Analysis and Accuracy Level Comparison Between Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) In Determining the Expected Return

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Abstract- The objectives of this study are to determine the eligible stocks to be selected based on the CAPM and APT methods, to determine the accuracy level of expected return of the stock using Mean Absolut Deviation (MAD), and to compare the accuracy level of CAPM and APT methods. Based on the CAPM method, there are 18 eligible stocks to choose : AKRA, ADRO, BPRT, CTRA, ICBP, INCO, KLBF, LPPF, LSIP, MYRX, PTBA, PTPP, PWON, TPIA, UNTR, UNVR, WSKT, TLKM. Based on APT method, there are 16 selected stocks: AKRA, ADRO, BPRT, CTRA, ICBP, INCO, LPPF, MYRX, PTBA, PTPP, PWON, TPIA, UNTR, UNVR, WSKT TLKM. MAD APT method is more accurate than MAD CAPM in determining the expected return. The comparative result shows that there is no significant difference between the accuracy of CAPM and APT methods in estimating the stock return of the company in Jakarta Islamic Index.

Index Terms- Capital Asset Pricing Model, Arbitrage Pricing Theory,Mean absolut Deviation, Jakarta Islamic Index

I. INTRODUCTION

Investments can be made both on real and financial assets. One of investment types in financial assets is investing in stocks. Stock is a form of the company ownership. Investment is related to the return and risk of an asset. The investor requires the capability to estimate the rate of return to assist in stock selection. In determining the expected rate of return, there are two estimation models that can be used: Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Model (APT).

CAPM was firstly introduced by William Sharpe, John Litner and Jan Mossin in 1964 [1]. This method determines the expected rate of return based on the systematic risk of stocks i.e. beta stock. Meanwhile, APT was firstly introduced by Stephen A. Ross in 1976 [1]. This method determines the expected rate of return based on a lot of factors other than market.

In determining the accuracy level of stock return prediction using CAPM and APT, there are several measurements that can be used; one of them is Mean Absolut Deviation (MAD). MAD is a sum of prediction errors regardless of the algebraic marks divided by the number of observed data [2]. Some researches use MAD method in determining the accuracy of CAPM and APT in predicting stock returns. [3] show that there is a small difference between MAD CAPM and APT and the results show that there is no significant difference between estimation results using CAPM and APT methods. The results have also shown that MAD APT is smaller than MAD CAPM; in other words, it is more accurate in predicting stock returns. In the contrary, [4] shows that CAPM is the most accurate method in predicting stock returns because it has a smaller MAD value compared to MAD APT.

The differences found in the result of these studies became the basis of this research to test the accuracy of CAPM and APT models in predicting stock returns in the Jakarta Islamic Index (JII). The Jakarta Islamic Index is an index at the Indonesia Stock Exchange which consists of stocks that meet the sharia criteria. One of the criteria of Islamic stock is that the shares are issued by the companies whose business activities are engaged in halal fields [5].

II. LITERATURE REVIEW

2.1 Capital Asset Pricing Model (CAPM)

Capital Asset Pricing Model (CAPM) is a model of the relationship between the rate of return and risk of an asset based on the systematic risk i.e. beta that cannot be diversified. [6] states that investors will focus more on undiversifiable risk in an effort to

Where:

minimize the risk at a certain rate of return. For individual stocks, the model of the relationship between rate of return and risk is indicated by Securities Market Line (SML) [7]. SML shows the relationship between covariance and expected return [8]. The equation of CAPM model is shown in the following model [7]:

$E(Ri) = R_f + \beta_i [(E (R_m) - R_f)]$

Where:

E(Ri) = Expected Return Saham
R_f = Risk Free Return
E(Rm) = Market Expected Return
β_1 = stock return's sensitivity of stock–i to market return

