Investment Portfolio
Report for HPPIB

Prepared by Group E

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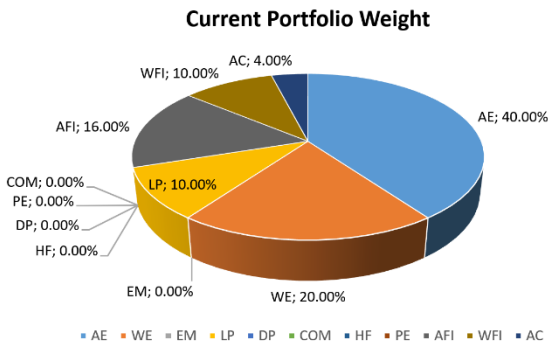
Executive Summary

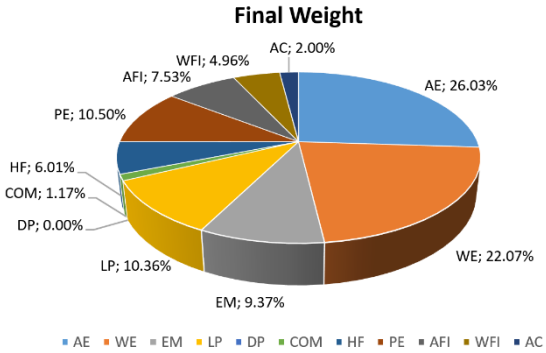
This report is prepared to construct an investment portfolio for our client, Happicity Pension Plan Investment Board (HPPIB), which is a defined contribution fund with an AUM of $3 billion. Our report consists of three parts, historical performance assessment, new asset allocation recommendation and rebalance strategy.

Firstly, we evaluate HPPIB's investment performance from June 2018 to June 2023. The original portfolio is constructed by 40% Australian shares, 20% international share, 30% fixed income & cash and 10% Property. We will analyze its absolute performance and compare it with Benchmark portfolio.

Secondly, we used three methods to design a new investment portfolio, the first two are bootstrap and historical rolling methods, which are quantitative methods. The third method is fundamental risk analysis, which is qualitative method.

Finally, we analyze the current rebalancing policy, which is now monthly based and may cost too much. We will use numerical analysis to show the cost of different rebalancing frequencies and give our recommendation for a more appropriate rebalancing strategy.





1. Objectives of Investment Plan

The core objective for our client, HPPIB, is to decide on a new asset allocation strategy for the next five years. Considering the investors of HPPIB are Happicity public sector employees, who have relatively stable income, we tend to ensure the balance of risk and return and avoid high probability of loss. Specific requirements and constraints of our client for the investment portfolio are as follows.

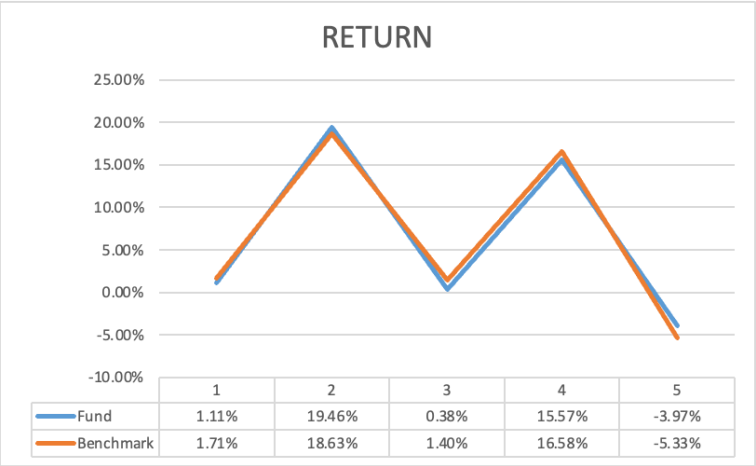
- Maximizing Sharpe ratio to best benefits its members.
- Annualized return: at least 3% above the expected inflation.
- Chance of negative compound return: no more than 20%.
- Tracking error of the fund versus the benchmark: no greater than 2%.
- Proportion of equity assets: within 15% range of the benchmark allocation.
- Proportion of illiquid assets: more than 20%.
- Proportion of cash: at least 2%.

