Optimizing Investment Portfolio of a State-Owned Company Pension Fund

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ABSTRACT: The Pension Fund of PT Pos Indonesia (Dapenpos) is considering cutting off all its stock from the portfolio and trying to find the optimal portfolio to increase the funding ratio level. This research is using Modern Portfolio Theory (MPT) by Markowitz to solve the current issue faced by the company by optimizing company's current portfolio, company's stock universe, and optimizing modified portfolio of company. Portfolio optimization of the company is complying to the OJK regulation as well as company's investment direction with constant government bond proportion of 30% and unchanged proportion of both direct investment and property assets. The historical existing portfolio of Dapenpos from 2017 to 2021 has an expected return of 8.83% with standard deviation of 3.45%, so it is suggested that both mutual fund and stock portfolio should be emptied and reallocated to time deposit and corporate bond. The efficient frontier from current portfolio optimization indicated that Dapenpos could get a higher return of 9.31% by choosing portfolio above the optimal frontier. The optimal LQ45 index has a range of return from 6.90% as its Global Minimum Variance (GMV) to 27.46% as its optimal portfolio suggestion. GMV LQ45 is the preferable portfolio to modify the existing portfolio, with an optimal modified portfolio expected retrurn's range of 7.37% to 9.28%. The decision of the fund manager to cut all the stock from its portfolio is validated by MPT tools with strategic reallocation to time deposit and corporate bond in gaining potential higher return with similar risk.

KEYWORDS: GMV, LQ45, MPT, Markowitz, Efficient, Portfolio Optimization.

INTRODUCTION

The industry of Pension Fund in Indonesia has seen an increase in its net asset from IDR260.82 trillion to IDR324.68 trillion or 5.63% compounded annual growth rate (CAGR). The pension fund industry has become a vessel for society to participate in national economic growth through its significant contribution in government's bond. The activity of Pension Fund is monitored and regulated by The Financial Authority Services (OJK) through regulation number 3/POJK [1]. Pension funds must create an optimal asset allocation and portfolio that bears optimal return with their risk tolerance consideration. PT. Pos Indonesia is one of the employee pension funds with defined benefit pension plan (DBPP) which is categorized as a level two funding quality by OJK. The company set a target for growing its asset which regulated in the annual planning (RKA). However, the achievement of the company towards the target has fluctuated for the last five years indicating that the investment activity in the company still not optimal. The company also shows a low return on its stock investment return that bears a negative figure in 2021 which made the investment manager to consider whether to cut all its stocks from its investment portfolio in 2022. Dapenpos's founder has reallocated its pension fund management to other institutions and is facing a constant increase in retirees. To improve their funding ratio, the company must maintain its net assets growth. For the last five years, the net assets have fluctuated with a fluctuating growth ranging from 2% to 11%. The fluctuation of net asset growth is aligned with the company's Return on Investment (ROI). To achieve high growth on the net asset, the company has implemented a conservative asset allocation. In response to the uncertainty of capital market, the fund manager is considering cutting all the stocks in its portfolio and will allocate it to government securities in 2023.

LITERATURE REVIEW

Modern Portfolio Theory (MPT) by Fabozzi, et. al in 2002 [2] is suitable to solve the problem in this research. It is a summary of MPT investment process which begins with expected return, volatility and correlation estimates, and constraints on portfolio choice as an input to optimize the portfolio. The output from the portfolio optimization will be several combinations of optimal return with minimal risk resulting from several possible assets proportion. Those combinations than will be an input for the investors to choose the optimal portfolio adjusted with its investment objective. Modern Portfolio Theory (MPT) is based on the research of Harry Markowitz in 1952 titled "Portfolio Selection" [3], which leveraging the function of diversification among asset classes in a portfolio to gain an efficient portfolio that suits to the investors' expected return and risk objective[4]. Considering the time horizon investment

