A TEST OF THE CAPM ON THE ICELANDIC STOCK MARKET

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ABSTRACT

In this article, we present the result of a study of the validity of the CAPM on the Icelandic stock market. This study starts in January 1999 and ends in May 2004. The results are surprising. They indicate that the CAPM has worked well in the small Icelandic stock market and that it, or the beta coefficient, does explain returns better than on larger foreign stock markets. There was a strong relationship between the beta coefficient and stock returns in this research. Further, the stock returns with high betas were higher than one would expect according to the CAPM. Therefore, the SML was steeper than one would expect according to the CAPM. Like the CAPM predicted there was no relationship between firm-specific risk and returns.

Introduction

In this paper, empirical tests are performed to test the explanatory performance of the capital asset pricing model (CAPM) on the Icelandic stock market. This study is divided into two parts. First, the beta coefficients and nonsystematic risk of Icelandic stocks are estimated. Then, the slope of the securities market line (SML) and whether there has been a significant relationship between nonsystematic risk and returns are measured. The findings are that there is a significant relationship between Icelandic stocks' betas and returns and that the CAPM does explain the returns of Icelandic stocks. However, as the CAPM predicted, there is no relationship between the nonsystematic risk of stocks and their returns.

An efficient capital market is one in which stock prices fully reflect available information. The notion that stocks already reflect all available information is referred to as the efficient market hypothesis (EMH). A precondition for the strong version of the hypothesis is that information and trading costs—the costs of getting prices to reflect information—are always zero. A weaker and economically more sensible version of the efficiency hypothesis states that security prices reflect information to the point where the marginal benefits of acting on information, i.e., the profits to be made, do not exceed the marginal costs (Jensen, 1968). Therefore, according to the EMH, stock prices change in response to new and unpredictable information and they follow a random walk—i.e., they are random and unpredictable.

It is common to distinguish between three versions of the EMH: the weak, the semi strong, and the strong forms. The weak form of the hypothesis asserts that stock prices already reflect all information that can be derived by examining trading data. The semi strong form of the hypothesis states that all publicly available information regarding the prospects of a firm must already be reflected in the stock price. Finally, the strong version of the EMH

states that stock prices reflect all information relevant to the firm, even information available only to company insiders.

The relationship between risk and returns is an important subject when studying capital market efficiency. It is obvious that investment in riskier assets such as stocks should generate a higher return than investment in less risky assets. It was not until the CAPM was developed that academics were able to measure risk and its return. CAPM is based on the assumption that asset returns are linearly related to their covariance with the market's return. The CAPM assumes that assets with higher systematic risk have a higher return than do assets with lower systematic risk, and that assets with the same systematic risk should give the same return. Therefore, if investors own stock with the same systematic risk as the market, i.e., the beta coefficient is 1, then the expected return is the same as the market return. If the beta coefficient is 0, then the expected return is the same as the risk-free rate of return. The CAPM also implies that there is no relationship between firm-specific risk and returns because specific risk can be eliminated through diversification.

Markowitz (1959) laid the groundwork for the CAPM. In his seminal research, he cast the investor's portfolio selection problem in terms of expected return and variance of return. He argued that investors would optimally hold a mean–variance-efficient portfolio—i.e., a portfolio with the highest expected return for a given level of variance. Sharpe (1964) and Lintner (1965a) built on Markowitz's work to develop economy-wide implications. They showed that if investors have homogeneous expectations and optimally hold mean–variance-efficient portfolios, then, in the absence of market friction, the portfolio of all invested wealth, or the market portfolio, is itself a mean–variance-efficient portfolio.

The Sharpe and Lintner derivations of the CAPM assume the existence of lending and borrowing at a risk-free rate of interest. Using this version of the CAPM, for the expected returns of asset *i* we have:

$$E[R_i] = R_f + \beta_{im}(E[R_m] - R_f) \quad (1)$$

$$\beta_{im} = \frac{Cov[R_i, R_m]}{Var[R_m]}, \quad (2)$$

where $E[R_i]$ is the expected return of the security, R_f is the risk-free return, and $E[R_m]$ is the return of a market index.

The CAPM is based on a number of simplifying assumptions:

1) There are many investors, each with an endowment (wealth) that is small compared to the total endowment of all investors. Investors are price-takers, in that they act as though security prices are unaffected by their trades.

2) All investors plan for one identical holding period.

3) Investments are limited to a universe of publicly traded financial assets,

such as stocks and bonds, and to risk-free borrowing or lending arrangements.

4) Investors pay no taxes on returns and no transaction costs on trades in securities.

5) All investors are rational mean–variance optimizers, meaning that they all use the Markowitz portfolio selection model.

6) All investors analyze securities in the same way and share the same economic view of the world. The result is identical estimates of the probability distribution of future cash flows from investing in the available securities; i.e., for any set of security prices, they all derive the same input list to feed into the Markowitz model.

