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Explanation of CAPM Model for Industry's Portfolios in the Tehran Stock Exchange

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Abstract: In order to modeling, estimating and making a comparative analysis of the behavior of CAPM Model's Beta over time, for Industrial Portfolios in Tehran Stock Market, this study estimates and extends the traditional Capital Asset Pricing Model for industrial portfolios in Tehran Stock Market with DBEKK_GARCH and Shwert_Seguin Models by using daily data from 01.09.1997-22.09.2015. Findings of this study, like the results of researches in the developing and developed countries, show that estimated CAPM Model's beta (known as systematic risk), for Industrial Portfolios is time-varying. Therefore, using the traditional Capital Asset Pricing Model with constant beta, may be not a good idea to modeling of systematic risk and forecasting the expected returns of capital assets as it may lead us to misleading results. Also findings show that the traditional CAPM and shwert seguin models have almost identical forecasting accuracy, though this accuracy is less than of the DBEKK GARCH Model's accuracy. The estimated systematic risk (Beta coefficient) from DBEKK GARCH and Shwert Seguin Models, doesn't show any trend over time.

Key words: Systematic risk, CAPM, DBEKK GARCH, shwert, seguin, time-varying

INTRODUCTION

Since, the introduction of capital asset pricing model by Sharpe (1964), for modeling and investigation of beta coefficient in the CAPM Model (as a measure of systematic risk) and forecasting the expected rate of return on financial assets, within mean-variance moments, this model as the cornerstone of financial economics has steadily attracted the attention of researchers in this field. The main objective of the researchers in this field is to identify the random behavior of financial data so that, determine the rate of expected values of financial assets and the risks, especially systemic risk and to provide the selection of investment portfolios optimization strategies for investment decisions in financial markets. In general this model assumes that, there is a linear relationship among the expected return of a financial asset and the market that financial asset is traded in it and this linear relationship is summarized in a parameter that called beta coefficient and is known as an indicator to measure systemic risk. Also, this model assumes that the beta coefficient is constant over time. The validity of this model depends on two basic limiter assumptions, one of which is the normality of the distribution of expected returns on assets and the other is that the financial asset markets investor's utility function is second-degree to the wealth of them. This means that the distribution of wealth can only be explained by its mean and variance. While today in the financial economics literature, it have been suggested that the model based on the mean and variance is not enough to describe the financial asset returns. It has long been known that the distribution of rate of returns on financial assets are not necessarily normal. In general, given the inadequacy of traditional linear CAPM Models, based on the idea of fixed beta coefficient that possibly it is not enough to modeling the systemic risk and forecasting expected returns of financial assets and even may lead to misleading results, financial researchers decided to replace them with another extended models such as GARCH Models and Schwert_Seguin Model. This will enable to model and analyze the dynamics of Beta coefficient (systematic risk) and also to increase accuracy of forecasting the expected returns of financial assets in CAPM Model. Due to the evolution of the CAPM Model in researches done outside of the our country and with a quick look at empirical researches conducted in regarding the analysis of the dynamics of this model and consequently the dynamics of systemic risk and the need to increase forecast accuracy rate of expected return on financial assets, it can be seen that not only there is very little studies in this field in the our country but also conducted studies mainly focus on the

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effects of variables such as macroeconomic variables, firm size, book value of assets on the static beta coefficient in the traditional CAPM Model.

Given the failure of the traditional capital asset pricing model and continue to use it in Iran, this study as a supplemental study, looking for the following purposes:

- Estimation of the traditional linear CAPM Model for industry sector portfolios in the Tehran Stock Exchange
- Using DBEKK_GARCH Model to explain and to estimate the CAPM Model to industry sector portfolios in the Tehran Stock Exchange
- Using Schwert_Seguin Model to explain and to estimate the CAPM Model to industry sector portfolios in the Tehran Stock Exchange
- Comparative evaluating and comparing the models used to explain the CAPM Model by using measures of the accuracy of their predictions

Following the above objectives involves testing the following hypotheses:

- Tehran Stock Exchange data, confirms the Beta coefficient variability (the dynamics of systemic risk), in the CAPM Model
- Changes in industry rate of returns in the Tehran Stock Exchange in the previous period (ARCH effects) has a significant and positive impact on their rates of return in current period
- Existence of volatility in the rates of returns of industries in the Tehran Stock Exchange in the last period (GARCH effects), causes volatility in the rate of returns for the current period
- Volatility of rates of returns of industries in the Tehran Stock Exchange is much larger than their changes

