SKEWNESS AND KURTOSIS FACTORS AND ASSET PRICING IN BORSA ISTANBUL

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ABSTRACT

SKEWNESS AND KURTOSIS FACTORS AND ASSET PRICING IN BORSA ISTANBUL

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Asset pricing always attracted a lot of attention in the finance world literature and it is built mainly on the mean-variance framework of the Capital Asset Pricing Model (CAPM). Although CAPM is commonly used by academics and practitioners, its validity is often questioned. The researchers have investigated the significance of CAPM by empirical tests, and there is a fairly large body of the literature about the shortcomings of the model. For these reasons, researchers on asset pricing have started to develop different models and consider higher moments in asset pricing. The aim of this study is to determine the effect of skewness and kurtosis factors on the variation of portfolio excess returns in Borsa Istanbul (BIST) over the period from January 1990 to June 2013. Excess returns are calculated for portfolios that are formed according to the size, book to market, momentum, coskewness, and cokurtosis factors. The Fama-French three-factor model is used as the base model and skewness and kurtosis factors are added to the base model separately. The incremental effect of skewness and kurtosis factors over the Fama- French factors is examined with time series regressions.

Keywords: Asset pricing, skewness, kurtosis, Borsa Istanbul

ÖZ

ÇARPIKLIK VE BASIKLIK FAKTÖRLERİ VE BORSA İSTANBUL İÇİN VARLIK FİYATLAMASI

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Varlık fiyatlandırma her zaman finans dünyası için önemli bir konu olmuştur ve Sermaye Varlıklarını Fiyatlandırma Modeli (SVFM) ile varlık fiyatlandırma ortalama ve varyans üzerine dayandırılmıştır. SVFM finans literatüründe yaygın kullanılan bir fomül olmasına rağmen geçerliliği her zaman sorgulanmıştır. Araştırmacılar ampirik testler ile modelin geçerliliğini incelemiş ve sonucunda modelin eleştirileri hakkında geniş bir literatür oluşmuştur. Bu sebeplerden dolayı, araşatırmacılar varlık fiyatlandırma modelleri üzerinde çalışmaya başlamış ve varlıkların yüksek momentleri de göz önünde bulundurulmaya başlanmıştır. Bu çalışmanın amacı, basıklık ve çarpıklık faktörlerinin Borsa Istanbul'da Ocak 1990 ve Haziran 2013 yılları arasında yer alan hisselerden oluşturulmuş portföylerin getiri değişkenliğine etkisinin olup olmadığının tespit edilmesidir. Portföyler büyüklük, defter değeri/ piyasa değeri, mometum, basıklık, çarpıklık faktörlerinine göre oluşturulmuştur. Analizlerde Fama French Üç Faktör Modeli temel model olarak kullanılmış ve basıklık ve çarpıklık faktörleri teker teker modele ilave edilmiştir. Basıklık ve çarpıklık faktörlerinin Fama French Üç Faktör Modeli üzerinde artırıcı etkisinin olup olmadığını gözlemlemek için zaman serisi regresyonu kullanılmış ve temel model ile karşılaştırma yapılmıştır.

Anahtar Kelimeler: Varlık Fiyatlama, Basıklık, Çarpıklık, Borsa İstanbul

To my beloved family

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CHAPTER 1

INTRODUCTION

Asset pricing has always been an attractive subject to finance researchers and investors for years. In the 1960s, finance theory was built on the mean-variance context with The Capital Asset Pricing Model (CAPM) which was developed by Sharpe [53], Lintner [38, 39] and Mossin [43]. CAPM has become the center piece of finance theory and attracted researchers' attention since its first appearance. Moreover, it has become a popular formula due to the simplicity and utility in asset pricing. According to CAPM, the first two moments of asset return (mean and variance) are used to determine the relation between risk and expected return. Although it is a commonly used formula in the finance literature, the validity of CAPM is always questioned. The researchers have investigated the significance of it by empirical tests during the last half century, and there has been a fairly large body of the literature about the criticism of the model. Many financial economists criticize CAPM because of its assumptions. They also support that only market factor is not adequate for explaining asset returns so they search an alternative model.

First, The Arbitrage Pricing Theory (APT) of Ross [49] appears. APT allows multi factors in asset pricing with flexible assumptions when it is compared with CAPM. After Ross defines APT, Fama and French [12] introduce size and book to market factors besides market factor to explain the cross-sectional variation in asset returns. After that, Carhart [4] extends Fama French three factor model by adding the momentum factor, and it is seen that these factors have a significant effect on asset pricing.

On the other side, it is known that CAPM is based on the relationship between mean and variance. In mean and variance concept, the distribution of the asset returns is assumed to be normal and investor's utility function is also assumed to be quadratic. When the returns are not normally distributed, the CAPM is not enough to price asset returns. However, empirical studies against CAPM show that asset returns in emerging and developed markets have skewed and leptokurtic distribution, so they are not normally distributed. If the returns are not normal, mean and variance are not enough to characterize the distribution of returns.

The need for higher comoments in asset pricing is taken into consideration by finance researchers due to the asymmetric and fat tailed distribution of asset return. The third moment (skewness), the fourth moment (kurtosis), or higher comoments have been included to the asset pricing model. In the literature, the studies with the third moment (skewness) in asset pricing start with Kraus and Litzenberger [32] and Friend Westerfield [17]. According to the studies, it is observed that skewness has an explanatory power on asset pricing. After some studies related to the third moment, Harvey and Siddique [23] define the effect of conditional skewness in asset pricing with the inclusion of CAPM and Fama French three factor model. On the other hand, Fang and Lai [15] and Dittmar [8] extend three moment CAPM with the inclusion of kurtosis factor. Moreover, Kostakis, Muhammad, and Siganos [31] investigate the application of the asset pricing for investors' preference regarding skewness and kurtosis in London Stock Exchange with the extended methodology of Harvey and Siddique [23].

In this dissertation, the effect of skewness and kurtosis on asset pricing is analyzed for Borsa Istanbul (BIST). There are few studies about the characteristics of asset return distribution and their effect on asset pricing for BIST. Harris and Küçüközmen [21] study the empirical distribution of Istanbul Stock Exchange (ISE) for the time period between 1988 and 1998. According to the result of the analysis, Jarque-Bera and Kolmogorov-Smirnov statistics indicates that the returns in ISE are not normally distributed. On the other side, Mısırlı and Alper [42] examine the effect of coskewness on asset pricing for ISE with the methodology of Harvey and Siddique [23] which is the first study to investigate the explanatory power of coskewness for ISE over the period July 1996 to December 2005. Moreover, there are different empirical evidences about the skewed and fat distribution in asset returns especially in emerging markets.

The aim of this study is to examine the impact of coskewness and cokurtosis in explaining the variation of excess returns on the different portfolio groups which are sorted based on beta, size, book to market value, momentum, skewness, and kurtosis for the time period between January 1990 and June 2013. In this study, the methodology of Harvey and Siddique [23] and Kostakis, Muhammad and Siganos [31] is used to calculate coskewness and cokurtosis factors, and these factors are included into Fama French factors to investigate their effect on asset pricing.

This dissertation definitely contributes to the current literature in two ways. First, although the previous studies researched the effect of skewness on asset returns in BIST, this is the first study for BIST to examine the roles of both skewness and kurtosis in asset pricing. Second, the time period of data is extended when compared with the previous studies for BIST.

The remainder of this study is organized as follows. In chapter 2, there is the literature review of asset pricing models. The existing literature of CAPM, multi factor models (Fama French three factor model and Carhart's model) and the asset pricing models with higher order comoments will be reported in detail. In chapter 3, information about the overview of data will be given. Moreover, the methodology of this study which includes data selection, portfolio formation, calculation of coskewness and cokurtosis, and the technique of analysis will be explained. In the next chapter, the time series regression will be conducted to the portfolios which are sorted based on beta, size, book to market, momentum and coskewness and cokurtosis factors, and the result of the regressions will be introduced particularly. In the final part of this study, conclusion will be provided.

CHAPTER 2

LITERATURE REVIEW

2.1 Single Factor Model

Finance theory has been built on the mean-variance framework. First, mean-variance portfolio selection is introduced by Markowitz [40]. After that Capital Asset Pricing Model (CAPM) is developed by Sharpe [53], Lintner [38, 39] and Mossin [43] and the model includes the first two moments of asset return distribution (mean and variance) for pricing. Sharpe [53] discusses a model of capital assets pricing under conditions of risk in his article. He tries to determine the relationship between the price of an asset and its risk. According to him, investors are assumed to prefer higher expected value and lower standard deviation (utility maximization). The investments which dominate others are also preferred.

It is difficult to create a basic rule for determining the desirability of individual assets because over-all investment opportunity curve depends not only on its expected return and risk, but also correlations with the other assets. There are two assumptions so as to derive conditions for equilibrium in the capital market. First, there is common pure rate of interest that is available to all investors for borrowing or lending on equal terms. Second, homogeneity of investor expectations is assumed.

Sharpe thinks that there is a significant relationship between the security's expected return and the part of the asset's total risk which is a systematic risk instead of a total risk. In order to define this relationship, he regresses the past returns of an individual asset on the past returns of an efficient combination of assets. He defines the slope of the regression line (β) as the systematic risk of asset. He thinks that the diversification does not avoid an investor to escape all types of risk. The responsiveness of an asset to an economic activity remains even in efficient combinations. Prices are adjusted according to this knowledge. Moreover, he suggests that the assets that are independent of the overall economic activity would return the pure interest rate, while the others are expected to get higher rates of return.

Lintner [38] was not aware of Sharpe's study while he was writing the final part of his article. Lintner's study parallels Sharpe's work. He deals with the problem of choosing optimal security portfolios for risk-averse investors, develops several equilibrium properties for the risk asset portfolio, and derives equilibrium market prices which show the presence of uncertainty. There are more assumptions than Sharpe's work. First part of the assumptions is related to the market. Each individual investor can invest his capital in risk free rates. A finite set of risky assets are trade in a single competitive market without transaction costs and taxes. All investors can also borrow or lend on equal rates without any limitations. All trades are made at discrete points in time. Second, there are assumptions about investors. Investor's joint probability distributions are related to dollar returns rather than rates of return. All investors have decided the fraction of capitals which are available for profitable investment. Investors prefer higher expected value and lower standard deviation. Moreover, an expected value, variance and covariance or correlations between each pairs are determined by each investor.

He defines that the market price of any company's equity is equal to the capitalization at the risk free rate of *certainty equivalent* that is calculated by subtracting the adjustment term from the expected value of these uncertain returns. An adjustment term is proportional to the accumulated risk for each company. Moreover, the related risk of each company's stock is calculated by the sum of the variance of its own accumulated dollar returns and its total covariance with other stocks.

After that Lintner [39] analyzes the suggestion of Markowitz that investors can make the evaluation of the probable results for each security simple by the statistical analysis which is the regression of an individual security's rate of return on some fundamental indexes of general business conditions or general index of the stock market itself.

According to the simple regression model, the values of stock will always move with both the intercept and the correlation coefficient in the same direction and inversely with the standard error of estimate ("residual variance"). Second, he thinks that changes in the slope coefficient are related to both an "income effect" and a "risk effect" that influence stock values inversely. On the other hand, Sharpe [53] defines the relation between regression slopes and yields. He hasn't considered the income effect. Lintner also mentions that stocks that are not dependent of general business conditions or the general index of the stock market must have expected returns higher than the pure interest rate without any hesitation about the returns. Lintner's opinion about this subject is different from Sharpe's view. The same results are appropriate for the price and weighted average expected return of all stocks having a positive correlation with the market.

He also touches on the diversification. According to his article, even if general business conditions and stock market level were perfectly predictable, there would still be risks in diversified portfolios. As a result, he states that diversification is not sufficient to eliminate all risks. In real life, there is always some residual or uncertainty. Consequently, Lintner and Sharpe have also different ideas about this point. Moreover, Lintner thinks that if stocks have correlation (positive) with some common factors such as the general market, the investor gets no gain from diversification. There are two approaches to getting gains from diversifying portfolios. The first one is that if the some risk assets have a negative correlation with the general business and stock market indexes, portfolios can get gains from diversification. The second approach is that if the residual variances are not zero and (positive) correlations with general indexes and other stocks are separately not perfect, the gains can be obtained.

After Sharpe [53] and Lintner [38, 39]'s works, Mossin [43] examines the attributes of the market for risky assets under the general equilibrium conditions. Sharpe's work and his article about the market characterization are similar. However, some parts of his ideas have become indefinite due to the inadequacy of the specification of equilibrium condition. There are several assumptions about analysis. First, the yield on asset and whole portfolio is a random variable and its distribution is known by investors. Second, all investors are homogeneous expectations about probability distributions. The last assumption remarks that the investors consider only expected return and variance about the investment decisions.

Mossin clarifies that the assets' equilibrium allocation corresponds to the Pareto optimum. Moreover, the ratio between the total stock of the asset's variance and the risk premium for an asset is equal for all assets. The percentage of total stocks of all risky assets is the same for each investor in equilibrium. However, it is not valid for the riskless asset due to the different attitudes towards risk. In addition to these results, all individuals have the same ratios between the holdings of two risky assets. He also examines the market line. According to his thought for market line, the ratio between per dollar expected return and standard deviation is constant. Furthermore, if investors behave irrationally, the equilibrium and market line are not meaningful. He also defines the term for the price of the risk. The price of the risk shows that investors prefer higher expected return to compensate for more risks.

After CAPM are introduced, it gets the researcher's attention and they start to make the empirical test of the model. Black [2] was interested in the empirical test of the capital asset pricing model. He studies capital market equilibrium according to two different assumptions. The first assumption is no risk free asset and no risk free borrowing or lending. Second, it is assumed that there is a risk free asset. Moreover, while long positions in the risk free asset are allowed, short positions in the riskless asset are not. In both assumptions, unlimited long or short positions for risky assets are allowed. According to the first assumption, Black defines that the efficient portfolio can be created by a weighted mixtures of portfolio m (market portfolio) and portfolio z (the minimum variance zero-beta portfolio). The fact that whether or not there is a risk free asset makes no difference to the linear relationship between the expected return of an efficient portfolio and its beta. If there is a riskless asset, the intercept for the linear function of expected return and beta is r_f. Otherwise, the intercept term is $E(R_z)$. Furthermore, he indicates that the minimum variance zero-beta portfolio Z has a covariance with the return on risky asset *i* which is proportional to 1- β_i.

According to the second assumption, Black defines that there are two different efficient portfolios. The efficient portfolios differ in the level of their risks. The less risky one is the combinations of the portfolio t which is the mixture of the portfolio m and z and the risk free asset. Otherwise, the more risk efficient portfolios are the same as the less risky efficient portfolio except for portfolio t. He also denotes that the return on the risk free asset is less than the return on the portfolio z. The expected return is the linearly dependent on β like the results of the first assumption and portfolios which are less risky have steeper slope than the higher risk portfolios. Black, Jensen, and Scholes (BJS) [3] also make the empirical test of asset pricing model because the earlier empirical tests of the model have problems about used methodology. For this reason, they use time series tests in their article and try to prevent misleading results of the cross sectional methods.

BJS use data that is taken from CRSP and that includes monthly price and dividend for NYSE security between January 1926 and March 1966. The market portfolio's monthly returns are expressed by the return on the portfolio which is the combination of equally weighted of each securities on the NYSE at the beginning of each month. BJS use 30-day rate on U.S. T-Bill rate between 1948 and 1966. From 1926 to 1947, the dealer commercial paper rate was used due to the unavailability of T-Bill rates.

BJS use the ranking and grouping procedure to prevent the selection bias. Inıtially, they estimate the coefficient (beta) for the periods 1926 -1930. According to the estimated beta values, they rank the securities from the highest to the lowest and create 10 portfolios. The calculation is done for the return on ten portfolios for each month of 1931 separately. These procedures are repeated for the next year until 1965. Therefore, 420 time-series observations are provided. Moreover, the least squares estimates of the parameters (α and β) are calculated for ten portfolios one by one. As a result, according to the time series regressions, high risk securities have lower expected excess returns (negative intercept) and low beta securities have higher expected excess returns (positive intercept) than the traditional form of asset pricing. Finally, BJS's conclusions of empirical tests suggest two factor model that is the linear function of the market factor (coefficient of β) and the second factor (R_z) (coefficient of 1-β). The second factor is also called beta factor and its covariance with market portfolio is zero.

After BJS's empirical test of CAPM, Fama and MacBeth [14] test the relationship between the expected return and the risk (two parameter portfolio model). According to this empirical test of CAPM, there are three questionable subjects:

Linearity (C1): There should be a linear relationship between the expected return and the risk in the efficient portfolio (m)

Beta factor (C2): β_i should be an only risk measure in the efficient portfolio.

Market excess return (C3): If there is a higher risk, there should be a higher expected return to compensate for the risk. $E(\tilde{R}_M) - E(\tilde{R}_0) > 0$ (The market excess return should be positive).

Fama and MacBeth suggest the stochastic model to test the expected-return conditions C1-C3 and the related hypotheses are formed. They are given below:

$$\tilde{R}_{it} = \tilde{\gamma}_{0t} + \tilde{\gamma}_{1t}\beta_i + \tilde{\gamma}_{2t}\beta_i^2 + \tilde{\gamma}_{3t}s_i + \tilde{\eta}_{it} \tag{2.1}$$

The related hypotheses:

Linearity (C1): The coefficient of β_I^2 should be zero to satisfy the linearity ($E(\tilde{\gamma}_{2t}) = 0$).

Beta factor (C2): The coefficient of s_i should be zero in spite of the fact that the beta is the only risk measure ($E(\tilde{\gamma}_{3t}) = 0$).

Market excess return (C3): The higher risk should be compensated by higher expected return ($E(\tilde{\gamma}_{1t}) = E(\tilde{R}_M) - E(\tilde{R}_0) > 0$).

Sharpe-Lintner (S-L): According to S-L model, the intercept term should be equal to the risk free rate ($E(\tilde{\gamma}_{0t}) = R_{ft}$).

Market efficiency (ME): The stock prices should reflect all available and relevant information in every point in time. ($\tilde{\gamma}_{2t}, \tilde{\gamma}_{3t}, \tilde{\gamma}_{1t} - [E(\tilde{R}_M) - E(\tilde{R}_0)], \tilde{\gamma}_{0t} - E(\tilde{R}_0)$ and $\tilde{\eta}_{it}$ are fair games).

Fama and MacBeth use the data that is taken from CRSP and that includes monthly percentage returns, dividend, and capital gains for NYSE securities between January 1926 and June 1968. The market portfolio's monthly returns (R_{mt}) are expressed by the return on the portfolio which is the combination of equally weighted of each security on the NYSE in month t. In this analysis, there is a "the regression phenomenon" problem like the BJS model. The solution is similar with the BJS model. The problem can be prevented by designing portfolios from ranked beta factor which are calculated from data for one period. The subsequent period to get beta values is used to test the "two parameter model." Portfolios are formed by using 7 years of data. Initial values of independent variables are calculated by using the next 5 years of data and the risk- return regression analysis are conducted month by month for the next 4-year.

As a result, based on t- statistics value, Fama and MacBeth conclude that the hypothesis of C1, C2, and C3 fails to reject. S-L hypothesis is not supported by the data. Finally, fair game properties related to the coefficients and disturbances of the regression analysis are appropriate for an efficient market.

In the following years, researchers continue to make empirical tests related to CAPM. Shanken [52] gathers the methods of the empirical tests which are the cross sectional regression (CSR), the multivariate Hotelling T^2 statistic, the maximum likelihood estimation (MLE), the Likelihood Ratio Test (LRT), the Lagrange Multiplier Test (LMT) and the Generalized Least Squares (GLS). According to Shanken, the analyses in the literature are not enough to answer important questions regarding CAPM.

Shanken uses the monthly return of the securities on CRSP between February 1953 and July 1971. The data is divided into three sub periods and the length of the sub periods is 74 months. The securities are ranked with reference to the market capitalization at the end of month preceding the sub-period and 20 equally-weighted portfolios are created by grouping. The consumer price index is used to compute real returns. He makes the cross sectional regression analysis to test the efficiency of CRSP index. He also considers "January effect" and divides his analysis into two parts regarding the inclusion of January. For the results, the CRSP index is not efficient apart from the size and January effects. Furthermore, the inefficiency is not defined by the firm-size effect for the periods of February-December.

2.2 Multi Factor Model

After Sharpe [53] and Lintner [38, 39], Ross [49] improves a different perspective for the capital asset pricing model. He creates an arbitrage portfolio with no wealth and no systematic risks. Considering his analysis, his arbitrage model that is indicated as an alternative model for the CAPM is formed. The approach of APT determines the asset values based on law of one price and no arbitrage. The model includes multi factors for asset pricing. On the other hand, APT has flexible assumptions in contrast to the CAPM, because the CAPM is a difficult model to test. The model is valid not only in equilibrium condition but also in disequilibrium situations. Moreover, market portfolio is not a special factor for the model.

As regards his analysis, the effect on the well-diversified portfolio of noise terms is assumed to become negligible by the law of large numbers for n. The assumption that investor has homogeneous expectations becomes weak in the arbitrage pricing model. By contrast with, the theory still requires homogeneous expectations and an agreement on the beta coefficient to get efficient results.

When Ross [49] formed The Arbitrage Pricing Theory (APT), the theory became an alternative for the widely known model (CAPM). After that, Roll and Ross [48] did an empirical research of the APT. The CAPM is based on a linear relationship with a single factor. On the other hand, the APT agrees with the institution behind CAPM without restricted assumptions. The APT does not require utility assumption other than monotonicity and concavity, the limitation about the number of the investment period (multiperiod or single period) and the market portfolio which is mean variance efficient. Moreover, there are two main differences between APT and Sharpe's CAPM. The first one is that APT allows more than one factor in the model and the second one is that there is a linear relationship between the asset's expected return and factor loadings because of the fact that the equilibrium condition can be satisfied with no arbitrage profit.

In order to make the empirical test, the data is taken from CRSP and includes daily returns between July 1962 and December 1972. The securities which are listed on NYSE are ranked alphabetically and divided into 42 groups. Roll and Ross divide their analysis into four parts. In the first part, a covariance matrix is calculated for each group. Second, the maximum likelihood estimation (MLE) method is used for determining the number of factors and matrix of loadings. After that, the estimation of factor loadings from the previous stage is used for determining the cross sectional variation of estimated expected returns. Finally, the cross sectional estimates are used to compute the size and statistical significance of the risk premium which is related to the estimated risk factors and these procedures are repeated for each groups. According to the study, APT is supported by the empirical data. There is enough evidence to conclude that there are at least three "price" factors for pricing. Moreover, there might be a fourth factor.

Another major step in the evaluation of the asset pricing comes from Fama and French [12]. Fama and French argue that factors other than β like size, leverage, earnings to price ratio (E/P) and book-to-market equity ratio have strong contribution to explaining the cross section of asset returns. The aim of Fama and French's research is to define the roles of these factors in asset pricing. Fama and French use all nonfinancial firms' data due to the leverage factor of financial firms. The data of the firms in the intersection of NYSE, AMEX and NASDAQ returns file and the merged COMPUSTAT annual industrial files of income statement and balance sheet data are used for the analysis. Both of them are taken from CRSP. The period of analysis is between 1962 and 1990. The cross-sectional regression approach of Fama Macbeth is used in the analysis. The factors except β are calculated definitely for individual stocks so there is no need for using portfolios in the regression of Fama and MacBeth. On the other hand, βs are estimated by portfolio formation method and assigned to individual stock in the portfolio. The data is divided into 10 size portfolios and then each of ten portfolios are subdivided into 10 portfolios based on pre-ranking βs for individual stock. As a result, 100 portfolios are created. Furthermore, Fama –MacBeth regressions are conducted by using different combinations of beta, book to market, size and leverage as explanatory variables of average returns.

As a result, the outcome of the analysis is not supported to Sharpe-Lintner- Black (SLB) model which defines the relationship between beta and average returns. Moreover, book to market equity is the most powerful explanatory variable for the cross section of average returns. Size (ME) and book to market equity (BE/ME) make basic and strong contribution to the cross sections of average returns for 1963-1990 period. Therefore, the combination of size and book-to-market equity reduces the effect of leverage and E/P in the cross section of stock returns.

Following year, Fama and French [13] extend their study and Fama French three factor model becomes clear in this study. There are three differences between this study and the earlier study of Fama and French [12]. Primarily, the U.S. government and corporate bonds are included in the study. Secondarily, they make extension about the set of variable used explanatory variables. While size and book to market which is related to the stocks are used as explanatory variables in Fama and French [12], term-structure variables which are important for explaining bond returns are included in this study. Moreover, the time series regression is used with the methodology of Black, Jensen, and Scholes [3] instead of Fama-MacBeth cross-sectional regression.

The explanatory variables are divided into two sets in accordance with being able to explain the variation in bond and stock returns. In the first group which is related to the bonds, there are term premium and default premium variables. In the second group, there are excess market return, size and market equity ratio. In the bond return, there is a common risk related to unexpected changes in interest rates and the proxy for this risk, TERM, is calculated by the difference between monthly long-term government bond taken from Ibbotson Associates and the one-month Treasury bill rates taken from CRSP and calculated at the end of the previous month. Another common risk is the shifts in economic conditions changing the probability of default for corporate bonds and the proxy for default risk, DEF, is calculated with the difference between return on a market portfolio of long-term corporate bonds and long-term government bond returns.

In order to calculate the size, available stocks in NYSE are ranked in June of each year t from 1963 to 1991 and the median NYSE size value is used for breakpoints to separate NYSE, Amex and NASDAQ (after 1972) stocks into two groups based on the market value (Small and Big). Next, independent of the former grouping, the available stocks are divided into three groups depending on the ranked book to market value. Moreover, the stocks that have the lowest 30% of BE/ME value ranks are labeled as Low (L) stocks, the middle 40% as Medium (M) and the highest 30% as High(H). In the final part, six portfolios (S/L, S/M, S/H, B/L, B/M, B/H) are obtained from the intersection of two sizes and three BE/ME portfolio groups. The monthly value weighted returns of six portfolios are computed for the time period between July of year t and June of year t+1 and the portfolios are reformed in June of year t+1.

