INTERNATIONAL JOURNAL OF BUSINESS, 12(4), 2007 ISSN: 1083–4346

A Test of CAPM on the Karachi Stock Exchange

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ABSTRACT

This study investigates the applicability of the CAPM in explaining the cross section of stock return on the Karachi Stock Exchange for the period September 1992 to April 2006. Unlike earlier studies on emerging markets this study is carried out with a broader scope. Firstly, the tests are conducted on individual stocks as well as size sorted portfolios and industry portfolios. Secondly, the test accounts for the intervalling effect by employing three data frequencies namely daily, weekly and monthly data. Thirdly, keeping in view the infrequent trading prevailing in emerging markets in general and Pakistan's equity markets in particular the test is also carried out on beta corrected for thin trading, using the Dimson (1979) procedure. Contrary to earlier studies on emerging markets the premium for beta risk and the skewness have the expected signs. The risk return relationship however appears to be non-linear and is most profound in recent years when the market performance, backed by the high level of liquidity and trading activity, was outstanding.

JEL Classification: *G1, C24*

Keywords: *CAPM; Thin trading; Emerging markets; Pakistan*

I. INTRODUCTION

Capital asset pricing has always been an active area in the finance literature. The Sharp-Lintner-Black CAPM states that the expected return of any capital asset is proportional to its systematic risk measured by the beta. Based on some simplifying assumptions the CAPM is expressed as a linear function of a risk free rate, beta and the expected risk premium. An important quantity required for decisions on evaluating public and private funded projects is an appropriate cost of capital. This discount rate is often estimated by a model of expected return. The CAPM has been extensively employed for estimating cost of capital and evaluating the performance of managed funds. Implementing the CAPM on emerging markets seems problematic. This is due to inefficiencies in these markets such as prohibiting foreign capital, insider trading, and high transaction costs, as well as data problems such as infrequent trading. The stringent assumptions on which CAPM relies apparently make it difficult to apply, especially in emerging markets. However, these assumptions are not as inflexible as they appear. The model has now been tested for a range of emerging markets including those in South East Asia, Europe and Latin America, besides the developed markets of the US, the UK and Australia.

There is little empirical evidence on the risk return relationship and asset pricing tests in the South Asian capital markets, especially for Pakistan. In recent years the trading activity in the Karachi stock market has increased considerably. The market was declared the best performing stock market for the year 2002 in terms of the percentage increase in the market index. The Karachi Stock Exchange 100 index increased 112.2 % during 2002. For the sample period considered in the present study the KSE-100 index rose from 1145 on 1 September 1992 to 11342 on 28 April 2006, indicating an increase of approximately 890 % which amounts to an annual gain of approximately 64%. Among the factors behind this astonishing performance was the induction of the overseas Pakistani workers' remittance in the banking sectors, following a global ban on unofficial banking channels. This excess liquidity in the banks was transmitted as portfolio investment in the stock market. The declining interest rates also made equity investment attractive. Increased foreign exchange reserves and a stable exchange rate also contributed in this regard.

This development can be understood by considering an interesting aspect of the emerging markets in general and the Karachi stock market in particular, namely the lack of integration with the world markets. The emerging markets have great potential for equity risk diversification and they also offer higher average returns than the developed markets, see for example Harvey (1995). However, Wolf (1998) points out that the benefit from international diversification is much reduced if the returns to emerging markets are driven by factors originating outside of the market. This is the case when the market under consideration is more closely integrated with the world markets. Smith and Walter (1998) report the correlation of Pakistan's equity market with the US market for the period February 1993 to January 1996 to be -0.01. Harvey (1995) investigated the correlation of emerging markets with the world markets using monthly data from March 1986 to June 1992. The correlation of Pakistan's equity market with the Morgan Stanley Capital International (MSCI) developed market index and the overall world market index is reported to be 0.02 and 0.04 respectively. In his study of the world's emerging markets, Pakistan has been shown to be among the least correlated. In the year 2002, when the Karachi stock market performed the best in the world, the US Dow Jones and the European market indexes were at their lowest level in seven years. This relatively more segmented market, opened to international investors in 1991, therefore appears to provide great potential for international diversification. The low correlation provides a hedge against the shock transfers from the developed markets and other emerging markets. The Karachi Stock Exchange's unique international portfolio implications and attractive capital gains make the study of risk return relationship an interesting task. It will be important for international investors to know the nature of risk return relationship and other factors explaining these high rates of returns in this growing market. Some of the interesting questions relevant for investors are: Does the systematic risk measured by beta explain some of the variations in average returns? In other words, has the market really become mature enough to reward investors for bearing systematic risk, apart from political and macroeconomic risks that usually characterize emerging markets? Do other factors such as skewness significantly explain the variation in expected returns?