2.2 Arbitrage Pricing Theory (APT)

Arbitrage Pricing Theory (APT) was introduced by Stephen A. Ross in 1976. The Arbitrage Approach states that the expected return of an asset is not determined by one single variable (market mean and variance) but it is determined by various macroeconomic factors and the change sensitivity of each factor [1]. [9] states that in Arbitrage Pricing Theory, the expected return of a securities is determined by multifactor/index from other sources of risk. APT model can provide a more accurate expected return value and will not lead to arbitrate [1]. Equation of APT model is indicated by linear function against the following factors [1]:

$$\overline{R_i} = R_f + \beta_1 (R_1 - \overline{R_f}) + \beta_2 (R_2 - \overline{R_f}) + \ldots + \beta_n (R_n - \overline{R_f})$$

R_i = Expected Return of Stock

R_f = Risk Free Return
$\overline{R_{i-n}}$ = *Expected Return* of factors that affecting stocks
β_{in} = Return sensitivity of stock I to stock n to the factors that influence it.

2.3 *Mean Absolute Deviation* (MAD)

Mean Absolute Deviation is a measure of overall forecasting errors for a model [10]. The MAD value is calculated by taking the sum of the absolute values of each forecasting error divided by the number of data periods (n) [10]:

$$MAD = \frac{\sum |actual - Prediction|}{n}$$

III. METHODOLOGY

The population of this research are all stocks listed in the Indonesia Stock Exchange. Meanwhile, the research samples are stocks registered in Jakarta Islamic Index year 2018 which have the completeness of the data in March 2014 to March 2018. This research is using secondary data that obtained through the website www.yahoofinance.com and www.bi.go.id. The data period used is monthly data for the last 4 years i.e. from March 2014 to March 2018: Adaro Energy Tbk (ADRO), AKR Corporindo Tbk (AKRA), Aneka Tambang (Persero) Tbk (ANTM), Astra International Tbk (ASII), Barito Pacific Tbk (BRTP), Bumi Serpong Damai Tbk (BSDE), Ciputra Development Tbk (CTRA), XL Axiata Tbk (EXCL), Indofood CBP Sukses Makmur Tbk (ICBP), Vale Indonesia Tbk (INCO), Indofood Sukses Makmur Tbk (INDF), Kalbe Farma Tbk (KLBF), Lippo Karawaci Tbk (LPKR), Matahari Department Store Tbk (LPPF), PP London Sumatra Indonesia Tbk (LSIP), Hanson International Tbk (MYRX), Perusahaan Gas Negara (Persero) Tbk (PGAS), Tambang Batubara Bukit Asam (Persero) Tbk (PTBA), PP (Persero) Tbk (PTPP), Pakuwon Jati Tbk (PWON), Surya Citra Media Tbk (SCMA), Semen Indonesia (Persero) Tbk (SMGR), Summarecon Agung Tbk (SMRA), Telekomunikasi Indonesia (Persero) Tbk (TLKM), Chandra Asri Petrochemical Tbk (TPIA), United Tractors Tbk (UNTR), Unilever Indonesia Tbk (UNVR), Wijaya Karya (Persero) Tbk (WIKA) dan Waskita Karya (Persero) Tbk (WSKT). The factors that is used in APT Model is Inflation, Exchange Rate, Composite Stock Exchange Price Index and BI Rate.

3.1 Research Steps

A. Calculating Stock Expected Return by using CAPM model:
$E(Ri) = Rf + \beta i [(E (Rm) - Rf)]$

B. Calculating Stock Expected Return by using APT model:
$\overline{Ri} = Rf + \beta 1 (R1 - \overline{Rf}) + \beta 2 (R2 - Rf) + \ldots + \beta n (Rn - Rf)$

C. Calculating Mean Absolute Deviation (MAD) :

$$MAD = \frac{\sum |actual - Prediction|}{n}$$

D. Calculating the difference between CAPM and APT by using *Independent Sample t-Test*

The objective of this testing is to determine whether there are differences in average (mean) between two populations to see the average of two samples [11].

