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The Relationship between Risk and Return: An Empirical Study of Kuwait Stock Exchange

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Abstract

This paper examines the relationship between beta and returns of the industrial portfolio in Kuwait Stock Exchange using monthly data from June 2001 to October 2009. The study uses the M-GARCH (1.1) to estimate the time–varying beta and shows how the mean of time varying beta differs from the constant beta. It also shows that the unconditional relationship is rejected in this Market. The Study tested the model of Pettengill et al (1995), conditional on segmenting the up and down market. It was found that the results did not support this model where the market is down. Moreover, this Study concludes that the CAPM does not work in this small emerging market.

Keywords: Risk, Return, Kuwait Stock Exchange, CAPM model.

1. Introduction

The relationship between risk and return is one of the fundamental concepts in finance. It is considered quite important for investors who are interested in the estimation of investment risk which is related to asset pricing. The Capital Asset Pricing Model (CAPM), developed by Sharpe (1964) and Lintner (1965), is the most popular computational equation for the estimation of investment risk. CAPM argues that beta, or the systematic risk is the only relevant risk measure for investment and the relation between the returns of any asset is linearly related to its market beta.

Since the development of CAPM model by Sharpe and Lintner, many criticisms were pointed by the academics and practitioners to its validity as a model for asset pricing. Fama & MacBeth (1973) tested the linearity of the relationship between the expected return on a security and its risk market according to the assumption that the capital market is perfect hence., i.e no information or transaction cost incurred by investor, and they found that risky portfolios with higher betas tend to have higher returns than the less risky portfolios. But this linear relationship was criticized by the other asset pricing models like Arbitrage Pricing Theory (APT) which was developed by Ross (1976), who suggested that beta is not the only component that could measure the systematic risk or undiversified stock returns of other securities. Fama and French (1992) also found an insignificant relationship between beta and average returns. They concluded that the CAPM cannot describe the average stock returns; and that market capitalization and the ratio of book value to market value have significant explanatory power for portfolio returns. Despite these studies, there were other studies (Black, 1993; Jagannathan and Mcgrattan; 1995) that supported CAPM model and found that it may be still useful for measuring risk.

Pettengill et al (1995) presented an alternative approach to test the conditional relationship between risk and return in the US market. This approach depends on separating the periods of positive and negative market excess returns; and it was found that betas and returns are significantly and positively related when market excess returns are positive (up market); and significantly and negatively related when market excess returns are negative (down market). Isakov (1999) followed the approach of Pettengill et al. (1995) and examined the Swiss Stock Market for the period 1983–1991. He found that beta has a statistically significant relation to realized returns and depend on the expected sign of the market. He concluded that beta is a good measure of risk and is still alive and applicable.

Despite the popularity of Pettengill et al (1995) model, Cooper (2009) argues that there is much bias in the calculation of the coefficients, and, as a result, it could not help us more to prove the relationship between beta and returns. However, other studies show that beta tends to vary over time. Blume (1975), Huang and Cheng (2007), and Jagannathan and Wang (1996) show that conditional CAPM with a time-varying beta outperforms the unconditional CAPM with a constant beta. While there were many studies on the conditional CAPM in the developed markets, there were also other studies on emerging markets which tried to answer the question whether conditional CAPM is a valid model for these markets or not. Karacabey (2001) studied the beta-return relationship for Istanbul Stock Exchange, and his results showed that there is a conditional relationship between beta and returns, and beta is still a useful risk measure in this emerging market. However, Al Refai (2008) tested this relation in Jordan and found that unconditional relationship is rejected; but when he tested the Pettengill et al (1955) model, he found that during up markets, there is a conclusive statistical evidence for a positive relationship between beta and the realized returns for all industries. However, in down markets, the negative relationship is only evident for a few number of industries. Therefore, he concluded that the CAPM might not work in Jordan.

While there are few studies that empirically test the relationship between risk and return in the Arab World and the Gulf States financial markets, this study derives its importance because it examines this relationship between risk and return in Kuwait Stock Exchange (KSE) and explains the difference between constant Beta and time varying Betas. It also presents empirical evidence on the relationship between realized risk premium and betas, and whether they are related conditionally or unconditionally.

