

## Predictability of Stock Returns

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**Abstract:** Predictability of stock returns has been shown by empirical studies over time. This article collects the most important theories on forecasting stock returns and investigates the factors that affecting behavior of the stocks' prices and the market as a whole. Estimation of the factors and the way of estimation are the key issues of predictability of stock returns.

**Keywords:** Stock Returns, Theories on Stock Returns, Beta in Finance, Empirical Studies

**JEL Classification:** G10, G11

### 1. Introduction

When Markowitz wrote the article Portfolio Selection in 1952 the arguments about possibility of forecasting stock returns and estimating risk factors have started. The article became a basis for many research papers and he won Nobel Prize after almost 40 years writing the article. Sharpe, Lintner, and Mossin independently developed a model which has come to be known CAPM (capital asset pricing model) in 1964, 1965, and 1966 respectively. CAPM was based on Markowitz and it was using the logic of him. The CAPM tried to explain the behavior of stock returns by only one factor which is called beta. However the CAPM was criticized by many economists since implementation of the theory requires lots of data to evaluate. Another point stated by economists that the predicting future by past data is not reasonable. In addition the assumptions in the CAPM like -all investors have the same information, information is costless, and there are no taxes transactions costs- are unrealistic. After the CAPM, the APT (arbitrage pricing theory) was developed which has less restrictive assumptions. There are n-factors that affecting the behavior of the stocks in the APT. These factors are not defined in the APT. Furthermore CAPM and APT are single-period models. Robert Merton claimed that the possibility of uncertain changes affect the investment opportunity set and the demand function which is derived in the CAPM or the APT is not a single-period model. Then he introduced the ICAPM (intertemporal capital asset pricing model) to get multi-period aspects of market. The CCAPM (consumption-oriented capital asset pricing model) was a model that tried to explain and predict the future by the aggregate consumption. It had the same formula with the CAPM and only it differed from introducing consumption beta instead of beta in traditional CAPM.

## 2. Extended description of the Theories and Evidence

It has shown that the predictability of stock returns could be valid by empirical tests. Markowitz developed an idea on stock returns under some assumptions. The basic idea in Markowitz portfolio theory is to allocate optimum investments among different portfolios. His theory is a quantitative tool that allows measure risk and return. An investor wants to maximize returns for a given level of risk or wants to minimize risk for a given level of return.

The curve in the Figure 2 is known as Markowitz efficient frontier and according to Markowitz investors choose the optimum portfolios which lie on this curve. An investor who can bear more risk choose portfolios that are on upper part of the curve and investor who is a risk-averse choose portfolios that are lower part of the curve. It was shown in Markowitz Portfolio selection that the variance of rate of returns is measure of risk of return under some assumptions. The formula developed by Markowitz proved that diversifying portfolio reduces the total risk.

Capital Asset Pricing Model (CAPM) tries to calculate investment risk and it describes the relationship between the risk and expected return of an investment. The formula in CAPM is the equation of SML (Security Market Line).

$R_i$ : rate of a stock return

$R_m$ : rate of market return

$\beta$ :  $\text{cov}(R_i, R_m) / \text{var}(R_m)$

$R_f$ : risk-free rate

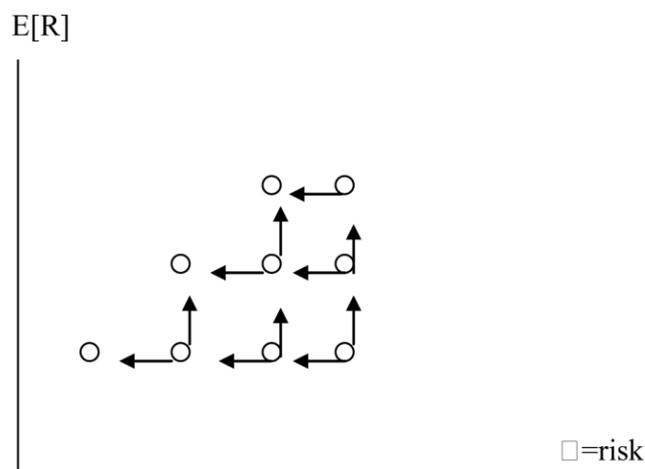
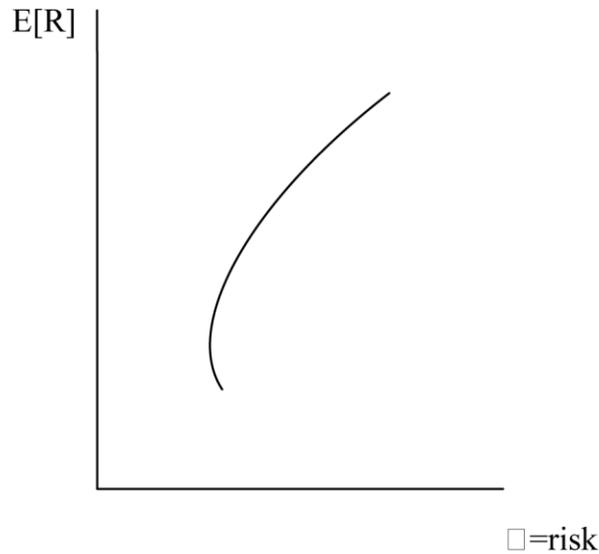