The hypotheses of this research are as follows [11]:
H_0 = The average of expected return in CAPM and APT is the same.
H_1 = The average of expected return in CAPM and APT is different.
The basis for decision making is as follows:

- If the probability is > 0.05, H_0 is accepted

If the probability is < 0.05, H_0 is rejected

IV. RESULTS AND DISCUSSION

Table 4.1 *Actual Return* and Stock *Beta*

Code	**AKRA**	**ADRO**	**ASII**	**BPRT**	**BSDE**	**CTRA**	**EXCL**	**ICBP**	**INCO**	**INDF**
Actual Return	0.0259	0.0253	-0.0002	0.0501	-0.0022	0.0079	-0.0005	0.0108	0.0146	-0.0002
Beta Saham,βi	0.7478	0.9421	1.4131	1.8335	1.8602	2.3874	0.7148	0.6231	0.7554	0.8769
Code	**KLBF**	**LPKR**	**LPPF**	**LSIP**	**MYRX**	**PGAS**	**PTBA**	**PTPP**	**PWON**	**SMRA**
Actual Return	0.0042	-0.0118	0.0086	0.0052	0.0084	-0.0064	0.0189	0.0126	0.0224	-0.0054

Beta Saham,βi	0.9696	0.0672	0.8752	0.3148	0.3982	1.4403	1.3017	1.6393	0.0735	2.3582
Code	**SCMA**	**SMGR**	**TPIA**	**UNTR**	**UNVR**	**WIKA**	**WSKT**	**TLKM**		
Actual Return	-0.0031	0.0032	0.0406	0.0114	0.0161	-0.0047	0.0102	-0.0031		
Beta Saham,βi	0.7874	1.3720	0.6337	0.7487	0.1037	1.6529	0.7739	0.7874		

Source : Data Processed (2018)

Table 4.1 shows the actual return value i.e. between -0.0118 up to 0.0501. The highest actual return value is BPRT stock while the lowest actual return is LPKR stock. The beta company stocks are between 0.0672 and 2.387. The greater the value of the beta stock, the more sensitive the stock is to market changes. The lowest beta value is LPKR stock while the highest beta value is CTRA stock.

Table 4.2 *Expected Return Capital Asset Pricing Model* (CAPM)

No.	Code	Actual return	αi	βi	E(Rm)	Rf (RBIrate)	E(Ri) CAPM
1	AKRA	0.0259	0.02	0.7478	0.0041	0.0065	0.0047
2	ADRO	0.0253	0.02	0.9421	0.0041	0.0065	0.0042
3	ASII	-0.0002	-0.01	1.4131	0.0041	0.0065	0.0031
4	BPRT	0.0501	0.04	1.8335	0.0041	0.0065	0.0020
5	BSDE	-0.0022	-0.01	1.8602	0.0041	0.0065	0.0020
6	CTRA	0.0079	0.00	2.3874	0.0041	0.0065	0.0007
7	EXCL	-0.0005	0.00	0.7148	0.0041	0.0065	0.0048
8	ICBP	0.0108	0.01	0.6231	0.0041	0.0065	0.0050
9	INCO	0.0146	0.01	0.7554	0.0041	0.0065	0.0047
10	INDF	-0.0002	0.00	0.8769	0.0041	0.0065	0.0044
11	KLBF	0.0042	0.00	0.9696	0.0041	0.0065	0.0041
12	LPKR	-0.0118	-0.01	0.0672	0.0041	0.0065	0.0063
13	LPPF	0.0086	0.00	0.8752	0.0041	0.0065	0.0044
14	LSIP	0.0052	0.00	0.3148	0.0041	0.0065	0.0057
15	MYRX	0.0084	0.01	0.3982	0.0041	0.0065	0.0055
16	PGAS	-0.0064	-0.01	1.4403	0.0041	0.0065	0.0030
17	PTBA	0.0189	0.01	1.3017	0.0041	0.0065	0.0033
18	PTPP	0.0126	0.01	1.6393	0.0041	0.0065	0.0025
19	PWON	0.0224	0.02	0.0735	0.0041	0.0065	0.0063
20	SMRA	-0.0054	-0.02	2.3582	0.0041	0.0065	0.0008
21	SCMA	-0.0031	-0.01	0.7874	0.0041	0.0065	0.0046
22	SMGR	0.0032	0.00	1.3720	0.0041	0.0065	0.0032
23	TPIA	0.0406	0.04	0.6337	0.0041	0.0065	0.0050
24	UNTR	0.0114	0.01	0.7487	0.0041	0.0065	0.0047
25	UNVR	0.0161	0.02	0.1037	0.0041	0.0065	0.0062
26	WIKA	-0.0047	-0.01	1.6529	0.0041	0.0065	0.0025
27	WSKT	0.0208	0.01	2.0249	0.0041	0.0065	0.0016
28	TLKM	0.0102	0.01	0.7739	0.0041	0.0065	0.0046

