly checking whether the regression residual from the first step is stationary using, say, an ADF test. In this sense, the Engle Granger method is largely the unit root test and will not be deliberated either

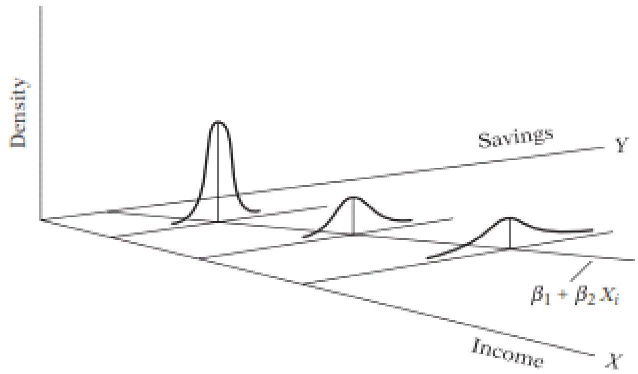
Heteroscedasticiy

One of the important assumptions of the classical linear regression model is that the variance of each disturbance term u, conditional on the chosen values of the explanatory variables, is some constant number equal to s_{i2}. This is the assumption of **homoscedasticity,** or *equal* (homo) *spread* (scedasticity), that is, *equal variance*. Symbolically,

$$E(u_i^2) = \sigma^2 \qquad i = 1, 2, \ldots, n$$

Diagrammatically, in the two-variable regression model homoscedasticity can be shown in following figures:





First, figure above shows, the conditional variance of Y_i (which is equal to that of u_i), conditional upon the given X_i , remains the same regardless of the values taken by the variable X. In contrast, secondfigure shows that the conditional variance of Y_i increases as X increases. Here, the variances of Y_i are not the same. Hence, there is heteroscedasticity.To make the difference between homoscedasticity and heteroscedasticity clear, assume that in the two-variable model Y_i, Y represents savings and X represents income. Figures above show that as income increases, savings on the average also increase. But in firstfigure, the variance of savings remains the same at all levels of income, whereas in second figure, it increases with income. It seems that in secondfigure, the higher-income families on the average save more than the lower-income families, but there is also more variability in their savings.

4. Empirical Analysis

As discussed in the methodology, the empirical analysis of the data was conducted in four steps.

First, normality test was applied on both the series to determine the nature of their distributions. For this purpose, Jarque-Bera statistics were computed, which are shown in Table 1. 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].Barring few SMEs stock returns, it is evident from the obtained statistics, that both the variables are non-normally distributed, as the skewness values ofstock returns and exchange rates are less than the critical value (@ alpha =0.05).

Second**,** after verifying the non-normal distribution of the two variables, the question of stationarity of the two time series postured concerns. A time series is considered to be stationary if its mean and variance are constant over time. To explicitly decide the actual nature of time series, ADF test was performed to check the stationarity of the time series. The results are shown in Table 2. Relating the obtained ADF statistics for the two variables with the critical values for rejection of hypothesis of existence of unit root, it becomes apparent that the computed p-values are lower than the significance level alpha = 0.05 thereby, leading to the rejection of the hypothesis of unit root for both the series. Hence, it can be safely verified on the basis of ADF test statistics that stock returns as well as exchange rates are, both, found to be stationary at level form. It may be noted here that because of stationarity at level form in both the series, Johansen Cointegration test cannot be applied to the variables to determine long-term relationship between them.

Third, Correlation test was applied between stock returns and exchange rates. Correlation test provides the first indication of the existence of interdependency among time series. Table.3 shows the correlation coefficients between stock returns and exchange rates. From the derived statistics, it can be observed that the coefficient of correlations are mostly negative between the two series. Thus, it can be inferred that the two series are weakly correlated.

Fourth, in order to determine heteroscedasticity between the two time series Breusch-Pagan test andWhite test were applied. The results are shown in the table 4 and table 5 respectively. Barring few exceptions, it can be analysed that the computed p-values are greater than the significance level alpha = 0.05, therefore, the residuals are homoscedastic.

5. Conclusion

This study has empirically examined the dynamics between the volatility of stock returns and movement of Rupee-US$ exchange rates. Absolute values of data were converted to log normal forms and checked for normality. Jarque-Bera test affirmed non-normal distribution of both the variables that posed questions on the stationarity of the two series. Consequently, 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 mostly indicated slight negative correlation between the two time series. Finally, applying Breusch-Pagan test and White test it can concluded that the two time series are homoscedastic.

