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The Optimal Portofolio Creation Using Markowitz Model

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Abtract

The research intends at analyzing the optimal portfolio creation using the Markowitz model (Mean variance) in the Chevron Pacific Indonesia pension fund.The research methodology used is qualitative descriptive method with panel and secondary data obtained from the Chevron Pacific Indonesia pension fund. The sampling technical method used the monthly data during the period January 2016 to December 2018. The data analysis technique used is a portfolio analysis using Markowitz model.In the analysis it was found that during the period. The writer considers investment activities Chevron Pacific Indonesia pension fund hasn't formed efficient portfolio and optimal, only produces an average realization return of 7.93% with a risk 3.50%. While efficient portfolio alternatives by using the mean variance model are: in GMV portfolio produces an expected return 7.93% with a risk 1.45%, while in Tangency portfolio an expected return is 8.07% with a risk 3.73%, while the maximum portfolio return produces an expected return of 10.24% with the highest level risk of 12.24%.

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Abstraks

Penelitian ini bertujuan untuk menganalisis penciptaan portofolio optimal dengan menggunakan model Markowitz (Mean variance) pada dana pensiun Chevron Pacific Indonesia. Metodologi penelitian yang digunakan adalah metode deskriptif kualitatif dengan panel dan data sekunder yang diperoleh dari dana pensiun Chevron Pacific Indonesia. Teknik pengambilan sampel menggunakan data bulanan selama periode Januari 2016 sampai dengan Desember 2018. Teknik analisis data yang digunakan adalah analisis portofolio dengan menggunakan model Markowitz. Dalam analisis ditemukan bahwa selama periode tersebut. Penulis menilai kegiatan investasi dana pensiun Chevron Pacific Indonesia belum membentuk prtfolio yang efisien dan optimal, hanya menghasilkan realisasi retun rata-rata sebesar 7,93% dengan risiko 3,50%. Sedangkan alternatif portofolio yang efisien dengan menggunakan mean variance model adalah: pada portofolio GMV menghasilkan expected return 7,93% dengan risiko 1,45%, sedangkan pada Tangency portfolio return yang diharapkan adalah 8,07% dengan risiko 3,73%, sedangkan return portofolio maksimum menghasilkan pengembalian yang diharapkan sebesar 10,24% dengan tingkat risiko tertinggi sebesar 12,24%.

Kata Kunci:
Dana Pensiun, Investasi, Markowitz, Portofolio, dan Risiko-Pengembalian

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1. Introduction

Based on data from the Financial Services Authority in 2018, Pension Fund investment is still dominated by capital market instruments, which in a period of 5 (five) years total Pension Fund investment has grown with an average annual growth of 10.76%. Investment in the capital market is one form that is often used in investing. According to Jones, (2019) explains in his book that investment can be defined as a commitment of funds for one or more assets that will be held for some period of time in the future.

Investment in the capital market is an investment that provides a high return, but the risk is high. Investors will try to optimize their investment portfolio, by analyzing the information related to their investment. Investors need in-formation relevant to investments as material for making decisions (Shen et al., 2017; Amir & Serafeim, 2018; Pahlevi & Oktaviani, 2018; Roychowdhury et al., 2019; and Kurniawati et al., 2019; Roychowdhury et al., 2019). Although in making decisions sometimes there are irrational emotions investors in making decisions. Investor decisions are also influenced by emotional and cognitive factors (Tuyon & Ahmad, 2017; Setiawan et al., 2018; Boda & Sunitha, 2018; Zahera & Bansal, 2018; Bikas & Saponaitė, 2018; Rasheed et al., 2018; Keswani, 2019; and Atif Sattar et al., 2020).

The fundamental thing in investment decisions is to understand the relationship between return and risk of an investment. Investors will look for relevant information, as a basis for analysis for subsequent decisions. In making decisions, investors are required to be able to do it quickly and precisely, so as not to lose the mo-ment. Timing in making investments is an important factor.

The investment process generally includes understanding the basics of investment decisions, the fundamental thing in investment decisions is understanding the relationship between return and risk of an investment. In the context of investment management, the level of investment profit is referred to as return, while risk according to Tandelilin (2017) is the possibility of an actual return that is different from the expected return.

