



Relationship between stock returns volatility and select corporate fundamentals: An empirical study

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Abstract

Volatility is a measure for variation of price of a financial assets or instruments over time periods. If stock price return is analyzed from the investor's point of view, investors try to maximize their return from their investment if the risk is higher. This research paper makes a study on the relationship between stock returns volatility and select corporate fundamentals. Panel data regression analysis reveals that the explanatory powers model has significant R square value in estimated regression model. It is observed that there is an inverse relationship between stock returns volatility and a few corporate fundamentals, like log transformed value of debt equity ratio, current ratio, return on capital employed, EPS, and Stock price return. On the other hand, market capitalisation has been found to be positively but insignificantly positive relationship with stock returns volatility.

Keywords: Financial ratios, fixed effect regression model, hausman test

Introduction

The Background of the Study

Many investors notice that the stock market is a volatile place to invest their wealth. Risk is represented by the dispersion of returns around mean. The greater the dispersion of returns around the mean, the larger will be the drop in the compound return. This study considers 12 different corporate fundamental factors (like, debt equity ratio, current ratio, total assets turnover ratio, price earnings ratio, price to book value ratio, interest coverage ratio, return on capital employed, return on net worth, market capitalisation value, return on equity, earnings per share, percentage change of dividend per share) and percentage of stock price return. There are different reasons, which affect efficient market model but volatility findings are often seen as the most powerful evidence against efficient market model as a class

Volatility creates risk that is associated with the degree of dispersion of returns around the average returns. In other words, the greater the chance of lower-than expected return, the riskier the investment. There is always a strong relationship between volatility and market performance. Volatility tends to decline as the stock market rises and increase as the stock market falls. When volatility increases, risk increases and returns decrease. With respect to other market segments stated earlier, stock market offers highest return simply due to this excessive volatility, which is defined as "variability of return" i.e. standard deviation of return on stock price computed by using formula

$$\frac{P_t - P_{t-1}}{P_{t-1}}$$

Where P_t is today's stock price in the secondary market;

P_{t-1} is yesterday's stock price in the secondary market.

Past Studies and Research Gap

Deitiana & Chriselda (2017) ^[6] explored the influence factors of dividend per share, earnings per share, book value, dividend payout ratio, return on net worth, price earnings ratio and firm size of the market prices of shares of manufactured companies. The results of this study are useful for investors to be able to see how to make decisions in investing their shares in a company, and for further research is useful to add insight and knowledge about the factors that can affect the market price of share in the company. Raithatha & Bapat (2013) ^[23] studied the relationship between stock prices with respect to corporate attributes with the objectives of stock volatility and corporate attributes using panel data analysis. In this paper, stock prices are treated as dependent variable and stock returns volatility are represented by beta and other corporate attributes, such as market capitalization (*MCAP*), debt-to-equity (*D/E*) ratio, current ratio (*CR*), earnings per share (*EPS*), and returns on capital employed (*ROCE*) as independent variables. This study finds that *Beta*, *EPS* and *MCAP* are highly significant (at the level of 5%) and others are not statistically significant to predict stock prices. Panel data analysis using Hausman test supports fixed effects model which substantiate explanatory variables were non-random. Amorim, Lima & Murcia (2012) investigated the fact how financial information reflects the economic and financial reality of a company during a given period, also relates to the systematic risk of an investment. The results shows that some accounting betas may explain the market beta and that these accounting betas are able to improve the prediction of the market beta when used the historical market beta and the majority of accounting beta versions displayed insignificant or even nonexistent relationship. Biase & Apolito (2012) ^[3] analysed the fundamental determinants of risk in the Italian banking sector. Seven

possible determinant ratios used in this study. In this paper, researchers had studied fixed effect model of panel data regression is appropriate regression model. Study also reveals that bank equity beta has been positively associated with bank size, loan and intangibles in bank total assets. On the other hand, bank systematic risk negatively associated with profitability, liquidity level and loan loss ratio. Amorim, Lima & Murcia (2012) have studied the beta of the companies have an association with the beta of the market and to know whether accounting variables can explain systematic risk. Study showed that certain accounting variables can help to explain the systematic risk like the percentage variation of the market to book indicator, total third-party capital over net worth, earnings before taxes over total assets, the degree of operational leverage, the degree of financial leverage and the financial indicator of liquidity. Ultimately, the results also showed the possibility that certain beta of the company may explain the market beta for a restricted number of companies in the sample and in certain case company beta are composed of components that are similar to the market betas.

In addition to previous studies, there is a need for further study on relationship between stock returns volatility and select corporate fundamentals. Main reasons behind conducting this study are as follows:

1. Number of empirical researches in the field of relationship between stock returns volatility and different corporate fundamental is not sufficient;
2. There are several corporate fundamental factors, which can affect stock returns volatility. The empirical researches review so far, analyzed the impact of any one or a few of those corporate fundamentals, which determine stock returns volatility;
3. Underlying different corporate fundamental factors have not been identified or less identified in the NSE listed traded stock, so far, the impact of corporate fundamental on stock returns volatility in NSE listed stocks;
4. In 2007, global financial crisis caused unprecedented upheavals to global stock markets and shaken investors sentiment. However, any such studies had not been undertaken in NSE-listed and traded stocks in the context of global financial crisis.

