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A differentiated approach to asset allocation in retirement

Investments

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Introduction

Portfolios often hold assets as to pay for future consumption. A consumption stream is a stream of cash out-flows that will be needed in the future by the investor or retiree This suggests that portfolios not only consists of assets but liabilities as well. Yet, we tend to focus solely on the assets when selecting an asset allocation. In general, we choose assets from an investment universe that have the potential to earn above a certain threshold. Then depending on our appetite for risk, we select the asset allocation that gives the best return for a given level of risk without explicitly accounting for the future stream of cash outflows to support our spending. This process thus neglects to consider the time and size of the liabilities.

A differentiated approach to asset allocation explicitly accounts for the liability by including it as a negative asset in the allocation framework. Applying Liability Relative Asset Allocation to retirement portfolios can help clients understand how spending affects their portfolio, how much risk needs to be taken to break even to service the liability and the probability of success.

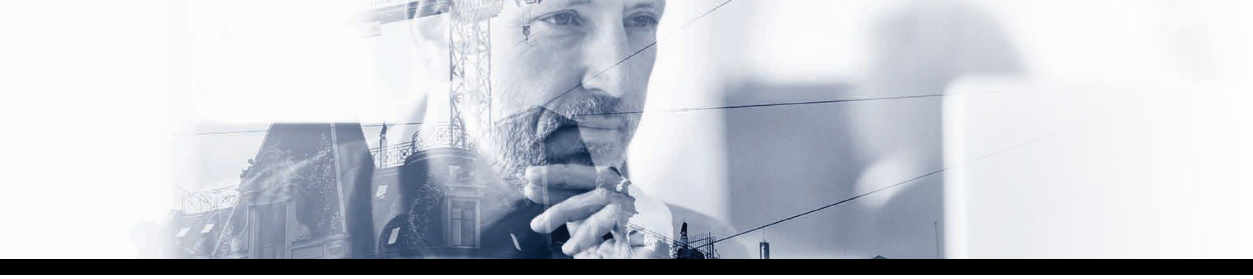
Liability Relative Asset Allocation

Asset Only (AO) strategic allocation decisions focus solely on assets whereas Liability Relative Asset Allocation (LRAA) involves assigning portions of capital to assets with reference to a specific liability. LRAA views a portfolio as a balance sheet holding assets and liabilities, with the difference between assets and liabilities representing a surplus. In some cases, a liability makes up a sizable portion of the balance sheet, sometimes greater than the asset, and creates a deficit.

The goal of LRAA is to better control the surplus/deficit to ensure that there are funds available to pay for future consumption. This can be done by incorporating the liability as another asset class in the mean-variance optimization framework.

The goal of Mean-Variance Optimization (MVO) is to best allocate investments between different assets in an AO allocation. MVO is based on the premise that low correlated assets reduce risk when combined to form a portfolio. It makes use of mean returns, standard deviations, and correlations of returns to develop an efficient frontier - a set of portfolios with an expected return greater than any other arrangement with the same risk or less risk[1]. The mean, standard deviation and correlation of the liability are included into the MVO framework to derive an LRAA. The result is a surplus frontier where the liability is simultaneously accounted for in the asset allocation decision.

[1] An efficient frontier is essentially a scatter graph that plots return on the y-axis and standard deviation (risk) on the x-axis.



The Liability

The liability is an important input into the LRAA framework. The size of the liability has a direct impact on the funding ratio. The funding ratio impacts the return of the entire portfolio and therefore determines how much risk is needed to fund future liabilities. Thus the size of the liability is fundamental in determining the strategic asset allocation.

The size of the liability is estimated as the present value of future cash outflows. In a retirement context, this would be the estimated present value of the drawdown. The size of the liability is affected by all of the factors used in the present value calculation. These factors include the income needed per year, the growth rate on income, the number of years to retirement as well as the discount rate applied to the stream of income. A more complex calculation would include probability weighted yearly drawdown based on the probability of surviving.

