Exploring the Existence of Size Effect: An Empirical Investigation on NSE

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Abstract

Size, as measured by the market value of equity capitalization of a company, is a fallacious explanation of expected return. Specification of size reduces the asset pricing model to either a logical identity which is tautologous or a data instigated auto regression of market generated variable which is a form of market timing. The so called technical analysis of the capital market pricing process is not considered to be sound scientific methodology, being devoid of theoretical motivation. The people small cap investment strategy is a financial fad based on this fallacy. The empirical evidence that risk-adjusted returns are larger for small firms than for large firms is known as the firm size effect. This effect was shown initially by Banz (1981) and Reinganum (1981). The existence of the firm size effect indicates that either the capital market is not efficient or that the return-generating model is misspecified, or both. However, according to recent empirical findings, the firm size effect does not appear to exist in all periods. The size effect is the anomalous pricing of the size factor as indicated by a significant risk premium in the conventional capital asset pricing model. There is considerable evidence, covering extended time periods that the average returns to small firm's stocks are substantially higher than the capital asset pricing model (CAPM) predicts. In particular, this small firm effect is seasonal related and is more pronounced in January. This is in consistent with equilibrium in a market where CAPM holds.This work attempts to determine whether such firm size anomalies and stock return seasonality exists in Indian stock market using data in the pre recessionary periods and post recessionary periods. Empirical results identify that in the post recessionary periods both the average gross returns and abnormal returns tend to be higher in small firm than in large firms. Such small firm effect is more obvious when it is measured by abnormal returns.

Key words: Capital Asset Pricing Model (CAPM), CNX Nifty, ANOVA, Correlation analysis

The Small Firm Effect

The so-called 'small firms' effect' has attracted the attention of both theoreticians and practitioners, and this is not incidental: Dimson and Marsh (1989) reported that over more than the last 33 years the Hoare Govett Smaller Companies Index (HGSC) had provided an annualized return six per cent larger than the All-Share Index. The fact that the smaller companies' index earned higher returns than the All-Share (Market) Index is not bad news for the Market Efficiency Hypothesis. The latter is not falsified unless there are returns above the risk-adjusted returns. Under the risk-adjusted returns we perceive the amount of return an asset (portfolio) earns, which is proportional to the risk borne by this asset (portfolio). Since investors can spread their wealth over a broadly diversified portfolio of securities, they should not be concerned with those elements of price volatility which are specific to each individual stock. Instead, the risk that matters to investors should be the element of volatility that cannot be diversified away even in a large portfolio. This undiversifiable element of risk, called beta-risk, reflects the extent to which the return on an asset moves together with the stock market. Therefore, if small firms' returns do not display excess returns after being adjusted for market risk (beta), this, will not constitute any kind of puzzle. During the 1980s an investor could consistently earn returns free of risk. More surprising was the fact that this could be done without special knowledge, intensive research, or use of inside information. All one had to do was to hold a well-diversified portfolio of small firms over a reasonable period of time.

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There are several lines of thought about why small firms may provide higher returns to their shareholders. Firstly, small firms may be more efficient than large firms. Secondly, the risk estimated by conventional methods may be underpriced. Thirdly, the strategy of portfolio formation, used for testing the size effect, may capture turbulence in small firm prices better than large firms. Thus, the excess returns earned by small size firms may have nothing to do with their intrinsic efficiency. Small firm's returns, therefore, may simply be due to trading strategy.

If we assume the first rationale, there are tempting reasons for investigating the size anomaly. Knight (1965) made an early reference to the firm size puzzle, which is as follows:

'The relation between efficiency and size of the firm is one of the most serious problems of theory, being, in contrast with the relation for a plant, largely a matter of personality and historical accident rather than of intelligible general principles. But the question is peculiarly vital, because the possibility of monopoly gain offers a powerful incentive to continuous and unlimited expansion of the firm, which force must be offset by some equally powerful one making for decreased efficiency'.

