

The Relationship between systematic risk and stock returns in Tehran Stock Exchange using the capital asset pricing model (CAPM)

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ABSTRACT

One of the most important issues in the capital market is awareness of the level Risk of Companies, especially “systemic risk (unavoidable risk)” that could affect stock returns, and can play a significant role in decision-making. The present study examines the relationship between stock returns and systematic risk based on capital asset pricing model (CAPM) in Tehran Stock Exchange. The sample search includes panel data for 50 top companies of Tehran Stock Exchange over a five year period from 1387 to 1392. The results show that the relationship between systematic risk and stock returns are statistically significant. Moreover, the nonlinear (quadratic) function outperforms the linear one explaining the relationship between systematic risk and stock returns. It means that the assumption of linearity between systematic risk and stock returns is rejected in the Tehran Stock Exchange. So we can say that the capital asset pricing model in the sample is rejected and doesn't exist linear relationship between systematic risk and stock returns in the sample.

Keywords: Systematic Risk; Non Systematic Risk; Capital Asset Pricing Model; Panel Data; Stock Exchange

1. INTRODUCTION

Stock Exchange as the pulse of economy is consideration economic analysis. Means of a formal capital market in which companies buy and sell stock or bonds or private institutions, under the rules and regulations are made. Also with Competitive environment as economic instruments, that makes it profitable companies able to finance the deal by selling shares and vice versa so that unprofitable companies are automatically excluded. And market can pay optimal allocation of resources and Securities market within the framework of a market mechanism that can operate in a more efficient allocation of financial resources. The evidence shows that countries with developed capital markets (stock) could be higher economic growth (Tehran stock exchange site).

The fact that investors are replace their money with one or more sheets of the stock that future returns is high to be suffered and it seems essential to consider another factor such as

risk besides return. Investors have been seeking greater returns and abhor risk. In exchange for bearing more risk and expected higher returns can be earned (Fischer, 1991).

One of the most important issues in the capital market is awareness the level Risk of Companies, especially “systemic risk (unavoidable risk)” that could affect stock returns, and can play a significant role in decision-making. It is believed that stock returns is a function of systemic risk and systemic risk represents the rate of change for per shares than Rate of return on the stock market (Jahan Khani and Colleagues, 1374).

This paper is a response to this require that pricing in Tehran stock exchange so that The linear relationship between risk and return based on the CAPM model assumptions is true or not? This study attempts to present the theoretical cornerstones relationship between systematic risk and return in the stock market during the years 1392-1387 to examine in the Tehran Stock Exchange. The reason for chose this period is using data from more up to date and consistent with economic conditions. Would be more logical than interpretation of the intervals farther the capabilities of today's economic conditions. In the second section of this paper represent the background of investigation and then Definitions and Theoretical Principles research on the relationship between risk and return and the capital asset pricing model was introduced. The next section introduces the research methodology and finally Conclusions and suggestions for future research in this area have been provided for those interested.

2. BACKGROUND OF INVESTIGATION

Sizova, Bollerslev, Osterrieder, Tauchen (2011): They investigate the relationship between risk and return, Also Fractional Cointegration based on daily data for the S&P 500 and the VIX volatility index, Their series were divided into different components. Their finding indicate that the relationship between volatility and the volatility-risk reward is strongly direct and positive. They also find that a fractionally cointegrated VAR. in addition they find that corresponding the qualitative conceptions from that same theoretical and their study represent variance risk premium estimated as the long-run equilibrium relationship within the fractionally cointegrated system results in non-trivial return predictability over longer interdaily and monthly return horizons.

Pollet, Kräussl, Jegadeesh (2010): They investigate the risk and returns of PE investments and LPEs using the market Prices of FOFs that invest in unlisted private equity funds. Their findings indicate that the market expects for PE to earn abnormal return is approximately 0.5 percent and for LPEs is approximately close zero after fees. Private equity fund returns are negatively related to the credit expand and positively related to Gross Domestic Product growth. In addition they find that both listed and unlisted PE has betas near to one.

Chudhary, Chudhary (2010): in this paper they examined the relationship between stock returns and systematic risk based on capital asset pricing model (CAPM) in the Bombay Stock Exchange. The sample search is 287 top companies of bombay (BSE) Stock Exchange that the data were collected over a thirteen years period from January 1996 to December 2009. Their findings (about intercept and slop of CAPM equation that states intercept should be equal from zero and slop should be excess returns) rely on negate hypotheses of capital asset pricing model and offer evidence against the CAPM. In addition, this paper investigated whether the CAPM adequately captures all-important determinants of returns including the residual variance of stocks. The results represent that residual risk has no effect on the expected returns of portfolios.