2. Data

In this study, we take the industrial sector index as the industrial portfolio consists of twenty eight industrial companies listed at Kuwait Stock Exchange. We use the monthly closing prices for the period from June, 2001 to October, 2009. Furthermore, the General Index is used as a proxy for the market portfolio and we use the Averages of Declared Inter Local Bank Interest Rates on Kuwait Dinar (KD) 3-months deposits as a proxy for risk free rate. We obtain the indices data from Kuwait Stock

Exchange website, and the 3-months deposits from the Central Bank of Kuwait. To obtain the monthly prices, we employ the log-return formulation, which is also known as log-price relatives since they are the log of the ratio of this period price to the previous period price. Therefore, the indices are converted to monthly continuous compound rates of returns as follows:

$$R_{it} = log\ (P_{it} / P_{it-1}) \quad (1)$$

Where: R_{it} represents the return on the industrial portfolio. P_{it} , P_{it-1} are the prices of the portfolio at time t and $t-1$ respectively. The annualized averages of declared inter local bank interest rates on Kuwait Dinar 3-months deposits are divided by 12 to convert them to monthly rates as follows: $R_M = R_N / 12$ where R_M is the monthly continuous compound rates of returns on the deposits, and R_N is the deposit rate with annualized compounding per annum.

Table (1) summaries the descriptive statistics of returns and excess returns of the sample statistics.

Table 1: Descriptive Statistics of Monthly Returns and Excess Returns: 2001-2009

	Returns	Excess Returns
Mean	1.237808	0.955903
Median	2.518075	2.1312
Maximum	15.94324	15.78524
Minimum	-29.3592	-29.72087
Std. Dev.	6.936895	6.955827
Skewness	-1.138212	-1.138823
Kurtosis	6.374146	6.390673
Observations	100	100

3. Methodology

3.1. Constant Beta Model

The positive linear relation between risk and expected return of risky asset is explained by the following equation:

$$R_{it} - R_f = \alpha_0 + \beta_1\ (R_m - R_f) + \varepsilon_t:\ \varepsilon_t \sim IID\ N\ (0,\sigma^2) \quad (2)$$

$$\beta_i = \frac{Cov\ (R_i, R_m)}{\sigma_m^2} \quad (3)$$

Where: R_{it} - R_f is the excess returns on portfolio, and R_m - R_f is the excess returns on market portfolio. ε_t is unsystematic error diversifiable risk, and α_0 is a constant and it is considered insignificant. We use Ordinary Least Squares (OLS) method to estimate constant beta which is measured as the covariance of the excess return of the industrial portfolio with the market excess returns divided by the variance of market excess returns.

3.2. Time-varying Beta Model

For analysis purposes for estimating the time varying beta, the researchers used in this Study the MGARCH (1.1) which is explained by the following functional form

$$R_{it} = \alpha_i + v_{it} \quad v_{it} \sim / \Omega_{t-1}(0, H_t) \text{ For } i = 1, 2 \quad (4)$$

Where $R_{it} = (r_{it}, r_{mt})$ is a 2×1vector of the excess industrial and market portfolio returns; and v_{it} is a 2×1vector of random errors for each excess return at time t corresponding to 2×2 conditional variance-covariance matrix H_t. The conditional variance of each equation can be denoted as:

$$H_t = C'C + A'v_t v_{t-1} A + B'H_{t-1} B \quad (5)$$

Where the time-varying beta is denoted as: $\beta_t = \tilde{H}_{12,t} / \tilde{H}_{22,t}$ where $\tilde{H}_{12,t}$ is the covariance between the excess industrials returns and the excess market portfolio returns, and $\tilde{H}_{22,t}$ is the variance of the excess market portfolio returns. In order to estimate models from the GARCH family, another technique known as Maximum Likelihood is employed. Essentially, this method works by finding the most likely values of the parameters given the actual data, and because the conditional variance is normally distributed, the Maximum Likelihood convert to Quasi Maximum Likelihood discussed in Bollerslev and Wooldridge (1992). The model is estimated by Quasi-Maximum Likelihood which corrects for non Gaussian errors. The log-likelihood function for the model is:

$$L(\theta) = -\frac{TN}{2}(\log\ 2\pi - \frac{1}{2}\sum_{t=1}^{T}(\log|H_t| + v_t H_t^{-1}/v_t) \quad (6)$$

Where θ denotes for the parameters to be estimated, N is the number of assets (N = 2 in case of the CAPM), and T is the number of observations (Engle and Kroner, 1995).

