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PAPER

# Predict the Ruture Returns of Shares. CAPM vs Multifactor Approach

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**Abstract** The Capital Asset Pricing Model is a milestone of the forecasting process of the company's returns by allowing investors to make a prediction of the returns of their investments. However, this model is based on several assumptions that are deemed to be unrealistic, such as the true market portfolio which is impossible to observe in the financial market, and for this reason financial researchers have tried to find other methods with the purpose to overcome the limits of the Capital Asset Pricing Model. Nowadays the alternatives are the Arbitrage Pricing Theory and the Multifactor Approach. The first one affirms that it is possible to predict the expected returns of a securities by analysing the responsiveness to disparate macro-economic factors. The latter allows to consider other factors which can affect the returns' trend such as the size of the firms, the earnings – price ratio (E/P), the book to market equity ratio (BE/ME) or the cash flow – price ratio (C/P). The main advantage of the Multifactor Approach is that the market portfolio or index is not considered the main source of information, but other accounting features can be introduced in the forecast process of the returns. Nevertheless, it seems impossible to say which is the best models that can explain in a proper way the stocks' returns.

**Keyword** Capital Asset Pricing Model - Arbitrage Pricing Theory - Multifactor Approach
Mean Variance Portfolio - Stock return

**Jel Classification** G11 - G17

The Capital Asset Pricing Model (CAPM) was made public for the first time in 1964 with the aim of creating a model for predicting the future return of an asset in relation to its risk. Of course, this model is based on the investor's choice regarding risky assets and all the possible combinations in order to create an optimal portfolio. The CAPM is rooted in Markowitz (1952), who declares that by matching different risky assets, their risk will not increase because they are not characterised by a positive correlation. By following the Markowitz's research, an investor must create his optimal portfolio by depicting his personal efficient frontier where the investor will allocate his preferred portfolio (Hillier et al., 2012). However, Sharpe (1964) has overtaken the model designed by Markowitz, by stating that the future return on a single stock depends on the return of its financial index and this index can be associated to a portfolio of securities. According to Hillier (2012), unsystematic risk, known as diversified risk, is the risk

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that comes from the portfolio but often it can be defeated by adding securities. On the other hand, the diversified risk is generated by the fluctuations in the financial market and financial operators often define it as market risk (Hillier, 2012). Unfortunately, these components cannot be defeated by diversifying the portfolio (Galagedera, 2007). Moreover, the investor, by combining a risk-free asset with the risky assets will find the optimal portfolio, which is denoted by the tangency point between the Capital Allocation Line with the Efficient Frontiers. In addition, the majority of the investors will choose this portfolio, and by definition, it is known as market portfolio, which embodied all the assets available in the market (Bodie et al., 2014). What is more, the CAPM presumes that all the investors are risk averse and they are worried about the mean and the variance of the return on their investments, and often the investors tend to select the mean-variance efficient portfolio in order to reduce the portfolio's variance and magnify the future expected return (Bodie et al., 2014).

However, in the literature it is possible to find out that other factors can affect the reliability of the CAPM and for this reason other models have been developed, as the Arbitrage Pricing Theory (APT) and the Multifactor Approaches, which are able to intercept other elements which can explain in a better way the returns.

## 1. Assumptions of the CAPM

The CAPM is able to estimate the security's returns in relation to its risk that is measured through its beta (β), and the traditional formula of the model is

$$E(Ri) = Rf + \beta[E(Rm)-Rf]$$

where E(Ri) represents the expected return of one security (i), Rf stand for the risk-free rate, β represent the risk of the security and [E(Rm) – Rf] stand for the difference between the expected return on the market and the risk-free rate.

The CAPM is a hypothetical model and in order to work it needs several assumptions and often they have been deemed as simplification and unreliable. The first assumption is that all investors follow a rational behaviour in their financial choice and the majority of them will choose a mean-variance portfolio (Bodie et al., 2014). This assumption is clear unfounded because their financial choices are often affected by other elements that can alter the final decision. These elements recall another assumption, that is known as single-period horizon (Bodie et al. 2014), because in a short period all the threats are eliminated. Other assumptions are related to the composition of the market, which is characterised by the possibility for the investor to short sell securities, although often there is a lack of available securities for this kind of trading (Bodie et al., 2014). What is more, in the CAPM the market is considered efficient. In the modern financial system operators and investors can access all the available information useful for their business and the stock prices will be a consequence of those information (Brealey et al., 2013). Thus, the market cannot be defeated. However, the real financial world shows that investors cannot access all the information and for this reason securities are traded in the market. This means that the assumption of the homogeneous expectation cannot be respected. On the other hand, the financial market has its own costs, but in CAPM taxes and costs due to the financial transaction are excluded (Bodie et al., 2014). Finally, it is known that the CAPM uses an index portfolio as benchmark, and the assumption is that this represents the true portfolio, which is mean variance. This hypothesis has been the subject of a severe critique by Roll (1977) which precisely criticises the fact that the actual portfolio is not observable.