Investors can form their investments in portfolios or collections of assets with the aim of diversifying the placement of their investment funds into several different assets so that the risk of loss from their investments can be reduced. However, in the portfolio there is also the problem of how investors choose and determine the best combination of return and risk, in order to form an optimal portfolio (Dell'ariccia et al., 2016; Chou et al., 2017; Bhargavi et al., 2017; Caldeira et al., 2017; Demiguel et al., 2018; and Sukharev, 2019).

To form an optimal portfolio, investors must determine an efficient portfolio first. According to Tandelilin (2017), an efficient portfolio is a portfolio that has the same level of risk with a high return or the same return with a low risk, while the optimal portfolio is a portfolio chosen by investors from a large collection of efficient portfolios.

There are several approaches to create an optimal portfolio, such as using a single index model, Markowitz, Decision Making Unit Efficiency, and Data Envelopment Analysis (Eko, 2008; Werastuti, 2012; Fuad & Agustanto, 2016; Putri & Muktiadji, 2018; Ermis et al., 2020; and Rachmatullah et al., 2020). These various approaches have their respective advantages and disadvantages as an approach.

The single index model was developed by William Sharpe in 1963. The single index model is based on the observation that the price of a security fluctuates in the direction of the market price index.

The formation of a stock portfolio using Data Envelopment Analysis (DEA) shows the results that the DEA has good capabilities to generate superior returns. The DEA model can combine various inputs and outputs more than one into the measurement single to determine the level of efficiency. The DEA method can select good stocks for investment managers (Chen, 2008; Pätäri et al., 2010; Pätäri et al., 2012; and Zamani et al., 2014).

The optimal portfolio theory was developed by Harry M Markowtz in 1952. In his approach Markowitz uses several statistical mea-sures such as expected return, standard deviation of both securities and portfolios, and correlation between returns. In optimal portfolio theory, Markowitz formulates the elements of risk and return in an investment, where risk can be minimized by diversifying and combining vari-ous investment instruments in a portfolio (Moreno et al., 2005; Oliva & Renò, 2018; Yunita, 2018; Shadabfar & Cheng, 2020; and Agus et al., 2020).

This will help investors in making their investment decisions. Therefore, the research fo-cuses on the use of the Markowitz model in ana-

lyzing portfolio optimization on the portfolio performance of the Chevron Pacific Indonesia Pension Fund.

According to Law Number 11 of 1992 concerning Pension Funds, Pension Funds are defined as legal entities that manage and run programs that promise pension benefits. Pension Program is any program that seeks pension benefits for participants, including the Defined Benefit Pension Program (PPMP) and the Defined Contribution Pension Program (PPIP).

The Chevron Pacific Indonesia Pension Fund is a Caltex Pacific Indonesia Pension Fund Foundation (Pension Fund CPI) which was established on January 9, 1989. With the change in the name of the Founder of Pension Fund CPI, namely PT. Caltex Pacific Indonesia became PT. Chevron Pacific Indonesia which is engaged in the Petroleum Exploration industry, then the Pension Fund CPI then changed its name to the Chevron Pacific Indonesia Pension Fund.

Research purposes is 1) Analyze the results of the calculation of the ideal (efficient) and optimal portfolio of investment instruments in the Pension Fund portfolio at Chevron Pacific Indonesia during the 2016-2018 period. 2) Analyzing the actual portfolio calculation on investment instruments in the Pension Fund portfolio at Chevron Pacific Indonesia during the 2016-2018 period. 3) Analyzing the comparison of the calculation results of the ideal (efficient) and optimal portfolio with the actual portfolio of investment instruments in the Pension Fund portfolio at Chevron Pacific Indonesia during the 2016-2018 period.

2. The Empirical Framenwork

Markowitz was the first to develop a formal concept of portfolio diversification–the quantified concept of diversification. It shows quantitatively why, and how, portfolio diversification works to reduce portfolio risk to investors when indi-vidual risk is correlated.

Harry Markowitz published an article entitled Portfoio Selection in the Journal of Finance in March 1952 which opened a world view of the modern portfolio where there is a concept of the relationship between risk and return. Markowitz's approach in choosing a portfolio is that investors should evaluate the portfolio based on the expected return and risk as measured by the standard deviation (variance).

According to Jogiyanto (2019:388), the Markowitz model uses the following assumptions: 1) The time used is only one period, 2) No transaction fees, 3) Investor preferences are only based on the expected return and risk of the portfolio, 4) No risk-free loans and deposits.

The conceptual framework for conducting optimal portfolio analysis is presented in Figure 1. Where for risk-free returns, Bank Indonesia's interest rate reference is used.