Coase (1937, 1960) argued that, to some extend bureaucratic costs of running firms are lower than the costs of co-ordination by market. It is not just costs of production that allow large firms to have a cost-advantage, but also costs of bargaining, implementing and enforcing the agreements also called transaction costs.

However, if firms grow without limit, bureaucratic costs may outweigh the cost of coordinating the economic activities by market. Moreover, hierarchies abolish market incentives. Therefore, the possibility of different profitability based on the size of the firm is not ruled out by economic theory. The problem, though, is that this hypothesis is difficult to test.

In the present study the following aspects of the Size effect has been studied upon:

1. ***Examined the presence of the size effect anomaly in Indian stock market.***
2. ***Verified whether a variance in return exists in different firm sizes.***
3. ***Assessed whether size based strategy can be followed to exploit the market by the investors.***

This study considers the daily indices reported by NSE. S&P CNX Nifty and CNX Nifty mid-cap and CNX small-cap were chosen as the indices to be studied. As stated, the study attempts to examine the presence of size effect in India's premier stock exchange; hence, the selection of the indices for the study was based on certain logical considerations.

The size of the companies are measured by the market capitalization

o **Large cap**: Companies with a market capitalization value of more than $10 billion.
o **Mid cap**: Company with a market capitalization between $2 and $10 billion
o **Small cap**: Company with a market capitalization of between $300 million and $2 billion.

Collection of Data

The study on the size effect has been done in two parts. The first study has been done by taking the data for a period of ten years. Upon more literature analysis another post recession study for a period of 5 years has also been done to find out the existence of the premium size effect in Indian stock market. Fifty companies each from large cap, mid cap and small cap has been selected and their daily returns are calculated. The required data have been downloaded from the NSE website http://www.nseindia.com and https://in.finance.yahoo.com/.

For the period of ten years, the daily prices from the date 1st April 2005 to 31stMarch 2015 has been taken for research. 2445 prices have been collected and their respective 2444 returns are compared to prove the hypothesis.

In order to examine the presence of the size effect, the following null hypothesis has been tested:

Hypothesis (Ho): $a_1 = a_2 = a_3$

Here, a_1, a_2, a_3 represents mean returns of large cap, mid cap and small cap companies respectively. The null hypothesis implies that there is no significant difference in mean returns across the trading days.

To test the hypothesis first the **correlation** among the returns is found out. Its significance level will prove that whether the correlation between the returns is only a matter of chance or permanent. If the correlation is a matter of chance then there exists the size effect in the stock market.

To test this null hypothesis first **ANOVA** is applied to find out whether the daily returns and the abnormal returns are dependent on each other or different.

First of all the **daily returns** on NSE index were computed using the first differences of the logarithmic price index.

The **abnormal return** is then calculated for each and every stock on a daily basis. Then the theoretical return is deducted from the real return, the difference between them is known as the abnormal return or error term. The theoretical return is calculated by applying the **CAPM model**.

$$R_i = R_f + \beta \left(R_m - R_f \right)$$

After calculating the returns, the abnormal return (Error Term) is computed as the difference between the actual return and theoretical return

$$(R_i - \overline{R_i})$$

is calculated for the "error term" i:e **"e_i"** which remains unexplained by CAPM model. Then the average of the error terms of the stocks present in the three indices on a daily basis is computed.

Parametric tests like mean, standard deviation, skewness and kurtosis have been applied to study the distribution pattern of the daily returns of the stock.

To test the existence of size effect The independent T-test is done to access whether there is a significant difference among the stock returns based on market capitalization. The comparison is done between: Large cap: mid cap, Large cap: small cap, Small cap: mid cap.

Analysis of variance (ANOVA) model is adopted to find out whether the daily returns are dependent on the trading days or independent on the market capitalization of the stocks.

Data Presentation and Interpretation

The calculated returns are put to find out the descriptive statistics. The descriptive statistics calculates the mean, standard deviation, skewness and kurtosis which reveals the nature of the data and quantifies the main features of the taken data. It helps to describe, and summarize data in a meaningful way such that a particular pattern might emerge from the data.