However, the existing research gap explored from the past studies, encourages to study the relationship between stock returns volatility and corporate fundamentals along with stock price returns in select NSE-listed stocks with the following objectives.

Objectives of the Study

In this research paper, an attempt has been made to explore the impact of corporate fundamentals on stock returns volatility of select NSE listed companies with the following sub-objectives:

1. To describe the characteristics of the data set during the study period (Refer to 5.1);
2. To analyse the impact of different corporate fundamentals on stock returns volatility in select NSE - listed companies (Refer to 5.2).

Data and Methodology

In order to fulfil the objectives of the study, an exploratory research design has been made. This study is based on secondary data, which have been collected from Capitaline corporate database and NSE official website. However, in this study, the judgement sampling method has been used to select top NSE listed 100 companies on the basis of market capitalization as done in the study for sample design. The research study has been made for 15 years from 2001-02 to 2015-16. It is significant to note that during the study period, the percentage of market capitalization of top 100 companies is 89.80% of total market capitalization of 302 companies. Moreover, these top 100 companies are categorized into different 13 sectors in considering the idea of Dalal Street Investment Journal (DSIJ) classification and NSE sector classification. Daily adjusted closing share price of select NSE-listed companies are considered here for calculation of daily stock price return series of each company.

Yearly stock returns volatility (Beta value) of top 100 NSE-listed companies are considered in the study as a dependent variable and 13 different independent variables [such as percentage of yearly stock price returns of select companies and 12 different corporate fundamentals (like Debt Equity Ratio, Current Ratio, Total Assets Turnover, Price Earnings Ratio, Price to Book Value Ratio, Interest Coverage Ratio, Return on Capital Employed, Return on Net worth, Market Capitalisation, Return on Equity, Earnings Per Share, Rate of Dividend Per Share)] are considered here. are collected from Capitaline corporate database. Both dependent and independent variables are chosen based on review of existing literature. In the study, different corporate fundamental variables have been transformed into log value. Reason behind the log transformation of any variable is that highly skewed distribution will be less skewed. Such transformation can reduce variability of data and make data confirm to normality (Feng, et. al., 2014) [10]. The methodology followed in this study is summarized below

Exhibit 1: Research Methodology

Type of Research	Empirical Research
Nature of Research Design	Exploratory Research Design
Data Set	Secondary data related to stock returns volatility (Beta Value), percentage of yearly stock price returns and different corporate fundamentals of top hundred NSE-listed companies are collected from Capitaline corporate database.
Study Period	The period of study has been taken from 2001-02 to 2015-16. This period is chosen because of different NSE listed companies share price has witnessed tremendous fluctuation.
Log transformation of select Independent Variables (IVs)	Different independent variables under this study are transformed into the logarithmic form. It is a data transformation method in which it replaces each variable (x) with a log(x) and most popular among the different types of transformations used to transform skewed data to approximately conform to normality.
Dependent Variable (DV)	Stock returns volatility represented by beta value (Beta is always calculated using regression analysis and represents the tendency of a security's returns to respond to swing in the stock market. Basic formula for

	calculating beta is the covariance of the return of a security with the return of the benchmark market index divided by the variance of the return of the benchmark market index over a certain period. This beta value calculated using NIFTY - NSE benchmark market index.)
Independent Variables (IVs)	The study explores the impact of corporate fundamental factors along with yearly percentage of stock price returns on stock returns volatility (beta value). The study also enquires the relationship between stock returns volatility and corporate fundamental factors along with yearly percentage of stock price returns. The existing literature available strongly supports about the movement of stock price with corporate fundamentals and stock price returns. Independent variables for the study are as follows: (i)Log of debt equity ratio (lnDER); (ii) Log of current ratio (lnCR); (iii) Log of total asset turnover ratio (lnTATR); (iv) Log of price earnings ratio (lnPER); (v) Log of price to book value ratio (lnPBVR); (vi) Log of interest coverage ratio (lnICR); (vii) Log of return on capital employed (lnROCE); (viii) Log of return on net worth (lnRONW); (ix) Log of market capitalisation (lnMCAP); (x) Log of return on equity (lnROE); (xi) Log of earnings per share (lnEPS); (xii) Log of percentage of dividend per share (lnDPS); (xiii) Percentage of yearly stock price returns (SPR).
Statistical Tools Used	Analysis to address stated objectives of the Study
Descriptive Statistics	To identify whether there is any difference in mean value, standard deviation, minimum and maximum value of stock returns volatility and select corporate fundamental.
Panel Data Regression	To assess the determinants of stock returns volatility, a panel data model has been used. The estimated model in a panel approach is as follows: $Y_{it} = \beta_0 + \beta_1 x_{1it} + \dots + U_{it}$ (Where <i>i</i> stands for the <i>i</i> th cross-sectional unit and <i>t</i> for the <i>t</i> th time period).
Hausman Specification Test	After running both the models, fixed effects model (FEM) and random effects model, Hausman test helps to determine the model, which is appropriate for the study. Hausman (1978) proposed a test based on the difference between the fixed effects and random effects estimates. Here, Null hypothesis is: random effects model is suitable and alternative hypothesis is: fixed effects model is suitable for the study. So, the hypothesis is as follows: <ul style="list-style-type: none"> • H₀= Random Effects Model is appropriate; • H₁= Fixed Effects Model is appropriate. If the test result shows that the p-value is statistically significant, fixed effects model is appropriate. Otherwise, random effects model is suitable for the study.
Poolability Test	Poolability test is compared with ordinary least squared (OLS) regression model and the new Least Square Dummy Variables fixed effects model has a higher R square value. If there is no significant cross sectional and temporal effect, OLS regression is appropriate. Otherwise, FEM is appropriate when an intercept and slope coefficients are constant across companies and time (Pillai Pillai, 2017).

