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Portfolio Optimization using Shariah-Compliant Asset Pricing Model in Indonesia

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ABSTRACT

This paper develops portfolio optimization using the Shariah-Compliant Asset Pricing Model (SCAPM) which maximizes the Sharpe ratio by considering investors' prevention of risk. There are four approaches to developing portfolio optimization (SCAPM without interest rates, SCAPM with zakah rate, SCAPM with nominal gross domestic product growth (GDP), and SCAPM with inflation). This is a quantitative study that implements these models in the Islamic capital market in Indonesia, namely Islamic stocks included in the Jakarta Islamic Index (JII) for the period January 2011-December 2018. Based on the results of the Kendall W concordance test, this study found that the four SCAPM optimum portfolios have a very high level of conformity for return, risk, and performance at a 95% confidence level. In terms of the plot and ratio of return and risk, based on the investor's prevention of risk: the optimum portfolio 1 (risk-seeker) and the optimum portfolio 3 (risk-neutral) tend to give the same results and these portfolios were more efficient than the optimum portfolio 2 (risk-averter). This study contributes to the existing literature in the area of mathematics and the Islamic capital market, specifically in terms of the optimal Sharia-compliant portfolio. It is the first study developing, implementing, and testing the optimal portfolio with four approaches SCAPM based on the investors' prevention of risk in Indonesia.

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A. INTRODUCTION

Markowitz was the first person who developed the idea of portfolio optimization known as modern portfolio theory (Markowitz, 1952). This theory is based on a mean-variance optimization model (MV), which solves portfolio problems using two indicators, namely, return and risk expectations (Alrabadi, 2016). This model suggests portfolio diversification to reduce investment risk as measured by portfolio return variance and try to calculate an efficient portfolio (Keykhaei & Panahbehagh, 2016). Tobin (1958) added risk-free assets to the Markowitz portfolio and redefined the efficient limit as a straight line between risk-free assets and optimal risk portfolios called capital market lines. Sharpe (1963) simplifies the MV matrix with a linear regression model that assumes that stock returns are linearly related to market returns, this model is known as the single-index model. This is the beginning of the discovery of the Capital Asset Pricing Model (CAPM).

The CAPM approach can be used to predict the return and risk expectations of an investment (Sukono et al., 2017). Al-Shammari et al. (2015) revealed that CAPM is one of the

most widely used models for estimating conventional stock returns. To Muslims, the key appeal of Islamic finance is the avoidance of certain major prohibitions, and most importantly riba, generally equated with interest rates (Farooq, 2019). According to Sahabuddin et al. (2018), shariah-compliant stocks are asset-backed financial instruments that apply an approach of capital raising movements for investors to participate in risk-sharing and profit-sharing but are strongly prohibited (interest) *riba*, (uncertainty) *gharar*, and (gambling) *Maysi*. Islamic financial instruments, however, are different from conventional financial instruments, and it is very important to design a CAPM model that can be applied to Islamic financial instruments (Jobst, 2007).

Efforts to replace the risk-free return variable in CAPM under shariah have been made by (Tomkins & Karim, 1987) by eliminating this variable because interest rates are prohibited in the concept of Islamic finance, (El-Ashker, 1987) replacing it with zakah rate because the zakah-rate is the minimum level of return expected so that Muslim investors can fulfill their religious obligations, (Shaikh, 2009) replacing it with nominal gross domestic product growth (GDP) because GDP makes interest rates change especially in some developed countries, and (Hanif, Risk and return under shari'a framework: An attempt to develop shari'a-compliant asset pricing model (SCAPM), 2011) replaced it with inflation because inflation hits every investment irrespective of riskiness in real world and the first preference of an investor is to maintain the capital and then expect return. These four models are further known as the Shariah-Compliant Asset Pricing Model (SCAPM) or Islamic Capital Asset Pricing Model (ICAPM).

Several researchers have evaluated SCAPM, (Sadaf & Andleeb, 2014) comparing SCAPM without interest rates, SCAPM with inflation, and CAPM from shariah-compliant stocks of the Karachi- Meezan Index (KMI-30) of Pakistan, the results that the returns would approximately the same when they use risk-free rate (t-bills rate) or inflation rate. Febrianto & Rachman (2016) did the same thing by adding SCAPM to the zakah rate on the Jakarta Islamic Index (JII) of Indonesia, they recommend inflation as a substitute for interest rates. Hakim (2016) comparing the two SCAPM approaches (SCAPM without interest rates and SCAPM with zero beta portfolio) with CAPM in Bursa Malaysia using three- and ten-year data, found that the models with three-year data reveal the remarkable similarity between SCAPMs and their distinctive difference from CAPM, and in ten years, the distinction between SCAPM and CAPM fades away. Hanif (2016) found that SCAPM (with inflation) is slightly better at explaining variations in cross-sectional stock returns than CAPM on the Karachi Stock Exchange Pakistan. Derbali et al. (2017) developed a new SCAPM mathematical model by integrating zakah, refining returns, and excluding short sales. Qudratullah (2021) has used these four approaches in measuring the performance of Islamic stocks in Indonesia.

