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Analysis of determining optimal portfolio in BPKH's portfolios using Tangency Portfolio model

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Abstract

Purpose – This study aims to analyze the actual portfolio of BPKH from the hajj fund investment and examine the optimization investment portfolio for BPKH based on PP No.5 Tahun 2018.

Methodology – The data used in this study was quarterly in the form of price and coupon for Sukuk instruments and the equivalent of yield rate for Sharia deposits. This study uses the Markowitz Diversification method with the Tangency Portfolio model as a model to determine optimal portfolio.

Findings – The result of this study showed that BPKH's actual portfolios in 2018 and 2019 can't be determined as efficient portfolios and the optimal portfolio. Meanwhile, BPKH's actual portfolios in 2020 and 2021 are included as efficient portfolios but not optimal portfolio. The result of an optimal portfolio in this study has a composition as follows: 30% of Sharia deposits, 5,60% of SBSN, and 64,40% of SDHI.

Implication – The finding of an optimal portfolio can recommend BPKH to allocate most of the hajj fund in SDHI than SBSN because the SBSN has high risk and still to allocate in Sharia deposits as worth maximum based on regulation in PP No.5 Tahun 2018. BPKH needs to diversify hajj fund investment wider such as Lembaga Tabung Haji (LTH) has done in Malaysia.

Originality – This study contributes to evaluate of whether BPKH's actual portfolios in the first third years since BPKH operation and after the first third years of BPKH operation are efficient and optimal or not. Furthermore, this study provides a combination of instruments in the scenario optimal portfolio.

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Introduction

Hajj is one of the five pillars of Islam and must be performed by Muslims if they can afford to perform it. The enthusiasm to perform hajj in Indonesia is massive. It can be seen in the large number of waiting list hajj pilgrims and increasing every year. It can be a privilege for Indonesia because the Saudi Arabia government provides Indonesia with a larger hajj quota yearly than other Muslim countries(Desk, 2020). According to Kementerian Agama publication and BPKH's Annual Report, Indonesia has 221.000 quota hajj provided by Saudi Arabia from 2018 to 2020. However, the number of hajj quotas can only accommodate pilgrims an average of 4% to 5% of the total number of hajj pilgrims on waiting list annually. It is the reason why the waiting period for the hajj pilgrim's departure in Indonesia is so long.

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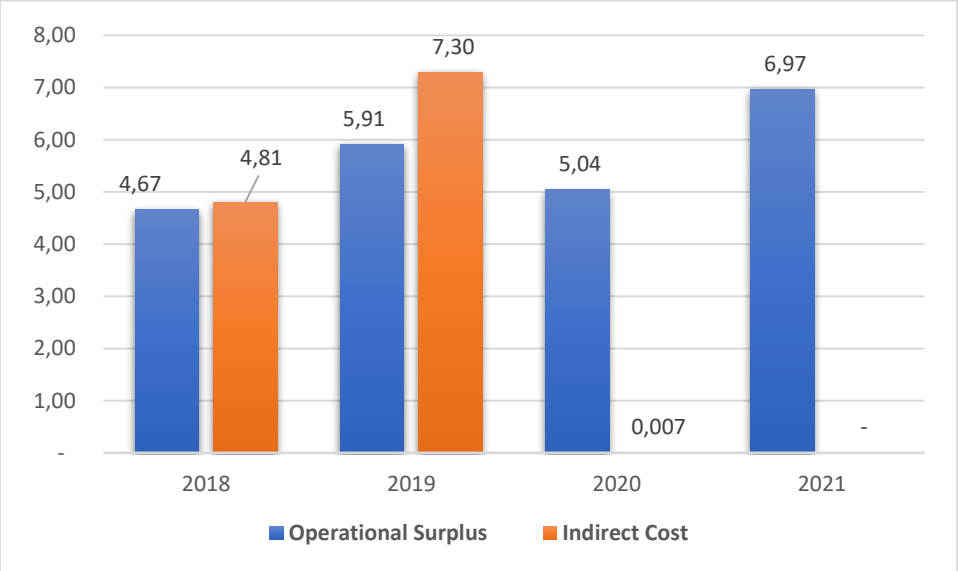
The increase in hajj pilgrims can increase the hajj fund managed by the hajj financial management agency (BPKH). BPKH manages the hajj fund using two instruments: investment instrument and placement in Sharia banking arranged by PP No.5 Tahun 2018. According to Article 27 Section 2-4 PP No.5 Tahun 2018, BPKH must allocate or invest their hajj fund to Sharia deposits a maximum of 50% in the first three years since BPKH started to operate and a maximum of 30% after the first three years since BPKH started to operate. The remains of hajj funds are invested in investment instruments. Currently, most of the hajj fund is allocated to investment instruments. The purpose of hajj fund management is to increase hajj performance quality, rationality, and efficiency of the hajj cost. Witjacsono et al. (2020) define hajj fund management as placing the BPKH's financial resources into business activities that do not contradict Sharia principles and constitution to obtain a yield, considering the potential risks.

Biaya penyelenggaraan ibadah haji (BPIH) or hajj cost consists of direct cost and indirect cost. The yield obtained from hajj fund management is used to distribute into pilgrim virtual accounts as a bonus, finance BPKH's operation expenses and grant for the Ministry of Religion (Kemenag), and primarily to provide subsidies in the form of the indirect cost of hajj cost (BPIH) for every registrant pilgrim. Meanwhile, the direct cost is directly paid by every single registrant pilgrim. The component of direct cost and indirect cost constantly change every year. According to Presidential Decree published in 2018, the direct cost is consisting flight costs, partly lodgement costs in Mekkah, and living costs. Meanwhile, in 2019, the direct cost component was just partly flight and living costs. The amount and composition of this indirect cost are not published in the President Decree, so that raises confusion. Nidjam (2017) shows the component of indirect cost consisting of service costs as long as in Saudi Arabia, consumption, transportation, passport, accommodation as long as in embarkation hostel, Manasik book, and others.