3. Data and Methods

In this study, the author uses a qualitative method because the scope of research is data from the Financial Statements of the Chevron Pacific Indonesia Pension Fund Investment Portfolio and data in the form of secondary data obtained from direct companies, while the publication of monthly 7-day repo rate data for 2016-2018 is ob-tained from the website. official Bank Indonesia.

This study uses a purposive sampling method which is a sampling technique for certain purposes only, which is limited for the period January 2016 to December 2018. This study uses secondary data obtained from agencies or institutions that are directly related and other supporting data that has been published as over the internet.

Data Analysis Technique

Calculating stock returns and risks Return shares can be calculated by the formula:

$$Ri = \frac{(P_t - P_{t-1})}{P_{t-1}}$$

Return stock expectations can be calculated by the formula:

$$E(Ri) = \frac{\sum_{t=1}^{N} Rit}{N}$$

Information: Rij= return stock i period j; E(Ri)= expected rate of return on investment; N= number of periods.

Stock risk can be calculated by the formula:

$$\sigma^2 = \frac{\sum_{t=1}^{N}[(Rit - E(Ri)]^2}{N}$$

Information: σ^2= variant. The variance is used to measure the risk of expected stock return i.

Covariance can be calculated by the formula:

$$\sigma ij = \frac{\sum_{t=1}^{N}[(Rit - E(Ri)]}{N}$$

The correlation coefficient can be calculated by the formula:

$$\rho = \frac{n\sum xy - n\sum x\sum y}{\sqrt{\{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]\}}}$$

Expected return of the portfolio can be calculated by the formula:

$$E(Ri) = \frac{\sum_{t=1}^{N} Rit}{N}$$

The risk of the portfolio can be calculated by the formula:

$$\sigma p^2 = x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2(x_1x_2\rho_{12}\sigma_1\sigma_1)$$