Black, Jensen and Scholes (1972) reported the first notable test of the CAPM. Their methodology is mainly a time series regression framework. The Sharp-Lintner version of the CAPM implies that the intercept term in the following time series regression is zero.

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \varepsilon_{it} \quad (1)$$

Here R_{it} and R_{mt} are the return on the asset and a proxy for the market portfolio respectively and R_{ft} is the risk free rate. Their method of testing employed portfolios instead of individual stocks in order to reduce the estimation error in risk variable estimation. Fama and MacBeth (1973) tested the cross section relationship implied by the Sharp-Lintner CAPM. The CAPM implies that the risk premium for beta is positive and the average return on the asset uncorrelated with the market is equal to the risk free rate of interest. In the first step of their two pass procedure the risk variables are estimated via a time series regression of the excess asset return on the excess markets return. The subsequent monthly returns on the asset are then cross sectionally regressed on the risk variables estimated from previous data which provide the estimates of the risk premium. The empirical evidence suggests that the relationship between average asset returns and the beta was positive, but not too strong. To test the model implication that beta is the only relevant risk variable, they also included the squared beta and the residual variance as explanatory variables. These variables did not significantly improve the explanatory power. Gibbons (1982) employed a multivariate methodology that combines the flavour of both the time series and cross section tests. These multivariate tests strongly rejected the efficiency of the equally weighted CRSP portfolio. Gibbons, Ross and Shanken (1989) provided an exact F test of the efficiency of a given portfolio. Using size portfolios they report that the efficiency of the value weighted CRSP portfolio was rejected for the 10 year sub periods starting from 1956, but in an earlier period the test was unable to reject efficiency.

In Asian markets Wong and Tan (1991) tested the validity of the CAPM in the Singapore Stock Exchange. The results indicate that the relationship between systemic risk and average return appeared to be linear in beta. However, the sign of the beta risk premium was opposite to that predicted by the CAPM and only a few beta coefficients were significant. Skewness appeared to be significant in two of the five years with individual stocks but with portfolio data the significant effect of skewness disappeared. Bark (1991) used the Fama and MacBeth methodology to test whether the CAPM is applicable to the Korean stock market. A positive trade-off between market risk and return is rejected and other factors such as unique risk were shown to play an important role in pricing risky assets. Cheung and Wong (1992) studied the relationships between stock returns and various measures of risk in the Hong Kong Equity Market over the period 1980-89. On the whole, the application of the CAPM in Hong Kong appeared weak. The market risk was only priced for the year 1984-85. Cheung, Wong and Ho (1993) performed empirical tests on the relationships between average stock returns and some measures of risk, including skewness, on two of the most important emerging Asian stock markets, Korea and Taiwan. The applicability of the CAPM seemed weak in both markets, particularly in Taiwan. Huang (1997) also reported an inverse relationship between returns and systematic risk, unique risk, and total risk respectively, in the Taiwan stock market.

For Pakistan's equity market Ahmad and Rosser (1995) used an ARCH-in-Mean specification to study the risk return relationship using sectoral indices. Ahmad and Zaman (2000) studied the relationship between excess monthly returns and anticipated and unanticipated market volatility using sectoral monthly data from July 1992 to March 1997. They provided evidence of a positive risk premium and a reward for willingness to accept uncertain market outcomes and concluded that the market provided reasonable compensation for risk and uncertainty. Iqbal and Brooks (2007) investigated the role of thin trading and censoring correction in beta estimation in asset pricing testing for Pakistan for 89 stocks over the period 1999 to 2005 and found that, while thin trading correction worked as expected, it did not impact the results of asset pricing tests. This study investigates the applicability of the CAPM in explaining stock returns on the Karachi Stock Exchange for the period September 1992 to April 2006. The methodology is similar to that of the two step Fama-MacBeth procedure. This method is predictive in nature as future returns are regressed on the currently estimated risk measures. Thus the method provides a useful framework to the investor for better management of investment funds. Unlike previous studies on emerging markets, this paper covers broader aspects of thin trading correction, return measurement interval and impact of different portfolios formation schemes on the test of risk return relationship.

The plan of the paper is as follows: In section II the data used in the study, that is the testable implication of the CAPM and the methodology, is reviewed. Empirical results are provided in section III and section IV concludes.