3.3. Conditional Relationship Between Beta and Returns.

In the standard test of the relationship between beta and returns, betas are estimated from a time-series regression of the excess stock returns on the excess market return:

$$R_{it} - R_f = \alpha_0 + \beta_{it}(R_{mt} - R_f) + u_{it} \quad (7)$$

Where R_{it} is the return on stock *i* in period *t*; R_{mt} is the return on the market index; R_f is the risk free rate β_{it} which is constant, i.e. it is the estimated beta of stock *i* in period *t*. The statistics used to test the relationship between beta and expected returns come from a period-by-period cross-sectional regression of returns on beta, as in Fama and MacBeth (1973):

$$R_{it} - R_f = \gamma_0 + \gamma_{it}\beta_{it} + \varepsilon_{it} \quad (8)$$

Where beta here is the systematic risk of portfolio estimated by the M-GARCH technique. The validity of the CAPM depends on γ_1; so the prediction of the CAPM is that $\gamma_1 > 0$. To test this, the time-series mean of γ_{1t} is examined. Because of the large amount of noise in returns, the power of this test tends to be low. As a result, such tests have generally been inconclusive. To increase the power of the test, Pettengill et al. (1995) suggested a conditional test. They proposed splitting the data into periods where the excess market return was positive and those where it was negative, and running the cross-sectional regression:

$$R_{it} - R_f = \gamma_0 + \gamma_{it}D_t\beta_{it} + \gamma_{2t}(1 - D_t) + \varepsilon_{it} \quad (9)$$

Where β_{it} is the systematic risk estimated by the M-GARCH (1.1) technique, D_t is a dummy variable that is equal to one when the market excess return in the period is positive, and zero when it is negative. The test is implemented by estimating in each month of the test period either γ_1 or γ_2, depending on the sign for excess market returns. The test statistics are $\bar{\gamma}_1$ and $\bar{\gamma}_2$, the time-series means of the estimated parameters. The test of whether there is a cross sectional relationship between returns and beta according to Pettengill (1995) corresponds to the following hypothesis: the first is a joint hypotheses $(H_0 : \bar{\gamma}_1 = 0, H_1 : \bar{\gamma}_1 > 0)$ and $(H_0 : \bar{\gamma}_2 = 0, H_1 : \bar{\gamma}_2 < 0)$, and the second is ($H_0$: $\mu = 0$, H_1: $\mu > 0$), the mean market risk premiums should be positive. The null hypothesis must be rejected to support the CAPM validity and the standard t-test is used to test the above relationship.

4. Empirical Evidence

4.1. Constant vs. Time-varying Beta

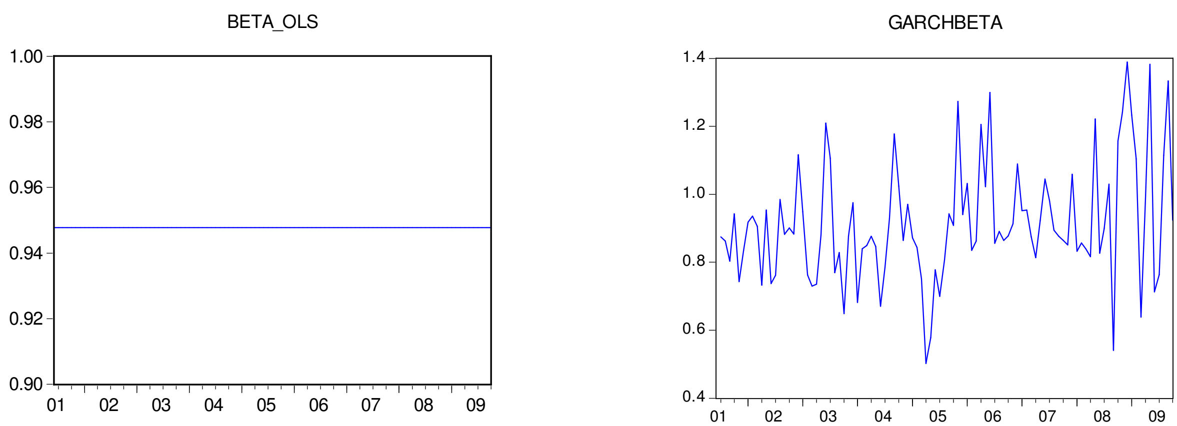
Table 2: Constant and time-varying beta of industrial portfolio

Industrial Portfolio	**OLS beta**	**GARCH beta**	**SD**
	0.947[a] (14.72)	0.913 (1.389/0.501)	0.175

Notes: A is significant at 1% level. Constant betas are estimated using the OLS method for the market model and t-statistic for the constant beta is in parenthesis. Time-varying betas are estimated using the M-GARCH (1.1) technique. Mean beta is the average beta and high\low betas are the highest\lowest betas after excluding the first observation, and S.D is the standard deviation of the beta series. Monthly returns of Industrial Portfolio are from June 2001 to October 2009, a total number of 101 observations.

