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# The effect of market conditions on the ability of the capital asset pricing model "CAPM" to explain the change in stock returns

Dr.AsaranGalalAsaran
*Philosophy Doctor Degree in Commercial Sciences, Business Administration,Menoufia University, Egypt*
*Instructor in Egyptian Banking Institute*
*Certified Lecture at Bank Misr*

***Abstract***
*The purpose of this study is to determine the effect of the stock market conditions, at different estimation periods for capital asset pricing model (CAPM) variables, on the ability of the CAPM to explain the change in stock returns, applied to the Egyptian stock market.*
*Where the researcher assumes that the different levels of market return (low - high) may affect the ability of the capital asset pricing model to explain the change in the stock returns. Especially most of the literary reviews of the capital asset pricing model were not exposed to the conditions of measuring the returns. That is the approach of the present study was to test the theory of capital asset pricing model at a different level of market return at a different basis of estimation periods of capital asset pricing model variables (6,12 months).*
*Because the Egyptian stock market is one of the emerging markets, the study of CAPM ability, to predict stock returns at a different level of market return (low - high) is critical.*
*This study is based on a different approach represented in testing the ability of the capital asset pricing model to explain the change in the stock returns according to a different level of the market return.*
*The EGX30 index was used as the most important indicator to measure the market index. 70% of the strongest stocks within the index were selected for the study tests during the period from 01/01/2009 to 31/03/2015.*
***Keywords:*** *Capital Asset Pricing Model (CAPM); Market returns; stocks expected returns; risk-free rate; systematic risk; Stock Exchange.*

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## I. Introduction

The capital market plays an important role in the development of an economy and is an essential part of financial system. In the capital market, the way securities are priced is the core issue and it has attracted the attention of researchers for long. The risk-return relationship performs a central role in the pricing of securities consequently helps in making judicious investment decision making. The capital asset pricing model (CAPM) of Sharpe (1964)[[25]], Lintner (1965)[[19]], and Mossin (1968) [[21]] marks the birth of asset pricing theory.

In the development of the asset pricing model, it is assumed that (a) All investors are single period risk-averse and prefer maximization of utility of terminal wealth. (b)They can choose portfolios solely based on mean and variance. (c)There are no taxes or transaction costs.(d) All investors have homogeneous views regarding the parameters of the joint probability distribution of all security returns. (e) All investors can borrow and lend at a given risk-less rate of interest. (Kapil and Sakshi, 2010) [[17]], Josipa D., and A. Zdravka (2013) [[16]].

CAPM has been widely used in asset pricing and risk management for its simplicity and handiness in measuring the systematic risk of a portfolio of stocks (Ryu, 2011) [[22]]. The capital asset pricing model (CAPM) describes the relationship between return and risk and is used extensively in describing how capital assets are priced, finding out how to choose stocks and building portfolios. (Strong, 1993) [[26]]

Some studies have criticized the capital asset pricing model, as the relationship between return and risk, in theory, does not explain the extent of the risk impact on return. Also, the extent of the risk effect on the return may exist in a period and does not exist in another. Nor does it mean that high systemic risk means a high rate of return. (Michailidis G., et al., 2006) [[20]]

This study attempts to present the effect of the market conditions (low-high level of market return), at different estimation periods for capital asset pricing model variables, on the ability of the CAPM to explain the change in stock returns during the years 2009-2015. Applying to the Egyptian stock market. The study is organized into four parts. Part 1 is the introduction; part 2 is an overview of the CAPM and effect of market return; part 3 deals with objectives, hypotheses, methodology, and data; part 4 focuses on the analysis of the results; part 5 presents the summary and conclusions.

This study aims to answer the following questions:

Does the CAPM capability differ in the interpretation of the change in stock returns when the stock market condition varies?

What are the determinants that explain the change in the stock returns, at different levels of market returns (low – high)?

What are the discriminate determinants that separate between low and high return differentials at different levels of market returns?

## II. Research Methodology

### 2-1 Study hypotheses

$H_1$:There is a significant positive effect of the level of market returns and the capability of the CAPM model to explain the change in the stocks returns differentials.