II. DATA AND METHODOLOGY

The daily, weekly and monthly closing prices for 101 stocks and the Karachi Stock Exchange (KSE) 100 index were collected from the DataStream database. The sample period covers 13 years and seven months from September 1992 to April 2006. The criteria for the selection was to collect the longest possible time series data on all active stocks for which the prices adjusted for dividend, stock split, merger and other corporate actions that were available in the database. The 101 stocks in the sample comprise about 80% market capitalization of the entire market. The KSE-100 index is a market capitalization weighted index. It comprises top companies from each sector of KSE in terms of their respective market capitalization. The rest of the companies are selected on the basis of market capitalization without considering their sector. This study has used the KSE-100 index as a proxy for the market portfolio. Market capitalization data is not available historically for all firms in the database. However, the financial daily Business Recorder has some recent year data. We selected the market capitalization of all selected stocks at the beginning of July 1999 which roughly corresponds to the middle of the sample period considered in the study. The weekly price data corresponds to the closing price of Thursday of each week while the monthly data available in the DataStream corresponds to the 13^{th} of each month. The daily, weekly and monthly raw returns are calculated assuming continuously compounding of the returns as, $R_{it} = \ln(P_t / P_{t-1}) * 100$. For computing excess returns the 30 day Repurchase Options Rate was used as a proxy for the risk free rate of return. Owing to imperfect money markets, an appropriate risk free rate is difficult to obtain for emerging markets. Therefore the tests are conducted for both excess return and the raw return data.

Fama and MacBeth (1973) employed beta, squared beta and the residual variance as the factors to explain cross section variation in expected returns. It is also of interest to test that the investors are only concerned with the mean variance trade-off and they do not consider the skewness 'SK' of the return distribution. Cooley *et al.* (1977) argues that skewness provides distinct and useful information apart from beta. Menezes *et al.* (1980) has mentioned skewness, among others, as a measure of downside risk. In incorporating skewness, a modified cross section model is specified as

$$R_{it} = \gamma_{0t} + \gamma_{1t}\beta_i + \gamma_{2t}\beta_i^2 + \gamma_{3t}\sigma_{\varepsilon i}^2 + \gamma_{4t}SK_i + \varepsilon_{it} \qquad (2)$$

Where R represents at time t the stock or portfolio return, β is the systematic risk of the asset, a measure of co-movement of the asset with the market, and σ^2_{ε} is the firm unique risk of the asset.

From this general model several testable implications of the CAPM can be derived. Firstly, the fundamental CAPM hypothesis that the risk premium of beta is positive is tested by a right tail t-test on the average of risk premium estimates γ_1 from the cross section regression (2). The CAPM implies that the risk return relationship is linear. This is tested as the two sided t-test on the average coefficients γ_2 on the regression (2). In the CAPM context, beta is the only relevant risk and the firm unique risk can be diversified away. This implication is tested as the two sided t-tests on the average risk premium estimates γ_3. Next, we would like to test whether, in making investment decisions, the investors treat the return distribution as symmetrical. Scott and Horvath (1980) argue the investors dislike even moments i.e. variance, but prefer the odd moments i.e. skewness. The movements at the right tail of the return distribution are beneficial so the increase in the skewness implies that the investors expect a smaller premium. This specifies a negative sign of the coefficient of the skewness. Therefore the significance of the skewness coefficient tested in this case is the left tail t-tests on the average coefficient γ_4. Moreover, the Sharp-Lintner version of the CAPM also implies that the asset uncorrelated with the market has expected return equal to the risk free rate. This implies that the intercept in the model expressed in the excess returns is zero. This is tested by a two sided t-test on the intercept of the model (2).

The risk measures are estimated through the market model regression.

$$R_i = \alpha_i + \beta_i R_m + v_i , \quad i = 1, 2, . . , N \tag{3}$$

where R_m is the return on the market portfolio and v_i is the random error which is assumed to be identically and independently distributed. The estimated slope coefficient β_i serves as a measure of the beta for asset i. The residual variance of the market model regression is used as a measure of unsystematic risk. 'SK' is estimated as the relative skewness of returns. The infrequent trading is an important feature of the Karachi Stock Exchange. In our sample data, the four most sluggish stocks in our sample were inactive for 283, 260, 222 and 182 consecutive trading days, respectively, so that even monthly data cannot avoid infrequent trading bias. The estimated beta from the OLS on the market model (3) for less frequently traded stocks are therefore likely to be downward biased as the returns of these stocks are not perfectly synchronized with the market return, see for example Dimson (1979) and Scholes and Williams (1977). Dimson (1979) reviews several alternatives for correcting the bias. In this study the aggregating beta procedure with two backward and forward lags is adopted. The modified market model regression is

$$R_i = \alpha_i + \beta_{i-2} R_{m-2} + \beta_{i-1} R_{m-1} + \beta_i R_m + \beta_{i+1} R_{m+1} + \beta_{i+2} R_{m+2} + u_i \tag{4}$$

From which the Dimson beta is estimated as

$$\beta_{iDim} = \beta_{i-2} + \beta_{i-1} + \beta_i + \beta_{i+1} + \beta_{i+2} \tag{5}$$

Handa *et al*. (1989) shows that as the return interval is increased the spread between the betas of low and high risk securities will increase. Further, betas estimated using returns measured over different intervals will be affected by their different standard errors. The standard error of the beta estimated using longer interval returns will be greater as there are fewer observations available. Singleton and Wingender (1986) document that measurement of the skewness and therefore the associated risk premium is also sensitive to the return measurement interval. Considering the sensitivity of beta and skewness to the return interval, the tests have been performed at three frequencies - daily, weekly and monthly.