Source: Financial Statement of BPKH 2018-2021

Figure 1. BPKH's operation surplus and Hajj Indirect Cost (in RpTrillion)

Figure 1 shows operation surplus obtained from the difference between the yield of the hajj fund management with BPKH's operation expenses, grant for Kementerian Agama, and distribution into virtual pilgrim accounts can't fulfill the total amount of indirect cost in 2018 and 2019. In contrast, the hajj performance in 2020 and 2021 has been unable perform because it has been postponed caused the Covid-19 pandemic, so the BPKH's indirect cost just to pay for procurement and shipment of hajj bangles and Manasik books, while in 2021 there is nothing indirect cost paid by BPKH. BPKH's financial statement for 2018 to 2021 shows that the yield obtained from hajj fund management in 2018 and 2019 can't be reached BPKH's yield target or just fulfilled 94% in 2018 and 99% in 2019. According to Badan Pemeriksa Keuangan (BPK) investigation report in 2018, the minus gap of the difference between the operating surplus and the

total indirect cost for pilgrims departing in 2017 is taken paid by the yield from registrant pilgrims on waiting list or not passing yet in 2017, (Badan Pemeriksa Keuangan, 2018).

This study aims to analyze whether BPKH's actual portfolio includes an efficient and optimal portfolio or not and examine the optimization investment portfolio for BPKH based on PP No.5 Tahun 2018 using the Markowitz Diversification method with the Tangency Portfolio model. The method is based on Modern Portfolio Theory and measures combinations of instruments fit to obtain some efficient portfolio choices through the efficient frontier curve. Meanwhile, the model determines an optimal portfolio between efficient portfolios.

Literature Review

BPIH deposit is paid by hajj pilgrims based on the Wadi'ah yad Dhamamah (guaranteed savings) principle (Abidin, 2016). In that principle, the recipient of the deposit can be using assets or goods from the depositor (the owner) for business or investment activity as long as the recipient of the deposit is responsible for the risk or disadvantage that appeared by the recipient of deposit and must be returning them all and entirely to the depositor. The depositor of an asset or good can withdraw his deposit at any time (Ghozali & Mafaza, 2020). The BPKH's business activity is managing the hajj fund through investment instruments and placement in Sharia banking. BPKH generates benefit value from their management as a return annually (Witjacsono et al., 2019a). Hassan (2019) adds that the benefit value generated by their management is used to distribute into pilgrim virtual accounts as a bonus, finance BPKH's operation expenses and grant for the Ministry of Religion (Kemenag), and primarily to provide subsidies in the form of the indirect cost of hajj cost (BPIH) for registrant pilgrims.

Studies conducted by Setyawan et al. (2020) and Pujiharto et al. (2022) show the total BPIH (direct cost and indirect cost) tend increased since 2011 worth IDR37,7 million per pilgrim to IDR70,7 million per pilgrim in 2019. The total indirect cost increased significantly, whereas the total direct cost fluctuated, but the trend is up. Ismal & Septiana (2019) explain that one of the causes of the total BPIH tends increase is the exchange rate risk facing the hajj funds has yet to be anticipated by the authority.

Studies conducted by Hassan (2019) and Baig (2016) generate a comparison of hajj fund management in Malaysia, Indonesia, Pakistan, and the Maldives. One of the results of their study is hajj funds management agency known as Lembaga Tabung Haji (LTH) in Malaysia besides can increase the subsidy of indirect cost to help Malaysian pilgrims mitigate the hajj cost, the benefit value (return) generated by LTH can also stabilize the direct cost of hajj cost became fixed cost so that the total direct cost charged by Malaysian pilgrims is set over the years. Ridhwan et al. (2014) add that LTH is investing its hajj funds into the untouchable sector by BPKH currently, such as plantation, services, oil and gases. Moreover, LTH can establish subsidiary companies in the financial, property, and plantation sectors. The consistency of LTH to provides high grant and indirect cost payment, making it LTH a popular saving product among Muslims in Malaysia (Rahman et al., 2020).

Modern Portfolio Theory from Markowitz (1952) was used to solve the problem of an investment portfolio through two fundamental indicators, expected return measured by mean of return and risk measured by variance. He also suggested investors diversify their investment across industries because the firms in different sectors have lower covariance than firms within an industry to make the variance (risk) an investment small. Krisnawan (2019) defines an investment portfolio as combining several investment instruments or firms in different sectors. This theory generates a linear correlation between risk and return. The more risk you'll earn from an investment, the more return you will earn (Adnyana, 2020). A portfolio that generates maximum expected return with a certain risk is known as an efficient portfolio. Efficient portfolio is not just one portfolio, but there are several portfolios. Among efficient portfolio choices, a portfolio will become the investor's choice portfolio because it has the risk fit with their risk preferences. The portfolio is known as an optimal portfolio (Tandelilin, 2010).

Rachmatullah et al. (2021) elaborate the Markowitz Diversification method in 6 steps to solve and determine investment portfolios as follows: measure the actual return of each instrument,

average the total actual return (expected return), measure variance or standard deviation (risk), measure covariance between the two instruments, measure expected return and risk of the portfolio. A study conducted by Supandi (2016) generates three models for determining the optimum portfolio between efficient portfolios and can be described through an efficient frontier curve. The three models are Minimum-variance, Mean-variance, and Tangency Portfolio. The Tangency Portfolio is a model to be used in this study because this model is the most suitable model for BPKH's risk preferences compared to the other two models. Ghofar et al. (2020) mention that BPKH's risk preferences are medium-risk with a higher return.

Some studies have used this method to analyze and evaluate the institution's investment portfolio. A study conducted by Fauji (2016) used this method to analyze the optimum portfolio in BPJS Ketenagakerjaan. Another study conducted by Krisnawan (2019) used this method to analyze the optimum portfolio Tunjangan Hari Tua program in PT Taspen (Persero). A study by Pratiwi et al. (2019) used Markowitz's theory and method to analyze the return and risk portfolio to find efficient portfolios in managing hajj funds and recommend an optimal portfolio based on BPKH's investment preference for Bank Penerima Setoran-Biaya Penyelenggaraan Ibadah Haji (BPS-BPIH). Moreover, BPKH also used Markowitz's theory and method to base their investment activities (Witjacsono et al., 2019b).