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Appendix

Table 1. Normality Tests:

Variable\Test	Shapiro-Wilk	Anderson-Darling	Lilliefors	Jarque-Bera
(Return on Shares Aurolab)	0.002	0.000	0.001	0.003
(Return on shares Bal)	0.000	0.001	0.023	< 0.0001
(Return on shares Coral lab)	0.003	0.001	0.002	0.001
(Return on shares DIL LTD)	0.051	0.013	0.005	0.090
(Return on shares Gufic)	< 0.0001	< 0.0001	< 0.0001	< 0.0001
(Return on shares Hesterbio)	0.157	0.052	0.222	0.357
(Return on shares Ishita Drugs)	< 0.0001	< 0.0001	< 0.0001	< 0.0001
(Return on shares Jagson)	< 0.0001	< 0.0001	0.001	< 0.0001
(Return on shares Jenburket)	0.003	0.001	0.000	< 0.0001
(Return on shares Kilitch)	< 0.0001	< 0.0001	0.000	< 0.0001
(Return on shares Lincon)	< 0.0001	< 0.0001	< 0.0001	< 0.0001
(Return on shares Medicamen)	0.022	0.009	0.067	0.047
(Return on shares NGL)	0.068	0.119	0.150	0.032
(Return on shares Roopa)	0.012	0.003	0.001	0.068
(Return on shares Sharon)	< 0.0001	< 0.0001	< 0.0001	< 0.0001
(Return on shares Twilight)	< 0.0001	< 0.0001	0.008	< 0.0001
(Return on shares Unja)	< 0.0001	< 0.0001	< 0.0001	< 0.0001
(Return on shares Venkat Pharma)	< 0.0001	< 0.0001	< 0.0001	< 0.0001
(Return on shares Vista)	< 0.0001	< 0.0001	< 0.0001	< 0.0001
(Return on shares Zyden)	< 0.0001	< 0.0001	< 0.0001	< 0.0001
(Variation in Exchange rate)	0.001	0.000	0.002	< 0.0001

SOURCE: Author's computation

Table 2. Unit root and stationarity tests (Dickey-Fuller test (ADF(stationary)

Variable\Test	Tau (Observed value)	Tau (Critical value)	p-value (one-tailed)	alpha
(Return on Shares Aurolab)	-5.276	-0.789	< 0.0001	0.05
(Return on shares Bal)	-4.359	-0.789	0.004	0.05
(Return on shares Coral lab)	-3.619	-0.789	0.031	0.05
(Return on shares DIL LTD)	-4.218	-0.789	0.006	0.05
(Return shares Gufic)	-4.753	-0.789	0.001	0.05
(Return on shares Hesterbio)	-4.361	-0.789	0.004	0.05
(Return on shares Ishita Drugs)	-5.529	-0.789	< 0.0001	0.05
(Return on shares Jagson)	-3.577	-0.789	0.034	0.05
(Return on shares Jenburket)	-4.376	-0.789	0.003	0.05
(Return on shares Kilitch)	-5.207	-0.789	0.000	0.05
(Return on shares Lincon)	-4.186	-0.789	0.006	0.05
(Return on shares Medicamen)	-4.760	-0.789	0.001	0.05
(Return on shares NGL)	-4.590	-0.789	0.002	0.05
(Return on shares Roopa)	-4.272	-0.789	0.005	0.05
(Return on shares Sharon)	-4.095	-0.789	0.008	0.05
(Return on shares Twilight)	-3.909	-0.789	0.014	0.05
(Return on shares Unja)	-3.843	-0.789	0.017	0.05
(Return on shares Venkat Pharma)	-4.320	-0.789	0.004	0.05
(Return on shares Vista)	-4.914	-0.789	0.000	0.05
(Return on shares Zyden)	-4.481	-0.789	0.003	0.05
(Variation in Exchange rate)	-3.700	-0.789	0.024	0.05

SOURCE: Author's computation

Table 3. Correlation matrix (Pearson)

Variables	Exchange rate
Return on Shares Aurolab	-0.198
Return on shares Bal	-0.304
Return on shares Coral lab	-0.306
Return on shares DIL LTD	-0.212
Return on shares Gufic	-0.277
Return on shares Hesterbio	-0.247
Return on shares Ishita Drugs	-0.222
Return on shares Jagson	-0.351
Return on shares Jenburket	-0.248
Return on shares Kilitch	-0.212
Return on shares Lincon	-0.177
Return on shares Medicamen	-0.077
Return on shares NGL	-0.008
Return on shares Roopa	-0.253
Return on shares Sharon	-0.351
Return on shares Twilight	-0.219
Return on shares Unja	-0.316
Return on shares Venkat Pharma	-0.231
Return on shares Vista	-0.224
Return on shares Zyden	-0.274