Fama and MacBeth (1973) explained the importance of portfolio construction for empirical tests of CAPM. Tests involving portfolios not only result in smaller measurement error in the estimated risk measure but also increase precision of the estimates by providing a greater number of degrees of freedom. We formulate portfolios from the stocks based on the market capitalization. For size sorted portfolios the data of mid sample (July 1999) market capitalization are used to rank the stocks into

17 portfolios, from the lowest to the highest capitalized stocks. The first portfolio consists of 5 stocks, while the rest comprise 6 stocks each. The portfolio return is calculated as the equally weighted average return of the stocks in the portfolio. The construction method for the beta portfolios is similar to that of the size portfolios, except that the ranking of the stocks is based on their beta estimated for the full sample time series regression. Keeping in view the critique of Lo and Mackinlay (1990) that the portfolio formulation according to stocks characteristics such as the size and beta may bias the test results, we have also formulated the industry portfolios. The stocks are classified into 16 major industrial sectors. The sector sizes range from two stocks in Transport and Communication to 13 stocks in both the Textiles and Investment Banks and Financial Companies sectors. These sectors serve as natural portfolios.

While there are advocates of portfolio formulation in asset pricing tests, Roll (1977) points out that portfolio formulation may conceal the security related information present in the individual stocks. This is important especially for the emerging market research where the market is driven by a few blue chip stocks. Keeping this fact in mind, the tests are also performed on individual stocks. The method of testing is similar to that of Fama-MacBeth (1973), that is, basically predictive in nature. In each of the three cases the sample period of 13 years and seven months is divided into three roughly equal parts of four and a half years. The three sub periods are September 1992 to March 1997, April 1997 to October 2001, and November 2001 to April 2006 respectively. The first period data are used to estimate independent variables measuring risk. For daily frequency the first period has 1190 return observations. At weekly frequency there are 238 data points for estimation of risk variables and for monthly data there are 54 observations. The estimates of the risk are updated by discarding the first observation and including the next observation in the sample. This is continued till the last available data range for conducting the market model regression (3) or the modified version (4). The next sub period data are employed for testing empirical implications of the CAPM. For a given period a cross-section regression of average return from the stocks or portfolios is run on the independent variables estimated from the last estimation sample. The first estimates of the risk premium are thus obtained. The process is repeated for all the time periods available. Thus we have a time series for each of the coefficients in equations (3). The statistical significance of the estimated risk premium is tested using a t-statistic given by,

$$t(\bar{\hat{\gamma}}) = \frac{\bar{\hat{\gamma}}}{S(\bar{\hat{\gamma}})/\sqrt{n}} \tag{6}$$

Here $\bar{\hat{\gamma}}$ and $S(\bar{\hat{\gamma}})$ are the average and standard deviation of the estimated coefficient, respectively. The cross section tests are performed for two disjoint sub periods i.e. April 1997 to October 1997 and November 1997 to April 2006. The objective here is to examine the stability of the risk return relationship in the two sub periods. This is important because the volatile political and macroeconomic scenario in emerging markets might make the risk return relationship unstable. The test is also performed for the whole period April 1997 to April 2006 in order to estimate a more precise risk premium.

III. EMPIRICAL RESULTS

Table 1 presents some descriptive statistics for the cross section of the raw returns of the sample stock employed in the study. To remove undue sampling variation for each stock, one year time series data at the beginning and the end of the sample have been used to compute the average returns. The cross section characteristics are computed from these time series averages. It appears that the average and variation of the cross section returns are quite stable for the two extremes of the sample period. The stock returns in the recent period have become more positively skewed. A more important change is observed in the kurtosis of the distribution which is substantially decreased for each return interval and at the conventional level of significance the Jarque-Bera test is unable to reject the normality of the cross section of the stock returns. This shows that for this period, as the market becomes more liquid and the trading activity increases, the stock returns are more likely to be described by a normal distribution.

Table 1
Distributional characteristics of the cross section of the sample stocks returns

This table presents the descriptive statistics of the sample stocks returns measured in percentage. One year time series averages at the beginning and one year time series averages at the end of the sample are employed to compute the relevant measures. The last column gives the Jarque-Bera test of normality of the raw returns. P-values of the test appear in parenthesis.