$H_2$: There is a difference in significant determinants that explain the change in the stock returns differentials when levels of market returns vary**.**

$H_3$:The discriminate determinants that separate between low and high return differentials are different when levels of market returns vary**.**

### 2-2 Methodology

The methodology of the study can be presented through the following points:

- Estimate the expected return according to the capital asset pricing model, based on the following equation:

Where:
$R_i$ is the expected rate of return on asset i
$B_i$ is the beta of stock i.
$R_m$ is the rate of return on the market portfolio
$R_f$ is the risk-free rate

The averages of CAPM model components (risk-free rate, beta coefficient, the market rate of return) were calculated using averages (6, 12 months) during the period from 01/01/2009 to 31/03/2015. The expected rate of return on asset *i* according to the CAPM $R^*_{i(t,v)}$ will be calculated according to the equation:

$$R^*_{i(t,v)} = R_{f(t,v)} + B_{i(t,v)}\left(R_{m(t,v)} - R_{f(t,v)}\right)$$

*t=1, 2, 3, ..., n*

v = average period calculation =6,12 months

- The average of actual return $R_{i(t,v)}$ data was calculated on an average basis (6,12months) during the period from 01/01/2009 to 31/03/2015.
- The average of market return levels data was calculated on an average basis (6, 12 months) the period from 01/01/2009 to 31/03/2015and divided into two groups: the first includes the lower 25% of the data, the second include the higher 25% of the data.
- CAPM ability to explain the change in stocks returns differentials (expected according to CAPM $R^*_{i(t,v)}$ and the actual return $R_{i(t,v)}$.will be tested according to the levels of market return (low –high) using the following function :

- Perform a multiple regression analysis of the CAPM model, where the stocks return differentials will be a dependent variable, the determinants of the CAPM model will be independent variables. To determine the significant variables and their explanatory power, according to the levels of market return (low- high), according to the time basis for calculating the model variables (6,12 months).
- Using discriminant analysis by Z-score models, applying the significant determinants of the CAPM regression model, according to the levels of market returns (low- high), according to the time basis for calculating the model variables (6,12 months).In order to identifythe determinants ofdiscrimination that separate low and high returns differentials.

**2-3 Data**

The data used in the study can be presented as follows:

- Data selection:

The study uses daily-adjusted closing stock prices for the important companies within the economic sectors of the EGX30 index listed on the Egyptian Stock Exchange for the period of January 2009 to March 2015 with a total of 75 months. This period has witnessed the events of the Egyptian revolution and before and after the revolution, which affected the economic environment, the levels of the stock market return. The researcher thinks that this period is suitable to study the impact of the levels of market return on the ability of the CAPM model to explain the change in stock returns.

The Egyptian Exchange has launched its main index EGX30 on 1 February 2003. The index includes the top 30 companies in terms of Liquidity and activity. The Index is weighted by market capitalization and adjusted by the free float. EGX30 avoids concentration on one industry and therefore has a good representation of various industries/sectors in the economy. The daily closing values of the EGX30Index are used as a proxy for the market portfolio.

Furthermore, the yield on 91-days treasury bills of the government of Egypt is incorporated as a risk-free return.

The following companies that came out of the EGX30 index and the date of exit, which were excluded from the study sample:

Egyptian Company for Mobile Services (MobiNil) in 18/10/2009, Qatar National Bank Alahly in 31/01/2013,Al Baraka Bank Egypt in 31/01/2012, United Housing & Development in 31/07/2014,El Kahera Housing in 31/07/2014, National Real Estate Bank for Development in 31/07/2013, Orascom Construction Industries (OCI) in 31/07/2013, Arab Moltaka Investmentsin 31/01/2012,El Ahli Investment and Development in 29/07/2010,Raya Holding For Technology And Communications in 31/07/2013,Remco for Touristic Villages Construction in 31/07/2014,Egyptian Media Production City in 27/01/2011.

The following companies that listed in the index, were excluded because of their inclusion in the index late dates of the study period.

Arab Real Estate Investment CO.-ALICO in 02/02/2014, El Shams Housing & Urbanization in 03/02/2013, Egyptians Housing Development & Reconstruction in 01/02/2015, Medinet Nasr Housing in 02/02/2014, Heliopolis Housing in 03/02/2013, Egyptian Abroad for Investment & Development in 03/08/2014, GB AUTO in 01/08/2013, Prime Holding in 30/08/2014, Belton Financial Holding in 01/02/2015, El Wadi Co. For Touristic Investment on 02/02/2014.