To test these hypotheses, firstly the traditional model is estimated using ordinary least squares method, then in order to demonstrate the instability of beta coefficient of this model over time, Generalized Autoregressive Conditional Heteroskedasticity and Schwert_Seguin Models are used. Also, in order to make a distinction between the techniques used and the criteria used in comparing the predictive accuracy of the models in relation to each other, Mean Absolute Error (MAE) and Mean Squared Error (MSE) in the name are anticipated. It is obvious that these two criteria are used within the sample, just to compare the forecasting accuracy and forecasting error of the models relative to each other, not as a comprehensive metric for comparing them.

Literature review: In general, the research work carried out in the capital asset pricing model and forecast the volatility of rates of return of capital assets can be separated into two groups. The first group includes studies that based on classic econometric models and examine the linear relationship between the rate of returns of securities that are studied and the rate of returns of security's market. That is, in this type of studies, using the traditional asset pricing model, the excess return of a stock to be viewed as a function of variables such as stock market excess return, ratio of book value to market value and so on and then by using ordinary least squares method it should be to estimated. However, since this method supplies constant and fixed coefficients, thus it may cause misleading results. While it has been proved that the criteria for systemic risk over time (beta coefficient) is not fixed and static. The second group of research conducted in the field are based on advanced modeling of time series that enable dynamically estimation of the beta coefficient by using the internal structure of time series data to identify the dynamics and the formation process of systemic risk criteria. Unfortunately, a review of the research carried out within the country shows that much of the research conducted in the country is among the first group of linear models are based on classic econometrics and the use of advanced time-series models in explicating the capital asset pricing model, there is not much studies. Below are a few of the research work carried out in the country include:

Alinezhad *et al*. (2014), have done a research to investigate the impact of institutional investment on systemic risk in the listed companies in Tehran Stock Exchange. Results of their study show that institutional investment, have a significant effect on systemic risk. But with regard to firm size as a control variable, specified that institutional investment had a meaningful and positive impact on systemic risk. However, this effect was not significant in small firms.

Piri *et al*. (2013), in an study examined the relationship between systemic risk and value added by using dynamic panel data showed that relationship between systemic risk and added value is inverse and negative.

Saeidi and Ramsheh (2011), in order to identify the determinants of systematic risk of shares of companies listed in Tehran Stock Exchange conducted an investigation. The findings show that there is a significant relationship between Beta coefficient and operating profit growth, variability of operating income, operating income correlation with the index of the market portfolios and the growth variables. The above-mentioned studies have calculated the variance and covariance values of stock return rates and rates of return of the stock market by using the statistical formulas, selected in the sample. While, today, this type of traditional calculation of the beta coefficient of capital asset pricing model with fixed and static linear coefficients have been lost their effectiveness and have replaced by extended time-varying beta models. Despite the small number of studies in the extended time-varying beta models In Iran in the foreigner countries, several studies has been done over the past three decades, on the capital asset pricing model and its time-varying beta coefficient as a measure of systematic risk. The following are some examples summarized.

Reddy and Durga (2015), test the CAPM for the Indian stock market using Black Jensen Scholes methodology. The sample involves 87 stocks included in the Nifty and Nifty Junior indices from 1st Jan 2005 to Aug 2014. The test was based on the time series regressions of excess portfolios return on excess market return. The major findings of the study are: CAPM holds only partially in the sense that market risk premium is a significant explanatory variable. There is a positive relationship between excess portfolios returns and betas but there is no evidence indicating that higher risk means higher returns. Further, they find that a non-linear relationship between portfolios returns and betas.

Barberis *et al*. (2015), studied a heterogeneous-agent model in which some investors form beliefs about future stock market price changes by extra-plating past price changes while other investors have fully rational beliefs. They find that the model captures many features of actual returns and prices. Importantly, however, it is also consistent with the survey evidence on investor expectations. This suggests that the survey evidence does not need to be seen as a nuisance; on the contrary, it is consistent with the facts about prices and returns and may be the key to understanding them.