Dividing assets by the present value of the liability gives a funding ratio. The funding ratio is important in a LRAA framework because it scales the return on assets. Scaling returns does not take place in an MVO where only assets are considered, so clients with similar income needs and risk tolerances are placed into the same fund. Under the LRAA framework, the funding ratio helps differentiate clients by placing more emphasis on how well the asset is prepared to service the liability. For instance, if a client has a funding ratio of 86%, earns 10% return on investments and requires 4% to pay for expenses, the client's actual return would equate to 4.62% (86% X 10% - 4%). Whereas a client with a 100% funding ratio, invested in the same fund with the same expense requirement, would earn 6% (100% X 10% - 4%). This means that the client with the 86% funding ratio would arguably need to have a higher risk tolerance for return volatility in order to reach the same ending market value as the client with the 100% funding ratio.

From this description we can determine a few relationships between the funding ratio and the factors used in the calculation for the present value of the liability:

- The higher the income needed, the greater the liability, the lower the funding ratio;
- The higher the growth rate on income needed, the greater the liability, the lower the funding ratio;
- The longer the retirement period, the greater the liability, the lower the funding ratio;
- The higher the discount rate, the smaller the liability, the higher the funding ratio; and
- The lower the probability of surviving, the smaller the liability, the higher the funding ratio.

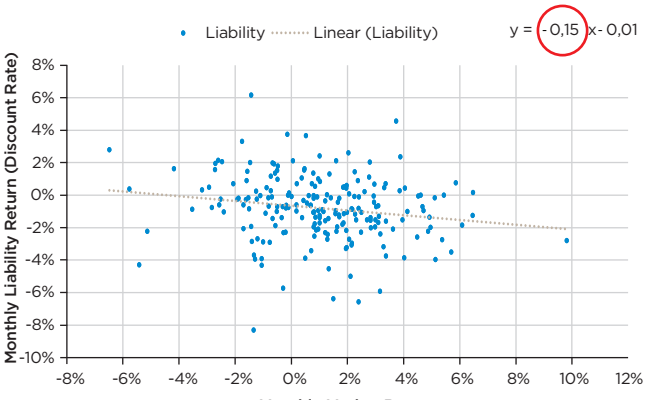
Another important factor regarding the liability is the discount rate applied to the cash flows. A high discount rate will lower the present value of the liability and overstate the funding ratio, whereas a low discount rate would have the opposite effect. It is therefore imperative to be prudent with the discount rate. Moreover, the discount rate represents the liability's risk character. Since a retiree is relatively certain of the amount that they will need to cover their expenses each year, the nature of their liability resembles a long term risk-free rate.

Unpacking liability relative Investing

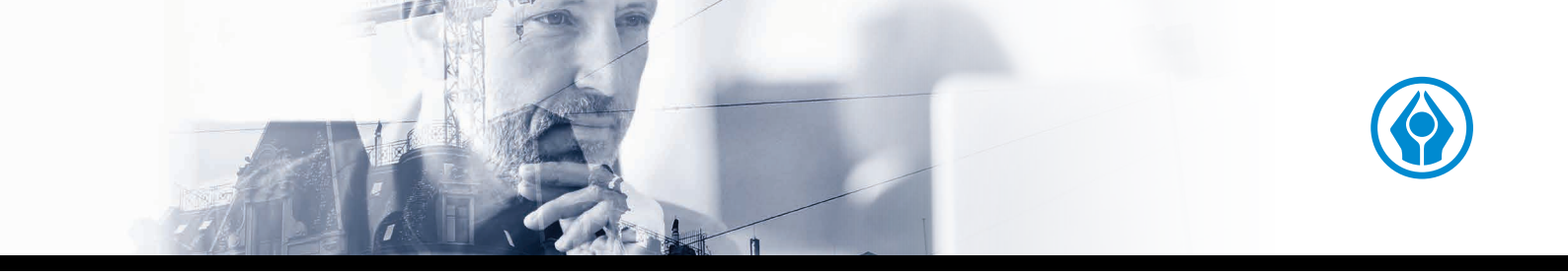
Including the return and risk characteristics of the liability in the optimisation framework means that we are including a short position in the portfolio. A short position in this instance can be described as a negative asset. Where the risk characteristics of the liability are matched with assets within the optimisation framework a natural hedge is formed. For natural hedges to take place the assets need to react in a similar manner to market movements as the liability. In other words, the asset and liability need to have a strong positive correlation so that movements in the liability can be completely offset by the movement in the asset.