### *1.1 Criticisms against the CAPM*

According to Roll (1977) the CAPM can be tested only if the market portfolio corresponds with the mean-variance portfolio. Moreover, it is known that the CAPM function is a linear function and the future returns of a security are dependent on the market portfolio, which must be efficient (Roll, 1977). What is more, Roll (1977) affirms that the CAPM can be tested if and only if the market portfolio is visible because by definition the market portfolio should include all the securities which are possible to trade within the market. However, in the reality as component of the testing measurement it is possible to use only a proxy because of the difficulties in having the true market portfolio. Furthermore, the CAPM, to be tested, must respect other two important assumptions such as all the investors must be characterised by homogeneous expectations and the market portfolio must be efficient (Roll, 1977). A model without this two characteristic cannot be verified (Roll, 1977). From this point of view, the CAPM is a hypothetical model and Roll (1977) emphasises the physical limitation that in the real financial world it is often impossible to create a true market portfolio, thus testing the CAPM can produce untrustworthy outcomes.

The severe critique made by Roll (1977) is an important milestone of the CAPM theory. However, Brown and Brown (1987) affirms that by creating different portfolios what makes the difference is the relevance and the quality of each elements by obtaining a good approximation of the future returns.

By reviewing the literature, financial researchers have discovered the presence of other factors which can affect the security returns. For instance, Basu (1977) discovers that exist a relation between the returns' risk and the price-earnings ratios, thus the financial market is not completely efficient.

On the same wave, Banz (1981), by analysing twenty-five portfolios of common stocks in the NYSE and the returns during the years 1936 – 1975, discovers that small companies have returns' risk that is higher than the common stock which include big companies. It seems to be that there are other elements that affect the returns. The result is that the CAPM is unable to predict the large returns that the small companies earned and what is more, there is no relation with their risk. In this case the size of the company can be considered as an additional factor that affect companies returns (Banz, 1981). The main limitation of this research is that there is a lack in the theory in order to define this effect, and it is almost impossible to declare whether the size effect should be considered as real effect or a proxy (Banz, 1981).

Yonezowa and Hin (1992) have also questioned why the CAPM is not an effective method in order to predict the returns by analysing stocks that are traded in the Japanese Tokyo Stock Exchange from January 1952 to December 1986. Several critics are made regarding the nonexistence of the market portfolio in accordance with the characteristics of the Japanese investors that often tend to reduce portfolio diversification (Yonezowa and Hin, 1992).

### 1.2 Enhancement of the CAPM. The Arbitrage Pricing Theory

The CAPM is rooted on several unrealistic assumptions which make this model sometimes too stiff and uncorrelated with the real financial world, because of the presence of other factors that can affect the fluctuation of the asset's returns. It seems to be unrealistic that the returns depend only on its sensitivity to the market portfolio.

An extension of the CAPM can be represented by the Arbitrage Pricing Theory (APT), created by Ross (1976), who affirms that it is possible to predict the expected returns of a securities by analysing the responsiveness to disparate macro-economic factors. What is more, the considered portfolio must contain heterogeneous securities in order to maximise its diversification power for the purpose of eliminating the company specific risk (Ross, 1976). In addition, the APT

requires that the stock market has to be efficient in order to avoid any opportunity of arbitrage, based on the law of one price, and the tradable securities are almost infinite in quantity (Bodie et al., 2014 - Ross, 1976). An advantage of the APT is that it is created by considering only a portfolio that is well diversified and not the true market portfolio (Bodie et al., 2014), and for this reason it is possible to use different indexes. Moreover, by using a well-diversified portfolio, all the investors can have the opportunity to overtake any possibility of arbitrage opportunity and it seems possible to leave out residual risks because of the diversification (Bodie et al., 2014).

### *1.3 APT and CAPM*

In the APT, what is more important for the operators is that the factors are unveiled and valuated in a proper way. However, as every theoretical model there is some limitations that obstruct the practical application, such as the incalculable quantity of securities and the observable factors that can alter the returns.