McCurdy, G. Morgan (2011): They investigate equilibrium model for the inter temporal evolution of the basis in foreign currency markets. The weights are specified in a hedged by the prices of futures and spot contracts position and by Internal and external interest rates. Evaluating this hedged position using an inter temporal asset pricing model leads to a testable equilibrium model of the futures basis. Systematic risk will be commensurate to the conditional covariance of the basis with a generalized discount factor. Empirical implementation uses a conditional (CAPM) in which both the quantity and the price of covariance risk are free to vary over time. However, for this application, the estimated inter temporal risk is insignificantly different from zero the risk in the futures market offsets that in the spot, providing an effective hedge.

3. THEORETICAL FOUNDATIONS OF STUDY

3. 1. Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM) in finance literature divided two parts: single factor and multifactor that attempts to explain the relationship between the systematic risk of an asset and its corresponding expected return. The capital asset pricing model based on simplifying assumptions, of which can be expressed as follows: The first assumption is that Investor purpose is the maximizing of expected utility from final wealth. Second, all investors have homogeneous expects about the risk/reward trade-offs in the market. The third assumption is that Information simultaneously and freely available to all investors and investors can't be affected stock prices by buying and selling stock. The fourth assumption is that Taxes, transaction costs, there is no limit to short sell or other market constraints. Investors are considered to maintain diversified portfolios, as the market does not reward investors for bearing diversifiable risk. Consequently, the CAPM implies that if a security's beta is known, it may to calculate the parallel expected return. The relationship is known as the **Security Market Line (SML)** equation and the measure of systematic risk in the CAPM is called Beta.

$$R_j - R_f = \alpha_j + \beta_j(R_m - R_f) + \varepsilon_j$$

If we include time effects in the model will be:

$$R_{it} - R_{ft} = \alpha + \beta_j(R_{mt} - R_{ft}) + \varepsilon_{it} \quad ; \quad t = 1, \dots$$

If the model with it's assumption was correct then α_i significantly isn't different from zero, and then we have:

$$H_0: \quad \alpha_i = 0 \quad i = 1, \dots, N$$

where N: is the number of securities.

$$R_{it} - R_{ft} = \beta_j(R_{mt} - R_{ft}) + \varepsilon_{it} \quad ; \quad t = 1, \dots, T$$

R_{it} = expected return for i share.

R_{ft} = risk free rate.

β_j = beta(systematic risk).

R_{mt} = return on the market.

The equation represent the risk premium on asset j to the risk premium on the market: This relationship is clarified by the parameter beta. Assets having risk premium that Oscillate less than one-for-one with the market ($\beta_j < 1$) are called defensive assets; they offer a means of escaping from systematic risk of the market as a whole. Being attractive to investors in this respect, they command a relatively low expected return over the riskless assets. Assets having risk premium that oscillate more than one-for-one with the market ($\beta_j > 1$) are called aggressive assets; Investors must receive a higher expected return to tempt them to take on this additional risk. Assets that oscillate one-for-one with the market ($\beta_j = 1$) are said to be neutral; Over-or under weighting the market portfolio by the neutral asset does not affect the risk of portfolio, and so neutral assets receive the same expected risk premium as the market.

The capital asset pricing model illustrates with essentially graph that called SML and in this graph The x-axis represents the risk (beta), and the y-axis represents the expected return. The market risk premium ($R_{mt} - R_{ft}$) is determined from the slope of the SML. The CML is derived by drawing a tangent line from the intercept point on the efficient frontier to the point where the expected return equals the risk-free rate of return.

The CML is considered to be superior to the efficient frontier since it takes into account the inclusion of a risk-free asset in the portfolio. The capital asset pricing model (CAPM) demonstrates that the market portfolio is essentially the efficient frontier. This is achieved visually through the security market line.

