



# A Review of An Evaluation of Twin Tower Type Structure Having Connection at Various Heights

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**Abstract :** study of an analytic model of an G+19(60m)storey high rise building model have been created and analyzed using software csi etabs .the earthquake of zone III have been considered for building during analysis. Modern structures have extremely integrated and multi-functional architectural designs. A multi-tower is a group of two tall buildings that are linked to each other. In this work, the analysis of high-rise tall twin structure towers connected at various heights is studied. The goal of this study is to ensure that connecting beams in twin tower structures that are subjected to lateral loads are used effectively and are positioned. The model is examined for static and dynamic analysis in this building, which is in Vadodara Zone III. The parameters like Storey Displacement, Drift and Base Shear are to be studied in ETABS software

**Keyword:** twin tower, earthquake zone, seismic loading, storey drift, base shear, max .displacement

## I. INTRODUCTION

Now days due to population growth increase day by day on earth also on each country in civil field also we must take care of modernization of structure. In these Modern buildings now have multistory especially in urban areas where they are being built very close together two single towers. Two single towers connected by like passageways make for a twin tower connected building. The connecting body is provided at a specific height and creates an irregular structural for a building. The connection facilitates communication between towers and acts as a critical exit route if a tower is damaged by natural disasters like fire. The type of connection chosen for the passageway affects both the behavior of the structure and the members of the passageway. Due to making passage between this two-twin tower we can create an extremely passageway for a resident and in some cases like emergencies like fire. It helpful in such cases. We carried out the analysis to check the better structure ability. the static and dynamic analysis. In static analysis consist of applied deadload and in dynamic type of analysis there would be. in this there is a natural element checks like wind analysis, earthquake analysis. Earthquake effect is more disastrous than wind effect. due to over structure is in Vadodara zone III. And, were carried out earthquake analysis we must takes IS Code 1893. And for wind analysis there's IS code 875 part 3 required.