Table: 1 Descriptive Statistics – Total Return

	N	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Large Cap	2445	.0049	.7383	.545	-.778	.050	8.485	.099
Mid Cap	2445	.0267	1.1893	1.415	-.899	.050	24.791	.099
Small Cap	2445	-.0114	1.2628	1.595	-.601	.050	3.867	.099
Valid N (listwise)	2445							

Interpretation of Descriptive Statistics

The table 1 above displays the descriptive statistics of the daily returns from the stocks for the period of 2005 to 2015. The stock returns are calculated based on the size of the company. The mean return from the mid cap is maximum i.e. 0.02 with a standard deviation of 1.18. The return from the large cap is lower than mid cap i.e. 0.049 with bit less standard deviation of 0.73. But the mean return from the small cap is negative i.e. -0.0114 with a still high standard deviation of 1.262. From this we can infer that the return from the mid cap is higher is a bit risky with a high standard deviation. The small cap has performed the worst in this period of research. In this period of 10 years the performance of the mid cap has outshined all the other categories of stocks based on size.

The figure 1 below shows the graphical representation of the average returns for large cap, mid cap and small cap companies which clearly reveals the outperformed mid cap stocks.

Figure 1   Means Plot – Total Returns
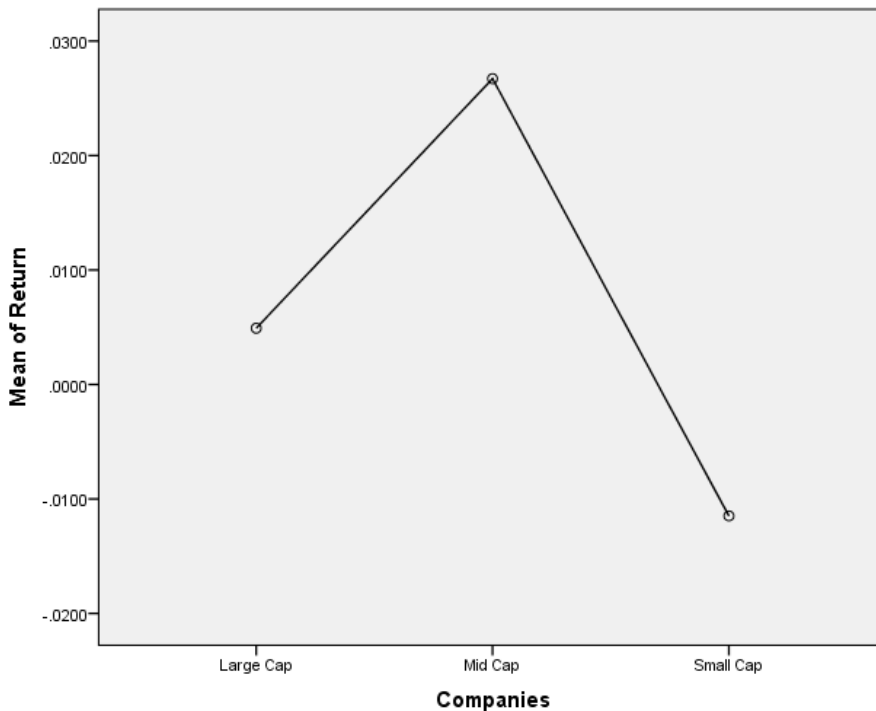
Coefficient of Correlation of Returns

It tracks the direction of the movements of the returns of the variables. In this present study the correlation between large cap, mid cap and small cap companies have been done to know how strongly each pair is correlated which would realize the fact that whether the size related anomaly is a permanent structure or a matter of chance.