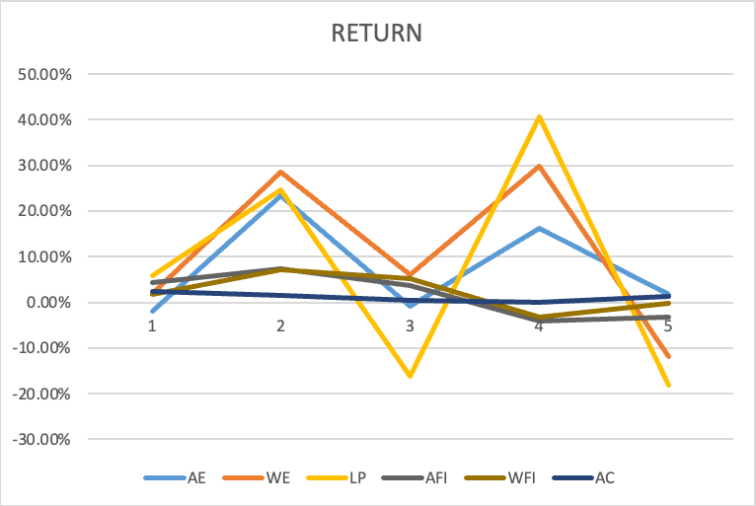
2. Assessment of Historical Performance

In the short term, the fund has met most of the objectives and performed well based on data from 2018-2022. The Sharpe ratio of the fund was equal to that of the benchmark, indicating that under the same unit of risk, the risk-adjusted returns of the fund and the benchmark were the same. Furthermore, the fund has relatively lower risk and excess return than benchmark. The reason is that its beta of 0.98 was close to 1, indicating that the fund was affected by the market and its volatility was slightly less than the market's volatility. Moreover, an alpha of 0.0003 showed that the fund's return slightly exceeded the benchmark. In short, the fund did well in these parts.

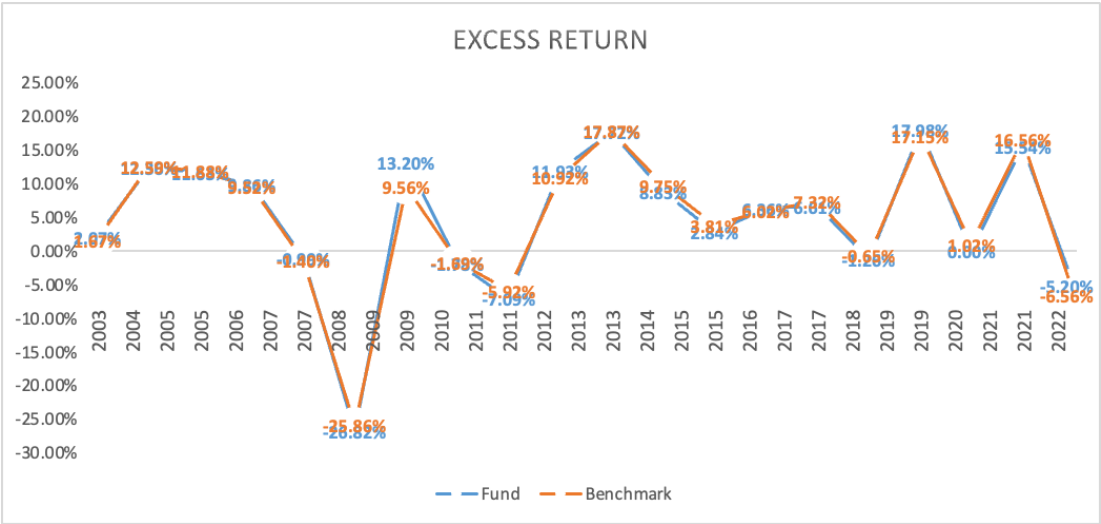
Performance from 2018-2022 (last five years)		
Key metrics	**Fund**	**Benchmark**
E[R]	6.51%	6.60%
E[R-rf]	5.41%	5.50%
Stdev[R-rf]	10.57%	10.74%
Sharpe ratio	51.22%	51.22%
Beta	0.98	
Alpha	0.0003	
Loss probability	20%	20%

In addition, the first line chart shows that the overall change trend of the fund in the past five years had been a volatile decline. Based on the second line chart, the changing trends of the return of Australian equity, world equity and listed properties in the fund were close to the overall changing trend, and they contributed to volatility. The return of Australian fixed income and World fixed income fluctuate less. Australian cash's return had the smallest fluctuations and has been positive for five years. Therefore, the fund can reduce the proportion of highly volatile assets such as equity and increase the proportion of less volatile assets such as Australian cash to stabilize and improve its return.





In the long run, the excess return of the fund in the first 20 years was mostly positive, and its other key metrics including standard deviation and Sharpe ratio were in close proximity to the benchmark. In addition, its Sharpe ratio and beta showed a fluctuating upward trend. This reflects that the fund had achieved relatively good investment returns and had increased sensitivity to the market. Furthermore, the fund's Sharpe ratio in the past ten years has reached 85.36%, which is almost twice the Sharpe ratio in the past 20 years. This is due to the increase in excess return and the reduction in standard deviation. Over time, the fund's alpha turned from negative to positive, meaning that its performance in terms of excess returns improved. As a result, the fund's performance is gradually improving.