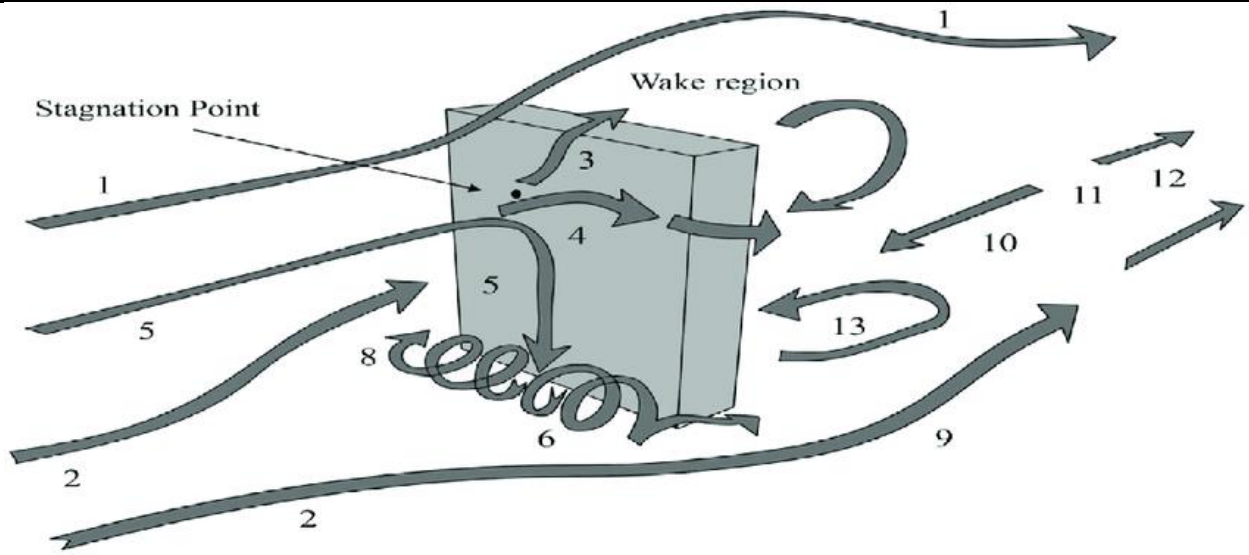


Figure 1 windward directions on tall structure

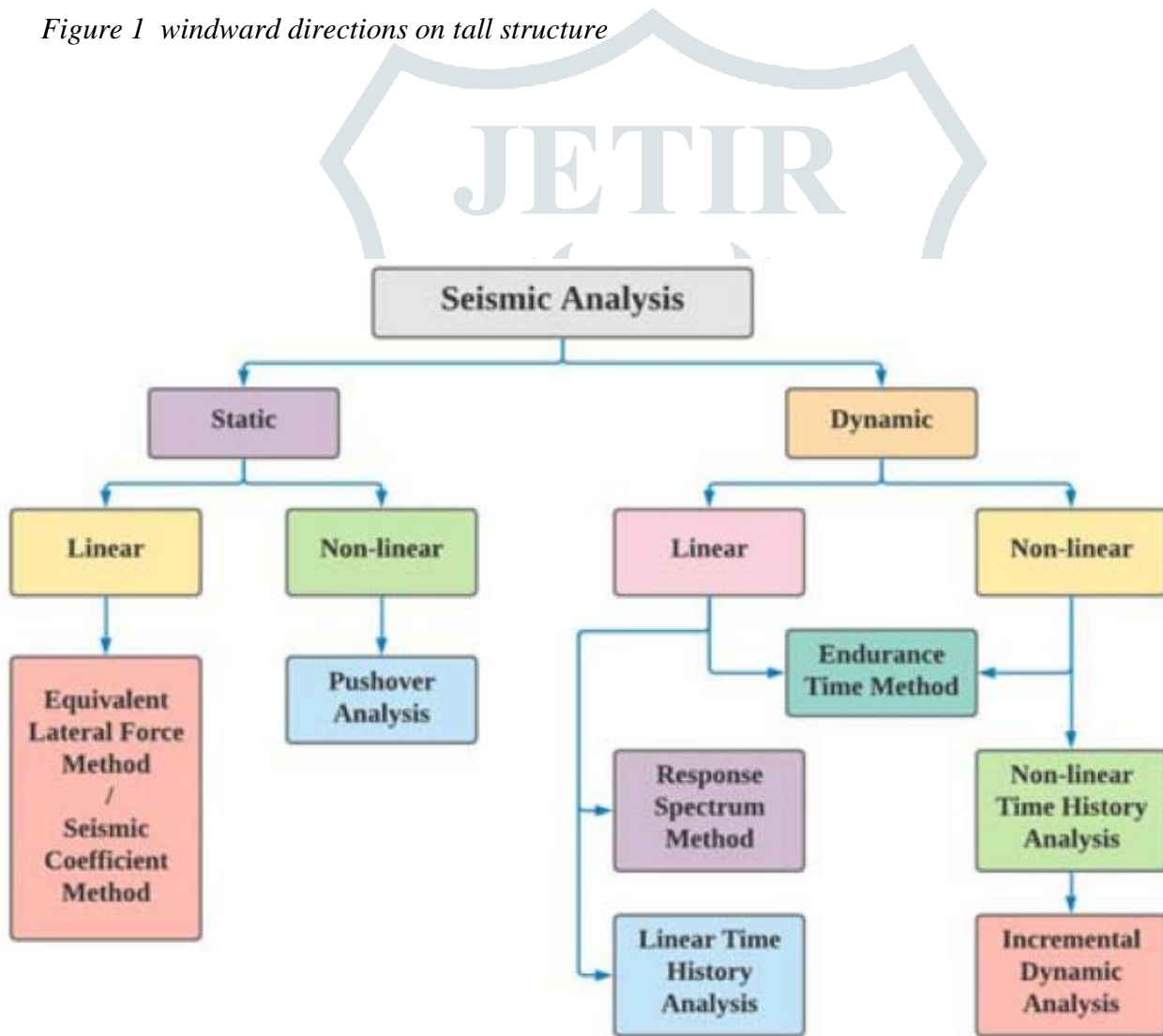


Figure 2 types of seismic analysis

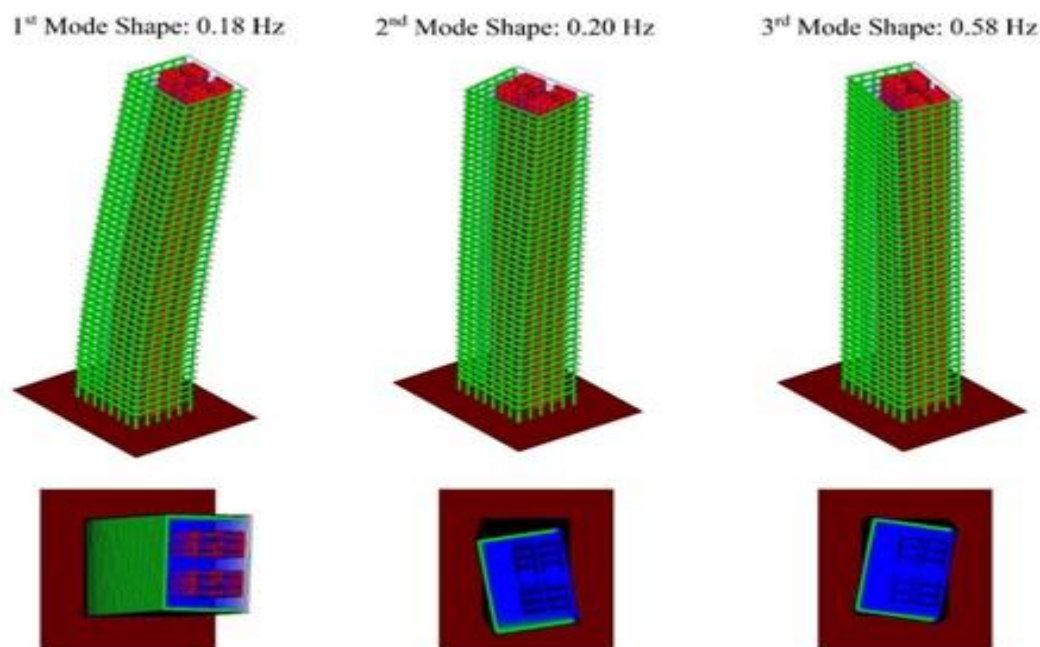


Figure 3 earthquake analysis of building

We using the connecting beam of different size's at various heights to check their reactions after applying loads and doing analysis . at some cases they in replacement of beams they are using structural links also.

## II. Literature review

### study on effect of connecting beams in a twin tower structure.

We have connecting beam between the 2 towers on this paper they G+14 3basement and 20x40m size of building. The hyperlink among this tower is 3m x3.4 m and tower peak are 54m. Purpose of this observe is to find location, shape and size of link. And numerous heights that's where it comfortable. Flexible transfer floors between towers and its impact had been examined. The flexible connections among towers will considerably lessen the drift of multi-tower high-rise buildings and act as energy dissipation mechanism in case of common earthquake. In the prevailing look at, the connecting beams were proposed to hyperlink the two person towers above its basement stage as opposed to sky bridges. The maximum lateral sway and maximum lateral waft has been checked after implemented of wind load.

