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Investment Portfolio Optimization and Performance (Case Study on PLN Pension Fund Period 2010-2020)

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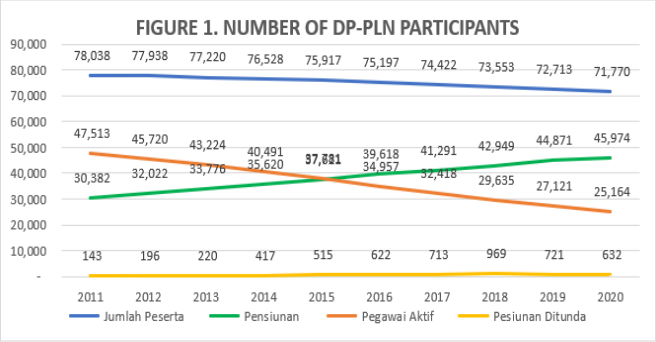
Abstract:- The Purpose of the research was to analyze the composition of the Investmen Portfolios that can provide optimal results. Portfolio optimization calculation using Model Markowitz with two assumptions, namely maximizing portfolio return and using Risk Adjusted Return (RAR). In the last three years, namely 2018, 2019 and 2020, the ROI phenomenon of DP-PLN investments is below the technical interest rate of 8.5%, so it is necessary to optimize the investment portfolio. Return on investment portfolio of DP-PLN The optimal result in this study is 11.30% with a portfolio risk of 3.77%. To achieve a return with this risk, DP-PLN needs to increase its investment in Bonds to 59.84% and Land and Buildings to 20.00%. In addition, DP-PLN needs to reduce investment in Savings and Time Deposits to 1.25%, Shares and Mutual Funds to 0%, Direct Investment to 3.91%, and maintain the composition of SBN at 15.00%. This research is able to provide the additional return on investmen that is greater than risk free asset to the total risks of the investment portfolio owned by DP-PLN which is reflected in the positive Sharpe Ratio value of 1.44%, positive Treynor Ratio 0.06 % and positive Jensen Ratio 0, 02 % which shows better performance than the market.

Keywords:- *Portfolio Optimization , Markowitz, Sharpe, Treinor, Jensen.*

I. INTRODUCTION

Pension fund is a legal entity that manages and runs a pension program that promises retirement benefits. The Pension Fund consists of the Employer Pension Fund (DPPK), Financial Institution Pension Fund (DPLK), and Profit-Based Pension Fund (DPBK) as regulated in Indonesian Law No. 11 of 1992 . PLN Pension Fund is included in the Employer Pension Fund (DPPK) formed by a person or entity that employs employees, as founders, to organize a Defined Benefit Pension Program or a Defined Contribution Pension Program, for the benefit of some or all of its employees as participants, and which causes obligations to the Employer . DP-PLN participants as of December 31 , 2020 totaled 71,770 people, which consist from Participant Active as much 25,164 person , Participant Non Active (Retired) as many as 45,974 people and Postponed Pensions as many as 632 people with the composition in figure 1 below:



From table 1 above showing that the more year participant active decrease and amount retired increase in influence to drop reception dues participants and fees founder, and the more increase obligation in the end will also affect the fund adequacy ratio (RKD) so that portfolio investation must be optimal.

According to Regulation Financial Services Authority Number 29/POJK.05/2018 regarding Change on Authority Regulation Financial Services Number 3/POJK.05/2015 concerning Pension Fund Investment, there are 19 (nineteen) types of investments that are allowed for placement of funds by the Pension Fund. In Thing In this case, DP-PLN in fulfilling its obligation to be able to provide the best results to stakeholders, especially to participants , must develop the most optimal form of investment portfolio management plan from the types of allowed investment conditions legislation.

The portfolio formed by the DP-PLN Management must be selected based on the Investment Directions that have been determined by the DP-PLN Founder in such a way so that realizing an optimal portfolio with the hope of obtaining maximum results in accordance with the desired level of risk. The optimal portfolio is an efficient portfolio which can be defined as a portfolio that provides the greatest *return* with a certain level of risk.

