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The Conditional Capital Asset Pricing Model: Evidence from Karachi Stock Exchange

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C O N T E N T S

List of Tables

List of Appendix Tables

ABSTRACT

This is an attempt to empirically investigate the risk and return relationship of individual stocks traded at Karachi Stock Exchange (KSE), the main equity market in Pakistan. The analysis is based on daily as well as monthly data of 49 companies and KSE 100 index is used as market factor covering the period from July 1993 to December 2004. The natural starting-point of this study is to test the adequacy of the standard Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965). The empirical findings do not support the standard CAPM model as a model to explain assets pricing in Pakistani equity market. The critical condition of CAPM—that there is a positive trade-off between risk and return—is rejected and residual risk plays some role in pricing risky assets. This allows for the return distribution to vary over time. The empirical results of the conditional CAPM, with time variation in market risk and risk premium, are more supported by the KSE data, where lagged macroeconomic variables, mostly containing business cycle information, are used for conditioning information. The information set includes the first lag of the following business cycle variables: market return, call money rate, term structure, inflation rate, foreign exchange rate, growth in industrial production, growth in real consumption, and growth in oil prices. In a nutshell, the results confirm the hypothesis that risk premium is time-varying type in Pakistani stock market and it strengthens the notion that rational asset pricing is working, although inefficiencies are also present in unconditional and conditional settings. The observation is that the dynamic size and book-to-market value coefficient explain the cross-section of expected returns in a few sub-periods. The conditional approach to testing the CAPM and the three-factor CAPM shows that the asset prices relationship is better explained by accommodating business cycle variables as information set. The findings of the conditional three-factor CAPM also give support to the fact that time-varying firm attributes have only a limited role in Pakistani market to explain the asset price behaviour.

JEL classification: C53 E44 G11

Keywords: Capital Asset Pricing Model, Fama-French Three Factor Model, Market Risk, Residual Risk, Size, Book-to-market Value, Information Set, Business Cycle Variables.

1. INTRODUCTION

The capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1966), and Black (1972) is the major analytical tool for explaining the relationship between expected return and risk used in financial economics. The CAPM model measures the risk of an asset by covariance of asset's return with the return of all invested wealth, known as market return. The main implications of the model are that expected return should be linearly related to an asset covariance with the return on market portfolio, called the beta risk. The principle of risk compensation is that higher beta risk is associated with higher return. However, empirical evidence has found weak or no statistical relationship to support this relationship [Banz (1981); Basu (1983); Fama and French (1992) and others].

The well documented poor empirical performance of Sharpe (1964) and Lintner (1966) static version of CAPM has motivated much research on conditional test of this asset pricing model [Gibbons and Ferson (1985); Ferson, Kandel, and Stambaugh (1987); Bollerslev, Engle, and Woodridge (1988); Harvey (1989); Ng (1991) and Jagannathan and Wang (1996), among others]. These tests incorporate conditioning information to allow risk and prices of risk to vary through time. This suggests while empirical examining CAPM by using the data from the real world, it is appropriate to make certain assumption, which are more close to real world. The unconditional CAPM is derived by examining the behaviour of the investor in only one period, where in real world investment decision are made over many periods. The assumption of betas of assets and the risk premium remain constant is also not reasonable because the betas and expected return generally depends on nature of information available at any point of time, and they vary over time as information set varies. The relative risk of a firm cash flow is likely to vary over the business cycles as Jagannathan and Wang (1996) have argued that to the extent that the business cycle is induced by technology and taste shocks, the relative share of different sectors in the economy fluctuates, inducing fluctuations in the betas of the firms in these sectors. In addition, during recession, for example the financial leverage of poorly performing firms may increase relative to other firms causing their stock betas to rise. In bad times the risk premium is high because investors want to smooth their out their consumption, therefore to make sure that investors hold their portfolio of stocks, the risk premium must be high in equilibrium. This line of argument implies that the instrument variables that are used for conditioning

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information must be related to current and/or future macroeconomic environment.

Another response is that empirical inadequacy of standard CAPM may be due to a number of seemingly unexplained patterns in asset returns that has resulted to use attribute sorted portfolios of stocks to represent the additional risk factor in the standard model. The most prominent work in this regard is series of papers by Fama and French (1992, 1993, 1995, 1996, 1998 and 2004).[1] The three-factor model of Fama and French (1996) says that the expected return in excess of risk-free rate is explained by the excess market return, the difference between the return on portfolio of small stocks and return on portfolio of large stocks (SMB) and the difference between the return on portfolio of high book-to-market stocks and return on a portfolio of low book-to-market stocks (HML). The three factor model of Fama and French (1993) is now widely used in empirical research that requires a model of expected return [Iqbal, *et al.* (2008); Ferson and Harvey (1999) and numerous other studies]. Given the prominence of Fama-French (1992) three-factor model it is interesting to test its empirical performance as an asset pricing model in an emerging market Pakistan

The main focus of this study is to examine empirically how well the market equilibrium model of Sharpe (1964) and Lintner (1966) can explain the risk return relationship in case of Pakistani market. This study extends the standard CAPM of Sharpe (1965) and Lintner (1966) by including Fama-French (1993) variables The conditional version of Sharpe-Lintner CAPM and Fama-French three factor CAPM is empirically investigated by estimating CAPM by allowing time variability in line that is suggested by Ferson and Harvey (1993, 1999) and others. These extended CAPM are dynamic, in which investors update their estimates of means, variances and covariance of asset returns each period to new information set. This implies that expected excess returns vary with time to reflect time variations in systematic risk and price of risk. The present study adds to the existing literature, first, by testing the conditional standard and the three-factor model for the firm-level data both daily as well as monthly, where book-to–market value is used as a variable instead of portfolio sorted on these two attributes of the firms. Second, for more insight, the investigation is done for different time intervals as the market has a different sentiment in different periods, and, third, the information sets used for conditioning the models are different.[2] This study contributes to exiting

[1]There are several arguments on the firm specific attributes that are used to form Fama-French factors. Haugen and Baker (1996), Daniel and Titman (1997) are of the view that such variables may be used to find assets that are systematically mispriced by the market. Others argue that these measures are proxies for exposure to underlying economic risk factors that are rationally priced in the market [Fama and French (1993, 1995, 1996)]. Another view is that the observed predictive relation are largely the result of data snooping and various biases in the data [Mackinley (1995); Black (1993); Kathari, Shanken, and Sloan (1995)].

[2]In emerging markets the return distribution is time varying due to volatile institutions,

literature for emerging markets by testing consumption CAPM for Pakistani market in static and dynamic context

The study is organised as follows. The previous empirical evidence on standard CAPM and its various extensions are discussed briefly in Section 2. Section 3 provides the empirical methodology followed in this study. The empirical results of unconditional and conditional standard CAPM and three-factor are presented and discussed in Section 4, while Section 5 concludes the study.

2. PREVIOUS EMPIRICAL EVIDENCE

The Sharpe-Lintner CAPM has been subjected to extensive empirical testing in the past and various researchers have come up with mixed findings. Lintner (1966) and Douglas (1969) are the earliest studies to conduct tests of CAPM on individual stocks in the excess-return form. They have found that the intercept has values much larger than the risk-free rate of return, while the coefficient of beta is statistically has a lower value, though it is statistically significant and the residual risk affects asset returns. According to Miller and Scholes (1972) these results, which contradict the CAPM, arise due to measurement error. As regards the test of CAPM on portfolios, Fama and McBeth (1973) have performed the classical test. The study estimated beta from time series regression over the monthly data for the period 1935-1968 and then performed a cross-sectional regression for each month to compute risk premium. Fama and McBeth (1973) have formed twenty portfolios of assets. Their results show that the coefficient of beta is statistically significant and its value has remained small for many sub-periods. Fama and McBeth (1973) have validated the CAPM on all stocks listed on NYSE during 1935-1968, while Tinic and West (1984) who has used same NYSE data for the period 1935-1982 have found contrary evidence. Their study finds that residual risk has no effect on asset returns, however, their intercept is much greater than risk-free rate and the results indicate that CAPM might not hold. Black, *et al*. (1972) have tested CAPM by using time series regression analysis. The results show that the intercept term is different from zero and in fact is time varying. The study also finds that when $\beta > 1$ the intercept is negative and when $\beta < 1$ then intercept is positive. Thus the findings of Black, *et al*. (1972) violate the standard CAPM. Sharpe and Cooper (1972) have examined the risk return relationship on the stocks traded on NYSE for the period 1931–1967 and found contrary evidence.

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political and macroeconomic conditions [Iqbal, *et al.* (2008)]. Such type of conditions are also responsible for higher-moment asset price behaviour [Iqbal, *et al*. (2008); Javid and Ahmad (2008)].

As regards the findings about other markets, Greene (1990) investigated the CAPM on UK private sector data and has shown that CAPM does not hold. Sauer and Murphy (1992) have confirmed that CAPM is the best model for describing the German Stock Market data. In a more detailed study Hawawini (1993) could not confirm the validity of CAPM in equity markets in Belgium, Canada, France, Japan, Spain, UK and USA. The other studies which have tested CAPM for different countries include Lau, *et al*. (1975), for Tokyo Stock Exchange, Sareewiwathana and Molone (1985) for Thailand Stock Exchange and Bark (1991) for Korean Stock Market.

The mixed empirical findings on the risk return relationship have proposed different responses and as a result CAPM has extended in different ways. One response is that the lack of empirical support for standard CAPM is due to time-varying market risk and risk premium [Bollerslev, Engle, and Wooldridge (1988); Ferson and Harvey and others]. In an early works on conditional CAPM Fama and McBeth (1974) extended CAPM to multi-period analysis but empirical tests indicate poor performance of the model. Merton (1980) analysed three equilibrium expected market return for the period 1926-1978 for US market. The main conclusion he derives from his exploratory investigation are, first in estimating models of expected market return, the non-negativity restriction of the expected excess return should be explicitly included as the part of specification. Second estimators which use realised returns should be adjusted for hetroskedasticity.

Since the introduction of ARCH type processes by Engle (1982) and others, testing for time-varying volatility of stock market returns (and hence the time-varying beta) has been given considerable attention in the literature [Bollerslev, Engle, and Wooldridge (1988); Ng (1991); Bollerslev, Engle, and Nelson (1994)]. The ARCH-based empirical models appear to provide stronger evidence, of the risk-return relationship than do the unconditional models. Gibbons and Ferson (1985), Ferson, Kandel and Stambaugh (1987) and Ferson (1988) are some early work that test the asset pricing models at the conditional level and allow expected return to vary through time. However, all of these studies assume that that the conditional covariances are constant. Time variation in conditional covariances that has been modeled with the autoregressive conditional hetroskedasticity in the mean model ARCH-M of Engle, Lillen and Robbins (1987), Bollerslev, Engle and Wooldridge (1988), Bodurtha and Mark (1988) and Ng (1991) carry out tests of Sharpe (1964) and Lintner (1966) specification by modeling the conditional covariances as a function of past conditional covariances. Following the instrumental approach of Campbell (1987), Harvey (1989) undertakes test of conditional CAPM that allow for both time varying expected returns and conditional covariances and they use Generalised Method of Moments (GMM) as estimation technique.

Ferson and Harvey (1991, 1993, 1999)) in their studies of US stocks and bond returns, reveal that the time variation in the premium for beta-risk is more important than the changes in the betas themselves. This is because equity risk premiums are found to vary with market conditions and business cycles. Schwert (1989) attributes differential risk premium between up and down markets due to varying systematic risk over the business cycle. Jagannathan and Wang (1996) have shown that about 50 percent cross-sectional variation in average return is explained by conditional CAPM. The study by Jagannathan and Wang (1996) also finds empirical support for conditional CAPM when betas and expected return are allowed to vary over time assuming that CAPM hold period by period. When a proxy for return on human capital is also included in measuring aggregate wealth, the pricing errors are found to be statistically insignificant.