However, as stated by Connor (1984) it is possible to delete the assumption of the infinite number of securities because if the market is competitive and in equilibrium the relationship between price and nature of the factors has no effect on a proper constructed market portfolio. This statement has been confirmed by Chen and Ingersoll (1993), by analysing the fact that an optimal portfolio could exist and could be chosen by investors that want to maximize their utility. Moreover, the APT approach can be enhanced and it seems to be possible to reach an alternative model which overcomes the necessary assumptions of the proper diversification of the portfolio by adding, as a new factor, the market portfolio itself, in order to find a true relationship between asset and prices (Wei, 1988). As demonstrate by Wei (1988), often it is possible to remove some factors from the APT model, which have an explanation power of the assets' returns, and the final findings is that by following these procedures the theory collapses into the CAPM. Another observation of Wei (1988) is that the market portfolio, and its relevance in the asset pricing model depends on the quantity of the factors that can be excluded and that the APT is an approximation. Finally, as showed by Wei (1988) by combining together the research of Connor (1984) and Ross (1976), it is possible to obtain a new model, that include as an additional factor the market portfolio, as an alternative true asset-pricing connection.

At the first look CAPM and APT seems to be two parallel worlds with nothing in common because one of the aim of the CAPM is to minimize the specific risk of the firm and on the other hand APT tries to leave out part of the systematic risk. However, Khan and Sun (1997) try to study whether exist a model that allows to combine the CAPM and APT. As stated by Khan and Sun (1997), one way could be by investigating the market risks and the main risks come out by planning the market portfolio. Nevertheless, this approach often can be limited because by applying the APT in the real world is almost impossible to remove all the risks linked to the firms as well as the correlation between the market factors (Khan and Sun, 1997). A way to overcome these limits it seems to be the creation of a model that contains internal factors, generated from the returns (Khan and Sun, 1997). The aim of this model is to identify a formula that focuses its attention on the different factors which affect the financial environment, but the main limit is that there is no practical demonstration (Khan and Sun, 1997).

An empirical work on the APT and CAPM has been conducted by Ostermark (1990) in order to understand which is the best model between APT and CAPM to predict the returns of the Finnish market and Swedish as well. Ostermark (1990) uses daily data from the Helsinki Stock Exchange from February 1970 to December 1987, and from Stockholm Stock Exchange from 1977 to 1987, by creating twelve portfolios. Overall, in these specific markets, the APT can explain and predict in a better way the stock's returns than the CAPM, but CAPM works better in the Swedish market, describing almost 50% of the returns (Ostermerk,1990).

### *1.4 Multifactor Approach*

The APT is based on the fact that the future returns of security are predictable by looking at only one factor, but in the real world the returns can be altered by several factors. Thus, the APT can be enhanced by adding different factors that are part of the business life, but the trouble is to identify them. The well-known model used is the Fama-French three factors model that consider three main factors in order to explain the stock returns (Bodie et al., 2014). The main advantage of this model, but in general of the multifactor approach, is that the market index is not considered as the main source of information and each factor is characterised by a specific beta (Bodie et al., 2014). The three factors model created by Fama and French (1992) considers as important elements the size of the company and the book to market ratio.

As described by Fama and French (1996), by reviewing the literature it seems to be that other factors can affect the returns' trend such as the size of the firms, the earnings – price ratio (E/P), the book to market equity (BE/ME) or the cash flow – price ratio (C/P). Moreover, the model described in Fama and French (1993) is able to understand the relationship between the above factors and the expected returns. The formula that discloses the relationship between the expected returns and the three factor model is

$$E(Ri) - Rf = bi * [E(Rm) - Rf] + Si*E(SMB) + Hi*E(HML)$$

where E(Ri) -Rf represents the future return of the portfolio less the risk-free rate, SMB stand for return of the portfolio formed by small stocks less portfolio made by large stocks, HML stand for the return of a portfolio characterised by high book to market stocks less portfolio with low book to market stocks and finally bi, Si and Hi represent the incline of the regression model (Fama and French, 1996). The main advantage of the Fama and French's (1996) model, by analysing twenty-five portfolios constructed on NASDAQ, AMEX and NYSE, is that it is possible to forecast the portfolios' returns which are constructed by including the size of the firms and their book to market equity ratio as well. Moreover, the model is able to depict the trend of portfolios' return characterised by E/P ratio, C/P ratio and expansion of sales as demonstrated by Lakonishok et al. (1994).