Results and Analysis

1. Objective 1: Describing the characteristics of the data set during the study period

1.1 Descriptive Statistics results

The descriptive statistics are used to understand the basic features of data series and the mean value difference.

Table 1: Descriptive Statistics results

Variables	Mean	Standard Deviation	Min	Max
Depended Variable: Stock returns volatility represented by beta value	.875	.439	-.218	4.86
Independent Variables:				
Log of debt equity ratio (lnDER)	-.30419	.60657	-2	1.83410
Log of current ratio (lnCR)	.092	.215	-.602	1.81
Log of total asset turnover ratio (lnTATR)	.098	.418	-2	1.95
Log of price earnings ratio (lnPER)	1.21	.422	0	3.42
Log of price to book value ratio (lnPBVR)	.470	.43	-.82	2.12
Log of interest coverage ratio (lnICR)	2.39	2.28	-10.72	11.40
Log of return on capital employed (lnROCE)	-.575	.413	-2.88	.251
Log of return on net worth (lnRONW)	-.691	.364	-2.82	.364
Log of market capitalisation (lnMCAP)	9.08	1.60	3.52	12.76
Log of return on equity (lnROE)	-.692	.350	-2	1.18
Log of earnings per share (lnEPS)	2.07	1.41	-3.21	6.15
Log of percentage of dividend per share (lnDPS)	.059	.468	-1.30	1.74
percentage of yearly stock price return (SPR)	42.84216	143.5898	-87.36423	4320.732

Mean value of stock returns volatility indicated through beta value is 0.875 along with S.D. value is 0.439 and these values vary between -.218 and 4.86. On the other hand, mean value of stock return is 42.824 with S.D. 143.58 and this value varies from -87.36 to 4320.7 and beta value distribution is lower than stock price return value. The study

discloses the mean, median and other descriptive statistics regarding log of debt equity ratio which indicates the relative proportion of shareholder’s equity and debt of companies’ capital structure. Mean value of such ratios is -.3041 with SD is 0.606 with minimum value -2 and maximum value 1.83.

2. Objective Analysing the impact of different corporate fundamentals on stock returns volatility in select NSE-listed companies

2.1 Different Assumptions Test before running Panel Data Regression Analysis

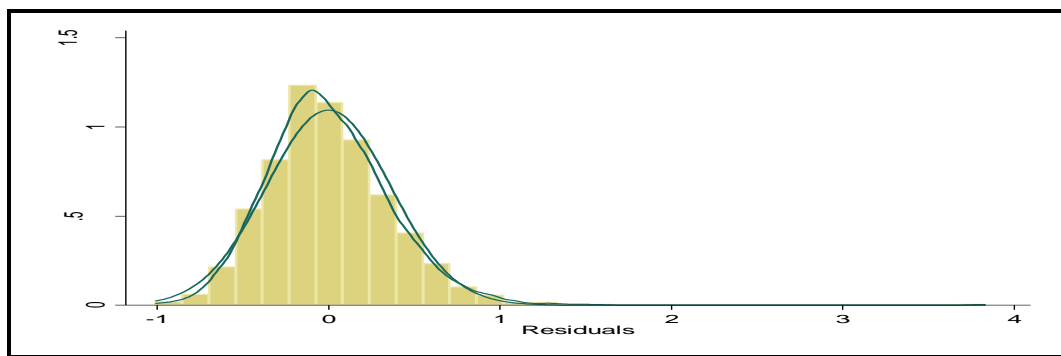
Table 2: Different Assumptions Test before running Panel Data Regression