The well-documented failure of standard CAPM has motivated much research in to testing multifactor asset pricing models. Due to a number of seemingly unexplained patterns in asset returns that has led researchers to use attribute sorted portfolios of stocks to represent the factors in multifactor model. Some of such puzzling anomalies are small firm effect, January effect, earning-to-price ratio, book to market value and leverage etc. Reiganum (1981) has found that small capitalisation firms have risk adjusted returns that significantly exceeds those of large market value firm. Keim (1983) finds more than 50 percent of the excess return for small is concentrated in the first week of January; this effect is called January effect. Bhandari (1988) finds that leverage is positively related to expected stock returns. The studies of Banz (1981), Rosenberg, Reid, and Lanstein (1985) and Lakonshok, Shleifer, and Vishney (1994) show that firm's average stock return is related to size (stock price times number of shares), book-to-market equity (the ratio of book value of common equity to its market value), earning-price ratio, cash flow-price ratio, past sales growth. The most influential work of Fama-French three factor model in which they add two variables besides the market return, the return on small minus big shocks (SMB) and the return of high book/value minus low book/market value stocks (HML). Fama and French (1992) show that there is virtually no detectable cross-sectional beta mean return relationship. They show that variation on average return of 25 size and book/market sorted portfolio can be explained by betas on the latter two factors. Fama and French (1993) find that higher book-to-market ratios are associated with higher expected return, in their tests that also include market. Fama and French (1995) explain the real macroeconomic aggregate non-diversifiable risks that are provided by the return of HML and SMB portfolios. Fama and French (1996) extend their analysis and find that HML and SMB portfolios comfortably explain strategies based on alternative price multiplier (price-to-earning, book-to-market), strategies based on five year sale growth and tendency of five year return to reverse. All these strategies are not explained by CAPM betas. Fama and French (1996) conclude that many of CAPM average return anomalies are related and they are captured by their three factor model. Latter they show in their work Fama and French (2004) its usefulness for practitioners as an alternate model to CAPM. The study by Faff (2001) tests the Fama-French model using the daily Australian data and finds less support of three-factor model in explaining the cross-section variation in expected return. He comes up with negative size effect. The contradictory evidence is found by Drew and Veeraraghavan (2003) study, who report that size and book-to-market value explain the variation in expected return and reject the claim that these factors are due to seasonal phenomena or due to data snooping for Australia.

Chang, Johnson and Schill (2001) observe that as higher-order systematic co-moments are included in the cross-sectional regressions for portfolio returns, the SMB and HML generally become insignificant. In contrast to Fama-French Findings Clare Priestley and Thomas (1998) find a significant and prominent role of beta in explaining expected return. The find some role of size variable however, stock prices have no role in explain the expected return. Kathari, Shanken and Sloan (1995) conclude a significant role of beta and economically small role of size variable in their findings. Therefore, they argue that SMB and HML are good proxies for higher-order co-moments. Ferson and Harvey (1999) claim that many multifactor model specifications are rejected because they ignore conditioning information. They show that identified predetermined conditional variables (market return, per capita growth in durable consumption, spread between Moody's Baa corporate bonds and long term US corporate bond, change in difference between 10-years treasury bond return and three-month treasury bill return, unanticipated inflation and one month treasury bill return less the rate of inflation) have significant explanatory power for cross-sectional variation in portfolio returns. They reject the three factor model advocated by Fama and French (1993). They come to the conclusion that these loadings are important over and above Fama and French three factors and also the four factors of Elton, Gruber and Blake (1995).

In case of Pakistani market Iqbal and Brook (2007) find evidence of non-linearity in the risk return relationship and come to the conclusion that for Pakistanis Stock market the unconditional version of the CAPM is rejected. Iqbal, *et al (*2008) have tested CAPM and Fama and French (1993) three-factor model for Pakistani market and conclude that the unconditional Fama-French model augmented with a cubic market factor perform the best among the competing models. Latter in their study Iqbal, *et al*. (2008) they find that the pricing model with higher co movements does not appear to be superior to the model with Fama-French variables. Ahmed and Zaman (1999) attempt to investigate the risk-return relationship for Pakistani market and the results of GARCH-M model show the presence of strong volatility clusters implying that the time path of stock returns follows a cyclical trend. Ahmad and Qasim (2004) find asymmetric asset pricing behaviour and show that the positive shocks have more pronounced effect on the expected volatility than the negative shocks in case of Pakistani market.

The above review of literature indicates an increasing interest in analysing the activities of the stock market in Pakistan but many issues in this area still remain uncovered. In addition most of the studies are based on the sector indices and overall market index. In particular, risk return relationship, which is the central issue of financial economics, needs an in-depth research. It is in this perspective this study aims to make contribution in the literature on stock market by testing the unconditional and conditional CAPM using the firm level data.

3. EMPIRICAL METHODOLOGY AND DATA

The analysis in this study starts by testing the empirical validity of standard mean-variance model which postulates a linear relationship between return and covariance risk of risky assets. Business cycle variables are included as information set to explain asset price dynamics and the conditional asset pricing model is tested.

3.1. Mean-variance Capital Asset Pricing Model

We start our analysis by empirical model developed by Sharpe (1964) and Lintner (1966) in which a relationship for expected return is written as:

$$E(R_{it}) = R_f + \beta_i [E(R_{mt}) - R_f] \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

where $E(R_{it})$ is the expected return on *i*th asset, R_f is risk-free rate, $E(R_{mt})$ is expected return on market portfolio and β_i is the measure of risk or market sensitivity parameter defined as $Cov(R_i - R_f, R_i - R_f)/Var(R_i - R_f)$. This equation measures the sensitivity of asset return to variation in market return. In risk premium form CAPM Equation (1) is written as:

$$E(r_{it}) = \beta_i E(r_{mt}) \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (2)$$

where r_{it} is the excess return on asset *i* and r_{mt} is the excess return on market portfolio over the risk-free rate. Equation (2) says that the expected excess return on any asset is directly proportion to its β_i.

It is assumed that the ex-post distribution from which returns are drawn is ex-ante perceived by the investor. It follows from multivariate normality, that Equation (2) directly satisfies the Gauss-Markov regression assumptions. Therefore for empirical testing of CAPM is carried out on the basis of the equation:

$$r_{it} = \lambda_0 + \lambda_1\beta_i + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

The coefficient λ_1 is the premium associated with beta risk and an intercept term λ_0 has been added in the equation.

Following Black (1972) a more general version of CAPM is tested for adequacy, which holds in the absence of risk-free assets. In this case a zero-beta portfolio R_{Zt} is used as a proxy for risk-free asset. Thus denoting the zero-beta portfolio return by R_{Zt}, zero-beta CAPM is written as follows:

$$E(R_{it}) = E(R_{zt}) + \beta_i(E(R_{mt}) - E(R_{zt})) \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

The zero-beta portfolio plays the same role as risk-free rate of return in Sharpe-Lintner model.

The validity of Sharpe-Lintner-Black CAPM is examined in this study by testing three implications of the relationship between expected return and market beta given in Equation (3). First expected returns are linearly related to their betas and no other variable has marginal explanatory power. Second the beta premium is positive, meaning that expected return on market portfolio exceeds the expected return on assets whose returns are uncorrelated with the market return. Third in Sharpe-Lintner version, assets portfolio uncorrelated with the model have expected return equal to risk-free interest rate, and beta premium is equal to the expected market return minus the risk-free rate. Further note that if $\lambda_0 = 0$ and $\lambda_1 > 0$, this implies that Sharpe-Lintner CAPM holds, while if $\lambda_0 \neq 0$ and $\lambda_1 > 0$ then Black CAPM holds.[3]

To test the linearity of the risk-return relationship we include a quadratic term of β_i in the standard model given in Equation (3), and the model takes the following form,

$$r_{it} = \lambda_0 + \lambda_1\beta_i + \lambda_2\beta_i^2 + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

To test the hypothesis that the risk associated with residuals has no effect on the expected asset return, residual risk, $SD(\varepsilon_{it})$ of each asset is added as an additional explanatory variable:

$$r_{it} = \lambda_0 + \lambda_1\beta_i + \lambda_2 SD(\varepsilon_{it}) + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

In the Sharpe-Lintner and Black versions of CAPM, the joint hypothesis is that market portfolio is mean-variance efficient, this implies that difference in

[3]The Black version predicts only that beta premium is positive and intercept is equal to the return of zero-beta portfolio, where Sharpe-Lintner version predicts that intercept is not different from zero and the coefficient of beta is equal to excess market return over the risk-free rate.

expected return across assets are entirely explained by difference in market betas, other variables should add nothing to the explanation of expected return. In this study, it is tested by adding predetermined explanatory variables in the form of beta-square to test linearity and residual standard deviation to test that beta is the only essential measure of risk. The model becomes:

$$r_{it} = \lambda_0 + \lambda_1\beta_i + \lambda_2 SD(\varepsilon_{it}) + \lambda_3\beta_i^2 + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

If coefficients of the additional variables are not statistically different from zero, this outcome will be consistent with the hypothesis that the market proxy is on minimum variance frontier.

3.2. The Conditional Capital Asset Pricing Model

The standard CAPM of Sharpe (1965) and Lintner (1966), which describes stock return relative to market return, and main implication of the model, is that expected returns are linearly related to asset risk. In conditional version of the Sharpe-Lintner CAPM we impose this restriction that conditionally expected return on asset are linearly related to the conditionally expected return on market portfolio. Therefore the conditional specification of mean variance CAPM for asset *i* is written as:

$$E_{t-1}(r_{it}|Z_{t-1}) = \beta_i E_{t-1}(r_{mt}|Z_{t-1}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

$$\beta_{it} = \text{cov}(r_{it}, r_{mt}|Z_{t-1}) / \text{var}(r_{mt}|Z_{t-1}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

where $E_{t-1}()$ indicates the conditional expectation, given information set at time *t*–1. The market beta β_{it} is conditional covariance of the asset return with market portfolio divided by the conditional variance of the market portfolio, conditional on the information set Z_{t-1} at time *t*. The information set Z_{t-1} is available at time *t*–1 and is subset of market-wide information set ω_t. The empiricists do not get to see market-wide information, so it is convent to consider expectation conditional on an observable subset of information Z_{t-1} which is publicly available. The market beta is slope coefficient of conditional regression of asset return on market portfolio given in the above Equation (8) and it is used as explanatory variable in the following cross section equation:

$$r_{it} = \lambda_{0t} + \lambda_{1t}\beta_{it} + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (10)$$

The λ_{0t} is intercept and λ_{0t} is risk premium for conditional market risk.

The objective in this section is to apply a framework of testing conditional asset pricing in the presence of conditional lagged information variables. The conditional CAPM imply that the expected return of an asset is related to their sensitivity of changes in the state of the economy, called the time series of betas for each state of economy. For each relevant state there is market price or premium per unit of beta. The major determinants of price movements of stocks are business cycle variables. The lagged business cycle variables are entered into model in linear form for estimating beta risk month by month. The time variation is allowed in the model and conditional variance and covariance of economic risks are estimated month by month using business cycle variables. The empirical literature suggests that there are many sources of variability of beta and price of beta.[4] In conditional return distributions much of the variability is due to variables that derive business conditions in the economy.[5] Therefore to model the conditional information, a set of lagged macroeconomic variables that derive the business condition and have long been used in the conditional asset pricing literature are used.[6] The purpose is to examine time varying betas and risk premium in Pakistan and their deriving forces from the perspective of macroeconomic environment in the country.

To estimate the model, the two-step procedure, a modified version of Fama and McBeth (1973) is applied. In the first step the conditional market betas are estimated using Davidian and Carroll (1987) method.[7] The second step is to estimate the cross-sectional regression for each month by using the conditional beta. This gives time-series of time-varying risk premium. The average is computed and *t*-test is applied to see if the premium is different from zero.

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[4]Grossman (1981) argued that parameters of CAPM should be conditional on prices of assets. Bossaerts and Green (1989) develop a model in which conditional expected return are inversely related to price of assets. Kandel and Stambaugh (1989) develop a model economy in which a dividend yield, a default related yield spread, and a measure of term structure slope track time varying expected risk premium. Ferson and Harvey (1991, 1993, 1999) used predetermined lagged economic variables as information instruments that derive business conditions and influence asset return.