The movement in the asset and liability is measured by beta[2]. It is known as the market risk or systematic risk of the asset or liability. Graph 1 depicts the linear relationship between the liability return and the market return. We have assumed that the Government Bond Index (GOVI) represents the liability return and that the market is a Regulation 28 compliant multi-asset portfolio.

GRAPH 1: Liability relative to the multi-asset benchmark

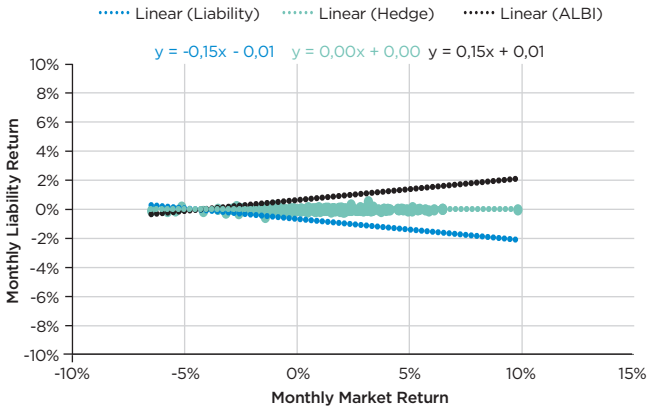


[2] Beta is the slope in a linear equation that measures the change in the asset or liability relative to the change in the market return.



The formula in the top right-hand corner of the graph describes the predicted return for the liability. The 'x' in the formula is the return on the market. Even though the GOVI has a positive relationship with the market, in reality, the slope of the liability (circled in red on the graph) is negative to represent that it is a negative asset. Plugging the actual market returns into the formula per month would derive the straight line shown in Graph 1. The difference between the predicted value and the actual value is the **unexplained risk**, while the difference between the predicted value and the average is the **explained risk**. Unexplained risk and explained risk make up total risk which is equivalent to standard deviation. The explained/expected component comes from the market or beta in the equation (red circled number) and the unexplained/unexpected component is an idiosyncratic risk. To hedge the liability we need to find an asset with similar market risk. This is shown in Graph 2 where the liability is hedged using the All Bond Index ALBI.

GRAPH 2: The liability, ALBI and hedge relative to the multi-asset benchmark



Effectively all market risk has been removed. Only the unexpected risk remains and consequently the monthly returns in the liability-relative portfolio do not sit directly on the hedged line and have a standard deviation of 0.33% annually.

These differences get larger as we decrease the funding ratio because the assets will need portions of higher beta assets to offset the liability beta. Although the combination will eliminate the market risk, the combination would constitute a looser hedge due to higher beta assets having greater unexpected risk and consequently increase the standard deviation of the hedge.