in pension fund, MPT could be utilized for the operations of pension fund [5]. Several studies had tried to construct an optimal portfolio for state-owned pension fund's portfolio in Indonesia such as by Miftah in 2018 for PT Telkom Indonesia's pension fund (Dapentel)[6]; Prawita in 2019 for PT. LEN Industry pension fund [7]; and Surianegara and Sudjono [8] which examined PT PLN pension fund performance from 2010 to 2020. In her study, Miftah examined the existing portfolio of Dapentel from 2013 to 2017 and concluded that the portfolio was below the efficient frontier curve indicated by its sharpe ratio. Using Markowitz optimal portfolio, she recommended an allocation of each asset that bears optimal return with return and risk of 12.95% and 3.58% respectively. Prawita, on the other hand created an optimal portfolio for PT LEN industry based on its historical portfolio performance through builing a possible scenario from OJK's regulation and expected return of bank deposit interest rates, resulting in a portfolio with a return of 10.88% and risk 2.74% with lowest coefficients of variance as its major consideration. Diversification of assets in portfolio is the underlying concept for MPT based on Markowitz's demonstration that equal portfolio expected return to its asset classes weighted average expected return will have lower risk compared to its asset classes' average risk. The diversification of portfolio that leads to several possibilities of portfolio based on its asset proportion will be bounded by possible portfolios with the best trade-off between its risk and return or called efficient frontier [9]. Thus, the Sharpe ratio, the ratio of average excess return to its adjusted total risk in the portfolio [10], one of tools to evaluate the portfolio performance will be boosted as the asset classes are diversified or having no positive correlated between each asset. The importance of correlation between each assets drives the investment manager to invest in an asset with unusual return and risk like property and direct investment.

DATA COLLECTION AND METHODOLOGY

In conducting the research, the author used primary and secondary data with different methods in collecting the data. The primary data that is used in this research directly collected from Dapenpos by interviewing the fund manager about the business issue that is faced by the company and had been elaborated in first chapter. After conducting the interview, collaborated with the literature review, the author gained an insight for the data that is needed and retrieving secondary data such from the company. The secondary data from Dapenpos related to this research consist of investment portfolio summary from 2017 to 2021, investment direction of the company in 2021, and stock portfolio performance from 2017 to 2021 which then will be retrieved from yahoo finance [11] to conduct the optimization. The method that the author used for analysing the data in this research complies to Moder Portfolio Theory (MPT). Based on the conceptual framework and the research design of this research, first method in optimizing the portfolio is by calculating the expected return for each investment instrument within the portfolio. The calculation for the expected return on each instrument will be conducted through arithmetic average. After getting the expected return on each instrument asset, the risk can be calculated using standard deviation formula for each instrument to gain the perspective of volatility on each asset. The analysis of the instruments in the portfolio can be done based on the expected return and the risk to see the performance of the portfolio as well as to gain the perspective of Dapenpos's risk profile over past five years from 2017 to 2021. This first and second data analysis method applied for the three scenarios. The next thing to be analyzed is the covariance and correlation between each asset in the portfolio. Output for this analysis will be presented in a matrix n-squared with n is number of instruments in the portfolio. The lower correlation in the instrument will result higher diversification in the portfolio. The analysis on the covariance and correlation of the portfolio will show whether the asset selected by Dapenpos had been diversified enough. Optimization of the portfolio is conducted after expected return, risk and correlation had been calculated. Solver by Microsoft Excel will be the tool to optimize the portfolio. The output of the optimization will be the maximal slope of Capital Allocation Line (CAL) and minimum variance frontier for each of scenario. On doing the optimization by Solver, the restriction of the weight will be complied to the OJK regulation combined with Dapenpos's investment direction.

RESULTS AND DISCUSSION

A. Existing Portfolio Analysis and Optimization

The return and risk of Dapenpos's existing portfolio was like in Table I. Overall, from the asset in the existing portfolio, Dapenpos's direct investment had the highest expected return, this is due to significant increase in 2019 up to 35.63% comparing to the other four years which had average return of 5.11%. Land and building also has a similar trend with the direct investment of Dapenpos, showing an anomaly return in 2019 compared to average other four years. However, due to time limitations and data lackness about Dapenpos's direct investment and property, the author did not change the proportion of these assets and did not exclude these assets

from the portfolio to see its influence on the asset's correlation. Dapenpos had a low risk of 3.74% with a return of 8.78% or can be said that the portfolio yields a return of 2.56 times from the risk that was taken. Time deposits yields the highest expected return per risk that had been taken with 7.4 times followed by corporate bond with half of time deposit's value, while both stock and mutual yields the lowest value of -0.05 and 0.17 respectively. Based on this analysis, it is more favorable for the company to put their fund on the time deposits than in the market.

