Validity of capital asset pricing model: evidence from Karachi stock exchange

Syed ali, Raza and Syed tehseen, jawaid and Imtiaz, arif and Fahim, qazi

IQRA UNIVERSITY

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First Author

Syed Ali Raza
Business Graduate,
IQRA University,
Karachi-75300, Pakistan
Email: syed_aliraza@hotmail.com
Contact No. 0092-333-3448467

Second Author

Syed Tehseen Jawaid
Lecturer,
IQRA University,
Karachi-75300, Pakistan

Third Author

Imtiaz Arif
Assistant Professor,
IQRA University,
Karachi-75300, Pakistan

Fourth Author

Fahim Qazi
Assistant Professor,
Dadabhoy Institute of Higher Education,
Karachi, Pakistan

Abstract

This study investigates the validity of Capital Asset Pricing (CAP) Model in Karachi stock exchange (KSE). The data of 387 companies of 30 different sectors on monthly, quarterly and semiannual basis are used. The Paired sample t- test is applied to find the difference between actual and expected returns. Results show that capital asset pricing model (CAPM) predict more accurately the expected return on a short term investment as compare to long term investment. It is recommended that the investors should more focus on CAPM results for short term as compare to long term investments in KSE.

Key words: Portfolio choice, Investment Decisions, Capital Assets Pricing Model, Risk,

JEL Classification: G11, G12, G32,

1. Introduction

Capital Asset Pricing Model (CAPM) is one of the central model use by portfolio managers, professional and investors to predict the expected risk and expected return on investment. The main focal point of CAP model is to check whether the returns are statistically related to risks (betas). According to CAP model the investor needs to be compensated in two ways, for time value of money (risk free rate) and for taking risk. The CAP model was introduced by Jack Treynor, John Lintner, William Sharpe and Jan Mossin in the early 1960's and further refined later.[1]

The findings and results of CAP model are very mix. The results of studies from late sixties, seventies and early eighties supported the validity of CAP Model.[2] In these decades it is concluded that the CAP model is able to predict the expected return on investments. But in the mid of eighties it is found that the single risk factor model does not accurately predict the expected return on stocks because there are so many other factors affecting the returns on investments such as firm size, market value, financial ratios, price earnings ratio, economic conditions, seasonality effect, inflation.[3]

Karachi Stock exchange is not sustainable market and investors find very fluctuations in prices of stocks for that reason Karachi stock exchange have very different risk-return relationship. The investors discover that the market can up or down dramatically in a few sessions. In December 2008 the Karachi stock exchange 100 index was down to 3300 points

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[1] Bodie, Kane and Marcus. (2003).

[2] Black, Jensen and Scholes. (1972), Fama and MacBeth. (1973), Blume and Friend (1973), Lau, and Quay. (1974), Dowen (1988), Jagannath and Wang. (1993), Jagannathan and McGrattan. (1995).

[3] Banz. (1981), Basu. (1983), Tinc. (1984), Groenewold and Fraser. (1997), Scheicher. (2000).

from 9187 points to 5865 points in just 13 trading sessions. After the just two months the 100 index of Karachi Stock Exchange was up to 2638 points from 5707 points to 8345 points in just 19 trading sessions.[4]

The main problem of KSE for investors and portfolio managers is to quantify the risk associated with securities and expected return on bearing this risk. Therefore the main objective of this study is to determine that how accurately the capital asset pricing model predicts the expected return and risk associated with securities listed on Karachi stock exchange. Rest of the study proceeds as follow; section two is reviewing the literature followed by methodology in section three, estimations and results are discussed in chapter four, conclusion and recommendations are drawn in section five.

2. Literature Review

In respect to the literatures regarding to the empirical test of the CAPM, many researchers have already engaged the relevant study in financial markets of different countries. In this section after summarizing the CAPM theoretical background, empirical studies are reviewed.