Table:2 Correlations – Total Returns

		Large Cap	Mid Cap	Small Cap
Large Cap	Pearson Correlation	1	.012	-.012
	Sig. (2-tailed)		.556	.557
	N	2445	2445	2445
Mid Cap	Pearson Correlation	.012	1	.629**
	Sig. (2-tailed)	.556		.000
	N	2445	2445	2445
Small Cap	Pearson Correlation	-.012	.629**	1
	Sig. (2-tailed)	.557	.000	
	N	2445	2445	2445

**. Correlation is significant at the 0.01 level (2-tailed).

Analysis of the Correlation of Returns

The Table 2 shows the correlation among the different types of stocks. It shows a positive correlation between the large cap and mid cap i.e. 0.12. But the correlation among the small cap and large cap is negative (i.e. -0.12). The correlation between mid cap and small cap (0.629) is also highly positive. This increases the chances of earning abnormal return by designing a portfolio taking different stocks from large cap and small cap.

Though the coefficient of correlations among the mid cap and small cap is positive but it is highly significant rejecting the null hypothesis. This implies that the correlation is just a matter of chance and it is not permanent. So far as the level of significance of the coefficient of correlation among the mid cap and large cap and large cap and small cap is concerned it is highly in significant, which accepts the null hypothesis in these cases.

Analysis of Variance (ANOVA)

The one-way analysis of variance is used to determine whether there are any significant differences between the means of three or more independent (unrelated) groups. It compares the means between the groups you are interested in and determines whether any of those means are significantly different from each other. Specifically, it tests the null hypothesis.

Table: 3 ANOVA – Total Return

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.796	2	.898	.758	.469
Within Groups	8687.173	7332	1.185		
Total	8688.969	7334			

Interpretation of ANOVA

The table 3 above shows the ANOVA of the returns of the different stocks of different sizes. We can see from the table that the level of significance is more than 0.05 (i.e. 0.469) which proves that there does not exist a significant difference among the returns of the stocks. The returns of the different stocks are independent. Since, the ANOVA is highly insignificant it accepts the null hypothesis.

Data analysis – abnormal return

(Error term)

The following table shows the descriptive statistics, coefficient of correlation and ANOVA for the abnormal return which was calculated using CAPM model. This is done to know which companies from the Large cap, Mid cap and Small cap earned above abnormal return.

Table 4: Descriptive Statistics – Error Term

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Large Cap	2445	-.046115	.97714	.0197614	-.084866	-.007364
Mid Cap	2445	-.007468	1.13273	.0229081	-.052389	.037453
Small Cap	2445	-.044967	1.19627	.0241931	-.092408	.002474
Total	7335	-.032850	1.10588	.0129125	-.058162	-.007538

Figure 2   Means Plot – Error term
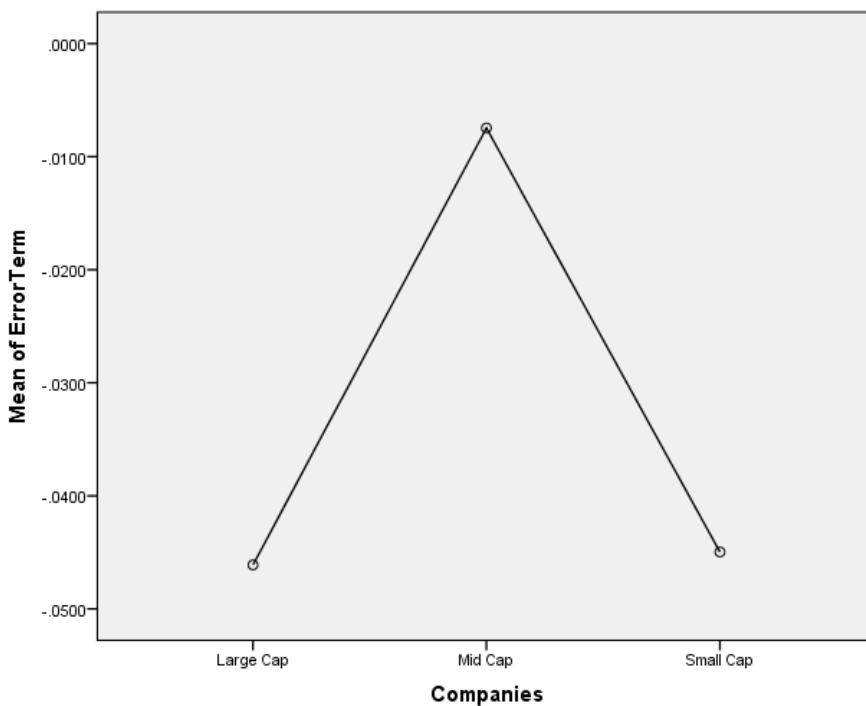
Table 5: Correlations – Error Term