Covariance shows a joint variability between each asset which is better for diversification the more negative value is. As had been portrayed in Table 2, the lowest covariance is between on-call-deposit and listed stocks instrument with -16.52×10^{-4}, while the highest covariance is between property and direct investment asset with 186.98×10^{-4}. Overall, on call deposits has the lowest covariance value with other instrument assets in the portfolio followed by time deposits, while both direct investment and property showed the highest average covariance between other instrument in the portfolio.

Table 1. Expected return and risk of Dapenpos's portfolio from 2017 to 2021.

	Portfolio returns					E(r)	Risk
	2017	2018	2019	2020	2021		
On Call Deposit	0.35%	0%	0%	0.40%	4.95%	1.14%	**2.14%**
Time Deposit	7.92%	7.78%	9.23%	8.39%	6.30%	7.92%	**1.07%**
Government Bond	14.75%	2.02%	12.50%	13.77%	7.92%	10.19%	**5.26%**
Listed Stocks	6.01%	2.51%	4.30%	-0.68%	-14.19%	-0.41%	**8.09%**
Corporate Bond	12.12%	5.25%	12.34%	9.25%	9.84%	9.76%	**2.86%**
Mutual Fund	5.18%	0.32%	11.16%	-12.55%	3.67%	1.56%	**8.81%**
Direct Investment	6.36%	5.25%	35.63%	4.56%	4.27%	11.21%	**13.67%**
Land and Building	0.97%	0.24%	31.21%	0.49%	0.68%	6.72%	**13.69%**
Total	**10.25%**	**4.91%**	**13.86%**	**8.48%**	**6.65%**	**8.78%**	**3.74%**

Table 2. Bordered covariance matrix of Dapenpos's existing portfolio.

Covariance (x 10^{-4})	On Call Deposit	Time Deposit	Govt Bond	Listed Stocks	Corp. Bond	Mutual Fund	Direct Investment	Land and Building
On Call Deposit	4.57	-1.96	-2.05	-16.52	0.25	1.52	-9.68	-8.60
Time Deposit	-1.96	1.15	2.38	6.99	0.91	0.67	10.24	9.96
Govt. Bond	-2.05	2.38	27.71	11.65	12.89	-1.62	18.73	18.68
Listed Stocks	-16.52	6.99	11.65	65.47	3.29	9.89	40.98	36.11
Corporate Bond	0.25	0.91	12.89	3.29	8.21	11.57	20.32	20.38
Mutual Fund	1.52	0.67	-1.62	9.89	11.57	77.59	75.86	74.37
Direct Investment	-9.68	10.24	18.73	40.98	20.32	75.86	186.94	186.98
Land and Building	-8.60	9.96	18.68	36.11	20.38	74.37	186.98	187.53

Asset that can be invested by pension fund is regulated by Financial Services Authority (OJK) as well as minimum and maximum proportion in each instrument. The OJK's regulations that concern about the instrument proportion are: POJK No. 29/POJK.05/2018 juncto No. 03/POJK.05/2015 about Pension Fund investments; POJK No. 1/POJK.05/2016 about government bond investment for non-banking financial agency: this regulation obligated pension fund to have at least 30% weight of government bond; POJK No. 56/POJK.05/2017 about government bond investment for non-banking financial agency which enable pension fund to fulfill minimum 30% weight of government bond with corporate bond that involve the infrastructure funding with a maximum weight of 50%. This will be input in Solver as the constraint especially for government bond that will be constant at 30% to comply with OJK's regulation.