Choudhry and Wu (2009), estimated the weekly time-varying systematic covariance risk of UK firms from January 1989 to December 2003 using a GJR-GARCH Model and a bivariate GARCH, Baba-Engle-Kraft-Kroner GARCH (BEKK-GARCH, Engle and Kroner and forecasts of the time-varying betas were examined to evaluate out-of-sample forecasting ability. Although, there is a lot of literature on GARCH-type models no single GARCH-type model has been found to be superior to all others to model and forecast the time-varying systematic covariance risk. Mergner and Bulla (2008), investigated the time varying behavior of systematic risk for 18 pan-European sectors. Using weekly data over the period 1987-2005, 6 different modeling techniques in addition to the standard constant coefficient model were employed: a bivariate t-GARCH (1, 1) model, two Kalman filter-based approaches, a bivariate stochastic volatility model estimated via the efficient Monte Carlo likelihood technique as well as two Markov switching models. A comparison of ex-ante forecast performances of the different models indicate that the random walk process in connection with the Kalman filter is the preferred model to describe and forecast the time-varying behavior of sector betas in a European context.

Schwert and Seguin (1990), used predictions of aggregate stock return variances from daily data to estimate time varying monthly variances for size-ranked portfolios. They proposed and estimated a single factor model of heteroskedasticity for portfolios returns. This model implies time-varying betas. Implications of heteroskedasticity and time-varying betas for tests of the Capital Asset Pricing Model (CAPM) are then documented. Accounting for heteroskedasti City increases the evidence that risk-adjusted returns are related to firm size. They also estimated a constant correlation model. Portfolios volatilities predicted by this model were similar to those predicted by more complex multivariate GARCH procedures.

MATERIALS AND METHODS

This is an empirical study. The population of study consists of all companies operating in the industrial sector up in Tehran Stock Exchange. The theoretical basis of the models used in this study is the results of various studies regarding the instability of Beta coefficient in CAPM Model. Therefore, to explain the capital asset pricing model for industries in the Tehran Stock Exchange, the DBEKK_GARCH (1, 1) and Schwert-Seguin Models used. To estimate these models, the daily data from 01.09.1997-22.09.2015 was used. The rational for using daily data is that). Data with a longer horizon such weekly, monthly and yearly data, could not show as the same transparency of daily data, the fleeting reactions to changes and innovations because they do not last more than a few days). Depth of daily data in terms of including the white noise is high and is affected by the days of the week. In addition, the use of daily data leads to findings with high contrast.

All the information needed can be derived through Tehran Stock Exchange website. In this way, that firstly, data on the total price index of Tehran Stock Exchange and total price index of industry's portfolios, mined from the website, then the rate of returns on Tehran Stock Exchange and the rate of returns in the industry are calculated from the following relationship:

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}}, \; R_{mt} = \frac{P_{mt} - P_{mt-1}}{P_{mt-1}} \quad (1)$$

Equation 1 relations can be written as follows:

$$R_{it} + 1 = \frac{P_{it}}{P_{it}}, \; R_{mt} + 1 = \frac{P_{mt}}{P_{mt-1}} \quad (2)$$

After taking the natural logarithm of the above equations, the following equations are obtained:

$$\text{In}(R_{it} + 1) = \text{In}(P_{it}) - \text{In}(P_{it-1}), \; \text{In}(R_{mt+1}) = \text{In}(P_{mt}) - \text{In}(P_{mt-1}) \quad (3)$$

When the simple returns of stocks is small, then by using the first order taylor series expansion, it can be demonstrated that:

$$\text{In}(R_{it} + 1) = \sum_{n=1}^{\infty} (-1)^{n+1} \frac{R_{it}{}^{n}}{n} \approx R_{it}, \; -1 < R_{it} \leq 1 \quad (4)$$

$$\text{In}(R_{mt} + 1) = \sum_{n=1}^{\infty} (-1)^{n+1} \frac{R_{mt} n}{n} \approx R_{it}, \; -1 < R_{it} \leq 1 \quad (5)$$

Thus, the rates of return of stock exchange and the rates of return of industries in stock exchange can be calculated as follows:

$$R_{it} = \text{In}(p_{it}) - \text{In}(P_{it-1}), \; R_{mt} = \text{In}(P_{mt}) - \text{In}(P_{mt-1}) \quad (6)$$

It should be noted that in all the above-mentioned relations P_{mt} is the Price Index of Tehran Stock Exchange in the current period and P_{mt-1} is that's value in the last period. R_{mt} shows the rate of return on the Tehran Stock Exchange. Also, P_{it} is the price index of industries in Tehran Stock Exchange in current period and P_{it-1} is that's value in the last period. R_{it} represent the rate of return of industries in the Tehran Stock Exchange. Before estimating the models mentioned above, it is necessary to explain the theoretical basics of them.

