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ESTIMATING BETA AND THE SECURITY MARKET LINE CAPM TEST FOR DOW JONES 30 DURING THE PERIOD (2015-2019)

Amro Saleem AlAmaren, Eastern Mediterranean University
Mustafa Saeed Alathamneh, Jadara University
Ashraf Mohammad Salem Alrjoub, AlBalqa Applied University

ABSTRACT

The aim of this study is estimating beta and the security market line CAPM test for Dow Jones 30 during the Period (2015-2019). The study discusses the definition of CAPM. Also, it discusses the study of CAPM and estimating beta; it then explains tested the CAPM model by using two passes first-pass regression and second-pass regression. Moreover, in first pass regression we calculate the excess return, beta βi, alpha αi, and R-Squared as regressed on S&P 500 for S&P 500 and companies, and In second pass regression as it was shown before in this study if CAPM is valid, then γ0 should equal zero and γ1 equal excess return.

The study uses the financial models and equations estimating beta and the security Market Line CAPM test. And the result show the CAPM, the average excess return equal 0.005809 (0.006658919 - 0.00085028) which is not equal to γ1 also γ0, not equal zero. Furthermore, the t-test for beta is not significant. As the result, the test of SML failed, so the CAPM is not valid and not describe the relationship between the excess return and portfolio β in the study. So the CAPM is not valid and the model does not clarify the result which came out, and we cannot explain the relationship between return and the sensitivity of stock in the portfolio.

Keywords: CAPM, Beta, Security Market Line, Dow Jones 30, Excess Return

INTRODUCTION

In the modern investment theory, firms, investors, portfolios managers are taking into consideration the risk and return in order to predict the price and return of financial assets. Moreover, the return of financial assets is considered one of the main puzzles in modern investment theory. In 1952 Harry Markowitz, He is the first one who studied the relationship between risk level and expected return for any financial asset, by a paper called "portfolio selection", then the Capital Asset Pricing Model (CAPM) is using one factor (Fluctuation in the market rate of return) that effect on pricing asset, This model was simultaneously and independently developed by William Sharpe (1964); John Lintner (1965); Jan Mossin (1966), after that Stephen Ross (1976); Richard Roll (1977) in their paper stated that the CAPM is not testable, because that the CAPM depended on only one factor. They developed this model for another model most testable called Arbitrage Pricing Theory (APT). Subsequently Fama & French (1993) develop this model by adding two factors on the CAPM, size risk premium (measure by market capitalization), and a value risk premium (measure by book-to-market ratio). This has provided an improved description the time series of the variation in of stock returns, thence Carhart (1997) used the momentum Factor (measure by different winner stock and loser stock). Fama & French (2014) added two factors (profitability factor and investment factor) for the asset pricing model. There are many differences regarding the model that presents the best interpretation of the factors affecting stock returns and financial portfolios.

Harry Markowitz (1952, 1959) was the first who developed the theories related to asset pricing. He derived the expected rate of return on a portfolio of assets and the expected risk size.

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He was the first researcher who talks about the relationship between risk and return. Following this study many researchers examined the relationship between risk and return such as, Sharpe (1964); Lintner (1965); Mossin (1966). The following sections present, the researcher's argents on this issue. The CAPM is the commonly widely used.

The CAPM was created by Jack Treynor (1961, 1962) and it was later intensified by (Sharpe, 1964; Lintner, 1965; Mossin, 1966) separately. In this model, they explain the expected return of a security or a portfolio equals the a risk-free rate plus a risk premium. The CAPM is used in financial decision, like estimating the cost of capital, measuring portfolio performance, and helps to compute the risk and return on an investment, which is accepted by the investor, by the following Formula1:

$$E(R_{i,t}) = R_{f,t} + \beta_{i,m}(R_{m,t} - R_{f,t})$$

Where:

$E(R_{i,t})$: is the expected rate of return on an asset or portfolio $_i$. $R_{f,t}$: is the risk free rate of return asset during period $_t$. $R_{m,t}$: is the expected rate of return market portfolio during period $_t$. $B_{i,m}$: is the slope coefficient (Market Beta) for asset or portfolio$_i$, can be inspected as a standardized test of systematic risk (market risk, non-diversifiable risk, or unavoidable risk).