Different Assumptions/ Regression Diagnostic	Statistical / Econometric Test	Remedial Measures
Linearity and Normality Test	Residual plot is used to know linearity and normality assumption before running a panel data regression. Test has been done by diagnostic plotting of dependent and independent variables residuals data points on graph. A normal probability plot of residuals is a scatter plot which shows the percentiles of the normal distribution. When the graphical plot is approximately linear, the error terms or residuals are likely normally distributed. Different variable's residual plot.	If linearity is not found, non linear model is to be used like ARIMA model. The log transformation is used to make data conform to normality or reduce the variability of data series.
Collinearity	Correlation matrix	Excluded the specific variable.
Heteroscedasticity	Modified Wald test	Avoiding outlier data point or square transformation
Stationary	Panel Unit Root Test using <ul style="list-style-type: none"> ▪ Levin, Lin & Chu Test ▪ Im, Pesaran Test ▪ ADF - Fisher Chi-square ▪ PP - Fisher Chi-square 	First different transformation

2.2 Normality Test

Normality test is used to check whether the sample company's different corporate fundamental variable, return and stock returns volatility represented by beta value are distributed normally or not. More precisely, the tests are a

form of model selection and can be interpreted in several ways, depending on one's interpretations of probability. Plotting of residual value of different variables in this study give a clear picture whether the data have the Skewness or Kurtosis matching a normal distribution.



(Source: Compilation of Capitaline Corporate Database- Data using STATA 13.0)

Chart 1: Plotting of Residual value for Different Variables

Inferences

Plotting residual value plot of corporate fundamentals variable and states that sample companies' different variables are normally distributed, which is represented in above graph.

2.3 Correlation of Different Corporate Fundamentals

The correlation coefficient among different variables of corporate fundamentals, percentage change in stock price return and Beta are as under:

Table 3: Correlation table of Different Corporate Fundamentals

	% of Return	LDE	LCR	LTAT	LPE	LPBVR	LIC	LROCE	LRONW	LMCAP	LROE	LEPS	LDPS	Beta
% of Return	1.00													
LDE	.054	1.00												
LCR	-.005	.053	1.00											
LTAT	.022	-.306	-.201	1.00										
LPE	.05	-.211	.016	.146	1.00									
LPBVR	.116	-.322	.057	.375	.566	1.00								
LIC	-.018	-.461	.195	.324	.247	.465	1.00							
LROCE	.035	-.114	-.077	.317	-.153	.237	.128	1.00						
LRONW	.11	-.161	.031	.338	-.187	.508	.306	.486	1.00					
LMCAP	-.061	-.205	-.024	.014	.319	.334	.260	.101	.052	1.00				
LROE	.108	-.144	.053	.35	-.171	.526	.273	.453	.843	.016	1.00			
LEPS	-.049	-.056	.009	.042	.022	.103	.296	.135	.083	.408	.042	1.00		
LDPS	-.044	-.280	-.014	.219	.23	.476	.451	.132	.307	.454	.305	.374	1.00	
Beta	.003	.195	-.12	-.304	-.203	-.386	-.373	-.091	-.224	.096	-.231	-.103	-.251	1.00

Correlation matrix shows (Table –3) that correlation coefficient among different variable of corporate fundamentals, percentage change in stock price return and beta, etc. there is an association among percentage change in stock price return and other explanatory variables, whereas percentage change in stock price return and debt equity ratio is associated with.054 or 5.4%. Similarly, other explanatory ratio, like total assets turnover, price earnings ratio, return on capital employed with percentage change in stock price are corelated with.022 or 2.2%,.05 or 5%,.035 or 3.5%. Negative correlation found between current ratio and percentage of stock price return is -.005 or -.05% and market capitalization and percentage of stock price return is -.049 and dividend per share with percentage change in stock price return is -.044. Now, we would consider the degree of association between beta (represents stock returns volatility) and corporate fundamentals. We have found lower degree of positive correlation with percentage change

of stock price return and market capitalization i.e., 3% and 9.6%. Moderate degree of association exists between beta and debt equity ratio is 19.5%. moderate and low degree of negative relation is found between beta with current ratio, total assets turnover, price earnings ratio, price to book value ratio, interest coverage ratio, return on capital employed, return on net worth, return on equity, earnings per share and dividend per share.

2.4 Heteroskedasticity Test

Heteroskedasticity is treated as a serious problem in regression results. Modified Wald test is used to detect group wise heteroskedasticity. This test has been performed to find out the effect of heteroskedasticity in the select fixed effect panel data regression model. If alternative hypothesis is selected, there is a problem of heteroskedasticity (Greene, 2003) [11]. In that case, the selected model should be modified by making it robust.

Modified Wald test for Group wise heteroskedasticity

Hypothesis	❖ H ₀ : Homoskedasticity exists in error term; ❖ H ₁ : Homoskedasticity does not exist in error term (i.e.; Heteroskedasticity).
Test statistics	Modified Wald Test with Probability Value
Underlying distribution	χ ² Test
Level of significance	5% or 0.05
Decision Rule	If p- value >0.05 (statistically significant), H ₀ is accepted and vice versa.