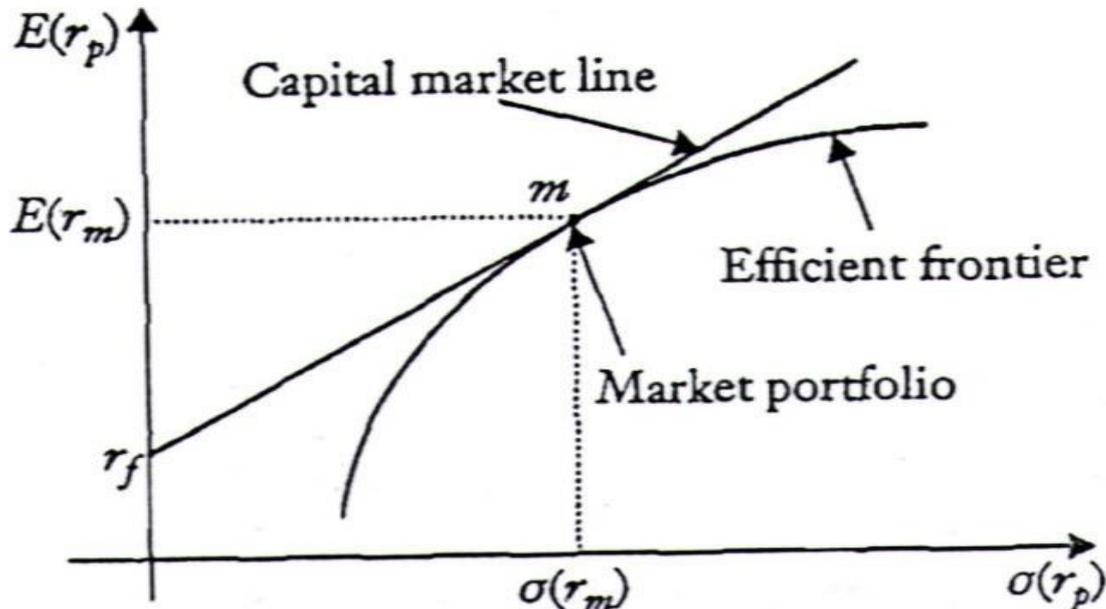


Figure 1. Capital market line.

Risk: A simple definition of risk is the possibility of a financial loss. The concept of risk could be examined in relation to an asset or portfolio. In the financial topics, risk can be divided into systematic risk (diversifiable risk) and non-systematic risk (diversifiable or unique risk).

Total risk = systematic risk + unsystematic risk

Systematic risk (market risk); Interest rates, recession and wars all represent sources of systematic risk because they affect the entire market and cannot be avoided through diversification. Whereas this type of risk affects a broad range of securities, unsystematic risk affects a very specific group of securities or an individual security. Systematic risk can be mitigated only by being hedged.

Non-systematic risk: Company or industry specific risk that is inherent in each investment. The amount of unsystematic risk can be reduced through appropriate diversification. Also known as “Business Risk”, “Liquidity and Marketability Risk”, “financial risk”, “credit risk” and “political risk”.

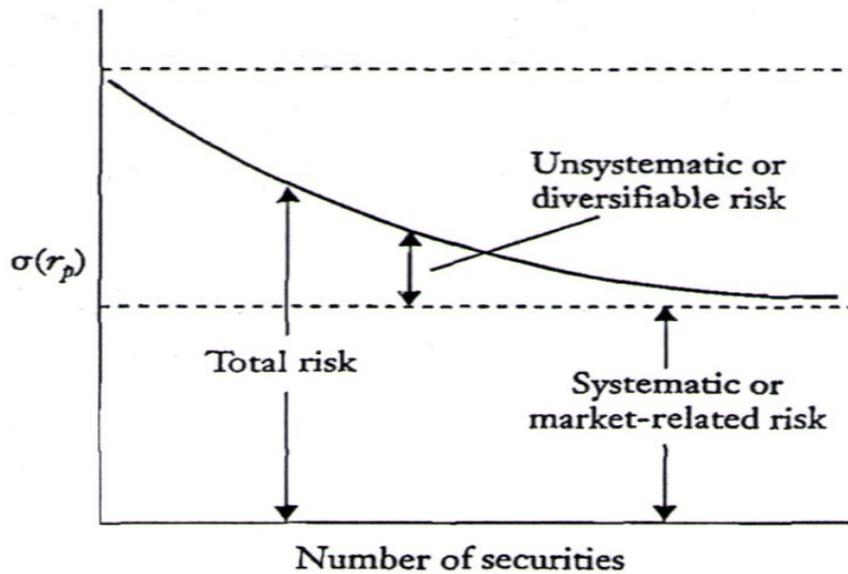


Figure 2. Function of relationship from risk.