Efficient frontier from the optimization of Dapenpos's portfolio in Figure 1 showed that the current portfolio of Dapenpos is not optimal. Global minimum variance (GMV) from the efficient frontier has a return of 7.41% with risk of 2.92%. In term of return, the existing portfolio of the company has a similar return to the optimal one around nearly 8.8%, but the optimal one has a lower risk with 0.4% difference. However, with the assumption that the company have a moderate risk profile and have a risk appetite of 3.7% same as the current portfolio, the company has a potential higher return of 9.31% following the one of combination in the efficient frontier. The combinations of investment instruments' weight that yield return and risk in the efficient frontier were tabulated in Table 3. The distribution of investment instruments' weight in the efficient frontier below the optimal portfolio are dominated by time deposit, which shows a gradual increase from 36.09% in GMV portfolio to 56.09% in the optimal one. Besides, On Call Deposit instruments also show a gradual decrease in its weight from 20% in GVM to 0% in optimal one. Based on the five years performance of the assets and the correlation with other assets in the efficient frontier, financial assets' weight with higher risk such as listed stocks and mutual funds should be zero to reach an optimal return. On the other hands, corporate bonds' weight is increase for the efficient frontier above the optimal one. As the objective of the Dapenpos is to increase its return so that the company can boost its financial performance, it is acceptable for the company to choose the portfolio with return of 9.31% rather than the optimal one with similar return to the existing portfolio.
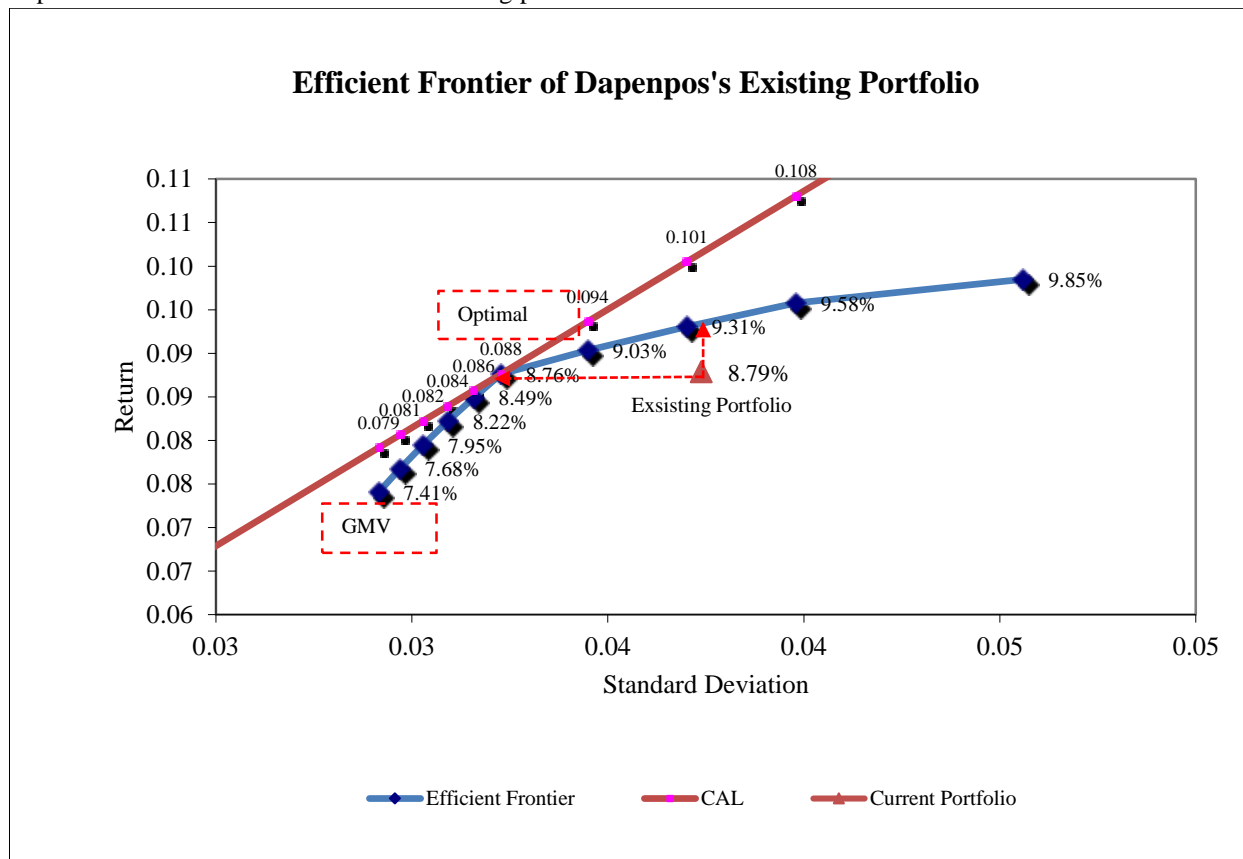

Figure 1. Efficient frontier of existing portfolio.

