Comparison of Beta and characteristic model. Evidence from Pakistan stock exchange.

By

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Comparison of Beta and characteristic model: Evidence from Pakistan stock exchange

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This thesis includes no material which has been already accepted for the award of any other degree or diploma in any university and confirms that to the best of my knowledge the thesis includes no material previously published or written by another person, except where due reference is made in the text of the thesis.

Umair Ali

(MMS-153023)

Dedication

I am dedicating this research work to my loving Parents to help me in every possible way for my successful future. Without your help, patience and confidence in me, I was not able to complete this whole journey. I love you.

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List of Abbreviations

CAPM	Capital Asset Pricing Model
E/P ratio	Price to Earnings Ratio
B/M ratio	Book to market Equity Ratio
NYSE	New York Stock Exchange
PSX	Pakistan Stock Exchange
DJIA	Dow Jones Industrial Average
EPS	Earnings per Share
BV	Book Value of Equity
MPS	Market Price per Share
MV	Market Value of Equity
MRF	Market Risk Premium
MVP	Minimum Variance Portfolio.
S.D	Standard Deviation
MOM	Momentum Premium
SMB	Small minus big
HML	High minus low

MOT	Momentum
BM	Beta models
CM	Characteristics models.
EW	Equal weighted.

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Abstract

This study, compare beta based model and characteristic based model in Pakistani market. A sample of 100 non-financial listed companies is selected from PSX for the period of 2000 to 2016. Minimum variance portfolio (MVP's) are created on the each of these models to measure the performance in term of risk and return trade off. Characteristics based model and beta based model are examined to explore the ability to reduce the portfolio risk. Portfolios form on characteristics based model achieve lower volatility then portfolio formed on beta based model. The robustness of results of both models is examined in different specification and compositions. The results explain characteristics base model have advantage over beta base model.

Keywords; - Characteristics model. Beta model. Portfolio risk. Carharrt Model. MVPs.

Chapter 01

1.1 Introduction.

Markowitz (1952) laid down the foundation of modern finance and argued that investors are risk averse in general. Investor prefer diversified portfolio to optimize risk. The expected return and risk associated with portfolio is a crucial input for decision making. CAPM assumes that investor have well diversified portfolio have systematic risk only. The reliable forecast of the expected return and risk are important for taking the capital budgeting decisions and risk adjusted discount rates. The simplest approach is to identify models that better analyze the portfolio risk.

There is large volume of empirical work on comparison of beta model and characteristics model. Many studies compare these models to examine the cross section of expected stock return. There is less preference made on model ability to control and estimate risk. The discussion starts from Connor (1995) stated that many users use these models to control risk. Connor (1995) analyzed the in-sample fit of these models. This work is extended by Chan (1999) who explain these models through out of sample estimation. Chan (1999) further reported that characteristic model is not actually used by many practitioners. Roll (1977) reported that asset pricing resulted in multi-factors instead of single market risk premium factor and suggest that single factor didn't capture complete risk characteristics.

Keim (1995) reported that size as factor for risk measure exist in US, Europe and Japan stock market. The work is extended by Jimmy (1999) report that SMB and HML as measure of risk. Jimmy (1999) study that these anomalies exist in global stock market. Similarly, Heston (1995) report the use of SMB and HML factors to measure risk. Fama and French (1998) report that strong relationship between SMB and HML exist in global stock market. Similarly, Basu (1977) reported the P/E ratio influence the expected returns and capture the risk characteristic. The study further reports that stocks with lower P/E ratios tend to outperform stocks that have higher P/E ratios.

Rouwenhorst (1998) report the global evidence for momentum effect as common risk factor. In Fama and French model factors are associated with risk exposure. The mean

variance portfolio optimization is used for uncovering the securities with high risk. Moreover, many practitioners work on modeling for expected return is based on theoretical research. Empirical studies also focus on model equilibrium and note the change in expected average return and mention the ways in which return show inconsistence. Mean portfolios optimization show substantial benefits in case of reduction of risk and provide minimum variance portfolio.

The base of Investment theories is found back to the Markowitz 1952 to 1959 who proposed mean minimum variance framework. Markowitz contribute in the domain of, diversification and measurement of systematic risk and portfolios return. The theory derives expected risk measure of portfolio. The theory reported that variance in rate of return is meaningful measure for portfolio risk. The study provide formula for computing variance in portfolio. The covariance is an important factor of portfolio selection in Markowitz model. Investor can maintain their rate of return while reducing the risk level of portfolio by combining the stocks that have negative and low positive correlation. Markowitz theory of portfolio examine the goodness of portfolio based on means and variance of the return of assets present in portfolio. The Markowitz model is foundation of modern theories of portfolio.

The work of Markowitz is extended by Sharpe on capital asset pricing model and add the concept of risk free rate and method of measure risk. Capital market theory extend portfolios theory. The capital market theory defines the relationship of expected return to its systematic risk. The CAPM model report relationship among systematic risk and expected return of stock. The factor which differentiate the CAPM from Markowitz theory is assuming of risk free asset. The existence of risk free rate has important implications for possible return and risk. The CAPM theory assume the capital market are in equilibrium. Beta reflect standard measure of systematic risk. Covariance of any stock with its market portfolio is the relevant risk measure. Benz (1981) add the linear relationship in market risk and security return in CAPM and size effect on security return. Beta relate the covariance with the market portfolio. Beta model explain excess returns by configuring of common factors and exposure to these factors. Factors exposure to excess return are called beta and value of these factor result in beta values. Beta explain

the cross section of expected return. Asset pricing model develop by Sharpe shows relationship among systematic risk and return but beta is only instrument necessary to measure risk. Beta has significant relationship with business risk, leverage and business fee.

Howton (1998) reported significant relationship to risk. Beta model usually used by practitioner measure values in standard unit time. On the other hand, when beta model is applied on returns of S&P 500 index for the period 1987 to 2003, beta report the positive relationship during up market and show negative relationship in down market, hence this shows that beta risk tends to be time varying. Measuring suitable beta factor in real word situation is a difficult task. Fama report that CAPM are not delicate to expand the market proxy other than common stock. The expected market return is dominated by volatility of stock return. The study further report that high average return cannot be explained by beta for global stock market portfolio. The CAPM developed by Sharpe (1964) has never been an empirical success. The drawback of CAPM is that use historical data to examine the relationship between excess return and market whereas real decision made in future.

Later in 1970's research started on different variables like price ratios, size and momentum that enhance the explanation of returns provided by beta. The estimated cost of equity by CAPM for high beta stock are too high relative to historical returns of stock. Similarly, estimated cost of equity of low beta stock are too low as compared to historical returns of stocks. Contrary to this the estimated cost of equity of stocks by Book/market report high returns and CAPM report that estimates cost of equity for these stocks are too low. The stability of beta for portfolio of stock increase dramatically. The stability of beta depends on size of portfolio and time of portfolio. The bigger the portfolio and longer the time the more stable is beta of portfolio. The beta movement from higher beta stock portfolio decline to unity and lower beta stock portfolio to unity with time. After the empirical failing of CAPM, abnormal return produced by inactive stock if strategy of these stock move toward CAPM. Stocks that have low beta report abnormal positive returns as compared to expected. When the size and P/E effect includes in test to examine the portfolio performance along null beta then beta report inverse impact on portfolio returns.

Fama (1992) reported joint role of beta and other factor such as size, earning/price, book/market and leverage in explaining the cross section of average returns. The study further reported that beta alone and in combination of these factors give little information about returns. The factor size and book to market give more explanation about returns than beta. In asset pricing theory, the spread of excess return in cross section of stocks is one of the important fact. The incapability of CAPM to price portfolio sorted out by B/M and size characteristics is reported by Fama and French (1996). Later, many studies report the multifactor models to explain various anomalies of risk. These models include beta in addition to other factors to explain the variation in excess portfolio return.

The multifactor model included beta as an important factor in their model, it provides basic theoretical background for risk factor. Cochrane (2005) reported that while CAPM does not identify the risk underline in portfolio but gives restrictions that these multifactor models must satisfy. Mirza and Shahid (2008) argue the applicability of Fama and French three factor model in equity market in Pakistan.

The factors use in multifactor model explains the asset pricing phenomena. The factor model explains market performance by analyzing different factor associated to securities. The main factor in the model are size, book to market and excess return. These three factors are SMB, HML and Market premium. The model associate with CAPM refer to beta factor and by adding book to market and size. The beta of CAPM is a measure of risk of stocks. The factors used in multifactor model are smaller in number than number of securities in portfolios. The few factors report in this model reduce the matrix operations required in CAPM to compute portfolio risk. This model improves the computation and numerical stability. The model is better to analyze portfolio because of numerical stability in security volatilities and correlation of large covariance matrix. The factors SMB and HML are used as proxy for risk factor in stock returns.