In research on optimization portfolios for Islamic stocks, researchers have done and most use the MV model (Markowitz), the single-index model, or both (Chasanah et al., 2017) (Yuliani & Achsani, 2017) (Yunita, 2018) (Zein, et al., 2019). Masri (2018) develops a shariah-compliant optimization model for portfolio selection in an Islamic market using a goal programming approach with an empirical study from the Bahrain Islamic Market. (Fadhila et al., 2024) used the genetic algorithm method on stocks that are members of the Jakarta Islamic Index.

Therefore, this paper discusses the optimum portfolio analysis method using the four SCAPM approaches by maximizing the Sharpe ratio. As far as I am aware, this study is the first

to develop and implement the optimal portfolio with four approaches SCAPM based on the investors' prevention of risk (risk-seeker, risk-averter, and risk-neutral) in Indonesia. This study contributes to the existing literature in the area of mathematics and the Islamic capital market, specifically in terms of the optimal Sharia-compliant portfolio. As well as providing investors with insight into strategies for constructing portfolios on the Islamic stock market in Indonesia.

B. METHODS

This is quantitative research, samples were selected for Islamic stocks incorporated in the Jakarta Islamic Index (JII) as of December 2018 that have complete data for the period January 2011-December 2018 and the sample obtained is 27 stocks. The data used are monthly data during the period. The data used in this research is secondary data originating from www.idx.co.id/, www.yahoo.finance.com and www.bps.go.id which includes: closing prices and dividends of selected shares, market price indices, namely the Composite Stock Price Index (JKSE, JII), nominal gross domestic product (GDP) growth, and inflation (INF). The data analysis process consists of three stages, namely: the selection of portfolio candidates, the formation of optimal portfolios SCAPM, and The SCAPM Optimum Portfolio Analysis.

1. The selection of stocks as portfolio candidates was carried out in two steps. The first step was to analyze data on selected stocks and market indexes, namely calculating the monthly return, descriptive statistics of return (mean and standard deviation), a ratio of stocks (mean: standard deviation), and beta stocks. The second step, selecting candidates for the portfolio based on the investor's prevention of risk, namely: portfolio 1 is risk-seeker, portfolio 2 is risk-averter, and portfolio 3 is risk-neutral.
2. The formation of optimum portfolios SCAPM.
   There are four SCAPM approaches and three the investor's prevention of risk so that there are 12 optimum portfolios formed, the following is the portfolio code:

Table 1. Code and Description of Portfolio Optimum

No	Code	Description
1	P1N	SCAPM-NRF Optimum Portfolio for risk-seeker investors
2	P2N	SCAPM-NRF Optimum Portfolio for risk-averse investors
3	P3N	SCAPM-NRF Optimum Portfolio for risk-neutral investors
4	P1Z	SCAPM-ZR Optimum Portfolio for risk-seeker investors
5	P2Z	SCAPM-ZR Optimum Portfolio for risk-averse investors
6	P3Z	SCAPM-ZR Optimum Portfolio for risk-neutral investors
7	P1G	SCAPM-GDP Optimum Portfolio for risk-seeker investors
8	P2G	SCAPM-GDP Optimum Portfolio for risk-averse investors
9	P3G	SCAPM-GDP Optimum Portfolio for risk-neutral investors
10	P1I	SCAPM-INF Optimum Portfolio for risk-seeker investors
11	P2I	SCAPM-INF Optimum Portfolio for risk-averse investors
12	P3I	SCAPM-INF Optimum Portfolio for risk-neutral investors

The process of forming each optimum portfolio in Table 1, starting from calculating the components in Equation 12, determining the cut-off point $\left(ERB_i > maks\left(C_j\right)\right)$,

determining the stocks that make up the optimum portfolio, and finally calculating the proportion of each stock using Equation 11.

3. The SCAPM Optimum Portfolio Analysis. The analysis was carried out by calculating returns, risks, and ratios as well as performing a graphical analysis of the 12 SCAPM optimum Portfolios. Then the model, the testing model was conducted to test the consistency of the measurement results of the four SCAPM approaches in measuring return, risk, and performance (ratio) on three portfolios. The consistency test uses Kendall's W concordance test ((Kendall & Smith, 1939); (Wallis, 1939)).

Some of the theories used in this study are the Capital Asset Pricing Model (CAPM), Shariah-Compliant Asset Pricing Model (SCAPM), Portfolio Performance, and Optimization Portfolio with SCAPM.

1. Capital Asset Pricing Model (CAPM)

CAPM is one of the pillars of modern finance that answers fundamental questions in the financial sector, namely how investment risk affects returns (Perold, 2004). CAPM was developed separately by (Sharpe, 1964), (Treynor, 1962), (Lintner, 1965), and (Mossin, 1969), whose values are influenced by systematic risk, market return, and risk-free return. In general, the CAPM formula can be expressed as:

$$E(R_i) = R_f + \beta_{Mi}\left[E(R_M) - R_f\right] + \varepsilon_i \tag{1}$$

where: $E(R_i)$ is the expected return of the *i* stock, R_f is the risk-free return, β_{Mi} is the *i* stock beta which is the systematic risk of the *i* stock, $E(R_M)$ is the expected market return, and ε_i is the *i* stock residual return. Equation 1 can also be written:

$$E(R_i - R_f) = \beta_{Mi}\, E\left[R_M - R_f\right] + \varepsilon_i \tag{2}$$

2. Shariah-Compliant Asset Pricing Model (SCAPM)

In the SCAPM model, (Tomkins & Karim, 1987) eliminated risk-free returns because interest rates are prohibited. (El-Ashker, 1987) replaced it with zakah rates which are equivalent to 2.5%, ie 2.5% / (1-2.5%) = 2.56% because zakah is the minimum rate of return that investors expect to be able to fulfill their religious obligations towards investment assets owned. (Shaikh, 2009) replaces it with GDP because in some developed countries GDP makes interest rates change. (Hanif, 2011) substitutes it with inflation for reasons inflation is related to the real risk that must be borne by every investor and the first preference of an investor is to maintain capital and then expect profits. So the SCAPM model can be expressed as follows:

SCAPM without interest rate (SCAPM-NRF):

$$E(R_i) = \beta_{Mi}\, E[R_M] + \varepsilon_i \tag{3}$$

SCAPM with zakah-rate (SCAPM-ZR):

$$E(R_i - Z) = \beta_{Mi}\, E[R_M - Z] + \varepsilon_i \tag{4}$$

SCAPM with GPD (SCAPM-GDP):

$$E(R_i - G) = \beta_{Mi}\, E[R_M - G] + \varepsilon_i \tag{5}$$

SCAPM with inflation (SCAPM-INF):

$$E(R_i - I) = \beta_{Mi}\, E[R_M - I] + \varepsilon_i \tag{6}$$

Equation 3 to Equation 6, generally can be expressed as:

$$E(R_i^*) = \beta_{Mi}\; E[R_M^*] + \varepsilon_i \tag{7}$$

3. Portfolio Performance

According to (Sharpe, 1966), future stock or portfolio performance can be predicted using two measurements, namely the expected rate of return and predicted variability of risk expressed as deviation standards using the following formula:

$$SR = \frac{E(R_p^*)}{\sigma_p^*} \tag{8}$$

Where: $R_i^* = (R_i - R_f)$

$$E(R_p^*) = \sum_{i=1}^{p} w_i\, E(R_i^*)$$

$$\sigma_p^* = \sqrt{\sum_{i=1}^{p} \sum_{j=1}^{p} w_i w_j \sigma_{ij}^*}$$

$$w_i \geq 0, \text{ for each } i = 1,2, \dots, p$$

Risk-free return (R_f) in Equation 8 can be removed, replaced with the zakah rate, replaced with GDP, or replaced with inflation as in SCAPM.

4. Optimization Portfolio with SCAPM

To get the optimum portfolio, one of the standard strategies that can be used is to maximize the Sharpe Ratio, which is commonly called the optimal risk portfolio (Cornuejols & Tütüncü , 2007). The optimum portfolio model developed in this paper is the optimum SCAPM portfolio that maximizes the Sharpe Ratio. The optimization problem can be formulated as follows:

$$Maximizing\ (SR) = \frac{E(R_p^*)}{\sigma_p^*} \tag{9}$$

With constraint: $\sum_{i=1}^{p} w_i = 1$

$$w_i \geq 0, \text{ for } i = 1,2, \dots, p$$

where: $E(R_p^*) = \sum_{i=1}^{p} w_i\ E(R_i^*)$

$$\sigma_p^* = \sqrt{\sum_{i=1}^{p} \sum_{j=1}^{p} w_i w_j \sigma_{ij}^*}$$

The problem in Equation is a quadratic equation problem, with the Lagrange method can be expressed as:

$$L = \left(\sum_{i=1}^{p} w_i\ E(R_i\ )\right)\left(\sum_{i=1}^{p} w_i^2 \sigma_i^{*2} + \sum_{i=1}^{p} \sum_{\substack{i=1 \\ i \neq j}}^{p} w_i w_j \sigma_{ij}^*\right)^{-\frac{1}{2}} - \lambda\left(\sum_{i=1}^{p} w_i - 1\right) \text{-} \gamma_i M_i \tag{10}$$

with λ and γ_i is the Lagrange multiplier and M_i is the slack variable.

From Equation 10, we get the equation for the optimum portfolio proportion of the four SCAPM models as follows:

$$w_i = \frac{Z_i}{\sum_{i=1}^{p} Z_i} \tag{11}$$

$$\text{Where:} \quad Z_i = \frac{\beta_{Mi}}{\sigma_{\varepsilon_i}^2}\left[ERB_i\ - C_j\right] \tag{12}$$

with: $ERB_i\ = \frac{E(R_i^*)}{\beta_{Mi}}$

$$A_j\ = \frac{E\left(R_j^*\right)\beta_{Mj}}{\sigma_{\varepsilon_j}^2}$$

$$B_j\ = \frac{\beta_{Mj}^2}{\sigma_{\varepsilon_j}^2}$$

$$C_j\ = \sigma_M^{*2} \frac{\sum_{j \epsilon k} A_j}{\left(1 + \sigma_M^{*2} \sum_{j \epsilon k} B_j\ \right)}$$

In Equation 12, three things that distinguish one SCAPM from another: *first*, the value of $E(R_i^*)$, which will affect the value of ERB_i . *Second*, the value of the variance of the error (e_i) of each portfolio-forming stock whose value depends on an estimate of $R_i(\hat{R}_i)$. *Third*, the variance value of R_M^*.