Earlier literature

Considerable research has been undertaken to test the CAPM. The main findings have been that the CAPM is not entirely valid as a model that explains stock returns, and that factors other than beta provide a better explanation. Lintner's (1965b) study of the American stock market from 1954 to 1963 found that the SML, i.e., the line that shows the relationship between systematic risk (beta) and returns, was too flat. In other words, higher returns were not proportional to higher systematic risk. Later research that tested the CAPM on the American stock market has shown that stocks with higher systematic risk do not give higher returns for periods, even for a decade. Research by Black et al. (1972) and Fama and MacBeth (1973) showed that returns of high beta stocks were lower than the CAPM would have predicted. They concluded that the SML was too flat. In their seminal research, Fama and French (1992) found no relationship between returns and beta on the US stock market from 1963 to 1990, but a weak positive relationship between 1941 and 1990.

A number of studies have found that there is a significant relationship between nonsystematic risk and returns. Nonsystematic risk is the risk that the CAPM does not explain. According to the CAPM, there should be no relationship between nonsystematic risk and returns. In a study on the US stock market, Friend et al. (1978), Lakonishok and Shapiro (1984), and Fuller and Wong (1988) found that there was a significant positive relationship between nonsystematic risk and stocks' returns. The finding of Corhay et al. (1988) in relation to the British stock market was similar, i.e., there was a positive relationship between returns and nonsystematic risk for British stocks.

The results of these findings have been that academics have doubted the validity of the CAPM. Nevertheless, academics have not discarded the CAPM and pervasive arguments support the CAPM. Moreover, it is difficult to test the model. Richard Roll (1977) put forward arguments, known as Roll's critique, supporting the model. He pointed out that:

1) There is a single testable hypothesis associated with the CAPM: the market portfolio is mean–variance efficient.

2) All the other implications of the model, the best known being the linear relation between the expected return and

beta, follow from the market portfolio's efficiency and therefore are not independently testable.

3) In any sample of observations of individual returns there will be an infinite number of ex post mean–variance efficient portfolios using the sample period returns and covariances. Sample betas calculated between each such portfolio and individual assets will be exactly linearly related to sample average returns.

4) The CAPM is not testable unless we know the exact composition of the true market portfolio and use it in the tests. This implies that the theory is not testable unless all individual assets are included in the sample.

5) Using a proxy such as stock indexes for the market portfolio is subject to two difficulties. First, the proxy itself might be mean–variance efficient even when the true market portfolio is not. Conversely, the proxy may turn out to be inefficient, but obviously, this alone implies nothing about the true market portfolio's efficiency. Furthermore, most reasonable market proxies will be very highly correlated with each other and with the true market portfolio, regardless of whether they are mean–variance efficient. Such a high degree of correlation will make it seem that the exact composition of the market portfolio is unimportant, whereas the use of different proxies can lead to quite different conclusions.

The Icelandic stock market

The total market value of quoted companies on the Icelandic stock market at the end of 2003 was approximately 9,200 million USD, or 82% of GDP. By contrast, in 1993, the total market value was only 270 million USD, which was then 4% of GDP. Figure 1 shows the total value of transactions of stocks on the Icelandic Stock Exchange (ICEX) and the total market value of quoted companies from 1993 to 2003. As the figure shows, the size of the market and its turnover has increased exponentially. In 1993, the total volume of stock trading on the ICEX was only 13 million USD, but by 2003, it had grown to 7,750 million USD.

The number of registered companies reached a peak in 1999–2000, when 75 companies were trading on the exchange. Since then, the number has declined steadily, mainly because of mergers and acquisitions. Figure 2 shows the number of registered companies on ICEX and the year-end value of the ICEX-15 index. The ICEX-15 index is an index consisting of the 15 largest stocks quoted on the ICEX weighted by market capitalization. The figure shows clearly that the Icelandic stock market has been an excellent place in which to invest. The geometric mean annual return of the ICEX-15 index was 17.1% from the beginning of 1993 to the end of 2003. The return of the market was negative only in 2000 and 2001.

Data and methodology

This research covers the period from the beginning of January 1999 until the end of May 2004. Monthly returns of 27 stocks registered on the ICEX were used in this study. These 27 stocks are all of the stocks that were registered during the whole

period, so it was impossible to get a larger sample.

Figure 1: Total market value of stocks and the total value of transactions, 1993–2003
Source: The Icelandic Stock Exchange

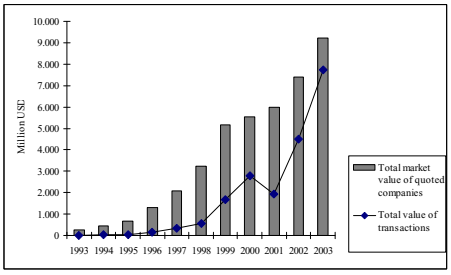
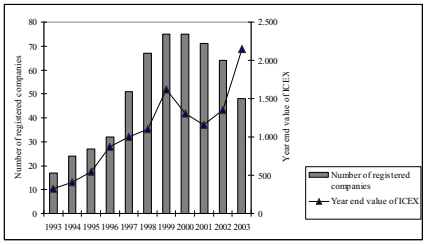


Figure 2: Number of registered companies on ICEX and the year-end value of the ICEX-15
Source: The Icelandic Stock Exchange



The study was performed in two steps. First, the alpha and beta coefficients as well as the nonsystematic risk of the 27 stocks in the sample were estimated applying OLS regression. Then, those results were used to analyze if "correct" relationships existed between beta coefficients, nonsystematic risk, and returns.