The following Table 1 shows the companies, the sector of the company, the company weight/sector weight, the company weight within the index EGX30.

- The sample data calculation:

− Collect daily closing prices for stocks within the EGX30 index.

− The daily stocks return, and market returns calculated by using the natural logarithm according to the equation: $r_t = Ln(\, r_t / r_{t-1})$

− Calculate the systematic risk (Beta), market return, market risk per month, for stocks within the EGX30 index. As well as the monthly risk-free return of Egyptian Treasury bills 91 days.

− Calculate the monthly average of market return, beta coefficient, risk-free return on a time basis 6,12 months according to the following equations:

According to time base = 6 months $t_n \frac{\sum_{n-6}^{n-1} t}{6}$

According to time base = 12 months $t_n \frac{\sum_{n-12}^{n-1} t}{12}$

− Calculate the monthly average expected return based on the CAPM model according to a previous time basis.

− Calculate the monthly average actual return, market risk according to a previous time basis.

− Levels of Market returns data is divided into two groups; the first includes the higher 25% of the average monthly market returns according to previous time basis, the second includes the lower 25% of the average monthly market returns according to a previous time basis.

− Returns differentials (expected according to CAPM $R^*_{i(t,v)}$and the actual return$R_{i(t,v)}$ data is divided into two groups; the first include the higher 25% of the average monthly Returns differentials according to

previous time basis, the second include the lower 25% of the average monthly Returns differentials according to previous time basis.To apply the discriminant analysis by Z-score models, according to the significant determinants of the CAPM regression model.

**Table 1:The companies, the sector, the company weight / sector weight, and the company weight within the index EGX30.**

| Company Name | Sector Category | (Weight / sector) % | Weight for the Egx30 index |
|---|---|---|---|
| Egyptian Kuwaiti Holding | Financial services (excluding banks) | 13.61% | 1.94% |
| Global Telecom Holding | Telecommunication | 40.90% | 3.07% |
| Amer Group Holding | Financial services (excluding banks) | 12.00% | 1.71% |
| TM G Holding | Real state | 39.45% | 7.98% |
| Citadel Capital - Common Shares | Financial services (excluding banks) | 14.21% | 2.03% |
| Egyptian for Tourism Resorts | Travel & Leisure | 53.59% | 0.83% |
| Orascom Telecom Media and Technology Holding | Telecommunication | 21.92% | 1.65% |
| Commercial International Bank (Egypt) | Banks | 86.18% | 35.75% |
| Egyptian Financial Group-Hermes Holding Company | Financial services (excluding banks | 32.34% | 4.62% |
| Palm Hills Development Company | Real state | 13.46% | 2.72% |
| Pioneers Holding | Financial services (excluding banks) | 10.30% | 1.47% |
| Six of October Development & Investment (SODIC) | Real state | 11.98% | 2.42% |
| Telecom Egypt | Telecommunication | 32.11% | 2.41% |
| Total | | | 68.61% |

## III. Literature Review

### 3-1 An overview of the CAPM and effect of market return

The Capital Asset Pricing Model (CAPM) of Sharpe (1964) [[25]] and Lintner (1965) [[19]] remains a benchmark asset pricing models in the academic literature.According to (Brown P. and Walter T., 2013) [[3]] CAPM, which is fundamentally an extant concept, is used widely by corporations in their forward-looking capital budgeting and capital structure decisions, and by academics when considering adjustments for differences in risk. According to(Del, V.,2014) [[6]] CAPM has been widely recognized as one of the cornerstones of modern finance. While it originated from expected utility (EU) theory, in the past few years its robustness progressively came to light. Notably, CAPM is a suitable basis also under different choice paradigms.

According to the CAPM, the risk of an asset is measured by "beta" which is the covariance between the asset's return and the return on the market portfolio per unit of variance for the market return. Capital Asset Pricing Model (CAPM), the expected excess return on a portfolio of assets over a risk-free rate depends on a simple measure of the portfolio's risk relative to the market portfolio:

$$E[r_{i,t}] = B_i E[r_{m,t}]$$

Where $r_{i,t}$ is the return for portfolio i in excess of the risk-free return, $r_{m,t}$ is the market return in excess of the risk-free return, and $B_i$ is the measure of the portfolio's risk" beta", defined as

$$B_i = \frac{cov(r_{i,t}, r_{m,t})}{var(r_m)}$$

According to (Roll R., 1977) [[22]] using a proxy for the market portfolio has two difficulties. First, the proxy might be mean-variance efficient even when the true market portfolio is not. Alternatively, the proxy might be inefficient, and cannot be used to test the efficiency of the true market portfolio. Toshiki H. (2013) [[27]] the study showed that the market portfolio is not efficient and moreover, not profitable. The empirical support for CAPM in the Japanese market is weak. There is evidence to suggest past return data contains useful information.