Studies conducted by Setyawan et al. (2020) dan Pujiharto et al. (2022) analyze investment portfolios in hajj funds management by BPKH. Setyawan et al. (2020) generated some scenarios of investment portfolios with a utilization combination of 4 instruments (deposit, SDHI, stock, and real sector) using Mean-variance models. The scenarios are the conservative portfolio combination, the moderate portfolio combination, the portfolio composition in aggressiveness, and the Global Minimum Variance. In this model, determining an optimal portfolio is determined by the own BPKH based on their return and risk preference. However, BPKH's actual portfolios in 2017-2019 are a conservative portfolio combination with 50% in Sukuk and 50% in deposit. Pujiharto et al. (2022) generated BPKH's scenarios of investment portfolios based on PP No.5 Tahun 2018 using Absolute Mean Error (AME) and Absolute Variance Error (AVE) approach. The scenarios are the existing portfolio, the moderate scenario, and the optimistic scenario. The change in the portfolio of hajj funds placement from Islamic Bank to investment become one of the stimulus factors has increased the total yield of hajj funds. This study suggests BPKH allocate the hajj funds 20% to Islamic Bank and 80% to investment. This study also recommends that BPKH increase the direct cost of hajj from IDR25 million to IDR30 million.

Research Method

This quantitative study uses secondary data such as the price and coupon of each Sukuk instrument, the equivalent of yield rate of Islamic banks (BUS) and Sharia business units (UUS), and BI 7-day Repo Rate as an interest rate. The data is taken quarterly from quartal-1 2018 to quartal-4 2021. The reason why the period is taken from 2018 to 2021 is that BPKH was established in July 2017 and started its full-annual operation in 2018, then ended in 2021 because this year is the first year after 3 years since BPKH establish. This paper is going to see the difference in BPKH's instrument percentage or composition between the period of the first 3 years BPKH operated and the period after 3 years BPKH establish. The population was the investment instruments mentioned in UU No.34 Tahun 2014 and PP No.5 Tahun 2018. Purposive sampling was used to select instrument investment based on criteria regulated in PP No.5 Tahun 2018 as follows:

1. Government Sukuk (SBSN) issued by the central government;
2. Ownership of Sharia Bank Indonesia Certificate (SBIS)
3. Sharia stocks (efek syariah) regulated by Otoritas Jasa Keuangan (OJK)

In addition, Witjacsono et al. (2019) describe criteria for investment instruments determined by BPKH.

Table 1 shows several criteria used to determine investment instruments as samples in this study. Furthermore, the instruments are also taken based on the largest composition percentage in BPKH's actual portfolio from 2018 to 2021, which is Sharia deposits is the largest, then government sukuk (tradeable SBSN), mutual funds, SDHI, corporate sukuk, and other instruments

(below 1% such as shares, saving, giro, bank financing). Mutual funds are not included in the samples because mutual funds have managed by the fund manager. From these criteria, the samples generated in this study are four instruments and 23 single assets that are still active in the period 2018 to 2021. Table 2 shows the serial code or product type of single assets from each instrument. There are 4 single assets in Sharia deposits, 6 in government sukuk (SBSN), 8 in corporate sukuk, and 5 in SDHI.

Table 1. BPKH's instrument criteria

No	Instrument Type	Requirement
1.	Government Sukuk (SBSN)	• Have optimal return • Have acceptable risk
2.	Sharia shares	• Registered in Indonesia Stock Exchange (IDX) • Including LQ45 shares
3.	Corporate Sukuk	• Have investment grade provided by rating institution controlled by OJK • Have a grade A- (A minus) or bigger to investment issued by State-owned Enterprises (BUMN) and have a grade A (A flat) or bigger to investment issued by other companies
4.	Mutual funds	• Controlled by OJK • Have a counterpart fund manager to manage a fixed-income fund • Have an investment grade
5.	Deposit	• The type of deposit is Sharia deposits • Maksimum has one year tenor

Table 2. Sample list

No	Instrument Type	Serial Code/Product Type
1.	Sharia deposits	• One-month tenor • Three-months tenor • Six-months tenor • One-year tenor
2.	Government Sukuk	• IFR0006 • IFR0007 • IFR0010 • PBS005 • PBS007 • PBS015
3.	Corporate Sukuk	• SIPPLN01BCN2 • SIPPLN02CCN2 • SIPPLN02BCN1 • SIPPLN02BCN2 • SIISAT01ECN2 • SIISAT02ECN2 • SIAPAI01C • SMBRIS01SB
4.	Sukuk Dana Haji Indonesia (SDHI)	• SDHI-2023A • SDHI-2024A • SDHI-2025A • SDHI-2029A • SDHI-2020B

The data of Sharia deposits obtained from Statistika Perbankan Syariah (SPS) published by OJK in the form equivalent of yield rate. The type of SBSN in this study is SBSN tradeable and uses the Islamic Fix Rate (IFR) and Project Based Sukuk (PBS) price and coupon as SBSN data.

The data in the form of price and coupon of corporate Sukuk obtained from the State-owned Enterprises (BUMN) minimum has a grade A- of investment and other companies minimum has a grade A of investment. The SDHI variable use price and coupon non-tradeable series from SBSN. The price and coupon of three Sukuk instruments were obtained from Bloomberg of Economics and Business Faculty Diponegoro University.

This study uses the Markowitz Diversification method to analyze the return and risk portfolio. This method illustrates relations between belief and choice of portfolio geometrically according to the expected returns-variance of returns rule (Markowitz, 1952) and is also used to solve the portfolio problem according to expected return measured by return mean and risk measured by return variation (Alrabadi, 2016). This method assisted the Solver program in Microsoft Excel to determine an investment portfolio. After determining the investment portfolios as efficient portfolios, this paper uses the Tangency Portfolio model as a model to determine an optimal portfolio.