For instance, in an asset portfolio made up of the JSE All Shareholder Weighted Index (SWIX) and the ALBI, a 70% funding ratio would require 4% of the SWIX beta to offset the liability. This produces a hedged beta of zero for the liability relative portfolio, and the standard deviation increases from 0.33% annually to 0.63% annually. To ensure that we add controls for this we can set our objective to minimise the standard deviation for a given level of return in the optimisation framework. Because a certain amount of beta has to be taken to offset the liability, the optimiser will focus on minimising the idiosyncratic risk for a given level of expected return. In this way, a hedge portfolio for each level of funding is produced. It should be noted that a hedged portfolio only means that surplus risk is neutralised, the return of that portfolio may still be insufficient to close a deficit between assets and liabilities. To close a deficit, the beta of the assets has to be greater than the beta of the liability. In other words, a surplus beta is needed to close the deficit. Taking surplus beta implies taking a high surplus standard deviation and allows an efficient frontier to be traced out. Liability relative efficient frontiers will thus start at the zero beta asset allocation (minimum surplus variance portfolio) and extend to the highest surplus beta allocation.

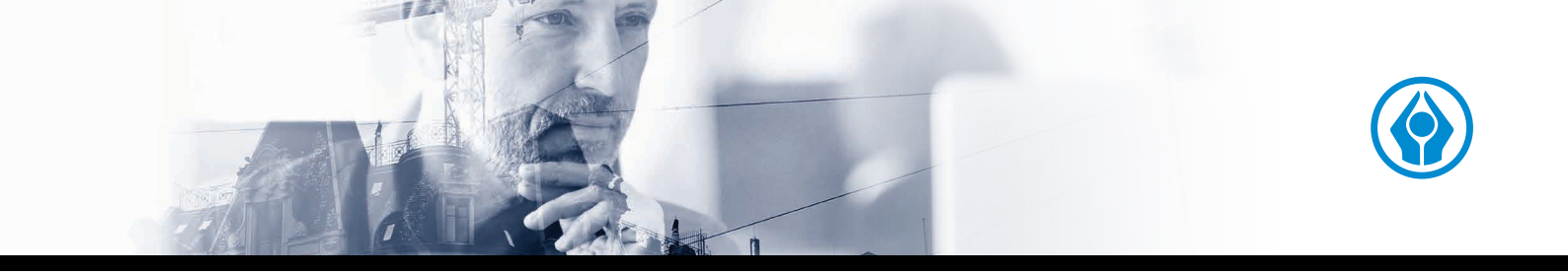
Application of liability relative investing to different levels of funding

Applying Liability Relative Asset Allocation (LRAA) to the historical data shown in Table 1 and constraining the asset to be within the limits stipulated by Regulation 28 results in the efficient frontiers shown in Graph 3. Although individual client annuities are not required to stay within Regulation 28 limits during retirement, the constraints help to not concentrate the portfolio in the best performing asset class over the period.

TABLE 1: Historical data for the liability relative strategic asset allocation

Asset Class	SA Bonds	SA Equity	Property	SA Cash	Global Equity	Global Bonds	Global Cash	Liability
Return	9.62%	14.76%	18.91%	8.02%	9.48%	7.69%	4.51%	-9.54%
Standard Deviation	7.00%	14.53%	15.95%	0.54%	15.85%	16.24%	17.05%	6.86%
Beta	0.15	1.67	0.89	-0.01	1.20	0.02	-0.11	-0.15

Source: Data taken INET for the period 28/02/2002 – 31/05/2019



Looking at the data in Table 1, the minimum surplus variance portfolio would largely consist of SA Bonds because its risk and return attributes are similar to that of the liability. In instances that the funding ratio is greater than 100%, the optimiser would look to reduce the beta by adding negative beta assets such as SA Cash and Global Cash to the minimum surplus variance portfolio. At funding ratios below 100%, the minimum surplus variance portfolio would include higher beta assets. Based on the reward to standard deviation ratios the optimiser would first seek to add SA Property until the 25% constraint is exhausted and then seek SA Equity exposure thereafter. The other assets will not receive an allocation because their reward to risk ratios are suboptimal. These observations can be seen in Table 2.