The SMB factor defines the mimicking the risk factor in returns related to size and is the difference between the simple average of the returns on S/H, S/M and S/L portfolios and B/H, B/M, B/L portfolios. Moreover, the HML factor defines the mimicking the risk factor in returns related to book to market value and it is the difference between the simple average of the returns on B/H, S/H portfolios and B/L, S/L portfolios. After the calculation of independent variables, different portfolios are formed to calculate dependent variables. For bonds, two governments and five corporate bond portfolios are formed and their excess returns are used in time series regressions. For stocks, 25 portfolios are formed based on size and book to market value and their excess returns are used as an explanatory variable. After that time series regressions are conducted. According to the result, when TERM and DEF (bond factors) are used as explanatory variables, they have an explanatory power for the excess returns on both stock and bond portfolios. Moreover, when SMB, HML, and RM-RF (stock factors) are used as explanatory variables, they also have explanatory effect on the excess returns on both stock and bond portfolios. When all five portfolios are used as explanatory variables, it is observed that bond factors lose their effect for stock portfolios and vice versa.

Carhart [4] extends the Fama- French three factor model and includes momentum factor to the model. He conducts an analysis to examine the persistence in mutual fund performance. He also tries to define common and cost based factors for mutual fund persistence. He uses several sources for the data. He gets the data from Micropal/ Investment Company Data, Inc. (ICDI) for surviving fund and funds which have disappeared since 1989. Moreover, the data is taken for other non-surviving funds from FundScope Magazine, United Babson Reports, Wiesenberger Investment Companies, the Wall Street Journal and past printed reports from ICDI. His sample includes diversified equity funds monthly for January 1962- December 1993 period. Sector, international and balanced funds are excluded from the sample and the funds are divided into fund categories which are aggressive growth, long term growth, grow and income.

Carhart creates ten equally-weighted portfolios with reported returns at the beginning of each year. The reported returns include net operating expenses and security-level transaction costs. Furthermore, the top and bottom portfolios are subdivided into three parts. He forms 4-factor model with Fama and French's [13] 3-factor model plus an additional factor with Jegadeesh and Titman's [30] one year momentum anomaly. He estimates the performance of the CAPM, 3-factor and 4-factor models to make a comparison. The models are defined below:

$$r_{it} = \alpha_{iT} + \beta_{iT}VWRF_t + e_{it} \quad \mathrm{t} = 1,2,\ldots\ldots.,\mathrm{T}$$
$$r_{it} = \alpha_{iT} + \beta_{iT}RMRF_t + s_{iT}SMB_t + h_{iT}HML_t + e_{it} \quad \mathrm{t} = 1,2,\ldots\ldots.,\mathrm{T} \qquad (2.2)$$
$$r_{it} = \alpha_{iT} + \beta_{iT}RMRF_t + s_{iT}SMB_t + h_{iT}HML_t + p_{iT}PR1YR_t + e_{it} \quad \mathrm{t} = 1,2,\ldots\ldots.,\mathrm{T}$$

r_{it} : The return on a portfolio of the one-month T-bill returns

VWRF: Excess return on the CRSP value-weighted portfolio of all NYSE, Amex, and NASDAQ stocks

RMRF: Excess return on a value-weighted aggregate market proxy

SMB, HML and PR1YR*:* Returns on value-weighted, zero investment, factor-mimicking portfolios for size, book to market equity, and one-year momentum in stock returns

Carhart claims that considerable variations in returns can be defined by the 4-factor model when the performance of the model is tested. On the other hand, when a comparison is made between the CAPM, the 3-factor model, and the 4-factor model, it is seen that the 4-factor model considerably reduces the average pricing errors of the CAPM and the 3-factor model. The 4-factor model defines most of the spread and pattern in the formed portfolios rather than CAPM. Moreover, he also computes a cross sectional average for each decile portfolio's fund age, total net assets, expense ratio, turnover and maximum load fee to define the contribution of characteristics of mutual funds on performance. As a result, Carhart makes three suggestions for wealth-maximizing mutual fund investors. First of all, he says that an investor should avoid funds with persistently poor performance. The second suggestion is that funds with high returns last year have higher expected returns than average ones next year, but not in years thereafter. Finally, he suggests that the cost of expense ratios, transaction costs, and load fees are directly and negatively related to the performance.

2.3 The Third and Fourth Moments Model

On the other side, the CAPM of Sharpe [53] and Lintner [38, 39] are based on the first two moments of asset returns which are mean and variance. In mean and variance concept, the distribution of the asset returns is assumed to be normal and investor's utility function is also assumed to be quadratic. In the finance literature, researchers make critics about these assumptions so that the validity of CAPM becomes questionable. Several empirical tests of the CAPM indicate that the model is inadequate to explain variation of excess returns. When the returns are not normally distributed, the CAPM is failed. With respect to the empirical evidence, asset returns in emerging and developed markets have a skewed and leptokurtic distribution so that they are not normally distributed. Harris and Küçüközmen [21] indicate that the UK and US returns are not normally distributed for the time period between January 1979 and December 1999. There is also an evidence about the high degree of leptokurtosis for both the US and the UK returns and the UK returns seem negatively skewed. In the same year, Harris and Küçüközmen [22] also look into the empirical distribution of Istanbul Stock Exchange (ISE) for the time period between 1988 and 1998. Jarque-Bera and Kolmogorov-Smirnov statistics indicates that the returns in ISE are not normally distributed. If the returns are not normal, mean and variance are not enough to characterize the distribution of returns. For this reason, the higher comoments are taken into consideration by researchers. The third moment (skewness), the fourth moment (kurtosis), or higher components have been included to the asset pricing model and the multifactor models have been developed.

Kraus and Litzenberger [32] extend the capital asset pricing model by adding a systematic skewness on asset pricing in the US market. The extended theory is examined by the empirical test. The securities on NSYE between 1926 and 1935 are used. The 90-day Treasury Bills are used as a risk free asset. Moreover, the market index (M) is based on the average of the returns on all securities in his sample. The model tests whether there is a relationship between the realized mean deflated excess rates of return ($\bar{r_i}$) and ex post betas and gammas.
The created model is defined as below;

$$\overline{r}_i = b_0 + b_1\hat{\beta}_i + b_2\hat{\gamma}_i + u_i \qquad (2.3)$$

$\hat{\beta}_i$ (systematic standard deviation) denotes the estimates of beta on the *i*th risky asset portfolio. $\hat{\gamma}_i$ (systematic skewness) indicates the estimates of gamma on the *i*th risky asset portfolio. u_i is the error term. The estimates of beta and gamma are computed as below:

$$\hat{\beta}_k = \{ \sum_{t=1}^{T}(r_{Mt} - \bar{r}_M)(r_{kt} - \bar{r}_k)\}/\{\sum_{t=1}^{T}(r_{Mt} - \bar{r}_M)^2\} \qquad (2.4)$$

$$\hat{\gamma}_k = \{ \sum_{t=1}^{T}(r_{Mt} - \bar{r}_M)^2(r_{kt} - \bar{r}_k)\}/\{\sum_{t=1}^{T}(r_{Mt} - \bar{r}_M)^3\} \qquad (2.5)$$

In the analysis, a grouping method is used to form risk asset portfolios like BJS [3] and Fama MacBeth [14]. Securities are sorted according to both the beta and gamma estimates and 20 portfolios are formed. The cross-sectional regressions on beta are conducted according to the lending and borrowing rate. Moreover, the regressions of return on beta and gamma are conducted with the lending rate. The three moment capital asset pricing model predicts:

$b_0 = 0$, $b_1 > 0$, b_2 has the opposite sign of m_M^3 (third moment) and $b_1 + b_2 = E(\tilde{r}_M)$

The predictions of the three capital asset pricing model are consistent with the result of the regression analysis. According to the results, the intercept term ($\hat{b}_0$) is insignificant, while $\hat{b}_1$ is significant and positive. In addition, $\hat{b}_2$ is significant and negative (market index is positively skewed). On the other hand, the regression analysis is also conducted to examine the relationship between beta and gamma. The results of the analysis indicate that the there is a strong relation between gamma and beta so beta squared term is suggested rather than gamma to avoid collinearity problem. It is also seen that investors have aversions to variance and a preferences for positive skewness. As a result, when the skewness factor is added to the CAPM, there is a significant effect on the pricing model.

After three moment CAPM is introduced by Kraus and Litzenberger [32], researchers start to conduct empirical tests of the new model. First, Friend and Westerfield [17] test the study of Kraus and Litzenberger [32] which demonstrates the effect of coskewness as an additional explanatory variable in the CAPM with several comparison methods. They use different market portfolios and grouping methods in their analyses.

Several resources are used to create a market portfolio. In order to contain all common stocks, Standard & Poor's 500 Composite Index from 1947 to 1964 and NYSE Composite Index from 1964 to 1976 are used. On the other hand, the Salomon Brother's Total Performance Index from 1969 and 1976 and Moody's Composite Bond Index from 1947 to1968 are used to contain all corporate bonds. The U.S. Government bond index from 1947 to 1973 and Salomon Brother's government bond yields from 1974 to 1976 are also used to contain all long term marketable government issues. The weight of the market portfolio is defined annually according to the annual Federal Reserve Board Flow of Funds data on the market value of stocks and bonds held by the U.S individuals and financial institutions. Furthermore, one month Treasury return is used as a risk free asset.

Different market portfolios including both bonds and stocks together or stocks alone are formed for the analysis. Moreover, market portfolios are created based on both value-weighted index and equal-weighted index separately. They conduct their analyses both as individual assets and groups of assets. They also use predictive as well as contemporaneous measures of risk to see the difference between these conditions. For grouping, individual stocks are ranked based on beta and formed beta quintile. After that, 5 sub-groups based on coskewness within each quintile and 25 portfolios are created. They conduct their regression analyses based on the mentioned conditions. According to the result of the analysis, the findings are not consistent with Kraus and Litzenberger's study. Their research provides some but not definite proof for supporting the claims. The model created with the inclusion of coskewness to the CAPM is affected by different market indexes, sample period, testing and estimation method so that Kraus and Litzenberger's result is related to the sample time period and estimation procedures. Moreover, coefficients are affected by the expected market risk premium.

Second, Sears and Wei [49] try to define why the market risk premiums affect the empirical test of higher moment pricing model. When the additional explanatory variable (skewness) is included in the model created based on two-fund separation theory, the pricing model includes the market risk

premium in nonlinear form. If the nonlinearity situation is not noticed, misleading results about the test of model, the sign of variable and risk may occur.
Linear model of CAPM plus skewness is defined as:

$$\bar{R}_i - R_f = b_0 + b_1\beta_i + b_2\gamma_i \tag{2.6}$$
$$b_1 = [(\bar{R}_M - R_f)/(1 + K_3)];$$
$$b_2 = [K_3 (\bar{R}_M - R_f)/(1 + K_3)];$$

K_3 which equals b_2/b_1ratio, indicates the elasticity of the substitution between the risk of the standard deviation and coskewness. It is also observed that K_3 complement the measure of b_2 and extra information about the skewness concept are obtained from K_3 when it is not dependent on the effect $\bar{R}_M - R_f$.The examination of b_1, β_i,b_2, γ_i and joint effects of $\bar{R}_M - R_f$ and K_3 are conducted in the early studies but the ignorance of the interaction between $\bar{R}_M - R_f$ and K_3 causes the misleading results about the sign of risk and skewness. Moreover, Sears and Wei [51] try to examine the significance of b_2, K_3 which are the parameters of coskewness. As a result, b_2 is not significant for twelve subperiods while K_3 is significant for four subperiods.

After Sears and Wei [50], Lim [36] tests the Kraus and Litzenberger [32] three-moment capital asset pricing model by using Hansen's [20] generalized method-of-moments (GMM). The GMM is a convenient method to test the K-L model due to not requiring strong distributional assumptions on the returns of asset. It also prevents measuring error problems and obtains more efficient estimators.

The monthly stock return data is obtained from CRSP between 1933 and 1982. The U.S Treasury bill is used as a risk free asset. The equal weighted index of NYSE is also used as a market portfolio. Ten equally weighted portfolios are formed. First, beta and gamma values are estimated and the stocks are ranked based on the beta and gamma. After that the stocks are allocated with the highest 10 percent beta and gamma values to the first portfolio and the second 10 percent beta and gama values to the second portfolio. These procedures are repeated up to the 10th portfolio. The time period between 1933 and 1982 is divided into 5 year subperiods. The entire period of the model and subperiods are tested separately. The GMM estimates and the related test statistics are provided. According to the analysis, it is seen that coskewness with the market is preferred by investors when market returns have a positive skewness. Otherwise, investors do not prefer coskewness with the market. As a result, the analyses support some evidence that skewness is priced in the market. It is considered that this result is consistent with the findings of Kraus and Litzenberger [32] and Sears and Wei [50].

Lee et al. [35] also tries to look through the role of coskewness in the asset pricing with the multivariate testing method created by Gibbons [18]. Early studies using cross sectional regression method do not examine share restrictions so this ignored part is also tested. The monthly returns from CRSP files are used. The sample period is between 1941 and 1985. 3- month Treasury Bill taken from the Federal Reserve Bulletin is used as a risk free asset. First, $\hat{\beta}_i$ is computed and firms are ranked in terms of the beta values. The ranked firms are divided into five groups. Each group is also divided into five subgroups based on $\hat{\gamma}_i$ and 25 portfolios are formed. After that the following regressions are conducted and the related hypotheses are formed:

$$R_{it} - R_{ft} = c_i + [b_\beta \hat{\beta}_{it} + b_\gamma \hat{\gamma}_{it}](R_{mt} - R_{ft}) + \varepsilon_{it} \quad i = 1, \dots ,25 \quad t = 1, \dots, 60 \quad (2.7)$$

$$b_\beta = [1/(1 + K_3)];$$

$$b_\gamma = [K_3/(1 + K_3)];$$

Four hypothesis are created for testing in the analysis:

Hypothesis 1: Coskewness and /or covariance play no roles in the asset pricing by testing that γ share is equal to zero.

H_o: b_γ= 0 and H_o: b_β= 0

Hypothesis 2: Theoretical validity of equation by testing the share restriction.

H_o: $b_\gamma + b_\beta$= 1

Hypothesis 3: No abnormal returns by testing that the intercept term are zero.

H_o: c_i= 0

Hypothesis 4: The elasticity of substitution between covariance and coskewness risk equals zero.

H_o: K_{3i}= 0

For analysis, seemingly unrelated regression method (SUR) is used. As a result, the share restriction hypothesis is rejected. It is regarded that the covariance and coskewness risk is statistically significant. However, when the comparison is made based on the size of the coefficient, the coskewness risk has a small effect on the pricing rather than the covariance risk. Moreover, the hypothesis of the intercept term defining the abnormal return is rejected and this result indicates that Kraus and Litzenberger [32] model does not seem sufficient to describe the pricing behavior of risky asset.

In 1997, the empirical performance of the global conditional three-moment CAPM is researched by Nummelin [45]. The monthly Finnish stock market data is used for the analysis. The sample period is between 1987 and 1995. The generalized method of moments (GMM) is conducted for the estimation. As a result, it is considered that the conditional version of the global three moment-

CAPM has a good performance. Moreover, global coskewness has an effect on the cross section of expected returns.

Unlike Kraus and Litzenberger [32] and Lim [36], Harvey and Siddique [23] examine the effect of the inclusion of conditional skewness to the asset pricing model in order to realize the cross sectional variation in asset returns. Nonlinear multi-factor model is also used in their analysis. Monthly the U.S. equity returns from CRSP NYSE/AMEX and NASDAQ files are used. Their sample period is between July 1963 and December 1993. CRSP NYSE/AMEX value-weighted index is used as the market portfolio. Moreover, the SMB and HML hedge portfolios created by Fama and French is used to examine the impact of the size and book to market value. Five different portfolio groups are formed to make a comparison. First, 32 value-weighted industry portfolios are formed. The second group includes 25 portfolios which are formed on the size and book to market value. The third set contains 10 portfolios which are formed on the size deciles. Finally, 27 portfolios are created based on size, book to market value and momentum.
The direct measure of coskewness (β_{SKD}) is computed as below:

$$\hat{\beta}_{SKDi} = \frac{E(\varepsilon_{i,t+1}\varepsilon^2_{M,t+1})}{\sqrt{E(\varepsilon^2_{i,t+1})}E(\varepsilon^2_{M,t+1})} \tag{2.8}$$

The standardized direct coskewness for individual securities in NYSE/AMEX and the NASDAQ files are computed. After that, the stocks related to their past coskewness are ranked and three value weighted portfolios are formed for the analysis. S^- indicates the return on portfolio which includes 30 percent of the stocks with the most negative skewness. S^0 represents the middle 40 percent. S^+ also indicates the return on the portfolio which includes 30 percent with the most positive coskewness. Moreover, β_{SKS} which is computed by the regressing the portfolio excess return against the spread between the return on S^- and S^+ portfolios is defined. Furthermore, β_{S^-} defining the coskewness of an asset from its beta with the excess return on the S^- portfolio is computed. Cross Sectional Regression (CSR) and Full Information Maximum Likelihood Method (FIML) are used to test different portfolio sets. It is seen that Fama French three factor model is better than the CAPM based on R^2 in the analysis with CSR and FIML. Moreover, when the skewness factor is added to the CAPM and three factor model separately, the value of R^2 increases. Although R^2 increases in both models, the increase of R^2 value for the CAPM is more than the increase of R^2 value for 3 factor model. On the other hand, it is seen that SMB and HML have similar affects with skewness to capture information. Besides, the addition of the skewness factor to the three factor model reduces the Gibbons-Ross-Shanken F-statistic which is used to test the significance of the intercept term. As a result, there is some evidence that coskewness is important for explaining the cross section of asset returns. It is also seen that the momentum effect has a relation with the systematic skewness. In addition, the winner portfolio has a lower skewness than the loser portfolio.

In 2003, Harvey and Siddique's study [23] is repeated for the Taiwan market. Lin and Wang [37] try to examine the effect of the systematic skewness on the asset pricing for the Taiwan stock market which is the emerging market. They use only Fama French three factor model as the base model because the CAPM is not used for the significant pricing bias. The monthly returns of 132 securities which are listed on the Taiwan Stock Exchange are used. The sample period is defined between 1986 and 2000. The price of 30-day commercial paper which is traded in the secondary market is used as a risk free asset. The market portfolio is computed with the TAIEX which is the value weighted stock index.

The portfolios are formed according to the industry, size, momentum and both size and book to market value as Harvey and Siddique's work [23]. The analysis of Harvey and Siddique [13] is repeated and the similar result is obtained. When the skewness factor is added to the three factor model, the Gibbons-Ross-Shanken F-test statistic decreases and the value of R^2 increases. It is also seen that the systematic skewness is related to the size effect. On the other hand, according to the analysis, it is realized that the momentum strategies are suitable for longer periods in the Taiwan stock market. Additionally, the winner portfolio has a lower skewness than the loser portfolio and this result is consistent with Harvey and Siddique [23]'s work. As a result, the systematic skewness has an additional effect on the asset pricing.

After the study of Lin and Wang [37], Adesi, Gagliardini, and Urga [1] examine the portfolio coskewness by using a quadratic market model. In their analysis, they take the market coskewness into account and test its contribution in asset pricing models. The monthly returns of stocks in NYSE, AMEX, and NASDAQ are used. The sample period is between 1963 and 2000. The value weighted return on all NSYE, AMEX and NASDAQ is used as the market return. In addition, the 1-month Treasury bill rate of return from Ibbotson Associates is used as the risk free return.10 portfolios are formed based on the size.

The quadratic model is the extended version of the CAPM. It is defined as below:

$$r_t = \alpha + \beta r_{M,t} + \gamma q_{M,t} + \varepsilon_t, \quad \mathrm{t} = 1 \ldots\ldots\ldots\ldots \mathrm{T} \tag{2.9}$$

$$r_t = R_t - R_{F,t} \;;$$

$$r_{M,t} = R_{M,t} - R_{F,t} \;;$$

$$q_{M,t} = R_{M,t}^2 - R_{F,t} \;;$$

In this model, the square of the market returns is added to the CAPM which is a traditional market model. Pseudo Maximum Likelihood (PML) methods, restricted equilibrium models, Asymptotic Least Squares (ALS) statistic, Seemingly Unrelated Regressions (SUR), and Monte Carlo simulation method are used in the analyses. As a result, the coefficient of coskewness is statistically significant. According to the analysis, there is a correlation between the size and the coskewness. While the small size portfolios have negative coskewness with the market, large size portfolios have positive coskewness. These results are consistent with the study of Harvey and Siddique [23].The size factor has an abnormal effect on the cross section of expected returns because it is a proxy for neglected coskewness.

Moreover, Smith [54] examines the roles of conditional skewness in asset pricing. It is known that mean-variance efficient pricing models like CAPM require returns which have a normal distribution. Otherwise, quadratic utility is required. It is observed that returns are not normally distributed and investors are not interested in quadratic utility due to the requirement of the increasing absolute risk from investors. Therefore, new models are needed to solve the mentioned problem. The three moment CAPM is created with the inclusion of the skewness factor. Moreover, there are several unconditional tests of this model. It is realized that if the model holds conditionally, unconditional tests are not suitable so Smith prefers a conditional analysis.

17 value-weighted industry portfolios are formed and their returns are taken from Ken French's Website. His sample period is between 1963 and 1997. In the analysis, GMM by Hansen [20] and J_t test which is a goodness of fit test are used in the analysis. First, while the conditional two moment CAPM is rejected, the conditional three-moment CAPM is not rejected. Second, it is seen that although a small positive risk premium for coskewness when returns are negatively skewed is demanded by investors, they want a large negative premium when returns are positively skewed. Moreover, the analyses are also conducted for the multifactor models and the conditional skewness is added to these models as a factor. As a result, the addition of the coskewness to the Fama French three factor model does better than both three moment CAPM and only three factor model.

In 2009, the study of Harvey and Siddique [23] is repeated for Istanbul Stock Exchange (ISE) case. Mısırlı and Alper [42] examine the effect of coskewness on asset pricing for ISE which is the emerging market with the methodology of Harvey and Siddique [23]. This is the first study to analyze the explanatory power of coskewness for ISE. The monthly return of 194 securities which is traded on ISE is used. The sample period is defined from July 1996 to December 2005. The daily average of the overnight interbank rate is used as a risk free asset. The market portfolio is computed with the value weighted stock index of all stocks. The time period between July 1996 and June 1999 (36 months) are used for running time series regression, estimate the beta with the methodology of Fama MacBeth and design coskewness portfolios. Besides, the time period between July 1999 and December 2005 is used for empirical testing.

The portfolios are formed according to the industry, size, momentum and both size and book to market value as Harvey and Siddique's study [23]. The analysis of HS is repeated. CAPM and Fama French 3 factor model are tested by Gibbons-Ross-Shanken F-test [17]. After that coskewness is included in the CAPM and Fama French 3 factor model and the time series and the cross sectional regressions are conducted. According to the result of the analysis, coskewness has a significant effect on the CAPM, especially for size portfolios. Coskewness also has an explanatory power over the CAPM for industry portfolios but its effect is not as high as the size portfolios. Moreover, the coskewness factor does not have a significant effect over Fama French 3 factor model.

After the extension of the CAPM with the inclusion of skewness factor, Fang and Lai [15] added the kurtosis factor to the three moment CAPM and formed the four moment CAPM. Fang and Lai research the effect of cokurtosis on the asset pricing model and test the four moment CAPM There are several assumptions related to the model. Initially, there is a limited liability for all assets. There is a capital market which is perfect and competitive with no taxes, transaction costs, and indivisibility. Investors have homogeneous expectations about the return on the stock. The last assumption is that every investor wants to maximize the expected utility.

The stocks which are listed on the NYSE are used between January 1969 and December 1988. The data is taken from CRSP monthly return file. The U.S Treasury bills are used as a risk free rate. The value-weighted NYSE composite index is also used as the market portfolio.
The linear empirical type of the four moment CAPM is defined as below:

$$\bar{R}_i - R_f = b_1\beta_i + b_2\gamma_i + b_3\delta_i, \quad \text{i} = 1 \ldots\ldots\ldots\ldots n \qquad (2.10)$$

$\bar{R}_i$: The expected rate of return for ith risky asset,

β_i: It indicates the systematic variance, Cov $(R_i R_m)$ /var (R_m),

γ_i: It indicates the systematic skewness, Cov $(R_i R_m^2)$ $/E[(R_m - E(R_m))^3]$,

δ_i: It indicates the systematic kurtosis, Cov $(R_i R_m^3)$ $/E[(R_m - E(R_m))^4]$,

b_1, b_2, b_3: They indicate the market risk premium

According to the theory, $b_1 > 0 \; and \; b_3 > 0, b_2$ has an opposite sign with the market skewness. The securities are divided into three groups based on beta estimates. Next, each group is divided into three sub-groups based on coskewness estimates. Finally, these subgroups are again divided into three groups based on cokurtosis estimates and 27 portfolios are formed. The Ordinary Least Squares (OLS) method is used for estimation of risk premiums but the errors-in-variable problem affects the estimation. Instrumental variable estimation is used to prevent this problem. The estimations are conducted for the two-moment CAPM, the three-moment CAPM, the four moment CAPM, and the regression with only beta and cokurtosis. According to the analysis, it is seen that b_0 is statistically different from zero for two and three moment CAPMs. Moreover, b_2 is insignificant so that systematic skewness is not priced for the three moment CAPM. These results are consistent with the study of Friend and Westerfield [17] and Sears and Wei [51]. On the other hand, when the cokurtosis is added to the three moment CAPM, adjusted R^2 increases. The risk premiums for covariance (b_1) and coskewness (b_3) is significant for all of the three periods and their signs are consistent with the expectations. The risk premiums are positively correlated with variance and kurtosis so that investors do not prefer higher variance and kurtosis. Whereas the intercept term (b_0) is insignificant for two periods, the risk premium (b_2) is significant for two periods. The coefficient of skewness has an opposite sign with the market skewness. It indicates that expected rate of return is negatively correlated with skewness and investor demand higher expected return for the assets which are negatively skewed to compensate for their risk. As a result, investors demand higher expected return for higher systematic variance and systematic kurtosis. On the other hand, they demand lower expected returns for higher systematic skewness.