4. METHODOLOGY

Calculation of beta; to measure the systematic risk of an asset should be determined relationship between return on assets and return on the market. This relationship can be calculated by statistical correlation between asset returns and market returns.

$$\beta = \frac{COV(R_i, R_m)}{\sigma_{R_m}^2}$$

where $\sigma_{R_m}^2$ is the variance of market returns. β can also be acquired from the slope of the least squares line.

Calculation of return in Tehran stock exchange: The gain or loss of a security in a particular period. The return consists of the income and the capital gains relative on an investment. It is usually quoted as a percentage. In this paper return calculated by following formula:

$$R_{it} = \frac{P_{it} + P_{it-1} + D_{it} + H_{it} + G_{it} + T_{it}}{P_{it} + \alpha(1000)}$$

R_{it} = return for i shares; P_{it} = i Share price at end of period; P_{it-1} = i Share price at end of period; D_{it} = divided profit; H_{it} = Priority shares; G_{it} = bonus shares; T_{it} = Stock splits; α = percentage of Priority shares.

5. DISCUSSION

Samples studied in this research are the 50 top companies in Tehran Stock Exchange. And the range of the present study is the beginning of 1387 until 1392. For each year, five and totally 1250 data were collected to estimate and then with the Excell software sorted and classified. Finally, by software Eviews and Matlab were estimated.

In this section, we are following the linearity or nonlinearity of capital asset pricing model in Tehran stock exchange. At first, we have examined the pool or panel data with eviews software. According to the results in Table 1, panel of data was approved.

Table 1. Redundant fixed effects tests

prob.	statistic	standard deviation	d.f.	variable
0.0000	3.225481	- 0.04	(49, 1108)	coefficient

Given the type of data model, the next step of being a fixed or random data of companies we examined the Hausman test. In this section, the effect of model is random and then do the Hausman test. The results in Table 2 show that the probability of Random effects is equal to 1 and there is no trace of Fix effects in existing data. The value of $BETA_i$ estimated by fixed effects and random effects are significantly different from each other.

Table 2. Correlated random effects – hausman test.

prob.	chi-sq. statistic	Fixed effect	Random effect	d.f.
1	0.0000	-0.55	-0.57	1

Now we can be written Risk-return linear equation as the following equation.

$$Bazdeh = -0.57 BETA_i + 5.84$$

$$(0.711) \quad (0.62)$$

According to the results in Table (3), the coefficient of $BETA_i$ is not significant at the 5% level. Because T-Statistic achieved as -0.91 that no significant. So there is no linear correlation between risk and return. Thus non-linearity of the relationship between risk and return among the top 50 companies in Tehran Stock Exchange can be accepted.

Table 3. Panel EGLS, result of regression.

prob.	statistic	standard deviation	coefficient	variable
0.0000	8.22*	0.71	5.84	amount
0.36	-0.91	0.63	-0.57	beta
R-squared = 0.0078 Adjusted R-squared = 0.007 f-statistic = 9.2 Durbin-watson = 1.92 Prob (Fstatistic) = 0.0024				

Table 4. Panel EGLS, result of non-linear regression.

prob.	statistic	standard deviation	coefficient	variable
0.0000	7.42*	0.57	4.3	amount
0.02	2.32*	0.55	1.29	beta
0.0000	9.36	0.02	0.2	chi-beta.
R-squared = 0.22 Adjusted R-squared = 0.23 f-statistic = 171.21 Durbin-watson = 1.93 Prob (Fstatistic) = 0.0000				

However, according to the estimates obtained can be claimed that the linear relationship between the risk-return among the top 50 companies in Tehran Stock Exchange is not established. For non-linear relationship between risk and return in the Tehran Stock Exchange, We entered Chi-risk (β^2) in mentioned equation then linearity and non-linearity relationships are tested. In accordance with mentioned estimates (Table 4), the coefficients $BETA_i, (BETA_i)^2$ have been obtained which are both positive and significant.

According to equation, and the results are presented in Table 4 that the estimates achieved in the model, it can be inferred that the relationship between risk and return is non-linear in the Tehran Stock Exchange.