Formula (1) implies that the expected rate of return on the asset or portfolio is linearly and positively related to beta. The expected rate of return of the market portfolio has been higher than the risk free rate of return over a long period of time, and the risk free rate of return should be an intercept of CAPM Formula (Sharpe, 1964).

Empirical test of CAPM Reveals the presence of many issues when applied in the calculation of returns because many researchers have criticized the calculation of beta. For instance, Miller & Scholes (1972) exposed many issues in estimating beta appeared from change the risk free rate of return over time, and the expected rate of return on assets is non linearly correlated to the beta. Also, Jensen, et al., (1972) reject the standard of the CAPM because of the issue in estimating beta, such as using individual security's more than a portfolio. They used cross-sectional regression to investigate hypothesis, because the error term found is not independent standard is using cross-sectional, which can be evidence for the way in estimating beta, and that the standard of the CAPM is not found, because the intercept is higher than the risk free rate of return, the slope and intercept vary across time.

Others criticized the CAPM on other issues, Fama & MacBeth (1974) show that there is insignificant effect for the error term (residual), there is a positive relationship between return and beta, and the intercept is higher than the risk free rate.

The aim of study is trying to estimate and testing Betas and the security market line (capital asset pricing model issues), many previous studies used experimental tests for the capital Asset Pricing Model (CAPM).

DATA AND METHODOLOGY

To achieve the study objective, the researcher uses panel data analysis to analyze whether the asset pricing model, which includes Dow Jones 30 Industrials and the stock market index of 30 large, publicly-owned companies based in the United States. These 30 companies are also included in the S&P 500 Index and we get the data from Yahoo Finance database (2020), and U.S. Treasury bills rate is used as a proxy for the risk-free rate were obtained from Federal Reserve Bank of S. Louis database (2020), for 5 years from 1 – January – 2015 to 1 – December – 2019, and all the data are monthly data. Moreover, we excluded one company because of insufficient data, so the observations are 60 months.

This study is trying to estimate and testing Betas and the security market line (capital asset pricing model issues), many previous studies used experimental tests for the capital Asset Pricing Model (CAPM), as it was based on two passes first-pass regression and second-pass regression. In first-pass regression, we need to estimate beta for all stocks. In this study we use the Ordinary Least Square method (OLS). Risk premia for the individual asset is

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reducing in market risk Premium. Also, the market beta coefficient is estimated and the stock's beta and standard residual deviations for all stocks from the first-pass regression are used as inputs in the second-pass regression, wherever the Safety Market Line (SML) is estimated. Furthermore, In the second-pass regression, portfolio average returns are reduced portfolio beta estimates, squared beta estimates, and residual standard deviations. The squared beta estimate coefficient is used to measure the potential of non-linearity returns while the standard error coefficient measures the descriptive power of non-systematic risks (Kane et al., 2009).

Table 1
THE NAME OF THE COMPANIES INCLUDED IN THE STUDY SAMPLE

Dow Jones Companies
**Microsoft
**Apple
**Caterpillar
**Goldman Sachs Group
**Boeing
**Cisco Systems
**American Express
**Intel
**Walt Disney
**3M
**Home Depot
**International Business Machines
**Coca-Cola
**Johnson & Johnson
**Pfizer
**Chevron
**Nike
**JPMorgan Chase
**Merck
**McDonald's
**UnitedHealth
**Raytheon Technologies
**Procter & Gamble
**Travelers Companies
**Exxon Mobil
**Verizon Communications
**Visa
**Walmart
**Walgreens Boots Alliance

We calculated the logarithmic return of stock i at time t by the formula 2.:

$$r_t=\ln (P_t/P_{t-1})$$

In this formula rt is the logarithmic return of the company, Pt is the adjusted price of the current year and Pt-1 is the adjusted price of the previous year.