	2018-2022 (last five years)		2013-2022 (last ten years)		2008-2022 (last fifteen years)		2003-2022 (last twenty years)	
Key metrics	**Fund**	**Benchmark**	**Fund**	**Benchmark**	**Fund**	**Benchmark**	**Fund**	**Benchmark**
E[R-rf]	5.41%	5.50%	6.94%	7.23%	3.93%	3.95%	4.69%	4.68%
Stdev [R-rf]	10.57%	10.74%	8.13%	8.23%	11.76%	11.38%	10.56%	10.28%
Sharpe ratio	51.22%	51.22%	85.36%	87.84%	33.38%	34.70%	44.43%	45.50%
Beta	97.89%		98.34%		102.69%		45.50%	
Alpha	0.03%		-0.16%		-0.13%		-0.09%	

3. Quantitative Method Analysis

3.1 Bootstrap Method

3.1.1 Description of Method

Bootstrap is a statistical method used for resampling and estimating the distribution of a statistic. In this case, we use bootstrap method to help us generate 1000 random results from historical adjusted return for each year and predict continuous compounded yearly returns in the next 5 years. Then, by using solver, we can find the optimized weight for each asset in our portfolio, which has the highest Sharpe ratio and meet other constraints.

3.1.2 Data Selection and Adjustment

We use yearly data from 2002 to 2022 because historical return for Hedge Funds is not available before 2002. For the probabilities of observations to do Bootstrap random drawings, we first assume that the probability is equal every year and make some further analysis for 2008 financial crisis and 2020 global pandemic.

Years	Probability	Portfolio	Benchmark
2-Dec	4.95%	-10.43%	-9.87%
3-Dec	4.95%	5.92%	2.30%
4-Dec	4.95%	25.19%	13.94%
5-Dec	4.95%	17.33%	13.35%
6-Dec	4.95%	17.69%	11.27%
7-Dec	4.95%	3.26%	1.07%
8-Dec	1.00%	-25.73%	-22.53%
9-Dec	4.95%	12.18%	8.77%
10-Dec	4.95%	-0.23%	-1.29%
11-Dec	4.95%	-5.42%	-5.19%
12-Dec	4.95%	10.95%	10.62%
13-Dec	4.95%	19.21%	16.46%
14-Dec	4.95%	10.27%	8.18%
15-Dec	4.95%	4.36%	1.87%
16-Dec	4.95%	4.93%	3.82%
17-Dec	4.95%	6.02%	4.80%
18-Dec	4.95%	-1.24%	-2.56%
19-Dec	4.95%	15.18%	14.36%
20-Dec	4.95%	-2.67%	-2.87%
21-Dec	4.95%	17.84%	12.31%
22-Dec	4.95%	-7.35%	-9.60%

As the 2008 financial crisis was an extreme event, we reduced the probability of returns in 2008 to 1%. Although the occurrence of COVID-19 is also rare, it has a long-term impact on the global economic environment. Because global economic recovery is not as expected, we did not adjust the probability of returns in 2020 to reflect the low economic growth after pandemic.

3.1.3 Output

Bootstrap Analysis												
	AE	WE	EM	LP	DP	COM	HF	PE	AFI	WFI	AC	total
Current Weight	40.00%	20.00%		10.00%					16.00%	10.00%	4.00%	100.00%
Benchmark	25.00%	24.00%	3.00%	7.00%	5.00%	1.00%	4.00%	3.00%	14.00%	11.00%	3.00%	100.00%
New Weight	35.00%	19.00%	0.00%	10.70%	0.00%	0.00%	2.00%	18.00%	0.00%	13.30%	2.00%	100.00%

The new portfolio has a Sharpe ratio of 0.9684 and an annual return of 6.93%. Compared with the original portfolio and benchmark, the main difference of weight is the proportion of equity assets. It is notable that the weight for emerging markets is 0, because in recent years, especially after the pandemic, the performance of emerging markets has shown a significant decline.

Summary	Constraint	Portfolio	Benchmark
Terminal value	maximum	1.398235681	1.24007179
Absolute target	>=2.41%+3%	6.93%	4.40%
Sharpe ratio	maximum	0.9684	0.5505
Prob(loss in 5 year)	<=20%	7.92%	14.53%
Tracking error	<=2%	1.18%	
Illiquid asset	<=20%	20.00%	12.00%
Cash	>=2%	2.00%	3.00%
Equity	<74%	74.00%	59.00%
Sum of Weight	100%	100.00%	100%

3.2 Historical Rolling Method

3.2.1 Description of Method

The historical rolling method is also a statistical approach used to evaluate or simulate investment or trading strategies over time. It calculates overlapping cycles from historical data and generates new data available for us. In this case, we use 5-year rolling returns to examine the outcome for the next 5 years.