2.1 Theoretical Background

The risk is divided into two parts; unsystematic risk and systematic risk. The unsystematic risk is related to specific company, industry or security it also known as diversifiable risk or specific risk. The unsystematic risk can be eliminated by diversification. The systematic risk is related to entire market or entire financial system it also known as un-

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[4] Information is gather from official website of KSE: www.kse.com.pk

diversifiable risk or market risk (Interest rate, Recession, wars). The systematic risk is directly affecting the entire market and it cannot be eliminated by diversification.[5] Diversification can be defined by a proverb "do not put your all eggs in one basket". In diversification the investors reduced the risk by investing in a variety of securities.

In capital assets pricing model the (CAPM) unsystematic risk is eliminated through efficient diversification. The capital assets pricing model (CAPM) is mainly discussing about the systematic risk; the risk related to entire market. The measure of a systematic risk in CAPM is the beta. The capital assets pricing models argues that the expected return on investment or on security will be positively related to its market beta that's mean higher or lower the security's beta the higher or lower the expected return on investment.

The basic belief of capital assets pricing model is that the investor needs to be compensated more than the risk free return. According to CAP model the investor needs to be compensated in two ways, for time value of money (risk free rate) and for taking risk (beta of security). The capital assets pricing model was developed in hypothetical world with certain assumptions.[6] (i) There are many investors in market. (ii) All investments are for the same period of time. (iii) There are no taxes on trading. (iv) There is no transaction cost on trading. (v) All investors can lend and borrow unlimited amounts at the risk free rate. (vi) The investors are rational and risk averse. (vii) Investors have all and equal information. (viii) The investors have same expectations about expected returns. (ix) The investors deal with securities that are all highly divisible into small parts.

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[5] Bodie, Kane and Marcus. (2003).

[6] Bodie, Kane and Marcus. (2003), Horne. (2006), Copeland, Weston, & Shastri. (2007),

2.2 Empirical Studies

Black, Jensen and Scholes (1972) analyzed the impact of CAP model on New York stock exchange covering the period of 41 years from 1926 to 1966. They found that CAPM is applicable on New York stock exchange and they found positive relationship between beta and average return that's mean the investor will get high return on high risk securities. They also concluded that the CAPM model accurately predicts the expected return on securities.

Lau and Quay (1974) analyzed the validity of CAP model on Tokyo stock exchange. They used the data of period of 100 companies listed on Tokyo stock exchange for the period of five years (1964 – 1969). They found that the CAP model is accurately predicts the expected return of stocks and they concluded that CAP model is perfectly applicable on Tokyo stock exchange.

Dowen (1988) aruged in the favor of CAPM he concluded that investors may use beta as a tool but not as their only tool. He also concluded that that there is no sufficiently large portfolio guarntee the elimination of non systematic risk. Cheung and Wong (1992) analyzed the Hong Kong equity market from the period of 1980 to 1989 to study the relationship between risk and return in Hong Kong equity market. They concluded that applicability and validity of CAP model is very weak in Hong Kong stock market. Cheung, Wong and Ho (1993) analyzed the Korean and Taiwan stock exchanges to study the relationship between risk and return in emerging Asian markets. They concluded that the applicability and validity of CAP model is very weak in both markets, especially in Taiwan stock exchange.

Jagannath and Wang (1993) argued that the Capital Assets Pricing Model (CAPM) is widely used model to predict the risk of investment and expected return of the stocks among the

investors and portfolio managers. Groenewold and Fraser (1997) used data of eight sectors of Australian stock exchange for the period from 1983 to 1993 to make comparison between CAP model, GARCH model and Arbitrage Pricing Theory (APT) model. They found that the GARCH model and APT model provides almost same results and both models accurately predict the expected return of securities. They also concluded that the results of CAP model do not match with actual situations and provide misleading results to investors.

Huang (2000) analyzed the validity of CAP model on two different sets of securities. He used the data of 93 companies from the period of (1986-1993). He used two different sets of securities in first set he selected high risk securities and in second set he selected low risk securities. He found in their research that CAPM is accurately predicting the expected returns of low risk securities and give consistent results. On the other side the high risk securities give inconsistent results with CAPM that's mean CAPM is not accurately predicting the expected return of high risk securities. He concluded that the on the high risk securities the CAPM does not validate their results and CAPM does not accurately predicts the expected return on investments and investors could not relied upon CAP model.