The composition of the DP-PLN investment portfolio as of December 31, 2020 is Bonds (29%), SBN (15%), Mutual Funds (13%), Shares (11%), Property (11%), Direct Placements (11%), Money Market (10%) as shown in figure 2.

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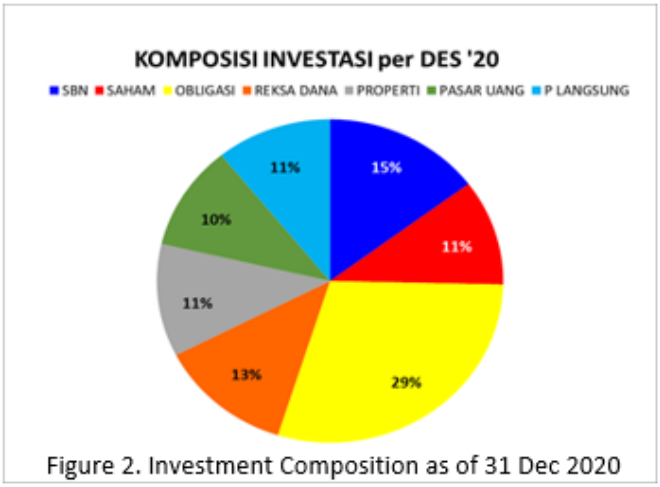

Figure 2. Investment Composition as of 31 Dec 2020

Large Pension Fund managed funds require the Pension Fund Management to manage the Pension Fund effectively professional, productive and *prudent*. Existing funds must be invested in sectors that optimally generate *returns* in accordance with the Investment Directions set by the Founder and the Supervisory Board . Therefore, it is expected that the return on the resulting portfolio can be optimal and achieve the investment target with certain risks. Therefore expected *return portfolio* which can be optimally generated and achieve the investment target . **Rolanda and Kurniasih (2017)** explain that three important things in forming a portfolio are risk, expected *return*, and the relationship between return and risk. By forming a portfolio, the risk that must be borne by the Pension Fund will be smaller than the risk of individual securities. Figure 3 describes the development of ROI DP-PLN 2010-2020

II. LITERATURE REVIEW

In the Financial Services Authority Regulation Number 3/POJK.05/2015 concerning Pension Fund Investments as amended by Financial Services Authority Regulation Number 29/POJK.05/2018, there are several types of investments that may be placed into fund placements by Pension Funds, namely (Tabel 1)

Investment Type	Minimum Limit	Maximum Limit
Savings and Deposits	1.25%	100%
Bond	15%	100%
SBN	15%	100%
Share	0%	100%
Mutual Fund	0%	100%
Direct Participation	0%	15%
Land and Building	0%	20%

Table 1:- Investment limits according to OJK

One measure that can represent the *sustainability* of Pension Fund funding towards its obligations is based on the Funding Adequacy Ratio (" RKD ") and Solvency Ratio, as regulated in POJK No. 8/ POJK.05/ 2018. In order for the Pension Fund to be in a *sustainable condition*, the RKD must be in a Funding Surplus condition (RKD > 100%).

III. RESEARCH METHOD

In study this approach method used is method studies case with secondary data from DP-PLN (Persero) period 2010 to 2020, and the data analysis used is method descriptive quantitative.

Data processing and analysis carried out are (1) Analysis of Markowitz Model Portfolio Optimization with the analysis stages collecting individual *returns* of each investment instrument, calculating *the* Expected *Return* of each investment instrument, calculating the risk of each investment instrument , calculating the investment portfolio risk and calculate the optimization of the investment portfolio using the MS Excel Solver computer program. (2) Measuring Investment Portfolio Performance by using Sharpe Ratio, Treynor Ratio and Jensen Ratio

IV. DISCUSSION RESULT

This study uses the Markowitz Model in conducting an analysis to determinethe composition of each investment instrument in the portfolio that produces optimal *returns* and measurable risks. The following are the results of the analysis stages that have been carried out:

1. Individual Return of Each Investment Instrument

This study uses *return data* for 11 years, from 2010 to 2020 which can be seen in Table 2 Source: PT PLN Pension Fund Investment Report (P ersero) 2010-2020

Table 2 describes the ROI of DP-PLN 2010-2020 on each different investment instrument and the lowest returns occurred in 2013, 2018, 2019 and 2020

Investment Type	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Savings and Deposits	10.47	6.57	7.17	7.55	8.14	10.07	9.08	8.51	7.92	8.53	7.78
Bond	12.66	12.29	11.40	6.96	10.43	9.36	10.14	10,12	8.29	9.95	9.30
SBN	13.34	12,12	9.15	-10.54	11.87	3.49	12.23	15,11	1.01	11.87	11.41
Share	18.58	-2.22	7.02	-10.84	29.37	-11.55	13.71	18,48	-5.23	2.70	-4.37
Mutual Fund	25.26	4.05	8.42	-14.90	22.92	-14.00	12.87	10.04	-4.64	1.11	-3.09
Direct Participation	39.96	49.05	7.42	11.03	0.97	1.09	0.97	0.73	7.86	2.84	3.66
Land and Building	15.07	14.47	15.63	19.57	24,12	23.02	12.91	13.36	25,80	13.16	13.97
Total Return	**14.85**	**10.25**	**11.14**	**3.12**	**14.49**	**3.82**	**11.01**	**11.34**	**5.93**	**7.89**	**6, 65**

Table 2:- Historical Return on Investment 2010-2020 (Expressed in Percent)

Based on Table 4, it can be seen that the *return* of each investment instrument as well as the *Total Return* during 2010-2020 is very volatile. The highest *total return* occurred in 2010 and the lowest occurred in 2013. In 2020, the investment instrument that yields the highest *return* is Land and Building by 13.97%, while the investment instrument that produces the lowest *return* is shares of -4.37%.

2. Expected Return for Each Investment Instrument

return is the expected rate of return for each investment instrument that will affect the determination of optimal portfolio allocation. The expected *return* that has been calculated based on the Markowitz Model can be seen in Table 3

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Investment Type	*Expected Return*
Savings and Deposits	8.34%
Bond	10.08%
SBN	8.28%
Share	5.06%
Mutual Fund	4.37%
Direct Participation	11.42%
Land and Building	17.37%

Table 3:- Expected Return of Each Investment Instrument
Source: Data Processed Results (2021)

Based on Table 3, it can be seen that the investment instrument that produces the highest *expected return* is Land and Building at 17.37%, while the investment instrument that produces the lowest *return* is Mutual Funds at 4.37%. This shows that there is a fairly high *gap in the returns* of each investment instrument. However, in the regulations that apply to the PT PLN (Persero) Pension Fund, both those set by the regulator (Financial Services Authority or OJK), the Founder (PT PLN (Persero) or PLN), as well as the Directors of the PT PLN (Persero) Pension Fund ("DP-PLN"), there are several allocation limits for each investment instrument which can be seen in Table 4

Investment Type	Minimum Limit	Maximum Limit
Savings and Deposits	1.25%	100%
Bond	15%	100%
SBN	15%	100%
Share	0%	100%
Mutual Fund	0%	100%
Direct Participation	0%	15%
Land and Building	0%	20%

Table 4:- Limitation of the Allocation of Each Investment Instrument
Source: Regulations from OJK, PLN, DP-PLN

Based on Table 4. It can be seen that only Savings and Time Deposits, Bonds, and SBN have a minimum limit, while other investment instruments do not have a minimum limit. The minimum limit for Savings and Time Deposits is 1.25%, while the minimum limit for Bonds and SBN is 15% each. At the maximum limit, only Direct Investment and Land and Buildings are not allowed to be 100%, while other investment instruments are allowed to be placed 100% (which means all DP-PLN funds can be placed in 1 (one) investment instrument as long as the optimal *return and measurable risk*). Investment in Direct Investment is limited to a maximum of 15% and investment in Land and Buildings is limited to a maximum of 20%.