### Parametric analysis of building with corridors

The connection provide potential for communication alongside special towers and is an important issue way of escape while one tower suffers emergencies like fire. Static overall performance of excessive upward thrust tall rcc structure is simple and mature. If this study consists of the study on the behavior of twin rcc buildings with connecting hall beneath dynamic loading and its behavior with adjustments of connecting beam region with various span. Via carried out dynamic hundreds they checked systems overall performance against the dynamic hundreds for higher components. Tale displacement. The most displacement and for story flow. We have G+9 story twin building. Having corridors at numerous stories with various span of corridors. Having slab of 125mm, and shear wall of 2 hundred mm. The ground movement of beyond histories takes in the Numerical quadrature Linear Time History Method will be suitable with a response spectrum constructed from the design earth's gravity values. The gain of these linear dynamic process with admire to linear static technique is that higher modes can be won. In RSA Method the insight into dynamic conduct by means of measuring pseudo-spectral acceleration, speed, or displacement as a feature of structural period for a given time history and level of damping. In story displacement is occur among the building with corridor at story 2. The displacement is impartial of the span of corridor and indicates version while the level of connection change. The displacement is most along the Y path. The story float is showing an easy curve and shows a small version alongside the span of hall and the extent of connection.

### Seismic response analysis of linked twin tall structure with structure coupling

Twin tower of forty-story strengthened concrete structures horizontally connected by means of structural hyperlinks at different heights. The connected building is made up for towers and as a beam for every hyperlink fixefully linked tothe parameter structural frame of the buildings. By applying earthquake time history, the seismic responses of the dualtowers were computed at distinctive places for the hyperlink by means of employing earthquake time history excitation, the seismic responses of the twin towers had been computed at distinctive places for the hyperlink the reaction of the shape has been calculated and compared to every different. Evaluation from comparison is prove that hyperlink is get us higher results for structural coupling. Each tower consists of forty floors strengthened concrete

frame-wall structure having 160 m peak and a consistent plan 30x30 m with the height. There's a structural hyperlink at remaining floors of 15m span and 18m wide. In finite detail evaluation length for Malaysian report is 20 sec and time step for that is 0.02 sec. Top nodes of models having better displacements in comparison with bottom nodes and most displacement occurred at remaining pinnacle story. In given graph. At this moment the horizontal motion will become our cause of invention. Peak values for nodes' displacements in x-route throughout the shaking were computed by way of dynamic evaluation and values of that had been plotted.

## Dynamic Analysis of Regular Twin Tall RCC Structure with Various Size of Links at Most Effective Location

Multi tower building came into to carry out the resistance in opposition to the forces wherein the shape is greater rigid and solid. Here G+39 and G+49 has been taking for evaluation links of different sizes has been taking at exceptional places. Right here analysis of constructing has been carried below lateral loading situations. Model has been analyzed below earthquake and the time history analysis for BHUJ IN TIME HISTORY ANALYSIS is taking for medium soil situation. The regular structure has been done with conditions like traditional Structure with Links of  $0.6H+0.8H$ ,  $0.6B$  width of the hyperlink. Best location will be looking at for width assessment. With of hyperlink will be  $0.2B$  and  $1.0B$ . In this base shear and displacement has been checked at zone four & five.

## Dynamic analysis of twin tower high rise structure with basement

The story structure having basement and without basement has been taking on this evaluation. The G+20, G+25, G+30 twin tower rcc structure taking with two and four basements is taking and constructing without basement is accomplished. The wind evaluation and earthquake evaluation has been wearing out. Because of increasing populations excessive upward thrust structure want is a good deal growth due to those buildings with car parking, basement need is growing now a days. Numerous evaluations like static and dynamic are taking. Inside the version earthquake in X direction method the seismic impact on the longer length and Y direction imply seismic effect at the shorter course of the shape. Within the base shear x-course are greater than in y-course. The outcomes show that the intensity of basement is accelerated the shear values has been multiplied. After that story displacement the soil condition and versatility have stable effect on dual tower response the basement wall backfills, and soil nonlinearity should decrease or growth the displacement responds relies upon upon sort of shape and ground motion.

## III. Conclusion

The observation of this study after applied dynamic loads on the rcc tall structure in different seismic zones.