Similarly, factor model applies to security market return. The models include statistical model, macroeconomic model and fundamental model. The fundamental and statistical models significantly outperform the macroeconomic model. Statistical models are outperformed by fundamental model based on explanatory power of model. The

fundamental factor model captured all risk characteristics that is captured by macroeconomic factor model. The fundamental model capture sensitivity of security prevailing in economy. This model uses firm specific factor to produce beta factor (Connor 1995).

Characteristic model explains excess return by stock characteristic. Three factor models are preferable for selecting minimum variance portfolio. Portfolio optimization supports in risk controls. The three-factor evaluation is as good as five factor models for portfolio formation. The evaluation and performance of these characteristics describes the cross section of average stock return and common time series variation in stock return. Three factor model outperform the ICAPM, the factor size and book to market gives more explanation of returns. The result also give insight that multifactor model alone cannot explain the returns.

The drawback of factor model reported by Gaunt (2004) on Australian stock market shows that book to market size and three factor models didn't work well but explain return of US stock. The report adds that risk factor of book to market does not appear in Australian market. The report explains that Fama and French three factor model explain fraction of the US listed big firms and does not explain the risk factor of big firms in non-US market.

This study focus on whether factor models satisfy cross sectional risk price and time series slopes to be justified as explained by CAPM. As per above perspective, in this research comparison of these models on Pakistan stock exchange is done. In this research, a new insight of these model's ability to evaluate expected stock return is provided. The performance of beta as well as characteristic model is examined. This research also identifies the model that is better in performance measurement of expected stock returns and risk related to these securities. The study compares, the beta model and characteristic model with refer to portfolio risk.

1.2 Research Gap.

Empirical studies discussed above show enough discussion on two types of model, i.e. beta based model and characteristics based models. The research on these models has

been done in developed countries and emerging markets to measure portfolio risk. However, there is lack of work in this context in Pakistani market. The debates are present on both models. This study focuses on characteristics based model and beta based models. The significance of study is to measure and examine these models in Pakistani market in term of risk. This research provides a gateway to future researchers in new domain.

1.3 Research question.

1. Whether portfolio formed on the basis on beta base model assume lower risk.

   (a). Whether portfolio formed on CAPM assume lower risk.

   (b). Whether portfolio formed on three factors assume lower risk

   (c). Whether portfolio formed on four factors assume lower risk.

   Whether portfolio formed on characteristic model assume lower risk.

   (a). Whether portfolio formed on two factors assume lower risk.

   (b). Whether portfolio formed on three factors assume lower risk.

   (c). Whether portfolio formed on four factors assume lower risk.

1.4 Research objectives.

To provide insight about the risk and return behavior of portfolio formed on the basis of characteristics base models.

To provide insight about the risk and return behavior of portfolio formed on the basis of beta base models.

To compare the performance of beta based models and characteristics based models in allocation framework.

1.5 Significance of research study.

This study contributes significantly in different perspective. First of all, this study is focus on Pakistan which is an emerging market. The study examines and explore the beta base model and characteristics base model to measure risk in Pakistani market. The area is unexplored domain in Pakistan market. These model is discussed in different perspective in term of equity market by using different factors and estimation window. The previous study on these models are mostly focus on returns in equity market and does not cover phenomenal growth in market. This study includes sixteen-year time-period range from Jun-2000 to Jun-2016 which is long enough from previous studies.

Secondly, the study investigates the beta and characteristics models collectively and explore the risk assumed by portfolio formed on the basis of each models. This study explores the effect of using different model and their capability to measure portfolio risk and return. This study give insight to foreigner and local investors about risk model performance while making investment decisions in Pakistani market.

Plan of study.

The study consists of five chapters.

Chapter 1 consist of Introduction, objectives, Research questions, Research gap and significance of study.

Chapter 2 consist of wide range review of previous studies.

Chapter 3 consist of data and methodology used in the study.

Chapter 4 consist of results and discussion.

Chapter 5 consist of conclusion, recommendation and limitations of study.

Chapter 02

Literature review.

The origin of investment theories is found back to Markovitz (1952-1959). The mean variance portfolio optimization is not used by many practitioners in past to measure risk associated to portfolio. After the introduction of CAPM finance become scientific subject in which models quantify and describe the capital market risk. There are considerable studies that shows the beta and characteristics model are used for analyzing the portfolio in term of controlling and measuring risk. The study explores the extent of average expected returns in term of risk measure instead non-risk factors. Modigliani (1974) reported the significant relation among risk and returns for measuring risk associated to portfolio. Shapiro and Mankiw (1986) report that beta model strongly associated with cross section average return and beta consumptions within multiple regressions.

Connor and Korajczyk (1988) reported another approach to measure risk in portfolio captured by the variance in returns of diversified portfolio. Similarly, Gibbons (1989) use characteristic base test portfolio. Linn (1990) reported that market returns are different in cross section of markets. Market returns are significantly volatile in different market and depend on the system of market. Kan (2009) study different models and investigate their performance by comparison. The study reported that CAPM of Petkova (2006) and Fama and French three factor (1993) model are best among all models. Zhang and Whilborg (2010) investigate the beta and expected return for six European markets for the period of 1996 to 2006. The study reported the significant relationship in expected stock and beta. The study reported beta is good measure of risk. Dijk (2011) reported the significant

positive and negative relationship among risk and return while using the model of Fama and Macbeth (1973).

Moreover, the study reported that beta is much important than characteristic in case of duration and rating. The study further reported that beta much more important while measuring expected return. Furthermore, the comparative model reported that portfolios with high beta have lower Sharpe and alpha ratio then portfolio of low beta assets. Similarly, Trinh (2016) apply beta and characteristics base model on London stock market and reported that three factor model is better than CAPM model. Similarly, Harris (2002) reported that domestic based CAPM shows better results of expected returns. Fama and French (1993) develop and three factor model by using size and book to market as risk premium. The study reported the significant relationship among average return and market to book equity, size and average return. Chen (1999) argue that characteristic model is not used by many practitioners to estimate risk. Nicholson (1960) reported the P/E effect on stock return. The study reported that low P/E stock gain higher return then the high P/E stocks. Similarly, the study of Rosenberg (1974) analyze two models, one is factor model and second beta model and both are applied to error term.

Ross (1976) reported that there are K many factors that affect the return other than beta. Size effect description have complete focus on accuracy of risk adjustment return toward small companies. Stattman (1980) investigate the variance among average return in US market and reported significant relationship with book to market. Lakonishok (1991) reported the effect of size and book to market on portfolio return working on Japan stock market for period of 1971 to 1988. Herrera and Lockwood (1994) reported negative relationship among stocks returns and size. Berk (1997) reported that big stock does not outperform by small stock. Kothari (1997) investigate the return for period of 1926 to 1991 and reported that return can be forecasted by B/M for DJIA stock. The result reported the three-factor evaluation is as good as five factor model for portfolio formation. The study reported the factor model in describing the cross section of average stock return and common time series variation in stock return.

Fama and French (1997) explore average return on S&P 500 index and finds that alone beta is not sufficient to fully explain expected average returns of stock. Fama and French reported that company size, earning to price, book to market, leverage have high impact on describing stock expected return. Size, market and value based introductions show sensitivity to risk in determining the expected average stock return. Later, Fama and French work on three factor model reported that returns are explained by size and market factor. Over the periods Fama and French model contributes to examining the average return on cross sectional base among different markets and countries. However, the duration of firm high growth is longer than duration of firm low growth and structural shift also effect firms differently (Fama 1993).

Many practitioners explore these models to control risk instead to analyze expected stock return (Connor 1995). However, comparison reported of Connor (1995) show that fundamental model is more realistic model in comparison to macroeconomic factor model and statistical factor model as they outperform both. Moreover, Fama and French (1995) discover the relationship among the profitability and risk factors. The sudy reported that firm with high book to market are consistently in distress as compared to firms with low book to market. Keim (1995) reported that size factor as risk measure exist in US, Europe and Japan stock market. Similarly, Heston (1995) reported the significant relationship of SMB and HML factors to measure risk. Similarly, Daniel and Titman (1997) reported that characteristics like size and B/M has impact on the cross section of expected stock return and risk.

Three factor model seems to be describe expected return better as compared to characteristic based model (Lewellen 1999). Halliwel (1999) reported premium of high book to market stocks and reported market beta lean downward when size and book to market falls. The study further reported strong negative relationship among size and beta. Chan (2000) investigate the momentum effect on 48 countries among 28 emerging countries from Latin America, Middle east, Africa, Asia and Europe. The study reported momentum factor significant relation exists in all markets. The Liew (2000) show that high to low momentum, size and market to book show significant examination on

growth. The results show that these factors provide explanation for examining returns and forecast change in portfolios and support the study of (Fama and French 1998).