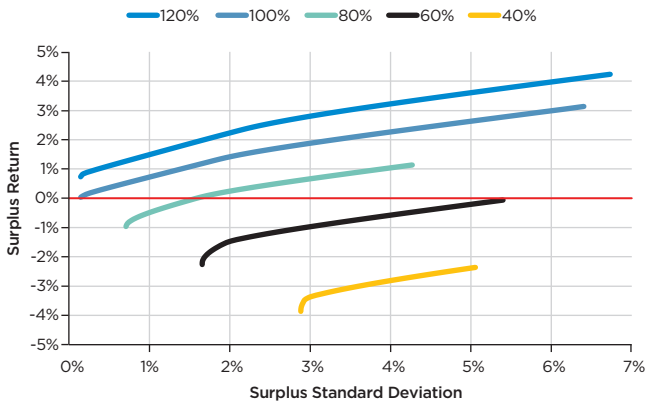
TABLE 2: Minimum surplus variance portfolio asset allocation and beta

Funding Ratio	120%	100%	80%	60%	40%
SA Bonds	81%	98%	94%	89%	77%
SA Equity	0%	0%	0%	0%	0%
Property	0%	0%	6%	11%	23%
SA Cash	18%	2%	0%	0%	0%
Global Equity	0%	0%	0%	0%	0%
Global Bonds	0%	0%	0%	0%	0%
Global Cash	0%	0%	0%	0%	0%
Portfolio Beta	0.15	0.15	0.16	0.14	0.13
Liability Beta	-0.15	-0.15	-0.15	-0.15	-0.15
Difference	0.00	0.00	0.01	-0.01	-0.02

The net beta for each of the funding ratios is very close to zero. The differences arise because there is a conflict between the objective of the optimisation and the beta objective. At lower levels of funding, beta needs to increase while minimising standard deviation. This makes it difficult for the optimiser to find the perfect hedge. Even so, the difference is negligible as the net betas are not significantly different from zero.

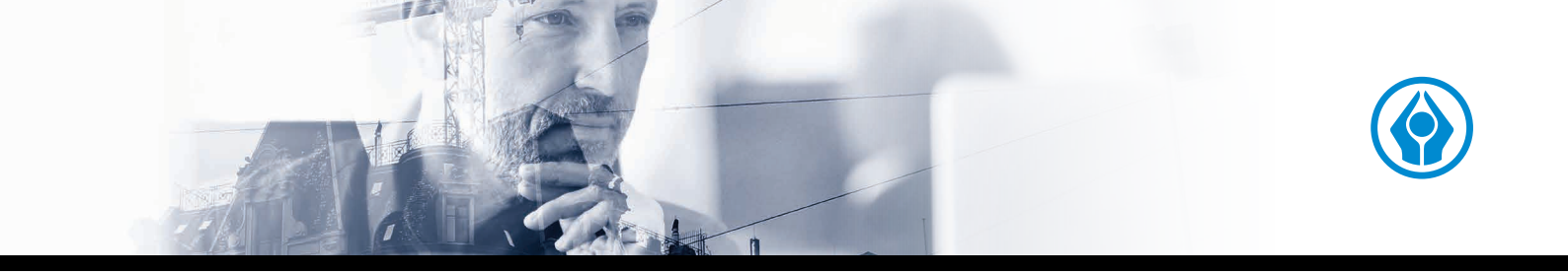
Graph 3 depicts the surplus efficient frontiers. The red line represents the breakeven point. If the frontier lies above the red line, the asset has a better probability of servicing the duration of the retirement period. As we decrease the funding ratio, lower surplus risk allocations have the potential to earn negative surplus returns. This suggests that clients with low funding ratios should take maximum risk in order to service their liability. However, taking maximum risk can't guarantee a positive outcome. In fact, as shown in Graph 3, some funding ratios are irrecoverable. At a funding ratio of 60 %, clients need to take maximum risk in order to ensure that their capital has a chance of providing for the entire duration of retirement. At 40% funding, no amount of surplus risk is sufficient enough to fund the liability.