3.2.2 Data Selection and Adjustment

As the same reason as Bootstrap, we selected quarterly data from 2002 to 2023 to make sure that data of each asset is available. Therefore, 5-year rolling returns start from December 2007 and we have more observation compared with yearly based method.

3.2.3 Output

Identifier	AE	WE	EM	LP	DP	COM	HF	PE	AFI	WFI	AC
Current Weigh	40%	20%	0%	10%	0%	0%	0%	0%	16%	10%	4%
Peer Group	25%	24%	3%	7%	5%	1%	4%	3%	14%	11%	3%
New Weight	17%	25%	3%	10%	2%	2%	10%	3%	15%	10%	2%

Summary	Constraint	Portfolio
Terminal value	maximum	1.790153649
Absolute target	>=2.41%+3%	12.35%
Sharpe ratio	maximum	0.070704048
Prob(loss in 5 year)	<=20%	34.38%
Tracking error	<=2%	1.25%
Illiquid asset	<=20%	15.36%
Cash	>=2%	2.00%
Sum of Weight	100%	100.00%

Because there is no result that can meet the loss probability of less than 20%, we relieve the constraint and keep other constraints unchanged. The final Sharpe ratio is 0.0707.

4. Fundamental risk analysis

4.1 Method Introduction

Economic diversification is the core of the fundamental risk analysis approach. In the following analysis, we will first identify the basic risks that the current portfolio is most exposed to, then we will consider how to maximize diversification at the expense of minimizing returns.

4.2 Identify fundamental risks

Types	Australian equity	World equity	Listed properties	Australian fixed income	World fixed income	Australian cash
Current Weight	40%	20%	10%	16%	10%	4%

Based on the fundamental risk analysis approach, our clients are mainly facing macroeconomic, illiquidity, systemic and home bias risks.

4.2.1 Macroeconomic risks

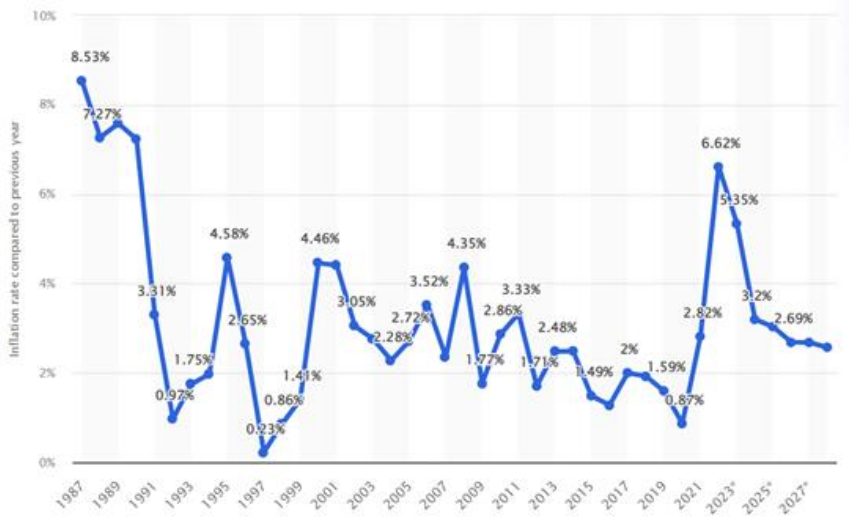
1) Economic risks

According to the global recession and economic fluctuation after the 2020 COVID-19 pandemic, Australia's GPD growth has dropped from 5.2% to 3.66% in 2022, which indicate the recovery might be temporary. IMF forecast suggest Australia will have lower growth between 1.7% and 2.29% for 2024-2028. This long-term low-growth environment may affect our investments in the domestic equity and real estate markets. Given the uncertainty of future economic environment, our clients' portfolios are exposed to economic risk.

Source：IMF,imf.org

2) Inflation

Inflation may reduce real returns on fixed income assets, especially when interest rates are low. When inflation rises, the fixed interest payments on bonds shrink in real terms. Our clients currently have 16% on Australian Fixed Income and 10% on World Fixed Income, inflation risk may need to be considered and asset allocation may need to be adjusted to protect the real return of the portfolio.



Source: IMF, World Economic Outlook Database April 2023, imf.org

4.2.2 Illiquidity risks

Illiquidity risks' essentials are the cost and ability to trade an asset (Warren). Most of our clients' assets are relatively liquid, such as equities and fixed income assets. However, listed properties may have a higher risk of illiquidity as real estate is often more difficult to sell quickly without affecting the price, which means higher cost and illiquidity.