Size, book to market and momentum of portfolios of local market perform good as compared to three factor model. These models perform well in capturing the average returns on book to market and size portfolios as compared on global level or apply on the size to momentum portfolios. Fama and French (2000) reported that three factor model explain the risk and value premium better then Daniel and Titman (1997) model. The study further reported the characteristics like book to market, size and HML predict the risk and expected return. Faff (2001) investigate three factor model on Australian market from period of 1991-1999. In this study, monthly as well as daily data are used. The study reported that book to market risk effect is found positive and statistically significant in case of market. Lee (2001) investigate the ARCH, GARCH model and finds negative and insignificant relationship between expected risk and expected return.

Similarly, Griffin (2002) show that three factor are more beneficial in explaining the time variation among portfolio and returns of individual stocks then world three-factor models. The reported show that local factor model yields low error in pricing in comparison to world factor model. Three factor models are also useful in explaining average stock return on domestic level then world or global level. Furthermore, the study of Fama and French (2004) show that time series and cross-sectional regression both show that variable like size, book to market, earning to price and debt to equity have explanatory power which is not covered by beta model. Rouwenhorst (1998) and Martin (2003) show that factor portfolio created on the basis of characteristics factors have significant relationship. The three-factor model portfolio considers strict change in stock returns.

Furthermore, Martin (2003) reported that factor model includes the cash flow to price and momentum factor not only gives strong variation in return of stock globally but also reported lowest error of pricing and rate of rejection. Hong (2003) investigate the momentum effect in East Asian countries and western countries and reported that momentum effect is most likely found in western markets as compared to Eastern markets. Similarly, according to Schwert (2003) firm effect vanish but the momentum

effect is not disappeared. Gaunt (2004) work on Australian stock market shows that book to market size and three factor models are well explained in US stock. The study further added that risk factor of book to market does not appear in Australian market but appear in US market. The reported explains that Fama and French three factor model explain fraction of the US listed big firms and do not explain the risk factor of size. These three factors model show some difficulties among non-US stock markets in case of examining risk. However, this study reported that three factor model gives better explanation of Australian market returns then CAPM.

Daniel (2001) studies Japanese market and investigate, factor and characteristics models. The study reported that characteristics model shows consistent results. The study rejected the factors model and support characteristics model. Nartea and djajadikerta (2005) apply three factor model to New Zealand stock market over period of 1994-2002 to explain the variation in stock return. Fama and Macbeth method is used in this study. The study reported that if size effect found significant then book to market seems weaker.

Serra and Estada (2005) investigate various factor over more than 30 countries and 1600 companies. The study reported that book to market and size contribute toward variations of returns. Similarly, study reported that variables used for average return other than beta mostly outperform function of CAPM. Fama and French (1998) show the forecasted ability of B/M and size leads the risk exposure. The Chordia (2006) find that Fama and French three factor model appears finest while examining the impact of book to market and size on cross sections of return. Similarly, Ang (2006) reported that beta is good forecaster for future co-variation of market movements.

Avrama (2006) reported that beta model improves most of the models examined, while analyzing the pricing abilities along with B/M and size. Beta helps in examining the impact of momentum and liquidity of cross section of return of individual stock, and explain the impact when returns are risk adjusted with momentum and liquidity factor.

The study of Wu (2006) show that returns of stock are interrelated to size and market to book and constraints in return of stock. Sinclaire and Auret (2006) apply the Fama and French three factor model to JSE from 1990 to 2000 to examine the stock risk and return

relationship. The results show the significant relationship and indicates the size, book to market are proxy for risk measure and forecast the stock returns. Standard models such as CAPM Fama and French (1992) model focus on the factor of systematic risk and this risk effect the stock returns. Mclnish (2008) investigate the momentum effect among seven Asian markets and reported that momentum is significant profitable strategy in five markets among seven markets.

Dreman (2008) reported the evidence of P/E and size effect on the stocks returns. Fama and French (2008) reported the momentum effect on the NYSE for the period of 1963-2005. Heston (2008) show that future stock return can be predicted or analyzed by past stock returns. While some other studies reported that market have global interacted supporter model that integrate foreign and local mechanism of factors constructed by characteristics of firms (Bekaert 2009, Fama and French 1998). Senthilkumar (2009) study Indian stock market to check the effect of stock return with value and size effect for period of 2002-2008. The study reported the positive and significant relation among average return and size. Book to market and size contribute to stock return deviations. Homsud (2009) investigate the Fama and French three factor model and CAPM on Thailand stock exchange for the period of 2002-2007. Furthermore, Hou (2011) reported that strong and consistent descriptive power of value factor in exploring return of stock.

The factors in the study includes size, book to market, cashflow to price, earning to price and dividend to price. The study reported that the three multi factor model have less pricing errors in emerging markets as compared to globally markets. The study further reported that size and value factor are compensation of systematic risk and relation of these factor to return. Hassan and Javed (2011) investigate the relationship of value, market and size effect on Pakistan equity market. The study sample consist of 250 firms and for the period of 2000-2007. The study reported value factor has significant effect on all portfolios. Similarly, Hou (2011) study 40 countries and about 25000 stock returns reported that multifactor and three factor model shows significant time-based variation in stock globally, the model includes cash flow to price, momentum, size and book to market. The study also reported that all other model show rejection and has errors in lower prices than multifactor model in which CAPM and model use book to market and

size as a factor. The study also reported consistent evidence of price to cash flow factor related with the co-variance risk model. The study rejected co-variance model and use characteristics based model that include book to market and size as model factors.

Moreover, Fama and French (2012) investigate the size, momentum and value affect to Asia Pacific, Japan North America and Europe and reported that B/M variable explain average stock returns. In addition, the study of Chen (2012) reported that portfolios having high volatility show positive relation in average variance. The study also reported that M/B ratio is a measure of growth and considered as risk factor. Fama and French (2010) reported SMB and HML as proxy of common risk factor related to average return. The problem reported in momentum factor exist in case of extreme variation and these variations are rare in nature (Fama and French 2012). Furthermore, Kogan (2013) reported that strong relationship exists among firm characteristics and cross section returns of stocks. These finding implies that book to market shows information regarding expected return of firm at fixed time relative to stocks of other firms. The studies reported the evidence of book to market factor variations in return. High variance in return decrease the accuracy of estimates. The characteristics such as book to market and size portfolio creates consistent that B/M forecast returns. However, results provide evidence for portfolios striking book to market strong predictive power when used in regression alone.

Kim (2015) use, cross section of portfolio average return, leverage, size, earning to price and book to market ratio and compare beta model against characteristics model on their ability to reduce risk. The ratio of book to market ratio show strong and significant relationship in average stock return compared to size. Binam (2016) reported that negative correlation among expected average return, company size and positive correlation among expected average return and book/market are CAPM model anomalies. Similarly, Seguin (2016) reported that when volatility in market increase small size companies' beta increase fast as compared to large size companies. These studies reported that there is some other factor such as size, book/market and risk that effect the average expected return.

Similarly, Engle (2016) use multi regression models and examines the performance of models in different dimensions and reported that factor model is more efficient in the estimation of expected average returns. Similarly, Zheng (2016) reported that fundamental factors are more significant to forecast cross section of expected stock return and focus on benchmark models to examine the sensitivity of portfolio. Chan (1999) use portfolio optimization approach in three factor model to control risk in portfolio. The study reported that three factor model is suitable for selecting minimum variance portfolio. The study further reported minimum variance optimization help in risk reduction.

Michaud (1989) and Winston (1993) reported the mean variance optimization and explore the importance of mean return to forecast the associated risk. Pogue and Cohen (1967), Gruber and Elton (1973) and Alexander (1978) use the approach of optimization and efficiency of risk models and find that factor model are significant in measuring variance of portfolios. Jagdeesh and Titman (1993) use factors such as size and book to market for measure of risk. Tarun Chordia (1997) study different factors such as size book to market and stock price. The study used natural logarithms of factor to keep the factors symmetric and avoid any association among the current and previous month returns. Kim (2015) use, the logarithms of characters to make the variable symmetric as to remove effect of previous months returns.

Review of literature above indicates that size and value effect are recognized worldwide. The review of studies indicate that the variables were size book to market E/P and momentum are used as measure for risk of portfolios. Work on beta vs characteristics model exist in many countries that includes US, Japan, Australia and Europe but there is no evidence in Asian and Pakistani market. Sometimes the beta model performs well compare to characteristics model is explored from Australian stock market. Sometimes characteristic model performs well as explored form US and Japan stock market.

Chapter 03

Data Description and Research Methodology.

3.1 Data Description.

The study explores the performance of beta based model and characteristics based model under mean variance efficiency framework proposed by Markowitz. The sample consist of 100 non-financial companies. The reason for selecting companies on basis of market capitalization is to avoid inactive companies and ensure frequently traded stocks. The study includes monthly closing stock prices of non-financial companies listed on Pakistan stock exchange (PSX). The time duration of sample is 16 years starting from Jun-2000 to Jun-2016.

The sample consist of non-financial companies as the fiscal year of non-financial companies close at on June while the financial year of financial companies close on December. Similarly, the financial companies and non-financial companies have different capital structure. The capital structure of financial companies comprises of equity. The capital structure of non-financial companies comprises of equity and debts. Table 3.1 shows the companies in the sample.