To check the study results, we provide a test that compares between various asset pricing models such as the CAPM (single factor). We are using simple Ordinary Least Squares (OLS) model by the formula 3:

$$r_{it} - r_{f,t} = \alpha_i + \beta_{mrp,i} MrP_t + \varepsilon_{i,t}$$

Where $r_i - r_{f,t}$ is the portfolio returns in excess of the risk-free rate at period t, in other words, rit is the return on security or portfolio i for period t, rft is the risk-free return, αi

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is the intercept, MrPt $(r_{m,t} - r_{f,t})$ is Market risk premium, rt is Average market return at period t, rf,t is a risk-free at period t, βmrp,i is the coefficient of the model (capture all variation in expected returns), εi,t is the error term.

The beta coefficient for each stock as regressed on S&P 500 are calculated from the following formula 4. :

$$\beta i = \frac{Cov(ri, rm)}{\sigma m^2}$$

In this formula Cov(ri,rm) is the covariance between excess return ri and and market return rm, and σm^2 is variation of market.

In next section the second-pass regression by using beta for 29 observations from Dow Jones Companies as an independent variable and considering that the average excess return for all companies during a period as dependent variable of beta coefficients to estimate the Security Market Line (SML) by using average excess return and beta by running the regression of the model:

$$\overline{r\imath - rfi} = \gamma 0 + \gamma 1 \beta i \qquad i=1, \ldots\ldots, n$$

Where the βi's are derived from formula 3 of the first regression, and the OLS method in the second regression is calculated to γ0 and γ1, and to check CAPM is valid, we should calculate γ0, γ1 and fond γ0=0, $\gamma 1 = \overline{r\imath - rfi}$.

RESULTS

The study tested the CAPM model by using two passes first-pass regression and second-pass regression and we able to reach the following results, in first pass regression we calculate the excess return $(Er_{it} - r_{f,t})$, beta βi, alpha αi, and R-Squared as regressed on S&P 500 for S&P 500 and companies, Table 2. Showed the results for the first regression.

Table 2
SHOWED THE AVERAGE EXCESS RETURN(Er_it-r_(f,t)), BETAβi, Alpha αi, AND R-SQUARED FOR S&P 500 AND COMPANIES.

	AVERAGE EXCESS RETURN	BATA	ALPHA	R-Squared
*S&P 500	0.67%	1	0.00%	1.0000
*Microsoft	2.13%	1.1920	1.34%	0.4686
*Apple	1.69%	1.2120	0.88%	0.3084
*Caterpillar	1.00%	1.5546	-0.04%	0.4724
*Goldman Sachs Group	0.32%	1.3254	-0.56%	0.3931
*Boeing	1.67%	1.1565	0.90%	0.2664
*Cisco Systems	1.08%	1.1974	0.29%	0.4376
*American Express	0.53%	1.0814	-0.19%	0.3811
*Intel	0.98%	0.9122	0.37%	0.2472
*Walt Disney	0.76%	0.9597	0.12%	0.3215
*3M	0.26%	1.0782	-0.46%	0.4631
*Home Depot	1.32%	0.9768	0.67%	0.4452
*International Business Machines	-0.02%	1.3548	-0.93%	0.4887
*Coca-Cola	0.64%	0.4200	0.36%	0.1636
*Johnson & Johnson	0.70%	0.7150	0.22%	0.3590
*Pfizer	0.60%	0.6146	0.19%	0.2053
*Chevron	0.38%	1.0079	-0.30%	0.3776
*Nike	1.28%	0.8128	0.74%	0.2422