3. Risk Each Investment Instrument

At the time of investment, in addition to generating *returns* , each investment instrument also has risks with different levels of risk for each type of investment. DP-PLN has a high obligation to pay Pension Benefits, so that investments made must apply the principle of prudence. One of the ways to do this is by paying attention to and minimizing the risks that may occur in investing. The risk of each investment instrument can be seen in Table 5

Investment Type	Risk
Savings and Deposits	1.17%
Bond	1.66%
SBN	7.54%
Share	13.47%
Mutual Fund	13.26%
Direct Participation	16.83%
Land and Building	4.85%

Table 5:- Risks of Each Investment Instrument
Source: Data Processed Results (2021)

Based on Table 5, it can be seen that investment instruments that have a risk above 10% are Stocks, Mutual Funds, and Direct Investment. This shows that investments in these investment instruments produce highly volatile and risky *returns* . An investment instrument that has a risk of above 5% but below 10% is SBN of 7.54%, this shows that although SBN is a Government Bond, the risk of fluctuations in SBN prices is quite high in the market.

Bond investment risk is quite low, at 1.66%. The risk in Bonds (Corporate Bonds) is lower than SBN (Government Bonds), this is due to the volume of buying and selling Bonds in the market is much lower than that of SBN, so the level of bond price fluctuations is lower. Investment risk in Savings and Time Deposits is the lowest, at 1.17%. This is due to Savings and Time Deposits that are not traded in the market, so they do not have a market price, but risks still occur when there is an increase or decrease in interest rates that can affect *returns* .

Every investment has a *return* and a risk. To determine the optimal investment allocation, it is necessary to calculate the *Risk Adjusted Return* (RAR). RAR is the *return* or return on investment that is obtained after taking into account the risks contained in the investment. Table 8 shows the RAR level of each investment instrument.

Investment Type	RAR
Savings and Deposits	7,10
Bond	6.08
SBN	1.10
Share	0.38
Mutual Fund	0.33
Direct Participation	0.68
Land and Building	3.58

Table 6:- RAR of Each Investment Instrument
Source: Data Processed Results (2021)

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Based on Table 6, it can be seen that the investment instruments that produce the highest RAR are Savings and Time Deposits at 7,10. The investment instrument that produces the lowest RAR is Mutual Funds at 0.33. The higher the RAR, the more optimal investment performance. However, DP-PLN has a high obligation in the payment of Pension Benefits. Therefore, in this study, determining the optimal allocation is done by maximizing the *return* and determining the minimum RAR assumption of 3,00. This is done so that the *return* generated is quite high but the risk is still measurable.

4. Composition of Each Investment Instrument

The composition of each investment instrument can be formed by optimizing portfolio *returns* with measurable risks. To produce an optimal portfolio, this study uses a computer program Microsoft Excel Solver. In forming portfolio with maximum *return* and measurable risk, this study uses a minimum RAR assumption of three.

Table 7. shows the composition of each investment instrument produced with a portfolio *return* of 11.30% and a portfolio risk of 3.77%. The portfolio *return* exceeded the target set by the Founder of DP-PLN (PT PLN (Persero)) which was 8.5% (Technical Interest).

Investment Type	Composition
Savings and Deposits	1.25%
Bond	59.84%
SBN	15,00%
Share	0.00%
Mutual Fund	0.00%
Direct Participation	3.91%
Land and Building	20.00%
TOTAL	100%

Table 7:- Composition of Each Investment Instrument
Source: Data Processed Results (2021)

5. Optimal DP-PLN Investment Portfolio

The optimal investment portfolio produced in this study is an investment portfolio that produces the *expected* optimal *return* , which is 11.30% with a risk level of 3.77%. The optimal composition to generate the *expected return* and risk it can be seen on Table 8 . From the table it can be seen concluded that to produce an optimal portfolio, DP-PLN is not recommended to invest in stocks and mutual funds. This is because stocks and mutual funds in the DP-PLN portfolio generate small *returns* but carry high risks.