Table 3.1

Sample composition

	Number of firms in sample
Automobile assembler, parts and accessories	10
Cement	9
Chemical	11
Engineering	7
Fertilizer	4
Food and Personal Care	7
Glass and Ceramics	3
Oil and Gas	6
Pharmaceutical	5
Power Generation and Distribution	2
Sugar Mills	10
Textile	16
Technology and Communication	2
Tobacco	1
Transport	1
Miscellaneous	6
	100

The monthly closing prices of sample companies are obtained from KSE that is reliable source of data. The data of EPS, BV of shareholder equity, book to market and No. of share are obtained from the Balance sheet analysis (BSA) published by state bank of Pakistan. The T-bill rate are obtained from the state bank of Pakistan.

3.2 Research design.

The purpose of this study is finding out whether portfolio created with one model show minimum variance in comparison to second model. The methodology used in this study have two step processes. First step is model estimation used in the study and second step of portfolio optimization used in this study.

In this study, do not include estimation of any parameter and leave no possibility of model modification. If there is any issue in model specification and estimation there is no

effect on portfolio validity and so the model comparison based on these calculations. Kan and Robotti (2009) and Kan et al (2013) reported the approach for choosing the least miss-specified model. In this study model that mostly used by investor and having least issue of misspecification.

Black and Litterman (1992) reported the implication of input optimization on portfolio optimization. The quality of first step fully effect the quality of second step and portfolio optimization.

The basic structure of both beta model and characteristics model and VCM of MVP are discussed below.

3.3 Methodology.

The study examines the comparative strength of beta model to characteristic model as a risk model. The study analyzes the performance of these model historically. The study examines these two models for the emerging KSE 100 Index stocks, and construct the MVP minimum variance portfolio among estimate of each model.

The study use MVPs for analyzing the characteristic model by intercept term. The study use intercept term while working on variance and covariance matrix estimate. Sharpe ratio of beta based models and characteristics model are analyzed and reported with minimum variance portfolio performance.

The models are divided into two categories i,e beta based model and characteristics based model. A sample of 100 companies from period of 2000 to 2016 is used to measure risk and return under various estimation model. The beta based model used in this study CAPM, Three factor model and four factor model. Similarly, characteristics based model includes two factor, three factor and four factor model. The difference between two categories is that beta based model use size premium, value premium and momentum premium. The size premium is achieved through difference fraction of big stocks and small stocks. The value premium is estimated through difference of return of high book

to market stocks and low book to market stocks. The momentum is difference of return of portfolio of winner to portfolio of loser.

Two sample T-Test: Two-Sample Assuming Unequal Variances. The null hypothesis is the equality of volatilities in both the cases. A low P value and large f-statistic reject the null hypothesis.

The models used in this study are;

1. CAPM (Beta model)

$$E(R) = Rf + \beta\,(Rm - Rf) \quad (1)$$

2. Fama and French (Three factor model).

$$E(R) = Rf + ß_3(Rm - Rf) + ß_{smb} * SMB + ß_{hml} * HML \quad (2)$$

3. Carharrt

$$Rt - Rft = \alpha + \beta 1\, MKTt + \beta 2\, SMBt + \beta 3\, HMLt + \beta 4\, MOMt + et \quad (3)$$

4. Minimum variance portfolio model.

$$\text{var} = \sum_{j=1}^{n} v_j x_j^2 + 2\sum_{i=1}^{n-1}\sum_{j=i+1}^{n} q_{ij}\, x_i x_j = X^T Q X \quad (4)$$

The formula used to measure portfolio optimization of models based on characteristics based model and beta based models.

3.3.1 Beta Model.

Beta reflect standard measure of systematic risk. Covariance of any stock with its market portfolio is the relevant risk measure. Beta relate the covariance with the market portfolio. Beta model explain excess returns by configuring of common factors and exposure to these factors. These factors exposure to excess return are called beta and value of these factor result in beta values. Beta explain the cross section of expected return. Asset pricing model develop by Sharpe shows relationship among systematic risk and return but beta is only instrument necessary to measure risk.

The model represented by the equation.

$$R_{i,t} = \alpha_i + \beta'_i f_t + \acute{\varepsilon}_{i,t} \quad (5)$$

R_i = Stock return.

R_f = Risk free rate.

f_t = K-dimensional vector of factor return.

$\acute{\varepsilon}_{i,t}$ = Error term (which is assumed to be zero).

σ^2_i the variance of excess return is given below.

$$\sigma^2_i = \beta_i \sum_f \beta_i + \sigma^2_{i\acute{\varepsilon}} \quad (6)$$

$\sum_f$ = VCM of factor return

$\sigma^2_{i\acute{\varepsilon}}$ = variance of error term

Beta model is tested by two step processes used mostly in research work. Beta coefficient are estimated for all stock. In this step, actual excess return is regressed against excess return of market.

$$E(R_i) = R_F + \beta_i (R_M - R_F) \quad (7)$$

$E(R_i)$. = expected return of individual security.

B_i = beta of individual security.

3.3.2 Measurement of variables

The variables of book to market ratio, size and price to earnings ratio are calculated as follows;

3.3.2.1 Book to market ratio;

Book to market ratio is measured as.

$$B/M = \frac{BV}{MV}$$

Whereas;

B/M = Book to Market

BV= Book Value of Equity

MV= Market Value of equity= No of shares x MPS

3.3.2.2 Size;

Size of companies is measured on different basis i,e; total assets, total sales of market capitalization. This study use market capitalization as a measure of size.

Size= No of Shares x MPS = Market capitalization

3.3.2.3 Earnings to price ratio.

The earning to price ratios calculated by follows;

$$E/P = \frac{EPS}{MPS}$$

P/E = Price to earnings ratio

MPS = Market price of share

EPS = Earnings per share after tax

3.4. Portfolios constructions.

3.4.1 Size Sorted portfolio.

For construction of size sorted portfolios market capitalization of 100 companies is calculated. These companies are then arranged on the basis of Market capitalization.

Small fifty companies are named as S and Big fifty companies are named as B. Average returns of Small and big companies are calculated.

$$S = \frac{\sum Ri}{n}$$ where Ri is the return of small companies.

$$B = \frac{\sum Ri}{n}$$ where Ri is the return of big companies.

3.4.2 Value sorted portfolio.

The sorted small fifty companies are further sorted on high book to market to create book to market sorted portfolio. Twenty-five small companies with high book to market are named as S/H and twenty-five low book to market companies are named as S/L.

Similarly, the fifty big companies are further sorted on high book to market to create book to market sorted portfolio. Twenty-five companies with high book to market are named as B/H and twenty-five low book to market are named as B/L.

3.4.3 Momentum sorted portfolio.

For construction of portfolios on the basis of momentum, average return of each company is calculated for the period of six month from December to May for each year. Then all companies are sorted on the basis of average return. The sample of twenty-five small companies labeled high to market are further sorted on the basis of average return. A portfolio of 12 companies with higher return are winner companies named as S/H/W and 12 companies with low average return are loser companies named as S/H/L. The sample of small twenty-five companies labeled low to market are further sorted on the basis of average return. A portfolio of 12 companies with higher return are winner companies named as S/L/W and 12 companies with low average return are loser companies named as S/L/L. Each company monthly return for winner and loser stock portfolios is calculated for twelve months is respective year.

The sample of twenty-five big companies labeled high to market further sorted on the basis of average return. A portfolio of 12 companies with higher return are winner companies named as B/H/W and 12 companies with low average return are loser

companies named as B/H/L. The sample of small twenty-five companies labeled low to market are further sorted on the basis of average return. A portfolio of 12 companies with higher return are winner companies named as B/L/W and 12 companies with low average return are loser companies named as B/L/L. Monthly return for winner and loser stock portfolios is calculated for twelve months respectively.

The formula for calculating the average of monthly return is given below.

$$R_t = \frac{\sum Ri}{n}$$

I = 1,2,3, 4……50

R_t = Return of each company for month 't'.

3.5 Variable constructions.

All portfolio average returns are calculated such as S, B S/H, S/L, B/H, B/L, S/H/W, S/L/L, B/H/W, B/H/L and these averages are used to create variables. The variables are size premium, value premium and momentum premium. The variable constructions are as follow.

Market Premium = MRF = $(R_{mt} - R_{ft})$ (8)

Where. $R_m = \ln (I_t / I_{t-1})$

R_{ft} = Risk free rate.

Size Premium = SMB = Small companies minus Big companies.

= 1/4 * [(S/H/W – B/H/W) + (S/H/L – B/H/L) + (S/L/W – B/L/W) + (S/L/L – B/L/L)] (9)

Value Premium = HML = High book to market ratio – low book to market ratio.