$$\sigma p = \sqrt{\sigma_p^2}$$

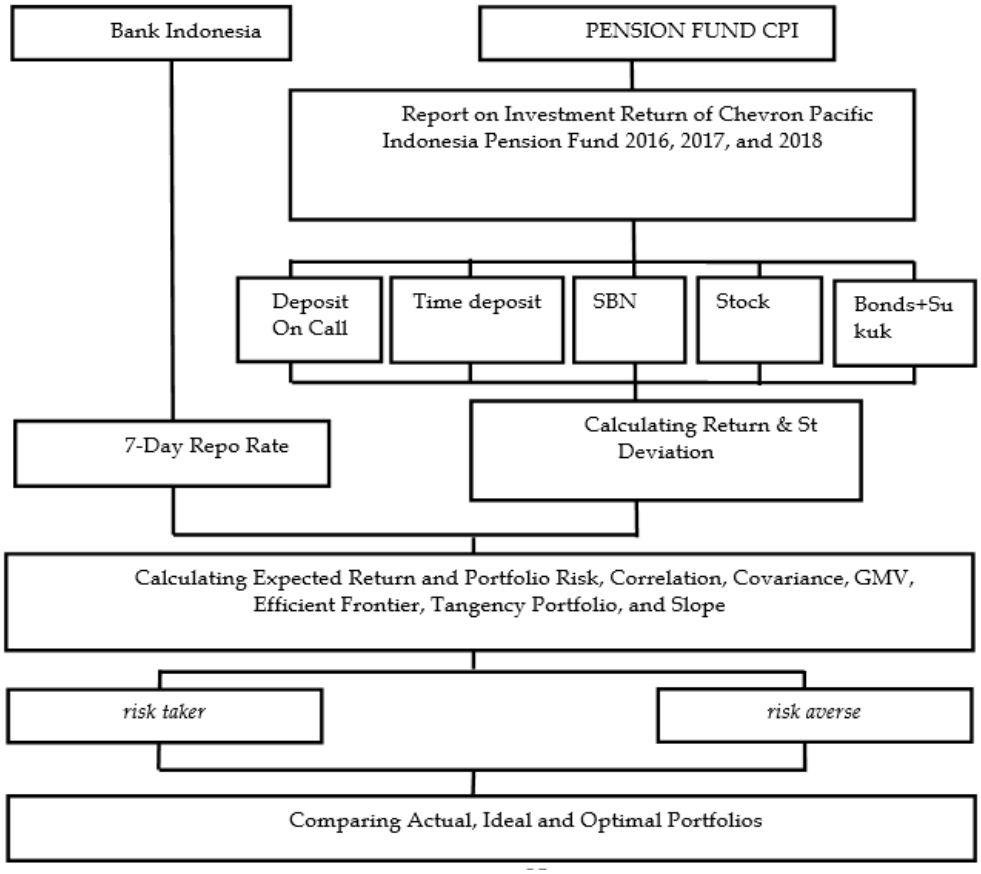

Figure 1. Conceptual Framework Portfolio

4. Result

Calculating Individual Asset Return

Return realization is obtained from the return on investment of instrument type i in the (n) month then divided by investment funds of instrument type i in the (n) month. Expected re-turn is the average of realized returns. After cal-culating the return for each individual asset, the following is the return generated by the Chevron Pacific Indonesia Pension Fund portfolio.

From the table 1, it can be seen that the portfolio return with the best performance was obtained in 2016 of 9.32% and the lowest occurred in 2017 of 7.56%. The decline in the performance of the Chevron Pacific Indonesia Pension Fund in 2017 was due to the downward trend in yields on deposit investment instruments. Based on data reported by KONTAN on January 29, 2018, the overall return on investment in pension funds decreased by 7.4% in 2017, the Financial Services Authority (OJK) noted that the return on investment (ROI) of pension fund managers decreased to 7.4% from an ROI of 8. 6% in 2016.

Table 1. Individual Return

Individual Return	Year			Average
	2016	2017	2018	
Deposit on Call	3.69%	1.78%	2.51%	2.66%
Time deposit	8.22%	7.06%	6.68%	7.32%
Government Securities	7.39%	8.63%	5.86%	7.29%
Stock	13.13%	5.88%	11.71%	10.24%
Bonds+Sukuk	10.98%	9.06%	9.45%	9.83%
Total Actual Portfolio Return	9.32%	7.56%	8.27%	8.38%

Table 2. Individual Risk of Portfolio Maker

No	Asset	E(Ri)	Variance	SD
1	Deposit On Call	2.66%	0.0100%	3.47%
2	Time deposit	7.32%	0.0010%	1.08%
3	SBN	7.29%	0.0061%	2.70%
4	Stock	10.24%	0.1376%	12.85%
5	Bonds+Sukuk	9.83%	0.0056%	2.59%

Calculating Investment Risk

In analyzing the investment risk in the Che-vron Pacific Indonesia Pension Fund, the author first analyzes the risk of each type of investment instrument forming the PENSION FUND CPI portfolio by using the 2016-2018 return data that has been calculated previously. It can be seen that the order of risk from the largest is Stocks 12.85%, Time Deposits on Call 3.47%, Government Securities (SBN) 2.70%, Bonds + Sukuk 2.59%, and Time Deposits 1.08% (Table 2).

Covariance and Correlation Analysis

Covariance and Correlation analysis is used to determine the relationship between an asset to other assets. With covariance and correlation, investors can allocate the optimal composition of assets in their portfolios to minimize risk and maximize returns. The portfolio covariance values are presented in table 3.

Table 3. Portfolio Covariance

Covariant 2016-2018	*DOC*	*DB*	*SBN*	*STOCK*	*BOND*
DOC	0.000811%	-0.000008%	-0.000040%	-0.000088%	0.000123%
DB	-0.000008%	0.000079%	0.000004%	-0.000150%	-0.000035%
SBN	-0.000040%	0.000004%	0.000491%	0.000174%	-0.000057%
STOCK	-0.000088%	-0.000150%	0.000174%	0.011149%	0.000819%
BOND	0.000123%	-0.000035%	-0.000057%	0.000819%	0.000453%

Table 4. Portfolio Correlation

Correlation 2016-2018	*DOC*	*DB*	*SBN*	*STOCK*	*BOND*
DOC	1.00	(0.03)	(0.06)	(0.03)	0.20
DB	(0.03)	1.00	0.02	(0.16)	(0.18)
SBN	(0.06)	0.02	1.00	0.07	(0.12)
STOCK	(0.03)	(0.16)	0.07	1.00	0.36
BOND	0.20	(0.18)	(0.12)	0.36	1.00

The data shown in the table 4 shows that the correlation between Chevron Pacific Indonesia Pension Fund investment instruments ranges from -0.18<0.36. The relationship between each instrument is very diverse, there are 4 (four) positively correlated assets, namely: Deposits on Call with Bonds, Time Deposits with Government Securities (SBN), Government Securities (SBN) with Shares, and Bonds with Shares. Meanwhile, 6 negative correlated assets are: Time Deposits with Time Deposits, Deposits on Call with Government Securities (SBN), Deposits on Call with Shares, Time Deposits with Shares, Time Deposits with Bonds, and Government Securities (SBN) with Bonds.

