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The Applicability of the Capital Asset Pricing Model: An Empirical Test

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Abstract

The Capital Asset Pricing Model (CAPM) describes the relationship between expected return and risk, offering a simple framework for asset pricing. Despite its popularity, the model has been criticized for relying on unrealistic assumptions and its limited ability to explain returns in practice. This paper reviews the theoretical foundation of CAPM, its extensions, and criticisms, focusing on the Sharpe–Lintner version. Using data from 30 companies over 16 years, we test the model's validity through three empirical approaches: full sample, sub-sample, and portfolio tests. Results indicate that CAPM can be appropriate for predicting returns of individual stocks, but is unsuitable for portfolios.

Keywords

CAPM; Systematic Risk; Market Efficiency.

1. Introduction

The CAPM, introduced by Sharpe (1964) and Lintner (1969), builds upon Markowitz's portfolio theory to link risk and expected return[1]. It assumes investors are rational and markets are efficient, allowing systematic risk (beta) to be the sole determinant of expected return[2]. While CAPM remains widely taught and used, empirical evidence has shown mixed results, prompting modifications such as the Intertemporal CAPM (ICAPM) and the Fama–French three-factor model. This study aims to evaluate whether the Sharpe–Lintner CAPM can accurately predict returns in real markets.

2. Literature Review

2.1. Theoretical Background

Markowitz (1959) established the mean-variance framework, introducing the efficient frontier and the concept of market portfolios[3]. Sharpe and Lintner extended this into CAPM, which predicts a linear relationship between expected return and beta. Black (1972) proposed a variant without a risk-free asset[4], while Merton (1973) introduced the ICAPM, incorporating multiple state variables[5].

2.2. Contributions and Advantages

CAPM offers a clear, testable prediction about the link between systematic risk and return, allowing investors to estimate expected returns without detailed forecasts of cash flows. It also serves as a benchmark for evaluating portfolio managers' performance and remains foundational in asset pricing theory.

2.3. Criticisms and Limitations

Critics, including Roll (1977) and Fama & French (2004), argue that CAPM's assumptions are unrealistic and that beta alone cannot explain cross-sectional differences in returns[6][7].

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Empirical studies show persistent anomalies related to firm size and book-to-market ratio, leading to the development of multi-factor models.

2.4. The Fama–French Three-Factor Model

Fama and French (1993, 1996) extended CAPM by adding size (SMB) and value (HML) factors[8], which capture return patterns unexplained by beta. While widely adopted, this model has also been criticized for being empirically driven rather than derived from strong theoretical foundations.

3. Methodology

We test the CAPM using the following regression equation:

$$E(R_i) - R_f = \alpha + [\,(R_M - R_f)\,]\,\beta_{iM} \tag{1}$$

Where $E(R_i)$ is the expected return of asset i, R_f is the risk-free rate, R_M is the market return, and β_{iM} measures the asset's systematic risk. The null hypothesis H_0: α equal to zero against H_1: α not equal to zero. If the test result is H_1, it means the unreasonable return on the market exists. The CAPM will be rejected. The rejection area will be considered to use a 95% confidence level. Specifically, if the result of the t-value is below 1.96 of the entire sample (sample size is 192), $\alpha = 0$, do not reject H_0. If the t-statistics exceed 1.96, $\alpha \neq 0$, reject H_0.

Data: Monthly returns for 30 companies from 2002–2017 (192 observations per firm).

Testing Procedure:

- Full Sample Test – regression for each company over the entire 16-year period.
- Sub-sample Tests – two periods (2002–2009, 2009–2017).
- Portfolio Tests – equal-weighted portfolio of all 30 stocks for the full sample and sub-samples.

4. Results

4.1. Full Sample

All 30 firms' t-statistics fell within the acceptance range for $H0$, suggesting CAPM could explain expected returns. However, R^2 values were low (<0.4 for most firms), indicating weak explanatory power.