Table 3. Distribution of Efficient frontier asset's proportion from of existing portfolio.

	GMV					Optimum		Similar Risk		
Return	7.41%	7.68%	7.95%	8.22%	8.49%	8.76%	9.03%	9.31%	9.58%	9.85%
Standard Deviation	2.92%	2.97%	3.03%	3.09%	3.16%	3.23%	3.45%	3.70%	3.98%	4.56%
Slope CAL	2.54	2.59	2.62	2.66	2.69	2.72	2.62	2.51	2.41	2.16
On Call Deposit	20.00%	16.00%	12.00%	8.00%	4.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Time Deposit	36.09%	40.09%	44.09%	48.09%	52.09%	56.09%	41.31%	26.53%	11.75%	2.00%
Government Bond	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	51.39%
Listed Stocks	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Corporate Bond	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	14.78%	29.56%	44.34%	32.70%
Mutual Fund	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Direct Investment	7.27%	7.27%	7.27%	7.27%	7.27%	7.27%	7.27%	7.27%	7.27%	7.27%
Land and Building	6.64%	6.64%	6.64%	6.64%	6.64%	6.64%	6.64%	6.64%	6.64%	6.64%

B. Optimization of LQ45 Index

The list of companies in LQ45 is updated twice a year and the author used the newest list of companies from August 2022 to January 2023 period with IPO date before 2017 with the list companies as the table below. From the 42 companies in the list, ARTO had both the highest expected return and risk among other companies, while BBCA had the lowest risk. The distribution of expected return and risk from LQ45 index generated from average monthly five year data of the companies as in Table 3.

Table 4. Expected return and risk of LQ45 historical data.

No	Ticker	Company	E(r)	Risk
1	ADRO	Adaro Energy Indonesia Tbk.	21.32%	18.86%
2	AMRT	Sumber Alfaria Trijaya Tbk.	21.01%	12.14%
3	ANTM	Aneka Tambang Tbk.	32.39%	36.54%
4	ARTO	Bank Jago Tbk.	188.43%	400.48%
5	ASII	Astra International Tbk.	-0.48%	8.34%
6	BBCA	Bank Central Asia Tbk.	21.53%	3.38%
7	BBNI	Bank Negara Indonesia (Persero) Tbk.	16.29%	15.20%
8	BBRI	Bank Rakyat Indonesia (Persero) Tbk.	17.65%	7.26%
9	BBTN	Bank Tabungan Negara (Persero) Tbk.	14.05%	30.94%
10	BFIN	BFI Finance Indonesia Tbk.	44.30%	26.37%
11	BMRI	Bank Mandiri (Persero) Tbk.	13.70%	6.73%
12	BRPT	Barito Pacific Tbk.	49.87%	42.50%