Bruner F., et al. (2008) [[4]] the study showed that the choice of the market portfolio is much more important for emerging market stocks than for developed market stocks.

Several previous studies have tested the "beta" relationship with expected return, (Diabi&Azzamil, 1995) [[5][7]] study found no significant relationship between systematic risk (beta) and expected return. Study (Jagannuathan&Wange, 1996) [[15]] examined the relationship between systemic risk (beta) and expected return on the NYSE & AMEX stock market during the period 1963-1990, based on the monthly revenue data and beta estimate according to the data of 24 months - 60 months. The results indicated that there was no significant relationship between the beta and the expected return. Study (Fama& French, 1996) [[9]] was applied to the New York Stock Exchange from 1928 to 1993 using monthly and annual data. The shares were divided into 10 portfolios according to beta values and their ranking from the smallest to the largest, study found a high average annual return with high beta, which means that the difference in the study period and the time basis for calculating the return may lead to different results. (Grauer, 1999 [[12]] (The study found the beta relationship between beta and expected return varies according to the method used in the test. (Daniel et. al,2001) [[4]] the study that tested the results of the Fama&french 1992 [[9]] study applied in US stock exchanges NYSE, AMEX, NASDAQ which showed no significant relationship between beta and expected return. While the Daniel study conducted on the Tokyo Stock Exchange in Japan indicated a positive relationship between beta and expected return, with no clear direction of the relationship. (Anter, 2003) [[1]] the study examined the effect of systemic risk on the performance of the Egyptian securities portfolio during the period from December 1995 to June 2002 for 20 Egyptian investments. The results showed no significant relationship between the systematic risks and the performance of investment funds' portfolios.

Sembiring f., et al. (2016) [23] the study showed that the CAPM model can explain the return of winners and losers, indicated by a positive and significant beta value which explains that the excess return of market affects positively to the return of winners and losers. The beta of winners found greater than losers while yield found lower. The result indicated that in market overreaction conditions, a portfolio with a higher beta yield lower return and a portfolio with a lower beta yield higher return.

Džaja J. and Aljinović Z. (2013) [8] the study showed that CAPM is not adequate for assessing the capital assets on observed Central and Southeastern European emerging markets.

**3-2 Some studies have tested the effect of the market return on stock returns, the results of these studies can be presented as follows:**

(Asaran G.,2014) [[2]] study, which tested a proposed model for the determinants of the performance and risks of investment funds, applying to 39 Egyptian investment funds during the period from the beginning of 2000 until the end of 2009. The results of the study showed that high market returns are one of the determinants of the performance of Egyptian investment funds according to the low systemic risk, while high and low market returns are determinants of the performance of Egyptian investment funds according to high systemic risk.

The study also showed that high and low market returns are determinants of the performance of Egyptian investment funds according to their high performance.

(Gregory M.,and Shapiro M. 1986) [[13]]The study showed that in periods of market decline, it can increase the ability to interpret stock returns deviation for small stocks by size, and vice versa in the market rise.

(Farrell, 1997) [[11]] The study showed that fund managers are increasing the beta value of the fund's portfolio when the market is expected to rise and vice versa when it is expected to decline.

This study presents a new scientific contribution, as it determines the effect of the stock market conditions (low-high) market return, at different estimation periods for capital asset pricing model (CAPM) variables (6-12 month), on the ability of the CAPM to explain the change in stock returns.

## IV. Results and Discussion

This section will study the Capability of the CAPM model to explain the change in the stock return, according to the levels of market returns. During different periods to estimate CAPM model variables (6,12months).

The results of the analysis will be divided into two groups, the first according to a 6-month basis to estimate the CAPM model variables. Second according to a 12-months basis to estimate the CAPM model variables.

