

An Analysis of Theories on Stock Returns

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Abstract: Objective in writing this article is to provide an overview of the theories that has been developed for stock returns which is an important area of financial markets' researches. Since the researches in this field are very active for the past quarter, it is not possible to describe all works that has been done in this area. Most important researches will be discussed without going deeper in mathematical tools and theories.

Keywords: Stock Returns, Markowitz, CAPM, APT, ICAPM, CCAPM, Fama-French 3-factor Model

1. Introduction

Empirical works have been showing that stock returns are predictable cross-sectional and by time. The discussions about prediction of stock price behavior started with Markowitz (1952) with his article – Portfolio Selection-. Markowitz won Nobel Prize in 1990 for his research about portfolio theory. However he has been criticized by many economists since implementation of the theory requires lots of effort to evaluate data and since he used historical data the prediction may not be accurate. In addition the assumption that stock returns are normally distributed is not true in reality. 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. Beta coefficient is a key parameter in CAPM world. Beta measures risk of an asset in relation to the market such as S&P500 or an alternative factor. Actually the CAPM is a simple model which is based on sound reasoning and some of the assumptions -all investors have the same information, information is costless, and there are no taxes transactions costs- are unrealistic in market. APT (arbitrage pricing theory) presented for a better estimation for stock returns than CAPM. CAPM is a modified theory while APT is a completely different model. APT's multiple factors provide a better indication of asset risk and a better estimate of expected return. There are n-factors effecting stock returns in APT but the number of factors are unknown. Furthermore CAPM and APT are single-period models. To get multi-period aspects of market ICAPM was developed. After that CCAPM (consumption-oriented capital asset pricing model) was introduced. It tried to explain behavior of stock returns by a logical extension of APT.

A long literature exists on prediction of stock market returns. Davis (2001) tried to explain the behavior of stock returns by analyzing a huge literature written in this field. He claimed that value and size factors could explain the behavior of stock returns in US market.

Lewellen (2000) argued in his doctoral thesis that predictability of stock returns is possible like many others. Although predictability of stock returns by using conventional tests is accepted generally by

economists there is no consensus about it. Campbell and Yogo (2006) claimed that the tests used for the predictability of stock returns can be invalid.

2. Theories

2.1. Markowitz Portfolio Selection

Empirical studies in finance show that forecasting stock returns is possible by developing some models. Markowitz – as some people call Einstein of finance- developed an idea on stock returns under some assumptions. Although some assumptions like ‘no taxes’, ‘information is available for everybody and it is costless’, ‘no transaction cost’ do not exist in real world, the tools developed by him allow to measure the 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.

According to Markowitz Portfolio theory 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.

2.2. Capital Asset Pricing Model

Capital Asset Pricing Model (CAPM) is based on Markowitz Portfolio Theory and it describes the relationship between the risk and return of a portfolio. 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

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

R_f : risk-free rate

When beta is equal to zero expected return is equal to risk-free rate (R_f) and when beta is equal to 1 it means that the expected return is equal to market return (R_m). 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 CAPM become very popular and because of the simplicity of the structure of the theory it started to use in many empirical studies. However the simplicity in the structure of the application has been criticized by economists. Breeden (1979) argued that the CAPM theory is based on the relaxed assumptions and he developed expanded CAPM to forecast stock returns. Lewellen (2000) also claimed that CAPM does not describe fully behavior of stock returns.

2.3. Arbitrage Pricing Theory

Arbitrage Pricing Theory (APT) was introduced by Ross (1976). 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. Expected rate of return is formulated as follow:

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

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. Connor and Korajczyk (1993) mentioned the success of APT but they also claimed that there are weakness and gaps in the theory. Furthermore Huberman (2005) argued that APT can be problematic since it is one-period model.

2.4. Intertemporal CAPM

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 (1973) 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. Breeden (1979) criticized the CAPM because of relaxing assumptions in the structure. He developed another model which is actually extension and generalization of Merton's model (1973). Indeed Breeden's model is simpler in the application and more testable than Merton's model.

2.5. Consumption-Oriented the Capital Asset Pricing Model

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:

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

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

β_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.

2.6. Fama and French Three Factor Model

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. Fama and French (1993) analyzed stock and bond returns. They analyzed five factors to explain them. They claimed that the three factors –an overall market factor, firm size and book-to-market equity- explain stock returns. 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 (Fama and French, 1995). 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

β : 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.

3. Conclusion: Estimation of the Parameter Beta in Models

Beta is the only explanatory power in the CAPM and CCAPM. Beta is the only factor that affecting the stock prices and return rates in these models. There are many factors in the models the APT and ICAMP. Fama and French 3-factor model contains three factors which influence the behavior of the return rates however beta is the factor that has the most explanatory power in this model. Estimation of the parameter beta in models is very important to get accuracy in predicting the stock prices and return rates. The chosen time interval causes to get a different beta, and since stock returns can be evaluated daily, weekly, monthly, or annually the chosen frequency also affects the accuracy of beta. Some empirical tests have shown that 3-year time interval and annually evaluated stock returns give better results. Most CAPM tests and the others have focused on cross sectional aspects of data. However the recent researches have shown that investigating the conditional relationship between beta and return gives better estimations under the assumption of time series analysis since beta is not stable over time.

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