SOURCE: Author's computation

Table 4. Test for Heteroscedasticity (Breusch-Pagan test):

Variables/Static	LM (Observed value)	LM (Critical value)	DF	p-value (Two-tailed)	alpha
Return on Shares Aurolab	7.310	3.841	1	0.007	0.05
Return on shares Bal	0.799	3.841	1	0.371	0.05
Return on shares Coral lab	0.634	3.841	1	0.426	0.05
Return on shares DIL LTD	0.005	3.841	1	0.944	0.05
Return on shares Gufic	0.808	3.841	1	0.369	0.05
Return on shares Hesterbio	1.399	3.841	1	0.237	0.05
Return on shares Ishita Drugs	1.569	3.841	1	0.210	0.05
Return on shares Jagson	1.046	3.841	1	0.306	0.05
Return on shares Jenburket	0.632	3.841	1	0.427	0.05
Return on shares Kilitch	0.014	3.841	1	0.905	0.05
Return on shares Lincon	1.977	3.841	1	0.160	0.05
Return on shares Medicamen	0.002	3.841	1	0.963	0.05
Return on shares NGL	0.002	3.841	1	0.963	0.05
Return on shares Roopa	1.915	3.841	1	0.166	0.05
Return on shares Sharon	0.498	3.841	1	0.480	0.05
Return on shares Twilight	1.252	3.841	1	0.263	0.05
Return on shares Unja	2.691	3.841	1	0.101	0.05
Return on shares Venkat Pharma	0.283	3.841	1	0.595	0.05
Return on shares Vista	0.686	3.841	1	0.408	0.05
Return on shares Zyden	5.674	3.841	1	0.017	0.05

SOURCE: Author's computation

Table 5. Test for Heteroscedasticity (White test (Wooldridge):):

Variables/Static	LM (Observed value)	LM (Critical value)	DF	p-value (Two-tailed)	alpha
Return on Shares Aurolab	7.934	5.991	2	0.019	0.05
Return on shares Bal	0.807	5.991	2	0.668	0.05
Return on shares Coral lab	0.836	5.991	2	0.658	0.05
Return on shares DIL LTD	0.678	5.991	2	0.712	0.05
Return on shares Gufic	1.794	5.991	2	0.408	0.05
Return on shares Hesterbio	2.339	5.991	2	0.311	0.05
Return on shares Ishita Drugs	1.680	5.991	2	0.432	0.05
Return on shares Jagson	1.050	5.991	2		0.05
Return on shares Jenburket	0.776	5.991	2	0.679	0.05
Return on shares Kilitch	0.019	5.991	2	0.991	0.05
Return on shares Lincon	2.863	5.991	2	0.239	0.05
Return on shares Medicamen	1.632	5.991	2	0.442	0.05
Return on shares NGL	1.675	5.991	2	0.433	0.05
Return on shares Roopa	1.916	5.991	2	0.384	0.05
Return on shares Sharon	1.977	5.991	2	0.372	0.05
Return on shares Twilight	1.660	5.991	2	0.436	0.05
Return on shares Unja	5.151	5.991	2	0.076	0.05
Return on shares Venkat Pharma	0.485	5.991	2	0.785	0.05
Return on shares Vista	0.686	5.991	2	0.710	0.05
Return on shares Zyden	18.948	5.991	2	< 0.0001	0.05

SOURCE: Author's computation

List of Small and Medium Pharmaceutical Firms Included in the Present Study

S.no	Company Name
1	Auro Laboratories Ltd.
2	Bal Pharma Ltd.
3	Coral Laboratories Ltd.
4	D I L Ltd.
5	Gufic Biosciences Ltd.
6	Hester Pharmaceuticals Ltd.
7	Ishita Drugs & Inds. Ltd.
8	Jagsonpal Pharmaceuticals Ltd.
9	Jenburkt Pharmaceuticals Ltd.
10	Kilitch Drugs (India) Ltd.
11	Lincoln Pharmaceuticals Ltd.
12	Medicamen Biotech Ltd.
13	N G L Fine-Chem Ltd.
14	Roopa Industries Ltd.
15	Sharon Bio-Medicine Ltd.
16	Twilight Litaka Pharma Ltd.
17	Unjha Formulations Ltd.
18	Venkat Pharma Ltd.
19	Vista Pharmaceuticals Ltd.
20	Zyden Gentec Ltd.