This study doesn't cover external factors such as inflation, exchange rate, or economic growth but some of the external factors are assumed to have been reflected in the rate of return rate performance in four instruments. The equivalent of yield rate as the Sharia deposits data is affected by bank profit, then the bank profit is affected by economic growth, (Asiyah et al., 2022). Then, the Sukuk instruments (SBSN, corporate bonds, SDHI) which are similar to the bond principle use price and coupon as the data. According to Rasudu (2021), the bond price has a negative relation to inflation and the exchange rate. The coupon doesn't have a relation to the bond price because in Sukuk instruments is a fixed coupon.

The first step to determining an investment portfolio is to measure the actual return of every single asset. The actual return formula for Sukuk instrument is as follows (Setyawan et al., 2020):

$$R_i = \frac{P_1 - P_t + C}{P_t - 1}$$

P_t symbolizes the price of a single asset in the t period and C symbolizes the coupon of a single asset. The actual return of Sharia deposits is measured by the average of the equivalent rate of yield. The second step is to measure the expected return of a single asset using an arithmetic mean as below this:

$$E_{(r)} = \frac{\sum_{t=1}^{n} R_{it}}{n}$$

The total observation data is symbolized by *n*. If the total data is less than 30, use the formula (*n-1*). The third step is to measure the risk using the standard deviation. The larger the value of the standard deviation, the larger the value of the risk. The standard deviation formula as follows:

$$SD = \sqrt{\frac{\sum (R_{it} - E_{(Ri)})^2}{n}}$$

The next step is to measure the coefficient of correlation to show how strong the relationship of return movement between the two instruments is. The value of the coefficient of correlation has a range from negative one (-1) to one (1), getting closer to -1, and the correlation of return movement between the two instruments is shown as unperfected correlated. Otherwise, getting closer to 1, the correlation of return movement between the two instruments is shown as perfected correlated. If the value of the correlation coefficient is 0, the two instruments have not shown the correlation.

$$Rij = \rho ij = \frac{n\sum XY - \sum X \sum Y}{\sqrt{[n\sum X^2 - (\sum X^2)][n\sum Y^2 - (n\sum Y^2)]}}$$

Covariance is the other calculation to identify the return movement between the two instruments. If the covariance value between the two instruments is positive, the return movement

of the two instruments is shown to move the same way. Otherwise, if the covariance of the two instruments is negative, the return movement of the two instruments is indicated to move the opposite way. The formula of covariance is shown below this:

$$\sigma_{ij} = \frac{\sum_{t=1}^{n}[(R_{it} - E_{(Ri)})(R_{jt} - E_{(Rj)})]}{n}$$

σ_{ij} symbolizes covariance of the *i* and *j* instrument returns. R_{it} symbolizes the covariance of the *i*-instrument return in the *t*-period. R_{jt} symbolizes the covariance of the *j*-instrument return in the *t*-period and $E_{(Ri)}/E_{(Rj)}$represents the expected return of *i* and *j* instrument.

The next step is to determine the weight of investment instruments in a portfolio equally. After that, we can determine the expected return and risk of the portfolio through, the expected return of instruments, the value of covariance between instruments, and the weighted instrument in a portfolio. The formula of portfolio expected return is below this:

$$E_{(Rp)} = \sum(E_{Ri}).W_i) \ldots$$

The W_i symbolizes the weight of the *i*-instrument. Besides that, the formula of portfolio risk is below this:

$$\sigma_p^2 = \sum_{i=n}^{n} w_i^2\,\sigma_i^2 + 2\sum_{i}^{K}\sum_{j}^{N} w_i.w_j.Cov(r_i\,r_{j)}$$

The σ_p^2 symbolizes the variance of the portfolio whereas the σ_i^2 symbolizes the variance of the instrument or securities. w_i and w_j symbolizes the weight of *i* and *j*-instrument. The $Cov(r_i r_2)$ symbolizes the covariance between *i* and *j*-instrument.

The next step is back to weighting the portfolio of investment using the Solver program in Microsoft Excel with a different composition of the instrument. This weighting uses the Solver to obtain BPKH's actual portfolios and efficient portfolios appropriate BPKH's return and risk preferences efficiently.

Sharpe ratio is a method to calculate how much the expected return per unit of the risk obtained investor from his investment portfolio. The Sharpe ratio is also used to show the performance of a portfolio. The formula of the Sharpe ratio is below this:

$$S_p = \frac{E_{(Rp)} - R_f}{\sigma_p}$$

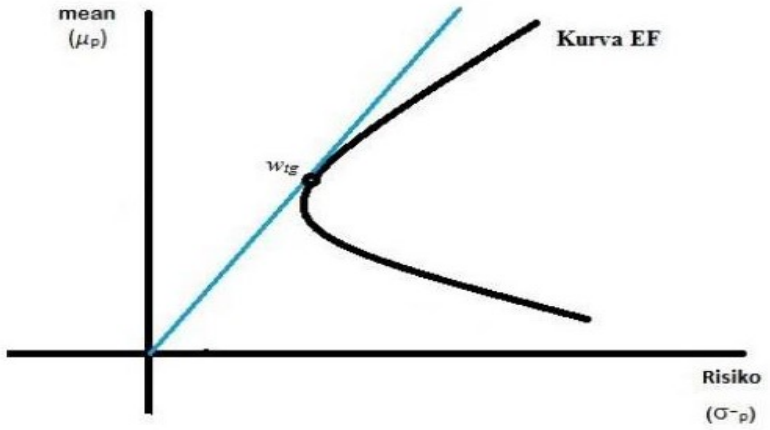
The R_f symbolizes the risk-free rate where the data use BI-7 day Repo Rate from Bank Indonesia. A risk-free rate shows an investment choice offers an expected return rate as significant as 0 risks (risk-free). The standard deviation or risk rate of the portfolio symbolized the σ_p.

Efficient portfolios have been formed is obtain points of return and risk and then connected with a scatter chart within Microsoft Excel to shape an efficient frontier curve. Meanwhile, there is a line known as the capital allocation line (CAL), which is a line that can show the relationship between risk-free assets and non-free assets within an efficient frontier curve. The line can be shaped starting from the point of 0 risks and a point of return as significant as the risk-free rate.