During the first part of this study, the following equation was applied for all 27 stocks using OLS regression:

$$R_i - R_f = \alpha_i + \beta_i (R_m - R_f) + e_i, \quad (3)$$

where R_i is the monthly return of stock *i*, R_f is the risk-free return, and R_m is the return of the market. As a proxy for the market, the ICEX-15, which is an index of the 15 largest firms weighted by market capitalization, was used. The coefficient e_i is an error term measuring the nonsystematic risk of the stocks.

After the first regression had been performed and the beta coefficients and nonsystematic risk of every stock had been estimated, the second regression was applied using OLS and the following equation:

$$\overline{R_i - R_f} = \gamma_0 + \gamma_1 \beta_i + \gamma_2 \sigma^2(e_i) + u, \quad (4)$$

where $\overline{R_i - R_f}$ is the average return of each stock in excess of the risk-free return, β_i is the beta coefficient of individual stock, $\sigma^2(e_i)$ is the variance of nonsystematic risk of every stock, and the coefficient *u* is an error term. This regression tests the CAPM applying the following null hypotheses:

$\gamma_0 = 0;\ \gamma_1 = \overline{R_m - R_f} = 0{,}0075;\ \gamma_2 = 0$.

According to the CAPM, none of these null hypotheses should be rejected. The coefficient γ_1 should equal zero because the SML starts at the y-axis at the average risk-free return. The coefficient γ_1 should be equal to the average return of the market in excess of the average risk-free rate of return, which averaged 0.75% per month during the period this study covers, because a stock with the beta coefficient of 1.0 should have the same excess return as the market. The coefficient γ_2 should equal zero because no significant relationship should exist between nonsystematic risk and returns.

Results

The main results are shown in Table 1, where the results of the last regression applying equation 4 are presented. There we see that the coefficient γ_0 equals –0.0067, but, as the t-statistic indicates, it is not statistically different from zero. This means that the SML of the Icelandic stock market did start at the y-axis below the average risk-free rate, but that those results are not statistically significant. The coefficient γ_2 is close to zero and not statistically significant. Therefore, there was no relationship between nonsystematic risk and returns and those results are according to the CAPM.

The coefficient γ_1 shows whether "the right" relationship according to the CAPM existed between the beta coefficient of the stocks in the sample and their returns. The regression gives the coefficient the value of 0.016, but the null hypothesis was that this coefficient should be 0.0075, which was the average monthly return of the market index in excess of the risk-free rate. Therefore, the SML on the Icelandic stock market was steeper than one would expect according to the CAPM. This means that the average return of stocks with low beta was lower than expected and the return of high beta stocks was higher than expected according to the CAPM. However, the null hypothesis is not rejected. The calculated value of the t-statistics is 1.77, which is not statistically significant at the 5% level. Therefore, the null hypothesis is not rejected and we are not able to conclude that the SML was steeper than one would expect.

Table 1. Main results of the regression applying equation 4

	Coefficient	t-value	P-value		F-value	P-value	R^2
γ_0	–0.0067	–1.42	0.17		5.99	0.007	0.33
γ_1	0.016	3.42**	0.002				
γ_2	–0.024	–0.06	0.95				

Source: Authors' calculations. **Significant at the 1% level

Conclusions

In this article, we present the result of a study of the validity of the CAPM on the Icelandic stock market. This study starts in January 1999 and ends in May 2004. The results are surprising. They indicate that the CAPM has worked well in the small Icelandic stock market and that it, or the beta coefficient, does explain returns better than on larger foreign stock markets. There was a strong relationship between the beta coefficient and stock returns in this research. Further, the stock returns with high betas were higher than one would expect according to the CAPM. Therefore, the SML was steeper than one would expect according to the CAPM.

These results are contradictory to similar studies of other stock markets. On other stock markets than the Icelandic one, the SML has normally been flatter than one would expect. In addition, in the case of the Icelandic stock market, the result that there was no significant relationship between nonsystematic risk and returns was in

accordance with the CAPM. However, on other stock markets, a positive relationship has often been found between nonsystematic risk and returns. The fact that there are only 27 stocks in the sample of this research and that it covers a relatively short period does seriously decrease the value of this research.

We might wonder how investors on the Icelandic stock market might use these results. Until now, they have paid little attention to the beta coefficient of Icelandic stocks. These results indicate that they should study it. If they are bullish about the market, these results show that the returns of stocks with high betas are significantly better than the returns of stocks with low betas. This strategy has worked well in the context of the bull run of the market in recent years.

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