Source : Data Processed (2018)

Table 4.2 shows that Rm and Rf values are derived from the average return value of Composite Stock Exchange Price Index and BI rate during the study period. The expected return value based on CAPM calculation is between 0.0007 and 0.0063. The highest expected return value of CAPM is PWON stock while the lowest expected return value is CTRA stock. There are 18 stocks that have the actual return value > expected return CAPM i.e. AKRA, ADRO, BPRT, CTRA, ICBP, INCO, KLBF, LPPF, LSIP, MYRX, PTBA, PTPP, PWON, TPIA, UNTR, UNVR, WSKT, TLKM. These stocks are eligible stocks to be purchased under the CAPM method as the actual return value of the stock is greater than the expected return value under the CAPM.

Table 4.3 *Expected Return Arbitrage Pricing Theory* (APT)

Code	Rinflasi	RExRate	RIHSG	Rf (BIrate)	α	βInflasi	βExRate	βIHSG	(RInflasi-Rf)	(RExRate-Rf)	(RIHSG-Rf)	E(Ri)
AKRA	0.0008	0.0062	0.0041	0.0065	0.0200	-0.1502	-0.8155	0.7478	-0.0057	-0.0003	-0.0024	0.0058
ADRO	0.0008	0.0062	0.0041	0.0065	0.0200	-0.1287	-1.0280	0.9421	-0.0057	-0.0003	-0.0024	0.0053
ASII	0.0008	0.0062	0.0041	0.0065	-0.0030	-0.0553	-1.1833	1.4131	-0.0057	-0.0003	-0.0024	0.0038
BPRT	0.0008	0.0062	0.0041	0.0065	0.0510	0.2201	-1.4089	1.8335	-0.0057	-0.0003	-0.0024	0.0012
BSDE	0.0008	0.0062	0.0041	0.0065	-0.0050	-0.1729	-1.7202	1.8602	-0.0057	-0.0003	-0.0024	0.0035
CTRA	0.0008	0.0062	0.0041	0.0065	0.0040	-0.3616	-2.7681	2.3874	-0.0057	-0.0003	-0.0024	0.0037
EXCL	0.0008	0.0062	0.0041	0.0065	-0.0060	-0.0566	-0.9245	0.7148	-0.0057	-0.0003	-0.0024	0.0054
ICBP	0.0008	0.0062	0.0041	0.0065	0.0070	-0.0069	0.0048	0.6231	-0.0057	-0.0003	-0.0024	0.0050
INCO	0.0008	0.0062	0.0041	0.0065	0.0090	-0.2013	-0.4566	0.7554	-0.0057	-0.0003	-0.0024	0.0060