After Fang and Lai [15], Dittmar [8] studies nonlinear pricing kernels to define cross sectional variation in equity returns. According to his article, a linear pricing kernel relates expected returns to covariance with the return on aggregate wealth like in the CAPM. A quadratic pricing kernel relates to the expected returns to covariance with the return on aggregate wealth and its squared like three moment CAPM. A cubic pricing kernel also looks like the four-moment CAPM. In the analysis, 20 industry-sorted portfolios and Hansen-Jagannathan distance measure are used. According to the analysis, the nonlinear pricing kernels perform better than linear single-factor pricing kernel and Fama- French linear multifactor model. As a result, nonlinear pricing kernels improve the ability of the describing of the cross section of the returns.

In 2003, Chiao, Hung, and Srivastava [5] analyzed both unconditional and conditional four moment CAPM and also the risk-return characteristics of the Taiwan stock market and tested the four moment asset pricing model. The daily return data on individual stock taken from the Taiwan Economic Data Center is used for the analysis. Their sample period is between January 1964 and December 1998. The returns on TAIEX are used as a market portfolio. Moreover, a value-weighted average of all Taiwan banks' 1-month deposit rates is used as a risk free rate. The first 5-year of the data is used for the estimation of covariance, coskewness, and cokurtosis risks. The data is divided into four 5-year subperiods for the analysis of the unconditional CAPM and divided into three overlapping 10-year subperiods for the analysis of the conditional four-moment CAPM. First, they test the asymmetry of return distributions with the Wilcoxon rank-sum test. It is found that the Taiwan stock market return is not symmetric. After that, the persistence of skewness and excess kurtosis is examined and it is seen that they exist and persist over time. According to these results, the model (CAPM) is extended by including the coskewness and cokurtosis. The two, three, and four-moment unconditional CAPM are tested but the results are not efficient to make a conclusion. According to Pettengill et al. [47], the unconditional CAPM do not capture the relationship between beta and return due to the contradiction between ex-ante (expected) return and ex-post (realized) return especially when the risk free rate is higher than the realized market return. For this reason, the conditional four moment CAPM which is separated into up $(R_{mt} > R_f)$ and down $(R_{mt} < R_f)$ market conditions is used to examine the risk-return relation of the market. After the reexamination, it is regarded that the conditional CAPM perform better than the unconditional CAPM. Specially, the test result of the up market conditions is consistent with the expected results. As a result, coskewness and cokurtosis have an effect on the asset pricing and investors prefer positive skewness and negative kurtosis.

Although a number of studies which have tested the higher co-moments for the US market, there is little work related to the other countries. Hung et al. [27] investigate the factors explaining the cross section of the UK stock returns and examine the effect of higher co-moments in stock returns. Their study is one of the first study containing the higher co-moments for the UK context. The UK stock returns and the 90-day Treasury bill rate are taken from the London Share Price Database 2000. The sample period is between January 1975 and December 2000. The returns are sorted according to beta values, size, and book to market value separately and formed 10 equally-weighted portfolios for each case. First, time series regression is conducted with the model for estimation as below:

$$R_{dt} = \alpha + \beta\left(R_{mt} - R_{ft}\right) + \gamma(R_{mt} - R_{ft})^2 + \delta(R_{mt} - R_{ft})^3 + sSMB_t + hHML_t + \xi_t \quad (2.11)$$

After that, dummy variables which are the methodology of Pettengill et al. [44] are used to separate up and down markets as below:

$$R_{Pt} - R_{ft} = \eta_0 + \eta_\beta{}^{\pm} D^{\pm} \beta_p + \eta_\gamma{}^{\pm} D^{\pm} \gamma_p + \eta_\delta{}^{\pm} D^{\pm} \delta_p + \varepsilon_p \quad (2.12)$$

According to this model, the cross section regression is conducted to beta, size, and book to value sorted portfolios separately. As a result, it is seen that beta is significant in explaining the UK stock returns. Fama French three factors are also significant and they increase the value of the adjusted-R^2 when it is added to the model but coskewness and cokurtosis do not have an effect on the explanatory power of the model. This analysis indicates that non-linear market model has a limited support to the effect of higher order moment.

After the study of Hung et al. [27] for London Stock Exchange, Lajili [33] investigates the effect of the size and book to market on explaining the stock returns with coskewness and cokurtosis for the French Stock Market. The sample period is between July 1976 and June 2001. All French stocks with the relevant DataStream data and their monthly returns are used. Primarily, the three factor model regression is conducted. After that, the methodology of Harvey and Siddique [23] is conducted to form the mimicking portfolios of coskewness and cokurtosis. The coskewness and cokurtosis are computed as defined below:

$$\varepsilon_{i,M} = \frac{E\left(\left(R_i - E(R_i)\right) \times \left(R_M - E(R_M)\right)^2\right)}{\sigma_i \sigma_M^2} \tag{2.13}$$

$$\kappa_{i,M} = \frac{E\left(\left(R_i - E(R_i)\right)^2 \times \left(R_M - E(R_M)\right)^2\right)}{\sigma_i^2 \sigma_M^2} \tag{2.14}$$

For coskewness portfolios, the two portfolios of positive coskewness (CSP) and negative coskewness (CSN) are used as explanatory variables. For cokurtosis portfolios, the two portfolios of low cokurtosis (CKF) and high cokurtosis (CKE) are used as explanatory variables. The time series regression of the three factor, coskewness, and cokurtosis is conducted as below:

$$R_i - R_f = \alpha_i + \beta_i\left(R_M - R_f\right) + s_i SMB + h_i HML + \kappa_i^- CKF + \kappa_i^+ CKE + \varepsilon_i^- CSN + \varepsilon_i^+ CSP + \epsilon_i \tag{2.15}$$

Next, the new type of portfolios is formed due to the high correlation between the market portfolio and the four portfolios of coskewness and cokurtosis. The new type of portfolios indicates the portion of portfolios of coskewness and cokurtosis orthogonal to the market portfolio. The time series regression of the three factor and coskewness is conducted as below:

$$R_i - R_f = \alpha_i + \beta_i\left(R_M - R_f\right) + s_i SMB + h_i HML + \varepsilon_i^- CSN^{\perp} + \varepsilon_{\mathrm{i}}^+ CSP^{\perp} + \epsilon_i \tag{2.16}$$

As a result, when only coskewness factor is added to three factor model, it is seen that coskewness portfolios do not develop the outcomes and do not add any additional explanation of time series variation of returns. Moreover, the relationship between size and book to market and returns do not change by the inclusion of coskewness. When coskewness and cokurtosis factors are added to the three factor model, it is seen that coskewness and cokurtosis portfolios do not add any additional explanation of time series variation of returns. There are also no changes for the relationship between size and book to market and returns. Finally, an interesting result is obtained. The comoment of order three (four) can be assigned to big (small) capitalizations.

In the following years, the finance literature has been continued to record the studies related to the effect of higher comoments on the asset pricing model for different countries. Messis, Iatridis, and Blanas [41] analyze the CAPM and the higher moment CAPM to define the performance of the stocks on Athens Stock Exchange. They test the four hypothesis in the study as defined below:

H_1 : There is unrestricted borrowing and lending at a unique risk free rate (Sharpe-Lintner hypothesis) so that $E(\gamma_{0t}) = 0$ in the defined equation:

$$\overline{R_{\iota t} - R_f} = \overline{\gamma_{0t}} + \overline{\gamma_{1t}}\beta_i + \overline{\gamma_{2t}}SKW_i + \overline{\gamma_{3t}}KUR_i + \overline{e_{\iota t}} \tag{2.17}$$

H_2 : The risk premium is positive and equal to the average excess return of the market portfolio. It indicates that $E(\gamma_{1t}) = E(R_{mt}) > 0$ in the defined equation:

$$\overline{R_{\iota t} - R_f} = \overline{\gamma_{0t}} + \overline{\gamma_{1t}}\beta_i + +\overline{e_{\iota t}} \tag{2.18}$$

H_3 : The distribution of the asset return is symmetrical, while skewness is (not) priced in the defined equation:

$$\overline{R_{\iota t} - R_f} = \overline{\gamma_{0t}} + \overline{\gamma_{1t}}\beta_i + \overline{\gamma_{2t}}SKW_i + \overline{e_{\iota t}} \tag{2.19}$$

H_4 : The distribution of the asset return is symmetrical, while kurtosis is (not) priced in the defined equation:

$$\overline{R_{\iota t} - R_f} = \overline{\gamma_{0t}} + \overline{\gamma_{1t}}\beta_i + \overline{\gamma_{3t}}KUR_i + \overline{e_{\iota t}} \tag{2.20}$$

First, the beta coefficients are estimated by the OLS regression in order to test the hypothesis. Then, the estimated beta coefficients are regressed against the average excess returns. 17 securities which are listed on the Athens Stock Exchange are used in the study. The sample period is between January 2001 and December 2005. The 3-year Treasury bill is used as a risk free rate.

According to the analysis of the second equation (first and second hypothesis), the intercept term is insignificantly different from zero and the result is consistent with the Sharpe-Lintner hypothesis. There is a positive and insignificant risk premium with respect to the second hypothesis. When the skewness factor is added to the model, it is seen that it has a positive sign (the opposite of market skewness) and a significant effect. Besides, when the kurtosis factor is added to the model, it is considered that kurtosis has a negative sign and an insignificant effect. There is a contradictory with the expectations. After that, the OLS regression is conducted to the individual stocks and it is seen that the securities are affected by the both the skewness and kurtosis. Finally, the Theil's U^2 test is carried out to test the CAPM and the higher moment CAPM. As a result, the higher moment CAPM is significantly better than CAPM according to the Theil's U^2 test.

In 2007, Iqbal, Brooks, and Galagedera [28] examined the effect of the higher comoments on the asset pricing model in the emerging market and compare the performance of Fama French factor with the higher comoments market factors. The multivariate test of Adesi, Gagliardini, and Urga [1] for arbitrage pricing with coskewness is extended by the addition of cokurtosis in this study. In the analysis, the multivariate methodology is used for the estimation of the cubic market model which prevents error invariables problem and multicollinearity. The samples of stocks traded on the Karachi Stock Exchange (KSE) are used in the study. The KSE 100 index and 30-day repurchase option rate are used as the market portfolio and the risk free rate separately. Moreover, seventeen equally weighted size portfolios which are ranked based on size, seventeen beta portfolios which are ranked based on beta values and industry portfolios are formed. It is seen that while the cokurtosis has an explanatory effect, the coskewness is not significant in cubic market equation either unrestricted or having the arbitrage pricing restrictions. For making a comparison between the Fama French factor and the higher-comoments factor, the non-nested test, the goodness of fit test and checking of pricing errors are conducted. It is seen that Fama-French factors have a better performance than higher comoments factors for explaining the variation in portfolio returns in all three types of portfolios. On the other hand, according to the goodness of fit test of unrestricted seemingly unrelated regression equation, the model which contains three moment factors is better than the CAPM with skewness and the CAPM with kurtosis.

In 2009, Javid [29] also analyzed the effect of the higher comoments for Karachi Stock Exchange (KSE) with a different methodology. He examines the conditional and unconditional higher-moment CAPM. The data of 50 firms whose stocks are traded on KSE is used in the study. The sample period is between January 1993 and December 2004. The KSE 100 index and six month treasury-bill rates are used as the market portfolio and the risk free rate respectively. According to the summary statistics, the returns are positive, volatile, asymmetric and fat tailed. First, the adequacy of the CAPM is tested but the model does not seem enough. The validity of the CAPM and the higher moment CAPM are researched by the Fama-MacBeth method and corrected with the Shanken adjustment factor. Moreover, the conditional two moment, three moment and four moment CAPM are conducted. According to the analysis of the unconditional CAPM, while the cokurtosis has a limited effect on the expected return, the skewness has an important role. These results are consistent with the Kraus-Litzenberger theory and Messis et al. [41]. On the other hand, the result for the conditional higher moment CAPM indicates that the covariance and cokurtosis have limited effects like as the unconditional part and the conditional coskewness seems important for returns. This result is consistent with Harvey and Siddique [23].

In a series of related work, Doan, Lin and Zurbruegg [11] examine the effect of higher moments on explaining the variation of stock returns for the firms which is listed on S&P US and Australian indices with Fama French [13] 3-common risk factors and the Jegadeesh and Titman [30] momentum effect. The effect of co-skewness and co-kurtosis for the Australian and US stock market is tested to make a comparison. All securities in the Australian S&P ASX 300 and the US S&P 500 indices are used in the analysis. While the sample period for Australian data is between January 2001 and July 2007, the data period starts from January 1992 to July 2007 for the US. The 90-day bank bill for Australia and the 30-day Treasury bill rates of the US are used as the risk free rate. Moreover, the portfolios are formed according to the Fama and French method. First, the data is divided into 5 groups according to the size. After that, each group is divided into 5 sub-groups based on book to market and 25 portfolios are formed. In the first part of the analysis, the summary statistics of the portfolios namely mean, standard deviation, unconditional skewness, and excess unconditional kurtosis are computed and Jarque-Bera test is conducted to check the normality. According to the Jarque-Bera test, the normality hypothesis is rejected. Furthermore, it is seen that the returns for the Australian data is more asymmetric but less leptokurtic. On the other hand, the returns for the US data are less asymmetric but more leptokurtic. In this study the coskewness and cokurtosis factors are calculated according to the formulas as follows:

$$Coskewness = \frac{E[(R_i - \bar{R}_i)(R_m - \bar{R}_m)^2]}{\sqrt{E[(R_i - \bar{R}_i)]^2} E[(R_m - \bar{R}_m)]^2} \tag{2.21}$$

$$Cokurtosis = \frac{E[(R_i - \bar{R}_i)^2(R_m - \bar{R}_m)^2]}{E[(R_i - \bar{R}_i)]^2 E[(R_m - \bar{R}_m)]^2} \tag{2.22}$$

After that, the stocks are ranked depending on coskewness (cokurtosis) and distributed to the five quintile portfolios. The first quintile portfolio includes the stocks with the lowest coskewness (cokurtosis) value and the last quintile portfolio includes the stocks with the highest coskewness (cokurtosis) value. The return premium is obtained from the difference between the return of highest coskewness (cokurtosis) and lowest coskewness (cokurtosis) portfolio.

In the second part of the analysis, the regression analysis with the coskewness and cokurtosis factors is conducted to examine the sensitivity of excess portfolio returns. As a result, while the coskewness has more significant role in explaining the Australian returns, the cokurtosis is more effective on the returns of the US. After that, the multivariate regression analyses are conducted. The coskewness and cokurtosis effects are added to the CAPM, Fama French 3 factor model and Carhart’s model. It is seen that the inclusion of coskewness to in the Fama and French 3 factor model improves the performance of the model and it also becomes better than the three moment

CAPM. Moreover, the addition of Fama French 3 factors and momentum to the model with the higher comoments develops the explanatory ability of the model and it is observed that higher comoments help to explain the variation which is not explained by other factors.

Doan [10] and Lin [37] extend Doan et al. [11]'s study and examine the effect of the systematic skewness and the systematic kurtosis on Australian stock markets. In the previous study, there is a failure about taking the errors in variables (EIV) problem into account. For this reason, the Dagenais and Dagenais higher moment estimators (DDHM) are used in this study. The weekly returns of securities which are listed on the Australia Stock Exchange (ASX) are used in the analysis. The sample period is between January 1992 and May 2009. The ASX 300 stock index and the 90-day bank-accepted bill rate are used as the market portfolio and risk free rate separately. The stocks are ranked based on systematic skewness and kurtosis and 25 portfolios are formed. First, the summary statistics are computed and the Jarque-Bera test to check the normality. It is seen that the normality hypothesis is rejected and they suggest that the inclusion of the systematic skewness and kurtosis can help for explaining the returns due to this reason. Moreover, the Fama and MacBeth regression method is used for the analysis. On the other hand, the Fama and MacBeth [14] two-pass methodology creates EIV problem so DDHM is used to correct this problem. According to the analysis, systematic skewness and kurtosis seem important for explaining the variation in returns. Although using DDHM estimator to solve the EIV problem reduces the significant of the factors, it does not change their effects and overall results. Furthermore, it is seen that the systematic skewness has more powerful effect than systematic kurtosis in the Australian stock market. On the other hand, it is observed that beta has weaker effect on the variation of stock returns and the significance of beta is affected by the DDHM estimator in a negative way. As a result, the higher moment factors have more robust result than beta when the correction is conducted. The results also show that there is a strong correlation between beta and the systematic kurtosis which takes place of beta when there is a heavy tailed distribution.

After the studies of Doan [10], Kostakis, Muhammad, and Siganos [31] investigate the application of the asset pricing for investors' preference regarding skewness and kurtosis in London Stock Exchange. They test that a risk-averse investor demands a higher risk premium when returns have negative coskewness or positive cokurtosis. The shares which listed on London Stock Exchange (LSE) are used in the study. The analysis is conducted during the period 1986-2008. They use the methodology of Harvey and Siddique [23] for the estimation of coskewness and cokurtosis at given month t. The CAPM regression is used to get the residuals $\varepsilon_{i,t}$. In addition, $\varepsilon_{m,t}$ is difference between excess market return for month t and the average value over the corresponding window of observation t-60 to t:

$$R_{i,t} - R_t^f = \alpha_i + \beta_{i,MKT}\left(R_{m,t} - R_t^f\right) + \varepsilon_{i,t} \tag{2.23}$$

After that, CSK_i and CKT_i are computed as below:

$$CSK_i = \frac{E[\varepsilon_{i,t}\varepsilon_{m,t}^2]}{\sqrt{E[\varepsilon_{i,t}^2]}E[\varepsilon_{m,t}^2]} \quad \text{and} \quad CKT_i = \frac{E[\varepsilon_{i,t}\varepsilon_{m,t}^3]}{\sqrt{E[\varepsilon_{i,t}^2]}E[\varepsilon_{m,t}^3]} \tag{2.24}$$

After CSK and CKT values for each stock *i* and each month *t*, the decile portfolios which are ranked with respect to standardized CSK and CKT separately are formed. It is seen that the portfolio which has the most negatively coskewed shares (P1) obtains higher average return than the portfolio which has the most positive coskewed shares (P10). These results are consistent with the outcome of Harvey and Siddique [23] for the US market. The rational investors demand premium for negatively coskewed stock returns while they accept lower return for positively coskewed returns. On the other hand, while investors demand premium for higher cokurtosis value of stock returns, they accept lower return for lower cokurtosis value of stock returns. Alpha values of value-weighted coskewness and cokurtosis portfolios are obtained for the CAPM, Fama French, and Carhart. It is observed that while there is a positive alpha in the most negatively coskewed returns, there is a negative alpha in the most positively coskewed returns. On the other hand, while there is a negative alpha value in the highest cokurtosis returns, there is a positive alpha value in the lowest cokurtosis returns. These findings support that coskewness and cokurtosis are priced on LSE. After that cross sectional regression for coskewness and cokurtosis portfolios are conducted with the methodology of Fama MacBeth. As a result, it is seen that commonly used models which are the CAPM, the Fama-French model cannot explain the cross-sectional variation of the CSK and CKT portfolio returns so they decide to examine the explanatory power of coskewness and cokurtosis. The %20 of the stocks with the most negative CSK(CKT) estimated values are assigned to the portfolio which is defined $S^{-}(K^{-})$ and the %20 of the stocks with the most positive CSK(CKT) estimated values are assigned to the portfolio which is defined $S^{+}(K^{+})$. Coskewness factor is described as a spread return $(S^{-} - S^{+})$ and the cokurtosis factor is described as the spread return $(K^{-} - K^{+})$.

First, the coskewness and cokurtosis risk factors are estimated with the equation as defined below:

$$\begin{aligned} R_{p,t} - R_t^f = \alpha_p + \beta_{MKT}\left(R_{m,t} - R_t^f\right) + \beta_{S^{-}-S^{+}}(S^{-} - S^{+})_t \\ + \beta_{K^{+}-K^{-}}(K^{+} - K^{-})_t + \varepsilon_{p,t} \end{aligned} \tag{2.25}$$

After the estimation of the factor loadings, the risk premium of coskewness and cokurtosis are estimated with the equation as defined below:

$$R_{p,t} - R_t^f = \lambda_0 + \lambda_{MKT}\hat{\beta}_{MKT} + \lambda_{S^- - S^+}\hat{\beta}_{S^- - S^+} + \lambda_{K^+ - K^-}\beta_{K^+ - K^-} + w_{p,t} \quad (2.26)$$

As a result, it is seen that the higher co-moment asset pricing model have a significant explanatory power in the cross section of the CSK and CKT portfolio returns.

In the same year, Heaney et al. [25] examine the effect of coskewness and cokurtosis on the asset pricing. They also test whether the CAPM with the higher moments can be alternative for the effect of size and book to market on the asset pricing. The data which is the monthly returns of all the US firms between January 1958 and December 2010 is taken from the CRSP NYSE/AMEX/NASDAQ files. The NYSE/AMEX/NASDAQ value-weighted index is used as a market portfolio. In the analysis, Fama and MacBeth cross-sectional regression is used. Individual firms are used rather than portfolios in the study. Harvey and Siddique's standardized measure and Kraus and Litzenberger's traditional measure are used for the calculation of coskewness and cokurtosis. There is some difference for these two measures but there is little effect on the results of the analysis. Therefore, only measures of HS are reported. The cross sectional regression between the excess return of firms and the combination of beta, size, book to market, momentum, HS coskewness and HS cokurtosis. As a result, there is not sufficient effect of coskewness and cokurtosis on pricing when the size and book to market factor is added to the model. Moreover, the sign of the co-skewness is negative as expected but the sign of cokurtosis is generally negative and this result is not consistent with the expectations and the previous studies.

In 2013, Hasan et al. [24] analyzed the effect of unconditional skewness and kurtosis for Dhaka Stock Exchange (DSE) which is the emerging market in Bangladesh. For the analysis, 80 non-financial companies listed on the Dhaka Stock Exchange are used. The sample period is between January 2005 and December 2009. Financial companies are not used in the study due to the different reporting system. The DSI Index and Bangladesh Government 3- Month T-bill rate are used as the market portfolio and the risk free asset separately First, Jarque-Bera test is conducted to check the normality. It is observed that normality hypothesis is rejected and returns are positive, volatile, and asymmetric and have fat tails.

After that, the Ordinary Least Squares (OLS) estimates of the two, three, and four moment CAPM are carried out. It is seen that the intercept for all models is significantly different from zero and there is an insignificant and negative beta for all models. Moreover, co-skewness and co-kurtosis coefficients are statistically significant. According to Lim [36], when the market returns are positively (negatively) skewed, the market premium for an asset's coskewness with market is negative (positive). In our study, it is observed that the risk premium for coskewness is positive and market has a negatively skewed distribution. This outcome is consistent with the study of Kraus and Litzenberger [32]. On the other hand, the risk premium of kurtosis is significant but it does not have the expected sign. It indicates that investors are not averse to kurtosis in their portfolios and do not demand a higher premium for the higher cokurtosis risk. Furthermore, when the higher moments are included to the CAPM, adjusted R^2 increases so coskewness and cokurtosis have an effect on the asset pricing in the DSE market. Overall, non-linear asset pricing model is better than commonly used model.

Finally, Lambert and Hübner [34] investigates the comoments risk premiums for the US market. When they estimate higher moment premiums, they try to remove the effect of correlated variables. All the NSYE, AMEX, and NASDAQ stocks which are available on the CRSP US stock database are used in the study. The sample period is from December 1955 to December 2011. The value-weighted return on all US stocks and one-month Treasury bill rate are used as the market portfolio and the risk free rate respectively. NYSE, AMEX, and NASDAQ stocks are divided into three groups based on covariance values. After that, each subgroups are divided into three parts based on coskewness values and then 9 subgroups are divided into three parts based on cokurtosis values. In the final step, 27 value-weighted portfolios are formed. Moreover, each moment premium can be described with the other two moments in the sorting of risk control. They are defined as $V_{S,K}, S_{V,K}, K_{V,S}$ and "V","S","K" and these terms indicate the covariance, coskewness and cokurtosis sequentially. In the analysis, a Fama-MacBeth two-pass cross sectional procedure is used to test the significance of moment factors. The models which are considered are defined as below:

$$M.1 \quad R_{i,t} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{iM} + \gamma_{2t}\hat{\beta}_{iSMB} + \gamma_{3t}\hat{\beta}_{iHML} + \gamma_{4t}\hat{\beta}_{iUMD} + \gamma_{5t}\hat{s}_{it} + \eta_{it}$$

$$M.2 \quad R_{i,t} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{iM} + \gamma_{2t}\hat{\beta}_{iC} + \gamma_{3t}\hat{\beta}_{iS} + \gamma_{4t}\hat{\beta}_{iK} + \gamma_{8t}\hat{s}_{it} + \eta_{it}$$

$$M.3 \quad R_{i,t} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{iM} + \gamma_{2t}\hat{\beta}_{iC} + \gamma_{3t}\hat{\beta}_{iS} + \gamma_{4t}\hat{\beta}_{iK} + +\gamma_{5t}\hat{\beta}_{iSMB} + \gamma_{6t}\hat{\beta}_{iHML} + \gamma_{7t}\hat{\beta}_{iUMD} + \gamma_{8t}\hat{s}_{it} + \eta_{it}$$

$$M.2^{*} \quad R_{i,t} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{iM} + \gamma_{2t}\hat{\beta}_{iC} + \gamma_{3t}\hat{\beta}_{iC}{}^{2} + \gamma_{4t}\hat{\beta}_{iS} + \gamma_{5t}\hat{\beta}_{iS}{}^{2} + \gamma_{6t}\hat{\beta}_{iK} + \gamma_{7t}\hat{\beta}_{iK}{}^{2} + \gamma_{8t}\hat{s}_{it} + \eta_{it} \tag{2.27}$$

where $\hat{\beta}_{iM}, \hat{\beta}_{iSMB}, \hat{\beta}_{iHML}, \hat{\beta}_{iUMD}$ indicates estimated market beta, estimated beta of SMB factor, estimated beta of HML factor, estimated beta of UML factor separately.$\hat{\beta}_{iC}^{2}, \hat{\beta}_{iS}^{2}, \hat{\beta}_{iK}^{2}$ indicate the nonlinear exposures to 2nd, 3rd and 4th moment related premiums respectively. $\hat{s}_{it}$ denotes the residual volatility of the time-series regression estimating the different betas. η_{it} reflects error term.