DP-PLN in investing DP-PLN must be guided by OJK Regulations, Founder's Directions, and Investment Guidelines that have been prepared. The resulting optimal composition for Land and Building is 20.00%, this amount is the maximum limit allowed in the regulations that DP-PLN must follow. In 2020, the composition of Land and Building of DP-PLN only reached 11%, meaning that DP-PLN needs to increase the composition in order to produce an optimal portfolio.

The formation of an optimal investment portfolio results in a composition that is quite different from the composition of the DP-PLN investment portfolio in 2020. Table 8 show the comparison.

Investment Type	Composition 2020	Optimal Composition
Savings and Deposits	10%	1.25%
Bond	29%	59.84%
SBN	15%	15,00%
Share	11%	0.00%
Mutual Fund	13%	0.00%
Direct Participation	11%	3.91%
Land and Building	11%	20.00%
TOTAL	100%	100%

Table 8:- Comparison of Investment Instrument Composition
Source: Data Processed Results (2021)

Table 8 shows that in order to achieve an optimal composition, DP-PLN is recommended to overhaul the total investment composition in 2020, only SBN which already has an optimal composition. In 2020, the composition of DP-PLN's investment in bonds is 29%, while to produce an optimal portfolio, DP-PLN is recommended to invest in bonds of 59.84%. It is certainly not easy to make an investment switch as soon as possible because it has to shift its composition to other investment instruments. Currently, DP-PLN is not allowed to *cut losses* on existing investments, so to expedite the process of moving the investment composition, it is necessary to consider submitting a proposal to allow a *cut loss*.

❖ *Performance Measurement*

1. Sharpe Ratio

Sharpe ratio is the measure of how much excess return is generated against each unit of total risk. (Arugaslan, et al. 2008). A positive Sharpe ratio indicates that the investment portfolio formed is able to provide additional investment return that is greater than risk free asset.. The risk free asset indicator used in this research was using the BI-7 Day Reverse Repo Rate (BI7DRR) . If the positive value of the sharpe ratio is higher, it means the portfolio's performance is better. But, if the sharpe ratio is smaller, the investment portfolio is increasingly risky. (Anggraeni, et al. 2015).

$E(R_p)$	11.30%
R_f	5.89%
σ_p	3.77%
Sharpe Ratio	1.44

Table 9:- Sharpe Ratio
Source: Data Processed Results (2021)

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Based on Table 9 , the Sharpe Ratio value is 1.44. This means that the portfolio owned by DP-PLN is able to provide additional investment return that is greater than *risk free assets* to the total risk of the investment portfolio owned by DP-PLN.

2. Treynor ratio

In evaluating portfolio performance with the Treynor method, using the past average return as the *expected return* and also beta as a measure of risk. Beta shows the size of the change in the *return* of a portfolio to changes in market *returns*.

Beta is considered the most suitable indicator to measure the volatility of the *return* of an asset or portfolio to market *returns* . Beta portfolio is used to determine the volatility of portfolio returns with *market returns* . Thus, beta is considered appropriate as a measure of the systematic risk of an asset or portfolio relative to market risk (Jogiyanto, 2010). An investment type that has a beta < 1 is said to be at less risk than the market portfolio risk. Conversely, an investment that has a beta value > 1 is said to have a greater systematic risk than market risk (Sulistyorini, 2009).

Type	Composition	Beta
Savings and Deposits	1.25%	0.12
Bond	59.84%	0.31
SBN	15,00%	0.72
Share	0.00%	0.69
Mutual Fund	0.00%	0.73
Direct Participation	3.91%	0.35
Land and Building	20.00%	2.74
Total Portfolio	100%	0.86
Treynor ratio	0.06	

Table 10:- Treynor ratio
Source: Data Processed Results (2021)

Based on Table 10, the Treynor Ratio value is 0.06. If the Treynor value is positive and the greater the portfolio performance, the better. This means that the portfolio owned by DP-PLN can be categorized as quite good because it still produces a positive Treynor Ratio.