=1/4 * [(S/H/W – S/L/W) + (S/H/L – S/L/L) + (B/H/W – B/L/W) + (B/H/L – B/L/L)] (10)

Momentum Premium = MOM

= 1/4 * [(S/H/W – S/H/L) + (S/L/W – S/L/L) + (B/H/W – B/H/L) + (B/L/W – B/L/L)] (11)

3.6 Characteristics model.

Fama and French (1992) state that character associated to assets better performed then beta model. They introduced size and book to market ratio to check asset performance. The study added size and value premium to their model. Characteristics model explains excess return by stock characteristic. Three factor models are preferable for selecting minimum variance portfolio. Portfolio optimization supports risk controls. The evaluation and performance of these characteristics describes the cross section of average stock return and common time series variation in stock return.

The model represented in following equations;

$$R_t - R_{ft} = \alpha + \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + e_t \quad (12)$$

R_t = return in portfolio I for time t.

R_{ft} = Risk free rate.

The equation includes.

MKT Market premium

E/P Earning to price.

SMB Size premium.

HML Value premium.

RF Zero risk return.

e_t Error term.

Alpha The impact of (alpha) management.

3.6.1 Measurement of variables

The variables of book to market ratio, size and price to earnings ratio are calculated as follows;

3.6.2 Book to market ratio.

Book to market ratio is measured as.

$$\text{Log(B/M)} = \text{Log}\left(\frac{total\ shareholderequity}{Market\ value\ of\ equity}\right)$$

Whereas;

B/M Book to market

MV Market value equity.

3.6.3 Size;

Size of companies can be measured on different basis i,e; total assets measure the size in term of market capitalization.

$$\text{Log(size)} = \text{Log}\left(No\ of\ shares * MPS\right)$$

Whereas;

Size. = number of share outstanding * Market price of share

No of shares = traded/registered at stock exchange

MPS = Market price of share.

3.6.4 Earnings to price ratio.

The earning to price ratios calculated by follows;

$$\text{Log(E/P)} = \text{Log}\left(\frac{\text{EPS}}{\text{MPS}}\right)$$

E/P	=	Earnings to price ratio
MPS	=	Market price of share
EPS	=	Earnings per share after tax.

3.7 Carharrt Model.

After Fama and French three factor model Carharrt (1997) expands this model by adding fourth risk factor. These risk factor captures the tendency of firm to produce future returns from past returns. The fourth risk elements in this model is momentum factor. The momentum factor is calculated as the average of best performance stock minus averages of worst performing stock from a specific period of time. The studies reported the momentum factor effectiveness and increase explanatory power with three factor model of Fama and French.

The Carharrt model can be written as in equation form;

$$R_t - R_{ft} = \alpha + \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + e_t \quad (13)$$

Whereas;

R_t = Return of portfolio.

R_{ft} = Risk free rate.

The equation includes the following.

MKT Market premium

SMB Size premium.

H Zero risk return.

HML Value premium.

e_t Random error.

α Alpha.

MOM Momentum.

Chapter 04

Empirical results and discussions.

4.1 Empirical results.

Table 4.1 exhibits the descriptive statistics of sorted portfolios.

Descriptive statistics include mean, median, standard deviation, skewness, excess kurtosis, minimum and maximum.

Table 4.1 Descriptive statistics of sorted portfolio.

	Mean	Median	SD	Kurtosis	Skewness	Minimum	Maximum
B	0.012	0.012	0.096	23.832	1.361	-0.498	0.762

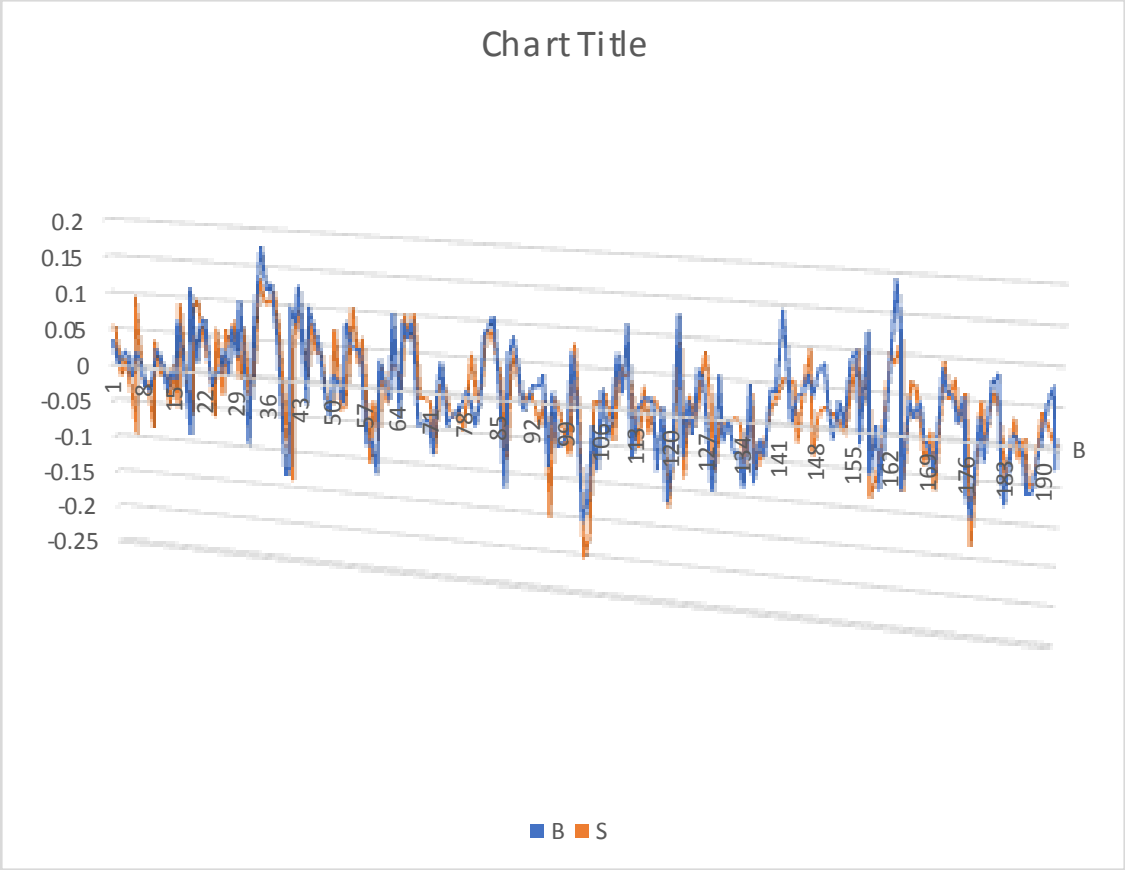
S	0.007	0.008	0.103	34.769	1.069	-0.677	0.867
SH	0.009	0.012	0.082	13.324	-0.395	-0.499	0.500
SL	0.006	0.005	0.131	45.824	2.051	-0.802	1.204
BH	0.016	0.015	0.093	10.284	0.670	-0.413	0.603
BL	0.008	0.002	0.107	33.706	1.969	-0.559	0.926
SHW	0.023	0.022	0.077	4.499	-0.921	-0.411	0.207
SHL	-0.006	-0.005	0.117	38.323	0.453	-0.890	0.945
SLW	0.024	0.027	0.108	13.886	0.044	-0.522	0.716
SLL	-0.013	-0.013	0.175	58.759	3.080	-1.154	1.708
BHW	0.034	0.026	0.106	4.583	0.174	-0.472	0.481
BHL	-0.001	-0.005	0.114	16.303	0.516	-0.662	0.774
BLW	0.025	0.016	0.115	21.407	1.009	-0.561	0.888
BLL	-0.009	-0.011	0.109	30.508	1.926	-0.627	0.904

In Table 4.1 Portfolio B report higher return then Portfolio S. The result match with theory that S Portfolio show risk of 10.4% higher than B Portfolio that show risk of 9.6%. Both stock show positive skewness. Both stocks show positive kurtosis. Highest return earned by small stock is 86% while big stock earned maximum of 76%. Big stock show loss of 49% whereas small stock show loss of 67%.

The behavior of small and big stocks shows consistent result as shown by portfolio B and S. The extreme case of Portfolio S/L/W and S/L/L where S/L/L stocks gain maximum 100% as compared to S/L/W shows maximum gain of 71%. But on the other hand, S/L/L shows risk of 17% higher than S/L/W 10%. Only portfolio S/H/W shows negative skewness. Portfolio S exhibit efficient result give maximum return at lower risk level. In all portfolios, small book to market stocks outperformed high book to market stocks. All other portfolios in table 4.1 shows consistent results as exhibits in portfolios B and S.

The behavior of B portfolio and S Portfolio average return show in fig 4.1.

Fig. 4.1



The result shows that in general B portfolio earned higher return as compared to S portfolio. Risk in S portfolio are higher than B portfolio. The skewness of all portfolio is positive except S/H/W stocks. All other portfolios results have same trend and aligned with these B and S portfolio.