LP is feasible due to the open-market and well-diversified portfolio, but the impact of possible subsequent inflation on house prices and real estate demand cannot be excluded.

4.2.3 Structural / Systemic risks

Systemic risk usually includes political, geographic, and other risks. The recent escalation of the Hamas-Israel conflict has made the international geopolitical environment, which was already affected by the Russo-Ukrainian conflict, more tense, and has increased structural market risk and uncertainty, with world markets likely to be more volatile, and energy asset prices also impacted.

On the other hand, the Wall Street Journal reported that Saudi Arabia will increase its oil production to garner support for a deal in the U.S. Congress, which could also lead to significant volatility in energy prices in the future.

4.2.4 Home bias risks

Home Bias prefers investing in domestic assets over foreign assets. Clients' portfolios contain up to 40% Australian equities and only 20% international equities, reflecting a clear Home Bias. This preference can limit the diversification of portfolios and an increased exposure to the volatility of the domestic economy and markets.

To reduce the impact of Home Bias, it may be necessary to re-evaluate and rebalance the international asset allocation to increase portfolio diversification while improving knowledge and understanding of international markets.

5. Weight Comparison

Weight Comparison											
	Australian equity AE	World equity WE	Emerging market EM	Listed properties LP	Direct properties DP	Commodities COM	Hedge funds HF	Private equity PE	Australian fixed income AFI	World fixed income WFI	Australian cash AC
Bootstrap Weight	35.00%	19.00%	0.00%	10.70%	0.00%	0.00%	2.00%	18.00%	0.00%	13.30%	2.00%
History Rolling Weight	17.07%	25.15%	3.00%	10.02%	2.33%	2.33%	10.02%	3.00%	15.05%	10.02%	2.00%
Average Weight	26.03%	22.07%	1.50%	10.36%	1.17%	1.17%	6.01%	10.50%	7.53%	11.66%	2.00%
Current Portfolio Weight	40.00%	20.00%	0.00%	10.00%	0.00%	0.00%	0.00%	0.00%	16.00%	10.00%	4.00%

Weight Fitted Comparison							
	Terminal value	Absolute target	Sharpe ratio	Prob(loss in 5 year)	Tracking error	Illiquid asset	Cash
Current Weight with Bootstrap	1.228132	4.20%	0.4762	15.73%	0.49%	0.00%	4.00%
Current Weight with History Rolling	1.375977	6.59%	0.0296	43.75%	5.22%	0.00%	4.00%
Bootstrap Method	1.398236	6.93%	0.9684	7.92%	1.18%	20.00%	2.00%
History Rolling Method	1.790154	12.35%	0.0707	34.38%	1.25%	15.36%	2.00%
Average Weight with Bootstrap	1.313900	5.61%	0.8077	9.62%	0.53%	17.68%	2.00%
Average Weight with History Rolling	2.597449	21.03%	0.0512	34.38%	7.89%	17.68%	2.00%
Adjusted Weight with Bootstrap	1.342658	6.07%	0.8169	10.02%	0.86%	16.51%	2.00%
Adjusted Weight with History Rolling	2.714562	22.11%	0.0494	34.38%	8.97%	16.51%	2.00%

Considering single-model risk and assumption limitations, we average the two quantitative methods. Bootstrap has a higher Sharpe ratio and risk control while historical rolling only has a higher absolute return. Average weight performs well in bootstrap and meets all client requirements, but performs poor in historical rolling, and we choose average weight and adjust it based on the two methods.

5.1 Explanation on Weight Selection

5.1.1 Weight Adjustment Constraints

When developing a portfolio for our clients' Pension Plan, we need to focus on asset allocation to meet the long-term objectives and client-specific needs. Second, consider the pension fund's liquidity needs and employees' risk tolerance. We should also compare E[r] and fees of different asset classes and optimize the allocation to reduce costs.

Our weight allocation adjustments are based on a combination of meeting client-specific needs, the risk appetite of pensions and the macro environment over the next five years. Inflation is based on RBA; we use the difference between 10-year bond and indexed bond which is a market-based method of expected inflation.

5.1.2 Final Selection

Weight Adjustment												
	AE	WE	EM	LP	DP	COM	HF	PE	AFI	WFI	AC	Return
Current Portfolio Weight	40.00%	20.00%	0.00%	10.00%	0.00%	0.00%	0.00%	0.00%	16.00%	10.00%	4.00%	4.20%
Selected Weight	26.03%	22.07%	1.50%	10.36%	1.17%	1.17%	6.01%	10.50%	7.53%	11.66%	2.00%	5.61%
Change(%)			+7.87%		-1.17%					-6.70%		
Adjusted weight	26.03%	22.07%	9.37%	10.36%	0.00%	1.17%	6.01%	10.50%	7.53%	4.96%	2.00%	6.07%

1. Australian Equity

AE has a large impact on the return and risk of the portfolio. It invests in limited categories due to its small share of the global market. We choose the weights after averaging the two quantitative methods (26.03%), and the reduction in the weight of AE is to minimize over-exposure to the local market from the original weight (40%).