- The size and location are unclear in this observation.
- The basement depth is directly affected to the maximum base shear value. Because the basement and basement wall are supported by the twin tower tall structure. But it can reduce the story drift value.
- Mostly structural geometry plays important role in dynamic analysis and due to twin tower high stiffness in x direction as compared to y-direction result, base shear in x-direction.
- These high and flexible structures have large movements under lateral forces like earthquakes.
- The effort of the connecting corridor location changes the structure behaviour in terms of displacement, drift, overturning moment, base shear, axial force and bending moments.
- The structural responses for this linked building system have been decreased in some cases compared to the single tower, referring to the extra link stiffness as gathering the single tower to withstand seismic excitation.
- Study has declared that structural links is more effectual in strengthening the tall structure and that its more effectual when it is at 0.8 of building height.
- Flat slab with Drop caps and Flat slab with banded beams is used to reduce the cost of the slab.
- the building spacing between two towers is unclear.
- determine greatest distance with link between two towers & size and span of beam. and height where its mounted also width of the connecting beam.

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KSE-100 index is an index of 100 companies selected from 580 companies on the basis of sector leading and market capitalization. It represents almost 80% weight of the total market capitalization of KSE. It reflects different sector company's performance and productivity. It is the performance indicator or benchmark of all listed companies of KSE. So it can be regarded as universe of the study. Non-financial firms listed at KSE-100 Index (74 companies according to the page of KSE visited on 20.5.2015) are treated as universe of the study and the study have selected sample from these companies.

The study comprised of non-financial companies listed at KSE-100 Index and 30 actively traded companies are selected on the bases of market capitalization. And 2015 is taken as base year for KSE-100 index.

**3.2 Data and Sources of Data**

For this study secondary data has been collected. From the website of KSE the monthly stock prices for the sample firms are obtained from Jan 2010 to Dec 2014. And from the website of SBP the data for the macroeconomic variables are collected for the period of five years. The time series monthly data is collected on stock prices for sample firms and relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE - 100 Index is taken from yahoo finance.

**3.3 Theoretical framework**

Variables of the study contains dependent and independent variable. The study used pre-specified method for the selection of variables. The study used the Stock returns are as dependent variable. From the share price of the firm the Stock returns are calculated. Rate of a stock salable at stock market is known as stock price.

Systematic risk is the only independent variable for the CAPM and inflation, interest rate, oil prices and exchange rate are the independent variables for APT model.

Consumer Price Index (CPI) is used as a proxy in this study for inflation rate. CPI is a wide basic measure to compute usual variation in prices of goods and services throughout a particular time period. It is assumed that rise in inflation is inversely associated to security prices because Inflation is at last turned into nominal interest rate and change in nominal interest rates caused change in discount rate so discount rate increase due to increase in inflation rate and increase in discount rate leads to decrease the cash flow's present value (Jecheche, 2010). The purchasing power of money decreased due to inflation, and due to which the investors demand high rate of return, and the prices decreased with increase in required rate of return (Iqbal et al, 2010).

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**I. RESEARCH METHODOLOGY**

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study, Data and Sources of Data, study's variables and analytical framework. The details are as follows;

**3.1 Population and Sample**

KSE-100 index is an index of 100 companies selected from 580 companies on the basis of sector leading and market capitalization. It represents almost 80% weight of the total market capitalization of KSE. It reflects different sector company's performance and productivity. It is the performance indicator or benchmark of all listed companies of KSE. So it can be regarded as universe of the study. Non-financial firms listed at KSE-100 Index (74 companies according to the page of KSE visited on 20.5.2015) are treated as universe of the study and the study have selected sample from these companies.

