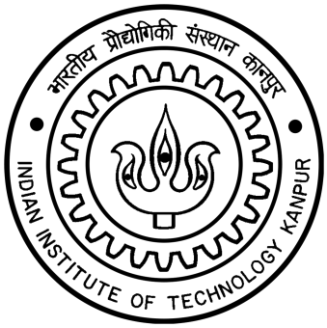
INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

DEPARTMENT

OF

INDUSTRIAL AND MANAGEMENT ENGINEERING



MBA 652A

STATISTICAL MODELLING FOR BUSINESS ANALYTICS

PANEL DATA ANALYSIS

FOR

MOVEMENT OF STOCK PRICES

Submitted By:

Nitesh Sharma (20114013)

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EXECUTIVE SUMMARY

This project aims at understanding the regression analysis of a **balanced** panel dataset, wherein the data frame has a stock price as a function of various independent variables. The information or the data which we have extracted is observed for over **4 years** i.e., 2016-2019, and the companies have been taken from the Index **Nifty50**. So, we have taken 49 companies across the time period of 4 years with total of 196 data points.

The project starts with a general understanding of the variables involved and the variations within each entity over the years. We tested various regression models to determine the best explanation for the variation in stock market prices.

There are various tests performed on the datasets i.e. **Pooled Regression, Entity Fixed Effects, Time Fixed Effects, Mixed Effects and Random Effects**. Finally narrowing down to the result gives us the relation of the stock market prices against different variables.

RESEARCH PROBLEM

The objective of this project is to analyze panel data for studying the effects of various factors on the Stock Price Movements. The study involves around taking various **independent** factors such as **Price to Book Value, Adjusted Earnings Per Share, Dividend Yield, Debt to Equity, Operating Margin, Return on Equity, Return on Assets,** etc. for each of the companies in the Nifty50 index and for each of the 4 years i.e., from 2016-2019. For this activity, we carried out various tests on the models generated so that we chose the best model, having those variables that have a significant impact on the dependent variable identified.

The data is the price history and trading volumes of the forty-nine stocks in the index NIFTY 50 from NSE (National Stock Exchange) India. The idea seems very basic at first as a dependency of the stock movement and the dependency on the various financial ratios is not new in finance, still the complexity will increase as we'll go from model and model.

This project will serve as a ground for us to test our subject knowledge gained in our classes and help us enhance and improve our understanding of the concept.

DATA

***Source*:**

http://www.moneycontrol.com/stocks/histstock.php

https://www1.nseindia.com/products/content/equities/indices/historical_index_data.htm

***Description*:**

Our data is a **Balanced Panel** Data set. Panel Data or Longitudinal Data is multi-dimensional data that involves measurements over time. Panel Data contains observations of various phenomena obtained over multiple periods. In our data set, we have taken 49 companies out of Nifty 50 Index and try to check the growth of the share price for the four years (196 observations). There are no missing values in the data set.

Variables:

Sr. No	Variables	Description
1.	Company	Name of the company
2.	Stock_Price_Rs	Stock Price
3.	Price_to_book_value	P/B Ratio
4.	Adjusted_EPS_(Rs)	Adjusted Earnings Per Share
5.	Dividend_Yield_(%)	Dividend Yield
6.	Debt_to_Equity	D/E Ratio
7.	Operating_Margin(In_10%)	Operating Margin
8.	ROA (In_10%)	Return on Assets
9.	ROE (In_10%)	Return on Equity
10.	Interest_Coverage	Interest Coverage
11.	Operating_Profit_Growth (In_10%)	Operating Profit Growth
12.	Revenue_Growth (In_10_%)	Revenue Growth

Dependent Variables & Independent Variables

Dependent Variable: **(Movement in Stock Prices)**

A dependent variable is the variable that is being tested and measured and whose value may be affected by the change of other independent variables. We need to determine a cause and effect relationship between the dependent and the independent variables.

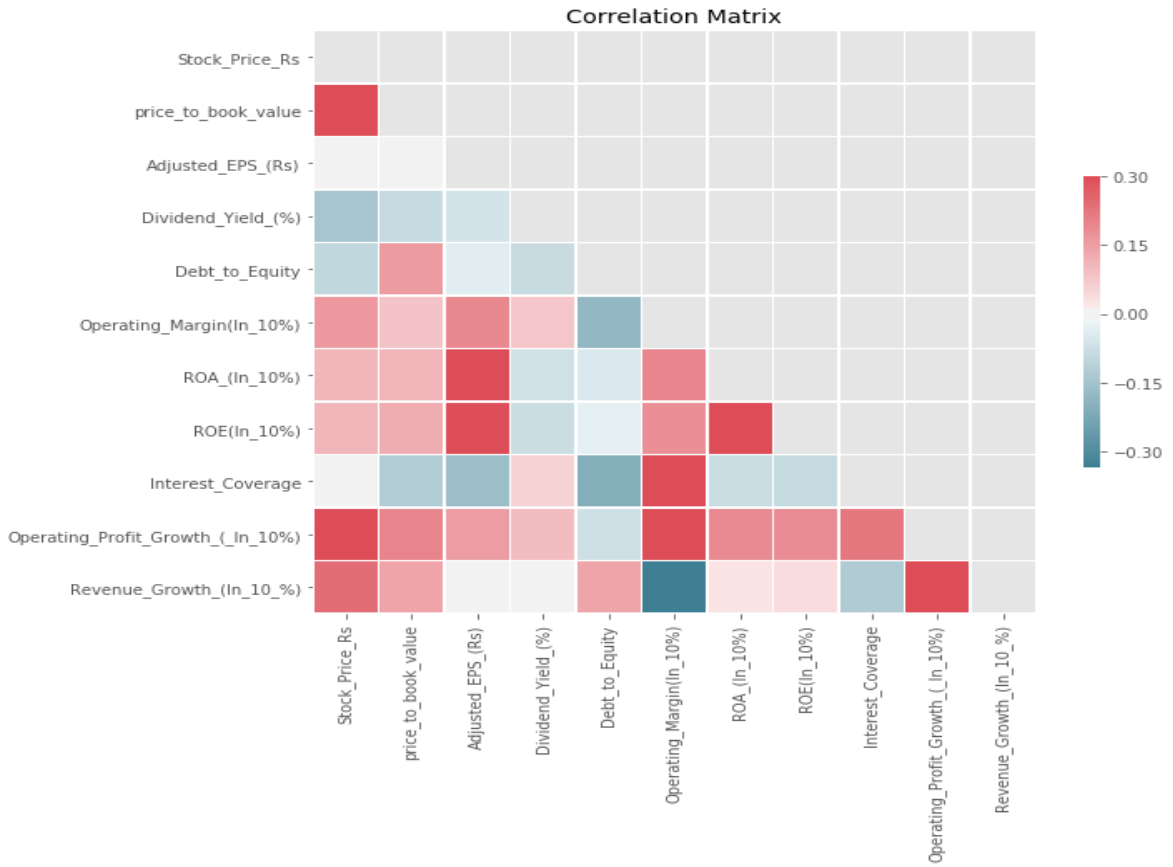
Independent Variable: **(Price To Book Value, Adjusted EPS, Dividend yield, Debt To Equity, Operating Margin, ROA, ROE, Interest Coverage, Operating Profit Growth, Revenue Growth)**