The last step is determining an optimal portfolio with the Tangency portfolio model. The investors use this model to determine an optimal portfolio that has a maximum Sharpe ratio. The portfolio has a maximum Sharpe ratio does not mean it can obtain maximum total return and risk but can obtain a maximum return at unit risk and is the most efficient portfolio (Supandi, 2016). This model is suitable with the BPKH's investment preference, which is moderate-return and low-risk (Witjacsono et al., 2019b). Figure 2 from Supandi (2016) shows the optimal portfolio determined by the Tangency portfolio located on a tangent point symbolized by (*wtg*) between the capital allocation line (CAL) and the efficient frontier (EF) curve.

The optimal portfolio including the composition determined by the Tangency Portfolio model is a final result of this study that can be a suggestion for BPKH to allocate or invest its hajj

funds into four instruments with the composition based on the composition of the optimal portfolio obtained in this study.



Source: Supandi (2016)

Figure 2. The Curve of Tangency Portfolio Model

Result and Discussion

Measuring Actual Return, Expected Return, and Risk of the Instrument

Figure 3 below shows the movement of the return rate from the four instruments. The instrument that has a stable rate of return is Sharia deposits even during the pandemic happens. It is happening because Sharia banks can afford to keep their bank performance indicators such as BOPO, RoA, and FDR is stable. This is proven by Ningsih & Aris (2022) that there is no difference between the Sharia bank revenue indicators (BOPO and RoA) before the pandemic and during the pandemic.

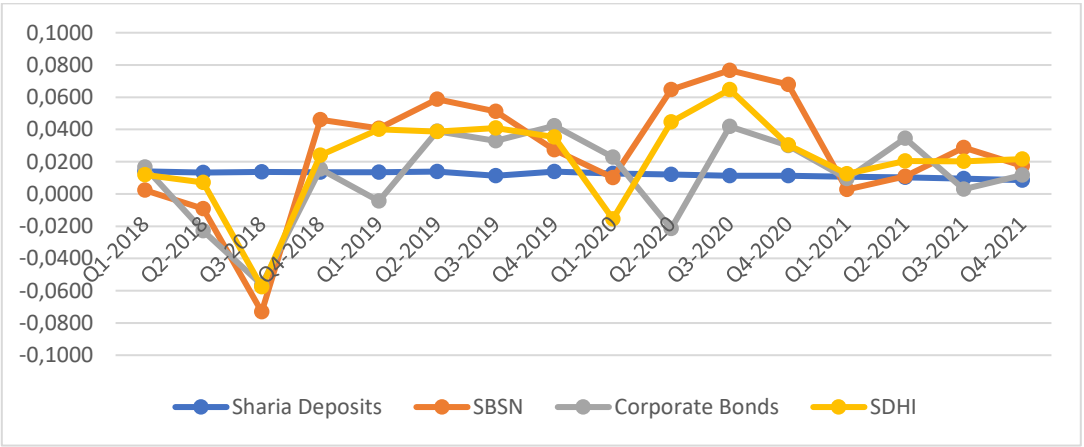


Figure 3. Instrument Rate of Return

Meanwhile, the three Sukuk instruments have a high volatility rate of return. This result contradicts the rate of return obtained by Witjacsono et al. (2019). They say the SBSN and SDHI include a low-risk instrument because the government guarantees the two instruments are. However, in another Witjacsono et al, (2020) paper, the Sukuk instruments especially SBSN can be faced liquidity risk which is looked at by the spread between the bid and ask price. One of the causes why the SBSN, corporate bonds, and SDHI have high volatility are they have a price. The extreme drawdown of Sukuk's return is happening in the third quarter of 2018 because affected by the interest rate from Bank Indonesia was increasing. Otherwise, the rising rate of return during the pandemic in 2020 is affected because the interest rate was decreasing. According to Rasudu (2021), the interest rate has a negative relation to bond price, while inflation doesn't have a relation to bond price as long as below 10% (stable inflation).

Table 3. Expected return, Standard Deviation, Coefficient of Variation of four-instruments

Instrument	E(r)	SD	CV
Sharia Deposits	0,0129	0,0019	0,1495
SBSN	0,0282	0,0373	1,3223
Corporate Bonds	0,0130	0,0275	2,1191
SDHI	0,0226	0,0280	1,2380

Table 3 shows the instrument with a minimum expected return and risk symbolized by standard deviation is Sharia deposits. Otherwise, the instrument with a maximum expected return and risk is SBSN. The result about the expected return and risk of Sharia deposits is in line with the study conducted by Krisnawan (2019) which obtained that deposits have a minimum expected return and risk than bonds and shares. The other study by Witjacsono et al. (2019) obtained the SBSN as one of the instruments that can provide a rate of return greater than other instruments but obtain a more significant risk. There is an axiom known as a "trade-off between risk and return," which means investors are willing to face heightened risk if they want to get a high return from their investment. Nopijantoro (2017) explained the SBSN especially Project Based Sukuk series can obtain a risk caused by the incompatibility of publishing time and the project realization issue. The coefficient of variation (CV) is the standard deviation divided by the expected return. The larger the CV, the more significant the dispersion, which means that the instrument was less attractive to investors as the choice of investment.

Measuring Coefficient of Correlation and Covariance

This step to measure correlation and covariance is a unity to show the relationship of return movement between the two instruments.

Table 4. Coefficient of Correlation of four instruments

Instrument	Sharia Deposits	SBSN	Corporate Bond	SDHI
Sharia Deposits	1	-0,163091482	-0,161489976	-0,194120734
SBSN	-0,163091482	1	0,628940539	0,910408650
Corporate Bonds	-0,161489976	0,628940539	1	0,620277365
SDHI	-0,194120734	0,910408650	0,620277365	1

Table 4 shows the Sharia deposits instrument has a negative correlation with other instruments, which means the relationship between Sharia deposits and other instruments (SBSN, corporate bond, SDHI) is unperfected correlated. This unperfected correlated meaning that the two instruments tend to have different characteristics. Otherwise, the Sukuk instruments such as SBSN, corporate bonds, and SDHI has a positive correlation, which means the relationship between Sukuk instruments is perfected correlated or the Sukuk instruments tend to have the same characteristic.