Moreover, they conduct a modified Fama-MacBeth model to examine the systematic conditional relationship between betas and realized returns. The dummy variable is added to separate the market into up and down parts. In the analysis, the following hypotheses are tested:

H.1: The Four-Moment Asset Pricing Model predicts positive return as a positive function of the market beta and cokurtosis, and a positive function of the negative coskewness. A higher risk in one of the betas is associated with higher returns.
$E(\gamma_{1t} + \gamma_{2t}) > 0$, $E(\gamma_{3t}) > 0$, $E(\gamma_{4t}) > 0$, *M.2*, $M.2^*$ and *M.3*

H.2: Betas are complete measures of the risk in the efficient market portfolio
$E(\gamma_{8t}) = 0$ for M.1 and $(E(\gamma_{5t}) = 0$, *M.2,* $M.2^*$ and *M.3*

H.3: The three moment-related premiums capture all nonlinear risks
$E(\gamma_{3t}) = 0$, $(E(\gamma_{5t}) = 0$, $E(\gamma_{7t}) = 0$ for $M.2^*$

Overall, when the stock market is up, the first and the second hypothesis are satisfied. The addition of moment related factors to Fama French or the addition of Fama French to moment related factors increase the R^2. On the other hand, both empirical premiums are not subsumed by the significant moment-related factors. In other words, the premiums of Fama French three factor and Carhart four factors keep their significance when the higher order co-moments are included in the models. This result is not consistent with Chung et al. [6] and Nguyen and Puri [44] and Heaney et al. [25]. Coskewness and cokurtosis risk premiums are considered with respect to up and down markets. When the market is up, an extra return is taken due to taking such risks but when the market is down, these risks cause negative realizations of the premiums.

2.4 Higher Moments Model

After the researchers realize the importance of the third and fourth moment on asset pricing, they extend their model and start higher comoments. Chung, Johnson, and Schill [6] analyze whether Fama-French 3 factor model is proxy for higher co-moment. For the analysis, CRSP and Compustat firms are used. The sample period is between 1930 and 1998. 30-day Treasury bill is used as a risk free rate. First, summary statistics are computed. The Jarque- Bera and Kolmogorov test is conducted to check the normality. While the normality hypothesis is rejected in Kolmogorov test, Jarque-Bera test is not rejected the normality for all periods. The Jarque-Bera statistic examines whether the third and fourth sample moments are matching the normal distribution but they argue that the skewness and kurtosis are not enough to define the distribution. Therefore, Kolmogorov statistics is considered due to the consistency with their purposes. According to the analysis, they consider higher comoments because risk-averse investors are worried about extreme outcomes.

After that, the methodology of Fama and MacBeth [14] is used. For each period t, the cross sectional regression with SMB and HML and systematic comoments are conducted. The equation is defined as below:

$$r(j,t) = \alpha_1 + \alpha_{SMB} s(j,t) + \alpha_{HML} h(j,t) + \sum_{i=2}^{n} a_t b(i,j,t) + e(j,t) \qquad (2.28)$$

$s(j,t)$ and $h(j,t)$ indicate the factor loadings for SMB and HML. $b(i,j,t)$ shows the *i*th systematic comoments. It is known that Fama and MacBeth analysis creates errors-in-variables (EIV) bias so the correction adjustment is carried out to solve the problems. As a result, when the systematic moments from 3 to 10 order are added to the model, the significance of SMB and HML decreases. For this reason, this study suggests that Fama French is proxy for higher comoments. On the other hand, when the standard co-moments from 3 to 10 are included to the model, Fama and French factors usually become insignificant. This indicates that systematic comoments decrease the significance of SMB and HML while standard moments do not.

Hung [26] extends the previous study of Chung, Johnson, and Schill [6] with the inclusion of the moment effect. He examines the performance of the momentum, size, and book to market factors versus higher systematic comoments. He also investigates whether the momentum factor is proxy for higher systematic comoments. The monthly returns of NSYE, AMEX, and NASDAQ firms in CRSP are used in the study. The sample period is between January 1926 and December 2005. Moreover, CRSP value-weighted index and one-month Treasury bill rate are used as the market portfolio and the risk free rate separately. First, the normality is checked for the momentum, size, and book to market portfolios and it is seen that the portfolios are not normally distributed. The cross-sectional regressions are conducted and the absolute pricing error is calculated for the two-moment, three moment, four moment CAPMs, Fama French and Carhart models. As a result, while the three moment CAPM well defines the cross section of returns for size portfolios, the four moment CAPM well defines the cross section of returns for momentum returns portfolios. Moreover, Fama and French [13] and Carhart [4] have higher absolute pricing errors than the three and four-moment CAPMs. In the cross-sectional analysis, the higher-order systematic co-moments are combined with momentum, size, and book to market to examine the proxy case. It is observed that when the co-moments order from 3 to 10 are included in the model, the significance of the size, book to market, and the momentum factor reduces. As a result, there is some evidence that momentum factor can be proxy for high order co-moments.

Nguyen and Puri [44] add one more factor which is liquidity factor compared to the study of Hung [26]. They try to show that Fama French 3 factors, momentum and liquidity factors can be described with higher order systematic comoments. In the analysis, the securities listed on NYSE, AMEX, and NASDAQ are used. The stocks are ranked with respect to size, book-to-market, momentum, and liquidity and 50 portfolios are formed based on sorted factors separately. Moreover, the measure of Pastor and Stambaugh [46] is used in the liquidity portfolios. 30-day Treasury bill is used as a risk free rate. First, the two-step Fama and MacBeth [14] procedure is conducted. The cross regressions of excess portfolio returns on SMB, HML, MOM, LIQ and systematic comoments are conducted as follows:

$$r(j,t) = a_0 + a_{rmrf}b(j,t) + a_{smb}s(j,t) + a_{hml}h(j,t) + a_{mom}m(j,t) + a_{liq}l(j,t) + e(j,t)$$

$$r(j,t) = a_0 + a_{rmrf}b(j,t) + a_{smb}s(j,t) + a_{hml}h(j,t) + a_{mom}m(j,t) + a_{liq}l(j,t) + \sum_{i=2}^{n} a_i b(i,j,t) + e(j,t) \tag{2.29}$$

$b(i,j,t)$ indicates the ith systematic comoments of portfolio j in month t.
Moreover, this analysis is also conducted for the standard moment:

$$r(j,t) = a_0 + a_{rmrf}b(j,t) + a_{smb}s(j,t) + a_{hml}h(j,t) + a_{mom}m(j,t) + a_{liq}l(j,t) + \sum_{i=2}^{n} a_i m(i,j,t) + e(j,t) \tag{2.30}$$

$m(i,j,t)$ indicates the ith standard moment of portfolio j in month t.
Moreover, GRS statistics which test whether the pricing errors are jointly equal to zero are conducted to avoid the errors in variables problem.

According to the outcome of the analysis, when a set of 10 or 15 systematic comoments are added to the model that includes SMB, HML, MOM, and LIQ, it is seen that the significance levels of the factors decrease considerably and these factors become insignificant mostly. On the other hand, this analysis is repeated with the standard moment and it is seen that the significance of common factors does not reduce when the standard moment is added to the model. Moreover, the GRS statistics reduces and pricing errors converge to zero. When a set of ten systematic comoments and 15 comoments or higher are added to the model, no change is observed in the analysis so a set of ten comoments is enough to define the extreme outcomes of investment.

CHAPTER 3

DATA AND METHODOLOGY

3.1 Data

3.1.1 Time Period, Frequency and Sources of Data

In this study, the dataset of the stocks listed on Borsa Istanbul (BIST) are used. The end of the month stock price is used between January 1990 and June 2013, and the stock returns are adjusted according to the dividends and splits. In addition, the data is taken from BIST records. However, the stocks belonging the financial institutions (banks, insurance companies, leasing and factoring companies, investment companies, investment trusts, and real estate investment trusts) are excluded from the data.

The monthly returns derived from the compounded interest of the 90-day or maturity closest to 90 days Treasury bill are used as a risk free rate. The interest rates are obtained from the bulletins of Borsa Istanbul. Moreover, BIST-100 index is used as a market proxy and the value of BIST-100 index are taken from Borsa Istanbul website.

3.2 Methodology

The primary aim of the study is to examine the effect of skewness and kurtosis on asset pricing model for Borsa Istanbul. Previous studies in the literature show that skewness and kurtosis have explanatory effects on asset pricing model. There are studies to examine the effect of skewness on asset pricing models in Turkey but this is the first study dealing with the effect of both skewness and kurtosis on asset pricing in a comprehensive manner. According to the progress of the asset pricing model, the first model is the capital asset pricing model (CAPM) of Sharpe [53] and Lintner [38, 39]. In the CAPM, the first two moments of asset returns distribution, which are mean and variance, are used defining the relationship between risk and return in the asset pricing model. After that, the three factor model of Fama French [13] and Carhart's model [4] are defined as the multifactor model in asset pricing. In this study, the third and fourth moments are included in the CAPM and Fama French Model.

This study has three major steps. First, sensitivity to market risk (β), the small-minus-big (SMB), high-minus-low (HML), winner-minus-loser (WML), systemic skewness, systematic kurtosis, coskewness, and cokurtosis factors which are the independent variables of the model are calculated individually. Second, the returns of the portfolios, which are formed according to the sorted beta, size, book to market, momentum, skewness and kurtosis factors, are calculated and used as the dependent variable. In the final part of the study, time series regressions are conducted to observe the explanatory power of the skewness and kurtosis in the CAPM and Fama French Model.

3.2.1 The Determination of Independent Variables

According to the finance literature, after the capital asset pricing model of Sharpe [53] and Lintner [38, 39], CAPM is summarized and expressed as a formula by Black [2]. According to the formula:

$$E(\tilde{R}_i) = R_f + \beta_i[E(\tilde{R}_M) - R_f] \qquad (3.1)$$

$\tilde{R}_i$:It is the return of the asset *i*
R_f:It is the return of the risk free asset
$\tilde{R}_M$:It is the return of the market portfolio
β_i:The market sensitivity of asset *i*
$\beta_i = cov(\tilde{R}_i, \tilde{R}_m)/var(\tilde{R}_m)$

Asset returns, the return of the market portfolio and risk free asset are observed factors and obtained from the Borsa Istanbul data base. On the other hand, beta factor is unobservable factor so it is estimated by the methodology of Fama and MacBeth [14]. According to the Fama and MacBeth, the first five years, between January 1990 and December 1994, are chosen as the sample period. The returns of the asset in the sample period are used to estimate the beta coefficient for each stock and stocks are sorted in ascending order based on the estimated beta coefficient. The sorted stocks are equally divided into ten portfolios based on the ranking order. If the grouping step is not equally distributed, the procedures are conducted as follows:

Let N is the number of the stocks in the sample period. The first int(N/10) stocks are assigned to Portfolio 1, the following int(N/10) stocks are assigned to Portfolio2 and the procedures continue like that. int (N/10) indicates that the value of N/10 is rounded down to the nearest integer. If N is an even number, the first and last portfolios have additional [N-10*int (N/10)]/2 stocks. On the other hand, if N is an odd number, the last portfolio has one more additional stock than the first portfolio.

After the stocks are assigned into the portfolios, the $\hat{\beta}_i$ coefficients for each asset are recalculated for the following four years which is the period between January 1995 and December 1998. Next, the recalculated $\hat{\beta}_i$ coefficients are used to compute the portfolio betas ($\hat{\beta}_{pt}$). The averages of the recalculated betas for each portfolio represent $\hat{\beta}_{pt}$. In $\hat{\beta}_{pt}$, the subscript p indicates the portfolio number (p=1, 2, 3…10) and t denotes the testing period which is January 1999 and December 2002 for the first period. The portfolio betas are adjusted monthly to consider the delisting of the stocks, while the $\hat{\beta}_i$ coefficient is updated annually by extending the initial estimation period one year. In detail, the recalculated $\hat{\beta}_i$ coefficient of the period January 1995-December 1998 is used to calculate the portfolio beta of the first month of the first testing period (January 1999). Similarly, the recalculated $\hat{\beta}_i$ coefficient of the period January 1995-December 1999 is used to calculate the portfolio beta of the first month of the first testing period (January 2000). The extension of the period for the recalculation $\hat{\beta}_i$ procedure continues until the end of the first testing period (2002). The table represents portfolio formation, initial estimation, and testing period. The time interval of this study is divided into four periods. The estimation of the beta factor for the first period is told above in detail. The same procedures are repeated for the remaining periods and the estimations of the beta factor are completed.

Table 3.1: The time interval for the estimation of beta

Periods	**1**	**2**	**3**	**4**
Portfolio Formation	1990-1994	1995-1998	1999-2002	2003-2006
Initial Estimation	1995-1998	1999-2002	2003-2006	2007-2010
Testing	1999-2002	2003-2006	2007-2010	2011-2013

According to the evolution of the asset pricing, the CAPM is based on a single factor. After that, Ross [49] introduced the Arbitrage Pricing Theory (APT) and the theory allows more than one factor in the model. The theory becomes alternative for the CAPM. Moreover, another major step in the progress of the asset pricing comes from the Fama French [13]. The Fama French three factor model is shown as follows.

$$R_{pit} = \alpha_{iT} + \beta_{iT} R_{mt} + s_{iT} SMB_t + h_{iT} HML_t + e_{iT} \; where \; t = 1,2, \dots T \tag{3.2}$$

R_{pi}: It is the excess return of the portfolio *i*

R_m: It is the excess return of the market portfolio

α_i: It is the intercept term
s_i, h_i: They are the associated factor loadings
$SMB\ (small - minus - big)$: It is the size factor
$HML\ (high - minus - low)$: It is the book to market factor
e_i: It indicates the error term

In this study, SMB and HML factors are calculated by the methodology with the Fama French [13]. First, the available stocks on the last trading day of June of year t (t=1990, 1991,…2013) are divided into three groups based on the market value. The market value is equal to the market price of stock times the number of stocks outstanding. The market value of the stocks is categorized depending on the cutoffs for the lowest 35% (Small), middle 30% (Medium) and the highest 35% (Big). Second, independent of the former grouping, the available stocks are divided into three groups depending on the ranked book to market value. Book to market equity (BE/ME) is equal to the book common equity for the fiscal year ending in calendar year t-1 divided by the market equity on the last trading day of year t-1. Moreover, the stocks that have the lowest 35% of BE/ME value ranks are labeled as Low (L) stocks, the middle 30% as Medium (M) and the highest 35% as High(H). In the final part, nine portfolios (S/L, S/M, S/H, M/L, M/M, M/H, B/L, B/M, B/H) are obtained from the intersection of three sizes and three BE/ME portfolio groups. For example, S/L represents the portfolio which contains the stocks in the small size and low book to market group. The monthly value weighted returns of nine portfolios are computed for the time period between July of year t and June of year t+1 and the portfolios are reformed based on the defined procedure above in June of year t+1. July is chosen as the beginning month of the period since the book equity for year t-1 is known.

The SMB factor defines the mimicking the risk factor in returns related to size and it is the difference between the simple average of the returns on S/H,S/M and S/L portfolios and B/H, B/M, B/L portfolios. Moreover, the HML factor defines the mimicking the risk factor in returns related to book to market value and it is the difference between the simple average of the returns on B/H, M/H and S/H portfolios and B/L, M/L, S/L portfolios. The formulation of the factors is defined below:

$$SMB_t = \frac{r_{t(S/H)} + r_{t(S/M)} + r_{t(S/L)}}{3} - \frac{r_{t(B/H)} + r_{t(B/M)} + r_{t(B/L)}}{3} \tag{3.3}$$

$$HML_t = \frac{r_{t(B/H)} + r_{t(M/H)} + r_{t(S/H)}}{3} - \frac{r_{t(B/L)} + r_{t(M/L)} + r_{t(S/L)}}{3} \tag{3.4}$$

The SMB and HML factors are calculated between February1990 and June 2013 and subscript *t* indicates the months in the defined period.

In 1997, Carhart goes further and includes momentum factor to the Fama French 3-factor model. Carhart-four factor model is defined as follows:

$$R_{pit} = \alpha_{iT} + \beta_{iT}R_{mt} + s_{iT}SMB_t + h_{iT}HML_t + p_{iT}WML_t + e_{iT} \text{ } where \text{ } t = 1,2, \dots T \tag{3.5}$$

WML_t $(winner - minus - loser)$: It is the momentum factor
p_i: It is the associated factor loading

First, the stocks are sorted depending on the past 11-month returns to calculate the WML factor and there is one month lag between the last day of the 11-month period and the day of ranking. P11L1 represents the 11-month return. Second, the sorted stocks are divided into two groups. The first group contains the stocks which have the lowest 30% of the ranked returns and labeled as Loser (L). Furthermore, the second group contains the stocks which have the highest 30% of the ranked returns and labeled as Winner (W). When N is the total number of stocks, N*30% (n) represents the number of stocks in the each of two portfolio groups and it is rounded down to the nearest integer.

The WML factor is equal to the difference between the equally weighted average of the winner portfolio returns and the equally weighted average of the loser portfolio. The formulation of the factor is defined below:

$$WML_t = \frac{\sum_{i=1}^{n} R_{Wit}}{n} - \frac{\sum_{i=N-n}^{N} R_{Lit}}{n} \text{ } where \text{ } n = N * 30\% \text{ is an integer} \tag{3.6}$$

The subscript *t* indicates the months between February 1990 and June 2013.According to the finance literature, the CAPM supports the adequacy of the variance to measure the risk and assumes that the returns are normally distributed but the subsequent studies do not support this assumption. It is considered that the mean and variance are not enough to define the distribution of the returns completely and the returns are not normally distributed. However, it is observed that the returns are skewed and have fat tails. Due to this reason, the role of higher moments, especially skewness (third moment) and kurtosis (fourth moment), becomes important in the finance literature and the higher moments are taken into consideration by the researchers.

Skewness and kurtosis are statistical measures to define the shape of the probability distribution of the random variable. Skewness is the third standardized moment of probability distribution and it measures the degree of the asymmetry of the distribution around its mean. The normal distribution is symmetric and its skewness is equal to 0. If skewness is greater (less) than 0, the distribution is positively (negatively) skewed. Positive skewed distribution has a long right tail and it means frequent small losses and a few extreme gains thus positively skewed stocks are preferred by investors. On the other hand, negative skewed distribution has a long left tail and it means frequent small gains and a few extreme losses. In other words, there is higher risk for extreme negative outcomes. For this reason investors do not like negative skewness and demand high premium for the negatively skewed stocks to compensate for the risk. The comparison between normal distribution and skewed distribution is shown below in the Figure. In the Figure, the bold shape indicates the normal distribution.

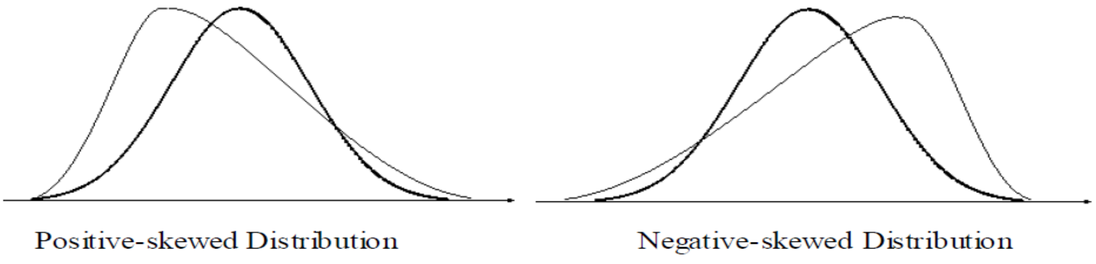

Figure 3.1 Comparisons of positive, negative skewed distribution and normal distribution [9]

Kurtosis is the fourth standardized moment of the probability distribution and it measures the peakedness of the distribution. The kurtosis value of the normal distribution is equal to 3 (mesokurtic distribution). If kurtosis is greater (less) than 3, the distribution is leptokurtic (platykurtic) distribution. The leptokurtic distribution has a sharper peak than normal distribution and has fatter tails. The fat tail indicates that there is a risk which is related to the outliers and extreme observations are much more probably to occur than the normal distribution. Investors try to avoid this type of risks, therefore risk averse investors demand higher rate of return for the leptokurtic distribution. On the other hand, the platykurtic distribution has a lower peak than normal distribution and has thinner tails, so the extreme observations are less likely observed than the normal distribution. For this reason, investors prefer platykurtic distribution. Figure represents the comparison of leptokurtic, mesokurtic (normal) and platykurtic distributions and the bold shape indicates the normal distribution.

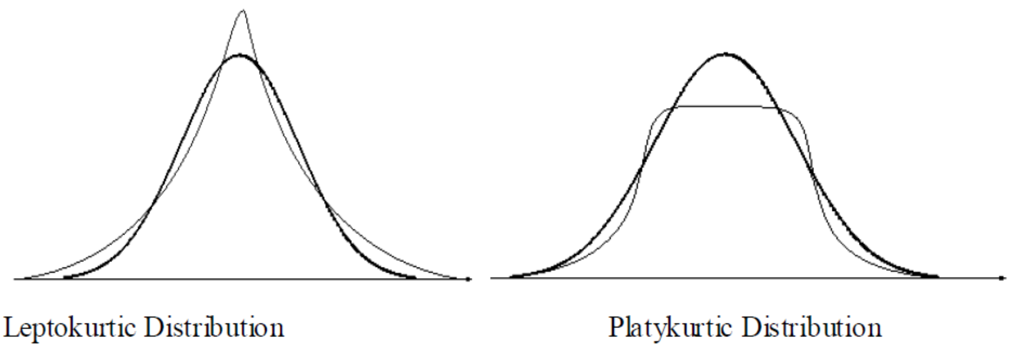

Figure 3.2 Comparisons of leptokurtic, platykurtic, and normal distribution [9]

The measures of the skewness, kurtosis, and excess kurtosis are shown as follows:

$$Standardized\ Skewness = \frac{E(R_i - \bar{R}_i)^3}{{\sigma_i}^3} \tag{3.7}$$

$$Standardized\ Kurtosis = \frac{E(R_i - \bar{R}_i)^4}{{\sigma_i}^4} \tag{3.8}$$

where $R_i . \bar{R}_i$ and σ_i indicates asset return, average of return and standard deviation of asset i separately. It is seen that the market index is not taken into account in the formulas of skewness and kurtosis and the measures are not convenient to examine the effects on asset pricing. For this reason, a formula defining the relation between asset's skewness (kurtosis) and market portfolio's skewness (kurtosis) are necessary to study their impacts on the pricing context. In the finance literature, there is a complication about the formulation of the skewness and kurtosis with market index in asset pricing. There are a lot of different formulations about the concept. Moreover, there are the same formulations with different names and this situation makes a confusion. For this reason, we use mostly accepted formulas and try to make them clear. To observe the explanatory power of skewness and kurtosis on asset pricing with market context, two different terms and formulations are used respectively in this study. The first terms are systematic skewness and systematic kurtosis .Second, coskewness, and cokurtosis are reported in detail.

Kraus and Litzenberger [32] define the systematic skewness instead of total skewness in asset pricing. The non-diversifiable measure of skewness is defined with systematic skewness like systematic risk (beta). According to the Kraus and Litzenberger, the formulation of systematic skewness is defined as follows.

$$Systematic\ skewness\ (S_i) = \frac{E[(R_i - \bar{R}_i)(R_m - \bar{R}_m)^2]}{E[(R_m - \bar{R}_m)^3]} = \frac{Cov(R_i, R_m^2)}{E[(R_m - \bar{R}_m)^3]} \tag{3.9}$$

Fang and Lai [15] define the systematic kurtosis in asset pricing with the methodology of Kraus and Litzenberger [32]. Systematic kurtosis is non-diversifiable measure of kurtosis like systematic risk and skewness.

$$Systematic\ Kurtosis\ (K_i) = \frac{E[(R_i - \bar{R}_i)(R_m - \bar{R}_m)^3]}{E[(R_m - \bar{R}_m)^4]} = \frac{Cov(R_i, R_m^3)}{E[(R_m - \bar{R}_m)^4]} \tag{3.10}$$

where $R_i, R_m, \bar{R}_i, \bar{R}_m$ indicate asset return, market return, average of asset return and average of market return separately. The formulation of systematic skewness and systematic kurtosis defined above are used in this study.