Return Interval	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Bera (P-value)
		Beginning of the sample			
Daily	0.0560	0.1562	-0.3172	6.2373	45.799 (0.0000)
Weekly	0.2584	0.8094	-0.2646	6.0159	39.458 (0.0000)
Monthly	1.7768	3.5587	-0.4877	7.2526	80.112 (0.0000)
		End of the sample			
Daily	0.0736	0.1466	0.3009	2.6202	2.131 (0.3444)
Weekly	0.3965	0.7345	0.2555	2.5633	1.901 (0.3864)
Monthly	1.8182	3.5714	-0.2336	3.9950	5.085 (0.0786)

Table 2 presents the average coefficient of the risk variable in cross section Fama-MacBeth equations with individual stock returns. The averages are estimated over the relevant testing period. A right sided t-test is used to test the statistical significance of the beta risk premium. The remaining coefficients are tests as two sided alternative. Panel A reports the regressions with OLS beta estimates whereas the results with Dimson beta with two lead and lag appear in Panel B.

Table 2
Average risk premium coefficients for the cross section regressions for individual stocks

Panel A: OLS beta

Test Period	constant	β	β^2	$\sigma_\varepsilon{}^2$	SK	$\overline{R}^2$
			Daily Data			
April 97 – October 01	-0.0564*	0.0833	-0.1208	-0.0010	-0.0113*	0.0742
November 01 – April 06	0.0544*	0.3274*	-0.1999**	0.0002	-0.0084*	0.0776
April 97 – April 06	-0.0013	0.2050*	-0.1605*	-0.0003	-0.0099*	0.0759
			Weekly Data			
April 97 – October 01	-0.3189*	1.0164**	-1.8047**	-0.0008	-0.0936*	0.0825
November 01 – April 06	0.3674*	1.2153*	-1.0537	-0.0002	-0.0694*	0.0754
April 97 – April 06	0.0242	1.1159*	-1.4292*	-0.0005	-0.0815*	0.0790
			Monthly Data			
April 97 – October 01	-1.4025*	2.7885	-2.4158	-0.0018	-0.3387**	0.1019
November 01 – April 06	1.8087*	3.1602*	-1.4991	-0.0004	-0.4162**	0.0923
April 97 – April 06	0.2031	2.9744*	-1.9574**	-0.0011	-0.3774*	0.0971

Panel B: Dimson beta

Test Period	constant	β	β^2	$\sigma_\varepsilon{}^2$	SK	$\overline{R}^2$
			Daily Data			
April 97 – October 01	-0.0595*	0.0679	-0.0733	-0.0010	-0.0109*	0.0735
November 01 – April 06	0.0619*	0.2063*	-0.0946	0.0002	-0.0080*	0.0747
April 97 – April 06	0.0009	0.1362**	-0.0836	-0.0003	-0.0095*	0.0741
			Weekly Data			
April 97 – October 01	-0.3643*	0.5969	-0.4837	-0.0011	-0.0843*	0.0827
November 01 – April 06	0.3135*	0.9129*	-0.4880*	-0.0001	-0.0714*	0.0759
April 97 – April 06	-0.0253	0.7549*	-0.4858*	-0.0006	-0.0778*	0.0793
			Monthly Data			
April 97 – October 01	-0.7349	-0.7639	0.3578	-0.0019	-0.1828	0.1216
November 01 – April 06	2.3854*	1.0705	-0.3994	-0.0002	-0.4548**	0.0852
April 97 – April 06	0.8252	0.1532	-0.0207	-0.0010	-0.3188**	0.1034

* and ** indicate significance at 5% and 10 % level of significance respectively.

Table 3 presents the average coefficient of the risk variable in cross section Fama-MacBeth equations with market capitalization portfolio returns. The averages are estimated over the relevant testing period. A right sided t-test is used to test the statistical significance of the beta risk premium. The remaining coefficients are tests as two sided alternative. Panel A reports the regressions with OLS beta estimates whereas the results with Dimson beta with two lead and lag appear in Panel B.

Table 3
Average risk premium coefficients for the cross section regressions for size portfolio

Panel A: OLS beta

Test Period	constant	β	β^2	$\sigma_\varepsilon{}^2$	SK	$\overline{R}^2$
	Daily Data					
April 97 – October 01	-0.0432	0.0683	-0.1399	-0.0072	0.0440*	0.3078
November 01 – April 06	0.0548	0.3192*	-0.2212**	0.0016	0.0020	0.2965
April 97 – April 06	0.0057	0.1938**	-0.1805	-0.0028	0.0230*	0.3020
	Weekly Data					
April 97 – October 01	-0.3756	1.3404	-2.8706	0.0044	-0.0861	0.3273
November 01 – April 06	0.2114	2.2346*	-2.5013**	0.0008	-0.0627	0.3108
April 97 – April 06	-0.0820	1.7875*	-2.6859*	0.0026	-0.0744	0.3190
	Monthly Data					
April 97 – October 01	-2.8560*	5.6142	-5.9819	0.0165	-0.6830	0.4157
November 01 – April 06	0.9430	6.2001*	-4.0993	-0.0007	0.0517	0.3331
April 97 – April 06	-0.9565	5.9072*	-5.0406*	0.0078	-0.3156	0.3744