2.5 Heteroskedasticity Test Results

Heteroskedasticity test is done for two fixed effects model in Panel data regression. Results of Modified Wald test for

heteroscedasticity in group wise fixed effect regression model is summarized here:

Table 4: Result of Modified Wald Test

Sl. No.	Model	Modified Wald Test	Decision Rule	Decision on H ₀	
1.	Fixed Effects Regression Model - (DV: Beta Value; IV: 12 Corporate Fundamentals and stock price returns)	χ ² value	3430.70	P-Value>0.05	Accepted
		P- value	0.056		

(Source: Compilation of Capitaline Corporate Database- Data using STATA 13.0)

Inferences

As the probability value is 0.056, which are greater than 0.05. Null Hypothesis (H₀) is accepted and alternative hypothesis is rejected in fixed effects panel regression model. It indicates that the problem of heteroskedasticity does not exist in this study and variances of residual are homogeneous.

(Dickey and Fuller 1979). In general, the approaches to unit root testing implicitly.

2.6 Stationary Test

Stationary Test is needed as to whether the different companies stock price return, stock return volatility (beta value) and different corporate fundamentals data series are stationary or non-stationary and we have applied panel unit root test (at level – individual intercept), which has been conducted by either Augmented Dickey-Fuller (ADF) Test

Panel Unit Root Test

Hypothesis	▪ H ₀ : Panel data series has unit root; ▪ H ₁ : Panel data series has not unit root.
Test statistics	Augmented Dickey – Fuller Test (At Level – Individual intercept)
Underlying distribution	▪ Levin, Lin &Chu test ▪ Im, Pesaran and Shin W-stat ▪ ADF - Fisher Chi-square ▪ PP - Fisher Chi-square
Decision Rule	If p- value <0.05, H ₀ is rejected and vice versa.

2.7 Stationary Test Results

The Augmented Dickey Fuller Test – at level for all the variables are given below in summarized form.

Table 5: Panel Unit Root Test Results (At Level – Individual intercept)

Particulars	Different Unit Root Test	Statistics & Corresponding ‘P’ value		Decision Rule	Decision on H ₀	Data series stationarity
		Test Statistics	P- Value			
Percentage of Stock price	Levin, Lin &Chu t	-26.68	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-23.68	0.000			

return	ADF - Fisher Chi-square	872.32	0.000			
	PP - Fisher Chi-square	1075.20	0.000			
Log of debt equity ratio	Levin, Lin &Chu t	-16.78	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-7.13	0.000			
	ADF - Fisher Chi-square	300.81	0.000			
	PP - Fisher Chi-square	229.01	0.000			
Log of current ratio	Levin, Lin &Chu t	-12.00	0.000	P-Value<0.05 (Except PP - Fisher Chi-square)	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-5.59	0.000			
	ADF - Fisher Chi-square	304.20	0.000			
	PP - Fisher Chi-square	150.49	0.880			
Log of total asset turnover ratio	Levin, Lin &Chu t	-5.40	0.000	P-Value<0.05 (Except Im, Pesaran and Shin W-stat)	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-1.48	0.068			
	ADF - Fisher Chi-square	220.40	0.004			
	PP - Fisher Chi-square	203.41	0.032			
Log of price earning (P/E) ratio	Levin, Lin &Chu t	-12.34	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-11.39	0.000			
	ADF - Fisher Chi-square	513.5	0.000			
	PP - Fisher Chi-square	589.4	0.000			
Log of price to book value ratio	Levin, Lin &Chu t	-11.18	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-10.11	0.000			
	ADF - Fisher Chi-square	453.19	0.000			
	PP - Fisher Chi-square	582.42	0.000			
Log of interest coverage ratio	Levin, Lin &Chu t	-6.23	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-4.10	0.000			
	ADF - Fisher Chi-square	277.55	0.000			
	PP - Fisher Chi-square	233.68	0.000			
Log of return on capital employed	Levin, Lin &Chu t	-5.41	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-2.94	0.001			
	ADF - Fisher Chi-square	251.8	0.000			
	PP - Fisher Chi-square	233.2	0.001			
Log of return on net worth	Levin, Lin &Chu t	-3.62	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-3.11	0.000			
	ADF - Fisher Chi-square	298.6	0.000			
	PP - Fisher Chi-square	324.4	0.000			
Log of market capitalisation	Levin, Lin &Chu t	-14.44	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-7.53	0.000			
	ADF - Fisher Chi-square	409.4	0.000			
	PP - Fisher Chi-square	562.5	0.000			
Log of return on equity	Levin, Lin &Chu t	-5.03	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-4.47	0.000			
	ADF - Fisher Chi-square	340.8	0.000			
	PP - Fisher Chi-square	364.1	0.000			
Log of Earnings per share	Levin, Lin &Chu t	-6.04	0.000	P-Value<0.05 (Except Im, Pesaran and Shin W-stat & ADF - Fisher Chi-square)	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-0.28	0.388			
	ADF - Fisher Chi-square	203.13	0.425			
	PP - Fisher Chi-square	321.05	0.000			
Beta value	Levin, Lin &Chu t	-6.23	0.000	P-Value<0.05	Rejected	Stationary series
	Im, Pesaran and Shin W-stat	-5.61	0.000			
	ADF - Fisher Chi-square	322.05	0.000			
	PP - Fisher Chi-square	565.09	0.000			