C. RESULT AND DISCUSSION

1. Selection of Portfolio Candidates

The results of the data analysis of individual stocks and market indexes in the first step are presented as follows:

Table 2. Descriptive Statistics, Ratios, and Beta Stocks

Stock	Mean	Std. Dev	Ratio	Beta
ADRO	-0,0061	0,1128	-0,0543	1,0450
AKRA	0,0114	0,0991	0,1148	1,4008
ANTM	-0,0091	0,1324	-0,0685	1,2962
ASII	0,0054	0,0722	0,0750	1,1541
BSDE	0,0058	0,0981	0,0590	1,9244
CPIN	0,0163	0,1161	0,1402	1,7514
CTRA	0,0126	0,1222	0,1029	2,0243
EXCL	-0,0100	0,1013	-0,0989	0,4761
ICBP	0,0158	0,0689	0,2297	1,0653
INCO	-0,0036	0,1464	-0,0245	1,1210
INDF	0,0048	0,0686	0,0700	1,1141
INDY	-0,0095	0,1915	-0,0495	2,0695
INTP	0,0032	0,0974	0,0330	1,2940
ITMG	-0,0086	0,1334	-0,0646	0,8297
JSMR	0,0037	0,0670	0,0556	0,8856
KLBF	0,0103	0,0655	0,1573	0,9410
PGAS	-0,0072	0,1136	-0,0632	1,2534
PTBA	0,0009	0,1288	0,0069	1,0554
PTPP	0,0115	0,1394	0,0824	2,1450
SCMA	0,0105	0,0910	0,1153	0,8773
SMGR	0,0041	0,0847	0,0485	1,5205
SMRA	0,0064	0,1231	0,0521	2,2984
TLKM	0,0094	0,0729	0,1297	0,6809
TPIA	0,0216	0,1359	0,1588	0,0853
UNTR	0,0030	0,081 0	0,0369	0,8599
UNVR	0,0115	0,0599	0,1921	0,2876
WIKA	0,0112	0,1208	0,0927	1,7939
^JII	0,0038	0,0383	0,0983	-
JKSE	0,0062	0,0363	0,1713	-

Table 2 obtained from information about Islamic stocks incorporated in the JII period 2011-2018, as follows: 20 stocks have a positive mean return, 17 of which have a mean return above the JII mean return and 12 of them have a mean return above the market mean return (JKSE). The stock that has the highest mean return is TPIA and the lowest is EXCL. Judging from the standard deviation values, it appears that the standard deviation of 27 stocks is greater than the standard deviation of JII and JKSE. This shows that the portfolio is effective in reducing risk.

The stock that has the largest standard deviation is INDF and the smallest is UNVR Judging from the value of the ratio between return and standard deviation, 9 stocks have a performance (ratio) better than JII, and only 2 stocks have performed better than JKSE, namely ICBP and UNVR.

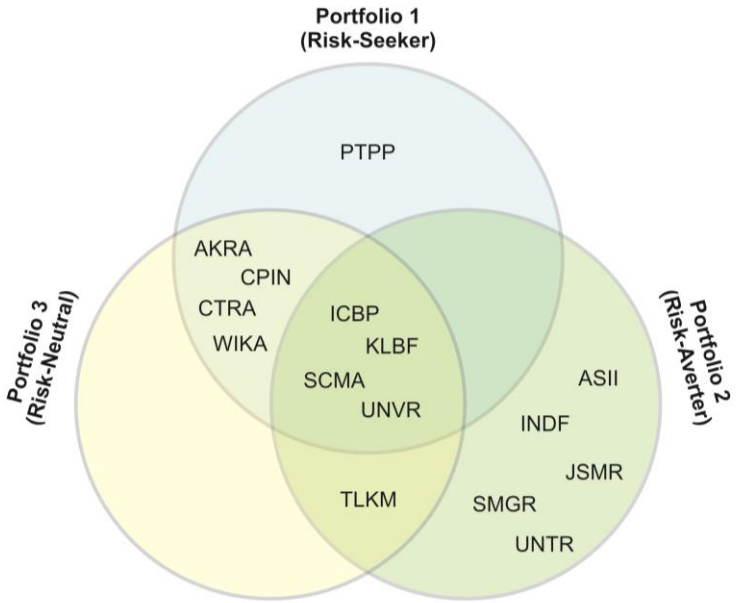


Figure 1. 10 Candidates for Portfolio based on Investors' Prevention of Risk

The second step, selecting candidates for the portfolio based on Table 1, each of which consists of three portfolios, namely: portfolio 1 is 10 stocks that have the highest mean return without regard to risk (risk-seeker), portfolio 2 is 10 stocks that have a positive mean return and the lowest standard deviation (risk-averter), and portfolio 3 are 10 stocks that have the highest ratio (risk-neutral). From Figure 1, portfolio 1 (risk-seeker) and portfolio 3 (risk-neutral) have the same 9 candidate stocks of the same optimum portfolio. The slight difference between the two portfolios is that PTPP is in portfolio 1 and TLKM is in portfolio 3. Meanwhile, portfolio 2 (risk-averter) has 4 stocks common with the two portfolios, namely ICBP, KLBF, SCMA, and UNVR. This shows that there is a match between the candidate stocks making up Portfolio 1 and Portfolio 3 on Sharia stocks in JII, while Portfolio 2 tends to be different from the two.