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No	Ticker	Company	E(r)	Risk
13	CPIN	Charoen Pokphand Indonesia Tbk	21.28%	11.00%
14	EMTK	Elang Mahkota Teknologi Tbk.	24.99%	25.75%
15	ERAA	Erajaya Swasembada Tbk.	54.63%	47.03%
16	EXCL	XL Axiata Tbk.	9.65%	13.19%
17	HMSP	H.M. Sampoerna Tbk.	-19.85%	7.39%
18	HRUM	Harum Energy Tbk.	56.77%	55.45%
19	ICBP	Indofood CBP Sukses Makmur Tbk.	5.18%	3.88%
No	*Ticker*	*Company*	*E(r)*	*Risk*
20	INCO	Vale Indonesia Tbk.	24.62%	21.74%
21	INDF	Indofood Sukses Makmur Tbk.	1.75%	5.32%
22	INDY	Indika Energy Tbk.	48.33%	57.23%
23	INKP	Indah Kiat Pulp & Paper Tbk.	61.52%	46.73%
24	INTP	Indocement Tunggal Prakarsa Tbk.	5.82%	15.83%
25	ITMG	Indo Tambangraya Megah Tbk.	31.84%	29.63%
26	JPFA	Japfa Comfeed Indonesia Tbk.	12.25%	20.24%
27	KLBF	Kalbe Farma Tbk.	6.68%	4.94%
28	MDKA	Merdeka Copper Gold Tbk.	54.53%	17.65%
29	MEDC	Medco Energi Internasional Tbk.	36.64%	48.80%
30	MIKA	Mitra Keluarga Karyasehat Tbk.	6.24%	10.63%
31	MNCN	Media Nusantara Citra Tbk.	-1.93%	21.69%
32	PGAS	Perusahaan Gas Negara Tbk.	3.47%	30.68%
33	PTBA	Bukit Asam Tbk.	19.56%	16.49%
34	SMGR	Semen Indonesia (Persero) Tbk.	3.77%	16.25%
35	TBIG	Tower Bersama Infrastructure Tbk.	34.42%	22.56%
36	TINS	Timah Tbk.	24.78%	37.93%
37	TLKM	Telkom Indonesia (Persero) Tbk.	7.26%	5.54%
38	TOWR	Sarana Menara Nusantara Tbk.	17.85%	15.42%
39	TPIA	Chandra Asri Petrochemical Tbk.	28.07%	29.12%
40	UNTR	United Tractors Tbk.	10.16%	11.12%
41	UNVR	Unilever Indonesia Tbk.	-9.40%	4.83%
42	WIKA	Wijaya Karya (Persero) Tbk.	-1.54%	27.70%

The efficient frontier of LQ45 index that is showed in Figure 2 indicates all the possible portfolios' return with the minimum risk. Optimal portfolio – the one that intersect with CAL line – has return of 23.08% with risk of 14.95%, while the GMV of LQ45 has a return of 6.9% with risk of 10.02%. Both returns and risks offered by the efficient frontier are far away from the current stock portfolio of Dapenpos which had -0.41% return with 8.09% risk. While the optimal whole portfolio of Dapenpos suggests that the listed stock of Dapnepos should be emptied, the optimization of LQ45 index will be a recommendation for Dapenpos if the fund manager would like to take a higher risk than the optimal existing portfolio.

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Table 5. Stock option from GMV and Optimal efficient frontier of LQ45 Index.

Ticker	GMV	Optimal
BBCA	12.14%	41.09%
MDKA	0.70%	19.67%
CPIN	7.63%	9.84%
AMRT	11.70%	9.38%
ICBP	22.49%	7.05%
HRUM	0.00%	4.37%
BRPT	0.00%	4.08%
EMTK	0.00%	3.83%
ARTO	0.00%	0.69%
Ticker	GMV	Optimal
ADRO	1.82%	0.00%
BMRI	3.44%	0.00%
EMTK	5.58%	0.00%
MIKA	7.68%	0.00%
TLKM	5.68%	0.00%
TOWR	1.00%	0.00%
UNTR	4.51%	0.00%
UNVR	15.64%	0.00%
E(r)	6.90%	27.46%
Risk	10.02%	14.95%
E(r) / Risk	0.69	1.84
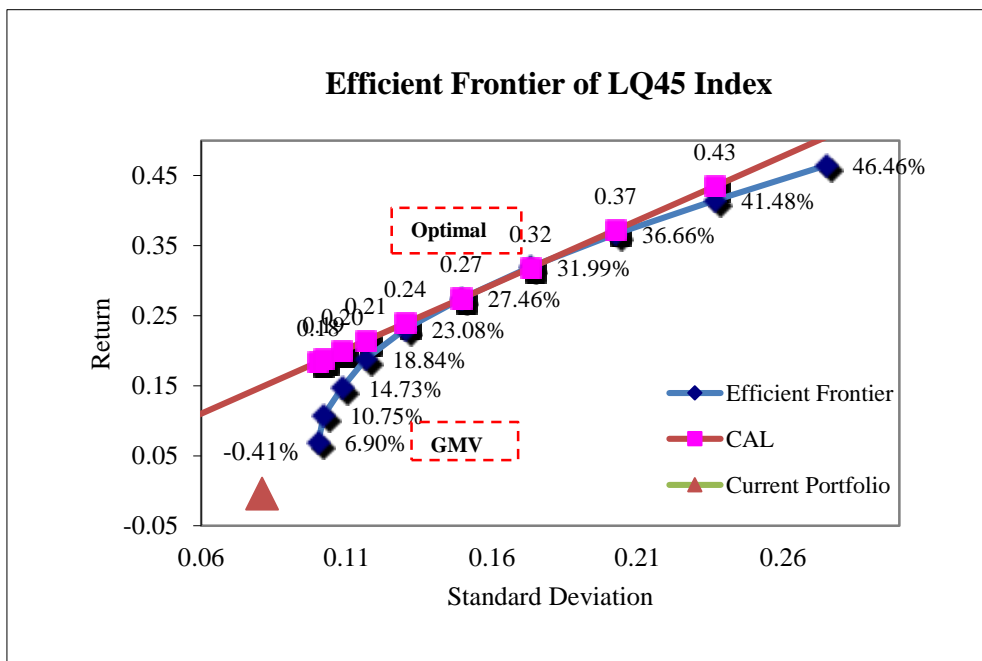
Figure 2. Efficient frontier of LQ45 index.