Extending of the CAPM Model using the model DBEKK_GARCH (1, 1): After introducing Auto Regressive-Conditional-Heteroskedasticity Models by Engle and extending to Generalized-Auto Regressive-Conditional-Heteroskedasticity Model by Bollerslev (1986) in order to include the structure of more complex un-stabilities, the modeling of volatility of financial asset's time series was another trending topics in the field of financial economics. So that, GARCH Models frequently were used to explain the volatility of returns of financial assets and returns of market of these assets. These models in the CAPM Model, indirectly calculate the time-varying beta coefficient, by estimating the conditional variance of returns on financial assets market and returns on ith portfolios, given the correlation between them. Before using these models, it should be noted that a series of methodological requirements must be provided. One of these requirements is that, before determining the characteristics of a GARCH Model, shall a set of mean equations for the production of residuals with zero conditional mean to be built.

While in the traditional CAPM returns are assumed to be IID, it is well established in the empirical finance literature that this is not the case for returns in many financial markets. Signs of autocorrelation and regularly observed volatility clusters contradict the assumption of independence and an identical return distribution over time. In this case the variance-covariance matrix of the industry and market returns is time-dependent and a non-constant beta can be defined as:

$$\beta_{im} = \frac{\text{cov}(R_i, R_m)}{\text{var}(R_m)} \quad (7)$$

where, the conditional beta is based on the calculation of the time-varying conditional covariance between the industry sector returns and the overall market return and the time-varying conditional market variance. For the estimation of time varying betas, the first methodological requirement is to specify a system of mean equations producing returns innovation ε_{it} and ε_{mt} with a conditional mean of zero before a GARCH specification is determined. In this study, below specification (Eq. 8) is used where the conditional return equation accommodates each market's own return and its return lagged one period:

$$R_{i,t} = \alpha_{i1} + \alpha_{i2} R_{i,\,t-1} + \varepsilon_{1t}$$

$$R_{m,t} = \alpha_{m1} + \alpha_{m2} R_{i,\,t-1} + \varepsilon_{1t} \quad (8)$$

In Eq. 8 α_{i1} and α_{m1} are the "long-term deviation" coefficients α_{i2} and α_{m2} also are the degree of spillover effects on time. The market information available at time t-1 is represented by the I_{t-1} information set. The random errors ε_{it} and ε_{mt} are the innovation for each market at time t with its corresponding 2×2 conditional varian cecovariance matrix (H_t) where H_t should depend on lagged errors ε_{it-1} and ε_{mt-1} (ARCH effect) and on lagged conditional covariance matrices H_{t-1} (GARCH effect). On the algebraic:

$$\mathrm{VEC}(H_t) = C + A \times EC(\varepsilon_{i,t-1}) + B \times \mathrm{VEC}(H_{t-1}) \qquad (9)$$

where, the relation (9) is a general bi-variate of GARCH (1, 1) variance-covariance specification. For the estimation of time varying betas, the second methodological requirement is to model the conditional variance and covariance structure of the returns so that, the time varying beta series could be estimated by relation (10):

$$\beta_{im} = \frac{\mathrm{cov}(R_i, R_m)}{\mathrm{var}(R_m)} = \frac{h_{12,t}}{h_{22,t}} \qquad (10)$$