[5]The underlying intuition is simple, investors want to smooth their out their consumption. At business-cycle troughs, the equity risk premium is high because investors are short of cash and use all their cash to keep consumption a permanent level. They do not have much discretionary cash for investing in stocks. Therefore to make sure that investors hold their portfolio of stocks, the risk premium must be high in equilibrium. The reverse is true in business peaks. This line of argument also implies that proper instrument variables must be related to current and/or future macroeconomic environment.

[6]Ferson and Harvey (1999) emphasised the importance of identified predetermined lagged economic variables have significant cross-section explanatory power for asset returns. These factor loadings are important over and above the variables advocated by Fama and French (1993) in their three-factor model and also four-factor of Elton, Gruber and Blake (1995). The explanatory power of loadings on lagged variables is robust to various portfolio grouping procedures and other considerations. The lagged variables reveal information about the cross-section of expected returns that is not captured by popular asset pricing factors.

[7]This method is also used by Schwert (1989), Harvey and Ferson (1991, 1993, 1999) and other recent studies.

The procedure to estimate conditional variance of market return and conditional covariance of asset returns with the market return is given in Appendix B. The conditional betas are then estimated as inverse of conditional variance vector multiplied by estimate vector of conditional covariance of asset returns with the market return. By using this vector of conditional betas, the cross section equation of conditional CAPM given in Equation (10) is estimated month by month and the slope coefficient gives risk premium for each month. In this way market risk and price of risk is allowed to vary over time. The average of these risk premiums is obtained and Fama-McBeth (1973) *t*-values are calculated to test that the premium is significantly different from zero. These *t*-values are also adjusted for Shanken (1992) adjustment.[8]

3.3. The Unconditional Fama-French Three-factor Model

We extend the standard CAPM by incorporating Fama and French (1993) variables, in order to examine whether these variables can explain the portion of expected return, which can not be explained by CAPM.[9] The two step procedure same as above is followed, the betas or sensitivity of asset return to market return and firm characteristic variables (size, and book-to-market value), which capture anomalies are estimated in the first stage. The second stage estimates the cross-section variation in expected returns is explained due to these firm characteristics.[10] The following time series regression model is estimated in the first stage,

$$r_{it} = \beta_{0t} + \beta_{rm} r_{mt} + \beta_{BM} \ln(BE/ME) + \beta_{SIZE} \ln(ME) + \varepsilon_{it} \quad \ldots \quad \ldots \quad (11)$$

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[8]Shanken (1992) suggests multiplying $\hat{\sigma}^2(\hat{\lambda}_{it})^2$ by the adjustment factor $[1+(\mu_m - \hat{\lambda}_{it})^2]/\sigma_m^2$.

[9]The ratios involving stock prices have information about expected return missed by the betas. The is because stock's price depends not only on expected cash flows but also on the expected return that discount expected cash flow back to the present. Thus a high expected return implies a high discount rate and a low price. These ratios thus can expose deficiency of CAPM that can not be explained by beta [Basu (1978)]. The earning-price ratio, debt-equity, and book-to-market ratios play their role in explaining expected return.

[10]The empirical analysis of individual assets returns have always doubts because of possible non-synchronous returns [Harvey and Siddique (1999)]. To reduce such concerns the betas are estimated by following Scholes and William (1977) suggestion that instrument variable is a better choice. Thus *GMM* is used for the time series estimation. The cross-section regression have problem because the returns are correlated and heteroskedastic, therefore *GLS* is used in cross-section regression. In addition, since betas are generated in the first stage and then used as explanatory variables in the second stage, the regressions involve error-in-variables problem. Therefore *t*-ratio for testing the hypothesis that average premium is zero is calculated using the standard deviation of the time series of estimated risk premium which captures month by month variation following Fama and McBeth (1973). We also calculated alternative *t*-ratios using a correction for errors in beta suggested by Shanken (1992).

The risk premium associated with these risk factors is estimated by cross-section regression Equation (2),

$$r_{it} = \lambda_0 + \lambda_{RM}\beta_{RM} + \lambda_{BM}\beta_{BM} + \lambda_{SIZE}\beta_{SIZE} + \varepsilon_{it} \quad \ldots \quad \ldots \quad (12)$$

where r_m is excess market return, *ln*(*ME*) is the natural log of market value of asset *i* and *ln*(*BE*/*ME*) is the natural log of ratio of book-to-market value. The β*s* measure the sensitivity of each asset associated to these variables. The λ*s* are cross-section regression coefficients which indicate the extent to which the cross-section of asset return can be explained by these variables at each year. Then time series means of these estimates are tested for significance The Fama French methodology allows β to compete as an explanatory variable with alternative explanatory variable. Fama-McBeth *t*-values are calculated and adjusted for Shanken (1992) adjustment factor.

3.4. The Conditional Fama-French Three-factor Model

The conditional information is very important in case of firms characteristic as well. Fama and French (1989) document time variation in risk premium. Time variability is captured by estimating Davidian and Carroll (1987)[11] betas by using predetermined lagged macro variables as instruments [Schwert (1989); Ferson and Harvey (1993)]. The information set Z_{t-1} includes lagged predetermined macroeconomic variable (market return, call money rate, term structure, industrial production, inflation rate, and exchange rate and oil prices growth) and a constant. The betas are allowed for time variation depending on Z_{t-1} by making them linear functions of predetermined instruments following Shanken (1990), Ferson and Harvey (1991, 1993, 1999), Ferson and Schadt (1996) and other studies. In order to introduce time-variability, Equation (1) is written in conditional form as follows

$$\begin{aligned} r_{it} &= \beta_{0t} + \beta_{rm}E_{t-1}(r_{mt}|Z_{t-1}) + \beta_{BM}\,E_{t-1}(BE/ME)|Z_{t-1}) \\ &\quad + \beta_{Size}E_{t-1}(ME|\,Z_{t-1}\rangle) + \varepsilon_{it} \end{aligned} \quad \ldots \quad \ldots \quad (13)$$

The cross-section regression equation takes the following form which estimates the risk premium by using GLS,

$$r_{it} = \lambda_{0t} + \lambda_1\beta_{rm} + \lambda_{2t}\beta^c_{BM} + \lambda_{3t}\beta^c_{SIZE} + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad (14)$$

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[11]The method is discussed in detail in Appendix B.

Where λ_{0t} is the intercept and λs are the slope coefficient using three risk factors, and β_{jt} are time series estimated factor sensitivities. A *t*-ratio for testing the hypothesis that the average premium is zero is calculated using the standard deviation of the time series of estimated risk premium, as suggested by Fama and McBeth (1973). Since estimated betas are used in second stage regressions, the regression involves error-in-variables. These *t*-ratios are adjusted for correction as suggested by Shanken (1992).

To estimate the conditional Fama-French model, the two-step procedure, a modified version of Fama and McBeth (1973) is applied. In conditional Fama-French model, the relevant conditional betas (market return, size, book-to-market value) are estimated as inverse of conditional variance-covariance matrix, multiplied by a vector of conditional covariance of an asset's return with the risk variables. First of all conditional variances are estimated by Davidian-Carroll (1987) method, which form the diagonal of variance-covariance matrix. Next, covariance terms are estimated to complete the variance-covariance matrix. Then for each month the vector of conditional betas is computed by inverting the 3×3 conditional variance-covariance matrix of the risk factors and post-multiplying the result with the vector multiplied by 3×1 vector of conditional covariance of risk factor with an asset's return. This process is repeated for each of the 49 assets. By using these matrices of conditional betas, the cross section Equation (14) is estimated month by month and slope coefficient yield risk premiums for each month. The average of economic risk premiums is then tested for the significance of its difference from zero.

3.5. Data and Sample

The econometric analysis to be performed in the study is based on the data of 49 firms listed on the Karachi Stock Market (KSE), the main equity market in the country for the period July 1993 to December 2004. These 49 firms were selected out of 779 firms, which contributed 90 percent to the total turnover of KSE in the year 2000.[12] In selecting the firms three criteria were used: (1) companies have continuous listing on exchange for the entire period of analysis; (2) almost all the important sectors are covered in data, and (3) companies have high average turnover over the period of analysis.

From 1993 to 2000, the daily data on closing price turnover and KSE 100 index are collected from the Ready Board Quotations issued by KSE at the end of each trading day, which are also available in the files of

[12]Appendix Table A1 provides the list of companies included in the sample.

Security and Exchange Commission of Pakistan (SECP). For the period 2000 to 2004 the data are taken from KSE website. Information on dividends, right issues and bonus share book value of stocks are obtained from the annual report of companies, which are submitted on regular basis to Securities and Exchange Commission of Pakistan (SECP). Using this information daily stock returns for each stock are calculated.[13] The six months treasury-bill rate is used as risk-free rate and KSE 100 Index as the rate on market portfolio. The data on six-month treasury-bill rates are taken from *Monthly Bulletin* of State Bank of Pakistan. The test of CAPM is carried out on individual stocks.

The empirical validity of CAPM model and conditional CAPM is examined by using daily as well as monthly data of 49 individual stocks traded at Karachi Stock Exchange during the period July 1993 to December 2004. The tests of these models are carried out in excess return form and the risk factor is excess market return above the treasury-bill rate. The sample period is divided into five overlapping intervals of five year each to estimate rolling betas for testing the validity of standard CAPM. The first interval is 1993 to 1997, the second 1994 to 1998, the third 1995 to 1999, fourth 1996 to 2000 and the fifth 1997 to 2001. These overlapping periods are used to estimate betas alternatively and next three years are used to test the model. The time series regression is also carried out for the entire period July 1993 to December 2004 and to test the validity of the models cross-sectional regression is done on the three-year sub-periods, 1993-1995, 1996-1998, 1999-2001 and 2002-2004; two large sub periods 1993-1998 and 1999-2004; and for the whole sample period 1993-2004.

In the conditional CAPM model in the information set lag business cycle variables are used. The emerging markets have special characteristics, which make them different from developed markets, so the choice of information variables is different. The set of instrument variables is selected following two criteria. First, the instrument variables in information set are standard and commonly used in literature and they drive the business conditions in the country. These variables include first lag of market return, inflation rate, inter bank call money rate, term structure, foreign exchange rate, growth in consumption, industrial production growth and crude oil price growth. The data for these macro variables are collected at monthly frequency and are taken from *Monthly Bulletin* of State Bank of Pakistan. The set of information variables, their notations and data sources are given in Table 1.

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[13] $R_t = \ln P'_t - \ln P'_{t-1}$, where R_t is stock return and P'_t , the stock price is adjusted for capital changes that is dividend, bonus shares and rights issued.

Table 1

Economic Variables

Definition	Data Source
Market Return Defined as KSE 100 Index (RM)	Ready Board Quotations of KSE and KSE website
Manufacturing Output Index (IP)	*Monthly Statistical Bulletin*, SBP
Per Capita Real Consumption (C)	Economic Survey
Call Money Rate (CR)	*Monthly Statistical Bulletin*, SBP
Term Structure: Difference b/w 10-Year Government Bond Yield and 6-Month Treasury Bills Rate (TS)	*Monthly Statistical Bulletin*, SBP
Whole Sale Price Index (WPI)	*Monthly Statistical Bulletin*, SBP
Oil Price Index (O)	OPEC Website
Foreign Exchange rate (E)	*Monthly Statistical Bulletin*, SBP

4. EMPIRICAL FINDINGS

The empirical validity of static version of standard CAPM is examined in this study by using daily as well as monthly data of 49 individual stocks traded at Karachi Stock Exchange during the period July 1993 to December 2004. In monthly returns variability is returns is averaged out and it is expected to get better performance of the standard model as compared to the one obtained with daily data. In addition, the validity of standard model is tested with five year rolling beta as well as with beta estimated for entire sample period 1993 to 2004. The standard CAPM is our benchmark model and rest of our study is based on the extension of this model in dynamic setting. Therefore to check the robustness of this model, we undertake testing the validity of this model in several ways. The test is carried out in excess return form above the risk-free rate and the market return is excess market return above the risk-free rate.