GRAPH 3: Liability relative efficient frontiers at different levels of funding



Breakeven asset allocation

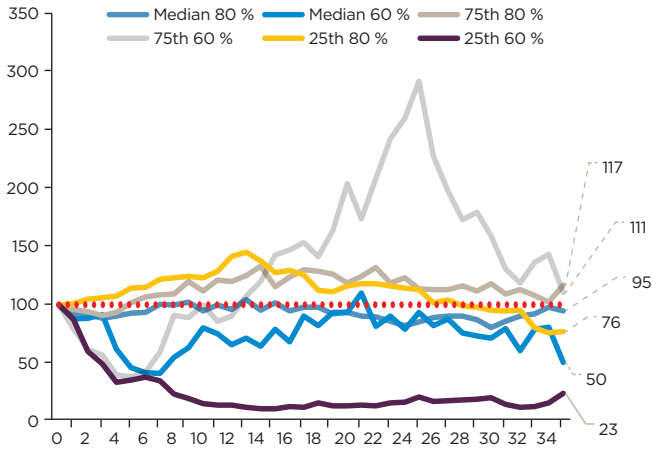
When using Liability Relative Asset Allocation (LRAA), clients with the same withdrawal can have substantially different breakeven points. This is because of the impact of the variables used to calculate the present value of the liability on the



funding ratio. Table 3 presents the breakeven allocation for 80% and 60% funding ratios respectively. The return and standard deviation values are the annualised results of the LRAA optimisation. Since breakeven is defined as the point at which the efficient frontier crosses the zero line in Graph 3, the expected surplus return is zero. The graph shows the simulated returns to the asset allocations for a period of 35 years. The red dotted line in the graph represents 100% of the starting funding ratio. It should be read as 100% of 80% or 100% of 60%. Any value above the red dotted line indicates that the funding ratio is increasing. Anything below the red dotted line indicates a worsening funding ratio. These values are then subjected to a simulation that predicts how these allocations would perform over a 35 year period.

TABLE 3: Breakeven asset allocation and simulation

Funding Ratio	80%	60%
Return	0%	0%
Standard Deviation	5%	19%
SA Bonds	75%	0%
SA Equity	0%	75%
Property	25%	25%
SA Cash	0%	0%
Global Equity	0%	0%
Global Bonds	0%	0%
Global Cash	0%	0%



As suggested by the data in Tables 1 and 3, the optimisation process puts the bulk of the assets in SA Bonds at higher funding levels, and then allocates to property. Once the 25% limit for property is reached the optimiser makes use of the SA equity asset class. The other asset classes are sub-optimal choices and thus receive no allocation. **Note that these allocations are demonstrative and based on historical performances and volatilities. These numbers will clearly change if asset projections change.**

Based on the median ending values of 95 (95% of 80%) and 50 (50% of 60%) for 80% and 60% respectively, it is unlikely that the funding ratio can be improved. Judging by the range between the 75th and 25th percentile of ending funding ratios, one is more susceptible to worsening the funding ratio when taking on higher surplus beta at lower levels of funding. Wider ranges indicate even more uncertainty. For an 80% funding ratio, half of the simulated results lie within the range of 76 to 117. For a 60% funding ratio, half of the outcomes lie between 23 and 111.

Conclusion

It is important to educate investors on the disadvantages of being too risk-averse. By using this methodology, investors can better understand their current position and have a more informed view of what their asset allocation should be in order to ensure that their investment is sufficient to service their retirement.

Investors will also gain a better indication of what their asset allocation should be in order to meet their consumption demands. Moreover, they will understand that at the breakeven point and above, there is still a possibility that they might fall short of their goal because of the other risks involved.

The frontiers show that at some funding ratios, it is impossible to recover from lost opportunities, no matter how much risk is taken. Thus investors might want to consider veering towards an income providing vehicle that is guaranteed instead of a living annuity, or a combination of a life annuity and a living annuity.

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