Panel B: Dimson beta

Test Period	constant	β	β^2	$\sigma_\varepsilon{}^2$	SK	$\overline{R}^2$
	Daily Data					
April 97 – October 01	-0.0386	0.0274	-0.0796	-0.0053	0.0435*	0.3084
November 01 – April 06	0.0359	0.3073*	-0.1873*	0.0032	0.0005	0.2955
April 97 – April 06	-0.0013	0.1673**	-0.1334	-0.0010	0.0220*	0.3018
	Weekly Data					
April 97 – October 01	-0.3207	0.3403	-0.5460	0.0074	-0.0879	0.3263
November 01 – April 06	0.1992	1.2130**	-0.7680	0.0031	-0.0942	0.3190
April 97 – April 06	-0.0607	0.7766	-0.6570	0.0052	-0.0910	0.3226
	Monthly Data					
April 97 – October 01	-3.3223*	5.5064**	-4.6124**	0.0124	-0.3516	0.3978
November 01 – April 06	0.8879	5.2591	-2.6235	-0.0080	0.1301	0.3242
April 97 – April 06	-1.1676	5.3828*	-3.6180*	0.0021	-0.1107	0.3610

* and ** indicate significance at 5% and 10 % level of significance respectively.

Table 4 presents the average coefficient of the risk variable in cross section Fama-MacBeth equations with industry portfolio returns. The averages are estimated over the relevant testing period. A right sided t-test is used to test the statistical significance of the beta risk premium. The remaining coefficients are tests as two sided alternative. Panel A reports the regressions with OLS beta estimates whereas the results with Dimson beta with two lead and lag appear in Panel B.

Table 4
Average risk premium coefficients for the cross section regressions for industry portfolio

Panel A: OLS beta

Test Period	constant	β	β^2	σ_ε^2	SK	$\overline{R}^2$
			Daily Data			
April 97 – October 01	-0.0316	-0.0087	-0.0530	-0.0085	0.0107	0.3824
November 01 – April 06	0.0497	0.2610*	-0.1561**	0.0066	-0.0150	0.3900
April 97 – April 06	0.0090	0.1261	-0.1045	-0.0009	-0.0021	0.3863
			Weekly Data			
April 97 – October 01	-0.3672	1.3084	-2.4935	0.0045	-0.2483*	0.3682
November 01 – April 06	0.6308**	-0.4233	-0.4668	0.0231*	-0.6495*	0.3667
April 97 – April 06	0.1317	0.4425	-1.4801	0.0138**	-0.4489*	0.3674
			Monthly Data			
April 97 – October 01	-0.8089	1.6975	-2.6849	-0.0052	-1.2277*	0.3498
November 01 – April 06	2.0055	2.0051	-0.7756	0.0036	-0.6447	0.3875
April 97 – April 06	0.5983	1.8513	-1.7302	-0.0008	-0.9362**	0.3698

Panel B: Dimson beta

Test Period	constant	β	β^2	σ_ε^2	SK	$\overline{R}^2$
			Daily Data			
April 97 – October 01	-0.0381	0.0290	-0.0724	-0.0076	0.0091	0.3682
November 01 – April 06	0.0462	0.2220**	-0.1153	0.0066	-0.0103	0.3857
April 97 – April 06	0.0040	0.1255	-0.0938	-0.0005	-0.0005	0.3770
			Weekly Data			
April 97 – October 01	-0.3601	0.6700	-0.7090	0.0022	-0.2267**	0.3676
November 01 – April 06	0.2446	0.6957	-0.5268	0.0206**	-0.5401*	0.3796
April 97 – April 06	-0.0577	0.6829	-0.6179**	0.0114	-0.3834*	0.3736
			Monthly Data			
April 97 – October 01	-0.5361	0.3637	-1.2143	-0.0034	-0.9320*	0.3208
November 01 – April 06	2.9999**	-0.9793	0.7852	0.0044	-1.0417**	0.3799
April 97 – April 06	1.2319	-0.3078	-0.2145	0.0005	-0.9869*	0.3503

* and ** indicate significance at 5% and 10 % level of significance respectively.

Table 5 presents the average coefficient of the risk variable in cross section Fama-MacBeth equations with beta sorted portfolio returns. The averages are estimated over the relevant testing period. A right sided t-test is used to test the statistical significance of the beta risk premium. The remaining coefficients are tests as two sided alternative. Panel A reports the regressions with OLS beta estimates whereas the results with Dimson beta with two lead and lag appear in Panel B.