The results test statistics show that the p-value is statistically significant in most of the cases in respective of Levin, Lin &Chu test; Im, Pesaran and Shin W-stat; ADF - Fisher Chi-square and PP - Fisher Chi-square (P- Value = 0.000 which is < 0.05). It shows that H₀ is rejected and H₁ is accepted form the above-mentioned test. It implies that panel data series does not any unit root. The results indicate that the variables used in the regression model are stationary (Brooks, 2014) ^[5]. It is also noted that when there is high p value then we do not reject H₀, rather accept null hypothesis (Bhowmik, 2015) ^[4].

2.8 Analysing the impact of different corporate fundamentals on stock price returns volatility in select NSE listed companies

2.8.1. Panel Data Regression

The Fixed Effects or Least Squares Dummy Variable Model

Fixed effects model is estimated through ordinary least squares method. This model estimates the firm effect and time effect or both. It is called fixed model as it allows individuality among the firms with own intercept value and these entire firm are not same; they have different intercept value. The model called fixed effects due to the fact that

though it has different intercept value across the cross-sectional units i.e. across the firm but the intercept is time-invariant. That means in fixed effects model the intercept remains constant over time. Further the model tested the individual effect through dummy variables. For this very reason this model also called Fixed Effects Least Square Dummy Variables (FELSDV) model, in short LSDV model. The basic equation of this model is

$$Y_{it} = \alpha_i + \beta_1 X_{it} + \varepsilon_{it}$$

or, $Y_{it} = \alpha_1 D_{1t} + \alpha_2 D_{2t} + \dots + \alpha_r D_{rt} + \beta_1 X_{it} + \varepsilon_{it}$

Here, Y is the dependent variable, X is the independent variables, i = 1,2,3,...,50 and t = 1,2,3....10, α_1 is the first cross-sectional intercept and α_2 is the second intercept and so on up to α_r and D_{1t} is the first cross-sectional unit and D_{2t} is the second cross-sectional unit.

The Random Effects or Error Components Model

This model does not use dummy variables for capturing the individual effect. This model has the common mean value for the intercept and assumes individual effect itself to be a random variable. Here, random error term reflects the individual differences in the intercept values across the cross section and in this model random error term is the composition of both individual error term as well as individual and time series random error term.

The model is

$$Y_{it} = (\alpha_i + \mu_i) + \beta_1 X_{it} + \varepsilon_{it}$$

$$= \alpha_i + \beta_1 X_{it} + \gamma_{it}$$

Here, $\gamma_{it} = (\mu_i + \varepsilon_{it})$ represents the random error term of two elements at a time first one is μ_i for individual random error item and ε_{it} is the combination of both individual and time series random error part.

Comparing Fixed Effects Model (FEM) with Random Effects Model (REM) in panel data regression, fixed effects model is ultimately selected through Hausman Test. Such fixed effects panel regression model is compared with pooled regression model using poolability test. Final model selection, which has been made on the basis of restricted F test results in Poolability Test, is fixed effect model. The effects of different corporate fundamentals on stock price returns in select NSE-listed companies are explained through fixed effects panel regression model.

2.8.2. Selection between Fixed Effects Model and random Effects Model: The Hausman Test

After running both the model in panel data regression (i.e. Fixed Effects Model and Random Effects Model), Hausman test helps to determine model, which is appropriate for the study.

Hausman Test

Hypothesis	<ul style="list-style-type: none"> H_0 : Random effects model is appropriate; H_1 : Fixed effects model is appropriate (i.e.; Fixed effects model is inappropriate).
Test statistics	(chi - square)- test with probability value
Underlying distribution	χ^2_{test}
Level of significance	5% or 0.05
Decision Rule	If p- value <0.05 (statistically significant), H_0 is rejected and vice versa.

2.8.3. Hausman Test Results

Hausman test is used to identify either FEM or REM in panel data regression. Results of Hausman test is summarized here

Table 6: Results of Hausman Test

Hausman test results		Decision Rule	Decision on H_0
χ^2 value (b-B)[(V_b - V_B)^(-1)](b-B)	146.79	P-Value < 0.05	Rejected
P- value	0.0000		

(Source: Compilation of Capitaline Corporate Database- Data using STATA 13.0)

Inferences

The chi square (χ^2) test shows that the p-value is statistically significant (prob >chi2 = 0.000 which is < 0.05). It shows that H_0 is rejected and H_1 is accepted from the test results. It implies that fixed effects model is appropriate instead of random effects model for the study.