The Level of Risk and Return of the Portfolio

The investment activities carried out by the Chevron Pacific Indonesia Pension Fund during 2016 to 2018 have allocated their investment

funds into several types of investment instruments with the composition of each asset as shown in the table 5. Investments made include Deposit on Call, Time Deposit, SBN, Stock, Bonds and sukuk. The average interest rate for deposits on call is the lowest, which is only 1.15%

Table 5. 2016-2018 Portfolio Composition

Asset	2016	2017	2018	Average
Deposit on Call	0.83%	0.43%	2.18%	1.15%
Time deposit	49.13%	40.44%	39.31%	42.96%
SBN	28.69%	30.87%	34.91%	31.49%
Stock	13.95%	16.99%	13.31%	14.75%
Bonds+Sukuk	7.40%	11.27%	10.29%	9.65%
Total	100.00%	100.00%	100.00%	100.00%

Table 6. Level of Return and Portfolio Risk

Instrument	2016		2017		2018		Average	
Investation	E(R)	SD	E(R)	SD	E(R)	SD	E(R)	SD
Deposit on Call	3.69%	5.72%	1.78%	1.15%	2.51%	1.46%	2.66%	3.47%
Time deposit	8.22%	1.43%	7.06%	0.26%	6.68%	0.47%	7.32%	1.08%
SBN	7.39%	2.19%	8.63%	1.55%	5.86%	41.15%	7.29%	2.70%
Shares (shares)	13.13%	18.16%	5.88%	4.89%	11.71%	11.81%	10.24%	12.85%
Bonds+Sukuk	10.98%	4.08%	9.06%	1.25%	9.45%	0.94%	9.83%	2.59%
Average	8.83%	4.21%	7.55%	1.56%	7.26%	3.08%	7.93%	3.50%
Actual Portfolio	9.32%		7.56%		8.27%		8.38%	

The composition of investment funds for three consecutive years Time Deposits dominated the CPI Pensiun Fund investment portfolio, ranging from 39.31% (2018) to 49.13% (2016) (Table 5). The table 6 shows that the composition compiled in the CPI Pensiun Fund portfolio during 2016-2018 has an expected return value and standard deviation that fluctuates every year. Meanwhile, during the 2016-2018 period, based on the Microsoft Excel program, the expected return value was 7.93%. with a standard deviation of 3.50%. Then the level of return for the CPI Pensiun Fund portfolio will be in the following range:

Lower limit = 7.93% - 3.50% = 4.43%

Upper limit = 7.93% + 3.50% = 11.43%

5. Discussion

Determining the Ideal and Actual Portfolio

Global Minimum Variance (GMV) Portfolio

This GMV portfolio has the lowest level of risk from the entire composition of the efficient portfolio generated on the Efficient frontier. To determine the GMV portfolio, here are the steps:

Objective function

Minimize VAR E(R) =

$$W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + W_3^2\sigma_3^2 + W_4^2\sigma_4^2 + W_5^2\sigma_5^2 + 2W_1W_2\sigma^{12} + 2W_1W_3\sigma^{13} + 2W_1W_4\sigma^{14} + 2W_1W_5\sigma^{15} + 2W_2W_3\sigma^{23} + 2W_2W_4\sigma^{24} + 2W_2W_5\sigma^{25} + 2W_3W_4\sigma^{34} + 2W_3W_5\sigma^{35} + 2W_4W_5\sigma^{45}$$

Terms and Limitations

=

$$W_1 + W_2 + W_3 + W_4 + W_5 = 1$$

W_1 is greater than zero (0), W_1>).