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Exchange rate is a rate at which one currency exchanged with another currency. Nominal effective exchange rate (Pak Rupee/U.S.D) is taken in this study. This is assumed that decrease in the home currency is inversely associated to share prices (Jecheche, 2010). Pan et al. (2007) studied exchange rate and its dynamic relationship with share prices in seven East Asian Countries and concluded that relationship of exchange rate and share prices varies across economies of different countries. So there may be both possibility of either exchange rate directly or inversely related with stock prices. Oil prices are positively related with share prices if oil prices increase stock prices also increase (Iqbal et al, 2012). Atallah (2001) suggested that oil prices cause positive change in the movement of stock prices. The oil price has no significant effect on stock prices (Dash & Rishika, 2011). Six month T-bills rate is used as proxy of interest rate. As investors are very sensitive about profit and where the signals turn into red they definitely sell the shares. And this sensitivity of the investors towards profit effects the relationship of the stock prices and interest rate, so the more volatility will be there in the market if the behaviors of the investors are more sensitive. Plethora (2002) has tested interest rate sensitivity to stock market returns, and concluded an inverse relationship between interest rate and stock returns. Nguyen (2010) studies Thailand market and found that Interest rate has an inverse relationship with stock prices.

KSE-100 index is used as proxy of market risk. KSE-100 index contains top 100 firms which are selected on the bases of their market capitalization. Beta is the measure of systematic risk and has a linear relationship with return (Horn, 1993). High risk is associated with high return (Basu, 1977, Reiganum, 1981 and Gibbons, 1982). Fama and MacBeth (1973) suggested the existence of a significant linear positive relation between realized return and systematic risk as measured by  $\beta$ . But on the other side some empirical results showed that high risk is not associated with high return (Michailidis et al. 2006, Hanif, 2009). Mollah and Jamil (2003) suggested that risk-return relationship is not linear perhaps due to high volatility.

### 3.4 Statistical tools and econometric models

This section elaborates the proper statistical/econometric/financial models which are being used to forward the study from data towards inferences. The detail of methodology is given as follows.

#### 3.4.1 Descriptive Statistics

Descriptive Statics has been used to find the maximum, minimum, standard deviation, mean and normally distribution of the data of all the variables of the study. Normal distribution of data shows the sensitivity of the variables towards the periodic changes and speculation. When the data is not normally distributed it means that the data is sensitive towards periodic changes and speculations which create the chances of arbitrage and the investors have the chance to earn above the normal profit. But the assumption of the APT is that there should not be arbitrage in the market and the investors can earn only normal profit. Jarque bera test is used to test the normality of data.

#### 3.4.2 Fama-McBeth two pass regression

After the test statistics the methodology is following the next step in order to test the asset pricing models. When testing asset pricing models related to risk premium on asset to their betas, the primary question of interest is whether the beta risk of particular factor is priced. Fama and McBeth (1973) develop a two pass methodology in which the beta of each asset with respect to a factor is estimated in a first pass time series regression and estimated betas are then used in second pass cross sectional regression to estimate the risk premium of the factor. According to Blum (1968) testing two-parameter models immediately presents an unavoidable errors-in-the variables problem. It is important to note that portfolios (rather than individual assets) are used for the reason of making the analysis statistically feasible. Fama McBeth regression is used to attenuate the problem of errors-in-variables (EIV) for two parameter models (Campbell, Lo and MacKinlay, 1997). If the errors are in the  $\beta$  (beta) of individual security are not perfectly positively correlated, the  $\beta$  of portfolios can be much more precise estimates of the true  $\beta$  (Blum, 1968).

The study follow Fama and McBeth two pass regression to test these asset pricing models. The Durbin Watson is used to check serial correlation and measures the linear association between adjacent residuals from a regression model. If there is no serial correlation, the DW statistic will be around 2. The DW statistic will fall if there is positive serial correlation (in worst case, it will be near zero). If there is a negative correlation, the statistic will lie somewhere between 2 and 4. Usually the limit for non-serial correlation is considered to be DW is from 1.8 to 2.2. A very strong positive serial correlation is considered at DW lower than 1.5 (Richardson and smith, 1993).