2. The Formation of Optimum Portfolios SCAPM.

The optimum portfolio formation stage of SCAPM starts by calculating the optimum portfolio forming components such as the variance of errors, determining the cut-off point ($ERB_i > max\ (C_j)$), determining the stocks that make up the optimum portfolio, calculating the proportion of each stock for each portfolio, as shown in Table 3, Table 4, and Table 5

Table 3. P1I Optimum Portfolio Calculation Components

Stock	$E(R_i - I)$	β_{Mi}	$\sigma^2_{\varepsilon i}$	ERB_i	A_i	B_i
ADRO	-0,0103	1,0450	0,0113	-0,0098	-0,9491	96,64
AKRA	0,0072	1,4008	0,0072	0,0052	1,4080	272,53
ANTM	-0,0133	1,2962	0,0153	-0,0102	-1,1236	109,81

Stock	$E(R_i - I)$	β_{Mi}	$\sigma^2_{\varepsilon i}$	ERB_i	A_i	B_i
ASII	0,0012	1,1541	0,0035	0,0011	0,4079	380,56
BSDE	0,0016	1,9244	0,0048	0,0009	0,6564	771,52
CPIN	0,0121	1,7514	0,0094	0,0069	2,2614	326,32
CTRA	0,0084	2,0243	0,0095	0,0042	1,7978	431,35
EXCL	-0,0142	0,4761	0,0099	-0,0297	-0,6811	22,90
ICBP	0,0116	1,0653	0,0033	0,0109	3,7567	343,90
INCO	-0,0078	1,1210	0,0198	-0,0069	-0,4395	63,47
INDF	0,0006	1,1141	0,0031	0,0006	0,2290	400,39
INDY	-0,0137	2,0695	0,031	-0,0066	-0,9121	138,16
INTP	-0,0010	1,2940	0,0073	-0,0007	-0,1707	229,37
ITMG	-0,0128	0,8297	0,0169	-0,0154	-0,6266	40,73
JSMR	-0,0005	0,8856	0,0035	-0,0005	-0,1171	224,08
KLBF	0,0061	0,9410	0,0031	0,0065	1,8629	285,64
PGAS	-0,0114	1,2534	0,0108	-0,0091	-1,3187	145,46
PTBA	-0,0033	1,0554	0,0151	-0,0031	-0,2281	73,77
PTPP	0,0073	2,1450	0,0134	0,0034	1,1745	343,36
SCMA	0,0063	0,8773	0,0073	0,0072	0,7616	105,43
SMGR	-0,0001	1,5205	0,0041	0,0000	-0,0233	563,88
SMRA	0,0022	2,2984	0,0082	0,0010	0,6271	644,22
TLKM	0,0052	0,6809	0,0047	0,0077	0,7587	98,64
TPIA	0,0174	0,0853	0,0185	0,2044	0,0804	0,39
UNTR	-0,0012	0,8599	0,0056	-0,0014	-0,1786	132,04
UNVR	0,0073	0,2876	0,0035	0,0255	0,6029	23,63
WIKA	0,0070	1,7939	0,0104	0,0039	1,2138	309,43

Table 4. P1I Optimum Portfolio-Forming Stocks

Stock	ERB_i	A_j	B_j	C_j	Note
TPIA	0,2044	0,0804	0,39	0,0001	in
UNVR	0,0255	0,6833	24,03	0,0009	in
ICBP	0,0109	4,4400	367,92	0,0039	in
SCMA	0,0072	5,2016	473,36	0,0042	in
CPIN	0,0069	7,4630	799,68	0,0048	in
KLBF	0,0065	9,3259	1085,31	0,0051	in
AKRA	0,0052	10,7339	1357,85	0,0051	in
CTRA	0,0042	12,5317	1789,19	0,0049	out
WIKA	0,0039	13,7456	2098,62	0,0048	out
PTPP	0,0034	14,9201	2441,99	0,0047	out

Table 5. P1I Optimum Portfolio Proportions

Stock	Z_i	Proportion
TPIA	0,1471	14.64%
UNVR	0,3151	31.53%
ICBP	0,3535	35.38%
SCMA	0,0549	5.50%
CPIN	0,0610	6.10%
KLBF	0,0668	6.68%
AKRA	0,0017	0.17%

There are 12 optimum SCAPM portfolios based on investors' preferences for risk. As an illustration, the following is the process of forming the optimum SCAPM-INF portfolio for

portfolio 1 (Risk-Seeker) with code P1I. *First*, calculate the components needed to calculate a stock portfolio based on SCAPM with INF (SCAPM-INF) for all samples. *Second*, calculating the cut-off-point and determining the stocks for the optimum portfolio (P1I), there are 6 stocks selected, namely TPIA, UNVR, ICBP, SCMA, CPIN, KLBF, AKRA. *Third*, calculate the proportion of each share. From Table 5, the largest proportion is ICBP (35.38%), then UNVR (31.53%), TPIA (14.64%), KLBF (6.68%), CPIN (6.10%), and the smallest is AKRA (0.17%). With the same process as above, the results of the proportion of shares for each portfolio are summarized as shown in Table 6.