Table 7. GMV. Portfolio

Instrument	Portfolio %		
	A	B	E
Deposit on Call	0.00	0.00	0.00
Time deposit	100.00	93.96	75.66
Government Securities	0.00	0.00	0.00
Stock	0.00	0.00	0.00
Bonds+Sukuk	0.00	6.04	24.34
Total	100.00	100.00	100.00
Risk	1.08	1.18	1.45
Expected Return	7.32	7.47	7.93

The table 7 shows that the composition of portfolio E recommends the smallest risk level of 1.45% and will produce an expected return that is the same as the average portfolio of the 2016-2018 Chevron Pacific Indonesia Pension Fund, which is 7.93% higher than the two portfolio schemes A and Portfolio B, so portfolio E can be made a candidate as a GMV portfolio. The limits for the level of profit for the GMV portfolio are as follows:

Upper limit = 7.93% - 1.45% = 6.48%

Lower limit = 7.93% + 1.45% = 9.38%

Optimal Portfolio at a Certain Expected Return (Efficient Frontier)

Using the same objectivity function as the GMV portfolio and adding the terms and constraints on the efficient frontier level, namely:

Terms and Limitations =

1) $W_1 + W_2 + W_3 + W_4 + W_5 = 1$

2) W_1 is the greater than zero; $W_1 \geq$

3) $E(R) = \sum_{i=1}^{n} W_1 R_1$

Table 8. Solver Results on Efficient Frontier with Certain Expected Return Levels

Instrument	Portfolio					
	Average	E	Q	R	S	T
Deposit on Call	1.15%	0.00%	0.00%	0.00%	0.00%	0.00%
Time deposit	42.96%	75.66%	1.25%	0.00%	0.00%	0.00%
SBN	31.49%	0.00%	0.00%	0.00%	0.00%	0.00%
Stock	14.75%	0.00%	0.00%	8.88%	41.55%	100.00%
Bonds+Sukuk	9.65%	24.34%	98.75%	91.12%	58.45%	0.00%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Risk	3.50%	1.45%	2.57%	3.50%	6.85%	12.85%
Expected Return	7.93%	7.93%	9.80%	9.87%	10.00%	10.24%

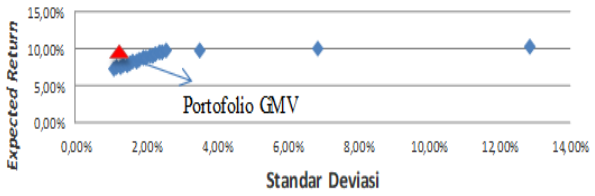

Figure 2. Efficient Frontier

Based on the table 8 and the figure 2, a portfolio selection is generated that yields a re-turn of between 7.93% up to 10.24% with a risk of 1.45% to 12.85%.If the Chevron Pacific Indonesia Pension Fund has a risk level of 3.50% then if you use *efficient frontier* Markowitz will generate a much higher return of 9.87% (Portfolio R).

Optimal Portfolio with Risk-Free Assets (Tangency portfolio)

In the previous portfolio, the recommended instrument group was a risky asset group. If a risk-free asset, such as a time deposit, is entered, a different portfolio will be obtained from before. Deposits will be included with risky portfolios such as stocks, bonds and government securities. So, by entering deposits into the portfolio, you will get a recommendation for the Chevron Pacific Indonesia Pension Fund portfolio from Microsoft Excel Solver as table 9.

Table 9. Asset Composition in Tangency Portfolio

Instrument	Portfolio					
	Average	E	Q	R	S	T
Deposit on Call	1.15%	0.43%	0.43%	0.43%	0.43%	0.43%
Time deposit	42.96%	49.13%	47.20%	45.71%	44.34%	42.62%
SBN	31.49%	28.69%	28.69%	28.69%	28.69%	28.69%
Stock	14.75%	13.31%	13.31%	13.90%	15.27%	16.99%
Bonds+Sukuk	9.65%	8.44%	10.37%	11.27%	11.27%	11.27%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Risk	3.50%	3.25%	3.28%	3.36%	3.52%	3.73%
Expected Return	7.93%	7.89%	7.94%	7.98%	8.02%	8.07%

Actual Portfolio Analysis on Efficient Frontier

In accordance with the data displayed, the analysis of the performance of the Chevron Pacific Indonesia Pension Fund portfolio can be explained as follows: 1) The results of the Pensiun Fund CPI portfolio are between the efficient frontier curves. These results indicate that the portfolio performance during the research period has not formed an efficient and optimal portfolio (figure 3). 2) Pensiun Fund CPI risk level interval is in the range of 1.56%-4.21%. With the characteristics of this level of risk, when using the efficient frontier curve, Pensiun Fund CPI is still possible to increase higher returns with the composition of the portfolio being predominantly placed in time deposits. 3) The risk level for three years in 2016, 2017, and 2018 Pensiun Fund CPI is lower than the rate of return it obtains.