		Large Cap	Mid Cap	Small_Cap
Large Cap	Pearson Correlation	1	.015	.024
	Sig. (2-tailed)		.456	.229
	N	2445	2445	2445
Mid Cap	Pearson Correlation	.015	1	.588**
	Sig. (2-tailed)	.456		.000
	N	2445	2445	2445
Small_Cap	Pearson Correlation	.024	.588**	1
	Sig. (2-tailed)	.229	.000	
	N	2445	2445	2445

Table 6: ANOVA – Error Term

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.364	2	1.182	.967	.380
Within Groups	8966.968	7332	1.223		
Total	8969.332	7334			

From the **table 4** the magnitude of mean of the error terms (i.e. abnormal returns) of the mid cap stocks is lower as compared to other type of stocks. This shows that the actual return from the mid cap stocks is very close to the theoretical return. In case of the large cap stocks the mean is also not very high. If we see these three stocks we can see that there is not much of size effect in the stock market during theperiod. From **table 5**, there shows a positive correlation between the large cap and mid cap, mid cap and small cap and also large cap and small cap. Though the coefficient of correlations among the mid cap and small cap is highly significant rejecting the null hypothesis. This implies that the correlation is just a matter of chance and it is not permanent. So far as the level of significance of the coefficient of correlation among the mid cap and large cap and large cap and small cap is concerned it is highly in significant, which accepts the null hypothesis in these cases.

The **table 6** above shows the ANOVA of the returns of the different stocks of different sizes. We can see from the table that the level of significance is more than 0.05 (i.e. 0.380) which proves that there does not exist a significant difference among the returns of the stocks. The returns of the different stocks are independent. Since, the ANOVA is highly insignificant it accepts the null hypothesis.

The above analysis for 10 years period on the actual returns and the abnormal returns reveals there is no statistical significance between the returns of large cap, mid cap and small

companies, hence accepting the null hypothesis. This nullifies the presence of size effect in the Indian stock market during this period.

Test of Size Effect in Post Recessionary Periods

Several literature analysis mentions the existence of size effect in the present stock market scenario. Keeping this in view, another study is done for a period of 5 years. The daily prices from the date 1st April 2010 to 31stMarch 2015 has been taken for research. 1247 prices have been collected and their respective 1246 returns are compared to prove the hypothesis.

Data Presentation and Interpretation

The calculated returns are put to find out the descriptive statistics. The descriptive statistics calculates the mean, standard deviation, skewness and kurtosis which reveals the nature of the data and quantifies the main features of the taken data. It helps to describe, and summarize data in a meaningful way such that a particular pattern might emerge from the data.

Table 7 Descriptive statistics – Daily Return

	N	Mean	Std. Deviation	Std. Error
Large Cap	1246	.038163	1.310908	.0371375
Mid Cap	1246	.070610	1.247025	.03532778
Small Cap	1246	-.813204	16.82268	.47658051
Total	3738	-.234809	9.77455	.15987375

Analysis of Daily Returns

The table 7 above displays the descriptive statistics of the daily returns from the stocks for the period of 2010 to 2015. The stock returns are calculated based on the size of the company. The mean return from the mid cap is maximum i.e. 0.07 with a standard deviation of1.24. The return from the large cap is lower than mid cap i.e. 0.0381 with bit high standard deviation of 1.31. But the mean return from the small cap is negative i.e. -0.813 with a very high standard deviation of 16.8226. From this we can infer that the return from the mid cap is higher and also more consistence with a lower standard deviation. The small cap has performed the worst in this period of research. In this period of 5 years the performance of the mid cap has outshined all the other categories of stocks based on size.