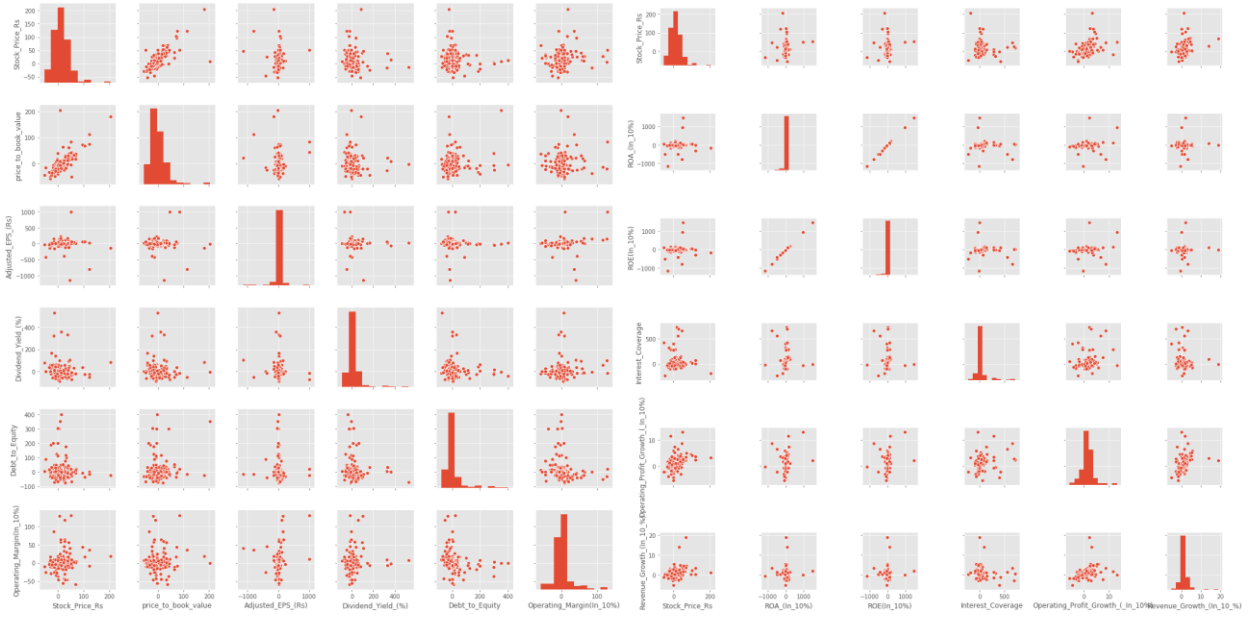
An independent variable is the variable that is being changed or controlled in an experiment to measure the effect on dependent variable.

Descriptive Statistics:

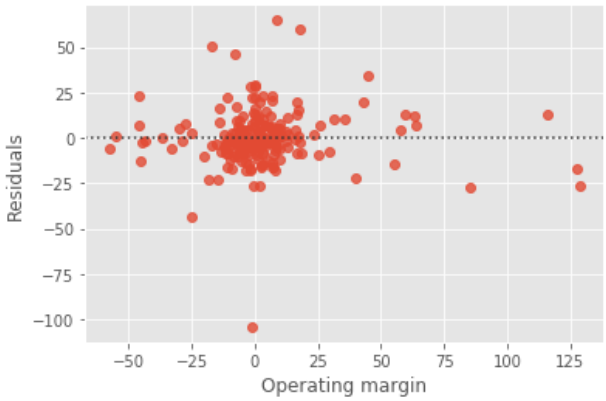
Variable	Mean	Min	1st Quad	Median	3rd Quad	Max
Stock_Price_Rs	13.238	-52.586	-4.862	8.537	28.469	206.010
price_to_book_value	0.2401	-57.3100	-18.50	-6.534	13.6087	203.946
Adjusted_EPS_.Rs	5.661	-1148.57	-9.283	9.919	24.835	1007.71
Dividend_Yield_	9.817	-91.071	-16.75	0.000	22.323	530.769
Debt_to_Equity	10.173	-75.00	-16.37	0.000	8.145	400.00
Operating_Margin.In_10	2.7590	-57.7443	-6.443	0.0937	7.272	128.846
ROA_.In_10	-5.424	-1133.33	-19.59	-2.197	9.804	1475
ROE.In_10	-7.492	-1157.14	-21.07	-5.104	9.960	1463.04
Interest_Coverage	23.449	-231.656	-22.82	0.0409	17.5817	725.025
Operating_Profit_Growth_._In_10	1.420	-5.527	0.400	1.416	2.257	13.033
Revenue_Growth_.In_10	1.2362	-5.236	0.361	1.0280	1.8753	18.9240

CORRELATION MATRIX





RESIDUAL PLOTS



PANEL DATA ANALYSIS

Panel Data Set, or a Longitudinal Data Set, is a set of cross-sectional data collected for the same parameters across various years. For the analysis of the panel dataset in hand, we have employed the following regression techniques:

1. **Pooled Regression Model**
2. **Fixed Effect**
    - Entity Fixed Effects
        - Entity Demeaned
        - Entity Effect with Binary Regressors
    - Time Fixed Effects
    - Mixed Effects
3. **Random Effects**

The Statistical modeling has been done in R Software using both LM and PLM function. This function is used for linear modeling of panel data.

POOLED REGRESSION MODEL

The pooled regression model ignores any differences over entities or time and treats each data as a separate entity. We use the "lm" function to carry out pooled regression on the data in R.

Model 1

Initial Model with No Variable Elimination:

```
Residuals:
     Min       1Q   Median       3Q      Max
-104.239   -7.414   -1.518    6.285   64.832

Coefficients:
                                 Estimate Std. Error t value Pr(>|t|)
(Intercept)                      7.521380   1.546380   4.864 2.45e-06 ***
price_to_book_value              0.729608   0.039695  18.380  < 2e-16 ***
Adjusted_EPS_.Rs.                0.023065   0.015095   1.528 0.128227
Dividend_Yield_...              -0.064879   0.018050  -3.594 0.000417 ***
Debt_to_Equity                  -0.080909   0.019298  -4.193 4.27e-05 ***
Operating_Margin.In_10..        -0.067929   0.087018  -0.781 0.436019
ROA_.In_10..                     0.521039   0.110934   4.697 5.14e-06 ***
ROE.In_10..                      0.512626   0.109238   4.693 5.23e-06 ***
Interest_Coverage                0.002411   0.011502   0.210 0.834222
Operating_Profit_Growth_._In_10.. 3.154764   0.902162   3.497 0.000589 ***
```

```
Revenue_Growth_.In_10_..          1.431434   0.802153   1.784 0.075983 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 16.39 on 185 degrees of freedom
Multiple R-squared:  0.7351, Adjusted R-squared:  0.7208
F-statistic: 51.33 on 10 and 185 DF,  p-value: < 2.2e-16
```

Analysis

Operating Margin and **Interest Coverage** has been dropped due to insignificant p-values from the next model.