Harvey and Siddique [23] take the coskewness factor in asset pricing model into account in order to realize the cross sectional variation in asset returns. The coskewness is a statistical measure which makes a comparison between the symmetry of the asset and market distribution and measures the contribution of the stock to the skewness of the market portfolio. Negative coskewness indicates that the asset adds the negative skewness to the market portfolio and there is higher chance of extreme low returns, thus the risk averse investors demand a higher return for this type of stocks. On the other hand, positive coskewness is preferred by the investors due to the higher probability of extreme high observations. According to Harvey and Siddique, the formulation of standardized unconditional coskewness is defined as follows:

$$Standardized\ Unconditional\ Coskewness\ (CSK_i) = \frac{E(\varepsilon_{i,t+1}\varepsilon^2_{M,t+1})}{\sqrt{E(\varepsilon^2_{i,t+1})}E(\varepsilon^2_{M,t+1})} \quad (3.11)$$

where $\varepsilon_{i,t+1} = r_{i,t+1} - \alpha_i - \beta_i(r_{M,t+1})$, the residual from the regression of CAPM, $\varepsilon_{M,t}$ is the difference between excess market return in month *t* and the average market return over the window of returns t-60 to t. $r_{i,t}, r_{m,t}$ are the return of asset i and market return at time t and α_i, β_i are intercept term and beta coefficient.

Kostakis, Muhammad, and Siganos [31] develop the methodology of Harvey and Siddique [23] and include the cokurtosis factor to asset pricing model. The cokurtosis is a statistical measure which makes a comparison between the peakedness for the return distribution of asset and market and measures the contribution of the stock to the kurtosis of the market portfolio like coskewness. Higher cokurtosis indicates that stock has a sharper distribution than the distribution of market portfolio so that investors like lower cokurtosis. Moreover, cokurtosis value is positively related with the expected rate of return like beta. The formulation of cokurtosis factor is shown below:

$$Standardized\ Unconditional\ Cokurtosis\ (CKT_i) = \frac{E(\varepsilon_{i,t+1}\varepsilon^3_{M,t+1})}{\sqrt{E(\varepsilon^2_{i,t+1})}E(\varepsilon^3_{M,t+1})} \quad (3.12)$$

The formulation of coskewness and cokurtosis which is defined above are used in this study for the time period January 1990 and June 2013. Following the approach of Harvey and Siddique, standardized unconditional coskewness (cokurtosis) are calculated for each asset depending on 60 months returns. After that, stocks are ranked according to their calculated coskewness (cokurtosis) for each month and formed two value weighted portfolios. First portfolio; S^- (K^-) includes 30% of stocks with the lowest coskewness (cokurtosis) and second portfolio; S^+ (K^+) includes 30% of stocks with the highest coskewness (cokurtosis). The value weighted returns are calculated with 60 months observations for two portfolios. Coskewness factor is described as the spread of 61st-

month returns $(S^- - S^+)$ and cokurtosis factor is described as the spread of 61st -month returns $(K^+ - K^-)$. These calculations are used to proxy for systematic skewness (kurtosis). This procedure is applied the values of both $S_i(K_i)$ and $CSK_i(CKT_i)$ and the factor loadings are obtained. The methodology of Harvey Siddique [23] is similar with the procedure of Fama French [13] to form SMB and HML, so higher expected return is expected for higher coskewness and cokurtosis factors.

3.2.2 The Determination of Dependent Variables

In this study, independent variables are calculated according to the formulas which are defined above. To test the explanatory power of $R_{mt}, \beta_{it}, SMB_t, HML_t, WML_t, S^- - S^+, K^+ - K^-$, the different type of portfolios are formed and their returns are used as dependent variables. Five portfolio groups which are beta sorted portfolios, size and book to market sorted portfolios, momentum sorted portfolios, systematic skewness (kurtosis) sorted portfolios and coskewness (cokurtosis) sorted portfolios.

First, the estimation of beta coefficient with the methodology Fama and MacBeth [14] is defined in the determination of independent variables part. After the estimations of beta coefficient are completed, assets are ranked in ascending order according to the estimated beta coefficient and divided into ten portfolios based on the ranking order. The value weighted returns for ten portfolios are calculated for the months of each year. If stocks in the portfolios leave the market, this situation is taken into consideration to calculate the portfolio returns. Ten beta sorted portfolio returns are calculated as dependent variables for the period between January 1990 and June 2013.

Second, size, book and both size and book sorted portfolios are created. The procedure of portfolio formation is explained in the calculation of SMB and HML factors. According to the procedure, three independent size sorted portfolios, three independent book to market sorted portfolios and nine size and book to market portfolios are formed and their portfolio returns are calculated as dependent variables for the time period between January 1990 and June 2013.

Third, according to Carhart's [4] momentum factor definition, the momentum sorted portfolios are formed. The procedure of portfolio formation is told in the calculation of WML factor. According to the procedure, the stocks are divided into ten portfolios depending on their returns over the past 12, 24, 36, 48 and 60 months and there is one- month lag between the calculated past returns and portfolio formation. Ten portfolios are formed for 12, 24, 36, 48, 60 months respectively and their returns are calculated for the time period between January 1990 and June 2013.

Finally, the skewness and kurtosis sorted portfolios are formed. The stocks are ranked in ascending order based on the systematic skewness (kurtosis) and coskewness (cokurtosis) and grouped into ten portfolios. After that, the portfolios' returns are calculated as dependent variables for the systematic skewness (kurtosis) and coskewness (cokurtosis) sorted portfolio separately.

3.2.3 The Testing Procedure

After the calculation of the dependent variables and independent variables which are $R_{mt}, \beta_{it}, SMB_t, HML_t, WML_t, S^- - S^+, K^+ - K^-$, the time series regressions are conducted. The skewness and kurtosis factors are included in the CAPM, Fama French 3-factor model and Carhart four factor model one by one. Moreover, negative skewness and positive kurtosis are also included in the CAPM, Fama French 3-factor model and Carhart four factor model one by one to test the explanatory effect on the asset pricing model. In this study, two different calculations for skewness and kurtosis are used. First, the factor loading of systematic skewness and kurtosis are added to the models respectively. After that, the factor loading of coskewness and cokurtosis are added to the models separately and time series regressions are done. When the factors related to the skewness and kurtosis are included to in the CAPM, Fama French 3-factor model and Carhart four factor model, a lot of combinations for time series regressions appear. Although time series regressions of all models are conducted, we only report the effect of skewness and kurtosis on Fama French 3 factor model because WML factor in Carhart's model consistently appear to be insignificant, regardless of how portfolios are formed and which factors are included to the model. In addition, the skewness and kurtosis factors which are calculated by the methodology of Harvey and Siddique [23] and Kraus and Litzenberger [32] are both included to in the models but we only report the results by the methodology of Harvey and Siddique due to the similarity in the outcomes. As a result, the filtration of the outcomes avoids the complexity and help to define the results clearly.

CHAPTER 4

ANALYSIS AND EMPIRICAL RESULTS

4.1 Preliminary Analysis

The aim of this study is to examine the impact of skewness and kurtosis in explaining the variation of excess returns on the portfolio groups which are sorted depending on beta, size, book to market, momentum, coskewness and cokurtosis factors for BIST. In this part of the study, some summary statistics will be calculated as preliminary analysis to examine the effect of higher moments. Before time series regressions are conducted, these summary statistics are calculated whether there is evidence about the role of third and fourth moment on asset pricing. First, skewness and kurtosis are calculated and then normality test is conducted to examine the distributional characteristics of asset returns in BIST. After that, coskewness and cokurtosis coefficients are calculated for the same portfolio groups.

Table 4.1 represents the skewness and kurtosis values, Kolmogorov-Smirnov statistics and its p-value to examine whether the returns of portfolio groups are normally distributed. While skewness measure indicates the third central moment about the mean, kurtosis measure represents the fourth central moment about mean. Moreover, Kolmogorov-Smirnov test is used to check the normality and it is a widely used nonparametric test. According to Kolmogorov-Smirnov statistic and its p-value, the normality of portfolio returns is determined. The hypothesis of the normality is defined as follows:

H_0: The portfolio returns are normally distributed

H_1 : The portfolio returns are not normally distributed

On the other hand, different portfolio groups are formed and the returns of the portfolios are used for the calculation of summary statistics. There are eleven panels which indicate these groups. Panel A indicates 10 value-weighted beta sorted portfolios. Panel B and Panel C denote three sorted portfolios according to book to market value and firm-size (market value) separately. In Panel D, there are 9 portfolios which are sorted based on both size and book to market value. In Panel E, F, G, H and I, ten momentum portfolios are formed according to different time intervals which are 11,24,36,48 and 60 months. In the final part of the table, Panel J and K present ten portfolios which are sorted according to coskewness and cokurtosis value separately. Summary statistics are calculated based on these formed portfolio returns. According to all of the panels in Table 4.1, skewness measure is higher than 0 and this result indicates that portfolio returns are positively skewed. Moreover, kurtosis measure is considerably higher than 3, and this result indicate that the portfolio returns have leptokurtic distribution with fat tails. It means that the risk might come from the outlier observations in asset returns so conservative investors do not prefer these types of stocks. For this reason, kurtosis factor might be important for BIST. In addition, p-value of Kolmogorov-Smirnov is lower than 0.05 so that H_0 is rejected. As a result, the portfolio returns are not normally distributed with 95% confidence. According to these results, the CAPM is failed due to the non-normality of portfolio returns for BIST. Therefore, skewness and kurtosis factors can be important for BIST.

Table 4.2 represents the summary statistics of coskewness and cokurtosis coefficients according to the same portfolio groups in Table 4.1. The beta coefficient of $S^- - S^+$ (coskewness factor), $K^+ - K^-$ (cokurtosis factor), S^- (negative coskewness factor) and K^+ (positive cokurtosis factor) are calculated with the univariate regressions of different portfolio returns. According to the summary statistics result, it is seen that market factor is positive and significant for all types of portfolio combination. Likewise, $S^- - S^+$ which is calculated by the methodology of Harvey and Siddique [23] is positive as expected for all types of portfolio combination. Moreover, the coefficient of coskewness factor is rarely significant for beta and book to market sorted portfolios, while it is mostly significant for size and all time interval momentum sorted portfolios. Coskewness factor is also significant in half of ten coskewness and cokurtosis sorted portfolios separately. S^- is also tested to examine the importance in asset pricing model because negative skewed distribution has a long left tail and it means that investors can get a greater chance of extreme outcomes. According to the table, negative coskewness is positive and significant for all types of portfolio combination. On the other hand, the coefficient of $K^+ - K^-$ is calculated by the methodology of Kostakis, Muhammad, and Siganos [31]. Cokurtosis factor is always negative except for beta sorted portfolios and it is insignificant for all types of portfolio combination. The sign of cokurtosis factor is not as expected. Positive cokurtosis (K^+) is also included to see the effect on asset pricing model. Positive kurtosis defines higher kurtosis. Higher kurtosis distribution (leptokurtic) has a sharper peak and fatter tails when it is compared to the normal distribution. Extreme observations and large fluctuations are occurred much more likely in fat tail distribution, so positive cokurtosis factor is expected to be significant and positive. According to the table, it is obviously seen that positive cokurtosis factor is significant and positive for all different portfolio types. This preliminary analysis indicates that there is evidence about the effect of skewness and kurtosis factor in explaining the asset returns in BIST. In the next section, these factors will be included in Fama-French model and formally tested with the time series regressions.

Table 4.1: Summary Statistics

This table indicates summary statistics of eleven portfolios groups. Panel A indicates 10 value-weighted beta sorted portfolios. Panel B and Panel C denote three sorted portfolios according to book to market value and firm-size (market value) separately. In Panel D, there are 9 portfolios which are sorted based on both size and book to market value. In Panel E, F, G, H and I, ten momentum portfolios are formed according to different time intervals which are 11,24,36,48 and 60 months. Panel J and K present ten portfolios which are sorted according to coskewness and cokurtosis value separately. Skewness and kurtosis are third and fourth central moment about the mean.

Panel A

Beta-Sorted Portfolios – Value-Weighted Portfolio

Portfolio No	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
1	1,722	7,558	0,136	<0,010**
2	0,579	2,143	0,094	<0,010**
3	1,573	7,449	0,107	<0,010**
4	0,960	6,280	0,096	<0,010**
5	1,519	9,389	0,11	<0,010**
6	0,911	6,181	0,095	<0,010**
7	0,683	4,518	0,077	<0,010**
8	1,352	9,512	0,13	<0,010**
9	0,895	5,305	0,105	<0,010**
10	0,585	3,552	0,082	<0,010**

Panel B

Book to Market-Sorted Portfolios – Value-Weighted Portfolio

Book to Market Portfolio	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
Low	1,136	4,080	0,115	<0,010**
Medium	1,159	3,855	0,118	<0,010**
High	1,109	3,240	0,125	<0,010**

Table 4.1-Continued

Panel C Size-Sorted Portfolios – Value-Weighted Portfolio				
Size Portfolio	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
Small	0,667	2,264	0,098	<0,010**
Medium	0,760	2,674	0,108	<0,010**
Big	1,037	3,587	0,109	<0,010**

Panel D Size and Book to Market-Sorted Portfolios – Value-Weighted Portfolio				
Size and B/M Portfolios	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
S/L	0,940	3,349	0,104	<0,010**
S/M	0,722	2,022	0,09	<0,010**
S/H	0,843	2,903	0,107	<0,010**
M/L	0,660	2,116	0,079	<0,010**
M/M	0,724	2,641	0,091	<0,010**
M/H	1,017	3,898	0,129	<0,010**
B/L	0,979	3,712	0,108	<0,010**
B/M	0,910	3,041	0,096	<0,010**
B/H	2,027	10,320	0,14	<0,010**

Panel E P11L1 Momentum – Value-Weighted Portfolio				
Portfolio No	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
1	14,307	224,390	0,291	<0,010**
2	0,980	2,891	0,101	<0,010**
3	1,263	4,789	0,092	<0,010**
4	0,970	4,738	0,089	<0,010**
5	0,713	1,527	0,113	<0,010**
6	0,766	2,053	0,117	<0,010**

7	0,877	3,080	0,116	<0,010**
8	0,760	3,875	0,11	<0,010**
9	0,777	3,691	0,086	<0,010**
10	0,611	2,666	0,106	<0,010**

Panel F

P24L1 Momentum – Value-Weighted Portfolio

Portfolio No	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
1	1,436	5,036	0,128	<0,010**
2	1,032	3,958	0,095	<0,010**
3	0,995	3,602	0,101	<0,010**
4	0,839	2,673	0,113	<0,010**
5	1,312	5,551	0,119	<0,010**
6	0,875	2,521	0,102	<0,010**
7	0,781	2,481	0,092	<0,010**
8	0,614	2,743	0,078	<0,010**
9	0,780	2,321	0,105	<0,010**
10	0,556	2,324	0,08	<0,010**

Panel G

P36L1 Momentum – Value-Weighted Portfolio

Portfolio No	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
1	1,200	4,225	0,117	<0,010**
2	0,758	3,666	0,087	<0,010**
3	0,692	2,588	0,091	<0,010**
4	1,013	3,396	0,104	<0,010**
5	1,277	3,953	0,134	<0,010**
6	0,982	2,958	0,111	<0,010**
7	0,902	3,259	0,095	<0,010**

8	0,709	2,496	0,092	<0,010**
9	0,935	4,756	0,083	<0,010**
10	0,770	3,185	0,096	<0,010**

Panel H

P48L1 Momentum – Value-Weighted Portfolio

Portfolio No	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
1	1,108	5,094	0,096	<0,010**
2	0,773	2,563	0,088	<0,010**
3	0,964	3,579	0,11	<0,010**
4	1,001	3,849	0,098	<0,010**
5	0,976	2,755	0,115	<0,010**
6	0,818	3,458	0,109	<0,010**
7	1,384	4,606	0,129	<0,010**
8	0,906	2,861	0,12	<0,010**
9	1,236	5,156	0,094	<0,010**
10	1,220	3,989	0,121	<0,010**

Panel I

P60L1 Momentum – Value-Weighted Portfolio

Portfolio No	Skewness	Kurtosis	Kolmogorv-Smirnov	P-Value
1	0,987	4,113	0,09	<0,010**
2	0,705	3,755	0,081	<0,010**
3	0,934	4,362	0,099	<0,010**
4	0,981	3,953	0,089	<0,010**
5	1,213	5,099	0,118	<0,010**
6	0,968	4,284	0,097	<0,010**
7	0,896	3,624	0,1	<0,010**
8	1,190	4,488	0,113	<0,010**

Portfolio No	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
9	1,128	4,490	0,112	<0,010**
10	1,027	3,553	0,106	<0,010**

Panel J

Coskewness Sorted – Value-Weighted Portfolio

Portfolio No	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
1	0,832	3,662	0,097	<0,010**
2	1,020	4,429	0,103	<0,010**
3	1,031	3,887	0,124	<0,010**
4	1,067	4,905	0,102	<0,010**
5	0,908	4,693	0,083	<0,010**
6	1,385	7,718	0,111	<0,010**
7	1,352	7,106	0,107	<0,010**
8	1,106	5,717	0,117	<0,010**
9	1,171	5,894	0,077	<0,010**
10	0,911	4,340	0,104	<0,010**

Panel K

Cokurtosis Sorted – Value-Weighted Portfolio

Portfolio No	Skewness	Kurtosis	Kolmogorov-Smirnov	P-Value
1	1,004	3,869	0,094	<0,010**
2	0,686	2,679	0,099	<0,010**
3	1,259	6,284	0,123	<0,010**
4	1,149	5,130	0,094	<0,010**
5	1,176	5,057	0,113	<0,010**
6	1,311	8,245	0,096	<0,010**
7	0,872	3,639	0,08	<0,010**
8	1,338	7,438	0,09	<0,010**
9	1,043	5,239	0,093	<0,010**
10	0,893	4,869	0,095	<0,010**

** and *indicates that the test is significant at 5% and 10% levels, particularly

Table 4.2: Summary Statistics of beta coefficients

This table indicates the beta coefficient of coskewness, cokurtosis, negative coskewness, and positive cokurtosis. $\beta^{S^- - S^+}$ is computed by the regression of the portfolio excess return on the returns of $S^- - S^+$. $\beta^{K^+ - K^-}$ is computed by the regression of the portfolio excess return on the returns of $K^+ - K^-$. β^{S^-} is computed by the regression of the portfolio excess return on the returns of S^-. β^{K^+} is computed by the regression of the portfolio excess return on the returns of K^+.

Panel A

Beta-Sorted Portfolios – Value-Weighted Portfolio

Portfolio No	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
1	0.8375**	0.1472	0.5615**	-0.1002	0.8375**
2	0.8437**	0.1344	0.5756**	0.0568	0.8845**
3	0.9912**	0.1808*	0.6746**	-0.0035	1.0031**
4	0.8320**	0.1800**	0.5836**	0.0808	0.8646**
5	0.9083**	0.4686**	0.7540**	0.2059	0.9612**
6	0.8567**	0.1120	0.5762**	0.1392	0.8904**
7	0.8888**	0.1371	0.5805**	0.1705	0.8969**
8	0.9155**	0.1135	0.5885**	0.0666	0.9134**
9	0.9051**	0.1316	0.6137**	0.0922	0.9345**
10	0.9074	0.1235	0.6005**	0.0654	0.9331**

Panel B

Book to Market-Sorted Portfolios – Value-Weighted Portfolio

Book to Market Portfolio	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
Low	0.8869**	0.0894	0.5809**	-0.0951	0.8697**
Medium	0.9704**	0.1184	0.6226**	-0.0914	0.9231**
High	0.9582**	0.1473*	0.6071**	-0.1107	0.8808**

Table 4.2-Continued

Panel C Size-Sorted Portfolios – Value-Weighted Portfolio					
Size Portfolio	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
Small	0.8200**	0.1796**	0.5299**	-0.1171	0.7510**
Medium	0.8987**	0.2089**	0.6060**	-0.0986	0.8464**
Big	0.9320**	0.0866	0.5991**	-0.0822	0.8993**

Panel D Size and Book to Market-Sorted Portfolios – Value-Weighted Portfolio					
Size and B/M Portfolios	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
S/L	0.8637**	0.1945**	0.5645**	-0.05613	0.8059**
S/M	0.8459**	0.1744**	0.5349**	-0.18466	0.7618**
S/H	0.8602**	0.1902**	0.5571**	-0.08019	0.7890**
M/L	0.8408**	0.3198**	0.6371**	-0.09981	0.8219**
M/M	0.9208**	0.1732**	0.5922**	-0.12306	0.8501**
M/H	0.9317**	0.1677**	0.6178**	-0.09459	0.8884**
B/L	0.8899**	0.1036	0.5841**	-0.05088	0.8715**
B/M	0.9257**	0.1017	0.6085**	-0.05063	0.9054**
B/H	1.0463**	0.0741	0.6410**	-0.1139	0.9636**

Panel E P11L1 Momentum – Value-Weighted Portfolio					
Portfolio No	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
1	1.0041**	0.1667	0.6856**	-0.1387	0.9949**
2	0.9112**	0.1602*	0.6308**	-0.0885	0.9095**
3	0.9104**	0.1837**	0.6323**	-0.0905	0.9106**
4	0.9069**	0.1405*	0.6101**	-0.0406	0.8995**

5	0.9097**	0.1905**	0.5992**	-0.1560	0.8508**
6	0.9192**	0.1445*	0.5766**	-0.1524	0.8372**
7	0.9022**	0.1587**	0.5795**	-0.0757	0.8395**
8	0.9060**	0.2954**	0.6592**	-0.0775	0.8650**
9	0.8965**	0.0970	0.5406**	0.0271	0.8128**
10	0.8186**	0.1245*	0.4945**	-0.2460**	0.6980**

Panel F

P24L1 Momentum – Value-Weighted Portfolio

Portfolio No	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
1	0.9544**	0.1141	0.5559**	-0.0609	0.8402**
2	0.9769**	0.1142	0.6207**	-0.2129	0.9088**
3	0.9620**	0.1455*	0.6139**	-0.0587	0.8972**
4	0.9008**	0.1691**	0.5901**	-0.1081	0.8421**
5	0.9522**	0.1642*	0.6357**	-0.0869	0.9192**
6	0.9007**	0.1344*	0.5862**	-0.1439	0.8555**
7	0.9102**	0.1398*	0.6108**	-0.1099	0.8935**
8	0.8815**	0.1525*	0.5746**	-0.0498	0.8431**
9	0.8746**	0.3766**	0.6728**	-0.0728	0.8459**
10	0.8520**	0.1270*	0.5528**	-0.0923	0.8065**

Panel G

P36L1 Momentum – Value-Weighted Portfolio

Portfolio No	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
1	0.9650**	0.1390	0.6175**	-0.0779	0.9131**
2	0.9341**	0.1557*	0.5980**	-0.0762	0.8658**
3	0.9560**	0.1514*	0.6141**	-0.0790	0.8925**
4	0.9256**	0.1240	0.5678**	0.0060	0.8495**
5	0.9603**	0.1199	0.6205**	-0.1253	0.9182**

6	0.9234**	0.3638**	0.6739**	-0.1195	0.8516**
7	0.9103**	0.1443*	0.5745**	-0.1365	0.8354**
8	0.8934**	0.1665**	0.5884**	-0.1678	0.8380**
9	0.8818**	0.1291	0.5870**	-0.0810	0.8692**
10	0.8542**	0.1792**	0.6019**	-0.0703	0.8596**

Panel H

P48L1 Momentum – Value-Weighted Portfolio

Portfolio No	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
1	0.8574**	0.1550*	0.5808**	-0.0717	0.8400**
2	0.8837**	0.1196	0.5916**	-0.1464	0.8656**
3	0.8935**	0.3325**	0.6743**	-0.0303	0.8768**
4	0.8983**	0.1242	0.5732**	-0.0544	0.8496**
5	0.9221**	0.1956**	0.6079**	-0.1904	0.8616**
6	0.9216**	0.1627**	0.5967**	-0.0965	0.8651**
7	0.9975**	0.1675**	0.6315**	-0.1219	0.9091**
8	0.9466**	0.1726**	0.6137**	-0.1175	0.8870**
9	0.9389**	0.1209	0.5935**	-0.0053	0.8775**
10	0.9299**	0.1433*	0.6112**	-0.0512	0.8935**

Panel I

P60L1 Momentum – Value-Weighted Portfolio

Portfolio No	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
1	0.8472**	0.3394**	0.6585**	-0.0387	0.8479**
2	0.8382**	0.1382*	0.5705**	-0.0573	0.8285**
3	0.9004**	0.1208	0.5903**	-0.1196	0.8625**
4	0.9318**	0.1454*	0.6047**	-0.0625	0.8972**
5	0.9445**	0.1866**	0.6248**	-0.1223	0.8980**
6	0.8962**	0.1308	0.5853**	-0.0670	0.8641**

7	0.9457**	0.1672**	0.6260**	-0.1196	0.8988**
8	0.9400**	0.1280	0.6000**	-0.0813	0.8865**
9	0.9211**	0.1231	0.6047**	-0.0766	0.8942**
10	0.8798**	0.1654**	0.5933**	-0.0283	0.8525**

Panel J

Coskewness Sorted – Value-Weighted Portfolio

Portfolio No	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
1	0.8199**	0.2575**	0.6058**	-0.2566**	0.8243**
2	0.9002**	0.2047**	0.6226**	-0.1977	0.8804**
3	0.8836**	0.4073**	0.7182**	-0.0488	0.9070**
4	0.9202**	0.1863**	0.6267**	-0.1215	0.9031**
5	0.8389**	0.1249	0.5586**	-0.0060	0.8313**
6	0.8853**	0.1584*	0.6122**	-0.0280	0.8974**
7	0.8803**	0.1219	0.5909**	-0.0553	0.8806**
8	0.8906**	0.0532	0.5823**	-0.0168	0.8817**
9	0.8832**	0.0668	0.5676**	-0.0664	0.8570**
10	0.9371**	0.0710	0.6152**	0.0263	0.9359**

Panel K

Cokurtosis Sorted – Value-Weighted Portfolio

Portfolio No	β to $R_m - R_f$	β to $S^- - S^+$	β to S^-	β to $K^+ - K^-$	β to K^+
1	0.8892**	0.2042**	0.6253**	-0.3639**	0.8721**
2	0.9057**	0.2573**	0.6549**	-0.3372**	0.8963**
3	0.9088**	0.1791**	0.6198**	-0.2610*	0.8826**
4	0.8528**	0.1240	0.5800**	-0.0147	0.8550**
5	0.9257**	0.1313	0.6238**	-0.0027	0.9211**
6	0.8837**	0.1545*	0.5936**	-0.0021	0.8717**
7	0.8504**	0.0894	0.5655**	0.0344	0.8452**

8	0.8980**	0.1066	0.6023**	0.0571	0.9170**
9	0.8946**	0.2998**	0.6746**	0.0883	0.9041**
10	0.8374**	0.1160	0.5673**	0.0092	0.8390**

** and *indicates that the test is significant at 5% and 10% levels, particularly.

4.2 The Time Series Regression Analysis

In this part of the study, Fama-French model is used as a base model and coskewness and cokurtosis factors are included in this model separately. Fama-French model and new models are tested with the time series regressions and compared to examine the effect of skewness and kurtosis. The dependent variables of time series regressions are the portfolio returns which are sorted depending on beta, size, book to market, momentum, coskewness and cokurtosis factors. The portfolio returns are regressed on the independent variables of excess market return $(R_m - R_f)$, SMB and HML. After Fama French Model is tested with the time series regression, $S^- - S^+$, $K^+ - K^-$, S^- and K^+ are added to the Fama French model separately to research the explanatory power. The results of time series regression are given in the tables particularly. The intercept term, factor loadings, the adjusted- R^2, are reported in the tables with the p- value in the parenthesis below each value.