Figure 3:   Graphical Presentation of the Returns
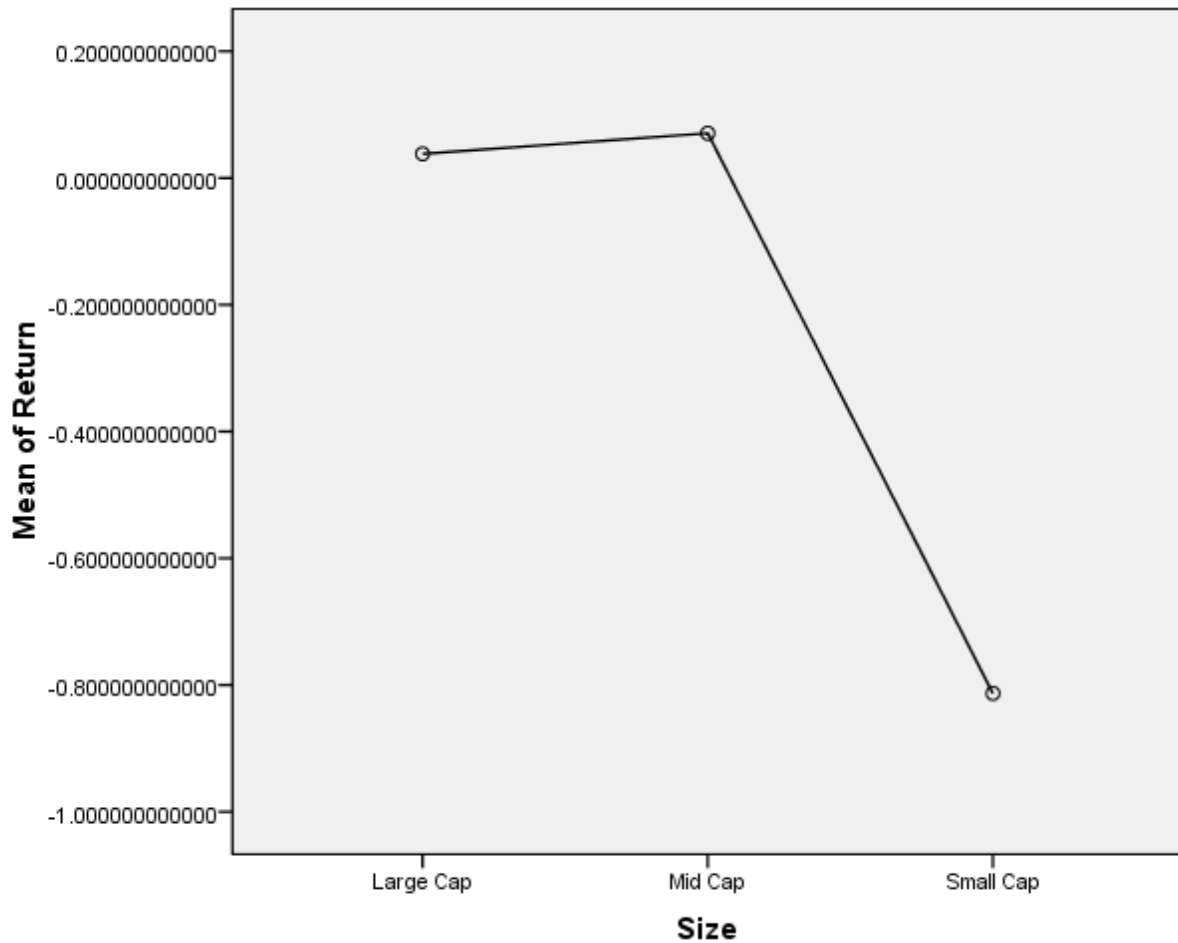
The figure above is the graphical presentation the returns. From this figure it can be inferred that the mean return from the mid cap is higher than any other types of stocks. This shows the performance of the mid cap has outshined all the type of stocks.