2.8.4 Poolability Test

Details of restricted F test are discussed here:

Poolability Test

Hypothesis	<ul style="list-style-type: none"> H_0 : Common intercept for all companies; H_1 : Intercept varies for companies.
Test Statistics	F test with corresponding p value
Underlying Distribution	$\text{Restricted F test (F)} = \frac{(R_{UR}^2 - R_R^2) / J}{(1 - R_{UR}^2) / (n - k)}$ <p>Where,</p> <ul style="list-style-type: none"> R_{UR}^2 = R square of the unrestricted regression (second model i.e., Fixed effect model); R_R^2 = R square of the restricted regression (first model i.e., OLS model). <p>(J = number of linear restrictions on the first model; k = number of parameters in the unrestricted regression; and n = NT = number of observations.)</p>
DF	Total number of variables = 13
Level of Significance	5% or 0.05
Decision Rule	If p- value <0.05, H_1 is accepted and H_0 is rejected.

Poolability Test Results

Restricted F test is conducted between OLS regression and the Least Square Dummy Variable Fixed Effects model. This test is useful for the presence of individual effects. Results of poolability test is summarized here:

Table 7: Poolability test result

Model	F test value	P- Value	Decision Rule	Decision on H ₀
Restricted F Test	12.75	0.000	P - Value < 0.05	Rejected

Here, F= 12.75, with a p-value equal to zero. It shows that H₀ is rejected and H₁ is accepted for the test result. The difference in the explanatory powers of the model is highly significant and concludes that the pooled OLS regression is invalid and Fixed Effects model is appropriate. It is also observed that with this greater p-value, the null hypothesis of zero company effect is rejected.

2.8.5. Development and Interpretation of panel data regression model (Fixed Effects Model)

In the panel data regression – fixed effect model, 12 independent variables and beta value are selected. Variables are transformed into log value for the purpose of smooth calculation process. In this study, dependent variable is stock price return and select corporate fundamentals along with share price returns are used as independent variables. The following panel data regression model is considered to estimate the relationship between dependent variable and independent variables. The format of the equation is as follows

- $BETA_{it} = \alpha + \beta_1 \ln DER + \beta_2 \ln CR + \beta_3 \ln TATR + \beta_4 \ln PER + \beta_5 \ln PBVR + \beta_6 \ln ICR + \beta_7 \ln ROCE + \beta_8 \ln RONW + \beta_9 \ln MCAP + \beta_{10} \ln ROE + \beta_{11} \ln EPS + \beta_{12} \ln DPS + \beta_{13} SPR + \epsilon_{it}$
- β_1 to β_{13} = Regression coefficient
- DER, CR, TATR, PER, etc. indicates different corporate fundamentals used as independent variables
- α = Intercept term

Here, ‘i’ is the *ith* company (100 companies in this study) and ‘t’ is the time period (from the year 2001-02 to 2015- 16 i.e.; 15 years) for the determinants and ‘ln’ stands for log value.

Table 8: Parameter Estimates for Panel Data Regression Fixed Effects

Intercept (α)		0.5890
Estimate (β)	β_1	-.013
	β_2	-.113
	β_3	-.229
	β_4	.0182
	β_5	-.137
	β_6	.006
	β_7	-.017
	β_8	.049
	β_9	.051
	β_{10}	.024
	β_{11}	-.0396
	B_{11}	.045
	β_{13}	-.00005

(Source: Compilation of Capitaline Corporate Database- Data using STATA 13.0)

The fixed effects panel regression equation results are shown here:

Table 9: Fixed Effects Panel Regression Equation Model

Model No.	Equation
1.	$BETA = 0.5890 - 0.0131 \ln DER - 0.1130 \ln CR + 0.0182 \ln PER - 0.1373 \ln PBVR + 0.0061 \ln ICR + 0.0495 \ln RONW - 0.0513 \ln MCAP + 0.0249 \ln ROE - 0.017 \ln EPS + 0.051 \ln DPS - .00005 SPR$

From the estimated values of panel data regression (Fixed Effects), it is observed that out of thirteen independent variables (IVs), five independent variables (such as price earnings ratio, interest coverage ratio, return on net worth, return on equity and percentage change in dividend per share) positively influence stock returns volatility represented by beta value. As per the study, other eight independent variables (Debt equity ratio, Current ratio, Total asset turnover ratio, Market capitalisation, Price to book value ratio, Return on capital employed, Earnings per share, stock price return) negatively influence the stated theme.