To test validity of CAPM model, two-step estimation procedure, that is time series and cross-sectional estimation procedure, is used as proposed by Fama and McBeth (1973). In the first step betas are estimated in time series regression framework using *Generalised Method of Moment approach (GMM)*.[14] Lagged market return and lagged asset returns are used as instruments. In the second step a cross section regression of actual returns on betas is estimated for each month in the test period. The cross-section regression have problem because the returns are correlated and heteroskedastic, therefore *Generalised Least Square (GLS)* is used in cross-section regression. The

[14]The empirical analysis of individual assets returns have always doubts because of possible non-synchronous returns [Harvey and Siddique (1999)]. To reduce such concerns the betas are estimated by following Scholes and William (1977) suggestion that instrument variable is a better choice. Thus *GMM* is used for the time series estimation.

standard deviations of residuals from the beta estimation equation are used for the estimation of error covariance matrix involved in the *GLS* estimation procedure. Finally, the parameter estimates obtained for all the months in the test period are averaged out. The mean risk premium so obtained is used to test, applying *t*-statistics, the null hypothesis that the risk premium is equal to zero. Therefore tests based on usual standard errors are unreliable. Since betas are generated in the first stage and then used as explanatory variables in the second stage, the regressions involve error-in-variables problem. Therefore *t*-ratio for testing the hypothesis that average premium is zero is calculated using the standard deviation of the time series of estimated risk premium which captures month by month variation following Fama and McBeth (1973). We also calculated alternative *t*-ratios using a correction for errors in beta suggested by Shanken (1992). The R^2 is average of month by month coefficient of determination.

Table A3 in Appendix A present the first stage estimates that indicate sensitivity of the asset return to market return using the daily data and monthly data in excess return form over risk-free rate for the whole sample period 1993 to 2004. The results show that the value of β_i is highly significant for all stocks with both the daily and monthly data.

First, the time series estimation is carried out for the entire period daily and monthly from July 1993 to December 2004 as suggested by Cochrane (2001). Then these estimated betas are used in cross section regression on each month and average of these estimated coefficients of cross section regression is taken for test period. The results of Table 2 indicate that there is no improvement in the results even after using the beta for longer time period. The coefficient of systematic risk or market risk λ_1 is inconclusive and insignificant for most of the sub-periods and overall sample period. In years where coefficients are positive its magnitude is very small and insignificant. These finding are the same as we come up by using rolling betas in our cross-section model, that there is no positive and significant compensation on average to bear market risk. The intercept term is significantly different from zero for sub-period 1999-2004. When the other measure of risk that is residual risk is incorporated in the equation, the average of monthly estimated coefficient of residual risk λ_2 is positive and statistically significant in 1993-1995, 1993-1998 and overall period 1993-2004 and also the average of the monthly coefficient of determination becomes better. These results contradict the CAPM and suggest that residual risk affect the asset price behaviour in some periods. The results also show no non-linearity in the relationship between average return and market risk. These results show no support of fundamental hypothesis that on average there is a positive trade off between risk and return. However, results show some improvement in terms of higher coefficient of determination, when other

Table 2

Average Risk Premium for the Unconditional CAPM

	Beta Estimated on Daily Data					Beta Estimated on Monthly Data				
	A $r_{it} = \lambda_0 + \lambda_1 \beta_i + \varepsilon_{it}$									
	λ_0	λ_1	λ_2	λ_3	R^2	λ_0	λ_1	λ_2	λ_3	R^2
1993–1995	–0.01	0.01			0.22	0.00	0.01***			0.19
	(–0.76)	(0.54)				(–0.250	(1.57)			
	[–0.64]	[0.48]				[–0.24]	[1.54}			
1996–1998	–0.01	–0.01			0.26	–0.02	–0.01			0.23
	(–0.66)	(–1.07)				(–1.34)	(–1.44)			
	[–0.62]	[–1.00]				[–1.31]	[–1.38]			
1999–2001	0.003	0.002			0.25	0.01	0.00			0.21
	(0.04)	(0.05)				(0.51)	(0.09)			
	[0.04]	[0.05]				[0.50]	[0.09]			
2002–2004	0.04*	0.003			0.24	0.03*	0.00			0.18
	(3.49)	(–0.42)				(3.43)	(0.08)			
	[1.41]	[–0.40]				[3.42]	[0.07]			
1993–1998	–0.01	0.002			0.24	–0.01	0.00			0.24
	(–0.97)	(–0.36)				(–0.97)	(–0.36)			
	[–0.89]	[–0.36]				[–0.96]	[–0.35]			
1999–2004	0.02*	0.002			0.25	0.02*	0.00			0.25
	(2.19)	(–0.24)				(2.23)	(–0.34)			
	[1.54]	[–0.24]				[2.22]	[–0.33]			
1993–2004	0.01	0.00			0.25	0.01	0.00			0.25
	(0.89)	(–0.44)				(0.90)	(–0.50)			
	[0.84]	[–0.43]				[0.89]	[–0.49]			

Continued—

Table 2—(*Continued*)

				B $r_{it} = \lambda_0 + \lambda_1\beta_i + \lambda_2 SD(\varepsilon_{it}) + \varepsilon_{it}$				
1993–1995	0.00	0.01	0.45*	0.23	0.02**	0.002***	0.16*	0.20
	(0.03)	(0.89)	(2.33)		(1.55)	(1.29)	(4.02)	
	[0.03]	[0.67]	[1.06]		[1.46]	[1.27]	[1.95]	
1996–1998	0.001	0.004	–0.43	0.20	0.00	–0.01***	–0.09***	0.23
	(–0.05)	(–0.52)	(–1.01)		(–0.32)	(–1.58)	(–1.36)	
	[–0.05]	[–0.52]	[–0.04]		[–0.31]	[–1.51]	–[1.25]	
1999–2001	0.00	0.00	0.07	0.29	0.00	0.00	–0.01	0.23
	(–0.04)	(–0.03)	(0.21)		(0.40)	(0.03)	(–0.44)	
	[–0.04]	[–0.03]	[0.06]		[0.39]	[0.03]	[–0.44]	
2002–2004	0.04	0.00	–0.26	0.27	0.02	0.00	0.07	0.28
	(2.930	(–0.05)	(–0.91)		(0.75)	(0.05)	(1.16)	
	[1.06]	[–0.05]	[–0.05]		[0.75]	[0.05]	[1.04]	
1993–1998	0.003	0.002	0.44**	0.27	0.01	0.00	0.12*	0.27
	(–0.03)	(0.26)	(1.79)		(0.61)	(–0.59)	(3.09)	
	[–0.03]	[0.25]	[1.07]		[0.58]	[–0.57]	[2.25]	
1999–2004	0.02*	0.00	–0.10	0.28	0.01**	0.00	0.03	0.29
	(1.77)	(–0.05)	(–0.45)		(1.81)	(0.32)	(0.88)	
	[1.18]	[–0.05]	[–0.08]		[1.81]	[0.32]	[0.87]	
1993–2004	0.01	0.004	0.26***	0.21	0.01**	0.00	0.04*	0.27
	(1.25)	(0.16)	(1.60)		(1.64)	(–0.22)	(1.76)	
	[1.05]	[0.16]	[1.10]		[1.61]	[–0.22]	[1.66]	

Continued—

Table 2—(*Continued*)

C $r_{it} = \lambda_0 + \lambda_1\beta_i + \lambda_2\beta_i^2 + \varepsilon_{it}$

1993–1995	–0.03***	0.05***		–0.02	0.23	0.00	0.01*		–0.00*	0.20
	(–1.62)	(1.45)		(–1.63)		–(0.14)	(2.28)		(–2.32)	
	[–0.61]	[0.36]		[–0.93]		[–0.14]	[2.22]		[–2.31]	
1996–1998	–0.01	–0.01		0.002	0.28	–0.02	0.00		0.00	0.22
	(–0.51)	(–0.30)		(0.08)		(–1.29)	(–0.92)		(–0.81)	
	[–0.48]	[–0.26]		[0.08]		[–1.26]	[–0.88]		[–0.77]	
1999–2001	0.00	0.01		0.001	0.27	0.00	0.00		0.00	0.27
	(–0.10)	(0.13)		(–0.13)		(0.17)	(0.26)		(–1.12)	
	[–0.10]	[0.12[		[–0.13]		[0.17]	[0.26]		[–1.12]	
2002–2004	0.04*	–0.01		0.00	0.25	0.03*	0.00		0.00	0.28
	(3.23)	(–0.31)		(0.22)		(3.36)	(–0.76)		(1.31)	
	[1.23]	[–0.27]		[0.22]		[3.35]	[–0.73]		[1.28]	
1993–1998	–0.02***	0.01		–0.01	0.26	–0.01	0.00		0.00*	0.25
	(–1.52)	(0.56)		(–0.74)		(–1.10)	(0.51)		(–2.07)	
	[–1.06]	[0.40]		[–0.70]		[–1.08]	[0.49]		[–2.01]	
1999–2004	0.02***	0.00		0.00	0.26	0.01	0.001		0.00	0.27
	(1.68)	(–0.05)		(0.00)		(0.95)	(–0.03)		(0.02)	
	[1.18]	[–0.05]		[0.00]		[0.95]	[–0.03]		[0.02]	
1993–2004	0.002	0.01		0.004	0.26	0.001	0.002		0.004	0.26
	(0.14)	(0.37)		(–0.54)		(0.61)	(0.25)		(–1.21)	
	[0.14]	[0.34]		[–0.53]		[0.61]	[0.25]		[–1.20]	

Continued—

Table 2—(*Continued*)

				D $r_{it} = \lambda_0 + \lambda_1\beta_i + \lambda_2 SD(\varepsilon_{it}) + \lambda_3\beta_{it}^2 + \varepsilon_{it}$						
1993–1995	–0.01	0.03	0.40**	–0.01	0.24	0.02**	0.001	0.22*	0.004	0.22
	(–0.61)	(0.99)	(1.95)	(–0.85)		(1.98)	(0.002)	(3.02)	(1.18)	
	[–0.42]	[0.34]	[1.06]	[–0.67]		[1.84]	[0.001]	[1.16]	[1.17]	
1996–1998	0.01	–0.03	–0.49	0.01	0.27	0.00	–0.01*	–0.13	0.004	0.25
	(0.62)	(–0.86	–1.18	0.85		0.00	(–1.83)	(–1.28)	(0.91)	
	[0.48]	[–0.47]	[–0.04]	[0.70]		[0.00]	[–1.77]	[–0.98]	[0.85]	
1999–2001	–0.01	0.01	0.09	0.00	0.27	–0.01	0.002	0.08***	0.002***	0.23
	(–0.25)	(0.23)	(0.28)	(–0.28)		(–0.64)	(0.85)	(1.48)	(–1.58)	
	[–0.24]	[0.21]	[0.06]	[–0.28]		[–0.64]	[0.84]	[1.15]	[–1.58]	
2002–2004	0.05*	–0.02	–0.31	0.01	0.28	0.02*	0.00	0.05	0.00	0.29
	(2.99)	(–0.85)	(–1.04)	(1.01)		(2.43)	(–0.05)	(0.74)	(0.31)	
	[0.87]	[–0.53]	[–0.05]	[0.93]		[2.43]	[–0.04]	[0.70]	[0.30]	
1993–1998	0.001	0.003	0.45*	0.002	0.28	0.01	–0.01***	0.17*	0.00***	0.23
	(0.11)	(–0.07)	(1.84)	(0.18)		(1.04)	(–1.39)	(2.64)	(1.45)	
	[0.11]	[–0.07]	[1.07]	[0.18]		[0.97]	[–1.36]	[1.53]	[1.39]	
1999–2004	0.02***	–0.01	–0.11	0.003	0.25	0.01	0.00	0.07***	0.00	0.28
	(1.58)	(–0.25)	(–0.51)	(0.28)		(0.90)	(0.67)	(1.52)	(–1.11)	
	[0.97]	[–0.24]	[–0.08]	[0.28]		[0.90]	[0.67]	[1.32]	[–1.11]	
1993–2004	0.01	0.002	–0.27*	0.00	0.29	0.01***	0.00	–0.05	0.00	0.29
	(1.22)	(–0.22)	(–1.68)	(0.33)		(1.38)	(–0.56)	(–1.20)	(0.43)	
	[0.96]	[–0.22]	[–0.11]	[0.32]		[1.36]	[–0.56]	[–1.13]	[0.43]	

Note: The *t*-values in round and squared brackets are, respectively, Fama-McBeth *t*-values and error-adjusted Shanken t-values. The * shows significant at 1 percent, ** is significant at 5 percent, and *** is significant at 10 percent level.

measure of risk such as residual risk and non-linear beta are added. This leads to the conclusion that other risk factors also affect average asset return. When both residual risk and non-linear beta is added in standard model the results remain the same that residual risk plays some role in price determination in few sub-periods. Further during the sub periods and overall period results show no statistically significant nonlinear relationship between returns and systematic risk but coefficient of determination improves by adding non-linear beta. These results leads to contradiction of the hypothesis, that the relationship between systematic risk and asset average return is positive but there are no non-linear, and nor the other measure of risk such as residual risk has effect on average return.