Table 5. Covariance of four-instruments

Instrument	Sharia Deposits	SBSN	Corporate Bonds	SDHI
Sharia Deposits	0,000003699	-0,000009040	-0,000006997	-0,000008197
SBSN	-0,000009040	0,001394773	0,000645700	0,000951489
Corporate Bonds	-0,000006997	0,000645700	0,000754612	0,000477064
SDHI	-0,000008197	0,000951489	0,000477064	0,000782742

Table 5 shows the Sharia deposits instrument has a negative covariance with Sukuk instruments. The negative covariance means the return movement between Sharia deposits with Sukuk instruments such as SBSN, corporate bonds, and SDHI are shown to move oppositely. Otherwise, the covariance between Sukuk instruments has a positive covariance, which means the return movement between Sukuk instruments is shown to move linearly. The result of correlation and covariance in this study is in line with the result of the study conducted by Fauji (2016) which the deposits have negative correlation and covariance with bonds. The negative correlation between

Sharia deposits and Sukuk instruments is the reason why BPKH and Kementerian Agama always allocated most the hajj fund into Sharia deposits and Sukuk instruments such as SBSN and SDHI over the year (Witjacsono et al., 2019a). Markowitz (1952) suggested that investors diversify their investments into instruments with minimum correlation and covariance to minimize the risk. A different result showed the study by Setyawan et al. (2020) that obtained the correlation between Sharia deposits with SDHI is positive.

Determining Investment Portfolios

The needs in determining a portfolio are the weight of instruments, expected return, risk, Sharpe ratio, and the risk-free rate. Weighting instruments in a portfolio are customized by Government Regulation No.5 of 2018 on Hajj Fund Management Chapter 27. In the rule, BPKH must allocate or invest their hajj fund to Sharia deposits a maximum of 50% in the first three years since BPKH starts to operate and a maximum of 30% after the first three years since BPKH starts to operate. The rule makes determining a portfolio in this study divided into two periods, portfolios in the first three years since BPKH started to operate (2018-2020) and portfolios after the first three years since BPKH started to operate (2021).

Table 6. Investment portfolio in the first three years since BPKH started to operate

Portfolio	Weight				E(r) of portfolio per kuartal	SD of portfolio per kuartal	*Risk Free Rate* per kuartal	*Sharpe Ratio*
	Sharia Deposits	SBSN	Corporate Bonds	SDHI				
Minimum Return	50,00%	0,00%	50,00%	0,00%	1,29%	1,36%	0,33%	0,7058
GMV	50,00%	0,00%	26,00%	24,00%	1,52%	1,24%	0,33%	0,9661
Maximum Sharpe	50,00%	0,00%	4,95%	45,05%	1,73%	1,34%	0,33%	1,0445
Maximum Return	0,00%	100,00%	0,00%	0,00%	2,82%	3,73%	0,33%	0,6683
Actual in 2018	58,02%	36,02%	1,49%	5,43%	1,88%	1,46%	0,33%	1,0581
Actual in 2019	53,74%	23,02%	3,33%	19,91%	1,83%	1,44%	0,33%	1,0492
Actual in 2020	40,54%	41,80%	3,23%	14,43%	2,07%	1,98%	0,33%	0,8775

Through measuring the Solver program was obtained 3 of BPKH's actual portfolios and four efficient portfolios were shown in Table 6. In BPKH's actual portfolios in 2018 and 2019, the composition of Sharia deposits is too much and exceeds the limit arranged by Government Regulation No.5 of 2018, which is a maximum of 50%. Meanwhile, the composition of Sharia deposits in the actual portfolio of 2020 was allocated to other instruments such as SBSN and SDHI. Therefore, the actual portfolio of 2020 obtained an expected return better than in 2018 and 2019, and the risk is getting bigger.

The four efficient portfolios consist of obtaining minimum return, minimum risk known as Global Minimum Variance (GMV), maximum Sharpe, and maximum return. In this case of the portfolio obtaining maximum return, BPKH can't choose the portfolio because BPKH is prohibited by the rule from investing 100% of the hajj fund in one instrument. The minimum return portfolio suggested BPKH invest 50% of their hajj funds into Sharia deposits and the remaining 50% into corporate bonds. The GMV portfolio suggested BPKH invest 50% of their hajj funds into Sharia deposits, 26% to corporate bonds, and the remaining to SDHI. Meanwhile, the maximum Sharpe portfolio suggested BPKH invest 50% of their hajj funds into Sharia deposits, 45,05% to SDHI, and the remaining to corporate bonds. There is no one efficient portfolio that suggested BPKH invest their hajj funds in the SBSN instrument because the instrument has the biggest risk than other instruments.

In determining the four efficient portfolios it is based on a study by Bertho & Hendranata (2020), which also determine efficient portfolios become four portfolios consisting of the portfolio obtaining maximum return, minimum return, minimum risk, and maximum Sharpe ratio. This result supports the result by Witjacsono et al. (2019), which clarifies the Sharia deposits composition in the actual portfolio of 2018 and 2019 exceeds 50% and does not fulfill the limit arranged by the Government Regulation.