Comparative Analysis of Actual Portfolio Results with Efficient and Optimal Portfolios (Sharpe Ratio)

By using the Sharpe formula and 7-Day (Reverse) Repo Rate interest rate data, the results

obtained are as tabel 10. The actual portfolio performance during the research period based on the sharpe ratio resulted: 2016 was not better, while in 2017, 2018 and the average were considered better.

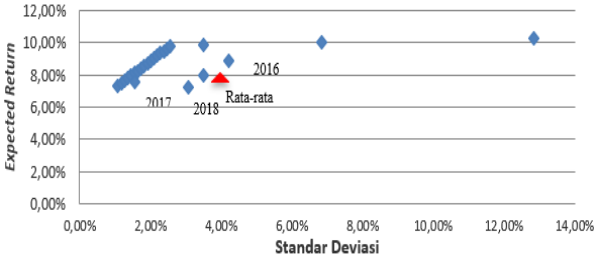

Figure 3. Pensiun Fund CPI Portfolio per year against Efficient Frontier.

Tabel 10. Sharpe Ratio

	Return Portfolio	*Risk Free Rate*	*Excess Return*	St. Dev	*Sharpe Ratio*
2016 Portfolio	8.83%	0.50%	8.33%	4.21%	1.98%
2017 Portfolio	7.55%	0.38%	7.17%	1.56%	4.59%
2018 Portfolio	7.26%	0.42%	6.83%	3.08%	2.22%
Average	7.93%	0.43%	7.50%	3.50%	2.14%
GMV	7.93%	0.43%	7.50%	1.45%	5.17%
Tangency	8.07%	0.43%	7.64%	3.73%	2.05%
Max Return	10.24%	0.43%	9.80%	12.85%	0.76%

6. Conclusions and Suggestions

Conclusions

The results of the efficient and optimal portfolio calculation based on the Markowitz model are as follows: 1) The results of this study indicate that the selection of the proportion of assets or types of investment instruments, ex-pected return, and portfolio risk is efficient and optimal using the Markowitz model (Mean variance) with three approaches: Global Mini-mum Variance (GMV), Efficient Frontier, and Tangency Assets. 2) PENSION FUND CPI portfolio assets have the following characteristics: a) The order of assets based on portfolio compo-sition is: time deposits, government securities, stocks, bonds and sukuk, and deposits on call. b) Order based on the highest rate of return, namely: stocks, bonds and sukuk, time deposits, state securities, and deposits on call. c) The order based on the lowest risk volatility is time deposits, bonds and sukuk, government securities, deposits on call, and stocks. 3) The optimal portfolio alternative for PENSION FUND CPI generated using the mean-variance model can be considered as follows: a) Global Minimum Variance Portfolio (GMV), recommends the lowest risk level among the available portfolio options with an expected return equal to the average CPI PENSION FUND portfolio. b) *Tangency portfolio*, yields a higher rate of return with a higher level of risk than the GMV portfolio. c) The maximum return portfolio pro-vides the highest risk level of 12.85% with the largest return rate of 10.24%. 4) Calculation of the Markowitz efficient frontier method by adjusting the provisions (regulations) related to investment compo-sition, the optimal portfolio is achieved with a composition of 0.43% on call deposits, 42.62% time deposits, 28.69% Government Secu-rities, 16.99% shares, and 11.27% bonds and su-kuk. This composition has an expected return level of 8.07% and a risk of 3.73%. The actual portfolio during the research period has *return* realization in 2016 was higher than the ideal portfolio in the tangency portfolio. While the returns in 2017, 2018, and the average portfolio during the study period were lower. From the results of the analysis, the results of portfolio performance are: a) Has a sharpe ratio that varies with the tangency portfolio. Here are the results: 2016 portfolio performance no better and Better portfolio performance in 2017, 2018 and 2016-2018, b) Meanwhile, the efficient frontier based on the results of the mapped Chevron Pacific Indonesia Pension Fund performance is still below the formed efficient frontier curve, meaning that it has not formed an efficient and optimal portfolio.

Suggestions

This study uses only one optimal portfolio formation model, namely the Markowitz model (Mean-Variance Model). To produce a truly optimal portfolio composition, it is necessary to compare the existing optimal portfolio formation models. The research period is limited to only 3 years, and is limited to using only the Markowitsz model. For further research, the data uses research samples in more detail with a longer obser-

vation period. The research period should use the period when the market moves normally. The research model can be carried out with various models so that it will give better results.

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