One of the important points about GARCH Model is the specifications of this model. On one hand, it should be flexible enough to be able to represent the dynamics of the conditional variance and covariance. On the other hand, the specification should be parsimonious enough to allow for relatively easy estimation of the model and also allow for easy interpretation of the model parameters. Another feature that needs to be taken into account in the specification is imposing the positive definiteness (as covariance matrices need, by definition to be positive definite). One possibility is to derive conditions under which the conditional covariance matrices implied by the model are positive definite but this is often infeasible in practice. An alternative is to formulate the model in a way that positive definiteness is implied by the model structure (in addition to some simple constraints). In the extant literature, the two most popular parameterizations for the GARCH Models are: VEC and BEKK. The BEKK parameterization is adopted for the purposes of this analysis because this model is designed in such a way that it has less parameters and the estimated covariance matrix will be positive definite which is a requirement needed to guarantee non-negative estimated variances. BEKK_GARCH has the attractive property that the conditional covariance matrices are positive definite by construction. The quadratic forms of the matrices, A and B, enable to guarantee the positive definiteness of. The model has the following form:

$$H_t = C\bar{C} + A'(\varepsilon_{i,t}\,\varepsilon_{i,t})A + BH_{t-1}B \qquad (11)$$

where, A and B are n×n parameter matrices and C is lower triangular, being symmetric matrix of constants. The elements a_{jk} of the symmetric n×n matrix A measure the degree of innovation from market k to market jb_{jk} and the elements of the symmetric n×n matrix B indicate the persistence in conditional volatility between market k and market j. This can be expressed for the bivariate case of the BEKK as:

$$H_t = CC' + \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ b_{21} & \alpha_{22} \end{bmatrix}, \begin{bmatrix} \varepsilon_{1,t-1} & \varepsilon_{1,t-1} & \varepsilon_{1,t-1} & \varepsilon_{2,t-1} \\ \varepsilon_{2,t-1} & \varepsilon_{1,t-1} & \varepsilon_{2,t-1} & \varepsilon_{1,t-1} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{12} \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{12} \end{bmatrix}, \begin{bmatrix} h_{11,t-1} & h_{12,t-1} \\ h_{21,t-1} & h_{22,t-1} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{12} \end{bmatrix} \qquad (12)$$

In this parameterization, the parameters c_{jk}, a_{jk} and b_{jk} cannot be interpreted on an individual basis: "instead, the functions of the parameters which form the intercept terms and the coefficients of the lagged variance, covariance and error terms are of interest". The parameters of the BEKK Model do not represent directly the impact of the different lagged terms on the elements of. Also, the parameters, easily diverge when a model of the type of the full-rank BEKK Model is adopted. In the related literature, the Diagonal BEKK Model is more popular due to its property of convergence of parameters used in empirical research. Particularly, the Diagonal BEKK is more well-organized in estimating than the full BEKK Model, when the number of samples is a constraint. On these grounds, the Diagonal BEKK (hereafter DBEKK) form of the parameterization is adopted in this study for the ease of direct interpretation of the estimated parameters and the property of convergence of parameters. Namely, the matrices, A and B are diagonal and the elements of the variance covariance matrix H_t, depends only on lagged values of itself and lagged values of ε1t and ε2t. The matrix representation of the bi-variate DBEKK Model is shown as below:

$$H_t = \begin{bmatrix} c_{11} & 0 \\ c_{21} & c_{22} \end{bmatrix} \times \begin{bmatrix} c_{11} & c_{12} \\ 0 & c_{22} \end{bmatrix} + \begin{bmatrix} \alpha_{11} & 0 \\ 0 & \alpha_{22} \end{bmatrix} \times \begin{bmatrix} \varepsilon_{1,t-1} & \varepsilon_{1,t-1}\,\varepsilon_{1,t-1} & \varepsilon_{2,t-1} \\ \varepsilon_{2,t-1} & \varepsilon_{1,t-1}\,\varepsilon_{2,t-1} & \varepsilon_{2,t-1} \end{bmatrix} \begin{bmatrix} \alpha_{11} & 0 \\ 0 & \alpha_{22} \end{bmatrix} + \begin{bmatrix} b_{11} & 0 \\ 0 & b_{22} \end{bmatrix} \times \begin{bmatrix} h_{11,t-1} & h_{12,t-1} \\ h_{21,t-1} & h_{22,t-1} \end{bmatrix} \begin{bmatrix} \alpha_{11} & 0 \\ 0 & \alpha_{22} \end{bmatrix} \qquad (13)$$