2. World Equity

We are one of the major contributors to portfolio risk and return. It has diversification potential and access issues. Since WE (9.45%) have had a higher E(r) than AE (7.78%) and EM (7.81%) over the last 20 years based on our Expected return analysis, we will choose the average (+2.07%).

3. Emerging Market

EM has high returns and high risks. Additionally, it has illiquidity, capacity and access issues. Current weight is 0% and the final weighting is 6.7% + 1.17% (from DP and WFI). Emerging market equities were added to seek new potential growth returns globally.

4. Listed Properties and Direct Properties

LP contributes to excess returns through security selection and market timing. It is liquid but subject to market risk. Additionally, DP is less liquid but can provide stable income to the portfolio. It is subject to credit and management risk. We reduce the DP weighting by 1.17% due to the illiquidity and high transaction costs. Also, repeat investments may scale up the risk of the same sector. Whereas LP's Reits funds are relatively liquid and publicly transparent, so we maintain consistency and use average.

5. Commodity

Since commodities return have low or negative correlation with stocks and bonds, it can diversify the portfolio and contribute to risk-adjusted returns (U.S. Securities and Exchange Commission 2008). They can combat inflation risk in the future economic environment, which is good for diversification, but given risks such as geopolitics and Saudi Arabia's increased production (explained later section), we choose average (+1.17%).

6. Hedge Fund

HF charges high fees that can reduce portfolio returns and has liquidity and investment

risk. However, its flexibility and diverse strategies aiming for positive returns under a variety of market conditions, which can reduce portfolio risk and overall volatility. Particularly in the current context of high economic uncertainty, HF may provide risk management and capital protection to the portfolio, we choose average (+6.01%).

7. Private Equity

PE gains returns through dividends and capital appreciation and require long-term investment. They have access and illiquidity risk, typically concentrating in private markets, which may help clients avoid the short-term volatility and uncertainty of the public markets. PE's longer investment horizon matches client's needs. Investing in PE with high growth potential can gain quality returns to the portfolio over the next five years. We choose average (+10.5%).

8. Australian and World Fixed Income

AFI and WFI have low volatility and they provide stable returns and diversify portfolio risk. Although their risk is low, they are subject to interest rate, currency and default risk. Fixed income is often seen as a hedge against inflation risk, and AFI's (2.3%) expected return outperforms WFI's (2.2%). We keep the average weighting For AFI's, for WFI's we subtract 6.7% and move to the EM market to maximize the Sharpe-ratio while meeting clients' needs.

9. Australian Cash

AC provides stable but low returns to the portfolio. Additionally, it is highly liquid and low risk. We reduce it by 2% in pursuit of higher returns while maintaining a minimum 2% cash weighting requirement.

5.2 Management Fees Adjustment

Indicative Investment Management Fees

Asset	*Active*	*Passive*	
Australian Equities	0.50%	0.10%	
World Equities	0.50%	0.10%	
Emerging Markets	0.80%	0.20%	
Listed Property	0.60%	0.15%	
Australian Fixed Income (inc. ILBs)	0.25%	0.10%	
World Fixed Income	0.30%	0.15%	
Australian cash	0.10%		*< Assumption based on australian super* https://www.australiansuper.com/compare-us/fees-and-costs
Alternatives			
Direct Property, Infrastructure	1.20%		
Hedge Funds, Private Equity	2.00%		*< Includes incentive fees*
Commodity Futures Fund	0.75%	0.25%	

Note: The data provided in the assignment are gross-of-fees. To compute investor specific return, relevant fees need to be subtracted.

Fees Adjustment

	AE	WE	EM	LP	DP	COM	HF	PE	AFI	WFI	AC	Total Fees
Management Fees (%)	*0.10%*	*0.10%*	*0.20%*	*0.15%*	*1.20%*	*0.25%*	*2.00%*	*2.00%*	*0.10%*	*0.15%*	*0.10%*	
Current Weight	40.00%	20.00%	0.00%	10.00%	0.00%	0.00%	0.00%	0.00%	16.00%	10.00%	4.00%	
Fees	*0.04%*	*0.02%*	*0.00%*	*0.02%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.02%*	*0.02%*	*0.00%*	*0.11%*
Selected weight	26.03%	22.07%	1.50%	10.36%	1.17%	1.17%	6.01%	10.50%	7.53%	11.66%	2.00%	
Fees	*0.03%*	*0.02%*	*0.00%*	*0.02%*	*0.01%*	*0.00%*	*0.12%*	*0.21%*	*0.01%*	*0.02%*	*0.00%*	*0.44%*
Adjusted weight	26.03%	22.07%	9.37%	10.36%	0.00%	1.17%	6.01%	10.50%	7.53%	4.96%	2.00%	
Fees	*0.03%*	*0.02%*	*0.02%*	*0.02%*	*0.00%*	*0.00%*	*0.12%*	*0.21%*	*0.01%*	*0.01%*	*0.00%*	*0.43%*