Model 2

Eliminating Variables (Operating Margin & Interest Coverage)

```
Residuals:
     Min       1Q   Median       3Q      Max
-104.132   -7.426   -1.536    6.335   64.764

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                      7.64568    1.52073   5.028 1.16e-06 ***
price_to_book_value              0.72607    0.03871  18.756  < 2e-16 ***
Adjusted_EPS_.Rs.                0.02437    0.01457   1.673 0.095985 .
Dividend_Yield_...              -0.06512    0.01798  -3.622 0.000376 ***
Debt_to_Equity                  -0.08107    0.01903  -4.260 3.24e-05 ***
ROA_.In_10..                     0.50752    0.10917   4.649 6.29e-06 ***
ROE.In_10..                      0.49885    0.10738   4.646 6.38e-06 ***
Operating_Profit_Growth_._In_10..  2.64563    0.59686   4.433 1.58e-05 ***
Revenue_Growth_.In_10_..         1.84377    0.59330   3.108 0.002180 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 16.33 on 187 degrees of freedom
Multiple R-squared:  0.7342, Adjusted R-squared:  0.7228
F-statistic: 64.57 on 8 and 187 DF,  p-value: < 2.2e-16
```

Analysis

All the variables in this Pooled OLS model have all the significant values but ignores the time and individual effects if any.

FIXED EFFECTS:

A) Entity Fixed Effects

Entity Demeaned Model

In entity fixed models, each company is considered as a separate entity. In entity demeaned method, all the values across the years, for each company are averaged and the average is then subtracted from the 4 observations. This way, we obtain the entity demeaned observations which are then regressed.

```
Balanced Panel: n = 49, T = 4, N = 196

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-100.81482   -6.52180   -0.55652    5.74439   66.74135

Coefficients:
                                 Estimate Std. Error t-value  Pr(>|t|)
price_to_book_value              0.700497   0.044031 15.9091 < 2.2e-16 ***
Adjusted_EPS_.Rs.                0.036094   0.016266  2.2191 0.0281039 *
Dividend_Yield_...              -0.056764   0.021154 -2.6833 0.0081749 **
Debt_to_Equity                  -0.069461   0.022733 -3.0555 0.0026941 **
ROA_.In_10..                     0.529475   0.141813  3.7336 0.0002745 ***
ROE.In_10..                      0.514216   0.140121  3.6698 0.0003450 ***
Operating_Profit_Growth_._In_10..2.143246   0.706419  3.0340 0.0028814 **
Revenue_Growth_.In_10_..         1.079559   0.727206  1.4845 0.1399328
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    135730
Residual Sum of Squares: 40225
R-Squared:      0.70363
Adj. R-Squared: 0.58423
F-statistic: 41.2512 on 8 and 139 DF, p-value: < 2.22e-16
```

Analysis

The model seems to have low adjusted R^2, operating margin and interest coverage has been eliminated from the final model and we will try to build more models which will handle time and individual effects.

Entity Fixed Effects (Binary Regressor)

Entity Fixed Effects controls that unobservables that might be correlated with regressors across the entities. In this model, we have introduced **n different intercepts** one each for company using **N-1 binary regressors**.

Model 1:

Adding Company With No Variable Dropped

(Adani Port is missing and all the Intercepts calculated are with respect to Adani Port)

```
Residuals:
     Min       1Q   Median       3Q      Max
-100.077   -6.617   -0.347    5.842   66.428

Coefficients:
                                 Estimate Std. Error t value Pr(>|t|)
(Intercept)                      6.943206   8.765414   0.792 0.429664
price_to_book_value              0.699941   0.045717  15.310  < 2e-16 ***
Adjusted_EPS_.Rs.                0.036684   0.016859   2.176 0.031278 *
Dividend_Yield_...              -0.057887   0.021347  -2.712 0.007550 **
Debt_to_Equity                  -0.070800   0.023116  -3.063 0.002640 **
Operating_Margin.In_10..        -0.052457   0.100265  -0.523 0.601692
ROA_.In_10..                     0.540749   0.144753   3.736 0.000274 ***
ROE.In_10..                      0.525072   0.143209   3.666 0.000351 ***
Interest_Coverage               -0.003012   0.013322  -0.226 0.821463
Operating_Profit_Growth_._In_10.. 2.635918   1.067271   2.470 0.014749 *
Revenue_Growth_.In_10_..         0.712609   0.950700   0.750 0.454803
CompanyAsian_Paints_Ltd.         5.592611  12.138319   0.461 0.645716
CompanyAxis_Bank_Ltd.           -1.300602  12.465399  -0.104 0.917055
CompanyBajaj_Auto_Ltd.           4.534565  12.298967   0.369 0.712924
CompanyBajaj_Finance_Ltd.       28.127895  12.318804   2.283 0.023950 *
CompanyBajaj_Finserv_Ltd.       21.178946  12.755499   1.660 0.099126 .
CompanyBharat_Petroleum_Co.      3.435697  12.164113   0.282 0.778028
CompanyBharti_Airtel_Ltd.        3.947350  12.450564   0.317 0.751694
CompanyBharti_Infratel_Ltd.     -3.439652  12.861312  -0.267 0.789531
CompanyBritannia_Industries_Ltd. 13.639769  12.142427   1.123 0.263268
CompanyCipla_Ltd.               -2.232216  12.222761  -0.183 0.855360
CompanyCoal_India_Ltd.          -5.791413  12.808872  -0.452 0.651883
CompanyDr._Reddy's_Laboratories -4.252023  12.196115  -0.349 0.727897
CompanyEicher_Motors_Ltd.        6.605780  12.450532   0.531 0.596581
CompanyGAIL_(India)_Ltd.        -9.426399  12.213864  -0.772 0.441575
CompanyGrasim_Industries_Ltd.    3.526146  12.360924   0.285 0.775872
CompanyHCL_Technologies_Ltd.    -0.218915  12.391150  -0.018 0.985930
CompanyHDFC_Bank_Ltd.            6.896838  12.375328   0.557 0.578228
CompanyHero_MotoCorp_Ltd.        2.357116  12.181785   0.193 0.846858
CompanyHindalco_Industries_Ltd. -7.064505  12.605048  -0.560 0.576088
```

```
CompanyHindustan_Unilever_Ltd.    4.438103  12.218902   0.363 0.717003
CompanyICICI_Bank_Ltd.           -3.458771  12.198294  -0.284 0.777187
CompanyIndian_Oil_Corporation_    1.027846  12.371650   0.083 0.933909
CompanyIndusInd_Bank_Ltd.         5.999482  12.157986   0.493 0.622478
CompanyInfosys_Ltd.              -1.707577  12.172065  -0.140 0.888640
CompanyITC_Ltd.                   1.968221  12.160278   0.162 0.871657
CompanyJSW_Steel_Ltd.            -4.898213  12.693678  -0.386 0.700185
CompanyKotak_Mahindra_Bank_Ltd.   4.500342  12.172741   0.370 0.712172
CompanyLarsen_&_Toubro_Ltd.      -0.822971  12.147800  -0.068 0.946086
CompanyMahindra_&_Mahindra_Ltd.   0.446121  12.175768   0.037 0.970825
CompanyMaruti_Suzuki_India_Ltd.   7.921884  12.301756   0.644 0.520676
CompanyNestle_India_Ltd.          1.172978  12.217262   0.096 0.923653
CompanyNTPC_Ltd.                  1.608123  12.296414   0.131 0.896141
CompanyOil_N_G_C                 -5.789883  12.356331  -0.469 0.640117
CompanyPower_Grid_Corp.           1.031719  12.287410   0.084 0.933206
CompanyReliance_Industries_Ltd.  12.444822  12.266397   1.015 0.312111
CompanyShree_Cement_Ltd.         10.758031  12.371465   0.870 0.386049
CompanyState_Bank_of_India       -5.743739  12.176003  -0.472 0.637873
CompanySun_Pharmaceutical_       -5.339563  12.360732  -0.432 0.666437
CompanyTata_Consultancy_Services  1.097586  12.139542   0.090 0.928090
CompanyTata_Motors_Ltd.         -19.604633  12.294789  -1.595 0.113118
CompanyTata_Steel_Ltd.            8.248529  12.988745   0.635 0.526454
CompanyTech_Mahindra_Ltd.         4.577579  12.199672   0.375 0.708076
CompanyTitan_Company_Ltd.        10.772450  12.182089   0.884 0.378091
CompanyUltraTech_Cement_Ltd.      2.415541  12.189206   0.198 0.843205
CompanyUPL_Ltd.                   1.275387  12.485213   0.102 0.918786
CompanyVedanta_Ltd.               7.840745  12.476656   0.628 0.530766
CompanyWipro_Ltd.                -1.162078  12.170234  -0.095 0.924069
CompanyZee_Entertainment_         1.363920  12.114778   0.113 0.910526
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 17.11 on 137 degrees of freedom
Multiple R-squared:  0.7862, Adjusted R-squared:  0.6957
F-statistic: 8.686 on 58 and 137 DF,  p-value: < 2.2e-16
```