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*JPMorgan Chase	1.48%	1.2165	0.67%	0.4928
*Merck	0.95%	0.5404	0.59%	0.1426
*McDonald's	1.39%	0.4126	1.11%	0.1264
*UnitedHealth	1.83%	0.6344	1.40%	0.1703
*Raytheon Technologies	0.55%	1.2489	-0.28%	0.5874
*Procter & Gamble	0.70%	0.3653	0.46%	0.0979
*Travelers Companies	0.53%	0.8738	-0.05%	0.3769
*Exxon Mobil Corp	-0.23%	1.0155	-0.91%	0.4418
*Verizon Communications	0.75%	0.4703	0.43%	0.1128
*Visa	1.73%	0.9099	1.13%	0.5190
*Walmart	0.68%	0.3411	0.45%	0.0514
*Walgreens Boots Alliance	-0.33%	0.8849	-0.92%	0.1897

In second pass regression as it was shown before in this study if CAPM is valid, then γ0 should equal zero and γ1 equal $\overline{r_i - r_f}$, the regression showed the following results of the second-pass regression in table 3, the regression for all stock by the formula $r_{i,t}=\alpha_i+\beta_i r_{M,t}$, and the result of γ0 is 0.008654, γ1 is 0.0000936 and R-seq is 0.0000251 so the equation for SML is :

$$E(ri) = 0.008654 + 0.0000936\,\beta i$$

According to the CAPM, γ1 should be equal the $\overline{r_i - r_f}$, in our study the average excess return equal 0.005809 (0.006658919 - 0.00085028) which is not equal to γ1 also γ0, not equal zero. Furthermore, the t-test for beta is not significant. As the a result, the test of SML failed, so the CAPM is not valid and not describe the relationship between the excess return and portfolio β in the study, table 3 showed the second pass regression.

Table 3
SHOWED THE SECOND-PASS REGRESSION

Regression Statistics								
Multiple R	0.005012							
R Square	2.51E-05							
Adjusted R Square	-0.03701							
Standard Error	0.006268							
Observations	29							
ANOVA								
	Df	**SS**	**MS**	**F**	**Significance F**			
Regression	1	2.66E-08	2.66E-08	0.000678	0.979416			
Residual	27	0.001061	3.93E-05					
Total	28	0.001061						
	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	0.008654	0.003481	2.485848	0.01941	0.001511	0.015796	0.001511	0.015796
X Variable 1	9.36E-05	0.003592	0.026041	0.979416	-0.00728	0.007465	-0.00728	0.007465

The figure1 shows the relationship between expected return and beta (SML), and Alpha for the study sample, where the equation for the stock market line is $E(ri) = 0.008654 + 0.0000936\,\beta i$ the slope is equal 0.0000936.

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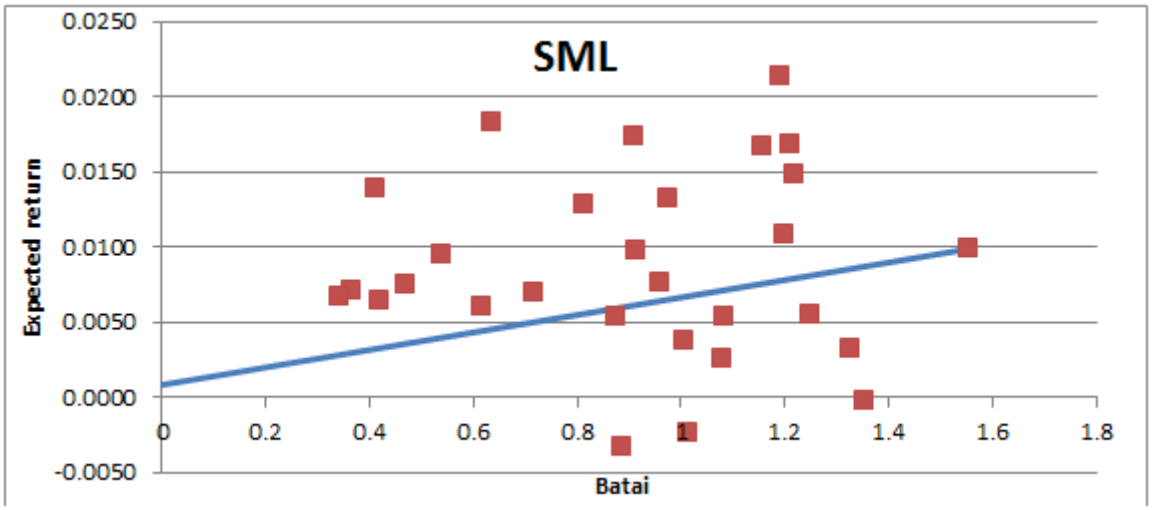