Scheicher (2000) researched on 12 companies listed on German stock exchange for the period of 23 years. He found that the expected return was not just predicted by a single risk factor. There are some other factors also affecting the returns of investments. He concluded that the results of other models like multi risk factor model and GARCH model more accurately predicts the expected return of investments on stock than CAPM model. Gomez and Zapatro (2003) analyzed the data of 220 US securities covering period of twenty six year from 1973 to 1978. They used two betas model considering the systematic market risk factor and active

management risk factor. They concluded that the result of their two betas model is better than CAPM.

Fraser and Hamelink (2004) made comparison between the results of CAP model and GARCH model. They researched on seven sectors of London stock exchange covers period of twenty two years (1975-1976). They found that the results of GARCH model more accurately predicts the expect return in compare to CAP model. Quo and Perron (2005) analyzed the data of 50 companies listed on New York stock exchange from the period of 1978 to 2004. They concluded that the capital asset pricing model only identify single risk factor and investor get wrong estimation of the expected return on their investments.

Grigoris and Stavros (2006) found that the basic statement or assumption of high return on high risk does not fulfill on Greek stock market. They used data of 100 companies of Athens stock exchange covering the period of five years from 1998 to 2002. They also conclude that the results of CAPM are consistent for shorter period but overall the CAPM does not provide accurate and consistent results. Hui and Christoper (2008) used the data of 95 companies of United States and Japan stock markets for the period of 11 years from 1996 to 2006. They found that CAP model does not provide accurate and consistent results when applied to stock markets of Japan and United States.

Eatzaz and Attiya (2008) made comparison between the CAP model and conditional multi risk factor model. They used data of 49 companies of Karachi stock exchange from the period of 1993 to 2004. They concluded that the results of CAPM model are consistent and accurate with only few securities and only for few years. They also found that multi risk factor model predicts more accurately results as compare to CAP model. Raei and Mohammadi (2008)

analyzed the data of 70 companies listed on NASDAQ stock market for the period of twelve years from 1994 to 2005. They concluded that methods of estimating expected return have been changed; CAPM is just useful for calculating cost of capital. They also found that the returns from CAPM models are always lower than compare to multi factor model (APT). They suggested that APT provide more accurate result compare to CAPM.

Tony Head (2008) argued that although the CAPM is widely used for predicting the expected return on stocks but the results of previous research have not always positively supported this model. Like many other models the main reason of criticism is a certain assumptions of CAP model. Hanif (2010) analyzed the validity of CAP model on Tobacco sector of Karachi stock exchange covering the period from 2004 to 2007. He found that CAP model is not applicable on Tobacco sector of Karachi stock exchange and the results of CAP model do not match with actual results.

Hanif and Bhatti (2010) analyzed the validity of CAP model on 60 firms listed on Karachi stock exchange covering the period from 2003 to 2008. They found that CAP model is not applicable on of Karachi stock exchange and the results of CAP model do not match with actual results. They concluded that the results of only 28 observations out of 360 observations are supporting CAPM.

3.   Methodology

The monthly, quarterly and semiannually actual returns of stock and return of market are calculated by following formula:

$$R = (CP - OP) / OP \qquad (3.1)$$

Whereas, R is the actual return, CP and OP are the closing and opening value of stock prices and market index. We calculate Beta of each sector by regression analysis. We calculate expected return of each sector by CAPM equation:

$$RA = RF + B (RM - RF) \qquad (3.2)$$

Whereas, RA is the expected return on sector A, RF is the risk free rate; B is the systematic risk; the risk related to entire market, RM is the average market return. We use statistical tool "Paired Sample t- test" to analyze the significance of difference between actual returns and expected returns.

To find the validity of CAPM we use secondary type of data. All the secondary data is gathered from following sources: website of Karachi stock exchange[7], record room of Brokerage house, website of state bank of Pakistan.[8] We used the data of stock prices and index value, the rate of treasury bills issued by government is used in this analysis as a risk free rate.[9] This research is conducted on 387 companies listed on 30 sectors of Karachi stock exchange to test the applicability and validity of Capital Asset Pricing Model.