Equivalently:

$$\begin{aligned} h_{11,t} &= c^2{}_{11} + a^{2_{11}}(\varepsilon_{1,t-1})^2 + b^2{}_{11}\,h_{11,t-1} \\ h_{12,t} &= c_{11}\,c_{21} + a_{11}\,a_{22}\,(\varepsilon_{1,t-1}) + b_{11}\,b_{22}\,h_{12,t-1} \\ h_{22,t} &= (c^2{}_{11} + c^2{}_{22}) + a^2 22(\varepsilon_{2,t-1})^2 + b2_{22}\,h_{22,t-1} \end{aligned} \qquad (14)$$

In the bi-variate DBEKK_GARCH (1, 1) Model there are seven parameters to be estimated and the conditional covariance matrices (that are positive definite by construction) are guaranteed to be stationary if $a_{ii}^2 + b_{ii}^2 < 1$, for i = 1, 2.

Extending of the CAPM by using Schwert-Seguin Model: Another way to explain the capital asset pricing model as an alternative to Generalized Autoregressive Conditional heteroscedasticity model is proposed by Schwert and Seguin (1990). They were added the heteroskedasticity in stock returns to the linear market model or to the traditional capital asset pricing model. Schwert and Seguin findings indicate that the failure of previous studies to confirm the traditional capital asset pricing model, perhaps be due to their failure in including of the heteroskedasticity in financial asset returns to the calculation of beta coefficient (as a measure of the systematic risk). Thus, it can be said that Schwert and Seguin model is a one-factor model of heteroskedasticity in stock returns in which the conditional variance of stock returns, obtained from the Generalized Autoregressive Conditional Heteroscedasticity process can be used to creating the beta coefficient's time series. As in the form presented in Eq. 15:

$$B_{SS} = b_1 + \frac{b_2}{h_{m,t}} \quad (15)$$

The $h_{m,t}$ represents the conditional variance of stock market returns and b_1 and b_2 are coefficients of the regression presented in Eq. 16:

$$R_{i,t} = \alpha_0 + \left(b_1 + \frac{b_2}{h_{mt}}\right) R_{m,t} + \varepsilon_{it} \quad (16)$$

According to Eq. 15, B_{SS} consists of a fixed component and a variable component. If b_2 is positive, then will be an inverse relationship between systematic risk and market volatility and vice versa if it is negative then will be an positive relationship between them. It is necessary to mention to obtain the $B'_{ss}{}^{s}$ time series, the conditional variance of stock market returns $h_{m,t}$, created by GARCH Models will be used.

Evaluation measures: Two measures are used to evaluate the forecast accuracy, namely, the Mean Square Error (MSE) and the Mean Absolute Error (MAE). They are defined by:

$$MAE = \sum_{t=1}^{T} \frac{R'_{it} - R_{it})^2}{T} \quad (17)$$

$$MAE = \sum_{t=1}^{T} \frac{R'_{it} - R_{it}}{T} \quad (18)$$

It is necessary to mention that the accuracy of the prediction and the values of MAE and MSE are inversely and they directly related with prediction errors. In other words, if the values of these two criteria are greater, then the accuracy of the forecast will be greater and forecast errors will be less.

RESULTS AND DISCUSSION

In this study, the results of estimates of traditional capital asset pricing model, DBEKK_ GARCH Model and Shwert_Seguein Model is presented.

Results of estimation of the linear market model: The result of estimating of traditional CAPM Model is given in Table 1 as follows.

As shown in Table 1, the intercept is statistically meaningless and very close to zero, i.e., it can be removed from the linear market model equation. This is exactly the result that the capital asset pricing model can be expected. The slope of the linear market model regression equation, or the beta coefficient, can be offered different interpretations. Firstly, it can be said that beta coefficient reflects the returns of capital asset's desires to the fluctuations in the capital market. As can be seen the beta coefficient equal to 1.019. It means that the volatility of stock returns of industries in the Tehran Stock Exchange compared to the volatility of stock returns of Tehran Stock Exchange is more. Secondly, higher beta means higher risk. As know, the risk of a basket will be achieved from the included risky assets in it. Also, due to the value of the estimated beta, we can say that, in the period under review, the risk of Tehran Stock Exchange has increased due to the inclusion of risky industrial companies. It should be noted that the positive sign of beta indicates that in the period under review, volatility in the industry has been in line with fluctuations in the stock exchange. But it seems that confirmation of all the terms mentioned above for a period of almost seventeen years, can't be done with certainty. Therefore, other models have been studied that the results of them are shown below.