Table 7. Investment portfolio after the first three years since BPKH started to operate

Portfolio	Weight				E(r) of portfolio per kuartal	SD of portfolio per kuartal	Risk Free Rate per kuartal	Sharpe Ratio
	Sharia Deposits	SBSN	Corporate Bonds	SDHI				
Minimum Return	30,00%	0,00%	70,00%	0,00%	1,29%	1,92%	0,33%	0,5035
GMV	30,00%	0,00%	36,52%	33,48%	1,62%	1,74%	0,33%	0,7406
Maximum Sharpe	30,00%	5,60%	0,00%	64,40%	2,00%	1,99%	0,33%	0,8413
Maximum Return	0,00%	100,00%	0,00%	0,00%	2,82%	3,73%	0,33%	0,6683
Actual in 2021	28,96%	63,42%	1,60%	6,02%	2,32%	2,54%	0,33%	0,7829

Table 7 shows the result of portfolios after the three years BPKH started to operate, consisting of BPKH's actual portfolio and four efficient portfolios. The composition of the portfolio in 2021 differs from actual portfolios in the over three years—the hajj funds in the actual portfolio of 2021 invested by BPKH mostly in SBSN instruments. Therefore, the expected return of the portfolio in 2021 is larger than the last three years, but the risk is increasing. The four efficient portfolios in this period have been customized about the composition of Sharia deposits instrument in their portfolio maximum of 30% based on the limit arranged in the Government Regulation No. 5 of 2018. The portfolio obtaining a maximum return after the first three years is the same as the portfolio obtaining a maximum return in the first three years. The portfolio obtaining a minimum return in this period suggested BPKH invest 30% of their hajj funds in Sharia deposits and 70% in corporate bonds. The portfolio obtaining a minimum risk (GMV) suggested BPKH invest 30% of their hajj funds in Sharia deposits, 36,52% in corporate bonds, and the remaining in SDHI. The portfolio obtaining a maximum Sharpe ratio suggested BPKH invest 30% of their hajj funds in Sharia deposits, 64,40% in SDHI, and the remaining in SBSN.

The result of determining portfolios supports a study by Setyawan et al. (2020) which obtained that if an investment hajj funds portfolio is dominated by deposits instrument, it will minimize the risk and the expected return of the portfolio. Otherwise, if a portfolio is not dominated by deposits instrument and the hajj funds are mostly allocated to Sukuk instruments, it will increase the risk and the expected return of a portfolio.

In comparison with management hajj funds in Malaysia Baig (2016) describe Lembaga Tabung Haji (LTH) allocated their hajj funds primarily to equity-basis investment, can reach 59% in 2013. Furthermore, 27% of their hajj funds are allocated to fix-income securities, 15% to property, and the remaining to cash. LTH also invests its hajj funds in ownership through its subsidiary, BIMB Holding Berhad (BHB). Through BHB, LTH can invest its hajj funds through Islamic banks, *takaful,* and stock-brocking. LTH also invests in the tech and information industry until the oil and gas industry. From the diversified management of their hajj funds, LTH can increase indirect cost subsidies and provide fixed direct costs consistently over the years between 2011-2019 (Hassan, 2019).

Determining an Optimal Portfolio

The four efficient portfolios determined in the last section can be formed into the curve known as efficient frontier with a scatter chart in Microsoft Excel. Efficient portfolios in an efficient frontier

curve have a maximum return at a particular risk or have a minimum risk at a certain return. There is an optimal portfolio between efficient portfolios. According to the Tangency model in the Markowitz Diversification method, an optimal portfolio is a portfolio that can obtain a maximum Sharpe ratio between efficient portfolios.

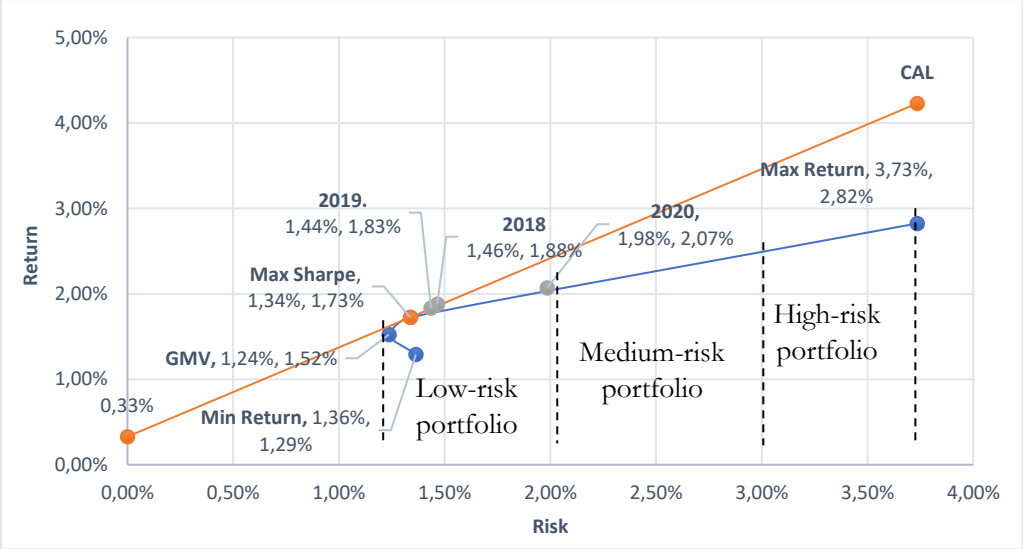


Figure 4. The Efficient Frontier curve and Capital Allocation line in the first three years period

Figure 4 shows actual portfolios in 2018 and 2019 are not within the curve, which means actual portfolios in 2018 and 2019 are not included in efficient portfolios as well as an optimal portfolio. Whereas the actual portfolio in 2020 included efficient portfolios in the first three years period but not an optimal portfolio because of the point of this portfolio within the curve. The optimal portfolio with the Tangency model in this period is the portfolio obtaining a maximum Sharpe ratio. The composition of this portfolio is 50% in Sharia deposits, 4,95% in corporate bonds, and 45,05% in SDHI. The portfolio can obtain a return of 1,73% and a risk of 1,34%.

According to a study by Pratiwi et al. (2019), portfolios can be divided based on standard deviation into three categories, low, medium, and high to obtain risk limits. The figure above shows low-risk portfolios with standard deviations below 2,07%, medium-risk portfolios with standard deviations between 2,07% to 2,90%, and high-risk portfolios with standard deviations above 2,90%. All of the actual portfolios and an optimal portfolio in this period are included in the low-risk portfolios category because their standard deviation is below 2,07%.