According to Richardson and smith (1993) to make the model more effective and efficient the selection criteria for the shares in the period are: Shares with no missing values in the period, Shares with adjusted  $R^2 < 0$  or F significant (p-value)

>0.05 of the first pass regression of the excess returns on the market risk premium are excluded. And Shares are grouped by alphabetic order into group of 30 individual securities (Roll and Ross, 1980).

### 3.4.2.1 Model for CAPM

In first pass the linear regression is used to estimate beta which is the systematic risk.

$$R_i - R_f = (R_m - R_f)\beta \quad (3.1)$$

Where  $R_i$  is Monthly return of this security,  $R_f$  is Monthly risk free rate,  $R_m$  is Monthly return of market and  $\beta$  is systematic risk (market risk).

The excess returns  $R_i - R_f$  of each security is estimated from a time series share prices of KSE-100 index listed shares for each period under consideration. And for the same period the market Premium  $R_m - R_f$  also estimated. After that regress the excess returns  $R_i - R_f$  on the market premium  $R_m - R_f$  to find the beta coefficient (systematic risk).

Then a cross sectional regression or second pass regression is used on average excess returns of the shares and estimated betas.

$$\hat{R}_i = \gamma_0 + \gamma_1\beta_i + \epsilon \quad (3.2)$$

Where  $\lambda_0 =$  intercept,  $\hat{R}_i$  is average excess returns of security  $i$ ,  $\beta_i$  is estimated beta coefficient of security  $i$  and  $\epsilon$  is error term.

### 3.4.2.2 Model for APT

In first pass the beta coefficients are computed by using regression.

$$R_i - R_f = \beta_{i1}f_1 + \beta_{i2}f_2 + \beta_{i3}f_3 + \beta_{i4}f_4 + \epsilon \quad (3.3)$$

Where  $R_i$  is the monthly return of stock  $i$ ,  $R_f$  is risk free rate,  $\beta_i$  is the sensitivity of stock  $i$  with factors and  $\epsilon$  is the error term.

Then a cross sectional regression or second pass regression is used on average excess returns of the shares on the factor scores.

$$\hat{R}_i = \gamma_0 + \gamma_1\beta_{i1} + \gamma_2\beta_{i2} + \gamma_3\beta_{i3} + \gamma_4\beta_{i4} + \epsilon_i \quad (3.4)$$

Where  $\hat{R}_i$  is average monthly excess return of stock  $i$ ,  $\lambda =$  risk premium,  $\beta_1$  to  $\beta_4$  are the factors scores and  $\epsilon_i$  is the error term.

### 3.4.3 Comparison of the Models

The next step of the study is to compare these competing models to evaluate that which one of these models is more supported by data. This study follows the methods used by Chen (1983), the Davidson and MacKinnon equation (1981) and the posterior odds ratio (Zellner, 1979) for comparison of these Models.

#### 3.4.3.1 Davidson and MacKinnon Equation

CAPM is considered the particular or strictly case of APT. These two models are non-nested because by imposing a set of linear restrictions on the parameters the APT cannot be reduced to CAPM. In other words the models do not have any common variable. Davidson and MacKinnon (1981) suggested the method to compare non-nested models. The study used the Davidson and MacKinnon equation (1981) to compare CAPM and APT.

This equation is as follows;

$$R_i = \alpha R_{APT} + (1 - \alpha)R_{CAPM} + e_i \quad (3.5)$$

Where  $R_i =$  the average monthly excess returns of the stock  $i$ ,  $R_{APT} =$  expected excess returns estimated by APT,  $R_{CAPM} =$  expected excess returns estimated by CAPM and  $\alpha$  measure the effectiveness of the models. The APT is the accurate model to forecast the returns of the stocks as compare to CAPM if  $\alpha$  is close to 1.

#### 3.4.3.2 Posterior Odds Ratio

A standard assumption in theoretical and empirical research in finance is that relevant variables (e.g stock returns) have multivariate normal distributions (Richardson and Smith, 1993). Given the assumption that the residuals of the cross-sectional regression of the CAPM and the APT satisfy the IID (Independently and identically distribution) multivariate normal assumption (Campbell, Lo and MacKinlay, 1997), it is possible to calculate the posterior odds ratio between the two models. In general the posterior odds ratio is a more formal technique as compare to DM equation and has sounder theoretical grounds (Aggelidis and Maditinos, 2006).