Results of estimation of the CAPM by using the DBEKK_GARCH (1, 1): In Table 2 the results of estimation if the GARCH_DBEKK Model by using maximum likelihood approach has been presented. This table contains the coefficients and z statistics of conditional mean equations of industries and Tehran Stock Exchange and variance of DBEKK_GARCH (1, 1).

Table 1: Estimation of the traditional CAPM Model

Coefficient	Estimated values	t-statistic
α_i	-0.0011	-0.487
β_{im}	1.0190	263.2

Table 2: Estimation of the CAPM by using the DBEKK_GARCH

Coefficient	Estimated value	Z-statistic
α_{i1}	-0.0002	-0.0199
α_{i2}	0.4024	38.2400
α_{m1}	0.0006	0.09700
α_{m2}	0.4110	39.6900
$M_{(1,1)}$	0.0093	36.9600
$M_{(1,2)}$	0.0081	35.5200
$M_{(2,2)}$	0.0076	31.7600
$A_{(1,1)}$	0.3132	68.9100
$A_{(1,2)}$	0.3256	67.9700
$B_{(1,1)}$	0.9376	644.160
$B_{(2,2)}$	0.9349	606.330

$R^{i,t} = \alpha_{i1}+\alpha_{i2} R_{i,\ t-1}+\varepsilon_{it}\ R_{m,}t = \alpha_{m1}+\alpha_{m2} R_{m,\ t-1}+\varepsilon_{it}$; GARCH (1, 1) = A+M*RESIS(-1)'*A+B* GARCH (-1)*B

Returns of industries and returns of the Tehran Stock Exchange during the last period have significant and positive impact on the current period's returns. The ARCH effects (A 1, 1) element of diagonal matrix A) of rates of return of industries in the Tehran Stock Exchange are strongly significant, i.e., the existence of ARCH effects strongly confirmed. Also, numeric value of element A (1, 1) suggest that 1% change per se (by ARCH) in the rates of return in the industry in the Tehran Stock Exchange in the last period, causing changes in the current period in 0.3132%. Beside, the volatility of industrial rates of return in the Tehran Stock Exchange (B (1, 1)) element of B diagonal matrix in the last period are strongly significant and are also larger in value. It means that GARCH effect's is strongly confirmed. Also, element number B (1, 1) show that a percentage volatility in rates of return of industries in the Tehran Stock Exchange in the last period, rises volatility in the current period in 0.9376%. It can be seen that GARCH effects is much larger than ARCH effects. It means that, the volatility of returns of industries in the Tehran Stock Exchange are much larger than their own changes.

The ARCH effects (A(2, 2) elements of A diagonal matrix) of rates of return of Tehran Stock Exchange are strongly significant, i.e., the existence of ARCH effects strongly confirmed. Also, numeric value of element A (2, 2) suggest that 1% change per se (by ARCH) in the rates of return in the Tehran Stock Exchange in the last period, causing changes in the current period in 0.3256%. Beside, the volatility of rates of return in the Tehran Stock Exchange (B (2, 2)) element of B diagonal matrix in the last period are strongly significant and are also larger in value. It means that, GARCH effects are strongly confirmed. Also, element number B (2, 2) show that a percentage volatility in rates of return of Tehran Stock Exchange in the last period, rises volatility in the current period in 0.9349%. It can be seen that GARCH effects is much larger than ARCH effects. It means that, the volatility of returns of Tehran Stock Exchange are much larger than their own changes.

Table 3: Estimation of the Shwert Seguin Model

Coefficient	Estimated value	t-Statistic
b_0	-0.00127	-0.5480
b_1	1.02840	173.8100
b_2	-0.00280	-2.0701

$(R_i-R_f) = \beta_0\beta_1(R_m-R_f)+\beta_2[(R_m-R_m/h_{m,t})] +\epsilon_1$

The stationary condition of conditional covariance matrix is established. Because sum of the elements of A (1, 1) and B (1, 1) and sum of elements of A (2, 2) and B (2, 2) are <1.