The three factors, which characterise the Fama and French three factors model, have been used in order to test the relationship between the Southwest Airlines' returns, calculated from monthly prices1 (28th February 1973 - 30th September 2015), with the model. The analysis considers a multiple regression model to understand whether the explanatory variables, Rm-Rf, SMB and HML2, can explain the company's returns.

The regression model between the Southwest's returns (Ysa) and the three factors is represented as:

$$Ysa = \beta1+\beta2(RmRf) + \beta3(SMB) + \beta4(HML) + \varepsilon$$

under the null hypothesis that $\beta2=\beta3=\beta4=0$. It is observable that all the factors have a small P-value, which means the null must be reject at significance level of 0.05, so they have an explanatory power of the Southwest's return. Moreover, the P-value of the F-statistic, which describe the overall regression model, is extremely low, and this is consistent with the low P-value of the factors. What is more, it is possible to analyse the value of $R^2$ and adjusted-$R^2$, which tell that 23.58% and 23.13% of returns'change is explained by the three factors. By rejecting the null at least one beta is different from zero, observing a joint effect of the explanatory variables. The regression model between Southwest's returns and each factor shows that HML has no explenatory power (Appendix – Table 3).

1 Data obtained from Datastream

2 Data available from the K. R. French data library website

**Table 1 Coefficient of the regression model between Southwest' returns and all the factors**

| | Estimate | Std. Error | T value | P-value |
|---|---|---|---|---|
| **Intercept** | 0.80968 | 0.42420 | 1.909 | 0.05686 |
| **RmRf** | 1.05969 | 0.09677 | 10.950 | <2e-16 |
| **SMB** | 0.40583 | 0.14909 | 2.722 | 0.00671 |
| **HML** | 0.37190 | 0.12572 | 2.958 | 0.00324 |
| | | | | |
| **$R^2$** | 0.2358 | | | |
| **Adjusted $R^2$** | 0.2313 | | | |
| **F-statistic** | | | | <2.2e-16 |

Note: Data obtained by using the statistical program R-studio

However, the three factors model has some limits and the main one is that this model is not able to describe returns of all portfolios. In an implicitly way it seems to recognise the Roll's (1977) critique of the CAPM where the true market portfolio does not exist. In addition, this model is not able to explain the returns generated in the short-terms because of the reasonless behaviour that investors assume in the short-term (Fama and French, 1996).

An evolution of the three factors model is used by Lam et al. (2010) by analysing the Hong Kong stock market and by using a four factor model which is based on the Fama-French three factors model plus a fourth factor that is the momentum, which declares that a company with good past performance will continue to have high performance in the near future. Moreover, Lam et al. (2010) investigate the security market from July 1981 to June 2001, regarding 689 companies which are part of the Hong Kong Stock Exchange, by creating twenty-five portfolios. According to Lam et al. (2010), this model is still valid during strong fluctuation of the market place. For this specific case the four factors model is a good financial tool.

A really new and innovative approach is the five factors model of Fama and French (2014) which is based on the previous three factors model enhanced by the factors RMW, which represents returns of mixed portfolio composed by stock with strong profitability, and CMA, which expresses the relation among stocks of weak and strong attitude of firms to invest. Although not perfect, this model can predict around 71% and 94% of the trend of the future returns (Fama and French, 2014).

### *1.5 Other empirical research on the multifactor approach*

Often the real financial world and investors' behaviour do not allow the CAPM to work in a proper way, due to the different ways in which the investors can react to the announcement of good or bad financial information (Lakonishok et al., 1993). For a good approximation of returns in presence of risk the best alternative is to use the multifactor approach because it allows to consider and add several parameters useful for detecting which are the factors that can explain in a better way the stock returns. The first step in order to decide about the goodness of a model is to detect the economic conditions, after that it is possible to decide which is the best model (Mackinlay, 1994).

A recent research, conducted by Bertholdy and Peare (2004), compares the performance of the CAPM and the Fama-French three factors model and discovers that for an individual stock the CAPM can forecast only 3% of the returns. Conversely, in this specific case, the three factors model can achieve the 5% of forecast of the return of the underlying stock (Bertholdy and Peare,

2004). The result is obtained by analysing the daily prices between the years 1970 – 1996 from the Center for the Research in Security Prices (CRSP), and are considered only stocks that have been traded more than 96% of the period in question (Bertholdy and Peare, 2004). Moreover, Bertholdy and Peare (2004) focus their attention on six likely market portfolios, by choosing four from CRSP, Standard and Poor's Composite Index, Morgan Stanley Capital World Index and Economy Index.
An additional prove that the CAPM is not a proper method in order to predict the stock returns come up from Gonzàles (2001) that analyses the stock market of the capital city of Venezuela, by detecting eight different portfolios during the year 1992 - 1998. The final result reports that for the Caracas Stock Exchange the CAPM is not a good tool because of the nature of developing country of Venezuela, thus the stock market is not well constructed and also because it is affected by the trend of the oil price (Gonzàles, 2001).