Table 6. The Proportion of Stocks in Portfolio 1

Stock	NRF	ZR	GDP	INF
TPIA	11,86%	12.93%	14.93%	14.71%
UNVR	32,47%	32.00%	31.39%	31.51%
ICBP	31,24%	32.63%	35.62%	35.35%
SCMA	7,28%	6.55%	5.40%	5.49%
KLBF	12,31%	10.71%	6.43%	6.68%
CPIN	3,62%	4.31%	6.24%	6.10%
AKRA	1,23%	0.88%	-	0.17%

In portfolio 1, the stock components forming the optimum portfolio of SCAPM-NFR, SCAPM-ZR, SCAPM-INF are the same, consisting of 7 stocks (TPIA, UNVR, ICBP, SCMA, KLBF, CPIN, and AKRA). The composition of SCAPM-GDP stocks consists of 6 stocks (TPIA, UNVR, ICBP, SCMA, KLBF, and CPIN). However, from the proportion of funds allocated, the proportion of SCAPM-NRF optimum portfolio stocks tends to have the same proportion as SCAPM-ZR and SCAPM-GDP tends to be the same as SCAPM-INF (e.g. see Table 6).

Table 7. The Proportion of Stocks in Portfolio 2

Stock	NRF	ZR	GDP	INF
UNVR	34,86%	35.37%	35.90%	35.79%
ICBP	33,74%	36.28%	40.98%	40.39%
TLKM	12,28%	10.91%	8.50%	9.12%
SCMA	7,13%	6.65%	5.76%	5.78%
KLBF	11,99%	10.80%	8.85%	8.92%

In portfolio 2, the four approaches have the same optimum portfolio-forming component consisting of 5 stocks (UNVR, ICBP, TLKM, SCMA, and KLBF) with SCAPM-NRF tending to have the same proportion as SCAPM-ZR and SCAPM-GDP tend to be the same with SCAPM-INF (e.g. see Table 7).

Table 8. The Proportion of Stocks in Portfolio 3

Stock	NRF	ZR	GDP	INF
TPIA	10,96%	12.08%	14.11%	13.87%
UNVR	30,01%	29.89%	29.66%	29.70%
ICBP	28,88%	30.47%	33.67%	33.32%
TLKM	10,50%	9.13%	6.91%	7.46%
SCMA	6,07%	5.55%	4.67%	4.71%
KLBF	10,19%	8.97%	5.52%	5.26%
CPIN	2,77%	3.54%	5.45%	5.68%

AKRA	0,62%	-	-	-

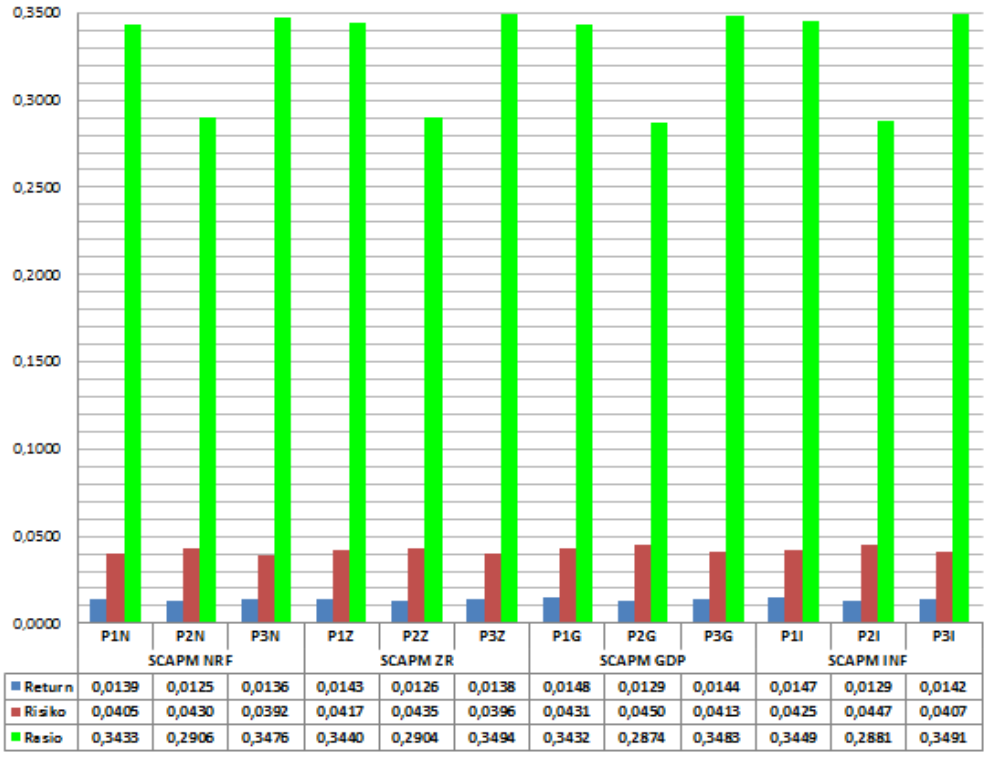
In portfolio 3, the stock component forming the SCAPM-NRF portfolio consists of 8 stocks (TPIA, UNVR, ICBP, TLKM, SCMA, KLBF, CPIN, and AKRA) while the other three models consist of 7 stocks (TPIA, UNVR, ICBP, TLKM, SCMA, KLBF, and CPIN). However, from the proportion of funds allocated, the proportion of SCAPM-NRF optimum portfolio stocks tends to have the same proportion as SCAPM-ZR and SCAPM-GDP tends to be the same as SCAPM-INF (e.g. see Table 8). In general, the optimum portfolio components 1 and 3 are the same, and both are different from portfolio 2. From the proportions between the SCAPM, it appears that the proportion of SCAPM-NRF stocks tends to have the same proportion as SCAPM-ZR and SCAPM-GDP tends to be the same SCAPM-INF.