Time series-of estimated systematic risk (beta estimates derived from GARCH_DBEKK Model), during the period studied, doesn't follow a specific process. The greatest and the minimum amount of beta is 1.23 and 0.359, respectively. The average amount of beta is equal to 1.023 that the comparison with the beta of the capital asset pricing model (i.e., 1.019), we can say that the average amount of time-varying beta in the Tehran Stock Exchange, obtained from GARCH_DBEKK Model, during the period under review is very close to the static beta of linear market model.

Results of estimation of the CAPM by using Shwert_Seguin Model: In order to demonstrate the volatility of Tehran Stock Exchange rates of return and calculation of time-varying beta, Shwert_Seguin Model adds new variable $r_{mt} = R_{mt}/h_{m,\ t}$ in the traditional capital asset pricing model. So, the calculation of the beta series or systemic risk, for the period under review, requires estimation of time series conditional variance of the rate of return on a stock exchange in this period, i.e., $h_{m,\ t}$ For this, the estimates of the conditional variance of the rates of return in the Tehran Stock Exchange, obtained from the GARCH_ DBEKK Model is used. These results are shown in Table 3.

In Table 3, the amount of intercept is statistically insignificant and very close to zero which means that it can be removed from the equation. Because in the calculation of systemic risk is also ineffective. The impact factor of the added variable to the capital asset pricing model, statistically is significant and negative and its impact on the rates of return of industry in the Tehran Stock Exchange is negligible. Also, time series of estimated systematic risk (beta estimates derived from Shwert_Seguin Model), during the period studied, doesn't follow a specific process. The greatest and the minimum amount of beta is 1.028 and 0.8467, respectively. The average amount of beta is equal to 1.011 that the comparison with the beta of the capital asset pricing model (i.e., 1.019), we can say that the average amount of time-varying beta in the Tehran Stock Exchange, obtained from Shwert_Seguin Model during the period under review is very close to the static beta of linear market model and the GARCH_DBEKK Model.

Table 4: Calculated evaluation measures to the forecast accuracy

Model name	Mae	Mse
Treditional CAPM Model	0.086831	0.022781
Garch_Dbekk Model	0.084253	0.021381
Shwert_Seguin Model	0.090251	0.022712

Evaluation measures: The value of calculated evaluation measures to the forecast accuracy, namely, the Mean Square Error (MSE) and the Mean Absolute Error (MAE), are presented in Table 4.

In Table 4 can be seen that due to theoretical basics, the prediction accuracy of traditional capital asset pricing model and Shwert_Seguin Model that are estimated by ordinary least squares method, compared to GARCH_DBEKK Model that directly estimated by using maximum likelihood estimation is less. Also, we can conclude that the prediction accuracy of time-varying beta models is greater than the prediction accuracy of static and constant beta models.

CONCLUSION

In the most studies in Iran, the excess returns of a portfolios has been viewed as a function of variables such as stock market returns, ratio of book value to market value and so on and then by using ordinary least squares method it has been estimated. However, since this method supplies constant and fixed coefficients, thus it may cause misleading results. While it has been proved that the criteria for systemic risk estimates over time are not fixed and static. Hence, in order to modeling, estimating and making a comparative analysis of the behavior of CAPM Model's beta over time for Industrial Portfolios in Tehran Stock Market, this study estimates and extends the traditional Capital Asset Pricing Model for industrial portfolios in Tehran Stock Market with DBEKK_GARCH and Shwert_Seguin Models. Like the results of researches in the developing and developed countries, show that estimated systematic risk for Industrial Portfolios in Tehran Stock Market is time-varying. Therefore, using the traditional Capital Asset Pricing Model with constant beta, may be not a good idea to modeling of systematic risk and forecasting the expected returns of capital assets, as it may lead us to misleading results. Also, the traditional CAPM and Shwert_Seguin Models have almost identical forecasting accuracy, though this accuracy is less than of the DBEKK_GARCH Model's accuracy. The estimated systematic risk (beta coefficient) from DBEKK_GARCH and Shwert_Seguin Models, doesn't show any trend in beta's behavior over time. Returns of industries and returns of the Tehran Stock Exchange during the last period have significant and positive impact on the current period's returns of them. Beside, existence of ARCH and GARCH effects of the returns of industries and returns of the Tehran Stock Exchange strongly confirmed.

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