Coefficient of Correlation

The **correlation** between large cap, mid cap and small cap companies have been done to know how strongly each pair is correlated which would realize the fact that whether the size related anomaly is a permanent structure or a matter of chance.

Table-8 Correlations- Daily Return

		Large_Cap	Mid_cap	Small_Cap
Large_Cap	Pearson Correlation	1	**.831****	-.924**
	Sig. (2-tailed)		.000	.000
	N	1246	1246	1246
Mid_cap	Pearson Correlation	**.831****	1	-.819**
	Sig. (2-tailed)	.000		.000
	N	1246	1246	1246
Small_Cap	Pearson Correlation	-.924**	-.819**	1
	Sig. (2-tailed)	.000	.000	
	N	1246	1246	1246

**. Correlation is significant at the 0.01 level (2-tailed).

Analysis of the Correlation of returns

The Table –8 shows the correlation among the different types of stocks. It shows a strong positive correlation between the large cap and mid cap i.e. 0.831. But the correlation among the small cap and large cap is highly negative (i.e. -0.924) and mid cap and small cap (-0.819) is also highly negative. This increases the chances of earning abnormal return by designing a portfolio taking different stocks from large cap and small cap or Mid cap and Small Cap.

Though the coefficient of correlations among the large cap and mid cap is very high and positive but it is highly significant rejecting the null hypothesis. This implies that the correlation is just a matter of chance and it is not permanent. In case of the coefficient of correlation among large cap and small cap is also highly hence it proves that this correlation is also a matter of chance. So far as the level of significance of the coefficient of correlation among the mid cap and small cap is concerned it is also highly significant, and shows that it is also a matter of chance and not permanent.

Analysis of Variance (ANOVA)

The one-way analysis of variance is used to determine whether there are any significant differences between the means of three or more independent (unrelated) groups. It compares the means between the large cap, mid cap and small cap companies to know whether any of their means are significantly different from each other. Specifically, it tests the null hypothesis:

Table –9 ANOVA – Daily Return

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	625.911	2	312.955	3.280	.038
Within Groups	356413.964	3735	95.425		
Total	357039.875	3737			

Analysis of ANOVA of Daily Return

The table 9 above shows the ANOVA of the returns of the different stocks of different sizes. We can see from the table that the level of significance is less than 0.05 (i.e. 0.038) which proves that there exist a significant difference among the returns of the stocks. The returns of the different stocks are independent. Though the ANOVA is highly significant but the coefficient of correlation among large cap and mid cap is high.

Post Hoc Test

When we get a significant F test result in an ANOVA test for a main effect of a factor with more than two levels, this tells us we can reject the null hypothesis. i.e. the samples are not all from populations with the same mean. Now, we can use post hoc tests to tell us which groups differ from the rest.

The post hoc test is the test for reliability of the data which is done when it is found that the relationship between the dependent and independent variable is highly significant. Now since the ANOVA test for the actual returns are highly significant hence, we go forward with post hoc test.

Table 10: Multiple Comparisons

(I) Size	(J) Size	Mean Difference (I-J)	Std. Error	Sig.
Large Cap	Mid Cap	-.03244653	.39137044	.934
	Small Cap	.85136800*	.39137044	**.030**
Mid Cap	Large Cap	.03244653	.39137044	.934
	Small Cap	.88381454*	.39137044	**.024**
Small Cap	Large Cap	-.85136800*	.39137044 7	.030
	Mid Cap	-.8838145*	.39137044	.024

*. The mean difference is significant at the 0.05 level.