**4-1 Capability of the CAPM model to explain the change in the stock return, according to the levels of market returns. (The estimation period is 6 months).**

**Table 2** shows the multiple regression analysis of the CAPM model, where the stocks return differentials will be a dependent variable, the determinants of the CAPM model will be independent variables.

| **Table 2 Capability of CAPM model to explain the change in the stocks returns differentials, according to the levels of market returns (The estimation period is 6 months).** | | | |
|---|---|---|---|
| variables | ALL market return | Low market return | high market return |
| Constant | 0.013<br>(12.558) *** | 0.012<br>(4.182) *** | 0.012<br>(6.392) *** |
| Average Marker return | -0.317<br>(-3.767) *** | 0.684<br>(2.153) ** | -0426<br>(-1.874) * |
| Risk free | -0.184<br>(-1.785) * | -0.266<br>(-1.029) | 0.132<br>(0.757) |
| ( Beta-systematic risk) | -0.010<br>(-22.740) *** | -0.007<br>(-5.879) *** | -0.012<br>(-17.447) *** |
| $R^2_{adj}$ Explanatory power | .453 | 0.215 | 0.645 |
| Number of observations (N) | 676 | 169 | 169 |
| F-statistic | 187.58*** | 16.31*** | 102.65*** |
| Durbin-Watson | 0.365 | 2.037 | 2.370 |

*** Significant at 1% significance level.
** Significant at 5% significance level.
* Significant at 10% significance level.
The results of the table show the following:
The significant CAPM determinant of return differentials according to low market returnsare the beta coefficient, average market return, it is the same as the high market returns. The CAPM determinants of return differentials according to low market returns have an explanatory power of21.5%. CAPM determinants of return differentials according to high market returns havean explanatory power of64.5%.
The specific determinant of beta is robust, as it is significant and has the same direction at different levels of market returns.

**Table 3** shows a Discriminatory determinant that separates between return differentials. According to the levels of market returns(The estimation period is 6 months)

| **Table 3 Discriminatory determinants that separate, between the low – high returns differentials (expected return and the actual return). According to the levels of market returns (The estimation period is 6 months)** | |
|---|---|
| **Components of the Z models** | **Equation Coefficient** |
| Average Marker return | 88.857 |
| Risk free | - |
| ( Beta-systematic risk) | 4.698 |
| Constant | -5.290 |
| Eigenvalue | 0.533 |
| % of Variance | 100% |
| Canonical Correlation | 0.59 |
| Wilks-Lambda | 0.652 |
| Chi-square $x^2$ | 143.161*** |
| Number of observations (N) | 338 |

*** Significant at 1% significance level.
** Significant at 5% significance level.
* Significant at 10% significance level

The results of the table show the following:
The discriminatory determinant separating low and high return differentials is beta coefficients, average marker returns. The Canonical correlation is 59%.Chi-square is equal to 143.16 at a significant level of 1%.

**4-2 Capability of the CAPM model to explain the change in the stock return, according to the levels of market returns. (The estimation period is 12 months).**

**Table 4** shows the multiple regression analysis of the CAPM model, where the stocks return differentials will be a dependent variable, the determinants of the CAPM model will be independent variables.

**Table 4 Capability of CAPM model to explain the change in the stocks returns differentials, according to the levels of market returns (The estimation period is 12 months).**

| variables | All market return | Low market return | high market return |
|---|---|---|---|
| Constant | 0.014<br>(16.140) *** | 0.016<br>(6.973) *** | 0.012<br>(5.141) *** |
| Average Marker return | -0.539<br>(-5.844) *** | -0.703<br>(-1.640) | -0.016<br>(-0.038) |
| Risk free | -0.349<br>(-4.106) *** | -0.871<br>(-4.017) *** | 0.117<br>(0.572) |
| ( Beta-systematic risk) | -0.010<br>(-23.862) *** | -0.007<br>(-6.788) *** | -0.013<br>(-20.759) *** |
| $R^2_{adj}$Explanatory power | 0.530 | 0.339 | 0.745 |
| Number of observations (N) | 592 | 148 | 148 |
| F-statistic | 223.11*** | 26.15*** | 144.30*** |
| Durbin-Watson | 0.230 | 2.227 | 2.702 |

*** Significant at 1% significance level.
** Significant at 5% significance level.
* Significant at 10% significance level.
The results of the table show the following:
The significant CAPM determinant of return differentials according to low market returns are the beta coefficient, risk-free, determinant of return differentials according to high market returns is the beta coefficient. The CAPM determinants of return differentials according to low market returns have an explanatory power of53%. CAPM determinants of return differentials according to high market returns have an explanatory power of 74.5%.
The specific determinant of beta is robust, as it is significant and has the same direction at different levels of market returns.