High book to market portfolio shows (Portfolio BH) higher return then low book to market portfolio (Portfolio BL). Standard deviation is higher in BL portfolio than BH portfolio. The minimum shows by both portfolios are negative and BL shows loss of 55% and BH shows loss of 41%. Both portfolio positive kurtosis. Both portfolios show positive skewness and BL shows higher skewness than BH.

Winner portfolios outperform loser portfolios. The return show by winner stocks are positive and negative returns shows by loser portfolios. Loser portfolios shows higher

risk 11.4% and winner portfolio show risk 10%. Both portfolios show loss and loser stocks show maximum loss of 66% then winner stock 47%. Both portfolios show positive skewness and kurtosis.

4.2 Descriptive statistics

Table 4.2 **Descriptive statistics.**

MKT, SMB, HML and MOM

Descriptive of Variable	**SMB**	**HML**	**MOM**	**MKT**
Mean	-0.00482	0.005853	0.033559	0.016658
Median	-0.00509	0.004231	0.024666	0.021622
SD	0.04365	0.054676	0.081241	0.077588
Kurtosis	8.156304	37.89058	14.54106	6.658871
Skewness	-1.30291	-2.33211	-1.21606	-1.17553
Minimum	-0.28694	-0.47978	-0.53684	-0.44891
Maximum	0.10463	0.316085	0.376798	0.241057

Descriptive Statistics of Characteristics.	*EP*	*Size*	*BM*	*MOM*

Mean	0.759829	7.295917	-0.14409	0.033385
Standard Deviation	0.263021	0.792762	0.331041	0.081065
Kurtosis	3.560076	-0.39298	-1.50849	14.58864
Skewness	1.889638	-0.36719	0.16131	-1.21142
Minimum	0.479884	5.748124	-0.65611	-0.53684
Maximum	1.711988	8.631462	0.628908	0.376798

Table 4.2 exhibits the descriptive statistics of premium and characteristics i,e size, value, market and momentum. All premiums are positive except size premium. Highest premium is of momentum lead by market and value premiums. The maximum volatility is found in the market premium as compared to value and size premium. Skewness is negative for all premiums. Momentum premium shows maximum return among all premiums. Momentum premium reports the highest volatility. All character Size, EP and momentum show positive return except BM character. Highest maximum is shown by size and Earning to price. Skewness are positive in E/P and B/M while negative in Momentum and size. Size shows the highest standard deviation as compared to other factors. Highest kurtosis shown by momentum lead by E/P while size and book to market show negative kurtosis.

4.3 Correlation

Table 4.3 Correlation matrix

	SMB	HML	MOM	MKT
SMB	1			
HML	-0.28663	1		
MOM	-0.12863	0.441643	1	
MKT	0.1304	-0.0159	0.240565	1

Correlation of Characteristics.

	EP	*Size*	*BM*	*MOM*
EP	1			
Size	-0.31509	1		
BM	0.767681	-0.62993	1	
MOM	0.043257	0.003881	0.014433	1

Table 4.3 report the correlation matrix of premiums and characteristics. Market premium have positive relationship with size and with momentum. However negative correlation existed among size premium, value premium, market premium and value premium. Correlation of size to E/P and B/M found negative. The highest positive correlation exists among B/M to E/P. All other characteristics shows positive correlation.

4.4 Data and regression diagnostics.

This study use data of 100 non-financial companies of Pakistan for the period of 2000 to 2016. Summary statistics of variables and excess returns is presented in Table 4.5. Excess return monthly summary statistics is presented panel A. The distribution of excess return has thick tails and skewed. In panel B summary statistic of factors. large positive means

of all four factors have in our sample period. In panel C summary statistics of characteristic are shown.

To make variables more symmetric in this study logarithm of size book to market and earnings to prices are taken. Momentum is calculated from month t-12 to t-5. Logarithm of momentum is not taken to keep align with other returns figure. Finally, in table 4.5 present the behavior of stock excess return. In panel D we represent the mean standard deviation skewness and excess kurtosis for all stocks include in this sample.

Table 4.5 Results statistics for excess return factors and characteristics.

The data consist of large Pakistan stocks from period June 2000 to June 2016. Stocks are on the basis of market capitalization. The list of selected stocks is constant over all period and include large cap 100 unique stocks. T-bills rate are subtracted to get excess return. [MKT shows market over risk free), SMB shows (small-big), HML shows (high minus low), and MOM shows (momentum)]. In panel C returns movement of 100 stocks are calculated and present. the returns and factors in panel A, B and C shows in percentage and that are monthly base.

Table 4.5 Results statistics for excess return factors and characteristics

A. Univariate statistics of excess return. (MKT)					
	N*T	Mean	SD	Skewness	Excess Kurtosis
Excess return	192	0.016658	0.0776	-1.1755	6.659

Panel A exhibits descriptive statistics of excess return. The risk associated to market premium is 7.7%. Market premium report negative skewness. These statistics based on market monthly returns minus risk free rate. The average return is 1.66%. the average risk is 7.7%.

The panel B includes statistics of characteristics base model factors. Size shows negative skewness. Book to market and Earning to price show positive skewness. Size and value shows negative Kurtosis while Earning to price show positive kurtosis.

B. Univariate statistics of characteristics.

	N*T	Mean	SD	Skewness	Excess Kurtosis
Log of size	192	7.295917	0.792762	-0.36719	-0.39298
Log of B/M	192	-0.14409	0.331041	0.16131	-1.50849
Log of E/P	192	0.759829	0.263021	1.889638	3.560076

C. Distribution of individual stock moments.

	N	Min	25^{th} Pct	50^{th}	75^{th}	Max
Mean excess ret	100	-0.01097	0.003346	0.00921	0.016088	0.027932
SD of excess ret	100	0.095932	0.143741	0.175661	0.242736	0.574334
Skew of excess ret	100	-4.56668	-0.32174	-0.00708	0.44093	6.32340
Excess kurtosis of excess	100	1.2177	4.04129	6.84092	36.9738	90.11362

In Panel C moment of excess returns are reported. The portfolio consists of 100 stocks return. The panel report the minimum return to maximum return in portfolio. The table report the minimum risk to maximum risk associated to this portfolio. Moment of skewness from lowest to highest level are exhibits. Panel reports average return at minimum 25^{th}, 50^{th}, 75^{th}, 100^{th}. As the moments goes upward the risk associated to stocks upward. At minimum level, the risk associated to portfolio is 9.5% whereas at maximum level risk goes to 57%. Similarly, skewness of portfolio shows the same trend. Panel C exhibits same trend found in kurtosis of portfolio.

Table 4.6 Regression analysis of beta based models and characteristics based models.

Beta model estimate for 100 stocks report 100 R-squared value. These values are reported in panel A of table 4.6. Characteristics model R^2 for 100 stocks for the period of 192

months presented in panel B. Each stock has pair of (19200). In panel C, we present pair wise correlation of excess return. Residual correlations are show in panel D.

Table 4.6 Regression analysis of beta based models and characteristics based models.

A. Distribution of R-squared beta model

	N	Min	25th	50th	75th	Max
MRF Model (BM1)	100	0.000035	0.010025	0.047033	0.193682	0.617409
MRF + SMB + HML (BM3)	100	0.003407	0.161304	0.298154	0.407795	0.621845
MRF+ SMB + HML+ Mmt (BM4)	100	0.004564	0.170548	0.319608	0.422728	0.657821

Panel A report the R-squared of beta models. In beta 1 model the minimum R-squared is 0.000035 and maximum of 0.617. the highest R-squared found in Beta 4 model in which maximum R-squared value is 0.6578.

B. Distribution of R-squared characteristic model.

	N	Min	25th	50th	75th	Max
Size + B/M Model (CM1)	100	0.000071	0.002296	0.005282	0.011251	0.027147
Size + B/M + Mmt (CM2)	100	0.000306	0.004904	0.010579	0.019456	0.075727
Size + B/M + Mmt + E/P (CM3)	100	0.001512	0.009524	0.016836	0.029814	0.075839

Panel B report the R-squared for characteristics based model. R-squared report for minimum to maximum calculated for each model. CM1 shows the minimum R-squared

0.000071 and maximum to 0.0271. Similarly, CM2 and CM4 R-squared are exhibited in Panel B. The minimum R-squared is found in CM1 model whereas maximum R-squared is found in CM3 model. The value of R-squared increase while moving from minimum to maximum.

Panel C represent Correlation of market excess return. The minimum correlation found in the portfolio is negative correlation. The positive correlation is found when moved from minimum to maximum. At maximum level, the strong positive correlation is reported.

C. Distribution of pairwise correlation of excess return.

No of pairs	Min	25th	50th	75th	Max
19200	-0.09115	0.109509	0.21895	0.440094	0.785754

Panel D report the pairwise correlation of residual for beta based model and characteristic based model. BM1 indicated negative correlation at minimum level while positive correlation at maximum level. BM2 and BM3 model indicates the same trend as shown by BM1 model. The correlation indicated by characteristic based model are higher and strongly positive. The trend among characteristics based model are same as beta based model but the degree of correlations are stronger in characteristics based model then beta based model.