C. *Optimal Modified Portfolio by Stock Replacement*

The past five years historical yearly stock portfolio of Dapenpos showed that the company could take risk up to 8.81%. Considering the efficient frontier from LQ45, all the mean-variance combination has a risk above current stock portfolio of Dapenpos. The author used GMV portfolio as the closest risk to the current stock portfolio risk of Dapenpos with a value of 10.02%. To input the GMV portfolio in exchange for the previous stock portfolio, the author created a yearly geometric return of GMV portfolio as in Table 6, complying with the return calculation conducted by Dapenpos. This method will reduce the variability or risk of the data since the number of data that used was significantly reduced from 60 amount of data into only five data, which impacted the risk that reduced from 10.02% into 7.04%. The reduce of data used as an input to the whole Dapenpos portfolio also impacted the return which gave high higher expected return of 7.55% than the return from efficient frontier of 6.90%.

The optimal modified portfolio has a return of 8.74% which only differs 0.02% from the optimal existing portfolio with a return of 8.76% as in Figure 3 and Table 7. Although based on the solver result the risk of modified portfolio's efficient frontier has a lower risk, it is still riskier than the existing optimization due to the input of the yearly return of LQ45 which reduce the dimentionality of portfolio variation. Efficient frontier of the modified portfolio suggests more proportion on call-on-deposit, time deposit, and stocks instrument on its GMV portfolio to optimal one. While it is suggested that the time deposits proportion should be increased to reach its optimal, the portfolio that yield higher return than the optimal one suggests reallocating both time deposit and stock instrument to corporate bonds with higher proportion of reallocation on the former instrument. Like the previous optimization of existing portfolio of Dapenpos which considered the risk that had been taken by Dapenpos in its historical portfolio, by taking the same level of risk of 3.74%, the closest efficient frontier of modified portfolio gives a return of 9.28% by investing almost 20% of its asset in time deposit, 6.5% in listed stocks, and almost 30% in corporate bonds. This portfolio is lower in terms of return compared to the efficient frontier of existing portfolio optimization which considered a 0.05% higher risk and 0.03% higher return with an empty stock portfolio and put more of its fund in time deposit instrument.
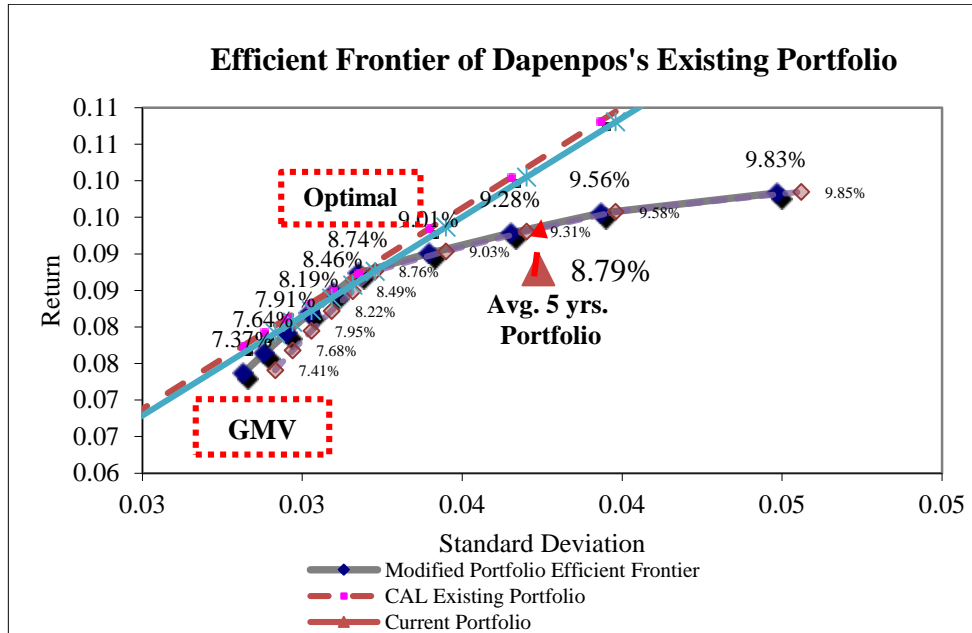
Table 6. Comparation of LQ45 and existing Dapenpos's stock portfolio.