Test of Significance

Significance of the parameter estimates are analysed with the help of t- test based on the following considerations:

Table 10: List of Hypothesis – t Test

Hypothesis-1	<ul style="list-style-type: none"> ▪ H₀: There is no significant relationship between dependent variable and independent variables ▪ H₁: There is a significant relationship between dependent variable and independent variables
Hypothesis-2	<ul style="list-style-type: none"> ▪ H₀: Each coefficient of the indirect variables is equal to 0 ▪ H₁: Each coefficient of the indirect variables is different from 0
Hypothesis-3	<ul style="list-style-type: none"> ▪ H₀: Each parameter estimate is equal to 0 ▪ H₁: Each parameter estimate is different from 0
Test statistics	t- test value of the each independent variable of the model
Underlying distribution	t- test
DF	K-1, where K = Number of variables 13
Level of significance	5% or 0.05
Decision Rule	t-value has to be higher than 1.96 (for a 95% confidence) or If p- value <0.05, H ₀ is not accepted and vice versa

(Source: Compilation of Capitaline Corporate Database- Data using STATA 13.0)

Table 11: Result of t – test

Independent Variables	Estimate	Std. Error	t- test value	P value	Decision Rule	Decision on H ₀
Log of debt equity ratio	-.013	.020	-0.63	0.530	P-Value>0.05	Accepted
Log of current ratio	-.113	.065	-1.73	0.084	P-Value>0.05	Accepted
Log of total asset turnover ratio	-.229	.067	-3.38	0.001	P-Value<0.05	Rejected
Log of price earnings ratio	.0182	.0382	0.48	0.633	P-Value>0.05	Accepted
Log of price to book value ratio	-.137	.056	-2.42	0.016	P-Value<0.05	Rejected
Log of interest coverage ratio (Log value)	.006	.008	0.75	0.452	P-Value>0.05	Accepted
Log of return on capital employed	-.017	.046	-0.38	0.704	P-Value>0.05	Accepted
Log of return on net worth	.049	.048	1.03	0.306	P-Value>0.05	Accepted
Log of market capitalisation	.051	.016	3.14	0.002	P-Value<0.05	Rejected
Log of return on equity	.024	.053	0.47	0.641	P-Value>0.05	Accepted
Earnings per share -Log value (EPS)	-.0396	.016	-2.45	0.014	P-Value<0.05	Rejected
Log of percentage of dividend per share (DPS)	.045	.036	1.25	0.211	P-Value<0.05	Accepted
Percentage of Stock price return (SPR)	-.00005	.000061	-0.95	0.343	P-Value>0.05	Accepted

(Source: Compilation of Capitaline Corporate Database- Data using STATA 13.0)

Inferences

All null hypotheses (H₀) are accepted for all the independent variables [except total assets turnover ratio (TATR), price to book value ratio (PBVR), market capitalisation (MCAP), and earnings per share (EPS)]. It suggests that only these corporate fundamentals significantly influence stock returns volatility of the select companies in the study.

Measuring Strength of Association

Table 12: Panel regression (Fixed Effects) results

R square (R ²) Value	Within	4.51%
	Between	23.39%
	Overall	14.82%

(Source: Compilation of Capitaline Corporate Database-Data using STATA 13.0)

In order to measure the strength of association between outcome variable and different predictor variable, R² is used. Overall R² Value is 14.82% or 0.1482. Moreover, within the sample companies, R square value is 04.51% and corresponding between companies, R square value is comparatively higher (i.e., 23.39% or 0.2339). Hence, the model explains 14.82% variability of the dependent variable indicating strong association between dependent variable and independent variables. ρ ('rho') value (explains intra-class correlation) indicates that 49.15% of the variance is due to differences across panel.

Determination of Model Fitness

Fitness of the fixed effects – panel data regression model is analysed with the help F test (ANOVA) as follows:

Hypothesis	<ul style="list-style-type: none"> H₀: All the panel regression coefficients in the model are equal to 0 H₁: All the panel regression coefficients in the model are different than 0
Test statistics	F test value with corresponding p value
Underlying distribution	F test
DF	Total number of predictor variables = 13
Level of significance	5% or 0.05
Decision Rule	If prob >F value is < 0.05 than we accept H ₁ and reject H ₀

Table 13: F test (ANOVA) result

Model	F test value	P- Value	Decision Rule	Decision on H ₀
F Test	4.59	0.000	P - Value < 0.05	Rejected

(Source: Compilation of Capitaline Corporate Database- Data using STATA 13.0)

Inferences

For the model, F test value is 4.59 and corresponding p value of F-test also shows significant at 1% level and this leads to the rejection of null hypothesis. It shows that H₀ is rejected and H₁ is accepted form the test result. It implies that fixed effects panel regression coefficients in the model are different than zero. Hence, model is statistically significant and fit to explain the dependent variable.

Conclusion

Relationship between stock returns volatility (represented by beta value) with select corporate fundamentals and stock price returns are presented in this chapter. Panel data regression analysis reveals that the explanatory powers model has significant R square value in estimated regression model. The results clearly indicate that stock returns volatility has been affected due to price earnings ratio, interest coverage ratio, return on Networth ratio, return on equity ratio, and percentage of dividend per share ratio.

Being panel data, three R² results are found, where within results showed 4.51% and between results showed 23.39%, where as the overall R² depicted 14.82%. In the current study, it is observed the inverse relationship between stock returns volatility and a few corporate fundamentals, like log transformed value of debt equity ratio, current ratio, return on capital employed, EPS, and Stock price return. On the other hand, market capitalisation has been found to be positively but insignificantly positive relationship with stock returns volatility.

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