Pairwise correlation

D. Distribution of pairwise correlation of residuals.

	No of pairs	Min	25th	50th	75th	Max
BM1	19200	-0.09756	0.004466	0.052608	0.091527	0.189015
BM2	19200	-0.11026	-0.00161	0.046713	0.090884	0.253239
BM3	19200	-0.13843	-0.01308	0.033954	0.087925	0.255154
CM1	19200	-0.00100	0.117486	0.179436	0.241331	0.390274
CM2	19200	-0.03601	0.077121	0.172269	0.253827	0.390339

CM3	19200	-0.03638	0.079898	0.17012	0.252324	0.38988

In table 4.6 R-squared and residual correlation are presented and these diagnostics are created from last estimation window. R-squared of each model is presented in Panel A of the table 4.6. Higher R-squared are obtained in beta model in comparison to characteristics model. The beta four factor model has best model in term of R-squared distribution among all models. Furthermore, in Panel C pairwise correlation of excess return distribution is shown. In this study, we expect the residual correlation. Residual correlation of all model near to zero except two factor beta model.

The results from characteristic model better than beta models in case of reduction of dimensionality. The results report the success of factor model that reflects dimensionality assumptions in explaining the covariance of all factor. The results indicate that characteristics model perform better than beta model.

4.7 compare of performance of minimum variance portfolio.

Minimum variance portfolio of return estimated by characteristics and beta model are created by using historical data. These MVPs are compared and results are analyzed.

4.8 Construction of MVPs.

The MVPs are created on the estimate of each model. The study focus on MVPs so that portfolio construction does not effected by estimate of mean return. The focus is clearly on the model volatility side. Chan et al (1999) follow the same approach. Each portfolio is formed for the period June 2000 to June 2016. Once the portfolios composition is determined, monthly returns of these portfolio are created till the creation of next portfolio.

MVP historical performance.

MVP are created by using monthly return for the period July 2000 to June 2016. The monthly returns are calculated for subsequent year. The last date for formation of portfolio is June 2015. Three beta models and three characteristics models are considering for measuring the risk and return. For comparison purpose, equal weighted

portfolios are used. Excess return is obtained from subtracting T-bills rate. Returns are expressed percentage and not annualized.

Table 4.8 Minimum variance portfolios historical performance.

Model	Monthly excess return		
	Mean	Standard deviation	Sharpe ratio
Equal weighted (EW).	2.85	24.30	0.1013
Beta model			
MRF (BM1)	2.79	1.59	1.7609
MRF + SMB + HML (BM3)	2.79	10.02	0.2788
MRF + SMB + HML + Mmt (BM4)	2.58	5.97	0.4315
Characteristics Model			
Size + B/M (CM2)	2.55	1.22	2.0873
Size + B/M + Mmt (CM3)	2.58	1.30	1.9814
Size + B/M + Mmt + E/P (CM4)	2.79	2.35	1.1888

Table 4.8.1 represent the risk and returns of characteristics models and beta models. In this study, portfolio based on characteristic model MVPs show lower volatilities as compared to portfolio based on beta model. The standard deviation shown by characteristics based model are from 1.2 percent to 2.5 percent whereas beta based model indicated standard deviation from 1 percent to 10 percent.

Sharpe ratio shows the risk adjusted return of beta based models and characteristic based models. Sharpe ratio greater than 1 is acceptable to Investor. In equal weighted portfolio Sharpe ratio is less than 1 which is unacceptable for Investors. In beta based models MRF (Market) are in acceptable region. All other beta based model report value lower than 1. On the otherhand characteristics based model report the results greater than 1. The results show he acceptance of models. The CM2 model report value greater than 2 that means size and book to market influence the returns. The Sharpe ratio greater than 2 is good and attractive for Investors. The Sharpe ratio results support characteristics based model better explained the minimum variance portfolio.

4.9 Test of equal volatilities.

Table 4.9 report the results of two sample T-Test: Two-Sample Assuming Unequal Variances. The null hypothesis is the equality of volatilities in both the cases. A low P value and large f-statistic reject the null hypothesis.

Table 4.9 Test for Equality of Variance.

Based on monthly return (T = 192)	Mean		Variance			
	M1	M2	V1	V2	F-stat	P-value
BM1 vs EW	0.00958	0.00958	0.00238	0.00937	3.93597	< 0.001***
BM3 vs EW	0.00958	0.00958	0.00586	0.00937	1.59729	0.000647***

BM4 vs EW	0.00958	0.00958	0.00648	0.00937	1.445598	0.005605**
CM2 vs EW	-0.00336	0.00958	0.09551	0.00937	10.1968	< 0.001***
CM3 vs EW	0.00958	0.00958	0.000299	0.009367	31.31541	< 0.001***
CM4 vs EW	0.00958	0.00958	0.00031	0.00937	29.87197	< 0.001***
BM1 vs CM2	0.0096	-0.0034	0.0024	0.0955	40.1344	< 0.001***
BM3 vs CM3	0.00958	0.00958	0.00586	0.00030	19.60527	< 0.001***
BM4 vs CM4	0.00958	0.00958	0.006480	0.00031	20.6641	< 0.001***

A comparison of beta based models with equally weighted models indicate that return of both models is same but volatility is found different. The volatility of all beta based models is lower than equally weighted model. The volatility of BM1 is minimum which indicates that BM1 shows optimum return per unit of risk. It is further added volatility of two groups is different.

A compare of characteristics based model with equally weighted model indicates that average expected return estimated by CM2 is negative where as it assumes maximum risk. The risk of CM4 model is lowest in comparison to other characteristics based models and equal weighted model. Therefore, CM4 is optimum portfolio in characteristics based models. Here again similar results are observed that volatility of two groups on return are different.

Finally, volatility of beta based model and characteristics based model is compared and found different. It is interesting that explained return of BM3 and CM3 are observed but volatility of characteristics based model is low. the similar results are observed for BM4 and CM4. Thus, the portfolio form on the base of return estimated by using characteristics based model are better performer.

Table 4.9 exhibits the difference in volatilities between characteristics based models and beta based models. The volatilities between equal-weighted and both models based comparison is presented. Precisely two variable and three variable characteristic based model with two variable and three variable beta based models are compared.

One variable and two variable characteristics based models are compare with one variable and two variable beta based models. Four variable model with three variable characteristic based model is compared. Four variables beta based model is compared with four variable characteristic based model. In first comparison mean of equal-weighted and BM1 model are same but variances are different. The model has positive F-statistics with significant P-value. This indicates that volatility of models is significant different. All beta based model appears to be better than equally weighted model as it appears the results at lower level of risk.

Chapter 05

Conclusion and Recommendations.

5.1 Conclusion.

The study compares the risk and return volatility of portfolio formed on the basis of explained return estimated through beta based model and characteristics based models.

The models are divided into two categories i,e beta based model and characteristics based model. A sample of 100 companies from period of 2000 to 2016 is used to measure risk and return under various estimation model. The beta based model used in this study CAPM, Three factor model and four factor model. Similarly, characteristics based model includes two factor, three factor and four factor model. The difference between two categories is that beta based model use size premium, value premium and momentum premium. The size premium is achieved through difference fraction of big stocks and small stocks. The value premium is estimated through difference of return of high book to market stocks and low book to market stocks. The momentum is difference of return of portfolio of winner to portfolio of loser.

The characteristics based models use size, book to market ratio and momentum. These models are used for estimation of return and hence their returns are used to create minimum variance portfolio.

Finally, risk and return of each portfolio is estimated by using mean variance efficiency framework proposed by Markowitz. The volatilities and MVP's of model indicates the characteristics model is better model then CAPM model. The variance of beta models is higher than characteristics. The standard deviation shown by characteristic model is 2.5% but in case of beta model the deviation is 10%. The advantage of characteristic model over beta model is consistent.

At the end, a question arise that which model perform better to measure covariance and variances. A comparison of beta based model and equally weighted models indicates that the volatility of the beta based model report less risk than equally weighted portfolio. Similar results are observed when characteristics based models. The evidence indicated that characteristics model performs better to beta model in term of measure misspecification as well. The characteristics model less violated the restriction of error in diagonal variance then beta model. The primary goal of factor model implementation is of reduction in dimensionality when characteristics model performs successfully than beta model. Thus, leads to preference of practitioner to use characteristic model due to flexibility and intuitive appeal. The study conclude that performance of portfolio based on characteristic model performs better than beta based models or naively diversified model.

5.2 Recommendations.

Investor takes decisions of investment on the basis of expected return estimated through different models and strategies. These models are CAPM, three factor models, Carharrt model and other characteristics based model. The characteristics models are based on firm fundamentals. The same results are also used for capital budgeting decisions. Investors are invested on the basis of portfolio expected returns.