As there is no detailed information about management fees on Australia cash, we will use the management fees of Australia's largest pension fund – 'Australian super' as a reference. (0.1%)

Return	6.07%
Fees	0.43%
Adjusted Real Return	5.61%
Abusolute Target	5.41%
Checking	5.61% > 5.41%

Due to the client's concern about the actual cost of portfolio investment, we have adjusted WFI, which has relatively underperformed in the expected return, but given the uncertainty of the future economy, we have increased our holdings of HF and PE with liquidity and the probability of loss over the next five years secured.

5.3 Weight Choosing Conclusion

Summary	Constraint	Final Portfolio	Checking
Terminal value	maximum	1.342658	√
Absolute target	>=2.41% (inflation) +3%	6.07%	√
Sharpe ratio	maximum	0.8169	√
Prob(loss in 5 year)	<=20%	10.02%	√
Tracking error	<=2%	0.86%	√
Illiquid asset	<=20%	16.51%	√
Cash	>=2%	2.00%	√
Equity	<74% (within 15% range of the benchmark allocation)	73.99%	√

6.Rebalancing strategies

6.1 Quarterly/annually base

Since each trade incurs 2bps fixed cost and 25bps Variable cost, this means that if the customers want to rebalance, with each rebalance, they need to pay 0.25% of the transactions as variable cost and 0.02% of the fund size as fixed cost. For monthly rebalance, an average return of 0.8% can be achieved due to the transaction fees. So, a new strategy should be figured out to raise the return rate. From the point of reducing the transaction fee, we recommend reducing the frequency for rebalancing directly, i.e., quarterly, or annually rebalancing is recommended.

The reasons and supporting data are as follows. First, for quarterly rebalancing, an average return of 1.34% can be achieved. If the duration is lengthened to once a year, and the time of the annual rebalancing is set to the end of the year, then its average return will become 2.57%. Comparing these two data, it is noticeably clear to see that the effect of the transaction fee on the return is still huge, and lengthening the duration of the rebalancing can effectively increase the return. Also, considering that Australia ends and opens its fiscal year in July, we strongly recommend setting the time of the rebalance as in July of each year. When a yearly rebalance is carried out in July of each year, it becomes an average return of 2.62%. The higher return may be because at the end of every fiscal year, the government would try to make the financial data look better, thus leading to the investors to be more confident and this led to the return going higher. So, a yearly rebalance carried out each July is strongly recommended.

6.2 Set rebalancing thresholds

In addition to regular rebalancing, there are other options for rebalancing, which is to set thresholds for the assets. According to Rosemary, in Australia, resident investors exhibit a significant preference for domestic equity holdings, with an average allocation of 73% in Australian equities. This represents an overweight position of approximately 70% compared to Australia's market capitalization weight of 3.5% in the MSCI World Index denominated in Australian dollars (Rosemary, 2012). Since Australia has strong home bias, many native people would more like to and Australian equity has the highest weighting, we can do something about Australian equity to make the rebalancing strategies more effective.

6.2.1 Using weights as a balancing condition

If we use the percentage deviation of Australian Equity from the original allocation as a balancing condition, the resulting return will be as shown below.

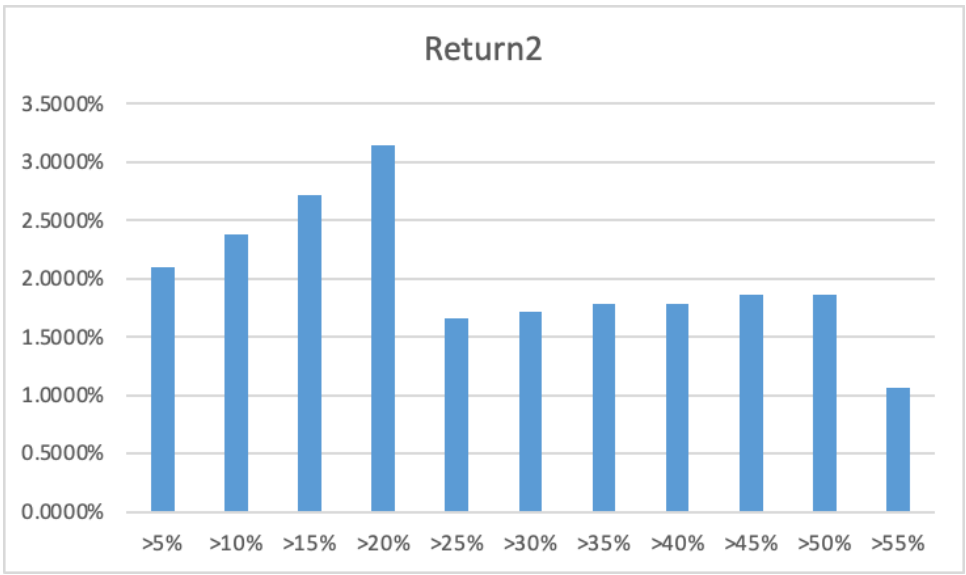
According to the bar chart, a rebalancing is done when the deviation is greater than 15%, i.e., limiting the change in the AE ratio to 15% will result in a higher rate of return,