The results of studies from late sixties, seventies and early eighties supported the validity of CAPM Model. But in the mid of eighties it is found that the single risk factor model does not accurately predict the expected return on stocks because there are so many other factors affecting the returns on investments. In past studies the researchers did not use any statistical tool for determine the difference between actual and expected return is significant or not. In this research

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[7] The web link is: www.kse.com.pk

[8] The web link is www.sbp.org.pk

[9] Ataullah. (2001), Sipra. (2006), Hanif and Bhatti. (2010) amongst others have used t-bills as a risk free rate.

we use statistical tool "Paired Sample t- test" to analyze the significance of difference between actual and expected return.

4. Estimation and Results

From the monthly, quarterly and semi annually data the actual and CAPM return are calculated by formulas and statistical tools for the analysis and findings of this study. According to the past studies the capital asset pricing model gives mixed results when applied on the stock markets of different countries. The CAPM provide accurate results or return on a certain securities for some years on the other side it does not give accurate results in some years. We also find some mixed but mostly favorable results when applied the CAPM on Karachi stock exchange and make comparison between different sectors.

The beta coefficient is states the relation between movement in particular security and movement in the market. Normally the value of beta of larger blue chip stocks are between zero and one but many stocks have higher beta value because they are much more responsive to market. If the value of beta is zero that's mean the return on particular security is independent of the market (Risk free securities, treasury bills or bonds issued by government). If the value of beta is 0.5 that's mean the stock is only half as sensitive as the market, beta less than 0.5 are also known as defensive beta. If the value of the beta is 1 that's mean the particular security and market both have the same sensitivity. The value of beta between 1 and 0.5 are also known as normal beta. If the value of the beta is 2 that's mean the particular stock is double as sensitive or riskier as the market.

4.1 Results on Monthly Basis

Results on monthly basis have been shown in table 4.1.

Insert Table 4.1: here

From table 4.1 we get the value of beta. When we run the regression analysis on data from 2004 to 2011 on a monthly basis we find that there is no sector have aggressive beta. There is only one sector having normal beta; technology hardware and equipment. There are total 29 sectors out of 30 sectors having defensive beta, some of these sectors are very close to risk free sector or very defensive sectors; automobile and parts, beverages, food producers, gas water and multi-utilities, household goods, life insurance, travel and leisure.

We apply Paired sample t- test to find the p-value which indicates the significance of difference between actual and expected return. If the p-value is less than 0.05 which means there is a significant difference between actual return and CAPM return. When we analyze the data on monthly basis we find the significant difference in only 3 sectors out of 30 sectors; equity Investment instruments, forestry and papers, household goods. The results of twenty seven sectors out of 30 sectors show that there is no significance difference in between actual return and CAPM returns. This confirms the validity of capital asset pricing model on Karachi stock exchange. The CAPM accurately predicts the expected return of different sectors of Karachi stock exchange.

Our results could not consistent with the findings of Hanif and Bhatti (2010) where they found that CAPM is not providing accurate result in most of time when applying on Karachi stock exchange. Our findings are partially consistent with the findings of Eatzaz and Attiya, (2008) where they found that the CAPM is not fully applicable in Pakistani Stock Market. Our

findings are consistent with the results of Lau and Quay. (1974) they found that CAPM provides the accurate results when applying on Tokyo stock exchange

4.2   Results on Quarterly Basis

Results on quarterly basis have been shown in table 4.2.

Insert Table 4.2: here

From table 4.2 we get the value of beta. When we run the regression analysis on data from 2004 to 2011 on a quarterly basis we find that only one sector have aggressive beta; banks. There are 13 sectors out of 30 sectors having normal beta, some of them are very close to beta equal to one and having high normal beta; bonds, financial services, fixed line telecommunication, support services. There are total 16 sectors having defensive beta, some of these sectors are very close to risk free sector or very defensive sectors; beverages , life insurance, travel and leisure.

We find the significant difference in only 7 sectors out of 30 sectors; construction and material, electricity, equity Investment instruments, forestry and papers, household goods, Industrial metal and mining, Personal goods. The results of twenty three sectors out of 30 sectors show that there is no significance difference in between actual return and CAPM returns. This confirms the applicability of capital asset pricing model on Karachi stock exchange.

4.3   Results on Semiannually Basis

Results on semiannually basis have been shown in table 4.3.