The portfolios are formed to get desired results. In this connection, this study recommends that estimation through characteristics based model may be more helpful in achieving desired investment objectives.

5.3 Directions for future studies

This study give direction for future researchers about model's performance in emerging market. These models may be used in different market to explore the models' consistency of results. The study on these models can be extended by using large sample to ensure consistent results.

The work may be extended by using different portfolios formation and other characteristics based models.

Appendix A.

Historical MVP, s.

6.1 Equal weighted and Beta based model MVP.

Portfolios				
	Equal weight	BM1	BM2	BM3
	Equal wt.	Min St Dev	Min St Dev	Min St Dev
Constraining variables	None	at μ=	at μ=	at μ=
values of constraint's	N/A	2.79%	2.7932%	2.5760%
	..... Portfolio Weight.....			
TRIPF	1%	0%	0%	0%
TREET	1%	0%	0%	0%
SEARL	1%	0%	0%	0%
TGL	1%	0%	0%	0%
SNGP	1%	0%	0%	0%
SEPCO	1%	0%	0%	0%
GLAXO	1%	0%	0%	0%
SITC	1%	0%	0%	0%

SIEM	1%	0%	0%	0%
SHFA	1%	0%	0%	0%
SHEL	1%	0%	0%	0%
STCL	1%	0%	0%	0%
SAZEW	1%	0%	0%	0%
RMPL	1%	0%	0%	0%
POML	1%	0%	0%	0%
PMPK	1%	0%	0%	0%
PSYL	1%	0%	0%	0%
PSO	1%	0%	0%	0%
PRL	1%	0%	0%	0%
PPVC	1%	0%	0%	0%
PPP	1%	0%	0%	0%
POL	1%	0%	0%	0%
PNSC	1%	0%	0%	0%
PIAA	1%	0%	0%	0%
PGCL	1%	0%	0%	0%
PECO	1%	0%	0%	0%
PCAL	1%	0%	0%	0%
PSMC	1%	0%	0%	0%
PKGS	1%	0%	0%	0%
NRL	1%	0%	0%	0%
MUREB	1%	0%	0%	0%
MERIT	1%	0%	0%	0%
MARI	1%	0%	0%	0%
KTML	1%	0%	0%	0%
KOHC	1%	0%	0%	0%
ICI	1%	0%	0%	0%
HAEL	1%	0%	0%	0%
HABSM	1%	0%	0%	0%
GATM	1%	0%	0%	0%
FZCM	1%	0%	0%	0%
FCCL	1%	0%	0%	0%
EXIDE	1%	0%	0%	0%
ENGRO	1%	0%	0%	0%
DIIL	1%	0%	0%	0%
DKTM	1%	0%	0%	0%
CHCC	1%	0%	0%	0%
BILF	1%	0%	0%	0%
BERG	1%	0%	0%	0%

BNWM	1%	0%	0%	0%
BGL	1%	0%	0%	0%
ARPL	1%	0%	0%	0%
ALTN	1%	0%	0%	0%
ALNRS	1%	0%	0%	0%
AGTL	1%	0%	0%	0%
AABS	1%	0%	0%	0%
ADTM	1%	0%	0%	0%
AGSML	1%	0%	0%	0%
PAKT	1%	0%	0%	47%
HUBC	1%	0%	0%	0%
KEL	1%	0%	0%	0%
PTC	1%	0%	0%	0%
ATBA	1%	0%	0%	0%
NATF	1%	0%	0%	0%
ATLH	1%	0%	0%	0%
BIFO	1%	0%	0%	0%
HINO	1%	0%	0%	0%
THALL	1%	0%	0%	0%
DLL	1%	0%	0%	0%
SEPL	1%	0%	0%	0%
COLG	1%	0%	0%	0%
INDU	1%	0%	0%	0%
BATA	1%	0%	0%	0%
DAWH	1%	0%	0%	0%
POL	1%	0%	0%	0%
NESTLE	1%	0%	0%	0%
MTL	1%	0%	0%	0%
FFC	1%	0%	0%	0%
INKL	1%	0%	0%	0%
IDYM	1%	0%	0%	0%
HINOON	1%	0%	0%	0%
GLPL	1%	0%	0%	0%
GTYR	1%	0%	0%	0%
UDPL	1%	0%	0%	0%
CRTM	1%	0%	0%	0%
SSGC	1%	0%	0%	0%
SING	1%	0%	0%	0%
SML	1%	0%	0%	0%
SHCI	1%	0%	0%	0%

SARC	1%	0%	0%	0%
SNAI	1%	0%	0%	0%
RUPL	1%	0%	0%	0%
REWM	1%	0%	0%	0%
QUET	1%	0%	0%	0%
PRET	1%	0%	0%	0%
PHDL	1%	0%	0%	0%
PAKCEM	1%	0%	0%	0%
LUCK	1%	0%	0%	0%
KSBP	1%	0%	0%	0%
KHTC	1%	100%	100%	53%
JSCL	1%	0%	0%	0%
∑wi	100%	100%	100%	100%
μ	0.98%	2.79%	2.79%	2.58%
σ_p	9.65%	1.59%	10.02%	5.97%
μ/σ	0.1013	1.7609	0.2788	0.4315

1. **Characteristics based model MVP's.**

Portfolios			
	CM1	CM2	CM3
	Min St Dev	Min St Dev	Min St Dev
Constraining variables	at μ=	at μ=	at μ=
values of constraint's	2.549%	2.5760%	2.80%
TRIPF	0%	0%	0%
TREET	0%	0%	0%
SEARL	0%	0%	0%
TGL	0%	0%	0%
SNGP	0%	0%	0%
SEPCO	0%	0%	0%
GLAXO	0%	0%	0%
SITC	0%	0%	0%

SIEM	0%	0%	0%
SHFA	0%	0%	0%
SHEL	0%	0%	0%
STCL	0%	0%	0%
SAZEW	0%	0%	0%
RMPL	0%	0%	0%
POML	100%	0%	0%
PMPK	0%	0%	0%
PSYL	0%	0%	0%
PSO	0%	0%	0%
PRL	0%	0%	0%
PPVC	0%	0%	0%
PPP	0%	0%	0%
POL	0%	0%	0%
PNSC	0%	0%	0%
PIAA	0%	0%	0%
PGCL	0%	0%	0%
PECO	0%	0%	0%
PCAL	0%	0%	0%
PSMC	0%	0%	0%
PKGS	0%	0%	0%
NRL	0%	0%	0%
MUREB	0%	0%	0%
MERIT	0%	0%	0%
MARI	0%	0%	0%
KTML	0%	0%	0%
KOHC	0%	0%	0%
ICI	0%	0%	0%
HAEL	0%	0%	0%
HABSM	0%	0%	0%
GATM	0%	0%	0%
FZCM	0%	0%	0%
FCCL	0%	0%	0%
EXIDE	0%	0%	0%
ENGRO	0%	0%	0%
DIIL	0%	0%	0%
DKTM	0%	0%	0%
CHCC	0%	0%	0%
BILF	0%	0%	0%
BERG	0%	0%	0%

BNWM	0%	0%	0%
BGL	0%	0%	0%
ARPL	0%	0%	0%
ALTN	0%	0%	0%
ALNRS	0%	0%	0%
AGTL	0%	0%	0%
AABS	0%	0%	0%
ADTM	0%	0%	0%
AGSML	0%	0%	0%
PAKT	0%	0%	0%
HUBC	0%	0%	0%
KEL	0%	0%	0%
PTC	0%	0%	0%
ATBA	0%	0%	0%
NATF	0%	0%	0%
ATLH	0%	0%	0%
BIFO	0%	33%	0%
HINO	0%	0%	0%
THALL	0%	0%	0%
DLL	0%	0%	0%
SEPL	0%	0%	0%
COLG	0%	0%	0%
INDU	0%	0%	0%
BATA	0%	0%	0%
DAWH	0%	0%	0%
POL	0%	0%	0%
NESTLE	0%	0%	0%
MTL	0%	0%	0%
FFC	0%	0%	0%
INKL	0%	0%	0%
IDYM	0%	0%	0%
HINOON	0%	0%	0%
GLPL	0%	0%	0%
GTYR	0%	0%	0%
UDPL	0%	0%	0%
CRTM	0%	0%	0%
SSGC	0%	0%	0%
SING	0%	0%	0%
SML	0%	0%	0%
SHCI	0%	0%	0%

SARC	0%	0%	0%
SNAI	0%	0%	0%
RUPL	0%	0%	0%
REWM	0%	0%	0%
QUET	0%	0%	0%
PRET	0%	0%	0%
PHDL	0%	0%	0%
PAKCEM	0%	0%	0%
LUCK	0%	0%	0%
KSBP	0%	0%	0%
KHTC	0%	67%	100%
JSCL	0%	0%	0%
∑wi	100%	100%	100%
μ	2.55%	2.58%	2.79%
σp	1.22%	1.30%	2.35%
μ/σ	2.0873	1.9814	1.1888

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