Table (2) reports the comparison between the constant beta which is estimated by using the OLS method, and the mean of the time-varying betas which is estimated by M-GARCH (1.1) technique. The results show that the OLS regression yield a statistically significant beta for the industrial portfolio which is equal to (0.947) and significant at 1% level; and the mean of the time-varying betas which is estimated by using M-GARCH (1.1) technique is (0.913); and SD for betas series is (0.175), and the highest/ lowest value for beta is (1.389/0.501) respectively. The comparison between the mean of time varying beta with the OLS beta shows that the betas for the Industrial portfolio are clearly variable and the mean of betas estimated by the MGARCH (1.1) differs from the OLS beta. This variation implies that the constant beta may underestimate/overestimate the risk of portfolio. Figure (1) explains the difference between constant beta and time varying beta.

Figure 1: Beta by using OLS vs. Beta by using M-GARCH (1.1)



4.2. Beta and the Realized Returns

First, we test the relationship between risk and returns by equation (8) which is the equation of Fama & MacBeth (1973). Table (3) shows the results of the regression of this relationship, which shows a negative value for the coefficient γ_2 and this coefficient is not statistically different from zero; therefore the relationship between the beta and average returns is not valid. This result points to the rejection of CAPM and leads us to conclude that there is an insignificant relationship between risk and returns.

Table 3: Regression results of the model: $R_{it} - R_f = \gamma_1 + \gamma_2 \beta_{it} + \varepsilon_t$

Industrial Portfolio	γ_1	γ_2
	6.57835	-6.154906

However, this result is inadequate to judge if the CAPM can be clearly supported or rejected in this market. Pettengill et al (1995) criticized this biased aggregation of regression of positive and negative market risk premium as Fama & MacBeth (1973), in that it does not give enough support to the positive relationship between risk and return. So, we test the relationship between risk and return during the up (positive risk premium) and down (negative risk premium) markets as Pettengill et al (1995) advocated to have enough evidence whether the CAPM is truly valid in this small market. Table (4) shows the results of Pettengill et al (1995) regression analysis conditional on the up and down market respectively as shown by applying equation (9). It is noticed that the coefficient γ_1 is not statistically different form zero for the industrial portfolio, and the estimated risk priced per monthly unit of beta is 62% for the whole of industrial portfolio. These results suggest not rejecting the null hypothesis of no relationship between risk and returns during up markets. Table (4) also shows that the estimation of coefficient γ_2 is negative and different from zero so this result suggests a clear rejection for the null hypothesis of no relationship between risk and returns during down markets where estimated reduction of priced risk per monthly unit of beta is (-11) for the whole of the industrial portfolio.

Table 4: Relationship between risk and return in up and down markets

Industrial Portfolio	Up Market	Down Market
	γ_1	γ_2
	0.625524	-11.07351[a]

Notes: A is significant at 10% level, up and down markets are periods of positive and negative realized excess returns

This means that when the market is up, the null hypothesis must not be rejected and this is inconsistent with Pettengill et al (1995); but when the market is down, we reject the null hypothesis and this consistent with Pettengill model in down market. We also test the second condition postulated by Pettengill et al (1995), which states that the mean market risk premiums should be positive. The results which are reported in Table (5) show that the mean excess market returns are positive and significant at 10% level. Here the excess market returns are in excess of 3-month deposit rate, and they were positive for 70 months and negative for 30 months and the t-statistics concerning the null hypothesis show that the mean excess returns are equal to zero.

Overall, these results do not seem to support the relationship between betas and returns, as they do not guarantee a positive reward for holding the risk as argued by Pettengill et al. (1995). These results also do not support the continued use of beta as a measure of risk in this market.

Table 5: Average market excess returns 2001-2009

	Up months	Down months	Mean	SD	t-statistics	p-value
2001-2009	70	30	1.195687	6.587352	1.815126	0.0725

5. Conclusion

In this paper, we investigated the risk-return relationship in Kuwait capital market. Using the time-varying betas estimated by the M-GARCH (1.1), the results show that there is some variability of beta compared to the OLS beta. Our findings about the validity of CAPM according to Fama & MacBeth did not support this relationship because we could not reject the null hypothesis of average risk premium which is not significantly different from zero. When we tested Pettengill et al (1995) model , the findings did not also support this model because we could not reject the null hypothesis in up market. Only in down market, we rejected the null hypothesis and our findings support the CAPM validity only in case of the market down. Therefore, this does not support the model of Pettengill et al (1995), and as a result this does not support the validity of CAPM in this market. These findings about this Kuwait emerging market is similar to another study on Jordan (Al Refai, H, 2008) where he found that CAPM does not work well in this small Jordanian market. However, Karacabey (2001) found that this model is good for the Istanbul Stock Exchange.

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