Table 5

Average risk premium coefficients for the cross section regressions for beta portfolio

Panel A: OLS beta

Test Period	constant	β	β^2	σ_ε^2	SK	$\overline{R}^2$
			Daily Data			
April 97 – October 01	-0.0612**	0.0888	-0.1180	-0.0017	-0.0294**	0.3309
November 01 – April 06	0.0894*	0.2717*	-0.1935*	-0.0051	-0.0063	0.3295
April 97 – April 06	0.0141	0.1802*	-0.1557**	-0.0034	-0.0179	0.3302
			Weekly Data			
April 97 – October 01	-0.3320*	0.9058	-1.8469	0.0036	-0.2596*	0.3316
November 01 – April 06	0.2852**	1.9813*	-1.8415**	-0.0049	-0.2136*	0.3320
April 97 – April 06	-0.0233	1.4436*	-1.8442**	-0.0006	-0.2368*	0.3323
			Monthly Data			
April 97 – October 01	-1.1711**	4.4607**	-4.4790	-0.0094	-1.2198	0.4152
November 01 – April 06	1.3460	5.1190*	-2.9224	-0.0036	0.2071	0.3857
April 97 – April 06	0.0874	4.8630*	-3.7007*	-0.0065	-0.5063	0.4005

Panel B: Dimson beta

Test Period	constant	β	β^2	σ_ε^2	SK	$\overline{R}^2$
			Daily Data			
April 97 – October 01	-0.0787*	0.1663	-0.1502	-0.0016	-0.0315**	0.3288
November 01 – April 06	0.0791**	0.2556*	-0.1605**	-0.0055	-0.0057	0.3288
April 97 – April 06	0.0002	0.2109*	-0.1553**	-0.0035	-0.0186	0.3288
			Weekly Data			
April 97 – October 01	-0.3122**	0.5591	-0.6657	0.0015	-0.2586*	0.3385
November 01 – April 06	0.2484	1.1216*	-0.5929	-0.0027	-0.2136*	0.3323
April 97 – April 06	-0.0319	0.8404*	-0.6293**	-0.0006	-0.2361*	0.3354
			Monthly Data			
April 97 – October 01	-2.2885**	5.3937**	-4.0457	-0.0043	-0.7082	0.3924
November 01 – April 06	0.5799	5.1191**	-2.0830	-0.0055	0.4723	0.3704
April 97 – April 06	-0.8543	5.2564*	-3.0644**	-0.0049	-0.1179	0.3814

* and ** indicate significance at 5% and 10 % level of significance respectively.

The results of estimating the cross section regression are reported in Tables 2 to 5. An important finding that appears to be rather surprising for an emerging market is that the signs of the average risk premium for beta and skewness are according to the expectation as specified by financial theory. In an overwhelming number of cases the sign of the beta risk premium is positive and that of the skewness coefficient is negative. This is in contrast with earlier studies on the emerging market. For example for a group of 19 emerging markets, including Pakistan, using eight year data from 1986 to 1993 Claessens, Dasgupta and Glen (1995) conclude that while similar factors govern the cross section of emerging market return, the signs of most of the coefficients are contrary to those found in developed markets. It is interesting to note that in their study, Pakistan was the only country with a significant negative beta risk premium. Wang and Tang (1991), Bark (1991) and Huang (1997) also report a negative risk-return relationship for the Asian markets of Singapore, Korea and Taiwan respectively. An even more interesting result is that the beta risk premium is mostly statistically significant, particularly in the recent sub period from November 2001 to April 2006 for the individual stock (Table 2), size portfolios (Table 3) and beta portfolios (Table 5). In these cases similar results also hold for the full testing period of April 1997 to April 2006. This is true for all three return intervals. With industry portfolios (Table 4) beta risk is priced for daily data only. The declining interest rates and the higher level of trading activity, backed by the booming liquidity of the banks and financial institutions in the most recent testing period, appear to make equity investment attractive and the market is rewarding for bearing the systematic risk. However, contrary to the CAPM, the risk return relationship is found to be non-linear. In most of the cases when the beta risk premium is significant the squared beta coefficient is also significant. According to Fama and MacBeth (1973) the negative sign for the beta squared coefficient indicates that the price of high beta securities are on average too high and their expected returns are too low, relative to those of low beta securities. This also indicates that the marginal effect of systematic risk on the stock returns depends on the initial level of risk of the security under consideration. This makes a portfolio allocation decision based on systematic risk somewhat difficult for investors. The skewness appears to explain the cross section variation of return with a theoretically consistent sign, except for the daily data with size portfolios (Table 3) when the sign is reversed. However, the skewness premium disappears with the size sorted portfolios for weekly and monthly data and for beta portfolios with monthly data. Therefore, the skewness effect appears to depend on the return interval in these cases.