The second comparison is done using posterior odd ratio. The formula for posterior odds is given by Zellner (1979) in favor of model 0 over model 1.

The formula has the following form;

$$R = [ESS_0/ESS_1]^{N/2} N^{K_0 - K_1/2} \quad (3.6)$$

Where  $ESS_0$  is error sum of squares of APT,  $ESS_1$  is error sum of squares of CAPM,  $N$  is number of observations,  $K_0$  is number of independent variables of the APT and  $K_1$  is number of independent variables of the CAPM. As according to the ratio when;

$R > 1$  means CAPM is more strongly supported by data under consideration than APT.

$R < 1$  means APT is more strongly supported by data under consideration than CAPM.



## IV. RESULTS AND DISCUSSION

### 4.1 Results of Descriptive Statics of Study Variables

Table 4.1: Descriptive Statics

Variable	Minimum	Maximum	Mean	Std. Deviation	Jarque-Bera test	Sig
KSE-100 Index	-0.11	0.14	0.020	0.047	5.558	0.062
Inflation	-0.01	0.02	0.007	0.008	1.345	0.510
Exchange rate	-0.07	0.04	0.003	0.013	1.517	0.467
Oil Prices	-0.24	0.11	0.041	0.060	2.474	0.290
Interest rate	-0.13	0.05	0.047	0.029	1.745	0.418

Table 4.1 displayed mean, standard deviation, maximum minimum and jarque-bera test and its p value of the macroeconomic variables of the study. The descriptive statistics indicated that the mean values of variables (index, INF, EX, OilP and INT) were 0.020, 0.007, 0.003, 0.041 and 0.047 respectively. The maximum values of the variables between the study periods were 0.14, 0.02, 0.04, 0.41, 0.11 and 0.05 for the KSE- 100 Index, inflation, exchange rate, oil prices and interest rate.

The standard deviations for each variable indicated that data were widely spread around their respective means.

Column 6 in table 4.1 shows jarque bera test which is used to check the normality of data. The hypotheses of the normal distribution are given;

$H_0$  : The data is normally distributed.

$H_1$  :The data is not normally distributed.

Table 4.1 shows that at 5 % level of confidence, the null hypothesis of normality cannot be rejected. KSE-100 index and macroeconomic variables inflation, exchange rate, oil prices and interest rate are normally distributed.

The descriptive statistics from Table 4.1 showed that the values were normally distributed about their mean and variance. This indicated that aggregate stock prices on the KSE and the macroeconomic factors, inflation rate, oil prices, exchange rate, and interest rate are all not too much sensitive to periodic changes and speculation. To interpret, this study found that an individual investor could not earn higher rate of profit from the KSE. Additionally, individual investors and corporations could not earn higher profits and interest rates from the economy and foreign companies could not earn considerably higher returns in terms of exchange rate. The investor could only earn a normal profit from KSE.

### Figures and Tables

Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table captions should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation "Fig.1" in the text, and "Figure 1" at the beginning of a sentence.

Use 10 point Times New Roman for figure labels. Use words rather than symbols or abbreviations when writing figure-axis labels to avoid confusing the reader. As an example, write the quantity "Magnetization", or "Magnetization, M", not just "M".

Table 1 Table Type Styles

Table Head	Table Column Head		
	Table column subhead	Subhead	Subhead
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## VII. ACKNOWLEDGMENT

The preferred spelling of the word "acknowledgment" in America is without an "e" after the "g". Avoid the stilted expression, "One of us (R.B.G.) thanks..."

Instead, try "R.B.G. thanks". Put applicable sponsor acknowledgments here; DONOT place them on the first page of your paper or as a footnote.

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