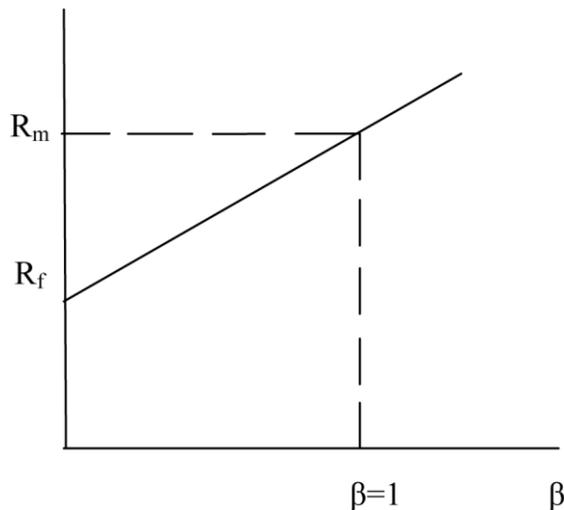
Figure 1: Illustration of investor's behavior under Markowitz's assumption



By using simple math the equation of the line above is found as follow:

$$R_i = R_f + \beta(R_m - R_f)$$

So in CAPM the rate of a stock return is defined as risk-free rate plus product of beta and market risk premium ( $R_m - R_f$ ). CAPM can be used for all stock after estimating beta.



Estimation of beta and market risk premium is the critical point in CAPM. Beta can be calculated as daily, monthly or yearly and all give different betas. Calculation of different time intervals gives also different betas and market risk premium also changes over time. The required estimations can be found after collecting lots of historical data. Predicting future by calculating some past data is sometime not reliable.

The Arbitrage Pricing Theory (APT) takes multiple sources of systematic risks into account. The basic assumption of APT is based on the absence of arbitrage in the market. The returns can be calculated if there is no arbitrage opportunity. Capital markets are perfectly competitive and trend of investors always prefers more wealth to less wealth. APT is less restrictive than CAPM in its assumptions. There is only factor in CAPM but in APT there are n factors which affect the expected rate of return. The APT has advantages in flexibility over the CAPM. Expected rate of return is formulated as follow:

$$E[R]=R_f + b_1f_1+b_2f_2+\dots+b_nf_n$$

$b_k$ : the sensitivity of the stock to the factor  $b_k$

$f_k$ : the risk premium for factor  $k$

It is stated in APT that there are n factors however these factors are not defined and even the number of factors are unknown. However it is reasonable because every stock can have specific effects that affect the return rate. APT does not rely on stock market and it does not deal with measure of the performance of market, instead of market it focuses on factors that affecting price of stock. The factors in APT can be adapted to changes that influence stock price and from this aspect it brings advantages to the user but determining these factors is not easy since it requires great research.

CAPM was one of the most important developments in finance when it was introduced. It became basis of many research papers. However it was started to criticize that it is a single-period model. The Intertemporal CAPM was an alternative for CAPM introduced by Robert Merton which is a multi-period model. Merton claimed that since real interest rate, stock market returns, inflation and therefore investment opportunity set can be changed after that investors may want to hedge risks which they exposure. The demand on hedging causes a change in the asset pricing equation. Merton stated in his model that since the model is based on consumer-investor behavior it must be intertemporal, ICAPM is a linear model to state the shifts of investments over time and predict investment opportunity set. Consumption-Oriented Capital Asset Pricing Model (CCAPM) is an extension of traditional CAPM. CAPM is based on market portfolio's return and it used it to understand behavior of the return rate. In CAPM the prediction of future relies on market portfolio's return. Beta in CAPM measures sensitivity of stock return to the expected market return. CCAPM has the same formula with CAPM only it differs from CAPM by explanation of beta. Beta in CCAPM is defined as follow:

$$\text{Consumption beta } (\beta_c) = \frac{\text{covariance of risky asset and consumption growth}}{\text{covariance of expected market returns and consumption growth}}$$