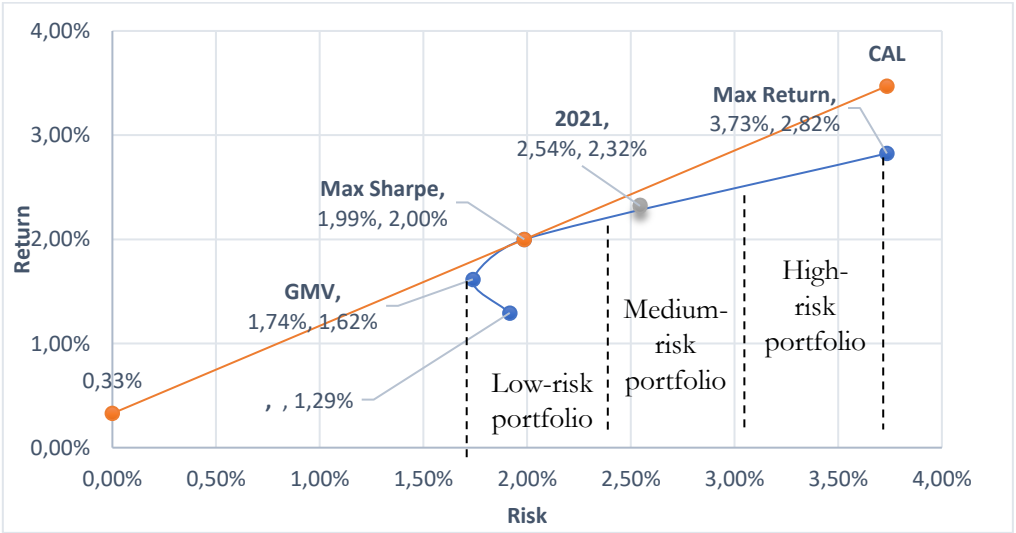


Figure 5. The Efficient Frontier curve and Capital Allocation line after the first three years period

Figure 5 shows the actual portfolio in 2021 is within the curve, which means the actual portfolio in 2021 included efficient but not an optimal one. The optimal portfolio after the first three years since BPKH started to operate is obtaining the maximum Sharpe ratio. Differing from the first three years, the composition in an optimal portfolio in this period is 30% in Sharia deposits, 64,40% in SDHI, and the remaining in SBSN instruments. The expected return obtained from this portfolio can reach 2,00%, and the risk of 1,99%.

Same as in the first three years, portfolios in this period can be divided based on standard deviation into low, medium, and high-risk portfolios. The figure above shows low-risk portfolios with standard deviations below 2,40%, medium-risk portfolios with standard deviations between 2,40% to 3,06%, and high-risk portfolios with standard deviations above 3,06%. In this period, if BPKH chooses the optimal portfolio as its investment portfolio, it can reduce its portfolio risk from medium to low risk by sacrificing a little expected return because the risk obtained from an optimal portfolio is below 2,40%.

There are similarities between the two optimal portfolios. First, the two optimal portfolios always maximize the composition of Sharia deposits based on the limit arranged by Government Regulation No.5 of 2018 on Hajj Fund Management Chapter 27. If the regulation limits the composition of Sharia deposits maximum of 50% in the first three years, then the composition of Sharia deposits in the optimal portfolio is also 50%. Suppose the regulation limits the composition of Sharia deposits maximum of 30% after the first three years since BPKH started to operate. In that case, the composition of Sharia deposits in the optimal portfolio is also 30%. Second, the SDHI instrument can be an alternative instrument if the composition of Sharia deposits is reduced. It is shown from the composition of SDHI is also dominant in the two optimal portfolios. A study by Witjacsono et al. (2019) also mentioned that the SDHI instrument could be BPKH's preferred instrument if the composition of Sharia deposits is reduced because the SDHI has a moderate return with low risk, guaranteed by the government, and provide immediate benefits to the pilgrims. So the two instruments, Sharia deposits and SDHI are important in an optimal portfolio and the future portfolio of BPKH.

The optimal portfolio result in the first three years since BPKH started to operate supports the optimal portfolio in a study conducted by (Setyawan et al., 2020). The optimal portfolio obtained in his research between 2017-2019 shows the composition is 50% in Sharia deposits and 50% SDHI. Furthermore, The optimal portfolio after three years since BPKH started to operate was obtained in this study similar to the moderate portfolio in a study by (Pujiharto et al., 2022). The moderate portfolio obtained by his research shows the composition is the placement of hajj funds in Islamic banks maximum of 30% and 70% in investment instruments.

Conclusion

The result and discussion above can obtain conclusions. First, actual portfolios of BPKH in 2018 and 2019 are not included efficient portfolios or the optimal portfolio. Whereas actual portfolios of BPKH in 2020 and 2021 included efficient portfolios but not optimal ones. Second, through the Tangency model and based on the Government Regulation No.5 of 2018, the optimal portfolio determined by the portfolio can obtain the maximum Sharpe ratio. The optimal portfolio in the first three years since BPKH started to operate as a composition is 50% in Sharia deposits, 4,95% in corporate bonds, and 45,05% in SDHI. After the first three years since BPKH started to operate, the optimal portfolio is recommended BPKH allocate the hajj funds 30% in Sharia deposits, 5,60% in SBSN, and 64,40% in SDHI. If BPKH chooses the optimal portfolio for their future portfolio, they can minimize the portfolio risk from medium-risk to low-risk. BPKH can provide immediate benefits to the pilgrims through investment in SDHI. In addition, this study suggests BPKH diversify its portfolio into many instruments the same Lembaga Tabung Haji (LTH) does. BPKH can enter into untouchable instruments by the own BPKH, such as technology, oil and gas, until subsidiary ownership.

As a limitation, this study does not consider external factors such as inflation, exchange rate, and the postponement of hajj performed in 2020 and 2021 because of the pandemic in the Markowitz method but assumed to have been reflected in return performance. The total of the instrument was considered in this study limited to four instruments. The four instruments were taken based on having the largest composition percentage in BPKH's actual portfolio.

For further research, it's necessary to consider all of the instruments in actual portfolios of BPKH, from the largest percentage to the smallest percentage of the composition and also consider entering external factors as well as the benchmark of each instrument in the measuring and determining portfolios by using a more precise method such as Single Index Model. Considering all of the instruments and entering the benchmark will make the study results more accurate and obvious.

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