3. Jensen's Ratio

Jensen's ratio is known as alpha. A portfolio with an excess of positive returns will have a positive alpha, while a portfolio that consistently provides an excess of negative returns will have a negative alpha (Anggraeni, et al. 2015). A positive alpha indicates that the investment portfolio is performing better than the market, while a negative alpha indicates that the investment portfolio has a lower performance than the market.

$E(R_p)$	11.30%
R_f	5.89%
B_p	0.86
R_m	9.92
Jensen's Ratio	0.02

Table 11:- Jensen's Ratio
Source: Data Processed Results (2021)

Based on Table 11 , the Jensen Ratio (alpha) value is 0,02. This shows that the DP-PLN investment portfolio produces better performance than the market.

4. Investment Portfolio Performance

In this study, the performance of the investment portfolio is measured by three ratios, namely the Sharpe Ratio, Treynor Ratio, and Jensen Ratio. Table 12. Illustrates the comparison of the results between the three ratios.

Ratio Type	Score
Sharpe Ratio	1.44
Treynor ratio	0.06
Jensen's Ratio	0.02

Table 12:- Investment Portfolio Performance Measure
Source: Data Processed Results (2021)

Based on Table 12, it can be seen that the three ratios for measuring the optimal portfolio performance of DP-PLN produce positive values. This shows that the optimal investment portfolio of DP-PLN produced in this study is able to provide additional investment return that is greater than *risk free assets* to the total risk of the investment portfolio owned by DP-PLN and produce better performance from the market.

The results of the performance measurement of the three ratios obtained indicate that there is no significant difference in the measurement of portfolio performance. If investors put more emphasis on portfolio beta as the main consideration, then the use of the Treynor Ratio will probably result in a better performance measure. However, if investors emphasize the risk of deviations in portfolio *returns* , the use of the Sharpe Ratio that uses the standard deviation of the portfolio may result in a better measurement. In addition, if investors consider the difference between the portfolio risk premium and the market risk premium, then the performance measure using the Jensen Ratio is the most appropriate method.

V. CONCLUSIONS AND SUGGESTIONS

A. Conclusion :

- This study produces an optimal DP-PLN investment portfolio using the Markowitz Model in conducting an analysis to determine the composition of each investment instrument in the portfolio that produces optimal *returns* and measurable risks. *Return* on investment portfolio of DP-PLN The optimal result in this study is 11.30% with a portfolio risk of 3.77%. To achieve a *return* with this risk,

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DP-PLN needs to increase investment in bonds to 59.84% and Land and Buildings to 20.00%. In addition, DP-PLN needs to reduce investment in Savings and Time Deposits to 1.25%, Shares and Mutual Funds to 0%, Direct Investment to 3.91%, and maintain the composition of SBN at 15.00%.

- Based on the performance measurement of the optimal portfolio produced as mentioned in number 1, it can be concluded that the optimal DP-PLN investment portfolio produced in this study is good, able to provide additional investment return that is greater than *risk free assets* to the total risk of the investment portfolio. owned by DP-PLN as reflected in the positive Sharpe Ratio value of 1.44. In addition, the optimal DP-PLN investment portfolio produced in this study is able to produce better performance than the market, which is reflected in the positive Treynor Ratio value of 0.06 and the positive Jensen Ratio of 0,02.

B. Suggestion :

- So that PLN DP reaches the optimal investment portfolio, it is recommended to reshuffle the investment portfolio in 2020 according to the results of this study , by looking at the results of the optimal composition in this study. It is certainly not easy to switch investments as soon as possible because DP-PLN does not yet have a *cut loss* policy , so it is necessary to propose to the founders so that DP-PLN is allowed to cut *loss* with the aim that the *cut loss* is not too deep and for recovery.
- OJK as a regulator in order to provide relaxation limitation investment, to investments that provide good and optimal returns and measurable risk _ like land and buildings

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