3. The SCAPM Optimum Portfolios Analysis

The analysis is carried out by calculating returns, risks, and ratios as well as performing a graphical analysis of the 12 SCAPM optimum Portfolios. The four SCAPM optimum portfolio models are in Figure 2 and explained as follows:

a. Based on the return value, the portfolio that has the highest return value is portfolio1, then portfolio 3, and the lowest is portfolio 2
b. Based on the risk value, the portfolio with the lowest risk is Portfolio 3, then Portfolio 1, and the highest is Portfolio 2
c. Based on the ratio (performance), the portfolio that has the highest performance is Portfolio 3, then Portfolio 1, and the lowest is Portfolio 2

This result is different from the findings of (Ivanova & Dospatliev, 2017) on the Bulgarian stock exchange in that the minimum risk portfolio (portfolio 2) has a lower risk-lower return, as shown in Figure 2, Figure 3, and Figure 4.



	P1N	P2N	P3N	P1Z	P2Z	P3Z	P1G	P2G	P3G	P1I	P2I	P3I
	SCAPM NRF			SCAPM ZR			SCAPM GDP			SCAPM INF		
Return	0,0139	0,0125	0,0136	0,0143	0,0126	0,0138	0,0148	0,0129	0,0144	0,0147	0,0129	0,0142
Risiko	0,0405	0,0430	0,0392	0,0417	0,0435	0,0396	0,0431	0,0450	0,0413	0,0425	0,0447	0,0407
Rasio	0,3433	0,2906	0,3476	0,3440	0,2904	0,3494	0,3432	0,2874	0,3483	0,3449	0,2881	0,3491