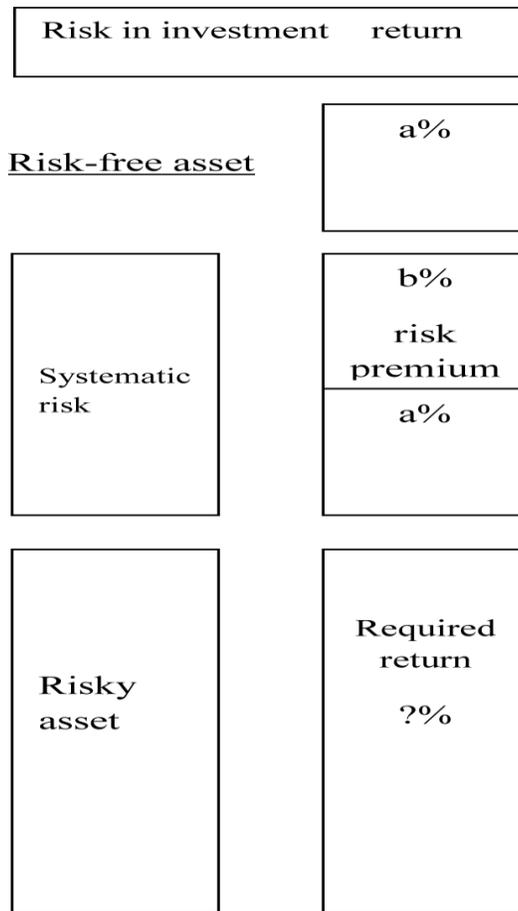


Figure 4: Finding required return in the CAPM as a basic idea

And formula for CCAPM is restated as follow:

$$R_i = R_f + \beta_c(R_m - R_f)$$

$R_i$ = expected return on risky asset i

$R_f$ = implied risk-free rate

$R_m$ = implied expected market return

$\beta_c$ = consumption beta of the risky asset i

The investors' consumption growth and risk aversion determines the expected return of risky asset and the risk premium. The consumption beta defined above provides the systematic risk in CCAPM world. In CCAPM, an asset is more risky if consumption is low or savings are high. The consumption beta can be found by empirical works and statistical methods like finding beta in CAPM. The CCAPM, like CAPM, is based on only one parameter and it has been criticized because of this issue. However the empirical works have shown that there are more than one affect that influence the stock prices and return rates. The empirical works also have shown that the CCAPM's predictions are not supported by those results. The CAPM and CCAPM are trying to explain stock returns based on only one factor. The APT and ICAPM are adding many factors that affecting stock returns but these factors are not stated. Empirical works have shown that after testing CAPM, beta in CAPM can explain 70% of the return in

the market. Eugene Fama and Kenneth French tried to explain the rest of 30% unexplained stock return by expanding capital asset pricing model. Fama and French expand CAPM by adding two more factors in the formula of traditional CAPM. In the empirical works Fama and French found that the two classes of stocks are better than the others. The value stocks have provided much better return than growth stocks that is stocks which have high book to market ratio and the small stocks have provided much better than large stocks in the market as a whole. After adding these two factors in capital asset pricing model the new formula is as follow:

$$R_i = R_f + \beta(R_m - R_f) + b_s * SMB + b_v * HML$$

$R_i$  = expected return rate on risky asset  $i$

$\beta$ : the beta measure the sensitivity of stock return to the expected market return but this beta is not same as beta in capital asset pricing model since in Fama-French 3 factor model there are two more factors added into the formula.

$R_f$  = risk-free interest rate

$R_m$  = expected market return rate

SMB = small market capitalization minus big market capitalization

HML = high book to market ratio minus low

$b_s$  and  $b_v$  = the coefficients of SMB and HML respectively.

These coefficients are determined by linear regression after defining SMB and HML.

It is seen that Fama and French 3 factor model explains 95% of the diversified portfolios returns after testing thousands of random stocks however when the same samples take into consideration the CAPM can explain 70% of the diversified portfolios return.

### 3. Conclusion

In Fama and French 3 factor model there are two additional factors to beta SMB and HML. These two factors cannot be distinguished when they are tested in empirical tests to compare their effects in the behavior of stock prices and expected returns. Even in Fama and French 3 factor model beta has more explanatory power. Beta in traditional CAPM is only explanatory term in the formula. In the APT and ICAPM there are many factors that affect the stock return and market as a whole however beta still exists in factors. Time interval and frequency of evaluating stock return and market return are affecting the beta. When beta is calculated according to monthly stocks the results are not same when stock returns annually are taken into consideration. The way of estimating beta is very important to get an accurate model in stock returns.

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