Insert Table 4.3: here

From table 4.3 we get the value of beta. When we run the regression analysis on data from 2004 to 2011 on a semiannual basis we find that only two sectors have aggressive beta; banks and technology hardware and equipment. There are 16 sectors out of 30 sectors having normal beta, some of them are very close to beta equal to one and having high normal beta; fixed line telecommunication , non life insurance, oil and gas, support services. There are total 12 sectors having defensive beta, some of these sectors are very close to risk free sector or very defensive sectors; beverages, life insurance, travel and leisure.

The calculation of Beta on a monthly and quarterly basis show decrease in beta as compared to semi annually basis. The sectors are shifted from aggressive to normal position and normal to defensive position. In semi annually basis we have two sectors having aggressive beta but in monthly basis we have no sector having aggressive beta. Likewise in semi annually basis we have 16 sectors having normal beta but in monthly basis we have only one sector who has normal beta. It means sectors are moving with market on semi annually basis. Our results of this movement of beta are consistent with the findings of Hanif, (2010) where he found that securities are not moving with market on a short term basis, they are moving on long term basis.

Our results of beta could not consistent with the findings of Huang (2000) where he found that CAPM is only applicable in low risk securities or with defensive securities. Our results show different picture, the bank sector have beta (1.08) and it has p-value (0.314) that's

means it has high aggressive beta but there is no significant difference in actual return and CAPM return in Banking sector of Karachi stock exchange.

We find the significant difference in only 8 sectors out of 30 sectors; bonds, construction and material, electricity, equity Investment instruments, forestry and papers, household goods, Industrial metal and mining, Personal goods. The results of twenty two sectors out of 30 sectors show that there is no significance difference in between actual return and CAPM returns. This confirms the applicability of capital asset pricing model on Karachi stock exchange.

We also find that CAPM more accurately predicts the expected return on a short term investment, in monthly basis we find there is no significant difference in return of 27 sectors as compared to 22 sectors in semiannual basis. Our findings are partially consistent with Grigoris and Stavros, (2006) they found that the results of CAPM are consistent for shorter period but overall the CAPM does not provide accurate and consistent results.

5.   Conclusion and Recommendations:

We conclude that CAPM accurately predicts the expected return of different sectors of Karachi stock Exchange. Findings indicate that CAPM predicts more accurately the expected return on a short term investment, in monthly basis there is no significant difference in return of 27 sectors as compared to 22 sectors in semiannual basis. Results show that the beta on a quarterly and monthly basis show decrease in beta as compared to semi annually basis. It means sectors are moving with market on semi annually basis. It is recommended that the investors should more focus on CAPM results for short term as compare to long term investments in KSE. The future area of research may include the comparing of statistically analyzed CAPM return with multifactor models like APT and GARCH model.

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Table 4.1: Results on Monthly Basis

S. No.	Sectors	beta	t-value	p-value
1	Automobile and parts	0.155	-0.488	0.643
2	Banks	0.466	-0.294	0.779
3	Beverages	0.115	-0.172	0.869
4	Bonds	0.289	-0.642	0.545
5	Chemical	0.277	-1.141	0.297
6	Construction and Material	0.235	-2.262	0.064
7	Electricity	0.236	-1.418	0.206
8	Electronic and Electrical Equipment	0.299	-0.663	0.532
9	Equity Investment instruments	0.233	-2.528	0.045
10	Financial Services	0.270	-1.195	0.277
11	Fixed Line Telecommunication	0.308	-0.993	0.359
12	Food Producers	0.089	0.804	0.452
13	Forestry and Paper	0.239	-2.632	0.039
14	Gas Water and Multi Utilities	0.176	-1.202	0.275
15	General Industries	0.266	-0.608	0.565
16	Health Care Equipment and Services	0.204	1.050	0.334
17	Household Goods	0.139	-2.991	0.024
18	Industrial Engineering	0.208	-0.173	0.869
19	Industrial Metals and Mining	0.301	-1.459	0.195
20	Industrial Transportation	0.275	-0.477	0.65
21	Leisure Goods	0.204	-0.932	0.387
22	Life Insurance	-0.015	-0.680	0.522
23	Non Life Insurance	0.387	-0.840	0.433
24	Oil and Gas	0.362	-0.540	0.609
25	Personal Goods	0.270	-1.633	0.154
26	Pharma and Bio Tech	0.154	-1.943	0.1
27	Support Services	0.345	-0.489	0.642
28	Technology Hardware and Equipment	0.887	-0.178	0.865
29	Tobacco	0.220	0.261	0.803
30	Travel and Leisure	0.170	-0.005	0.996