INDF	0.0008	0.0062	0.0041	0.0065	-0.0040	-0.0173	-0.5623	0.8769	-0.0057	-0.0003	-0.0024	0.0046
KLBF	0.0008	0.0062	0.0041	0.0065	0.0000	-0.0072	-1.0701	0.9696	-0.0057	-0.0003	-0.0024	0.0045
LPKR	0.0008	0.0062	0.0041	0.0065	-0.0180	-0.0339	0.1603	0.0672	-0.0057	-0.0003	-0.0024	0.0065
LPPF	0.0008	0.0062	0.0041	0.0065	0.0030	-0.0962	-1.1785	0.8752	-0.0057	-0.0003	-0.0024	0.0053
LSIP	0.0008	0.0062	0.0041	0.0065	-0.0010	-0.1088	-0.1027	0.3148	-0.0057	-0.0003	-0.0024	0.0064
MYRX	0.0008	0.0062	0.0041	0.0065	0.0030	-0.0476	-0.1599	0.3982	-0.0057	-0.0003	-0.0024	0.0059
PGAS	0.0008	0.0062	0.0041	0.0065	-0.0100	-0.0853	-1.5382	1.4403	-0.0057	-0.0003	-0.0024	0.0040
PTBA	0.0008	0.0062	0.0041	0.0065	0.0140	-0.1497	-1.6329	1.3017	-0.0057	-0.0003	-0.0024	0.0047
PTPP	0.0008	0.0062	0.0041	0.0065	0.0100	-0.0719	-1.5532	1.6393	-0.0057	-0.0003	-0.0024	0.0034
PWON	0.0008	0.0062	0.0041	0.0065	0.0150	-0.1415	-0.0070	0.0735	-0.0057	-0.0003	-0.0024	0.0071
SMRA	0.0008	0.0062	0.0041	0.0065	-0.0070	-0.1954	-2.1622	2.3582	-0.0057	-0.0003	-0.0024	0.0026
SCMA	0.0008	0.0062	0.0041	0.0065	-0.0070	-0.0859	-0.1005	0.7874	-0.0057	-0.0003	-0.0024	0.0051
SMGR	0.0008	0.0062	0.0041	0.0065	-0.0009	-0.1400	-1.3907	1.3720	-0.0057	-0.0003	-0.0024	0.0044
TPIA	0.0008	0.0062	0.0041	0.0065	0.0370	-0.1602	0.7864	0.6337	-0.0057	-0.0003	-0.0024	0.0056
UNTR	0.0008	0.0062	0.0041	0.0065	0.0070	-0.0738	-0.3456	0.7487	-0.0057	-0.0003	-0.0024	0.0052
UNVR	0.0008	0.0062	0.0041	0.0065	0.0100	0.0336	-0.2068	0.1037	-0.0057	-0.0003	-0.0024	0.0061
WIKA	0.0008	0.0062	0.0041	0.0065	-0.0070	-0.0486	-1.4940	1.6529	-0.0057	-0.0003	-0.0024	0.0032
WSKT	0.0008	0.0062	0.0041	0.0065	0.0190	-0.0783	-2.0038	2.0249	-0.0057	-0.0003	-0.0024	0.0027
TLKM	0.0008	0.0062	0.0041	0.0065	0.0060	-0.0181	-0.5592	0.7739	-0.0057	-0.0003	-0.0024	0.0049