In order to examine how betas estimated for the rolling widows and estimated for entire period make any difference in the results, the standard model and its variants are also tested based on the estimated rolling beta for five years. The next three years are used to test the adequacy of CAPM model by using these rolling betas. The Table 3 reports two sets of results to test the adequacy of CAPM model based on cross-section regressions with rolling betas estimated with daily as well as monthly data. These results of testing the standard model in panel A show that there is no positive and significant compensation on average to bear market risk. The finding that in several cases the market premium is estimated to be negative is contrary to the main hypothesis of CAPM, because critical condition of CAPM is that there is on average a positive trade off between market risk and return. The intercept terms λ_0 are not significantly different from zero in almost all sub-periods with the exception only in period 2001-2003 and 2002-2004 sub-periods. This result is in line with Sharpe-Lintner model to some extent. When the other measure of risk that is residual risk is included in the standard model in panel B, the results have shown that the monthly average estimates of the premium for residual risk λ_2 is marginally significant for the period 1998-2000 and 2002-2004. For the other sub-periods and overall period, it has inconclusive and also insignificant. The intercept is significant for the sub-periods 2001-2003 and 2002-2004. The results also reveal that when the variable residual risk is included in the standard model, the average of coefficient of determination improves. According to CAPM since the investors holds efficient market portfolio and diversify in many assets residual risk (i.e. nonsystematic risk) should have no impact on the risk return relationship. Therefore the findings contradict the CAPM and suggest that residual risk play some role in price determination in some sub-periods. The results of panel C shows that when non-linearity is added in the relationship between market risk and average return by including β^2 in the standard CAPM equation, there is positive premium for beta risk for overall sample period 1993-2004. However, during the sub periods and overall period show no statistically

Table 3

Average Risk Premium for the Unconditional CAPM

	Rolling Betas Estimated on Daily Data					Rolling Betas Estimated on Monthly Data				
	A $r_{it} = \lambda_0 + \lambda_t \beta_i + \varepsilon_{it}$									
Test Period	λ_0	λ_1	λ_2	λ_3	R^2	λ_0	λ_1	λ_2	λ_3	R^2
1998–2000	–0.01	0.004			0.20	0.00	0.003			0.25
	(–0.65)	(0.98)				(–0.18)	(0.12)			
	[–0.65]	[0.96]				[–0.18]	[0.12]			
1999–2001	–0.02	0.001			0.21	–0.01	0.003			0.20
	(–1.36)	(0.14)				(–0.64)	(0.42)			
	[–1.36]	[0.14]				[–0.64]	[0.41]			
2000–2002	0.01	–0.10			0.25	0.00	0.003			0.22
	(0.61)	(–1.41)				(0.02)	(0.42)			
	[0.60]	[–1.02]				[0.02]	[0.42]			
2001–2003	0.02**	–0.14*			0.28	0.02	–0.14*			0.28
	(1.73)	(–2.56)				(1.73)	(–2.56)			
	[1.71]	[–1.35]				[1.71]	[–1.35]			
2002–2004	0.04*	0.01			0.28	0.01	0.003			0.28
	(3.21)	(–1.27)				(1.22)	(0.86)			
	[3.18]	[–1.16]				[1.17]	[0.82]			
1993–2004	0.001	–0.02			0.25	0.00	–0.02			0.21
	(0.19)	(–0.83)				(–0.56)	(–1.20)			
	[0.19]	[–0.82]				[–0.56]	[–1.18]			

Continued—

Table 3—(*Continued*)

				B $r_{it} = \lambda_0 + \lambda_1\beta_i + \lambda_2 SD(\varepsilon_{it}) + \varepsilon_{it}$				
1998–2000	–0.04	0.003	0.81***	0.23	0.003	0.002	0.82**	0.28
	(–1.22)	(0.08)	(1.56)		(–0.15)	(0.10)	(1.63)	
	[–1.20]	[0.07]	[1.23]		[–0.15]	[0.10]	[1.53]	
1999–2001	–0.01	0.002	0.36	0.23	–0.02	0.01	0.30	0.25
	(–0.78)	(0.37)	(1.05)		(–1.24)	(0.78)	(1.28)	
	[–0.78]	[0.36]	[0.27]		[–1.24]	[0.77]	[0.84]	
2000–2002	0.01	0.08	0.06	0.27	0.004	0.003	0.03	0.24
	(0.48)	(0.84)	(0.14)		(–0.34)	(0.42)	(0.64)	
	[0.47]	[0.66]	[0.13]		[–0.34]	[0.42]	[0.61]	
2001–2003	0.04*	–0.01	–0.23	0.23	0.01	0.001	0.04	0.23
	(2.27)	(–0.52)	(0.90)		(1.15)	(–0.24)	(0.78)	
	[0.89]	[–0.01]	[0.07]		[1.15]	[–0.24]	[0.76]	
2002–2004	0.04*	–0.01	0.07***	0.20	0.01	0.003	0.13*	0.28
	(2.79)	(–1.43)	(1.36)		(1.22)	(0.86)	(2.68)	
	[1.11]	[–1.36]	[1.29]		[1.17]	[0.82]	[1.59]	
1993–2004	0.001	–0.03	0.30	0.28	–0.01	0.03	0.29	0.20
	(0.04)	(–1.05)	(1.19)		(–0.36)	(0.43)	(1.10)	
	[0.04]	[–1.00]	[1.08]		[–0.36]	[0.43]	[1.09]	

Continued—

Table 3—(*Continued*)

C $r_{it} = \lambda_0 + \lambda_1\beta_i + \lambda_2\beta_t^2 + \varepsilon_{it}$								
1998–2000	–0.03	0.01	0.34	0.22	0.003	0.002	0.004	0.26
	(–1.03)	(0.67)	(0.75)		(–0.19)	(0.44)	(–0.62)	
	[–1.03]	[0.66]	[0.24]		[–0.19]	[0.44]	[–0.61]	
1999–2001	–0.01	0.003	0.004	0.22	0.003	0.004	0.001	0.22
	(–0.61)	(0.18)	(0.07)		(–0.45)	(0.65)	(–0.04)	
	[–0.60]	[0.18]	[0.07]		[–0.45]	[0.65]	[–0.04]	
2000–2002	0.01	–0.08	0.001	0.27	0.001	0.01	0.01	0.23
	(0.64)	(–0.44)	(–0.12)		(–0.16)	(1.32)	(–1.44)	
	[0.64]	[–0.35]	[–0.12]		[–0.16]	[1.32]	[–1.44]]	
2001–2003	0.03*	–0.01***	0.001	0.20	0.001	0.01	0.004***	0.23
	(2.94)	(–1.36)	(–0.21)		(–0.16)	(1.32)	(–1.44)	
	[2.89]	[–1.31]	[–0.20]		[–0.16]	[1.32]	[–1.44]	
2002–2004	0.04*	0.003	0.001	0.28	0.03*	0.001	0.002	0.28
	(3.28)	(–0.60)	(–0.57)		(3.10)	(–0.27)	(1.04)	
	[1.35]	[–0.59]	[–0.57]		[3.09]	[–0.25]	[0.98]	
1993–2004	0.002	0.004**	0.14	0.26	0.004	0.01**	0.004	0.20
	(0.18)	(1.66)	(0.75)		(0.53)	(1.58)	(–0.18)	
	[0.18]	[1.33]	[0.43]		[0.53]	[1.57]	[–0.18]	

Continued—

Table 3—(*Continued*)

				D		$r_{it} = \lambda_0 + \lambda_1\beta_i + \lambda_2 SD(\varepsilon_{it}) + \lambda_3\beta_i^2 + \varepsilon_{it}$				
1998–2000	–0.05	0.02	0.06***	–0.01	0.23	–0.01	0.01	0.06	0.001	0.20
	(–1.38)	(1.10)	(1.67)	(–1.19)		(–0.37)	(0.69)	(0.54)	(–0.89)	
	[–1.33]	[1.05]	[0.19]	[–1.18]		[–0.37]	[0.68]	[0.45]	[–0.88]	
1999–2001	–0.03	0.02	0.47	–0.01	0.25	–0.02	0.01	0.15	0.004	0.27
	(–1.22)	(0.89)	(1.32)	(–0.94)		(–1.50)	(1.25)	(1.52)	(–1.43)	
	[–1.21]	[0.86]	[0.27]	[–0.94]		[–1.49]	[1.22]	[0.80]	[–1.42]	
2000–2002	0.01	0.002	–0.15	0.001	0.21	–0.01	0.01	0.04	–0.01	0.25
	(0.59)	(–0.10)	(–0.47)	(–0.20)		(–0.55)	(1.44)	(0.79)	(–1.49)	
	[0.58]	[–0.10]	[–0.27]	[–0.20]		[–0.55]	[1.43]	[0.73]	[–1.49]	
2001–2003	0.04*	–0.02	–0.29	0.003	0.23	0.01	0.003	0.07	0.003	0.15
	(2.39)	(–2.49)	(–1.03)	(1.05)		(0.66)	(0.54)	(1.09)	(–1.12)	
	[2.28]	[–2.35]	[–0.30]	[1.04]		[0.66]	[0.54]	[0.92]	[–1.10]	
2002–2004	0.04*	0.01	–0.10	0.003	0.21	0.01	0.01	0.14*	0.001	0.29
	(2.62)	(–1.05)	(–0.45)	(0.21)		(1.09)	(1.16)	(2.60)	(–0.47)	
	[2.59]	[–0.95]	[–0.23]	[0.20]		[1.05]	[1.11]	[1.47]	[–0.44]	
1993–2004	–0.01	0.01**	0.33	0.004	0.29	–0.01	0.01**	0.11*	0.003	0.29
	(–0.32)	(1.69)	(1.15)	(–1.51)		(–0.99)	(1.74)	(2.20)	(–1.41)	
	[–0.32]	[1.69]	[0.34]	[–1.51]		[–0.99]	[1.73]	[1.47]	[–1.41]	

Note: The *t*-values in round and squared brackets are, respectively, Fama-McBeth *t*-values, and error-adjusted Shanken *t*-values. The * shows significant at 1 percent, ** is significant at 5 percent, and *** is significant at 10 percent level.

significant non-linear relationship between returns and systematic risk, however, the coefficient of determination has improved. The intercept term is significantly different from zero in 2001–2003 and 2002–2004. When both residual risk and non-linear beta risk are incorporated in the standard CAPM model, the beta risk is positively rewarded only for the overall period 1993–2004, but other results remain the same.

The negative sign of estimated market risk premium, which implies that firms with higher market beta have lower expected return, suggests that beta risk is not a valid measure of risk in Karachi Stock Market. The wrong sign and insignificance for pricing of market index contrasts sharply with their positive and significance relation in time series regression as shown by Table A3 in Appendix A. The results suggest that although the market return explains much of the intertemporal movement, but these betas or exposure can not explain the cross section differences in average return. The negative sign of estimated market risk premium was also empirically found in Spanish Stock Market by Palacios (1975) and in Korean Stock Market by Bark (1991) and US stock market by Fama and French (1992, 1993 and 1996).