which is 2.7183%.

6.2.2 Using return as a balancing condition

If some constraints are imposed to make a rebalance when the AE has made more profit in a certain period in the past, the return obtained will be as shown in the graph below:

According to the variation of the bar chart, the maximum return can be obtained whenever the average value of the change in the return of AE in the last three quarters is greater than 20%, with a value of 3.1403%.

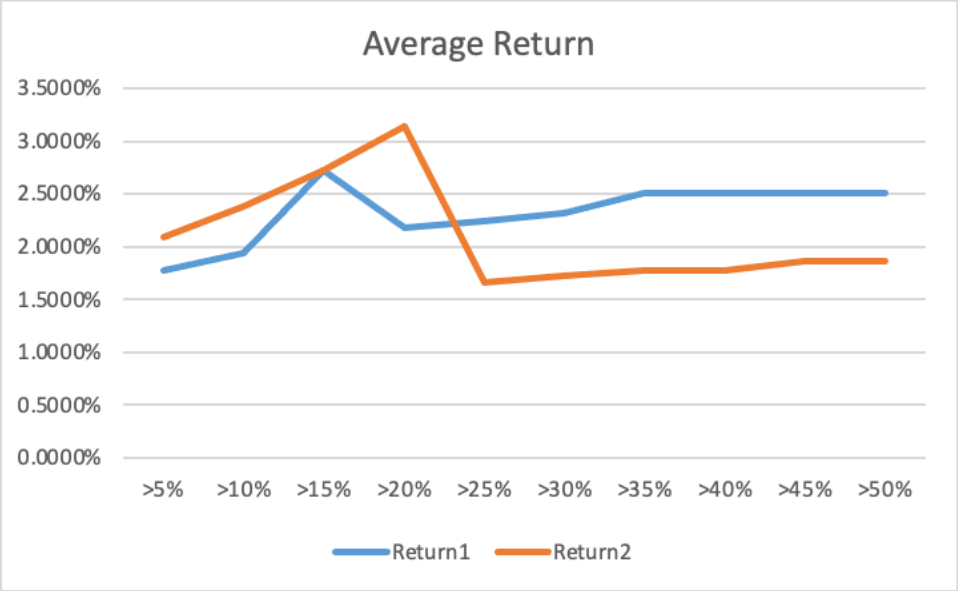


6.2.3 Comparison

The returns of the above two methods of setting thresholds are shown below:

Return1 represents the average return of the first threshold setting method and return2 represents the second one that referred to before. It can be clearly seen that the orange fold has a higher peak, so the best way to get the highest return should be to set a

limitation on the performance for the portfolio over the last three quarters, and the thresholds should be 20%, which means that if the performance or the portfolio is good over the last three quarters, we can sell some to rebalance. This led to the biggest return of 3.1403%.



7.Conclusion

Based on an analysis of HPPIB's historical portfolios, we find that HPPIB is risk-neutral and needs a more rational and up-to-date strategy. Based on the analysis of the data using three different methodologies, we obtained the optimal asset allocation ratios, i.e., 46.03% in Australian Equity, 22.07% in World Equity, 9.37% in Emerging Market, 10.36% in Listed Properties and Direct Properties, 1.17% in Commodity and 1.17% in Commodity. Properties and Direct Properties, 1.17% in Commodity, 6.01% in Hedge Fund, 10.5% in Private Equity, 7.53% in Australian Fixed Income, 4.96% in World Fixed Income and 2.00% in Australian Cash. Also, for the Rebalance strategy, we have chosen to set a threshold to maximize returns, that is, if the average return of AE over the last three quarters exceeds 20%, then the portfolio will be rebalanced, and the average return of 3.1403% will surely lead to a better performance of this portfolio in the future.

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