**Table 5** shows a Discriminatory determinant that separates between return differentials. According to the levels of market returns (The estimation period is 12 months)

**Table 5 Discriminatory determinants that separate, between the low – high returns differentials (expected return and the actual return). According to the levels of market returns (The estimation period is 12 months)**

| **Components of the Z models** | **Equation Coefficient** |
|---|---|
| Average Marker return | 429.186 |
| Risk free | 353.191 |
| ( Beta-systematic risk) | 5.291 |
| Constant | -9.551 |
| Eigenvalue | 1.056 |
| % of Variance | 100% |
| Canonical Correlation | 0.717 |
| Wilks-Lambda | 0.486 |
| Chi-square $x^2$ | 210.809*** |
| Number of observations (N) | 296 |

*** Significant at 1% significance level.
** Significant at 5% significance level.
* Significant at 10% significance level

The results of the table show the following:
The discriminatory determinant separating low and high return differentials is beta coefficients, average marker returns, risk-free. The Canonical correlation is 71.7%. Chi-square is equal to 210.80 at a significant level of 1%.

**4-3 Results of hypotheses tests**
**$H_1$**: Validation of the first hypothesis"There is a significant positive effect of the level of market returns and capability of the CAPM model to explain the change in the stocks returns differentials."

There is a significant difference in the CAPM model ability to explain the variability in stock return differentials according to levels of market returns (low-high) and estimation periods (6,12 months).Where the explanatory power of the CAPM model according to low market return was 21.5%, 33.9% according to the estimation periods (6,12 months), respectively. While The explanatory power of the CAPM model according to high market return was 64.5%, 74.5%, according to the estimation periods (6,12 months) respectively. Tables(2, 4)

$\mathbf{H_2}$: Validation of the second hypothesis"There is a difference in significant determinants that explain the change in the stock returns differentials when levels of market returns vary ".
There are differences of significant determinants that explain the change in the stock returns differentials when the levels of market returns (low-high)and estimation period (6,12 months) varies.Where the significant determinants according to the low market returns were (beta coefficient, average market return) at a 6-month estimation period, (beta coefficient, average market return, risk free at a 12-month estimation period.
While the significant determinants according to the high market returns were(beta coefficient, average market return) at a 6-month estimation period, (beta coefficient) at a 12-month estimation period. Tables (2, 4)

$\mathbf{H_3}$: Validation of the third hypothesis: "The discriminate determinants that separate between low and high return differentials are different when levels of market returns vary ".
There is a significant difference in the discriminate determinants that separate between low and high return differentials, according to market returns (low-high) and estimation periods (6,12 months).
Where the discriminate determinants that separate between low and high return differentials at 6-monthestimation period were beta coefficients, average marker returns,at 12 month'sestimation period were beta coefficients, average marker returns, risk-free. Tables (3, 5).

## V. Conclusion and future research

The purpose of this study is to determine the effect of the stock market conditions (levels of market returns) at different estimation periods for (CAPM) variables, on the ability of the CAPM to explain the change in stock returns.

The study showed the effect of the estimation periods for CAPM variables, on its ability to explain the change in return differentials. The effect of the 12-month estimation periods was higher than 6-months estimation periods according to the levels of market returns.

There are differences of significant determinants of CAPM variables, which explain the change in the stock returns differentials when the levels of market return and estimation periods vary.

There is a difference in the discriminate determinants of CAPMwhich separates the low and high return differentials at the different levels of market return and the estimation periods.

## VI. Recommendations

The researcher sees through the previous results that he can make recommendations to the investment fund managers and investors in the stock market as follows:

- The ability CAPM model to explain the change in stock returns, according to the high level of market return, then in the case of a low level of the market return.
- Relying on 12 months basis to estimate the CAPM model variables.
- Beta coefficients, average marker returns can classify the low and high return differentials correctly according to a 12-month basis to estimate the CAPM model variables.

Through the results of the study could provide a range of proposed research as follows:

- Study the CAPM ability to explain the change in stock returns according to a set of economic variables such as interest rates, exchange rates, inflation.

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