Now to examine the behaviour of market risk and risk premium over time, market beta is estimated for each month by Davidian-Carroll (1987) method following Schwert (1989), Ferson and Harvey (1991). The information set includes lagged predetermined macroeconomic variable (market return, call money rate, term structure, growth in industrial production, inflation rate, exchange rate, consumption growth and growth in oil prices) which have frequently been used by investors in making investment decisions. These instrumental variables are publicly available information set and expected to be correlated with assets returns. The risk premium is estimated for each month by cross-section regression. The results of average risk premium for market risk are presented in Table 4. The results indicate that there is improvement in the results. The sign of risk return trade-off is correct but *t*-ratios are not significant in all the sub-periods.

The investors get positive compensation for market risk in sub-periods 1993-1995, 1993-1998, 1999-2004, 2002-2004 and the overall sample period 1993-2004. The results suggest that there is positive and significant compensation on average to bear conditional market risk. The intercept term is significantly different from zero for most of the sub-periods and overall period.

In the next stage model with firm attributes is estimated by using modified version of Fama-McBeth (1973) estimation procedure. The results of this time series are given in the Appendix Table A3. Three-factor Fama-French (1993) model, time series regression (11) is done by applying GMM estimation technique using the lag explanatory variables as instruments. The results indicate that asset returns are positively related to market risk β_{rm}. The parameters of sensitivity to firm attribute (size, and book-to-market value), that

Table 4

Average Time-varying Risk Premium Associated with the Conditional CAPM

Year	λ_{0t}	λ_{1i}	R^2
1993-1995	–0.02***	0.02*	0.11
	(–1.70)	(2.66)	
	[–1.69]	[2.46]	
1996-1998	–0.02***	0.01	0.20
	(–1.57)	(0.48)	
	[–1.54]	[0.44]	
1999-2001	0.002	0.01	0.20
	(0.23)	(1.08)	
	[0.22]	[1.06]	
2002-2004	0.02*	0.02***	0.16
	(3.64)	(1.43)	
	[3.63]	[1.43]	
1993-1998	–0.02*	0.02**	0.16
	(–2.30)	(1.86)	
	[–2.29]	[1.72]	
1999-2004	0.01*	0.02**	0.18
	(2.59)	(1.79)	
	[2.57]	[1.78]	
1993-2004	–0.001*	0.02*	0.17
	(–2.80	(2.57)	
	[–0.28]	[2.50]	

Note: The *t*-values are reported below the average premium the Fama-McBeth *t*-values and the Shanken error adjusted *t*-values. The * shows significant at 1 percent, ** is significant at 5 percent, and *** is significant at 10 percent level.

is β_{SIZE} and β_{BM} have a mix relationship. The effect of increase in size of the firm and book-to market value on asset return is not consistent as indicated by the estimated values of β_{SIZE} and β_{BM}, however, for most of the firms it is positive, while only for few firms this factor loadings is negatively. In the second step these factor sensitivities are used as explanatory variables and cross section regression is estimated for each month to find reward or risk premium associated with these factors for unconditional multifactor model. The average of these cross-section coefficients are presented in Table 5.

With the addition of Fama-French variables in the cross-section equation, the premium for market beta remains inconclusive and insignificant. The relationship between the cross-section of returns and size is negative but insignificant for most of the sub-periods. When the book-to-market variable is incorporated with beta risk, the premium for market risk again becomes negative but insignificantly different from zero premium for book-to-market-value is

Table 5

Average Risk Premium of the Unconditional Three-factor CAPM

	λ_{0t}	λ_{RM}	λ_{BM}	λ_{SIZE}	R^2
		$r_{it} = \lambda_0 + \lambda_{RM1}\beta_{RM} + \lambda_{BM}\beta_{BM} + \varepsilon_{it}$			
1998-2000	–0.01	0.01	0.13		0.13
	(–0.62)	(1.36)	(0.42)		
	[–0.62]	[1.35]	[0.24]		
1999-2001	–0.02	–0.01	0.04		0.22
	(–0.87)	(–2.97)	(0.12)		
	[–0.86]	[–2.96]	[0.11]		
2000-2002	–0.03	0.001	0.52**		0.2
	(–1.46)	–0.91)	(1.90)		
	[–1.43]	[–0.91]	[0.35]		
2001-2003	0.04	0.00	0.02		0.36
	(1.44)	(0.06)	(0.05)		
	[1.32]	[0.06]	[0.05]		
2002-2004	-0.02	0.00	0.08		0.20
	(–1.06)	(–1.39)	(0.36)		
	[–1.05]	[–1.39]	[0.27]		
1993-2004	0.001	0.00	0.27		0.33
	(0.16)	(–0.47)	(1.10)		
	[0.16]	[–0.47]	[0.37]		
1993-2004	–0.01	0.00	0.18		0.23
	(–0.63)	(–1.41)	(1.20)		
	[–0.63]	[–1.41]	[0.57]		
		$r_{it} = \lambda_0 + \lambda_{RM1}\beta_{RM} + \lambda_{SIZE}\beta_{SIZE} + \varepsilon_{it}$			
1998-2000	0.00	0.00		–0.04	0.22
	(-0.23)	(1.08)		(–0.31)	
	[-0.23]	[1.07]		[–0.30]	
1999-2001	–0.02***	–0.01		–0.05	0.22
	(–1.83}	(–2.58)		(–0.46)	
	–1.82	[–2.58]		[–0.43]	
2000-2002	0.001	–0.01		0.17***	0.22
	(–0.33)	(–1.76)		(1.72)	
	[–0.33]	[–1.76]		[0.85]	

Continued—

Table 5—(*Continued*)

2001-2003	0.02*	0.00		0.23*	0.49
	(2.90)	(–0.44)		(2.24)	
	[2.76]	[–0.44]		[1.88]	
2002-2004	–0.01	0.001		–0.04	–0.29
	(–1.54)	(–1.23)		(–0.55)	
	[–1.54]	[–1.23]		[–0.52]	
1993-2004	0.01***	0.002		0.20*	0.47
	(1.66)	(–1.37)		(2.50)	
	[1.63]	[–1.37)		[2.10]	
1993-2004	0.001	–0.00		0.08***	0.27
	(0.19)	(–1.92)		(1.63)	
	[0.19]	[–1.92]		[1.54]	
$r_{it} = \lambda_0 + \lambda_{RM1}\beta_{RM} + \lambda_{BM}\beta_{BM} + \lambda_{SIZE}\beta_{SIZE} + \varepsilon_{it}$					
1998-2000	–0.03	0.01	0.34	–0.05	0.25
	(–0.88)	(1.22)	(0.85)	(–0.46)	
	[–0.87]	[1.21]	[0.24]	[–0.42]	
1999-2001	–0.01	–0.01	–0.03	–0.05	0.26
	(–0.50)	(–2.49)	(–0.09)	(–0.43)	
	[–0.50]	(–2.49)	[–0.09]	[–0.40]	
2000-2002	–0.03	–0.01	0.42	0.15	0.27
	(–1.32)	(–1.48)	(1.28)	(1.47)	
	[–1.28]	[–1.48]	[0.29]	[0.81]	
2001-2003	0.03	0.00	–0.11	0.23*	0.50
	(1.23)	(–0.49)	(–0.31)	(2.22)	
	[1.14]	[–0.49]	[–0.22]	[0.85]	
2002-2004	–0.02	0.00	0.14	–0.05	0.28
	(–0.96)	(–1.08)	(0.49)	(–0.63)	
	[–0.95]	[–1.08]	0.28	–0.58	
1993-2004	0.001	0.002	0.16	0.19*	0.48
	(0.02)	(–1.21)	(0.57)	(2.32)	
	[0.02]	[–1.21]	[0.30]	(1.05]	
1993-2004	–0.01	–0.001	0.15	0.07	0.39
	(–0.68)	(–1.71)	(0.79)	(1.35)	
	[–0.68]	[–1.70]	[0.43]	[1.04]	

Note: Two sets of *t*-values are reported, the Fama-McBeth *t*-values in round brackets and the error-adjusted Shanken *t*-values in square bracket. The * shows significant at 1 percent, ** is significant at 5 percent, and *** is significant at 10 percent level.

insignificant with no clear sign. The results remain the same when size and book-to-market-value variables are both incorporated in the cross-section model. This suggests that the risk factors associated with market return, size and style of the firm have are not significantly rewarded in the market. The intercept terms are significantly different from zero. This result is consistent with findings in literature, such as the one for the UK market by Clare, Priestly and Thomas (1998).

The time variability is allowed in betas and risk premium to estimate conditional three-factor model. The conditional betas of market return, size and style of firm variables are induced by Dividian-Carroll Method. These variables are conditional on a vector of lagged business-cycle variables and these time varying betas are used to estimate time varying risk premium month by month in the second stage. The averages of these risk premiums are reported in Table 6.

The conditional Fama-French (1992) model shows some improvement in explaining the cross-section variation in the expected returns (Table 6) over the results of unconditional Fama-French model (Table 5). The inclusion of conditional size variable in the model has made the market risk premium significantly different from zero in 1993-95 and marginally positive and significant in 2000-04 and for overall period 1993-04. The premium of size of the firm is positive and significant only for period 2000-04, and remains inconclusive and insignificant for rest of the periods. The relationship between average return and conditional book-to-market-value is positive and significant in the sub-periods 1999-2001, 1999-2004 and overall period. When the standard CAPM is augmented by the size and style variables, the market risk premium become significantly different from zero in 1993-1995 and 2000-2004. The book-to-market-value is positively and significantly priced in 1999-2001, 1999-2004 and in overall sample period 1993-2004. The size risk premium is marginally significant in 2000-2004 only and for the rest of period under study it remains inconclusive.

These results differ from the ones obtained in a series of papers for US market by Fama and French (1992, 1993, 1995, 1997, 2004), which suggest that these variables have important role in explaining cross-section of expected return and these variables outperform market return. Similarly Chan, Hamao and Lakonishol (1991) find a strong relationship between book-to-market-value and average return in Japanese market, while Capual, Rowley and Sharpe (1993) observe a similar that is book-to-market-value effect in four European stock markets. Likewise Fama and French (1998) find that the price ratios produce same results for twelve major emerging markets.

Table 6

Average Risk Premium of the Conditional Three-factor CAPM

	λ_{0t}	λ_{RM}	λ_{BM}	λ_{SIZE}	R^2
		$r_{it} = \lambda_{0t} + \lambda_{1RM}^{c}\beta_{rm} + \lambda_{BM}^{c}\beta_{BM} + \varepsilon_{it}$			
1998-2000	–0.05	0.01	3.88		0.11
	(–0.89)	(0.71)	(1.37)		
	[–0.82]	[0.69]	[0.03]		
1999-2001	–0.01	0.002	0.39		0.20
	(–0.50)	(–0.12)	(0.31)		
	[–0.49]	[–0.11]	[0.08]		
2000-2002	0.00	0.00	0.67		0.19
	(0.04)	(0.16)	(0.55)		
	[0.03]	[0.16]	[0.09]		
2001-2003	0.05	0.01	0.19		0.13
	(1.49)	(0.28)	(0.17)		
	[1.42]	[0.27]	[0.08]		
2002-2004	–0.03	0.001	1.98		0.16
	(–1.03)	(0.24)	(1.35)		
	[–1.03]	[0.23]	[0.07]		
1993-2004	0.03	0.01	0.43		0.16
	(1.57)	(0.58)	(0.51)		
	[1.54]	[0.58]	[0.12]		
1993-2004	0.00	0.001	1.17		0.16
	(0.03)	(0.58)	(1.41)		
	[0.03]	[0.58]	[0.12]		
		$r_{it} = \lambda_{0t} + \lambda_{1RM}^{c}\beta_{rm} + \lambda_{SIZE}^{c}\beta_{SIZE} + \varepsilon_{it}$			
1998-2000	0.05	0.01		0.88	0.11
	(1.38)	(0.79)		(0.53)	
	[1.11]	[0.77]		[0.05[	
1999-2001	–0.13	0.00		4.62***	0.20
	(–1.86)	(–0.20)		(1.61)	
	[–1.42]	[–0.19]		[0.04]	
2000-2002	0.06	0.01		0.84	0.19
	(1.14)	(0.38)		(0.37)	
	[0.97)	[0.37]		[0.05]	

Continued—

Table 6—(*Continued*)