Analysis for Post Hoc Test

The above table 10 shows the post hoc analysis of the returns for further analysis. From the Post-hoc analysis we can find out that which among the three types of stocks has performed differently. The level of significance between large cap and small cap is highly significant and also the significance of mid cap and small cap is also very high. Among the three types of stocks the small cap is independent of the market and it has performed differently that the other two types of stocks.

Data Analysis – Abnormal Return

(ERROR TERM)

To know whether the abnormal return is the cause of the size effect, the following tests have been done for the abnormal return. The table below shows the descriptive statistics, coefficient of correlation and ANOVA for the abnormal return which was calculated using CAPM model.

Table 11: Descriptive statistics – Abnormal Returns

	N	Mean	Std. Deviation	Std. Error
Large Cap	1246	-.00105	.02080	.000581
Mid Cap	1246	-.04895	1.01136	.028651
Small Cap	1246	-.81320	16.82268	.476580
Total	3738	-.28773	9.73463	.159220

The magnitude of mean of the error terms (i.e. abnormal returns) of the large cap stocks is lower as compared to other type of stocks. This shows that the actual return from the large cap stocks is very close to the theoretical return. In Case of the mid cap stocks the mean is also not very high. If we see these two stocks we can see that there is not much of size effect in the stock market during the period. But the mean of the error term is high in case of small cap with a standard deviation of 16.822. From this we can say that there exists a size effect in the stock market during the research period.

Table 12 Correlations-Error Term

		Large Cap	Mid Cap	Small Cap
Large Cap	Pearson Correlation	1	**0.997****	**0.997****
	Sig. (2-tailed)		0.000	0.000
	N	1246	1246	1246
Mid Cap	Pearson Correlation	.997**	1	**1.000****
	Sig. (2-tailed)	0.000		0.000
	N	1246	1246	1246
Small Cap	Pearson Correlation	.997**	1.000**	1
	Sig. (2-tailed)	0.000	0.000	
	N	1246	1246	1246

**. Correlation is significant at the 0.01 level (2-tailed).

Though the coefficient of correlation in case of the abnormal returns is very strong and positive but the level of significance is very high. High level of significance proves that the correlation is not universal but it is only matter of chance.

Table13 ANOVA (Error Terms)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	517.487	2	258.743	2.733	0.065
Within Groups	353612.387	3735	94.675		
Total	354129.874	3737			

The table 13 above shows the ANOVA of the abnormal returns. The ANOVA is insignificant proving that there is no significant difference among the mean of the error terms. From this we can say that all the three types of firms have shown similar performance so far as abnormal return or error term is concerned.

Observations from the Analysis on the   Existence of Size-Effect

The size effect is one of the most discussed issues of the stock market. There are several lines of thought about why small firms may provide higher returns to their shareholders. Firstly, small firms may be more efficient than large firms. Secondly, the risk estimated by conventional methods may be underpriced. Thirdly, the strategy of portfolio formation, used for testing the size effect, may capture turbulence in small firm prices better than large firms. Thus, the excess returns earned by small size firms may have nothing to do with their intrinsic efficiency. Small firm's returns, therefore, may simply be due to trading strategy.

From the last ten years data it was concluded that the size effect did not existed during this period. But the last five years data reveals that there exists a size effect in the Indian stock market. This might be the impact of recovery from recession. This means that an investor can achieve better return by designing a portfolio based on the size of the firm. The coefficient of correlation among the large cap and mid cap is high and positive but the coefficient of correlation among the large cap and small cap is negative and very strong. Same is in the case of mid cap and small cap stocks. So here we can conclude that one can make better return from the stock market by designing portfolios based on size based strategies. If we see the post hoc test of the actual returns we can see that there exist a size effect in the stock market and the small cap stocks are the drivers of the size effect. We can see that during this period the mid cap stock has performed better that the other two types of the stocks. But so far as the abnormal returns are concerned as the ANOVA is insignificant; we can say that the presence of the size effect in the Indian stock market is due to the systematic risk component of the stocks.

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