The equation is:

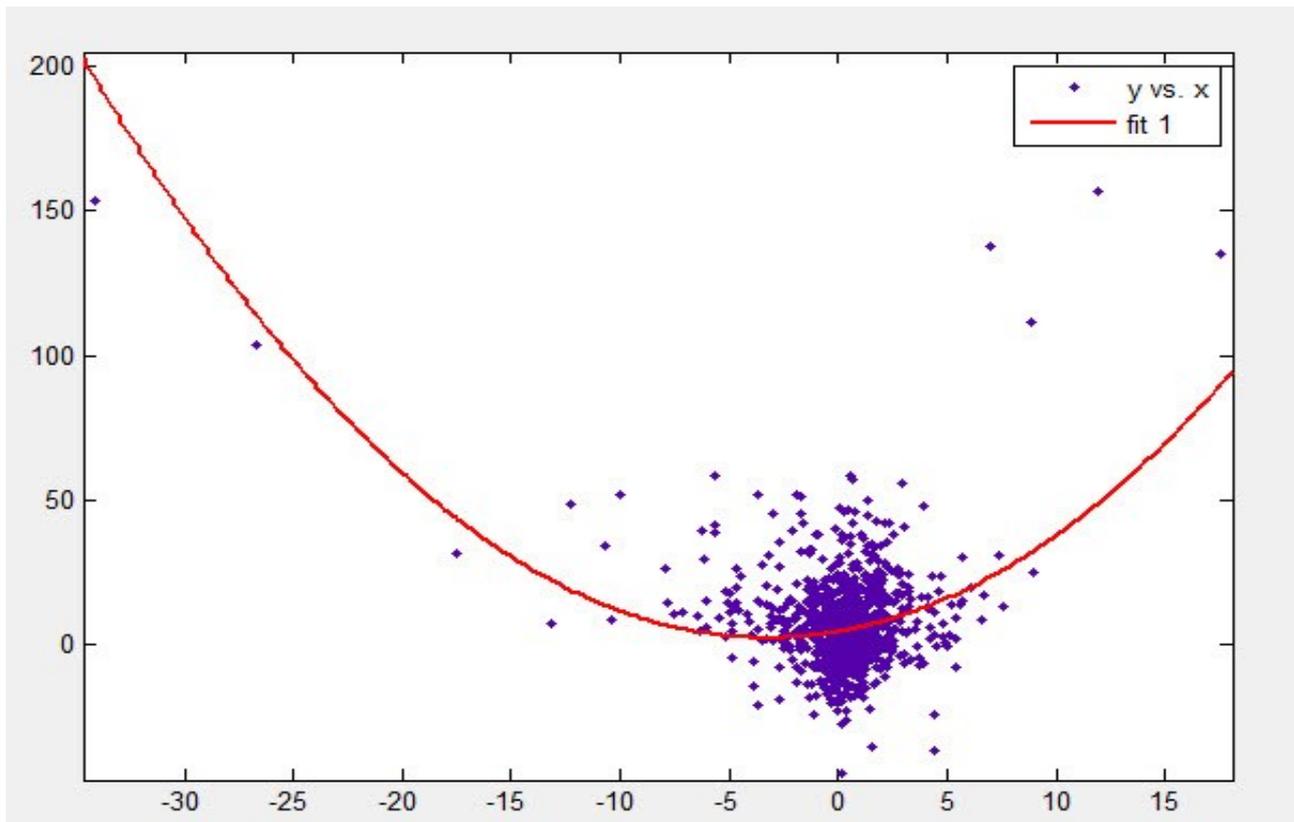
$$Bazdeh = 0.2 (BETA_i)^2 + 1.3 (BETA_i) + 4.27$$

(0.57)

(0.55)

(0.02)

The scatter plot show a positive relationship between risk and return in following scatter plot.



x- axis is beta y-axis is return

Figure 3. Scatter plot of data.

6. CONCLUSION

Period for this study is chosen from 01.01.1387 to 01.01.1391 and for each year, five and totally 1250 data were collected to estimate and then with the Excell software sorted and classified. Finally, by software eviws and matlab were estimated. However, according to the estimates obtained can be claimed that the linear relationship between the risk-return among the top 50 companies in Tehran Stock Exchange is not established. Thus non-linearity of the relationship between risk and return among the top 50 companies in Tehran Stock Exchange can be accepted.

The results indicate that the nonlinear (quadratic) relationship better than linear relationship able to explain relevancy between systematic risk and stock returns. The estimating of the model is Panel data techniques and the results of hypothesis tests show that the systematic risk and stock returns are statistically positive and significant relationship from there.

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