2001-2003	0.04	0.01		0.35	0.14
	(0.84)	(0.84)		(0.18)	
	[0.82]	[0.83]		[0.05]	
2002-2004	–0.05	0.00		2.92***	0.16
	(–1.10)	(0.22)		(1.68)	
	[–1.08)	[0.21]		[0.66]	
1993-2004	0.05	0.01		0.59	0.16
	(1.38)	(0.44)		(0.40)	
	[1.26)	[0.44]		[0.07]	
1993-2004	0.00	0.01		1.34	0.16
	(0.14)	(0.71)		(1.17)	
	[0.14]	[0.71]		[0.09]	
$r_{it} = \lambda_{0t} + \lambda^{c}_{1RM}\beta_{rm} + \lambda^{c}_{BM}\beta_{BM} + \lambda^{c}_{SIZE}\beta_{SIZE} + \varepsilon_{it}$					
1998-2000	0.01	0.01	2.67	–1.53	0.12
	(0.22)	(0.78)	(0.90)	(–0.90)	
	[0.22]	[0.76]	[0.03]	[–0.05]	
1999-2001	–0.16**	0.00	3.17	4.42	0.22
	(–1.99)	(–0.20)	(1.08)	(1.52)	
	[–1.35]	[–0.19]	[0.04]	[0.04]	
2000-2002	0.07	0.00	1.65	0.52	0.20
	(0.96)	(0.22)	(0.69)	(0.24)	
	[0.78]	[0.22]	[0.05]	[0.05]	
2001-2003	0.03	0.01	3.40	1.07	0.15
	(0.48)	(0.84)	(1.44)	(0.56)	
	[0.48]	[0.83]	[0.04]	[0.05}	
2002-2004	–0.08	0.00	2.94	1.71	0.13
	(–1.57)	(0.21)	(1.42)	(0.96)	
	[–1.39]	[0.20]	[0.05]	[0.06]	
1993-2004	0.05	0.01	2.53	0.80	0.18
	(1.04)	(0.67)	(1.51)	(0.55)	
	[0.95]	[0.67]	[0.06]	[0.07[	
1993-2004	–0.01	0.00	2.73*	1.24	0.15
	(–0.31)	(0.62)	(2.07)	(1.09)	
	[–0.31]	[0.61]	[0.08]	[0.09]	

Note: Two sets of *t*-values are reported the Fama-McBeth *t*-values in round bracket and the error-adjusted Shanken *t*-values in square brackets. The * shows significant at 1 percent, ** is significant at 5 percent, and *** is significant at 10 percent level.

The findings given in Table 6 also give support to the fact that time varying firm attributes have only limited role in Pakistani market in explaining asset price behaviour.

As regards the test of efficiency hypothesis, we examined whether the market portfolio is unconditionally minimum variance and also has minimum variance conditional on set of information variable. The results indicate the hypothesis the market portfolio is unconditionally efficient is rejected and also the efficiency conditional on observed instruments is also not accepted because the intercept term is significantly different in most of the sub-periods and overall period in almost all the models.

To sum up, the empirical findings indicate that static version of Sharpe-Lintner CAPM does not hold true in Karachi Stock Market for the overall sample period under study. The different sets of results have common features. They have shown that systematic risk-return trade-off is not always positive. These results reveal that there is no nonlinearity in the relationship and nonsystematic risk has some effects on average asset return. The intercept terms have mixed sign, small magnitude and significant *t*-ratio for few periods. However, the market beta is not sufficient to explain variation in the cross-section of expected returns rather the results indicate market risk is not positively compensated. This evidence implies that market portfolio is not mean variance efficient. The result of the conditional CAPM reveal that the model performed relatively well in explaining risk-return relationship in Pakistan during the sample period. The incorporating Fama French variable in time varying context have limited role in explaining cross-section of expected return in Pakistani market. Our empirical results of conditional standard CAPM and conditional three-factor CAPM confirm the notion of time variation in market risk and risk premium is confirmed to some extent by the KSE data.

The standard CAPM yield poor empirical results with Karachi Stock Market because KSE is small and relatively under-developed in comparison with other emerging markets where this model fits the data well. The main reason of inadequacy of standard CAPM for KSE is that this market is inefficient because of information barriers and other prevailing inadequacies in infrastructure. The market equilibrium model CAPM is based on the assumption of market efficiency, hence model may not be appropriate if assets are inefficiently priced. Also the influence of institutions and large share-holders that trade on monopolistic information with a large capital base is also one of the major reasons for market inefficiency in KSE. The investors mostly hold highly undiversified portfolios with small number of stocks and therefore one basic assumption of standard CAPM that investors hold large diversified portfolios is not applicable to the KSE. In short our empirical results suggest that the main implications of standard CAPM are not supported in the Karachi Stock Market.

5. SUMMARY AND CONCLUSION

The empirical findings indicate that the Sharpe–Lintner–Blade CAPM is also inadequate for Pakistan's equity market in explaining the economically and statistically significant role of market risk for the determination of expected returns. The critical condition of CAPM, a positive trade off between market risk and return, is rejected. For the most period of the study, negative sign in the estimated market premium is observed. Secondly, the residual risk plays some role in pricing risky assets. Thirdly there are some non-linearities in the risk-return relationship. The inadequacy of CAPM at KSE is attributed to market inefficiencies, undiversified portfolio held by Pakistani investors and short observation period and statistical bias induced by infrequent trading of small firms.

In response to this finding we have extended the model by taking into consideration the time-varying return distribution of the assets. The conditional approach to testing CAPM is to examine that the asset price relationship is better explained by accommodating business cycle variables as information set. The standard CAPM is extended with Fama-French (1992) variables, size and book-to-market value, in unconditional and conditional setting. The observation is that the dynamic size and style coefficient explain the cross-section of expected returns in few sub-periods. This evidence leads us to investigate macroeconomic risks that can describe the variation in expected returns in a more complete and meaningful way.

Appendix A

Table A1

List of Companies Included in the Sample

Name of Company	Symbol	Sector
Al-Abbas Sugar	AABS	Sugar and Allied
Askari Commercial Bank	ACBL	Insurance and Finance
Al-Ghazi Tractors	AGTL	Auto and Allied
Adamjee insurance Company	AICL	Insurance
Ansari Sugar	ANSS	Sugar and Allied
Askari Leasing	ASKL	Leasing Company
Bal Wheels	BWHL	Auto and Allied
Cherat Cement	CHCC	Cement
Crescent Textile Mills	CRTM	Textile Composite
Crescent Steel	CSAP	Engineering
Comm. Union Life Assurance	CULA	Insurance and Finance
Dadabhoy Cement	DBYC	Cement
Dhan Fibres	DHAN	Synthetic and Rayon
Dewan Salman Fibre	DSFL	Synthetic and Rayon
Dewan Textile	DWTM	Textile Composite
Engro Chemical Pakistan	ENGRO	Chemicals and Pharmaceuticals
Faisal Spinning.	FASM	Textile Spinning
FFCL Jordan	FFCJ	Chemicals and Pharmaceuticals
Fauji Fertiliser	FFCL	Fertiliser
Fateh Textile	FTHM	Textile Composite
General Tyre and Rubber Co.	GTYR	Auto and Allied
Gul Ahmed Textile	GULT	Textile Composite
Habib Arkady Sugar	HAAL	Sugar and Allied
Hub Power Co.	HUBC	Power Generation and Distribution
I.C.I. Pak	ICI	Chemicals and Pharmaceuticals
Indus Motors	INDU	Auto and Allied
J.D.W. Sugar	JDWS	Sugar and Allied
Japan Power	JPPO	Power Generation and Distribution
Karachi Electric Supply Co.	KESC	Power Generation and Distribution
Lever Brothers Pakistan	LEVER	Food and Allied
Lucky Cement	LUCK	Cement
Muslim Commercial Bank	MCB	Commercial Banks
Maple Leaf Cement	MPLC	Cement
National Refinery	NATR	Fuel and Energy
Nestle Milk Pak Ltd	NESTLE	Food and Allied
Packages Ltd.	PACK	Paper and Board
Pak Electron	PAEL	Cables and Electric Goods
Pakistan Tobacco Company	PAKT	Tobacco
Pakland Cement	PKCL	Cement
Pakistan State Oil Company	PSOC	Fuel and Energy
PTCL (A)	PTC	Fuel and Energy
Southern Electric	SELP	Cables and Electric Goods
ICP SEMF Modarba	SEMF	Modarba
Sitara Chemical	SITC	Chemicals and Pharmaceuticals
Sui Southern Gas Company	SNGC	Fuel and Energy
Sui Northern Gas Company	SSGC	Fuel and Energy
Tri-Star Polyester Ltd	TSPI	Synthetic and Rayon
Tri-Star Shipping Lines	TSSL	Transport and Communication
Unicap Modarba	UNIM	Modarba

Table A2

Summary Statistics of Daily Stock Returns

Company	No. of Obs.	Mean	St. Dev.	Skewness	Excess Kurtosis	Jarque-Bera
AABS	1990	0.13**	3.57*	0.65*	4.54*	1849.67*
ACBL	2697	0.10***	2.81*	-0.02	8.62*	8342.60*
AGTL	2094	0.21*	3.15*	0.40	11.48*	11556.03*
AICL	2681	0.08	3.54*	0.02	8.25*	7604.82*
ANSS	1544	0.00	7.75*	–0.61	11.34*	8364.52*
ASKL	2426	0.09	3.46*	0.22	8.32*	7016.92*
BWHL	1644	–0.01	4.61*	0.31	7.29*	3665.67*
CHCC	2491	0.07	3.42*	0.36**	4.36*	2023.86*
CRTM	2149	0.07	4.36*	0.20	11.14*	11127.45*
CSAP	1829	0.12	4.44*	0.49	12.77*	12504.90*
CULA	1664	0.06	4.31*	0.34	6.07*	2528.65*
DBYC	2166	0.00	6.57*	0.45	16.36*	24229.89*
DHAN	1489	–0.05	4.34*	1.37*	9.23*	5749.70*
DSFL	2707	0.02	3.25*	0.48**	4.85*	2753.04*
DWTM	385	–0.02	4.90*	0.68	11.43*	2125.84
ENGRO	2660	0.08	2.63*	0.11	8.55*	8107.69*
FASM	1405	0.18	2.96*	–1.28	23.45*	32574.22*
FFCJ	2080	0.03	3.26*	0.62**	7.23*	4656.48*
FFCL	2704	0.08	2.29*	–0.24	5.54*	3479.76*
FTHM	239	0.50	8.33*	0.39	5.63*	321.46*
GTYR	2192	0.08	3.51*	1.40*	13.89*	18339.20*
GULT	587	0.26	5.96*	0.43*	10.28*	2601.98*
HAAL	1863	0.20**	3.81*	0.45*	3.77*	1167.39*
HUBC	2380	0.08	3.13*	–0.81	17.86**	31877.97*
ICI	2667	0.03	2.90*	0.34	4.32*	2128.42*
INDU	2659	0.06	3.13*	0.59***	4.41*	2307.69*
JDWS	1716	0.14	5.74*	0.25*	8.01*	4607.77*
JPPO	1944	–0.02	4.10*	0.94*	8.13*	5637.21*
KESC	2702	–0.02	3.97*	0.69*	6.52*	5002.83*
LEVER	2429	0.06	2.35*	0.51**	8.54*	7491.23*
LUCK	2310	0.04	4.13*	0.47**	6.31*	3914.20*
MCB	2714	0.08	3.20*	–0.07	4.76*	2567.14*
MPLC	2430	–0.04	4.18*	0.54	3.75*	1540.80*
NATR	2391	0.09	3.19*	0.47***	6.14*	3850.41*
NESTLE	986	0.26**	4.18*	0.14	7.44*	2279.29*
PACK	1856	0.09	3.20*	–0.43	10.24*	8169.93*
PAEL	1933	0.02	5.79*	0.42	19.20*	29760.13*
PAKT	1862	0.01	3.97*	–0.02	9.26*	6654.47*
PKCL	1776	0.02	4.53*	0.21	5.57*	2307.90*
PSOC	2713	0.11***	2.71*	–0.28	11.19**	14189.96*
PTC	2402	0.03	2.80*	0.08	7.35*	5415.82*
SELP	2024	0.01	3.92*	–0.47	43.68*	161003.70*
SEMF	2598	0.10	3.14***	0.91***	9.67***	10486.12*
SITC	1807	0.09	3.24*	0.38	11.33*	9708.85*
SNGP	2711	0.08	3.13*	0.29	4.59*	2418.05*
SSGC	2706	0.05	3.25*	0.56	10.77*	13220.94*
TSPI	1833	–0.05	11.32*	0.12	7.71*	4542.77*
TSSL	1304	–0.11	8.79*	–0.34	18.43*	18478.51*
UNIM	1999	–0.04	10.35*	0.54	16.61*	23068.60*

Note: * indicates significance at 1 percent, ** indicates significance at 5 percent level.