	Portfolio returns					E(r)	Risk
	2017	2018	2019	2020	2021		
GMV	16.97%	12.55%	5.87%	1.54%	0.80%	7.55%	7.04%
Existing Stock	6.01%	2.51%	4.30%	-0.68%	-14.19%	-0.41%	8.01%

Figure 3. Efficient frontier of modifed portfolio.

D. Portfolio Evaluation

Portfolio evaluation is conducted by using Sharpe ratio for all analysis result that will be the recommendation to Dapenpos. The evaluation consists of GMV, optimal and similar risk portfolio from existing portfolio optimization efficient frontier, modified portfolio optimization efficient frontier, which are compared to the average five years existing portfolio of Dapenpos. Sharpe ratio is a tool to see the performance of risk premium from the investment compared to the risk taken by the investor. Average rate of Indonesia 10-years government bond is used as the risk-free rate to calculate the risk premium from the investment with value of 7.02% retrieved from marketwatch.com website [12]. The evaluation of the portfolio can be seen in Table 7, which similar risk efficient frontier portfolio from the modified one has the highest Sharpe ratio of 0.62.

Table 7. Portfolio evaluation.

Portfolio	Average 5 years	Modified Portfolio		
		GMV	Optimal	Similar Risk
Portfolio Return	8.78%	7.37%	8.74%	9.28%
Risk-free rate	3.74%	2.81%	3.18%	3.65%
SD	7.02%	7.02%	7.02%	7.02%
Sharpe Ratio	0.47	0.12	0.54	0.62

CONCLUSION

PT Pos Indonesia, part of the pension fund industry in Indonesia, has the potential to improve its investment by doing an optimization. Markowitz portfolio optimization can be used as a guideline for optimizing its portfolio. Based on historical data analysis, the author can conclude that the optimal portfolio that is suitable for Dapenpos considering its risk is by cutting off all of its stock and mutual fund instrument from its portfolio and reallocating those assets with a composition of 26.53% of time deposit and 29.56% of government bond. This portfolio composition has expected return of 9.31% with similar risk to the existing portfolio. However, considering the risk, the GMV portfolio might be suitable to re-enter the stock market after cutting off all its current portfolio. Based on the results of this research, the historical performance of Dapenpos showed that there is an ineffective investment strategy in the company that is accumulated especially in judging the stock market condition. Although the guideline of investment

is clear, the execution of the strategy is only focus on the long-term investment without having a clear guidline in any time horizon. This result on the accumulation of late anticipation of the market condition due to some disruption such as Covid-19. The author recommends Dapenpos to implement an optimization tool such as Markowitz Portfolio Theory for the company additional guideline in the market condition combined with the fundamental and technical analysis in each asset so that it has a comprehensive strategy that complements its internal investment direction before taking any decision. By developing an optimiziation tools that continuously update the current market condition, the fund manager can be more agile and firm in taking the decision to cut its unperformed assets. This research can be improved by more comprehensive data about other assets data outside the listed stock or by creating a mutual fund universe for the company to have a more comprehensive optimization. Other methods also can be applied to complement the optimization in the Dapenpos.

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