## Conclusion

To sum up, this article analyses the main characteristics and limitations of the CAPM trying to understand how the APT and Multifactor Approach can help this model in predicting securities' returns. Although several researchers have criticized the goodness of the CAPM and its assumptions, often deemed to be unrealistic and unreliable, by analysing the literature it seems that it is often difficult to find a model that can predict the returns but it is clear that the Multifactor Approach is able to depict in a more reliable way the future stock's returns. The APT also has limitations such as the incalculable quantity of securities and the observable factors that can alter the returns' trend. Often, the latter are unknown and difficult to predict in advance. In addition, the limit of infinite number of securities can be defeated by making the market as efficient as possible. On the other hand, the main advantage of the Multifactor Approach is that the market portfolio or index is not considered the main source of information any more, but other accounting features can be introduced in the forecast process of the returns. Like any model, even the Multifactor Approach has some limits and the main one is that this model is less reliable in the short-terms because of the reasonless investors' behaviour. Evolutions of the three factors model are described by Lam et al. (2010), who adds the momentum effect. It does not seem possible to give an indisputable conclusion on the poor quality of the CAPM and this area is still field of study, as demonstrate by the recent research of Fama and French (2014) but it is possible to say that other models can explain in a better way the stocks' returns.

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## APPENDIX

### Fitting regression model between Southwest Airlines returns and each factor

By fitting the regression model between the company's return and each single factor, under the null hypothesis that the beta of each factor is equal to zero, at significance level of 0.05 the null hypothesis is rejected because the explanatory variables, RmRf and SMB report a P-value of <2e-16 and 1.09e-07 respectively. Thus, the two factors have an explanatory power of the company's returns. Moreover, by looking at the value of R2, RmRf and SMB can explain 21.32% and 5.237% of the changes in the Southwest' returns respectively. However, the HML factors records a high P-value of 0.62423 and in this case, at a significance level of 0.05 the null hypothesis must not be rejected, thus the HML factor has no explenatory power. In addition it is observable that the value of its R2 is extremely low, reaching the figure of 0.04718%.

**Table 1 Coefficient of the regression model between Southwest' returns and RmRf**

| | Estimate | Std. Error | T value | P-value |
|---|---|---|---|---|
| **Intercept** | 0.99678 | 0.42649 | 2.337 | 0.0198 |
| **RmRf** | 1.08719 | 0.09256 | 11.745 | <2e-16 |

Note: The result are obtained by running a regrassion model between the Southwest's returns and RmRf. The R2 of the model is 0.2132, meaning that 21.32% of the changes in Southwest' returns are explained by the RmRf. The null hypotesis Ho: β=0 is rejected because P-value is less than 0.05 significance level.

**Table 2 Coefficient of the regression model between Southwest' returns and SMB**

| | Estimate | Std. Error | T value | P-value |
|---|---|---|---|---|
| **Intercept** | 1.3820 | 0.4664 | 2.963 | 0.00319 |
| **SMB** | 0.8368 | 0.1578 | 5.304 | 1.09e-07 |

Note: These outputs are obtained by running a regrassion model between the Southwest's returns and SMB. The R2 of the model is 0.05237, which indicates that 5.237% of the changes in Southwest' returns are explained by SMB. The null hypotesis Ho: β=0 is rejected because P-value is less than 0.05 significance level.

**Table 3 Coefficient of the regression model between Southwest' returns and HML**

| | Estimate | Std. Error | T value | P-value |
|---|---|---|---|---|
| **Intercept** | 1.55848 | 0.47916 | 3.252 | 0.00122 |
| **HML** | 0.06896 | 0.14068 | 0.490 | 0.62423 |

Note: These figures are obtained by running a regrassion model between the Southwest's returns and HML. The value of R2 is 0.0004718, which means that 0.04718% of the changes in Southwest' returns are explained by HML. The null hypotesis Ho: β=0 is not rejected because P-value is higher than 0.05 significance level.