Table A3

The Coefficient of Market Factor Sensitivity

	Beta Estimates by Daily Data		Beta Estimates by Daily Data	
	β_i	R^2	β_i	R^2
AABS	0.37*	0.30	0.37*	0.29
	(7.75)		(3.68)	
ACBL	0.98*	0.35	1.02*	0.54
	(38.15)		(12.56)	
AGTL	0.45*	0.36	0.56*	0.33
	(11.20)		(4.47)	
AICL	1.07*	0.24	1.56*	0.52
	(29.09)		(12.04)	
ANSS	0.61*	0.21	0.57*	0.20
	(4.29)		(3.98)	
ASKL	0.77*	0.35	0.92*	0.37
	(20.85)		(8.89)	
BWHL	0.72	0.5	0.26*	0.53
	(2.72)		(2.01)	
CHCC	0.85*	0.47	1.01*	0.49
	(22.44)		(11.39)	
CRTM	0.81*	0.39	1.04*	0.40
	(14.86)		(9.52)	
CSAP	0.72*	0.26	0.72*	0.23
	(10.68)		(6.34)	
CULA	0.64*	0.27	0.52*	0.27
	(11.41)		(5.35)	
DBYC	1.23*	0.39	1.38*	0.37
	(14.33)		(8.89)	
DHAN	0.81*	0.33	0.87*	0.32
	(14.70)		(7.97)	
DSFL	1.20*	0.38	1.41*	0.56
	(40.67)		(13.25)	
DWTM	0.52*	0.22	0.15*	0.25
	(2.71)		(2.66)	
ENGRO	0.86*	0.2 7	0.79*	0.35
	(30.98)		(8.63)	
FASM	0.53*	0.22	0.73**	0.25
	(4.97)		(4.97)	
FFCJ	1.15*	0.40	1.03*	0.41
	(37.31)		(6.18)	
FFCL	0.87*	0.41	0.87*	0.52
	(43.59)		(12.21)	
FTHM	–0.01	0.31	–0.07	0.30
	(–0.04)		(–0.58)	
GTYR	0.61*	0.29	0.71*	0.27
	(14.76)		(5.32)	
GULT	0.31**	0.21	0.09**	0.20
	(1.85)		(1.71)	
HAAL	0.47*	0.24	0.58*	0.27
	(9.28)		(5.33)	
HUBC	1.30*	0.54	1.23*	0.57
	(52.43)		(13.34)	

Continued—

Table A3—(*Continued*)

ICI	1.13* (43.24)	0.41	1.32* (14.65)	0.61
ICPSEMF	1.00* (33.03)	0.30	1.10* (11.39)	0.49
INDU	0.77* (23.57)	0.37	0.94* (9.74)	0.41
JDWS	0.31* (3.50)	0.31	0.48* (3.07)	0.36
JPPO	1.33* (32.29)	0.35	0.99* (8.76)	0.36
KESC	1.42* (39.88)	0.37	1.61* (15.58)	0.64
LEVER	0.49* (19.19)	0.23	1.17* (7.47)	0.29
LUCK	1.20* (25.17)	0.22	0.52* (11.42)	0.49
MCB	1.17* (41.70)	0.39	1.25* (15.87)	0.65
MPLC	1.21* (28.04)	0.24	1.30* (10.15)	0.43
NATR	0.79* (22.22)	0.27	0.86* (8.42)	0.34
NESTLE	0.54 (6.36)	0.24	0.33* (5.29)	0.30
PACK	0.52* (12.01)	0.27	0.68* (8.60)	0.35
PAEL	0.85* (10.58)	0.25	0.85* (5.48)	0.38
PAKT	0.66* (10.84)	0.26	0.65* (5.21)	0.37
PKCL	0.86* (14.17)	0.30	0.75* (4.45)	0.33
PSO	1.12* (51.26)	0.49	1.31* (17.15)	0.68
PTC	1.35* (77.93)	0.72	1.08* (17.10)	0.68
SELP	1.28* (32.98)	0.35	0.90* (8.27)	0.33
SITC	0.48* (10.17)	0.25	0.57* (7.46)	0.29
SNGP	1.25* (48.11)	0.46	1.37* (18.23)	0.71
SSGC	1.19* (41.59)	0.61	1.26* (17.97)	0.70
TSPI	0.73* (4.23)	0.41	0.81* (3.70)	0.49
TSSl	0.45* (3.08)	0.41	0.38* (2.31)	0.44
UNIM	0.92* (6.30)	0.32	0.85* (3.67)	0.39

Note: The beta measures the sensitivity of asset excess return to excess market return above the risk-free rate for the 49 stocks traded at Karachi Stock Exchange. The values below the coefficient are *t*-ratios

Appendix B

Estimation of Conditional Betas

To estimate conditional betas, first of all conditional variances are estimated. Suppose r_{it} is actual return and let $E\langle r_{it} | Z_{t-1} \rangle$ denotes its conditional return on available information set at time t–1. Let σ_{it} be the unconditional standard deviation of return on asset i and let $E\langle r_{it} | Z_{t-1} \rangle$, denotes its conditional form. The conditional standard deviation of r_{it} conditional on a vector of lagged predetermined macro variables (marker return, growth in consumption per capita,, growth in industrial production, call money rate, term structure, inflation rate, exchange rate and oil price growth rate) and a constant. These variables are likely to be correlated with asset return and form a publicly available information set. The assumption is that the conditional mean of r_{it} is linear in Z_{t-1}. Then the following steps are estimated to transform residuals for estimation of conditional variance function:

$$r_{it} = Z_{t-i}\delta + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(B1)}$$

$$\hat{\varepsilon}_{it} = r_{it} - Z_{t-i}\hat{\delta}_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(B2)}$$

Here $\hat{\delta}_i$ is the parameter estimate under OLS. The absolute values of residuals are used in the estimation of conditional standard deviation because it is a more robust choice [Davidian and Carroll (1987)]. Therefore a linear function for absolute residuals is estimated by OLS and $\hat{\theta}$ is obtained from the regression equation:

$$|\hat{\varepsilon}_{it}| = \sigma(\theta, Z_{t-1}) + v_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(B3)}$$

In next step the fitted $\sigma(\hat{\theta}, Z_{t-1})$ are used to estimate GLS estimates of δ^* given in the following regression equation:

$$r_{it} / \sigma(\hat{\theta}, Z_{t-1}) = \left[Z_{t-1} / \sigma(\hat{\theta}, Z_{t-1}) \right] \delta^* + \varepsilon^*_{it} \quad \ldots \quad \ldots \quad \ldots \quad \text{(B4)}$$

Then δ^* is used for Weighted Least Square to generate the final residuals, latter these residuals are used to estimate θ^*, that is:

$$\varepsilon^*_{it} = r_{it} - Z_{t-1}\delta^* \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(B5)}$$

$$|\varepsilon^*_{it}| = \sigma(\theta^*, Z_{t-1}) + v^*_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \text{(B6)}$$

The function $\sigma(\theta^*, Z_{t-1})$ is the fitted conditional standard deviation function. Therefore the conditional standard deviation becomes:

$$\sigma^* = \sigma(\theta^*, Z_{t-1})\sqrt{\pi/2} \qquad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \text{(B7)}$$

The term $\sqrt{\pi/2}$ is a bias adjustment factor, which corrects for the fact that mean absolute deviation differs from standard deviation.[15]

The square of conditional standard deviations estimated by above method gives the conditional variance of market return. To estimate conditional covariance of asset return with the market return need some more manipulation. To estimate conditional covariance between two variables $i \neq j$, the residual from Equation (B5) are taken for estimation of the following equation:

$$(\sqrt{\varepsilon^*_{it}})(\sqrt{\varepsilon^*_{jt}})s_{ijt} = Z_{t-1}\psi + \varepsilon_{ijt} \qquad \dots \quad \dots \quad \dots \quad \dots \quad \text{(B8)}$$

In this equation s_{ijt} is term that preserves the sign of the product of two residuals at each date. The fitted conditional covariances are:

$$sign(Z_{t-1}\hat{\psi})(Z_{t-1}\hat{\psi})^2(\pi/2) \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \text{(B9)}$$

Where $\operatorname{sgn}(x) = x/|x|$.

In this way the above procedure forms fitted value to estimate conditional covariance of asset returns with the market return. The conditional betas are then estimated as inverse of conditional variance vector multiplied by estimate vector of conditional covariance of asset returns with the market return. By using this vector of conditional betas, the cross section equation of conditional CAPM given in Equation (10) is estimated month by month and the slope coefficient gives risk premium for each month. In this way market risk and price of risk is allowed to vary over time. The average of these risk premiums is obtained and Fama-McBeth (1973) *t*-values are calculated to test that the premium is significantly different from zero. These *t*-values are also adjusted for Shanken (1992) adjustment.

Appendix C

Desegregation of Annual Consumption Data as Monthly data

The desegregation of the yearly real private consumption per capita into twelve months is done in such a way that the resulting series satisfies the

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[15]This adjustment is motivated by normal distribution, for which standard deviation is equals the mean absolute deviation multiplied by $\sqrt{\pi/2}$. Schwert (1989) and Hsieh and Miller (1990) also use this adjustment.

standard requirements,[16] the following procedure is adopted. Suppose the consumption per capita in year t is denoted by C_t, then the average monthly growth factor between the two years t and t–1 is given by, $G_{t,t-1} = (C_t / C_{t-1})^{1/2}$. This growth factor is discontinuous as it remains constant for all twelve months within a year and then suddenly changes to a different value in the first month of the next year. The growth factor is then smooth out by applying linear interpolation for each month to yield a continuous series of monthly growth factor. For this purpose first the monthly average growth factor for each year is placed in the middle of the year, then the following interpolation yields the growth factor for the month t,

$$G_{ti} = G_{t-1} + (G_t - G_{t-1})^{((i-0.5)/12)} \qquad \text{i-1,2….6}$$
$$= G_t + (G_{t+1} - G_t)^{((i-0.5/12)} \qquad \text{i=7,8….12} \qquad \ldots \qquad \ldots \quad \text{(C1)}$$

Then the monthly series of consumption (*Ct*) is derived by solving the following restrictions

$$\sum_{t=1}^{12} C_{t,1} = C_t \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \quad \text{(C2)}$$

$$C_{t,t+1} = G_{t,t+1} C_{t,i} \qquad \text{i=1,2,….11} \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \quad \text{(C3)}$$

Expressing all $C_{t,t+I}$ for all i=1,2…11in terms of $C_{t,1}$ by successive backward substitution the result of (C3) yields the solution for the first month consumption $C_{t,1}$

$$C_{t,1} = C_t [1 + G_{t,2} + G_{t,3} G_{t,2} + G_{t,4} G_{t,3} G_{t,2} + \ldots\ldots^{-1}$$
$$+ (G_{t,12} G_{t,11} G_{t,10} \ldots\ldots G_{t,1})] \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \quad \text{(C4)}$$

Finally once consumption for the first month is estimated from (C4), the consumption for the 11 months is obtained by using the relationship given in (C4). The series is obtained as continuous and smooth and its rate of change is also continuous.

[16]The temporal desegregation should satisfy a number of requirements. First the monthly values must sum to the annual values. Second the resulting monthly series should be continuous. In discrete time framework this practically means that the series should be smooth and free of any erratic fluctuations. The requirement for temporal disaggregating is that the series should be differentiable. This means that in discrete time, the rate of change in the series should be smooth [Chow and Lin (1971)].

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