4.2.1 The Time Series Regression of Beta Sorted Portfolios

The time series regression is conducted for the portfolios sorted based on the estimated beta by the methodology of Fama and MacBeth [14]. The beta sorted portfolio returns are used as a dependent variables. In the first part of the analysis, Fama French three factor is tested and the results are provided in Table 4.3. The model is seen below:

$$R_{pit} = \alpha_{iT} + \beta_{iT} R_{mt} + s_{iT} SMB_t + h_{iT} HML_t + e_{iT} \ where\ t = 1,2, \dots T \qquad (4.1)$$

According to the results, it is regarded that the intercept term consistently appears to be positive and statistically insignificant for each beta portfolio. The factor loading of excess market return is positive and significant for each portfolios and the value of the coefficient range from 0.89 to 1.0418. Moreover, SMB factor is positive and significant for ten portfolios. The value of SMB factor ranges between 0.4047 and 0.7661. HML factor is also positive except one portfolio and statistically significant in seven of ten portfolios. The value of coefficient is between -0.1304 and 0.4125. The adjusted- R^2 ranges from 0.69 to 0.86 and the average adjusted- R^2 is 0.81. After that, the coskewness factor is added to the model and it becomes the following equation:

$$R_{pit} = \alpha_{iT} + \beta_{iT} R_{mt} + s_{iT} SMB_t + h_{iT} HML_t + \beta_{S^- - S^+} (S^- - S^+)_t + e_{iT}$$
$$where\ t = 1,2, \dots T \qquad (4.2)$$

In Table 4.4, while intercept term is positive and insignificant, market factor is again positive and statistically significant for all of the portfolios. The factor loadings of excess market return also do not decrease when the coskewness factor is added to the model. SMB is also positive and significant for all portfolios and the value of coefficients remains at the same level. In addition, HML factor is positive and it is significant for half of ten portfolios. After the inclusion of coskewness factor, the number of portfolios which contains significant HML factor decreases. In addition, coskewness factor is positive for six of ten portfolios and it is insignificant except two portfolios. The addition of the coskewness does not change the range and average of the adjusted-R^2. As a result, it is seen that coskewness does not have a significant additional explanatory power over Fama French three factors model. Similarly, cokurtosis factor is added to Fama French the model and it becomes as follows:

$$R_{pit} = \alpha_{iT} + \beta_{iT}R_{mt} + s_{iT}SMB_t + h_{iT}HML_t + \beta_{K^+-K^-}(K^+ - K^-)_t + e_{iT}$$
$$where\ t = 1,2, \dots T \qquad (4.3)$$

In Table 4.5, the intercept term is still insignificant. The market factor and SMB remains its significance for each portfolio. HML is positive except one portfolio and significant for eight of then portfolios. Moreover, cokurtosis factor is positive and insignificant for eight of ten portfolios. When cokurtosis factors are added, the adjusted- R^2 keeps the same. Therefore, cokurtosis also does not have a significant incremental effect on Fama French three factors model. It is seen that cokurtosis is not significant effect for beta sorted portfolios.

In the final part of the time series regression, negative coskewness and positive cokurtosis factors are added to the Fama- French model separately. First, negative coskewness is included and the model becomes as follow:

$$R_{pit} = \alpha_{iT} + \beta_{iT}R_{mt} + s_{iT}SMB_t + h_{iT}HML_t + \beta_{S^-}(S^-)_t + e_{iT}$$
$$where\ t = 1,2, \dots T \qquad (4.4)$$

When S^- is included in the Fama French model, the intercept term remains insignificant. The market factor is still positive and significant. The factor loadings of market factor decrease slightly. Moreover, SMB and HML also stay significant and positive. The factor loading of HML also increases slightly. Negative coskewness factor is positive as expected and it is statistically significant for eight of ten portfolios. When negative coskewness factor is added into three factor model, the explained portion of variation in returns increases by 1%. Consequently, it is seen that negative coskewness has an additional explanatory power over Fama- French factors. Finally, positive cokurtosis is included into Fama- French factors and the following equation is provided:

$$R_{pit} = \alpha_{iT} + \beta_{iT}R_{mt} + s_{iT}SMB_t + h_{iT}HML_t + \beta_{K^+}(K^+)_t + e_{iT}$$
$$where\ t = 1,2, \dots T \qquad (4.5)$$

According to Table 4.6, the intercept term becomes significant after positive cokurtosis factor is added to the model. The market factor is still significant and positive but there is a considerable decrease in the value of the coefficient. SMB and HML factor is also positive and significant. When positive cokurtosis is added into three factor model, the explained portion of variation increases by 3 %, on average. Moreover, positive cokurtosis factor is positive and significant for each ten portfolios. As a result, positive kurtosis has an explanatory effect on asset pricing but the significance of the intercept term shows that there can be pricing error.

4.2.2 The Time Series Regression of Size and Book to Market Sorted Portfolios

The time series regressions are conducted for portfolios which are sorted based on size, book to market value, and both of them. The result of these portfolios will be given in detail in this part. In Table 4.8- 4.12, there are the parameter estimation of independent size and book to market sorted portfolios. First, the parameter estimation of independent size portfolios is interpreted. For the Fama-French three factor model, the intercept term is insignificant. The market factor is also positive and significant. SMB and HML factors are positive for small and medium size portfolios while these factors are negative for big size portfolios. The negative coefficient indicates that investors require lower returns from big size firms. These factors are significant for three size portfolios. Moreover, the adjusted-R^2 ranges from 0.90 to 0.94 and the average adjusted-R^2 is 0.91. When coskewness factor is added to three factor model, the intercept term is still insignificant. All of the Fama French factors have the same results as the three factor model. Coskewness factor is positive for all size portfolios but it is only insignificant for small size portfolios. The adjusted-R^2 does not change when coskewness factor is added to the model. After that, cokurtosis factor is added to the model. All of the factors and the adjusted-R^2 save their significance at the same level and the cokurtosis factor is negative and insignificant. In the last part of the regression analysis for size portfolios, negative coskewness is included and it is seen that all of the factors save their significance. However, the factor loadings of market excess return decrease slightly. Negative coskewness factor is positive and significant for all size portfolios and adjusted-R^2 increases by 1% on average when it is compared to the base model. Then, positive cokurtosis is included to the model and it is considered that intercept term becomes significant. Positive cokurtosis factor is positive and significant. The other factors again stay in the same significance level but the value of the market coefficient decreases considerably. The adjusted-R^2 also increases by 1% on average. Accordingly, positive kurtosis has an explanatory effect on asset pricing on BIST but the significance of the intercept term shows that there can be a pricing error.

Second, there is also the parameter estimation of independent book to market sorted portfolios in Table 4.8 - 4.12. According to the tables, the intercept term is insignificant for the Fama-French three factor model. The market factor is also positive and significant and the value of market coefficient is close to 1. SMB and HML factors are positive for high and medium level of sorted book to market portfolios while these factors is negative for stocks which have low book to market value. SMB and HML factors are also significant. The negative coefficient indicates that investors require lower returns from these stocks. Moreover, the adjusted-R^2 ranges from 0.84 to 0.90 and the average adjusted-R^2 is 0.86. When coskewness is added to three factor model, it is only significant for high and medium level of sorted book to market portfolios. On the other hand, cokurtosis is not significant for book to market portfolios. When negative coskewness is added to three factor model, it is seen that all of the factors save their significance and negative coskewness is also significant. The value of market coefficient falls considerably and the explained portion of variation increases by 5 %, on average. Moreover, the intercept term becomes significant for high and medium level of sorted book to market portfolios. When positive cokurtosis is added to three factor model, the intercept term is significant for three portfolios. The other factors remain significant, but the value of the market coefficient falls considerably by the addition of positive cokurtosis. The adjusted- R^2 increases by 5 %, on average.

Finally, there are 9 portfolios which are sorted according to both size and book to market value in Table 4.13-4.17. The results are similar with the other portfolios. The intercept term is insignificant in three factor model. HML factor is positive and significant except B/L and M/L portfolios. SMB factor is positive and significant for nine portfolios. When coskewness and cokurtosis factors are added to the base model separately, it is seen that they do not have an incremental effect over Fama French model. On the other hand, negative coskewness has a significant explanatory power but the addition of the factor to the model reduces the value of market coefficient. When positive cokurtosis is added to three factor model, all of the factors remain significant. The factor loading of market again reduces considerably. Although the coefficient of positive cokurtosis is significant, the intercept term is not as expected. Both of these two factors have significant effects over Fama French model separately and the explained portion of variation increases by 4 % by including negative coskewness and positive cokurtosis particularly.

4.2.3 Time Series Regression of Momentum Portfolios

In this part, the stocks are classified into decile portfolios depending on the returns over the past 12, 24,36,48,60 months, and time series regressions are conducted to these portfolios. In table 4.18-4.22, it is observed that coskewness and cokurtosis factors have insignificant effects over Fama French separately. The results are similar with the other portfolio combinations. When negative coskewness and positive cokurtosis are included to three factor model separately, SMB, HML, and market factor stay significant. In addition, S^- and K^+ become significant particularly. The intercept term is insignificant for negative coskewness case, while this term is significant for positive cokurtosis case.

4.2.4 Time Series Regression of Coskewness and Cokurtosis Sorted Portfolios

In this section, the stocks are ranked according to the value of coskewness and cokurtosis and then the stocks are classified into decile portfolios. The results of the time series regression are represented in Table 4.23-4.24. The coskewness and cokurtosis sorted portfolios have the same results as the other portfolio formations. While coskewness and cokurtosis factors have insignificant effects over Fama French model separately, negative coskewness and positive cokurtosis have explanatory powers over Fama French model particularly.

4.3 Results

According to time series regression of different portfolio combination, coskewness and cokurtosis factors do not have significant explanatory powers over Fama-French factors in BIST. Moreover, when these factors are added to three factor model separately, it is seen that they do not have an incremental effect on the adjusted-R^2. This result is consistent with the study of Mısırlı and Alper [42]. They examine the effect of coskewness on the variation of portfolio excess returns in BIST for the time period between July 1999 and December 2005. Although they only consider coskewness factor, the results about coskewness factor is the same. On the other hand, negative coskewness factor has a marginal contribution for explaining portfolio excess returns and it also increases the adjusted-R^2. When the negative skewness is added to the Fama French model, the intercept term is consistently statistically insignificant, regardless of how portfolios are formed. It indicates that the most of variation in returns is explained by Fama French three factors and negative coskewness. Moreover, when cokurtosis factor is added to three factor model, all of the factors remain significant. Positive cokurtosis factor also has a marginal contribution for explaining portfolio excess returns in BIST but the intercept term becomes significant. It indicates that the factors already included in the model are not sufficient to explain the variation in returns. It is obviously seen that the different portfolio combinations support all of these results and this outcome shows that the result of the analysis is robust. As a result, the empirical evidence shows that skewness and kurtosis factor have important roles for asset pricing in BIST.

Table 4.3: Parameter estimates of beta sorted portfolios for the Fama French Model

This table presents the result of time series regression of beta sorted portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the Fama French Model.

Beta-Sorted Portfolios – Value-Weighted Portfolio Returns										
	1	2	3	4	5	6	7	8	9	10
Intercept	0.0044	0.0027	0.0022	0.0042	0.0065	0.0027	-0.0031	0.0043	0.0027	0.0060
	(0.49)	(0.60)	(0.63)	(0.29)	(0.21)	(0.55)	(0.41)	(0.37)	(0.50)	(0.17)
$R_m - R_f$	**0.9228**	**0.9061**	**1.0418**	**0.8947**	**1.0154**	**0.9348**	**0.9470**	**0.9802**	**0.9501**	**0.9520**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7661**	**0.5422**	**0.5515**	**0.5504**	**0.7733**	**0.6976**	**0.5900**	**0.5976**	**0.4047**	**0.4512**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2774**	0.1591	**0.4125**	**0.1735**	-0.1304	**0.2464**	**0.3614**	**0.2539**	0.1503	**0.2751**
	(0.02)	(0.11)	(0.00)	(0.02)	(0.19)	(0.01)	(0.00)	(0.01)	(0.05)	(0.00)
OLS R^2	0.69	0.76	0.84	0.84	0.79	0.81	0.86	0.81	0.86	0.82

Table 4.4: Parameter estimates of beta sorted portfolios for the Fama French and coskewness factor

This table presents the result of time series regression of beta sorted portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes Fama French and coskewness factors.

Beta-Sorted Portfolios – Value -Weighted Portfolio Returns										
	1	2	3	4	5	6	7	8	9	10
Intercept	0.0051	0.0030	0.0006	0.0034	0.0017	0.0041	-0.0034	0.0051	0.0024	0.0057
	(0.42)	(0.56)	(0.90)	(0.39)	(0.72)	(0.37)	(0.38)	(0.29)	(0.54)	(0.21)
$R_m - R_f$	**0.9307**	**0.9097**	**1.0252**	**0.8870**	**0.9661**	**0.9489**	**0.9440**	**0.9888**	**0.9478**	**0.9486**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7982**	**0.5570**	**0.4840**	**0.5190**	**0.5730**	**0.7551**	**0.5779**	**0.6323**	**0.3954**	**0.4373**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	0.2428	0.1430	**0.4854**	**0.2073**	0.0858	0.1843	**0.3745**	**0.2164**	0.1603	**0.2900**
	(0.06)	(0.18)	(0.00)	(0.01)	(0.38)	(0.05)	(0.00)	(0.03)	(0.05)	(0.00)
$S^- - S^+$	-0.0472	-0.0218	**0.0993**	0.0460	**0.2944**	-0.0846	0.0178	-0.0510	0.0137	0.0204
	(0.46)	(0.68)	(0.03)	(0.25)	(0.00)	(0.07)	(0.65)	(0.30)	(0.73)	(0.66)
OLS R^2	0.69	0.76	0.85	0.84	0.83	0.81	0.86	0.81	0.85	0.82

Table 4.5: Parameter estimates of beta sorted portfolios for the Fama French and cokurtosis factor

This table presents the result of time series regression of beta sorted portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes Fama French and cokurtosis factors.

Beta-Sorted Portfolios – Value -Weighted Portfolio Returns										
	1	2	3	4	5	6	7	8	9	10
Intercept	0.0045	0.0026	0.0022	0.0041	0.0063	0.0025	-0.0034	0.0042	0.0026	0.0060
	(0.47)	(0.61)	(0.63)	(0.30)	(0.22)	(0.57)	(0.37)	(0.38)	(0.51)	(0.18)
$R_m - R_f$	**0.9236**	**0.9058**	**1.0420**	**0.8942**	**1.0139**	**0.9337**	**0.9457**	**0.9798**	**0.9496**	**0.9517**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7583**	**0.5454**	**0.5501**	**0.5557**	**0.7884**	**0.7087**	**0.6034**	**0.6019**	**0.4096**	**0.4547**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2690**	0.1626	**0.4108**	**0.1793**	-0.1140	**0.2585**	**0.3759**	**0.2586**	**0.1556**	**0.2789**
	(0.03)	(0.10)	(0.00)	(0.02)	(0.25)	(0.00)	(0.00)	(0.01)	(0.04)	(0.00)
$K^+ - K^-$	-0.0961	0.0398	-0.0184	0.0663	**0.1868**	0.1379	**0.1656**	0.0532	0.0605	0.0433
	(0.36)	(0.64)	(0.81)	(0.32)	(0.03)	(0.07)	(0.01)	(0.51)	(0.36)	(0.56)
OLS R^2	0.69	0.76	0.84	0.84	0.80	0.81	0.87	0.81	0.86	0.82

Table 4.6: Parameter estimates of beta sorted portfolios for the Fama French and negative coskewness factor

This table presents the result of time series regression of beta sorted portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and negative coskewness factors.

Beta-Sorted Portfolios – Value -Weighted Portfolio Returns										
	1	2	3	4	5	6	7	8	9	10
Intercept	0.0014	-0.0035	-0.0094	-0.0044	**-0.0139**	-0.0013	-0.0081	0.0022	-0.0056	-0.0011
	(0.84)	(0.54)	(0.05)	(0.30)	(0.00)	(0.80)	(0.06)	(0.68)	(0.18)	(0.81)
$R_m - R_f$	**0.8632**	**0.7819**	**0.8088**	**0.7216**	**0.6028**	**0.8535**	**0.8461**	**0.9383**	**0.7821**	**0.8072**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7336**	**0.4747**	**0.4248**	**0.4562**	**0.5490**	**0.6534**	**0.5352**	**0.5748**	**0.3134**	**0.3725**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3267**	**0.2615**	**0.6047**	**0.3163**	**0.2099**	**0.3134**	**0.4446**	**0.2885**	**0.2888**	**0.3945**
	(0.01)	(0.01)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
S^-	0.0579	**0.1205**	**0.2262**	**0.1681**	**0.4005**	0.0789	**0.0979**	0.0407	**0.1630**	**0.1406**
	(0.36)	(0.02)	(0.00)	(0.00)	(0.00)	(0.08)	(0.01)	(0.40)	(0.00)	(0.00)
OLS R2	0.69	0.77	0.86	0.85	0.86	0.81	0.87	0.81	0.87	0.83

Table 4.7: Parameter estimates of beta sorted portfolios for the Fama French and positive cokurtosis factor

This table presents the result of time series regression of beta sorted portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and positive cokurtosis factors.

	Beta-Sorted Portfolios – Value -Weighted Portfolio Returns									
	1	2	3	4	5	6	7	8	9	10
Intercept	-0.0074	**-0.0184**	**-0.0153**	**-0.0149**	**-0.0165**	**-0.0173**	**-0.0181**	-0.0079	**-0.0165**	**-0.0130**
	(0.32)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.16)	(0.00)	(0.01)
$R_m - R_f$	**0.6368**	**0.3941**	**0.6183**	**0.4326**	**0.4560**	**0.4499**	**0.5840**	**0.6841**	**0.4860**	**0.4916**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7735**	**0.5554**	**0.5625**	**0.5623**	**0.7877**	**0.7101**	**0.5994**	**0.6052**	**0.4167**	**0.4631**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3297**	**0.2527**	**0.4899**	**0.2580**	-0.0281	**0.3350**	**0.4277**	**0.3081**	**0.2351**	**0.3593**
	(0.01)	(0.01)	(0.00)	(0.00)	(0.75)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
K^+	**0.3197**	**0.5721**	**0.4734**	**0.5164**	**0.6252**	**0.5419**	**0.4056**	**0.3309**	**0.5186**	**0.5146**
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R2	0.70	0.81	0.87	0.88	0.84	0.85	0.89	0.82	0.89	0.86

Table 4.8: Parameter estimates of independent size and book to market portfolios for the Fama French Model

This table presents the result of time series regression of independent B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for Fama French model.

	Independent B/M Portfolios – Value-Weighted Returns			Independent Size Portfolios – Value-Weighted Returns		
	L	M	H	S	M	B
Intercept	0.0033	0.0031	0.0057	0.0034	0.0029	0.0039
	(0.22)	(0.44)	(0.15)	(0.23)	(0.26)	(0.07)
$R_m - R_f$	**0.9011**	**0.9611**	**0.9109**	**0.8904**	**0.9518**	**0.9287**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	-0.0778	**0.1952**	**0.1601**	**0.9818**	**0.6630**	**-0.1171**
	(0.06)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
HML	**-0.2523**	**0.3429**	**0.7202**	**0.4317**	**0.2290**	**-0.1078**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.90	0.84	0.85	0.90	0.91	0.94

Table 4.9: Parameter estimates of independent size and book to market portfolios for the Fama French Model and coskewness factor

This table presents the result of time series regression of independent B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and coskewness factors.

	Independent B/M Portfolios – Value-Weighted Returns			Independent Size Portfolios – Value-Weighted Returns		
	L	M	H	S	M	B
Intercept	0.0020	-0.0003	0.0028	0.0001	-0.0007	0.0015
	(0.45)	(0.91)	(0.40)	(0.98)	(0.80)	(0.50)
$R_m - R_f$	**0.8770**	**0.9444**	**0.8782**	**0.8554**	**0.9244**	**0.8999**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**-0.1218**	**0.1524**	0.1065	**0.9376**	**0.6877**	**-0.1526**
	(0.01)	(0.00)	(0.07)	(0.00)	(0.00)	(0.00)
HML	**-0.2651**	**0.2609**	**0.5567**	**0.3879**	**0.3328**	**-0.1587**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$S^- - S^+$	0.0274	**0.0846**	**0.1743**	0.0153	**0.0817**	**0.0470**
	(0.30)	(0.00)	(0.00)	(0.57)	(0.00)	(0.03)
OLS R^2	0.91	0.90	0.88	0.90	0.92	0.94

Table 4.10: Parameter estimates of independent size and book to market portfolios for the Fama French Model and cokurtosis factor

This table presents the result of time series regression of independent B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and cokurtosis factors.

	Independent B/M Portfolios – Value-Weighted Returns			Independent Size Portfolios – Value-Weighted Returns		
	L	M	H	S	M	B
Intercept	0.0024	0.0007	0.0049	0.0002	0.0003	0.0021
	(0.38)	(0.81)	(0.15)	(0.93)	(0.90)	(0.35)
$R_m - R_f$	**0.8805**	**0.9570**	**0.9042**	**0.8571**	**0.9363**	**0.9066**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**-0.1046**	**0.2061**	**0.2172**	**0.9471**	**0.7396**	**-0.1229**
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**-0.2868**	**0.2061**	**0.4449**	**0.3732**	**0.2786**	**-0.1909**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$K^+ - K^-$	-0.0508	-0.0206	-0.0306	-0.0566	-0.0344	-0.0307
	(0.18)	(0.63)	(0.52)	(0.13)	(0.36)	(0.33)
OLS R^2	0.91	0.90	0.87	0.90	0.91	0.94

Table 4.11: Parameter estimates of independent size and book to market portfolios for the Fama French Model and negative coskewness factor

This table presents the result of time series regression of independent B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and negative coskewness factors.

	Independent B/M Portfolios – Value-Weighted Returns			Independent Size Portfolios – Value-Weighted Returns		
	L	M	H	S	M	B
Intercept	-0.0035	**-0.0084**	**-0.0089**	-0.0047	**-0.0087**	**-0.0050**
	(0.24)	(0.01)	(0.01)	(0.12)	(0.00)	(0.04)
$R_m - R_f$	**0.7710**	**0.7881**	**0.6479**	**0.7655**	**0.7692**	**0.7747**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**-0.1566**	**0.1260**	0.0956	**0.9036**	**0.6602**	**-0.1855**
	(0.00)	(0.01)	(0.07)	(0.00)	(0.00)	(0.00)
HML	**-0.2003**	**0.3338**	**0.6386**	**0.4469**	**0.4064**	**-0.0898**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)
S^-	**0.1051**	**0.1614**	**0.2450**	**0.0880**	**0.1599**	**0.1262**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.91	0.91	0.90	0.91	0.93	0.95

Table 4.12: Parameter estimates of independent size and book to market portfolios for the Fama French Model and positive cokurtosis factor

This table presents the result of time series regression of independent B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and positive cokurtosis factors.

	Independent B/M Portfolios – Value-Weighted Returns			Independent Size Portfolios – Value-Weighted Returns		
	L	M	H	S	M	B
Intercept	**-0.0108**	**-0.0137**	**-0.0100**	**-0.0134**	**-0.0138**	**-0.0115**
	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
$R_m - R_f$	**0.6090**	**0.6605**	**0.5969**	**0.5778**	**0.6466**	**0.6276**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**-0.1049**	**0.2056**	**0.2167**	**0.9468**	**0.7391**	**-0.1233**
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**-0.2195**	**0.2764**	**0.5186**	**0.4428**	**0.3486**	**-0.1237**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
K^+	**0.2970**	**0.3238**	**0.3357**	**0.3054**	**0.3166**	**0.3048**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.92	0.91	0.88	0.92	0.93	0.95

Table 4.13: Parameter estimates of double sorted size and book to market portfolios for the Fama French Model

This table presents the result of time series regression for portfolios which are sorted based on B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the Fama French model.

Size and B/M Portfolios – Value-Weighted Returns									
	S/L	S/M	S/H	M/L	M/M	M/H	B/L	B/M	B/H
Intercept	0.0019	0.0053	0.0108	0.0043	0.0038	0.0019	0.0028	0.0020	0.0028
	(0.72)	(0.21)	(0.00)	(0.24)	(0.25)	(0.54)	(0.29)	(0.57)	(0.63)
$R_m - R_f$	**0.9611**	**0.9136**	**0.9243**	**0.9373**	**0.9681**	**0.9704**	**0.9156**	**0.9342**	**1.0079**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**1.0476**	**1.0496**	**1.0225**	**0.8065**	**0.6454**	**0.7477**	**0.1330**	**0.2176**	**0.2104**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)
HML	**0.2135**	**0.5441**	**0.5502**	-0.0737	**0.2710**	**0.4935**	**-0.1210**	**0.1734**	**0.6846**
	(0.00)	(0.00)	(0.00)	(0.11)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.74	0.82	0.87	0.84	0.87	0.90	0.90	0.85	0.75

Table 4.14: Parameter estimates of double sorted size and book to market portfolios for the Fama French Model and coskewness factor

This table presents the result of time series regression for portfolios which are sorted based on B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and coskewness factor.