Table 4.2: Results on Quarterly Basis

S. No.	Sectors	beta	t-value	p-value
1	Automobile and parts	0.484	-1.334	0.231
2	Banks	1.046	-1.939	0.101
3	Beverages	0.107	-0.294	0.778
4	Bonds	0.814	-1.986	0.094
5	Chemical	0.432	-1.419	0.206
6	Construction and Material	0.510	-3.442	0.014
7	Electricity	0.479	-3.049	0.023
8	Electronic and Electrical Equipment	0.270	-0.321	0.759
9	Equity Investment instruments	0.437	-2.534	0.044
10	Financial Services	0.866	-2.096	0.081
11	Fixed Line Telecommunication	0.783	-1.047	0.335
12	Food Producers	0.293	0.144	0.890
13	Forestry and Paper	0.264	-3.054	0.022
14	Gas Water and Multi Utilities	0.714	-0.716	0.501
15	General Industries	0.529	-1.274	0.250
16	Health Care Equipment and Services	0.633	-0.056	0.957
17	Household Goods	0.364	-3.919	0.008
18	Industrial Engineering	0.441	-1.104	0.312
19	Industrial Metals and Mining	0.646	-2.683	0.036
20	Industrial Transportation	0.490	-1.536	0.176
21	Leisure Goods	0.345	-2.134	0.077
22	Life Insurance	0.061	-0.718	0.500
23	Non Life Insurance	0.507	-1.097	0.315
24	Oil and Gas	0.733	-1.260	0.254
25	Personal Goods	0.439	-3.740	0.010
26	Pharma and Bio Tech	0.261	-2.350	0.057
27	Support Services	0.940	-1.365	0.221
28	Technology Hardware and Equipment	0.516	0.128	0.902
29	Tobacco	0.411	-0.258	0.805
30	Travel and Leisure	0.009	-0.064	0.951

Table 4.3: Results on Semiannually Basis

S. No.	Sectors	beta	t-value	p-value
1	Automobile and parts	0.619	-0.759	0.482
2	Banks	1.083	-1.119	0.314
3	Beverages	0.188	0.078	0.940
4	Bonds	0.751	-3.691	0.014
5	Chemical	0.584	-1.732	0.144
6	Construction and Material	0.647	-6.731	0.001
7	Electricity	0.493	-3.970	0.011
8	Electronic and Electrical Equipment	0.263	-1.253	0.266
9	Equity Investment instruments	0.358	-4.232	0.008
10	Financial Services	0.776	-1.378	0.227
11	Fixed Line Telecommunication	0.810	-0.341	0.747
12	Food Producers	0.368	-0.215	0.838
13	Forestry and Paper	0.378	-3.507	0.017
14	Gas Water and Multi Utilities	0.536	-0.721	0.503
15	General Industries	0.637	-1.394	0.222
16	Health Care Equipment and Services	0.630	-0.680	0.527
17	Household Goods	0.419	-3.562	0.016
18	Industrial Engineering	0.692	-0.873	0.423
19	Industrial Metals and Mining	0.703	-3.602	0.016
20	Industrial Transportation	0.512	-0.798	0.461
21	Leisure Goods	0.224	-2.394	0.062
22	Life Insurance	0.017	0.299	0.777
23	Non Life Insurance	0.804	-0.714	0.507
24	Oil and Gas	0.802	-1.124	0.312
25	Personal Goods	0.453	-4.438	0.007
26	Pharma and Bio Tech	0.383	-1.577	0.176
27	Support Services	0.916	-0.647	0.546
28	Technology Hardware and Equipment	1.317	0.220	0.834
29	Tobacco	0.575	-1.766	0.138
30	Travel and Leisure	-0.004	0.175	0.868