Analysis

The model seems to have decent adjusted R^2, insignificant variables Operating Margin and Interest coverage will be eliminated from the next model.

Model 2:

Dropping Interest Coverage & Operating Margin

```
Residuals:
     Min       1Q   Median       3Q      Max
-100.815   -6.522   -0.557    5.744   66.741

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                        7.09995    8.71164   0.815 0.416469
price_to_book_value                0.70050    0.04403  15.909  < 2e-16 ***
Adjusted_EPS_.Rs.                  0.03609    0.01627   2.219 0.028104 *
Dividend_Yield_...                -0.05676    0.02115  -2.683 0.008175 **
Debt_to_Equity                    -0.06946    0.02273  -3.056 0.002694 **
ROA_.In_10..                       0.52948    0.14181   3.734 0.000274 ***
ROE.In_10..                        0.51422    0.14012   3.670 0.000345 ***
Operating_Profit_Growth_._In_10..  2.14325    0.70642   3.034 0.002881 **
Revenue_Growth_.In_10_..           1.07956    0.72721   1.485 0.139933
CompanyAsian_Paints_Ltd.           5.53214   12.06961   0.458 0.647415
CompanyAxis_Bank_Ltd.             -1.40600   12.39313  -0.113 0.909837
CompanyBajaj_Auto_Ltd.             4.02704   12.05668   0.334 0.738876
CompanyBajaj_Finance_Ltd.         28.47772   12.22859   2.329 0.021312 *
CompanyBajaj_Finserv_Ltd.         20.54739   12.64733   1.625 0.106504
CompanyBharat_Petroleum_Corp.      3.08875   12.08415   0.256 0.798635
CompanyBharti_Airtel_Ltd.          3.74927   12.35408   0.303 0.761974
CompanyBharti_Infratel_Ltd.       -4.17872   12.68331  -0.329 0.742299
CompanyBritannia_Industries_Ltd.  13.75103   12.06834   1.139 0.256483
CompanyCipla_Ltd.                 -2.38014   12.15200  -0.196 0.845003
CompanyCoal_India_Ltd.            -6.31843   12.71236  -0.497 0.619953
CompanyDr._Reddy's_Laboratories   -4.30495   12.12705  -0.355 0.723137
CompanyEicher_Motors_Ltd.          5.40263   12.22632   0.442 0.659259
CompanyGAIL_(India)_Ltd.          -9.61887   12.12946  -0.793 0.429120
CompanyGrasim_Industries_Ltd.      3.52288   12.28588   0.287 0.774737
CompanyHCL_Technologies_Ltd.       0.21113   12.29384   0.017 0.986323
CompanyHDFC_Bank_Ltd.              8.20130   12.06500   0.680 0.497788
CompanyHero_MotoCorp_Ltd.          2.30924   12.10255   0.191 0.848956
CompanyHindalco_Industries_Ltd.   -7.15688   12.53099  -0.571 0.568831
CompanyHindustan_Unilever_Ltd.     4.39931   12.15003   0.362 0.717840
CompanyICICI_Bank_Ltd.            -3.13274   12.11624  -0.259 0.796360
CompanyIndian_Oil_Corporation_Ltd. 0.34695   12.24711   0.028 0.977440
CompanyIndusInd_Bank_Ltd.          6.36966   12.07471   0.528 0.598673
CompanyInfosys_Ltd.               -1.74790   12.10305  -0.144 0.885380
CompanyITC_Ltd.                    1.82203   12.08792   0.151 0.880406
CompanyJSW_Steel_Ltd.             -5.03959   12.55117  -0.402 0.688652
CompanyKotak_Mahindra_Bank_Ltd.    4.97294   12.07988   0.412 0.681215
CompanyLarsen_&_Toubro_Ltd.       -0.84705   12.07944  -0.070 0.944196
CompanyMahindra_&_Mahindra_Ltd.    0.38582   12.10479   0.032 0.974619
CompanyMaruti_Suzuki_India_Ltd.    7.53204   12.09988   0.622 0.534640
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CompanyNestle_India_Ltd.            1.06073   12.14740   0.087 0.930542
CompanyNTPC_Ltd.                    1.43869   12.22207   0.118 0.906465
CompanyOil_&_Natural_Gas           -6.38396   12.25268  -0.521 0.603178
CompanyPower_Grid_Corp.             0.95765   12.21768   0.078 0.937637
CompanyReliance_Industries_Ltd.    12.17806   12.17369   1.000 0.318875
CompanyShree_Cement_Ltd.            9.75635   12.20915   0.799 0.425595
CompanyState_Bank_of_India         -5.87148   12.10049  -0.485 0.628279
CompanySun_Pharmaceutical_         -5.42807   12.29013  -0.442 0.659421
CompanyTata_Consultancy_Services    0.99825   12.05779   0.083 0.934139
CompanyTata_Motors_Ltd.           -19.45448   12.19125  -1.596 0.112810
CompanyTata_Steel_Ltd.              7.65745   12.86764   0.595 0.552748
CompanyTech_Mahindra_Ltd.           4.49620   12.12996   0.371 0.711449
CompanyTitan_Company_Ltd.          10.81588   12.10403   0.894 0.373093
CompanyUltraTech_Cement_Ltd.        2.33440   12.11753   0.193 0.847517
CompanyUPL_Ltd.                     1.07300   12.40438   0.087 0.931192
CompanyVedanta_Ltd.                 7.47715   12.36489   0.605 0.546359
CompanyWipro_Ltd.                  -1.15342   12.09821  -0.095 0.924183
CompanyZee_Entertainment_           1.44967   12.04580   0.120 0.904382
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 17.01 on 139 degrees of freedom
Multiple R-squared:  0.7855, Adjusted R-squared:  0.6991
F-statistic: 9.091 on 56 and 139 DF,  p-value: < 2.2e-16
```