Size and B/M Portfolios – Value-Weighted Returns

	S/L	S/M	S/H	M/L	M/M	M/H	B/L	B/M	B/H
Intercept	0.0006	0.0063	0.0052	0.0024	-0.0015	0.0005	0.0004	0.0002	0.0013
	(0.89)	(0.09)	(0.11)	(0.52)	(0.66)	(0.87)	(0.90)	(0.95)	(0.73)
$R_m - R_f$	**0.9465**	**0.8642**	**0.8890**	**0.9340**	**0.9339**	**0.9662**	**0.9015**	**0.9335**	**0.9837**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**1.1541**	**0.8920**	**0.9655**	**0.8943**	**0.6738**	**0.7275**	**0.2243**	**0.2658**	**0.1933**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	0.0364	**0.3724**	**0.5409**	-0.0387	**0.3405**	**0.5543**	-0.0222	**0.2099**	**0.4064**
	(0.70)	(0.00)	(0.00)	(0.60)	(0.00)	(0.00)	(0.69)	(0.00)	(0.00)
$S^- - S^+$	-0.0746	0.0162	0.0437	**0.0906**	0.0496	**0.0668**	0.0115	0.0376	0.0541
	(0.11)	(0.65)	(0.17)	(0.01)	(0.14)	(0.02)	(0.68)	(0.23)	(0.14)
OLS R^2	0.78	0.84	0.88	0.85	0.87	0.91	0.90	0.89	0.87

Table 4.15: Parameter estimates of double sorted size and book to market portfolios for the Fama French Model and cokurtosis factor

This table presents the result of time series regression for portfolios which are sorted based on B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and cokurtosis factors.

Size and B/M Portfolios – Value-Weighted Returns									
	S/L	S/M	S/H	M/L	M/M	M/H	B/L	B/M	B/H
Intercept	-0.0003	0.0065	0.0057	0.0036	-0.0009	0.0013	0.0005	0.0007	0.0020
	(0.95)	(0.07)	(0.08)	(0.35)	(0.80)	(0.65)	(0.86)	(0.83)	(0.60)
$R_m - R_f$	**0.9351**	**0.8651**	**0.8955**	**0.9470**	**0.9407**	**0.9761**	**0.9033**	**0.9394**	**0.9915**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**1.1067**	**0.9019**	**0.9932**	**0.9517**	**0.7052**	**0.7699**	**0.2316**	**0.2897**	**0.2276**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	0.0822	**0.3512**	**0.5126**	-0.1007	**0.3044**	**0.5111**	-0.0291	**0.1878**	**0.3697**
	(0.36)	(0.00)	(0.00)	(0.16)	(0.00)	(0.00)	(0.58)	(0.00)	(0.00)
$K^+ - K^-$	-0.0091	**-0.1240**	-0.0104	-0.0592	-0.0566	-0.0157	0.0031	0.0166	-0.0323
	(0.89)	(0.01)	(0.82)	(0.26)	(0.24)	(0.70)	(0.94)	(0.71)	(0.54)
OLS R^2	0.77	0.84	0.88	0.84	0.87	0.91	0.90	0.89	0.86

Table 4.16: Parameter estimates of double sorted size and book to market portfolios for the Fama French Model and negative coskewness factor

This table presents the result of time series regression for portfolios which are sorted based on B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and negative coskewness factors.

Size and B/M Portfolios – Value-Weighted Returns

	S/L	S/M	S/H	M/L	M/M	M/H	B/L	B/M	B/H
Intercept	-0.0008	0.0017	-0.0010	-0.0066	-0.0073	**-0.0074**	-0.0057	**-0.0077**	-0.0080
	(0.88)	(0.67)	(0.77)	(0.11)	(0.06)	(0.02)	(0.07)	(0.03)	(0.05)
$R_m - R_f$	**0.9253**	**0.7778**	**0.7697**	**0.7580**	**0.8225**	**0.8131**	**0.7875**	**0.7834**	**0.8064**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**1.1020**	**0.8602**	**0.9335**	**0.8620**	**0.6490**	**0.6926**	**0.1767**	**0.2158**	**0.1398**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)
HML	0.0904	**0.4284**	**0.6072**	0.0457	**0.3979**	**0.6339**	0.0568	**0.3023**	**0.5106**
	(0.35)	(0.00)	(0.00)	(0.53)	(0.00)	(0.00)	(0.30)	(0.00)	(0.00)
S^-	0.0094	**0.0847**	**0.1202**	**0.1811**	**0.1135**	**0.1557**	**0.1105**	**0.1487**	**0.1770**
	(0.84)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.77	0.84	0.89	0.86	0.87	0.92	0.91	0.90	0.88

Table 4.17: Parameter estimates of double sorted size and book to market portfolios for the Fama French Model and positive cokurtosis factor

This table presents the result of time series regression for portfolios which are sorted based on B/M and size portfolios. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for the model which includes the Fama French and positive cokurtosis factors.

Size and B/M Portfolios – Value-Weighted Returns

	S/L	S/M	S/H	M/L	M/M	M/H	B/L	B/M	B/H
Intercept	**-0.0162**	-0.0066	**-0.0091**	**-0.0100**	**-0.0135**	**-0.0136**	**-0.0161**	**-0.0163**	**-0.0143**
	(0.01)	(0.14)	(0.02)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$R_m - R_f$	**0.6086**	**0.5983**	**0.5898**	**0.6692**	**0.6820**	**0.6702**	**0.5616**	**0.5901**	**0.6567**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**1.1061**	**0.9018**	**0.9927**	**0.9514**	**0.7049**	**0.7694**	**0.2310**	**0.2890**	**0.2271**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	0.1584	**0.4242**	**0.5841**	-0.0312	**0.3693**	**0.5831**	0.0494	**0.2668**	**0.4499**
	(0.07)	(0.00)	(0.00)	(0.65)	(0.00)	(0.00)	(0.29)	(0.00)	(0.00)
K^+	**0.3563**	**0.2927**	**0.3337**	**0.3039**	**0.2830**	**0.3339**	**0.3728**	**0.3809**	**0.3657**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.79	0.85	0.90	0.86	0.88	0.92	0.92	0.91	0.88

Table 4.18: Parameter estimates for P11L1 sorted portfolios

This table presents the result of time series regression of portfolios which are sorted based on 11 months past returns. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for five models.

P11L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0121	0.0052	0.0067	0.0034	**0.0119**	**0.0079**	0.0032	0.0041	0.0022	0.0015
	(0.08)	(0.19)	(0.11)	(0.32)	(0.00)	(0.03)	(0.35)	(0.27)	(0.53)	(0.76)
$R_m - R_f$	**1.0747**	**0.9583**	**0.9716**	**0.9590**	**0.9639**	**0.9518**	**0.9267**	**0.9570**	**0.9293**	**0.8495**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.9871**	**0.7094**	**0.7755**	**0.6696**	**0.6864**	**0.5177**	**0.5024**	**0.6067**	**0.4327**	**0.4207**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.4664**	**0.3537**	**0.2789**	**0.2483**	**0.2459**	**0.2775**	**0.3477**	**0.1838**	**0.1699**	**0.1769**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.67	0.83	0.82	0.86	0.85	0.84	0.86	0.84	0.84	0.71

P11L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0088	-0.0005	0.0038	0.0023	**0.0085**	0.0062	0.0007	0.0042	0.0027	-0.0063
	(0.25)	(0.89)	(0.31)	(0.51)	(0.01)	(0.09)	(0.82)	(0.29)	(0.43)	(0.16)
$R_m - R_f$	**1.1308**	**1.0035**	**0.9961**	**0.9738**	**0.9155**	**0.8922**	**0.8875**	**0.9277**	**0.8631**	**0.7745**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**1.1035**	**0.7565**	**0.8689**	**0.6792**	**0.6748**	**0.5400**	**0.4584**	**0.5500**	**0.4490**	**0.4521**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.7097**	**0.2054**	**0.4193**	**0.3007**	**0.3370**	**0.2878**	**0.2250**	0.1433	0.1308	**0.2363**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.05)	(0.01)
$S^- - S^+$	0.0149	-0.0053	0.0313	0.0074	0.0671	0.0409	0.0612	0.1644	-0.0129	0.0356
	(0.84)	(0.88)	(0.39)	(0.83)	**(0.04)**	(0.25)	(0.05)	**(0.00)**	(0.69)	(0.41)

OLS R^2	0.67	0.87	0.87	0.87	0.87	0.85	0.88	0.83	0.85	0.73

P11L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0089	-0.0006	0.0042	0.0024	**0.0093**	0.0067	0.0015	0.0063	0.0025	-0.0059
	(0.24)	(0.87)	(0.26)	(0.49)	(0.01)	(0.06)	(0.64)	(0.13)	(0.44)	(0.18)
$R_m - R_f$	**1.1325**	**1.0024**	**1.0006**	**0.9753**	**0.9245**	**0.8973**	**0.8966**	**0.9523**	**0.8622**	**0.7776**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**1.1126**	**0.7530**	**0.8888**	**0.6840**	**0.7171**	**0.5657**	**0.4973**	**0.6545**	**0.4411**	**0.4741**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.6967**	**0.2065**	**0.3981**	**0.2986**	**0.2868**	**0.2543**	**0.1853**	**0.0383**	**0.1464**	**0.1968**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.62)	(0.02)	(0.02)
$K^+ - K^-$	-0.0350	-0.0241	-0.0181	0.0282	-0.0918	-0.0891	-0.0151	-0.0239	0.0843	-0.1922
	(0.74)	(0.63)	(0.72)	(0.56)	(0.05)	(0.07)	(0.73)	(0.68)	(0.07)	(0.00)
OLS R^2	0.67	0.87	0.87	0.87	0.87	0.85	0.88	0.82	0.85	0.74

P11L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0024	-0.0064	-0.0036	-0.0035	0.0002	-0.0011	-0.0064	-0.0083	-0.0020	**-0.0114**
	(0.78)	(0.11)	(0.37)	(0.37)	(0.95)	(0.78)	(0.06)	(0.05)	(0.60)	(0.02)
$R_m - R_f$	**1.0114**	**0.8936**	**0.8551**	**0.8657**	**0.7565**	**0.7536**	**0.7509**	**0.6825**	**0.7776**	**0.6756**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**1.0559**	**0.7014**	**0.8198**	**0.6321**	**0.6372**	**0.4974**	**0.4282**	**0.5265**	**0.4012**	**0.4253**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.7923**	**0.2898**	**0.5081**	**0.3773**	**0.4209**	**0.3699**	**0.2952**	**0.2414**	**0.2010**	**0.2916**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
S^-	0.1164	**0.1041**	**0.1390**	**0.1042**	**0.1615**	**0.1381**	**0.1393**	**0.2578**	**0.0798**	**0.0995**

	(0.12)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.02)
OLS R^2	0.68	0.88	0.88	0.88	0.88	0.86	0.89	0.85	0.86	0.73

P11L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	-0.0056	**-0.0162**	**-0.0151**	**-0.0149**	**-0.0083**	**-0.0098**	**-0.0145**	-0.0080	**-0.0138**	-0.0113
	(0.56)	(0.00)	(0.00)	(0.00)	(0.04)	(0.02)	(0.00)	(0.11)	(0.00)	(0.05)
$R_m - R_f$	**0.8335**	**0.6824**	**0.6037**	**0.6184**	**0.5639**	**0.5602**	**0.5692**	**0.6585**	**0.5249**	**0.6685**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**1.1122**	**0.7525**	**0.8881**	**0.6833**	**0.7168**	**0.5654**	**0.4967**	**0.6540**	**0.4402**	**0.4745**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.7691**	**0.2825**	**0.4913**	**0.3783**	**0.3785**	**0.3403**	**0.2622**	0.1083	**0.2164**	**0.2397**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.15)	(0.00)	(0.01)
K^+	**0.3267**	**0.3495**	**0.4333**	**0.3890**	**0.3946**	**0.3690**	**0.3574**	**0.3209**	**0.3669**	0.1216
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.13)
OLS R^2	0.68	0.89	0.89	0.90	0.89	0.87	0.90	0.83	0.88	0.73

Table 4.19: Parameter estimates for P24L1 sorted portfolios

This table presents the result of time series regression of portfolios which are sorted based on 24 months past returns. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for five models.

P24L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0067	0.0050	**0.0104**	**0.0081**	0.0067	0.0067	**0.0083**	0.0000	0.0064	-0.0016
	(0.23)	(0.18)	(0.00)	(0.01)	(0.12)	(0.05)	(0.03)	(0.99)	(0.07)	(0.66)
$R_m - R_f$	**0.9716**	**1.0114**	**1.0136**	**0.9511**	**0.9880**	**0.9419**	**0.9542**	**0.9187**	**0.9390**	**0.8878**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6549**	**0.6448**	**0.6719**	**0.7113**	**0.5772**	**0.6704**	**0.6937**	**0.5688**	**0.6644**	**0.3941**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.5212**	**0.3485**	**0.2165**	**0.2700**	**0.2652**	**0.3124**	**0.3096**	**0.2441**	0.0884	0.0744
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.10)
OLS R^2	0.73	0.86	0.87	0.89	0.82	0.86	0.84	0.84	0.85	0.83

P24L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0025	0.0024	0.0064	0.0059	0.0044	0.0035	0.0072	-0.0010	0.0018	-0.0021
	(0.63)	(0.53)	(0.07)	(0.07)	(0.33)	(0.32)	(0.07)	(0.76)	(0.57)	(0.54)
$R_m - R_f$	**0.9245**	**0.9977**	**0.9760**	**0.9244**	**0.9795**	**0.9260**	**0.9606**	**0.9058**	**0.8933**	**0.8651**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6672**	**0.6286**	**0.6622**	**0.7023**	**0.6853**	**0.6634**	**0.6733**	**0.6117**	**0.5676**	**0.4821**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2461**	**0.3420**	**0.2155**	**0.2624**	**0.3579**	**0.4161**	**0.3507**	**0.3042**	**0.1344**	**0.1633**
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.02)
$S^- - S^+$	-0.0232	-0.0033	0.0017	0.0276	0.0389	0.0257	0.0167	0.0367	**0.2424**	0.0158
	(0.65)	(0.93)	(0.96)	(0.38)	(0.37)	(0.45)	(0.66)	(0.24)	(0.00)	(0.64)

OLS R^2	0.74	0.86	0.87	0.88	0.82	0.86	0.85	0.88	0.89	0.85

P24L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0022	0.0023	0.0064	0.0063	0.0048	0.0038	0.0074	-0.0005	0.0048	-0.0019
	(0.67)	(0.54)	(0.07)	(0.05)	(0.27)	(0.28)	(0.06)	(0.88)	(0.18)	(0.57)
$R_m - R_f$	**0.9210**	**0.9955**	**0.9763**	**0.9280**	**0.9852**	**0.9290**	**0.9626**	**0.9116**	**0.9297**	**0.8671**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6524**	**0.6260**	**0.6634**	**0.7196**	**0.7100**	**0.6794**	**0.6838**	**0.6351**	**0.7216**	**0.4921**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2609**	**0.3315**	**0.2149**	**0.2410**	**0.3321**	**0.3935**	**0.3367**	**0.2826**	-0.0195	**0.1502**
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.77)	(0.02)
$K^+ - K^-$	0.0028	**-0.1400**	0.0060	-0.0462	-0.0161	-0.0729	-0.0399	0.0148	-0.0250	-0.0354
	(0.97)	(0.01)	(0.90)	(0.30)	(0.79)	(0.13)	(0.46)	(0.74)	(0.61)	(0.46)
OLS R^2	0.74	0.86	0.87	0.88	0.82	0.86	0.85	0.88	0.85	0.85

P24L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0003	-0.0034	0.0007	-0.0006	-0.0046	-0.0035	-0.0002	-0.0068	**-0.0139**	**-0.0080**
	(0.96)	(0.42)	(0.85)	(0.87)	(0.34)	(0.37)	(0.96)	(0.06)	(0.00)	(0.04)
$R_m - R_f$	**0.8854**	**0.8901**	**0.8696**	**0.8013**	**0.8093**	**0.7945**	**0.8225**	**0.7950**	**0.5817**	**0.7551**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6356**	**0.5757**	**0.6128**	**0.6594**	**0.6266**	**0.6155**	**0.6172**	**0.5798**	**0.5566**	**0.4389**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2871**	**0.4237**	**0.2937**	**0.3398**	**0.4645**	**0.5008**	**0.4449**	**0.3678**	**0.2419**	**0.2370**
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
S^-	0.0339	**0.1022**	**0.1018**	**0.1214**	**0.1681**	**0.1292**	**0.1342**	**0.1111**	**0.3324**	**0.1073**

	(0.50)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.74	0.86	0.88	0.89	0.83	0.87	0.85	0.89	0.91	0.85

P24L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	-0.0118	-0.0095	**-0.0098**	**-0.0084**	**-0.0160**	**-0.0120**	**-0.0111**	**-0.0172**	**-0.0126**	**-0.0162**
	(0.07)	(0.05)	(0.02)	(0.03)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
$R_m - R_f$	**0.6347**	**0.7544**	**0.6417**	**0.6265**	**0.5576**	**0.6048**	**0.5834**	**0.5685**	**0.5713**	**0.5732**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6519**	**0.6260**	**0.6627**	**0.7192**	**0.7093**	**0.6791**	**0.6832**	**0.6344**	**0.7210**	**0.4916**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3267**	**0.4000**	**0.2915**	**0.3148**	**0.4322**	**0.4751**	**0.4278**	**0.3603**	**0.0655**	**0.2213**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.29)	(0.00)
K^+	**0.3123**	**0.2649**	**0.3650**	**0.3295**	**0.4668**	**0.3547**	**0.4142**	**0.3741**	**0.3913**	**0.3211**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.75	0.87	0.89	0.90	0.84	0.88	0.87	0.90	0.88	0.87

Table 4.20: Parameter estimates for P36L1 sorted portfolios

This table presents the result of time series regression of portfolios which are sorted based on 36 months past returns. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for five models.

P36L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	-0.0010	0.0040	**0.0105**	0.0064	**0.0118**	0.0085	0.0059	0.0037	0.0028	-0.0019
	(0.85)	(0.26)	(0.00)	(0.09)	(0.00)	(0.05)	(0.11)	(0.29)	(0.43)	(0.65)
$R_m - R_f$	**0.9852**	**0.9657**	**0.9993**	**0.9342**	**0.9918**	**0.9717**	**0.9446**	**0.9267**	**0.9195**	**0.8944**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6663**	**0.7299**	**0.7496**	**0.6658**	**0.6078**	**0.6731**	**0.5266**	**0.4998**	**0.4248**	**0.4093**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.4355**	**0.4045**	**0.3317**	**0.5247**	**0.2969**	**0.2252**	**0.2029**	**0.1872**	0.0870	0.0533
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.34)
OLS R^2	0.76	0.87	0.87	0.85	0.83	0.82	0.85	0.86	0.84	0.78

P36L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0015	0.0022	0.0073	0.0044	0.0080	0.0034	0.0023	0.0025	0.0029	-0.0007
	(0.76)	(0.53)	(0.04)	(0.21)	(0.05)	(0.36)	(0.50)	(0.45)	(0.41)	(0.86)
$R_m - R_f$	**1.0031**	**0.9519**	**0.9749**	**0.9127**	**0.9781**	**0.8874**	**0.9058**	**0.9054**	**0.9245**	**0.8966**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7300**	**0.7168**	**0.7236**	**0.6274**	**0.6502**	**0.5682**	**0.5724**	**0.4815**	**0.5710**	**0.4939**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3315**	**0.3573**	**0.2275**	**0.2964**	**0.3208**	**0.2628**	**0.2818**	**0.2312**	**0.2111**	**0.1912**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)
$S^- - S^+$	-0.0005	0.0255	-0.0026	0.0034	-0.0044	**0.2507**	0.0326	0.0646	0.0052	0.0687
	(0.99)	(0.46)	(0.94)	(0.92)	(0.91)	(0.00)	(0.31)	(0.04)	(0.88)	(0.09)

OLS R^2	0.78	0.87	0.87	0.86	0.84	0.85	0.87	0.87	0.86	0.81

P36L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0015	0.0025	0.0073	0.0044	0.0080	0.0066	0.0027	0.0033	0.0030	0.0002
	(0.76)	(0.47)	(0.04)	(0.20)	(0.05)	(0.11)	(0.42)	(0.32)	(0.40)	(0.97)
$R_m - R_f$	**1.0029**	**0.9557**	**0.9743**	**0.9141**	**0.9768**	**0.9245**	**0.9099**	**0.9139**	**0.9251**	**0.9069**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7296**	**0.7330**	**0.7220**	**0.6298**	**0.6472**	**0.7273**	**0.5929**	**0.5222**	**0.5742**	**0.5375**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3313**	**0.3407**	**0.2278**	**0.3007**	**0.3186**	0.1001	**0.2548**	**0.1812**	**0.2062**	0.1471
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.19)	(0.00)	(0.00)	(0.00)	(0.06)
$K^+ - K^-$	-0.0063	-0.0073	-0.0148	0.0718	-0.0547	-0.0656	-0.0728	**-0.1066**	-0.0187	-0.0117
	(0.93)	(0.88)	(0.77)	(0.13)	(0.33)	(0.25)	(0.11)	(0.02)	(0.70)	(0.84)
OLS R^2	0.78	0.87	0.87	0.86	0.84	0.81	0.87	0.87	0.86	0.81

P36L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	-0.0030	-0.0036	0.0012	-0.0006	0.0004	**-0.0138**	-0.0035	-0.0042	-0.0034	-0.0102
	(0.60)	(0.35)	(0.76)	(0.88)	(0.93)	(0.00)	(0.35)	(0.25)	(0.39)	(0.02)
$R_m - R_f$	**0.9187**	**0.8413**	**0.8615**	**0.8203**	**0.8361**	**0.5462**	**0.7965**	**0.7756**	**0.8073**	**0.7154**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6897**	**0.6788**	**0.6684**	**0.5855**	**0.5804**	**0.5478**	**0.5390**	**0.4564**	**0.5183**	**0.4467**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3945**	**0.4265**	**0.3133**	**0.3635**	**0.4287**	**0.3881**	**0.3464**	**0.2946**	**0.2957**	**0.2908**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
S^-	0.0804	**0.1093**	**0.1079**	**0.0888**	**0.1349**	**0.3618**	**0.1091**	**0.1332**	**0.1126**	**0.1829**

	(0.10)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.78	0.87	0.87	0.86	0.84	0.88	0.88	0.88	0.86	0.82

P36L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	**-0.0134**	**-0.0114**	**-0.0098**	**-0.0134**	**-0.0128**	**-0.0131**	**-0.0108**	**-0.0080**	-0.0162	**-0.0204**
	(0.03)	(0.01)	(0.02)	(0.00)	(0.01)	(0.01)	(0.01)	(0.05)	(0.00)	(0.00)
$R_m - R_f$	**0.6968**	**0.6689**	**0.6225**	**0.5474**	**0.5507**	**0.5212**	**0.6349**	**0.6840**	**0.5317**	**0.4837**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7291**	**0.7325**	**0.7214**	**0.6289**	**0.6466**	**0.7268**	**0.5927**	**0.5221**	**0.5735**	**0.5368**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.4025**	**0.4075**	**0.3103**	**0.3786**	**0.4220**	**0.1992**	**0.3250**	**0.2441**	**0.2986**	**0.2458**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
K^+	**0.3340**	**0.3129**	**0.3841**	**0.3991**	**0.4656**	**0.4409**	**0.3010**	**0.2522**	**0.4295**	**0.4618**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.79	0.88	0.89	0.89	0.87	0.84	0.88	0.88	0.89	0.84

Table 4.21: Parameter estimates for P48L1 sorted portfolios

This table presents the result of time series regression of portfolios which are sorted based on 48 months past returns. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for five models.