Source : Data Processed (2018)

From Table 4.3, Ri (Inflation, exchange rate, Composite Stock Exchange Price Index and BI Rate) values were obtained from the average returns of each factor during the study period. The expected return value based on APT calculation is between 0.001245 and 0.007131. The highest expected return value in APT is PWON while the lowest expected return value in APT is BPRT. There are 16 stocks that have actual return value > expected return in APT : AKRA, ADRO, BPRT, CTRA, ICBP, INCO, LPPF, MYRX, PTBA, PTPP, PWON, TPIA, UNTR, UNVR, WSKT and TLKM. These stocks are eligible stocks to be purchased in APT method because the actual return value of the stocks is greater than the expected value in APT.

From the calculation of expected return in CAPM and APT, there are 16 eligible stocks to be selected either based on CAPM and APT methods such as: AKRA, ADRO, BPRT, CTRA, ICBP, INCO, LPPF, MYRX, PTBA, PTPP, PWON, TPIA, UNTR, UNVR, WSKT TLKM. While KLBF and LSIP are chosen only based on APT method.

Table 4.4 *Mean Absolut Deviation* (MAD) CAPM and APT

No.	Code	Actual Return	E(Ri) CAPM	E(Ri) APT	MAD CAPM	MAD APT
1	AKRA	0.0259	0.0047	0.0058	0.02123	0.02011
2	ADRO	0.0253	0.0042	0.0053	0.02104	0.01998
3	ASII	-0.0002	0.0031	0.0038	0.00324	0.00393
4	BPRT	0.0501	0.0020	0.0012	0.04804	0.04884
5	BSDE	-0.0022	0.0020	0.0035	0.00075	0.00572
6	CTRA	0.0079	0.0007	0.0037	0.00724	0.00428
7	EXCL	-0.0005	0.0048	0.0054	0.01209	0.00591
8	ICBP	0.0108	0.0050	0.0050	0.00579	0.00576
9	INCO	0.0146	0.0047	0.0060	0.00998	0.00869
10	INDF	-0.0002	0.0044	0.0046	0.00404	0.00488
11	KLBF	0.0042	0.0041	0.0045	0.00422	0.00033
12	LPKR	-0.0118	0.0063	0.0065	0.01814	0.01829
13	LPPF	0.0086	0.0044	0.0053	0.00419	0.00325
14	LSIP	0.0052	0.0057	0.0064	0.00054	0.00119
15	MYRX	0.0084	0.0055	0.0059	0.00289	0.00256
16	PGAS	-0.0064	0.0030	0.0040	0.00939	0.01038
17	PTBA	0.0189	0.0033	0.0047	0.01560	0.01421
18	PTPP	0.0126	0.0025	0.0034	0.01013	0.00921
19	PWON	0.0224	0.0063	0.0071	0.01604	0.01523
20	SMRA	-0.0054	0.0008	0.0026	0.00619	0.00800
21	SCMA	-0.0031	0.0046	0.0051	0.00769	0.00821
22	SMGR	0.0032	0.0032	0.0044	0.00003	0.00122
23	TPIA	0.0406	0.0050	0.0056	0.03562	0.03497
24	UNTR	0.0114	0.0047	0.0052	0.00674	0.00620
25	UNVR	0.0161	0.0062	0.0061	0.00989	0.01001
26	WIKA	-0.0047	0.0025	0.0032	0.00720	0.00797
27	WSKT	0.0208	0.0016	0.0027	0.01922	0.01812
28	TLKM	0.0102	0.0046	0.0049	0.00563	0.00532
Average					0.01124	0.01081

Sumber : Data Processed (2018)

From Table 4.4, MAD value based on the CAPM calculation is between 0.00003 and 0.04804. The highest MAD value in CAPM is BPRT stock while the lowest MAD value in CAPM is SMGR stock. MAD value based on APT calculation is between 0.00033 and 0.04884. The highest MAD value in APT is INDF stock while the lowest MAD value in APT is KLBF stock. The average of the smallest MAD value is APT; therefore, APT accuracy level is higher than CAPM because APT has the smallest MAD value.

Table 4.5 Independen t-test result of MAD CAPM and MAD APT

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
MAD	Equal variances assumed	.013	.908	.126	54	.901	.00036	.00285	-.00535	.00607
	Equal variances not assumed			.126	53.996	.901	.00036	.00285	-.00535	.00607

Source : Data Processed (2018)

From Table 4.5, it can be seen that the significance value (Sig. 2 tailed) is 0.901. This value is greater than P-Value (5%). Therefore, Ho is accepted and it can be concluded that there is no significant difference between the CAPM and APT models in estimating the expected return of stocks listed in the Jakarta Islamic Index.

V. CONCLUTION AND RECOMENDATION

Based on the expected return value using CAPM method, there are 18 eligible stocks to be included in the investment portfolio : AKRA, ADRO, BPRT, CTRA, ICBP, INCO, KLBF, LPPF, LSIP, MYRX, PTBA, PTPP, PWON, TPIA, UNTR, UNVR, WSKT, TLKM. Based on APT Methode, there are 16 stocks to be included in the investment portfolio : AKRA, ADRO, BPRT, CTRA, ICBP, INCO, LPPF, MYRX, PTBA, PTPP, PWON, TPIA, UNTR, UNVR, WSKT TLKM.

The research result on the comparative test shows that there is no significant difference between the accuracy of CAPM and APT methods in estimating the stock return of the company in Jakarta Islamic Index for the March 2014-March 2018 period.

Investors can estimate stock return using both CAPM and APT methods. However, the more accurate method referring to this research is APT method because it has higher accuracy rate than CAPM.

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