FIGURE 1
SECURITY MARKET LINE (SML)

As can be seen from figure 2 the Beta and R-squared for each stock as regressed on S&P 500, it is noted beta and R-squared are in the same direction, but dissimilar measures that mean if the beta of stock increase as usual R-squared will increase and here the figure shows the positive relationship to them.

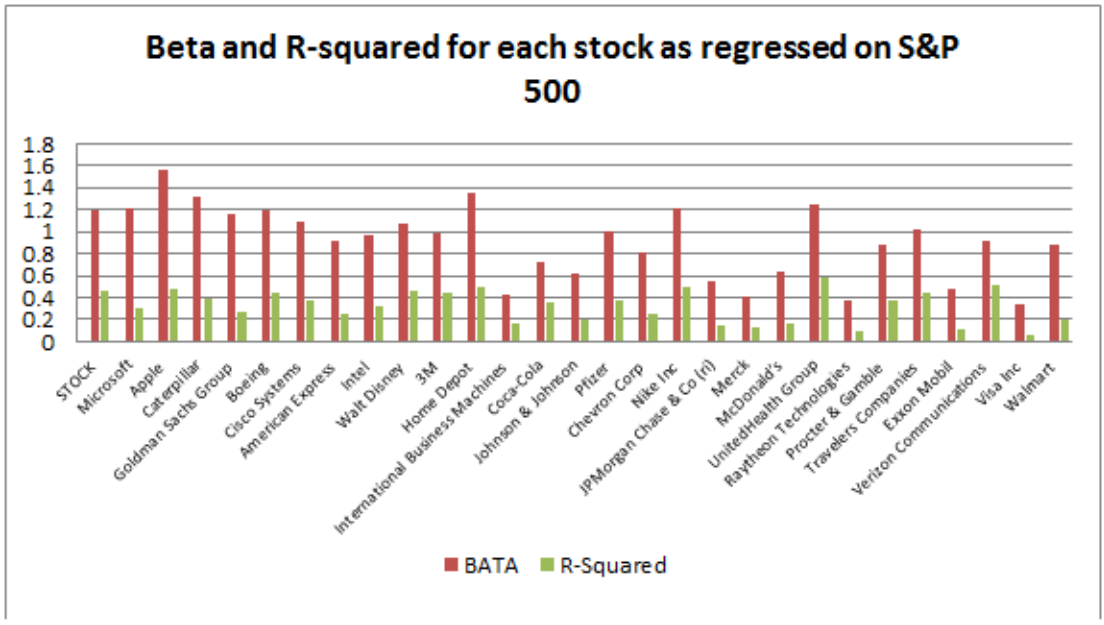

FIGURE 2
BETA AND R-SQUARED

CONCLUSION

To sum up, the study evaluated beta βi and the security market line. Moreover, the validity of CAPM model by using first pass regression and second pass regression mechanism to 29 companies of the Dow Jones 30 Industrials Index from January 2015 to December 2019, A study found that the capital asset pricing model does not support the premise that the highest beta is associated with a higher level of return. In addition, we found γ1 not equal the average

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excess return and γ0, not zero, so the test of SML failed, so the CAPM is not valid and the model does not clarify the result which came out, and we cannot explain the relationship between return and the sensitivity of stock in the portfolio.

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