P48L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0064	**0.0103**	**0.0101**	0.0029	0.0049	0.0025	**0.0126**	0.0053	0.0055	0.0042
	(0.17)	(0.01)	(0.02)	(0.44)	(0.26)	(0.50)	(0.01)	(0.20)	(0.16)	(0.37)
$R_m - R_f$	**0.8962**	**0.9186**	**0.9420**	**0.9108**	**0.9414**	**0.9529**	**1.0220**	**0.9772**	**0.9616**	**0.9702**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.5584**	**0.5189**	**0.7013**	**0.5702**	**0.6185**	**0.7395**	**0.6542**	**0.6130**	**0.5811**	**0.4530**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.1606**	**0.1585**	**0.2032**	**0.3641**	**0.3531**	**0.3613**	**0.3436**	**0.2651**	**0.2976**	0.0650
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.30)
OLS R^2	0.77	0.83	0.81	0.85	0.82	0.87	0.83	0.83	0.85	0.78

P48L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0031	**0.0083**	**0.0079**	0.0026	0.0018	-0.0001	0.0052	0.0032	0.0017	0.0007
	(0.43)	(0.03)	(0.04)	(0.45)	(0.64)	(0.97)	(0.14)	(0.42)	(0.62)	(0.87)
$R_m - R_f$	**0.9015**	**0.9368**	**0.9331**	**0.9342**	**0.9271**	**0.9326**	**0.9557**	**0.9470**	**0.9324**	**0.9489**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.5738**	**0.5995**	**0.6368**	**0.6546**	**0.5964**	**0.7022**	**0.5671**	**0.6062**	**0.5145**	**0.5056**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2022**	**0.2501**	**0.1888**	**0.2213**	**0.2713**	**0.4583**	**0.4316**	**0.3060**	**0.1872**	0.0777
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.37)
$S^- - S^+$	0.0302	-0.0042	**0.1916**	-0.0150	**0.0764**	0.0528	**0.0789**	0.0561	0.0039	0.0095

	(0.43)	(0.91)	(0.00)	(0.66)	(0.04)	(0.10)	(0.02)	(0.15)	(0.91)	(0.83)
OLS R^2	0.82	0.84	0.85	0.86	0.84	0.88	0.87	0.84	0.87	0.80

P48L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0035	**0.0082**	**0.0104**	0.0024	0.0027	0.0005	0.0062	0.0039	0.0018	0.0009
	(0.37)	(0.03)	(0.01)	(0.48)	(0.47)	(0.87)	(0.08)	(0.32)	(0.61)	(0.84)
$R_m - R_f$	**0.9059**	**0.9352**	**0.9624**	**0.9320**	**0.9372**	**0.9403**	**0.9671**	**0.9549**	**0.9337**	**0.9504**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.5929**	**0.5966**	**0.7586**	**0.6451**	**0.6446**	**0.7357**	**0.6171**	**0.6418**	**0.5171**	**0.5116**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.1822**	**0.2453**	**0.0711**	**0.2315**	**0.2120**	**0.4231**	**0.3779**	**0.2663**	**0.1899**	0.0724
	(0.01)	(0.00)	(0.34)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.38)
$K^+ - K^-$	-0.0123	-0.0817	0.0240	0.0085	**-0.1282**	-0.0241	-0.0482	-0.0511	0.0577	0.0066
	(0.82)	(0.12)	(0.66)	(0.86)	(0.02)	(0.60)	(0.32)	(0.35)	(0.22)	(0.91)
OLS R^2	0.82	0.84	0.83	0.86	0.84	0.88	0.87	0.84	0.87	0.80

P48L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	-0.0036	0.0018	-0.0060	-0.0011	-0.0059	-0.0076	-0.0047	-0.0044	-0.0047	-0.0060
	(0.41)	(0.66)	(0.12)	(0.79)	(0.16)	(0.03)	(0.21)	(0.32)	(0.21)	(0.23)
$R_m - R_f$	**0.7744**	**0.8177**	**0.6577**	**0.8669**	**0.7777**	**0.7886**	**0.7638**	**0.8013**	**0.8127**	**0.8237**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.5306**	**0.5407**	**0.6142**	**0.6142**	**0.5687**	**0.6637**	**0.5206**	**0.5688**	**0.4599**	**0.4516**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2813**	**0.3408**	**0.2954**	**0.2791**	**0.3432**	**0.5383**	**0.5339**	**0.3857**	**0.2743**	**0.1660**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)

S^-	**0.1256**	**0.1131**	**0.2905**	0.0621	**0.1536**	**0.1451**	**0.1946**	**0.1472**	**0.1148**	**0.1208**
	(0.00)	(0.00)	(0.00)	(0.07)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.83	0.85	0.88	0.86	0.85	0.89	0.89	0.85	0.87	0.81

P48L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	**-0.0131**	-0.0073	-0.0079	**-0.0113**	**-0.0127**	**-0.0168**	**-0.0131**	**-0.0139**	**-0.0161**	**-0.0176**
	(0.01)	(0.11)	(0.09)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$R_m - R_f$	**0.5645**	**0.6176**	**0.5864**	**0.6503**	**0.6216**	**0.5842**	**0.5701**	**0.5891**	**0.5669**	**0.5709**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.5924**	**0.5963**	**0.7578**	**0.6445**	**0.6444**	**0.7351**	**0.6165**	**0.6413**	**0.5163**	**0.5109**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2621**	**0.3262**	**0.1556**	**0.2957**	**0.2966**	**0.5075**	**0.4740**	**0.3554**	**0.2692**	**0.1593**
	(0.00)	(0.00)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)
K^+	**0.3727**	**0.3476**	**0.4099**	**0.3073**	**0.3460**	**0.3889**	**0.4337**	**0.3998**	**0.3994**	**0.4140**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.84	0.86	0.86	0.88	0.86	0.90	0.90	0.86	0.89	0.82

Table 4.22: Parameter estimates for P60L1 sorted portfolios

This table presents the result of time series regression of portfolios which are sorted based on 60 months past returns. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for five models.

P60L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0023	**0.0092**	0.0053	0.0005	0.0074	-0.0006	0.0044	0.0063	0.0043	-0.0008
	(0.58)	(0.02)	(0.15)	(0.90)	(0.07)	(0.87)	(0.25)	(0.11)	(0.26)	(0.85)
$R_m - R_f$	**0.9168**	**0.8754**	**0.9198**	**0.9631**	**0.9638**	**0.9197**	**0.9854**	**0.9658**	**0.9568**	**0.9117**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6846**	**0.5175**	**0.5201**	**0.5789**	**0.6493**	**0.5754**	**0.7068**	**0.6298**	**0.5728**	**0.5318**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	-0.0334	**0.1213**	**0.2938**	**0.2341**	**0.4125**	**0.3052**	**0.2714**	**0.3333**	**0.1865**	**0.1849**
	(0.58)	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.81	0.82	0.85	0.85	0.84	0.87	0.86	0.85	0.85	0.79

P60L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0000	**0.0091**	0.0052	0.0014	0.0057	-0.0002	0.0032	0.0028	0.0035	-0.0014
	(1.00)	(0.01)	(0.16)	(0.72)	(0.11)	(0.95)	(0.37)	(0.44)	(0.35)	(0.73)
$R_m - R_f$	**0.9097**	**0.8950**	**0.9249**	**0.9648**	**0.9612**	**0.9297**	**0.9580**	**0.9405**	**0.9376**	**0.9121**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6313**	**0.6248**	**0.5308**	**0.5911**	**0.6156**	**0.6316**	**0.6139**	**0.5162**	**0.5305**	**0.5187**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	0.0591	**0.2553**	**0.3224**	**0.1700**	**0.3013**	**0.3438**	**0.3259**	**0.3554**	**0.2030**	**0.1655**
	(0.45)	(0.00)	(0.00)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.03)
$S^- - S^+$	**0.1795**	0.0123	0.0230	0.0089	0.0668	0.0164	0.0520	0.0378	0.0053	0.0451
	(0.00)	(0.73)	(0.52)	(0.81)	(0.05)	(0.62)	(0.14)	(0.29)	(0.88)	(0.24)

OLS R^2	0.83	0.84	0.85	0.85	0.87	0.87	0.86	0.86	0.85	0.82

P60L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0023	**0.0093**	0.0055	0.0015	0.0066	0.0000	0.0039	0.0033	0.0036	-0.0008
	(0.59)	(0.01)	(0.13)	(0.69)	(0.07)	(1.00)	(0.28)	(0.36)	(0.34)	(0.84)
$R_m - R_f$	**0.9369**	**0.8969**	**0.9277**	**0.9661**	**0.9706**	**0.9322**	**0.9652**	**0.9461**	**0.9383**	**0.9192**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7454**	**0.6327**	**0.5453**	**0.5968**	**0.6579**	**0.6420**	**0.6468**	**0.5401**	**0.5339**	**0.5474**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	-0.0525	**0.2480**	**0.3034**	**0.1645**	**0.2545**	**0.3337**	**0.2887**	**0.3309**	**0.1985**	**0.1400**
	(0.51)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.06)
$K^+ - K^-$	0.0074	0.0044	-0.0513	-0.0001	-0.0558	0.0016	-0.0514	-0.0102	-0.0131	0.0305
	(0.90)	(0.93)	(0.31)	(1.00)	(0.26)	(0.97)	(0.30)	(0.84)	(0.80)	(0.58)
OLS R^2	0.81	0.84	0.85	0.85	0.87	0.87	0.86	0.86	0.85	0.82

P60L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	**-0.0130**	0.0025	-0.0019	-0.0033	-0.0019	-0.0064	-0.0056	-0.0041	-0.0044	-0.0084
	(0.00)	(0.54)	(0.65)	(0.45)	(0.63)	(0.09)	(0.15)	(0.30)	(0.29)	(0.06)
$R_m - R_f$	**0.6523**	**0.7704**	**0.7910**	**0.8765**	**0.8140**	**0.8139**	**0.7891**	**0.8086**	**0.7906**	**0.7789**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6105**	**0.5727**	**0.4803**	**0.5543**	**0.5835**	**0.5859**	**0.5631**	**0.4750**	**0.4638**	**0.4810**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.1586**	**0.3417**	**0.4102**	**0.2311**	**0.3766**	**0.4216**	**0.4248**	**0.4341**	**0.3097**	**0.2414**
	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
S^-	**0.2716**	**0.1207**	**0.1311**	**0.0855**	**0.1502**	**0.1129**	**0.1687**	**0.1313**	**0.1411**	**0.1336**

	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.85	0.85	0.86	0.85	0.88	0.88	0.88	0.87	0.86	0.83

P60L1 Momentum-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	**-0.0149**	-0.0073	**-0.0091**	**-0.0157**	**-0.0108**	**-0.0170**	**-0.0146**	**-0.0132**	**-0.0181**	**-0.0165**
	(0.00)	(0.10)	(0.04)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$R_m - R_f$	**0.5828**	**0.5565**	**0.6266**	**0.6113**	**0.6152**	**0.5821**	**0.5864**	**0.6069**	**0.4935**	**0.5967**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7447**	**0.6320**	**0.5449**	**0.5961**	**0.6574**	**0.6413**	**0.6462**	**0.5396**	**0.5331**	**0.5467**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	0.0285	**0.3261**	**0.3776**	**0.2463**	**0.3417**	**0.4143**	**0.3809**	**0.4101**	**0.3023**	**0.2116**
	(0.71)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
K^+	**0.3862**	**0.3713**	**0.3293**	**0.3871**	**0.3885**	**0.3820**	**0.4140**	**0.3702**	**0.4855**	**0.3516**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R^2	0.83	0.86	0.87	0.87	0.89	0.90	0.89	0.88	0.88	0.84

Table 4.23: Parameter estimates for coskewness and cokurtosis sorted portfolios

This table presents the result of time series regression of portfolios which are sorted based on coskewness and cokurtosis value separately. It also indicates the parameter estimates, their p-value in parenthesis below each value and adjusted R^2 value for five models.

Coskewness-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0020	0.0032	0.0082	0.0020	0.0042	0.0056	0.0037	0.0039	0.0005	0.0017
	(0.64)	(0.34)	(0.06)	(0.60)	(0.31)	(0.15)	(0.35)	(0.26)	(0.89)	(0.63)
$R_m - R_f$	**0.9002**	**0.9655**	**0.9940**	**0.9855**	**0.9027**	**0.9538**	**0.9297**	**0.9425**	**0.9198**	**0.9644**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7537**	**0.6341**	**0.8884**	**0.6782**	**0.6026**	**0.6590**	**0.5207**	**0.5388**	**0.4066**	**0.3031**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2320**	**0.2317**	**0.0188**	**0.3220**	**0.1922**	**0.2306**	**0.2592**	**0.2557**	**0.2343**	**0.1750**
	(0.00)	(0.00)	(0.81)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
OLS R^2	0.80	0.88	0.82	0.85	0.80	0.84	0.83	0.86	0.86	0.87

Coskewness-Sorted Portfolios – Value -Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0003	0.0021	0.0051	0.0011	0.0043	0.0053	0.0034	0.0049	0.0008	0.0018
	(0.94)	(0.54)	(0.19)	(0.77)	(0.31)	(0.18)	(0.39)	(0.16)	(0.81)	(0.60)
$R_m - R_f$	**0.8800**	**0.9518**	**0.9572**	**0.9744**	**0.9041**	**0.9501**	**0.9266**	**0.9539**	**0.9239**	**0.9659**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6689**	**0.5762**	**0.7340**	**0.6315**	**0.6086**	**0.6434**	**0.5077**	**0.5869**	**0.4237**	**0.3095**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3155**	**0.2888**	**0.1708**	**0.3681**	**0.1863**	**0.2460**	**0.2720**	**0.2083**	**0.2175**	**0.1688**
	(0.00)	(0.00)	(0.03)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)
$S^- - S^+$	**0.1335**	**0.0911**	**0.2429**	0.0736	-0.0094	0.0247	0.0205	**-0.0757**	-0.0268	-0.0100
	(0.00)	(0.01)	(0.00)	(0.05)	(0.82)	(0.52)	(0.59)	(0.03)	(0.42)	(0.77)

OLS R^2	0.81	0.88	0.85	0.85	0.80	0.84	0.83	0.87	0.86	0.87

Coskewness-Sorted Portfolios – Value -Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0019	0.0032	0.0082	0.0020	0.0042	0.0056	0.0037	0.0039	0.0005	0.0017
	(0.64)	(0.34)	(0.06)	(0.60)	(0.31)	(0.15)	(0.35)	(0.26)	(0.89)	(0.62)
$R_m - R_f$	**0.8978**	**0.9640**	**0.9940**	**0.9849**	**0.9033**	**0.9542**	**0.9298**	**0.9431**	**0.9198**	**0.9655**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7531**	**0.6337**	**0.8884**	**0.6781**	**0.6028**	**0.6592**	**0.5208**	**0.5389**	**0.4066**	**0.3034**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2141**	**0.2198**	**0.0191**	**0.3174**	**0.1971**	**0.2338**	**0.2602**	**0.2602**	**0.2343**	**0.1836**
	(0.01)	(0.00)	(0.81)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
$K^+ - K^-$	**-0.1988**	**-0.1330**	0.0025	-0.0510	0.0539	0.0363	0.0112	0.0503	0.0000	0.0948
	(0.00)	(0.00)	(0.97)	(0.34)	(0.35)	(0.51)	(0.84)	(0.30)	(1.00)	(0.05)
OLS R^2	0.81	0.88	0.82	0.85	0.80	0.84	0.83	0.86	0.86	0.87

Coskewness-Sorted Portfolios – Value -Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	**-0.0104**	-0.0052	**-0.0120**	-0.0058	0.0005	-0.0023	-0.0033	-0.0002	-0.0033	-0.0051
	(0.02)	(0.15)	(0.00)	(0.18)	(0.92)	(0.60)	(0.45)	(0.95)	(0.39)	(0.19)
$R_m - R_f$	**0.6705**	**0.8083**	**0.6188**	**0.8400**	**0.8334**	**0.8069**	**0.8002**	**0.8654**	**0.8492**	**0.8372**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6448**	**0.5596**	**0.7105**	**0.6092**	**0.5697**	**0.5894**	**0.4593**	**0.5022**	**0.3731**	**0.2428**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.4029**	**0.3488**	**0.2980**	**0.4303**	**0.2437**	**0.3399**	**0.3556**	**0.3130**	**0.2868**	**0.2697**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
S^-	**0.2192**	**0.1501**	**0.3581**	**0.1389**	**0.0661**	**0.1402**	**0.1236**	**0.0736**	**0.0674**	**0.1214**

	(0.00)	(0.00)	(0.00)	(0.00)	(0.11)	(0.00)	(0.00)	(0.03)	(0.04)	(0.00)
OLS R^2	0.83	0.89	0.88	0.86	0.80	0.85	0.84	0.87	0.87	0.88

Coskewness-Sorted Portfolios – Value -Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	**-0.0164**	**-0.0100**	**-0.0148**	**-0.0131**	**-0.0110**	**-0.0165**	**-0.0155**	**-0.0127**	**-0.0110**	**-0.0179**
	(0.00)	(0.02)	(0.00)	(0.01)	(0.03)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
$R_m - R_f$	**0.5221**	**0.6942**	**0.5221**	**0.6744**	**0.5894**	**0.4981**	**0.5354**	**0.6006**	**0.6833**	**0.5622**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.7530**	**0.6336**	**0.8875**	**0.6777**	**0.6020**	**0.6582**	**0.5200**	**0.5382**	**0.4062**	**0.3024**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3192**	**0.2943**	**0.1277**	**0.3938**	**0.2645**	**0.3357**	**0.3502**	**0.3345**	**0.2888**	**0.2678**
	(0.00)	(0.00)	(0.08)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
K^+	**0.4125**	**0.2961**	**0.5148**	**0.3395**	**0.3417**	**0.4972**	**0.4302**	**0.3730**	**0.2581**	**0.4388**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R2	0.83	0.89	0.86	0.87	0.82	0.87	0.86	0.89	0.87	0.90

Cokurtosis-Sorted Portfolios – Value-Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0065	0.0008	0.0033	0.0090	0.0010	0.0001	0.0074	0.0020	0.0030	0.0017
	(0.11)	(0.84)	(0.37)	(0.04)	(0.81)	(0.98)	(0.05)	(0.58)	(0.41)	(0.65)
$R_m - R_f$	**0.9530**	**0.9711**	**0.9659**	**0.9146**	**0.9940**	**0.9443**	**0.9103**	**0.9573**	**0.9714**	**0.8841**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6506**	**0.6296**	**0.6226**	**0.5693**	**0.6875**	**0.6245**	**0.5776**	**0.5945**	**0.5736**	**0.4619**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2905**	**0.2206**	**0.3409**	**0.1560**	**0.2928**	**0.2878**	**0.2038**	**0.2493**	-0.0774	**0.1832**
	(0.00)	(0.00)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.26)	(0.01)

OLS R^2	0.83	0.83	0.86	0.80	0.84	0.84	0.83	0.85	0.85	0.83

Cokurtosis-Sorted Portfolios – Value -Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0052	-0.0012	0.0023	0.0091	0.0011	-0.0004	0.0080	0.0023	0.0009	0.0015
	(0.19)	(0.77)	(0.54)	(0.03)	(0.79)	(0.91)	(0.04)	(0.53)	(0.79)	(0.68)
$R_m - R_f$	**0.9379**	**0.9472**	**0.9532**	**0.9162**	**0.9951**	**0.9381**	**0.9175**	**0.9607**	**0.9464**	**0.8819**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.5873**	**0.5290**	**0.5692**	**0.5760**	**0.6923**	**0.5982**	**0.6077**	**0.6089**	**0.4688**	**0.4526**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3528**	**0.3197**	**0.3934**	**0.1494**	**0.2882**	**0.3137**	**0.1741**	**0.2351**	0.0256	**0.1923**
	(0.00)	(0.00)	(0.00)	(0.08)	(0.00)	(0.00)	(0.02)	(0.00)	(0.71)	(0.01)
$S^- - S^+$	**0.0995**	**0.1583**	**0.0839**	-0.0106	-0.0074	0.0414	-0.0475	-0.0227	**0.1648**	0.0146
	(0.01)	(0.00)	(0.02)	(0.80)	(0.85)	(0.27)	(0.21)	(0.53)	(0.00)	(0.69)
OLS R^2	0.84	0.84	0.86	0.80	0.84	0.84	0.83	0.85	0.87	0.83

Cokurtosis-Sorted Portfolios – Value -Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	0.0064	0.0008	0.0033	0.0090	0.0010	0.0001	0.0074	0.0021	0.0031	0.0017
	(0.09)	(0.84)	(0.36)	(0.04)	(0.80)	(0.98)	(0.05)	(0.57)	(0.40)	(0.64)
$R_m - R_f$	**0.9494**	**0.9678**	**0.9637**	**0.9151**	**0.9948**	**0.9451**	**0.9115**	**0.9588**	**0.9730**	**0.8850**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6496**	**0.6287**	**0.6220**	**0.5695**	**0.6878**	**0.6247**	**0.5779**	**0.5949**	**0.5740**	**0.4621**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.2637**	**0.1960**	**0.3237**	0.1600	**0.2989**	**0.2937**	**0.2124**	**0.2604**	-0.0650	**0.1895**
	(0.00)	(0.01)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.34)	(0.01)
$K^+ - K^-$	**-0.2981**	**-0.2736**	**-0.1906**	0.0446	0.0673	0.0655	0.0961	**0.1242**	**0.1391**	0.0700

	1	2	3	4	5	6	7	8	9	10
	(0.00)	(0.00)	(0.00)	(0.45)	(0.23)	(0.22)	(0.07)	(0.01)	(0.01)	(0.17)
OLS R^2	0.85	0.85	0.87	0.80	0.84	0.84	0.83	0.86	0.86	0.83

Cokurtosis-Sorted Portfolios – Value -Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	-0.0042	-0.0125	-0.0055	0.0031	-0.0052	-0.0061	0.0032	-0.0040	-0.0113	-0.0053
	(0.33)	(0.00)	(0.18)	(0.52)	(0.25)	(0.16)	(0.46)	(0.34)	(0.00)	(0.20)
$R_m - R_f$	**0.7542**	**0.7235**	**0.8021**	**0.8059**	**0.8782**	**0.8299**	**0.8323**	**0.8459**	**0.7059**	**0.7533**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.5563**	**0.5122**	**0.5449**	**0.5178**	**0.6326**	**0.5703**	**0.5405**	**0.5417**	**0.4477**	**0.3998**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.4384**	**0.4048**	**0.4628**	**0.2369**	**0.3790**	**0.3729**	**0.2619**	**0.3321**	0.1200	**0.2805**
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.00)
S^-	**0.1897**	**0.2363**	**0.1564**	**0.1038**	**0.1105**	**0.1092**	**0.0745**	**0.1063**	**0.2533**	**0.1249**
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)
OLS R2	0.85	0.86	0.87	0.80	0.84	0.85	0.83	0.86	0.89	0.84

Cokurtosis-Sorted Portfolios – Value -Weighted Portfolio Returns

	1	2	3	4	5	6	7	8	9	10
Intercept	-0.0078	**-0.0155**	-0.0092	-0.0092	**-0.0176**	**-0.0156**	**-0.0089**	**-0.0227**	**-0.0159**	**-0.0164**
	(0.12)	(0.00)	(0.05)	(0.08)	(0.00)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)
$R_m - R_f$	**0.6591**	**0.6365**	**0.7080**	**0.5422**	**0.6112**	**0.6213**	**0.5745**	**0.4483**	**0.5825**	**0.5118**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
SMB	**0.6500**	**0.6290**	**0.6221**	**0.5686**	**0.6868**	**0.6239**	**0.5769**	**0.5936**	**0.5728**	**0.4612**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
HML	**0.3583**	**0.2978**	**0.4004**	**0.2419**	**0.3811**	**0.3623**	**0.2813**	**0.3667**	**0.0122**	**0.2691**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.85)	(0.00)

K^+	**0.3206**	**0.3651**	**0.2815**	**0.4063**	**0.4176**	**0.3524**	**0.3664**	**0.5554**	**0.4243**	**0.4062**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OLS R2	0.85	0.85	0.87	0.82	0.86	0.86	0.85	0.90	0.88	0.86

CHAPTER 5

CONCLUSION

Asset pricing has always been an attractive subject to finance researchers and investors for years. Finance theory is built on the mean-variance context with CAPM. Although CAPM has an important role in the finance literature, there have been criticisms about the model. The validity of CAPM assumes that returns are normally distributed and the market excess return is the only important factor for capturing the variations of returns. In order to relax some of the restrictive assumptions of CAPM, first, the Arbitrage Pricing Theory (APT) of Ross [49] introduces a multifactor model in asset pricing. Fama and French [12] introduce the size and book to market factors besides the market factor in order to explain the cross-sectional variation in asset returns. After that, Carhart [4] extends Fama French three factor model with the addition of momentum factor. On the other side, empirical evidences against CAPM indicate that asset returns in emerging and developed markets have skewed and leptokurtic distribution so they are not normally distributed. If the returns are not normal, the mean and variance context of CAPM are not sufficient to characterize the distribution of returns. Therefore, finance researchers have started to search alternative models, and they take higher order comoments into consideration to define the distributional characteristics of asset returns. In the light of this idea, the effects of coskewness and cokurtosis factors on the variation of portfolios, which are sorted based on size, book to market, estimated beta, momentum, coskewness, and cokurtosis, are examined for BIST over the period January 1990 to June 2013.

In the first part of the study, the independent variables which are market excess return, SMB, HML, WML, $S^- - S^+$, $K^+ - K^-$ are calculated. After that, portfolios are formed based on sorted value of size, book to market, estimated beta, momentum, coskewness, and cokurtosis factor. The returns of the portfolios are used as dependent variables. After the portfolio formation, skewness and kurtosis values of portfolio returns are calculated, and the normality test is conducted. According to the normality test, portfolio returns are not normally distributed. This result supports the aim of this study, and the effects of skewness and kurtosis are expected to be significant for explaining the variation of portfolio returns in BIST. In the final part of the study, time series regressions are conducted based on the above mentioned portfolio types, and they are interpreted one by one.

According to time series regression of different portfolio combinations, coskewness and cokurtosis factors do not have incremental effects on Fama-French factors in BIST. Coskewness and cokurtosis factors are insignificant and there is no effect on the adjusted- R^2. On the other hand, negative coskewness and positive kurtosis are included into the three factor model particularly. It is also observed that negative coskewness has a marginal contribution for explaining portfolio excess returns and it also increases the adjusted-R^2. It is considered that the factor loading of negative coskewness is positive and significant. This result indicates that investors in BIST require higher rate of return to compensate for their risk because of a greater chance of extreme outcomes. When the negative coskewness is added to the Fama French model, the intercept term becomes statistically insignificant, regardless of how portfolios are formed. It indicates that most of the variation in returns is explained by the combination of the Fama French three factors and negative coskewness. Moreover, when positive cokurtosis factor is added to three factor model, it is observed that this factor also has an explanatory power in BIST but the intercept term becomes significant. It indicates that the factors already included in the model are not sufficient to explain the variation in returns. The factor loading of positive cokurtosis is also positive and this result indicates that investors in BIST require higher rate of return for positive cokurtosis because of the higher probability of extreme observations and large fluctuations. In addition, the adjusted -R^2 increases by including these factors. As a result, this study contributes to the current literature by examining the importance of skewness and kurtosis for asset pricing by representing extensive evidence from BIST.

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