Analysis

Companies **Bajaj Finance, Bajaj Finserv** and **Tata Motors** had **significant** values at **90% Confidence Interval** with respect to **Adani ports.** However, the model handles only the **entity** fixed effects that controls the **unobservables** which might be **correlated** with **regressors.**

B) Time Fixed Effects (Binary Regressor)

Time Fixed Effects controls that **unobservables** that might be **correlated** with **regressors** across the **time period.** In this model, we have introduced t different intercepts one each for year using T-1 binary regressors.

Model 1:

Time Effect with No elimination of variable

```
Residuals:
    Min      1Q  Median      3Q     Max
-97.284  -7.128  -1.354   6.366  61.996

Coefficients:
```

```
                                 Estimate Std. Error t value Pr(>|t|)
(Intercept)                      5.169732   2.617119   1.975 0.049740 *
price_to_book_value              0.700613   0.041509  16.879  < 2e-16 ***
Adjusted_EPS_.Rs.                0.021667   0.015038   1.441 0.151347
Dividend_Yield_...              -0.070142   0.018049  -3.886 0.000143 ***
Debt_to_Equity                  -0.080417   0.019220  -4.184 4.45e-05 ***
Operating_Margin.In_10..        -0.029972   0.088310  -0.339 0.734703
ROA_.In_10..                     0.492233   0.111299   4.423 1.67e-05 ***
ROE.In_10..                      0.484089   0.109644   4.415 1.73e-05 ***
Interest_Coverage                0.002606   0.011575   0.225 0.822130
Operating_Profit_Growth_._In_10.. 2.749246   0.921146   2.985 0.003230 **
Revenue_Growth_.In_10_..         1.720412   0.802499   2.144 0.033375 *
factor(Year)2017                 6.534531   3.678112   1.777 0.077305 .
factor(Year)2018                 4.811295   3.468142   1.387 0.167052
factor(Year)2019                -1.089628   3.504711  -0.311 0.756230
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 16.23 on 182 degrees of freedom
Multiple R-squared:  0.7443, Adjusted R-squared:  0.7261
F-statistic: 40.76 on 13 and 182 DF,  p-value: < 2.2e-16
```

Analysis

The model seems to have good adjusted R^2, insignificant variables Operating Margin and Interest coverage will be eliminated from the next model.

Model 2:

Eliminating Operating Margin and Interest Coverage

```
Residuals:
    Min      1Q  Median      3Q     Max
-96.824  -7.131  -1.378   6.354  61.702

Coefficients:
                                 Estimate Std. Error t value Pr(>|t|)
(Intercept)                       5.17276    2.50629   2.064 0.040430 *
price_to_book_value               0.69751    0.04038  17.273  < 2e-16 ***
Adjusted_EPS_.Rs.                 0.02266    0.01446   1.567 0.118884
Dividend_Yield_...               -0.07036    0.01795  -3.921 0.000125 ***
Debt_to_Equity                   -0.08084    0.01888  -4.283 2.97e-05 ***
ROA_.In_10..                      0.48601    0.10930   4.447 1.51e-05 ***
ROE.In_10..                       0.47756    0.10756   4.440 1.55e-05 ***
Operating_Profit_Growth_._In_10..  2.55130    0.59221   4.308 2.68e-05 ***
Revenue_Growth_.In_10_..          1.88386    0.59374   3.173 0.001769 **
factor(Year)2017                  6.69702    3.53188   1.896 0.059505 .
```

```
factor(Year)2018                   4.94100    3.33705   1.481 0.140410
factor(Year)2019                  -1.05242    3.38029  -0.311 0.755895
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 16.15 on 184 degrees of freedom
Multiple R-squared:  0.7442, Adjusted R-squared:  0.7289
F-statistic: 48.65 on 11 and 184 DF,  p-value: < 2.2e-16
```

Analysis

Year **2017**, **2018** had **significant** values at **90% Confidence Interval** with respect to **Year 2016**. However, the model handles only the **time** fixed effects that controls the **unobservables** which might be **correlated** with **regressors.**

C) Mixed Effects

Containing Time and Entity both with Dummy Variables

In this model, variations across both the time and companies are considered. Through this both the effects that vary across the companies but remain same over time and the effects that vary across the time and remain same across the companies are handled.

Model 1:

Considering Time and Entity effect with all variable

```
Residuals:
    Min      1Q  Median      3Q     Max
-90.940  -6.300  -1.014   6.199  61.496

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                     3.152495   8.885248   0.355  0.72330
price_to_book_value             0.655062   0.048265  13.572  < 2e-16 ***
Adjusted_EPS_.Rs.               0.033809   0.016660   2.029  0.04440 *
Dividend_Yield_...             -0.062321   0.021191  -2.941  0.00386 **
Debt_to_Equity                 -0.068186   0.022954  -2.971  0.00352 **
Operating_Margin.In_10..        0.010153   0.101951   0.100  0.92082
ROA_.In_10..                    0.487299   0.145609   3.347  0.00106 **
ROE.In_10..                     0.471934   0.144180   3.273  0.00135 **
Interest_Coverage              -0.002438   0.013358  -0.183  0.85545
Operating_Profit_Growth_._In_10.. 1.951564   1.093521   1.785  0.07658 .
Revenue_Growth_.In_10_..        1.050283   0.943297   1.113  0.26752
factor(Year)2017                8.907647   3.925687   2.269  0.02486 *
factor(Year)2018                6.180174   3.662866   1.687  0.09388 .
factor(Year)2019                0.660199   3.733718   0.177  0.85992
```

```
CompanyAsian_Paints_Ltd.           5.868467  11.930427   0.492  0.62360
CompanyAxis_Bank_Ltd.             -1.576238  12.253150  -0.129  0.89784
CompanyBajaj_Auto_Ltd.             4.364375  12.099691   0.361  0.71889
CompanyBajaj_Finance_Ltd.         30.305239  12.149016   2.494  0.01383 *
CompanyBajaj_Finserv_Ltd.         22.778070  12.579903   1.811  0.07243 .
CompanyBharat_Petroleum_Corp.      3.411581  11.960019   0.285  0.77589
CompanyBharti_Airtel_Ltd.          3.309145  12.245136   0.270  0.78739
CompanyBharti_Infratel_Ltd.       -3.191636  12.701060  -0.251  0.80198
CompanyBritannia_Industries_Ltd. 14.277027  11.936257   1.196  0.23377
CompanyCipla_Ltd.                 -2.685118  12.016656  -0.223  0.82353
CompanyCoal_India_Ltd.            -6.710335  12.600140  -0.533  0.59522
CompanyDr._Reddy's_Laboratories   -4.579951  11.990861  -0.382  0.70310
CompanyEicher_Motors_Ltd.          5.882660  12.289269   0.479  0.63294
CompanyGAIL_(India)_Ltd.          -8.352188  12.016038  -0.695  0.48820
CompanyGrasim_Industries_Ltd.      3.545065  12.150454   0.292  0.77092
CompanyHCL_Technologies_Ltd.       0.273624  12.179638   0.022  0.98211
CompanyHDFC_Bank_Ltd.              9.013724  12.194551   0.739  0.46110
CompanyHero_MotoCorp_Ltd.          1.852142  11.975393   0.155  0.87732
CompanyHindalco_Industries_Ltd.   -5.123603  12.421718  -0.412  0.68065
CompanyHindustan_Unilever_Ltd.     5.064667  12.015334   0.422  0.67405
CompanyICICI_Bank_Ltd.            -2.814719  11.991399  -0.235  0.81478
CompanyIndian_Oil_Corporation_Ltd. 1.771580  12.177791   0.145  0.88455
CompanyIndusInd_Bank_Ltd.          6.932277  11.957484   0.580  0.56306
CompanyInfosys_Ltd.               -1.395342  11.963197  -0.117  0.90732
CompanyITC_Ltd.                    1.982757  11.953524   0.166  0.86851
CompanyJSW_Steel_Ltd.             -2.019681  12.531202  -0.161  0.87220
CompanyKotak_Mahindra_Bank_Ltd.    5.535660  11.975321   0.462  0.64465
CompanyLarsen_&_Toubro_Ltd.       -0.617762  11.939072  -0.052  0.95881
CompanyMahindra_&_Mahindra_Ltd.    0.201224  11.967247   0.017  0.98661
CompanyMaruti_Suzuki_India_Ltd.    8.454974  12.094845   0.699  0.48573
CompanyNestle_India_Ltd.           1.631679  12.008538   0.136  0.89212
CompanyNTPC_Ltd.                   1.374852  12.086989   0.114  0.90961
CompanyOil_&_Natural_Gas_         -6.550585  12.152199  -0.539  0.59075
CompanyPower_Grid_Corporation_     1.357780  12.078243   0.112  0.91066
CompanyReliance_Industries_Ltd.   12.899202  12.058792   1.070  0.28668
CompanyShree_Cement_Ltd.          10.325186  12.168780   0.848  0.39767
CompanyState_Bank_of_India        -5.414309  11.967172  -0.452  0.65169
CompanySun_Pharmaceutical_Ind     -5.898291  12.157851  -0.485  0.62837
CompanyTata_Consultancy_Services   1.360623  11.931421   0.114  0.90938
CompanyTata_Motors_Ltd.          -19.883183  12.086627  -1.645  0.10230
CompanyTata_Steel_Ltd.             7.766043  12.769925   0.608  0.54412
CompanyTech_Mahindra_Ltd.          4.663116  11.990515   0.389  0.69797
CompanyTitan_Company_Ltd.         12.059405  11.982556   1.006  0.31603
CompanyUltraTech_Cement_Ltd.       2.342059  11.980141   0.195  0.84530
CompanyUPL_Ltd.                    2.312118  12.276066   0.188  0.85089
CompanyVedanta_Ltd.                9.118638  12.272957   0.743  0.45879
CompanyWipro_Ltd.                 -1.598594  11.963093  -0.134  0.89390
CompanyZee_Entertainment_          1.595333  11.907133   0.134  0.89362
```

```
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 16.81 on 134 degrees of freedom
Multiple R-squared:  0.798,  Adjusted R-squared:  0.7061
F-statistic: 8.679 on 61 and 134 DF,  p-value: < 2.2e-16
```

Analysis

The model seems to have good adjusted R^2, insignificant variables Operating Margin and Interest coverage will be eliminated from the next model.

Model 2:

Eliminating Operating Margin and Interest Coverage

```
Residuals:
    Min      1Q  Median      3Q     Max
-91.209  -6.261  -0.900   6.083  61.936

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                        3.09641    8.80293   0.352 0.725572
price_to_book_value                0.65728    0.04630  14.197  < 2e-16 ***
Adjusted_EPS_.Rs.                  0.03305    0.01603   2.062 0.041123 *
Dividend_Yield_...                -0.06213    0.02095  -2.966 0.003560 **
Debt_to_Equity                    -0.06758    0.02242  -3.014 0.003076 **
ROA_.In_10..                       0.49101    0.14216   3.454 0.000737 ***
ROE.In_10..                        0.47597    0.14056   3.386 0.000927 ***
Operating_Profit_Growth_._In_10..  1.99230    0.69610   2.862 0.004875 **
Revenue_Growth_.In_10_..           1.00939    0.72870   1.385 0.168260
factor(Year)2017                   8.92043    3.72988   2.392 0.018143 *
factor(Year)2018                   6.21925    3.48125   1.786 0.076246 .
factor(Year)2019                   0.75253    3.55562   0.212 0.832702
CompanyAsian_Paints_Ltd.           5.87310   11.84358   0.496 0.620773
CompanyAxis_Bank_Ltd.             -1.60358   12.16310  -0.132 0.895306
CompanyBajaj_Auto_Ltd.             3.98738   11.83055   0.337 0.736605
CompanyBajaj_Finance_Ltd.         30.22893   12.02533   2.514 0.013111 *
CompanyBajaj_Finserv_Ltd.         22.74793   12.47614   1.823 0.070452 .
CompanyBharat_Petroleum_Corp       3.41372   11.85949   0.288 0.773902
CompanyBharti_Airtel_Ltd.          3.43760   12.12843   0.283 0.777276
CompanyBharti_Infratel_Ltd.       -3.46453   12.47209  -0.278 0.781601
CompanyBritannia_Industries_Ltd.  14.33806   11.84435   1.211 0.228171
CompanyCipla_Ltd.                 -2.69513   11.92588  -0.226 0.821548
CompanyCoal_India_Ltd.            -6.71790   12.47970  -0.538 0.591245
CompanyDr._Reddy's_Laboratories   -4.57356   11.90263  -0.384 0.701395
CompanyEicher_Motors_Ltd.          5.69398   12.00902   0.474 0.636159
```

```
CompanyGAIL_(India)_Ltd.           -8.46881   11.91176  -0.711 0.478325
CompanyGrasim_Industries_Ltd.       3.61857   12.05629   0.300 0.764529
CompanyHCL_Technologies_Ltd.        0.18282   12.06427   0.015 0.987932
CompanyHDFC_Bank_Ltd.               8.77990   11.84021   0.742 0.459649
CompanyHero_MotoCorp_Ltd.           1.94269   11.87771   0.164 0.870322
CompanyHindalco_Industries_Ltd.    -5.19130   12.32643  -0.421 0.674309
CompanyHindustan_Unilever_Ltd.      5.04919   11.92775   0.423 0.672734
CompanyICICI_Bank_Ltd.             -2.86185   11.88885  -0.241 0.810137
CompanyIndian_Oil_Corporation_Ltd. 1.84384   12.03721   0.153 0.878485
CompanyIndusInd_Bank_Ltd.           6.90201   11.85027   0.582 0.561238
CompanyInfosys_Ltd.                -1.41650   11.87596  -0.119 0.905234
CompanyITC_Ltd.                     1.93282   11.86166   0.163 0.870802
CompanyJSW_Steel_Ltd.              -2.28522   12.36253  -0.185 0.853622
CompanyKotak_Mahindra_Bank_Ltd.     5.49642   11.85600   0.464 0.643677
CompanyLarsen_&_Toubro_Ltd.        -0.62085   11.85252  -0.052 0.958302
CompanyMahindra_&_Mahindra_Ltd.     0.24310   11.87784   0.020 0.983701
CompanyMaruti_Suzuki_India_Ltd.     8.12276   11.87418   0.684 0.495095
CompanyNestle_India_Ltd.            1.62424   11.92063   0.136 0.891822
CompanyNTPC_Ltd.                    1.41500   11.99357   0.118 0.906257
CompanyOil_&_Natural_Gas_          -6.51119   12.03443  -0.541 0.589360
CompanyPower_Grid_Corporation       1.34943   11.99061   0.113 0.910561
CompanyReliance_Industries_Ltd.    13.01825   11.95061   1.089 0.277931
CompanyShree_Cement_Ltd.           10.26439   11.98096   0.857 0.393104
CompanyState_Bank_of_India         -5.34891   11.87431  -0.450 0.653095
CompanySun_Pharmaceutical_         -5.89092   12.06655  -0.488 0.626193
CompanyTata_Consultancy_Services    1.25310   11.83131   0.106 0.915807
CompanyTata_Motors_Ltd.           -19.71988   11.96858  -1.648 0.101736
CompanyTata_Steel_Ltd.              7.63299   12.63488   0.604 0.546770
CompanyTech_Mahindra_Ltd.           4.67848   11.90249   0.393 0.694885
CompanyTitan_Company_Ltd.          11.96949   11.88431   1.007 0.315643
CompanyUltraTech_Cement_Ltd.        2.38731   11.89023   0.201 0.841171
CompanyUPL_Ltd.                     2.22619   12.17765   0.183 0.855220
CompanyVedanta_Ltd.                 8.94193   12.14323   0.736 0.462773
CompanyWipro_Ltd.                  -1.54303   11.87272  -0.130 0.896787
CompanyZee_Entertainment_           1.60564   11.82023   0.136 0.892150
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 16.69 on 136 degrees of freedom
Multiple R-squared:  0.798,  Adjusted R-squared:  0.7103
F-statistic: 9.105 on 59 and 136 DF,  p-value: < 2.2e-16
```

Analysis

Companies **Bajaj Finance, Bajaj Finserv** and **Tata Motors and Year 2017, 2018** had **significant** values at **90% Confidence Interval** with respect to **Adani ports and Year 2016 respectively.**

RANDOM EFFECTS

Random Effects controls the unobserved heterogeneity when the heterogeneity is constant over time and not correlated with independent variables.

Model 1:

Random Effect with all variables

```
Balanced Panel: n = 49, T = 4, N = 196

Effects:
                 var std.dev share
idiosyncratic 292.67   17.11     1
individual      0.00    0.00     0
theta: 0

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-104.2392   -7.4144   -1.5176    6.2849   64.8318

Coefficients:
                              Estimate Std. Error z-value  Pr(>|z|)
(Intercept)                  7.5213801  1.5463802  4.8639 1.151e-06 ***
price_to_book_value          0.7296078  0.0396950 18.3803 < 2.2e-16 ***
Adjusted_EPS_.Rs.            0.0230652  0.0150953  1.5280 0.1265189
Dividend_Yield_...          -0.0648794  0.0180500 -3.5944 0.0003251 ***
Debt_to_Equity              -0.0809093  0.0192976 -4.1927 2.756e-05 ***
Operating_Margin.In_10..    -0.0679290  0.0870184 -0.7806 0.4350214
Interest_Coverage            0.0024107  0.0115020  0.2096 0.8339910
ROA_.In_10..                 0.5210392  0.1109338  4.6968 2.642e-06 ***
ROE.In_10..                  0.5126262  0.1092379  4.6928 2.696e-06 ***
Operating_Profit_Growth_._In_10 3.1547644  0.9021623  3.4969 0.0004707 ***
Revenue_Growth_.In_10_..     1.4314336  0.8021535  1.7845 0.0743443 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    187550
Residual Sum of Squares: 49686
R-Squared:      0.73507
Adj. R-Squared: 0.72075
Chisq: 513.309 on 10 DF, p-value: < 2.22e-16
```

Analysis

The model seems to have good adjusted R^2, insignificant variables Operating Margin and Interest coverage will be eliminated from the next model.

Model 2:

Random Effect with Interest Coverage and Operating Margin Eliminated

```
Balanced Panel: n = 49, T = 4, N = 196

Effects:
                 var std.dev share
idiosyncratic 289.39   17.01     1
individual      0.00    0.00     0
theta: 0

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-104.1315   -7.4258   -1.5355    6.3345   64.7639

Coefficients:
                           Estimate Std. Error z-value  Pr(>|z|)
(Intercept)                7.645679   1.520728  5.0276 4.965e-07 ***
price_to_book_value        0.726066   0.038711 18.7561 < 2.2e-16 ***
Adjusted_EPS_.Rs.          0.024374   0.014569  1.6731 0.0943130 .
Dividend_Yield_...        -0.065122   0.017979 -3.6221 0.0002922 ***
Debt_to_Equity            -0.081069   0.019032 -4.2595 2.049e-05 ***
ROA_.In_10..               0.507518   0.109166  4.6490 3.335e-06 ***
ROE.In_10..                0.498851   0.107383  4.6455 3.392e-06 ***
Operating_Profit_Growth_._ 2.645632   0.596859  4.4326 9.311e-06 ***
Revenue_Growth_.In_10_..   1.843766   0.593301  3.1076 0.0018859 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    187550
Residual Sum of Squares: 49850
R-Squared:      0.7342
Adj. R-Squared: 0.72283
Chisq: 516.536 on 8 DF, p-value: < 2.22e-16
```

Analysis

The model seems to have good adjusted R^2, operating margin and interest coverage has been eliminated from the final model.