Table 1. T-statistic 2002-2017

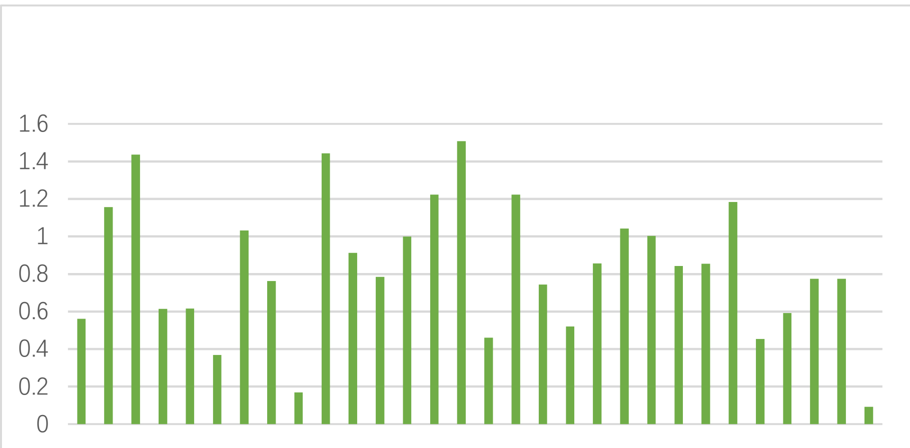

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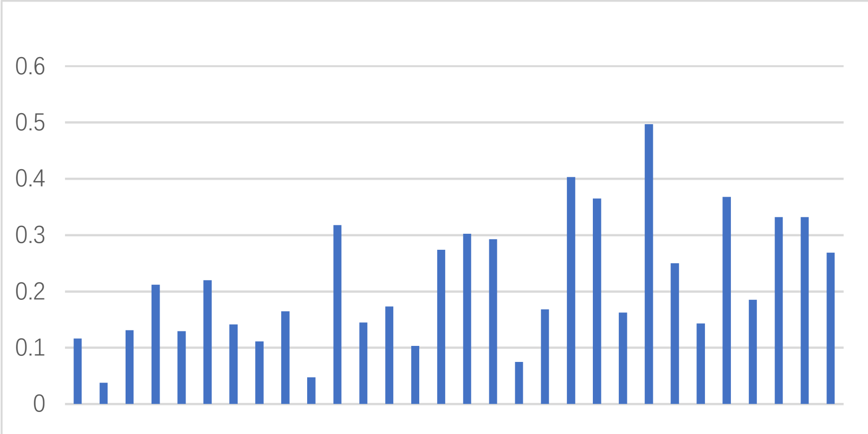
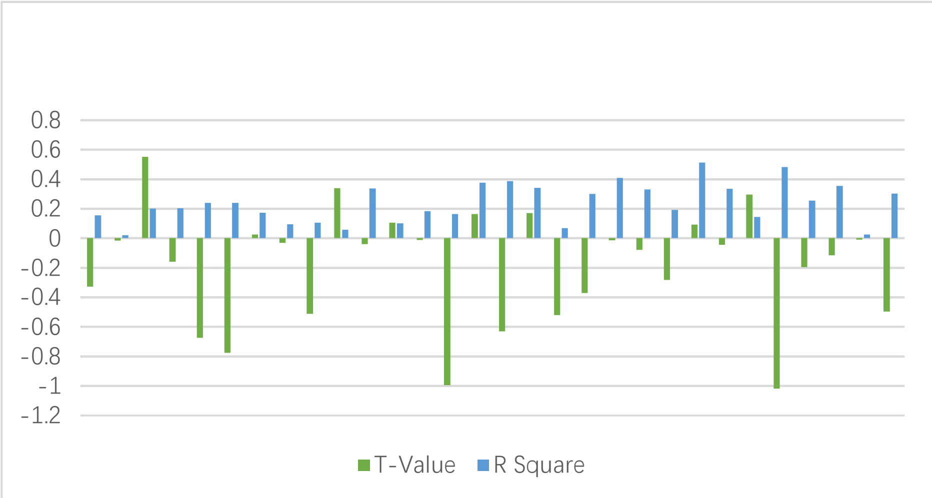
Table 2. R square 2002-2017