Figure 2. Performance of Portfolios of SCAPM

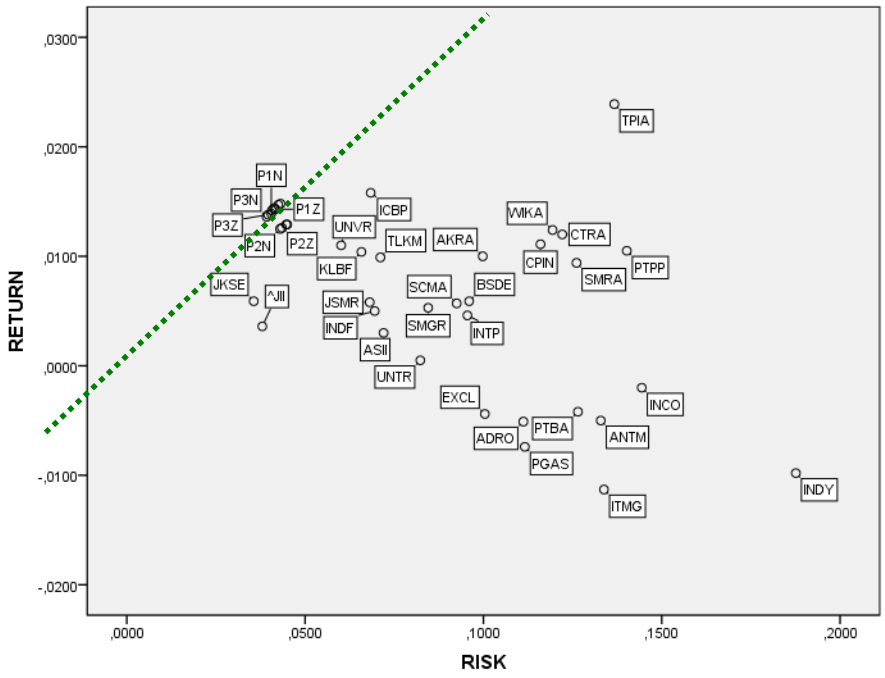


Figure 3. Plot Risk-Return Portfolios of SCAPM and All Stocks

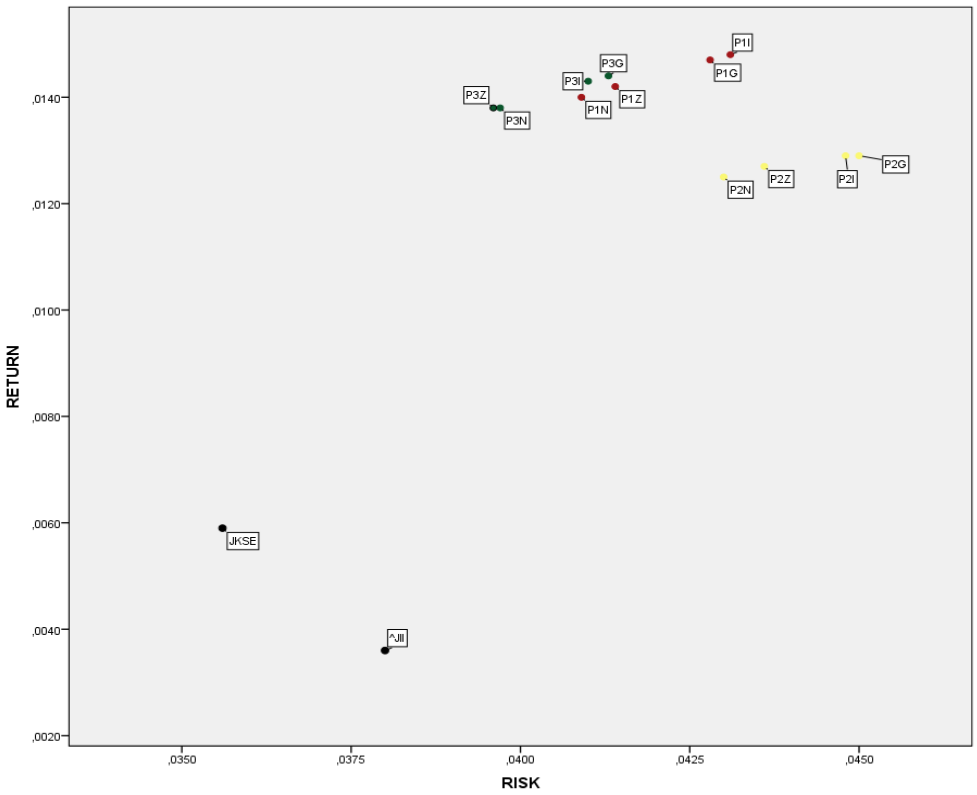


Figure 4. Plot Risk-Return Portfolios of SCAPM

It seems that Portfolio 1 and Portfolio 3 tend to have the same performance, and both have better performance than Portfolio 2 (Figure 3). Based on Figure 4, portfolio 3 tends to have a lower return and lower risk than portfolio 1. However, portfolio 3 has a slightly better performance than portfolio 1. So in the Islamic capital market in Indonesia, especially stocks that are members of JII, the right portfolio selection strategy is portfolio 3 (Figure 2, Figiure 3, and Figure 4). It is also known that there are no striking differences in performance between SCAPM optimal portfolios either SCAPM-NRF, SCAPM-ZR, SCAPM-GDP, or SCAPM-INF, for which a consistency test was conducted. The consistency test was carried out to determine the consistency of the measurement results of the four SCAPM approaches (SCAPM-NRF, SCAPM-ZR, SCAPM-GDP, and SCAPM-INF) in measuring return, risk, and performance (ratio) in portfolio 1, portfolio 2, and portfolio 3. Hypothesis: H_0 is there is no suitability of the measurement for all four approaches SCAPM; and H_1 is there is measurement suitability for all four approaches SCAPM.

Table 8. Consistency Test

	N	Kendall' W	Chi-Square	Asymp. Sig.	Result
Return	4	1,00	8,00	0,018	Ho rejected
Risk	4	1,00	8,00	0,018	Ho rejected
Ratio	4	1,00	8,00	0,018	Ho rejected

Based on the consistency test using Kendall's W concordance test. As seen in Table 8, the Kendall' W coefficient values for return, risk, and ratios are 1,00, with asymp. sig. 0,018. So at the 95% confidence level, Ho was rejected, which means there was measurement suitability for

the four SCAPM optimum portfolios. This is in line with the findings of Qudratullah (2021) who said that measuring the performance of Islamic stocks in Indonesia uses a modify the Sharpe Ratio with four approaches: eliminating interest rates, changing zakah rates, changing inflation, and changing nominal gross domestic product growth (GDP) gives almost the same results or has a very high level of suitability. This is similar to the findings of Sadaf & Andleeb (2014) that SCAPM without interest rates, SCAPM with inflation, and CAPM of Pakistan's Karachi-Meezan Index (KMI-30) sharia-compliant stocks provide roughly the same returns.

D. CONCLUSION AND SUGGESTIONS

There were four Shariah Compliant Asset Pricing Model (SCAPM) optimum portfolios developed in this paper, namely SCAPM without interest rate (SCAPM-NRF), SCAPM with Zakah rate (SCAPM-ZR), SCAPM with GDP (SCAPM-GDP), and SCAPM with inflation (SCAPM-INF). The four approaches were implemented in the Islamic capital market in Indonesia period January 2011 to December 2018 by forming three portfolios, namely: portfolio 1 (risk-seeker), portfolio 2 (risk-averter), and portfolio 3 (risk-neutral), so we get 12 portfolios. It was concluded that: (1) The components and proportion of the compilers of Portfolio 1 tend to be the same as Portfolio 3 both differ from Portfolio 2; (2) All (12) optimum portfolios of SCAPM performed better than all sharia stocks sampled including JII and JKSE. This shows that the formation of an optimal portfolio of SCAPM is effective in improving portfolio performance; (3) The results of the measurement of return, risk, and performance (ratio) of both Portfolio 1 and Portfolio 3 tend to be the same and more efficient compared to Portfolio 2. However, portfolio 3 has a slightly better performance than portfolio 1. So in the Islamic capital market in Indonesia, especially those that are members of the JII, the right portfolio selection strategy is portfolio 3 (risk-neutral); and (4) The results of the measurement of return, risk, and performance (ratio) of the four optimum SCAPM portfolios have a very high level of suitability so that the four SCAPM approaches are equally well used in the preparation of the optimum sharia-compliant portfolio.

The criteria for sharia stocks used in this study are stocks included in the Jakarta Islamix Index (JII). JII is 30 sharia stocks with high capitalization and the most liquid listed on the IDX. For further research, a larger sample can be used, such as sharia stocks that consistently record the Jakarta Islamix Index 70 (JII70) or the Indonesian Sharia Stock Index (ISSI) in a certain period. Further research can also be conducted by comparing the SCAPM optimum portfolio with other optimum portfolio methods.

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