MODEL COMPARISON

Factors Affecting Stock Prices Using Panel Regression						
Regressor	**Pooled OLS**	**Entity Demeaned**	**Entity With Dummy**	**Time With Dummy**	**Mixed Effects**	**Random Effects**
Price To Book Value	0.72 (0.03)	0.7 (0.04)	0.7 (0.04)	0.69 (0.04)	0.65 (0.05)	0.72 (0.04)
Adjusted EPS	0.02 (0.01)	0.03 (0.01)	0.03 (0.01)	0.02 (0.01)	0.03 (0.02)	0.02 (0.01)
Dividend Yield	-0.06 (0.01)	-0.05 (0.02)	-0.06 (0.01)	-0.07 (0.01)	-0.06 (0.02)	-0.06 (0.02)
Debt to Equity	-0.08 (0.01)	-0.06 (0.02)	-0.07 (0.02)	-0.08 (0.02)	-0.06 (0.02)	-0.08 (0.01)
ROA	0.5 (0.1)	0.52 (0.14)	0.53 (0.14)	0.48 (0.1)	0.49 (0.14)	0.5 (0.11)
ROE	0.49 (0.1)	0.51 (0.14)	0.51 (0.14)	0.47 (0.11)	0.47 (0.14)	0.49 (0.11)
Operating Profit Growth	2.64 (0.59)	2.14 (0.70)	2.14 (0.70)	2.55 (0.59)	1.99 (0.69)	2.64 (0.60)
Revenue Growth	1.84 (0.59)	1.07 (0.72)	1.08 (0.72)	1.88 (0.59)	1.01 (0.73)	1.84 (0.59)
Company Bajaj Finance*			28.4 (12.22)		30.2 (12.02)	
Company Bajaj Fiserv .			20.5 (12.64)		22.7 (12.47)	
Company Tata Motors .			-19.5 (12.19)		-19.7 (11.96)	
Year 2017 .				6.69 (3.53)	8.92 (3.73)	
Year 2018 .				4.94 (3.33)	6.21 (3.48)	
Company Effects?	No	Yes	Yes	No	Yes	No
Time Effects?	No	No	No	Yes	Yes	No
R Squared	0.72	0.58	0.7	0.73	0.71	0.73

TESTS

Breusch-Pagan Lagrange Multiplier Test

```
> plmtest(pooled, type=c("bp"))

        Lagrange Multiplier Test - (Breusch-Pagan) for balanced panels

data:  Stock_Price_Rs ~ price_to_book_value + Adjusted_EPS_.Rs. + Dividend
_Yield_... +  ...
chisq = 3.1586, df = 1, p-value = 0.07553
alternative hypothesis: significant effects
```

- **Null Hypothesis** is **Pooled OLS** is **Better** than Random Effects
- Since the **p-value is 0.075**, we **fail to reject null hypothesis**, thus we can say that **Pooled OLS is better**

Hausman Test

```
phtest(model52,model51)

        Hausman Test

data:  Stock_Price_Rs ~ price_to_book_value + Adjusted_EPS_.Rs. + Dividend
_Yield_... +  ...
chisq = 10.699, df = 8, p-value = 0.2194
alternative hypothesis: one model is inconsistent
```

- **Null Hypothesis** is **Random Effects** is **Better** than Fixed Effects
- Since the **p-value is 0.219**, we **fail to reject null hypothesis**, thus we can say that **Random effects** is better

Serial Collinearity

Serial correlation is usually present in panel data spanning over a long time period, which is false in our case (only 4 years).

CONCLUSION

- **Analysis** of various models and carrying out **various tests**, we have found the **Pooled OLS** model **better** than Fixed Effects or Random Model
- **Serial correlation** usually exists in panel data with long time series
- **Residuals** were **homoscedastic** in nature
- **Variables** found to be **significant** in **determining** the movement in **stock prices** were **Price to Book Value, Adjusted EPS, Dividend Yield, Debt to Equity, ROA, ROE, Operating Profit Growth and Revenue Growth**
- However, there is a lot of scope for **improvement** in the **model** with the introduction of **more data points** as the final model doesn't guarantee the perfect causal relationship as there could be **omitted variable bias** like **import and export of products from foreign companies and their import duties and GDP growth of other countries**

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R-CODE

Pooled Regression: Model 1

```
model1<-lm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+Operating_Margin.In_10..+ ROA_.In_10..+ ROE.In_10..+
Interest_Coverage+Operating_Profit_Growth_._In_10..+ Revenue_Growth_.In_10_..,data=df)
> summary(model1)
```

Pooled Regression: Model 2

```
model1<-lm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+ ROA_.In_10..+ROE.In_10..+Operating_Profit_Growth_._In_10..+
Revenue_Growth_.In_10_..,data=df)
> summary(model1)
```

Entity Demeaned Model

```
model52<-plm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+ ROA_.In_10..+ ROE.In_10..+Operating_Profit_Growth_._In_10..+
Revenue_Growth_.In_10_..,data=pk,model='within', effect='individual')
> summary(model52)
Oneway (individual) effect Within Model
```

Entity Effect Model 1

```
model2<-lm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+Operating_Margin.In_10..+ ROA_.In_10..+ ROE.In_10..+
Interest_Coverage+Operating_Profit_Growth_._In_10..+
Revenue_Growth_.In_10_..+Company,data=df)
> summary(model2)
```

Entity Effect Model 2

```
model22<-lm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+ ROA_.In_10..+ ROE.In_10..+Operating_Profit_Growth_._In_10..+
Revenue_Growth_.In_10_..+Company,data=df)
> summary(model22)
```

Time Effect Model 1

```
model3<-lm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+Operating_Margin.In_10..+ ROA_.In_10..+ ROE.In_10..+
Interest_Coverage+Operating_Profit_Growth_._In_10..+
Revenue_Growth_.In_10_..+factor(Year),data=df)
```

```
> summary(model3)
```

Time Effect Model 2

```
model32<-lm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+ROA_.In_10..+ ROE.In_10..+Operating_Profit_Growth_._In_10..+
Revenue_Growth_.In_10_..+factor(Year),data=df)
```

```
> summary(model32)
```

Mixed Effect Model 1

```
model4<-lm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+Operating_Margin.In_10..+ ROA_.In_10..+ ROE.In_10..+
Interest_Coverage+Operating_Profit_Growth_._In_10..+
Revenue_Growth_.In_10_..+factor(Year)+Company,data=df)
```

```
> summary(model4)
```

Mixed Effect Model 2

```
model42<-lm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+ ROA_.In_10..+ ROE.In_10..+Operating_Profit_Growth_._In_10..+
Revenue_Growth_.In_10_..+factor(Year)+Company,data=df)
```

```
> summary(model42)
```

Random Effect Model 1

```
model5<-plm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+
Debt_to_Equity+Operating_Margin.In_10..+Interest_Coverage+ ROA_.In_10..+
ROE.In_10..+Operating_Profit_Growth_._In_10..+
Revenue_Growth_.In_10_..,data=pk,model='random')
```

```
> summary(model5)
```

```
Oneway (individual) effect Random Effect Model
```

Random Effect Model 2

model51<-plm(Stock_Price_Rs~ price_to_book_value+ Adjusted_EPS_.Rs.+ Dividend_Yield_...+ Debt_to_Equity+ ROA_.In_10..+ ROE.In_10..+Operating_Profit_Growth_._In_10..+ Revenue_Growth_.In_10_..,data=pk,model='random')

> summary(model51)

Oneway (individual) effect Random Effect Model

****