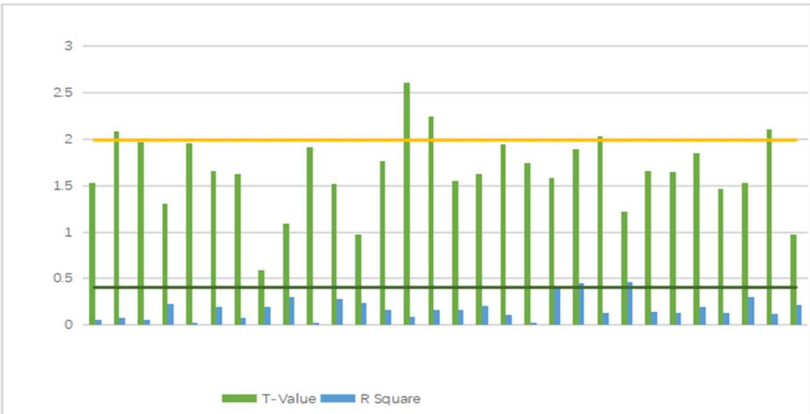
4.2. Sub-sample Tests

Table 3. First period 2002-2009



According to Table 3, the t-value presented by the green of 30 companies is higher than -1.9855 and lower than 1.9855. Thus, H0 is not rejected. However, the same problem with the entire sample test is that its R-squared is relatively low. It implies that this regression model can only explain several variances.

Table 4. Second period 2009-2017



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The yellow line presents T-value equals 1.9855. If the green line, which symbolizes T-value, is over the yellow line, the H0 is rejected. As Table 4 presents above, there are only five companies whose t-values are higher than 1.9855. Thus, they accept H1: α≠0. However, the rest of the 25 companies' data accept H0: α=0. The dark green line represents that R-squared equals 0.4. There are only two companies whose R-squareds are higher than 0.4. The rest of the 28 companies' R-squared is relatively low. Therefore, it cannot be proved that the CAMP is suitable in the market.

4.3. Portfolio Test

Table 5. Two sub-samples of portfolio

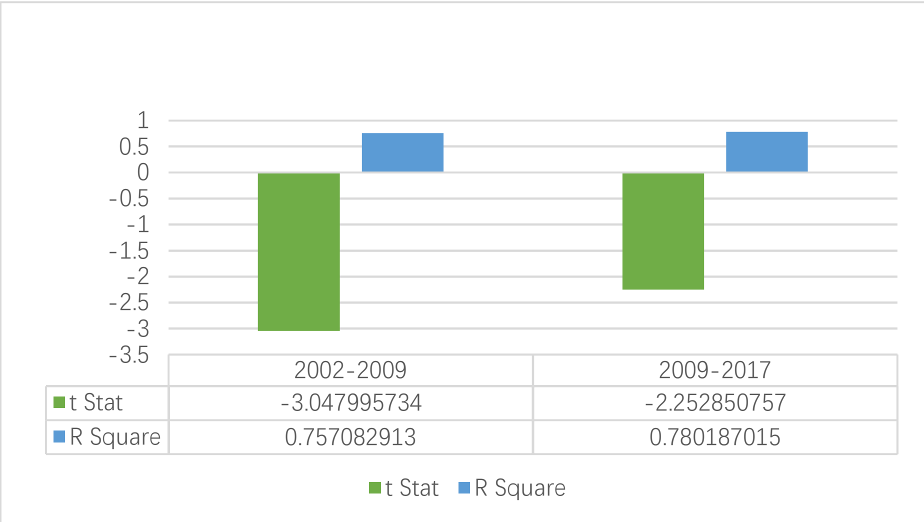

Table 5 shows the results of the period 2002-2009 and the period 2009-2017. The T-stats of them are both below 1.9855(sample size is 96). It implies that the market has a return that the CAPM cannot explain. In addition, the R-squared of them is relatively high, which is close to 0.8. In other words, the explanatory power of this regression model is relatively strong, and most of the variances are not described by this model. Thus, we reject H0: α=0 and accept H1: α≠0. In short, we can have a result that in this part, the CAPM is not suitable for the market.

5. Discussion

The empirical results reveal a split pattern: CAPM appears valid for predicting individual stock returns but inadequate for portfolios. This aligns with prior research showing that market beta is insufficient to capture all priced risks, especially in aggregated portfolios. The high R^2 in portfolio regressions suggests systematic patterns unexplained by the model, possibly due to omitted factors such as size, value, or momentum.

6. Conclusion

This study finds that the Sharpe–Lintner CAPM can be a useful tool for estimating expected returns of individual firms but is unreliable for portfolio-level predictions. Limitations include the small sample size (30 firms) and the focus on a single market. Future research should extend the sample, incorporate global data, and test multi-factor models to better reflect real-world conditions. Despite its shortcomings, CAPM remains a fundamental reference in finance, offering a clear framework for understanding the risk–return trade-off.

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