A similar return interval effect can be observed for the beta risk premium for the industry portfolios when the significant premium for the systematic risk disappears for the weekly and monthly data. Unsystematic risk is generally not priced. In three cases with industry portfolios (Table 4) the coefficient is statistically significant. The residual risk has substituted the systematic risk in these cases. The intercept is significant mostly with the individual stock and beta portfolio regressions, but its sign is mixed making it difficult to ascertain whether the component of stock return that is uncorrelated with the market is above or below the risk free rate. As far as the explanatory power of the cross section regression is concerned, the risk variables employed explain a reasonable amount of variation in the portfolios returns. On average, 35 % variation in portfolio returns is explained by the risk variables. This is not too low and in fact is much better when compared with earlier studies on the emerging markets. It is interesting to note that in Table 3 (pages 623-624) of Fama and MacBeth (1973) the average R-square is approximately 30 %. In terms of explanatory power, our results compare favourably with this pioneering US study. The individual stock regressions, as expected, have much lower explanatory power as in this case there is higher return variability and a more severe infrequent trading effect compared to portfolio data.

The earlier studies have documented that the impact of the return measurement interval in the risk measurement and its relationship to returns cannot be ignored. However, our empirical results are quite robust in the sense that in individual stocks, size and beta portfolio regressions, the sign and statistical significance of the beta risk premium remain stable across the three return intervals. The impact on the skewness coefficient is, however, different. For individual stocks the skewness effect over the three data frequencies is stable with correct sign. For beta portfolios skewness is significant with correct sign in daily and weekly data. For industry portfolios similar results are observed with weekly and monthly data. Skewness is priced with wrong sign only in size portfolios with daily data (Table 3).

The importance of higher moments measured with skewness or co-skewness is documented in literature when working with the emerging markets. This study also corroborates this finding. The results are reported only for the case when the regressions are run with excess returns. The empirical results are also quite robust to whether or not the regression is run with or without a measure of the riskless asset. The only exception is in the individual stock daily regressions when the skewness has a sign reversal when a proxy for the riskless asset is not employed. Our results also support a recent study by Iqbal and Brooks (2007) who report that the impact of thin trading correction to beta risk on asset pricing tests is minimal. As expected, the most pronounced effect of the infrequent trading correction is observed with individual stocks regressions (Table 2) where the Dimson correction has made the risk premium for beta noticeably smaller and even made them insignificant. Overall, two of the three fundamental hypotheses of the CAPM are not supported. The two hypotheses are the linearity of the risk-return relationship and that the beta is the only relevant risk variable explaining cross section variation in expected returns. The empirical results on this emerging market support the most fundamental positive risk-return relation hypothesis, especially in the most recent period.

IV. CONCLUSION

This study has investigated the empirical testing of the CAPM on the Karachi Stock Exchange. Using the methodology similar to that of the two step Fama-MacBeth procedure, the paper incorporates a thin trading correction and investigates the impact of intervalling effects. The tests are run both with and without a riskless asset. Overall, beta appears to explain the cross sectional variation in expected returns, especially with individual stocks, size and beta portfolios. This result is more prominent in the most recent year sample period. However, in these cases the risk return relationship is also non-linear in beta. The sign of the coefficients for the beta risk and the skewness are according to their expectation as predicted by theory. This aspect contrasts with the earlier studies on emerging markets which usually report incorrect signs for the risk premiums. The essential results do not change greatly, even after adjustment for infrequent trading and employing three different data frequencies. Skewness appears to play a role in explaining the cross section of the returns for individual stock, industry and beta portfolios. The investors in Pakistan's stock market appear particularly sensitive to higher moments measured by skewness. For the daily and weekly data industry portfolios and for monthly data, beta portfolios provide better explanatory power of the cross section relationship. On the average, more than 35% variation in monthly portfolio returns is explained by risk measures employed. It can be concluded that the market has become mature enough to yield the anticipated direction of the expected returns and systematic risk relationship and is rewarding investors for bearing the systematic risk. However, non-linearity in the risk return relationship needs to be considered for portfolio allocation decisions based on the systematic risk in this emerging market.

ENDNOTES

1. The Karachi Stock Exchange is the largest of the three stock markets in Pakistan. On April 17, 2006 the market capitalization was a US$ 57 billion which is 46 percent of Pakistan's GDP for the Fiscal Year 2005-06. (Ref: Pakistan Economic Survey 2005-06)
2. www.CNN.com, January 1, 2003. The newspaper USA Today and the magazine Business Week also reported the news. Similar performance continues in later years.
3. www.businessrecorder.com.pk
4. $SK = \frac{1}{N}\sum_{t=1}^{N}\left(\frac{R_t - \overline{R}}{\hat{\sigma}_R}\right)^3$
5. The industry sectors employed are Auto and Allied, Chemicals, Commercial Banks, Food Products, Industrial Engineering, Insurance, Oil and Gas, Investment Banks and Financial Companies, Paper and Board, Pharmacy, Power and Utility, Synthetic and Rayon, Textiles,

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