Key words: lifecycle investing; risk management; behavioural finance; superannuation

Lifecycle investing: is it more about behavioural finance than risk management?

While 'lifecycle investing' has been a marketing success, this paper demonstrates the fallacy of this approach when sold as a gradual risk reduction strategy, and argues that lifecycle investing is rooted more in behavioural finance than in lifetime risk management. A more appropriate approach would be to assess lifetime risk assumed and manage this according to the investor's risk profile.

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LIFECYCLE INVESTING, or varying the risk profile of an investor's portfolio over the life of the investor, has been a common practice among product manufacturers and is becoming increasingly popular with the shift to defined contribution retirement funding. Underlying this concept is the notion that as people get closer to retirement, and particularly as they enter the 'decumulation' phase, the portfolio risk ought to be reduced so as to lessen the variability of the portfolio return, and reduce the risk of loss.

Lifecycle investing has had an extensive literature. Samuelson (1969) maintained that the risk tolerance of investors should be constructed independent of the stage of life and he argued strongly for an investor-centric method of varying risk, independent of age. Bodie (2003, 2005 & 2006) furthered the discussion in lifecycle investing by demonstrating that age-based risk variation may not fulfil investor needs. Campbell and Viceira (2002) presented an approach that took into account investor time horizon, varying risk according to the likely cash flow needs of the investor, and Brandt (2003) developed a simulated approach to determine the optimum portfolio using stochastic techniques similar to those used in this paper.

Most models are concerned with optimising an individual investor utility. However, in practice, pension funds cannot readily accommodate investor-specific utilities when developing products for many investors. As such, there has been a move by some to argue for the development of some form of risk reduction over the life of the investor. This approach has been taken widely by 401k plans in United States. In the United States, 401k funds had historically held low levels of growth assets, and lifecycle investing was a way of increasing the exposure of investors to risky assets. The purpose of the lifecycle approach was therefore to increase the exposure to risky assets for investors, by adopting more risky strategies earlier in the accumulation phase. The Australian experience of superannuation funds is, of course, entirely different with investors accepting far greater exposure to risky assets throughout their accumulation phase.

This paper analyses the investment return outcomes and the risk undertaken by the investor. In relation to returns, the paper uses Monte Carlo simulation to estimate the cumulative impact of a dollar invested at each age.

The paper also assesses risk taken at each age as a proportion of the total (and deflated) return available to a typical investor over the entire life of the investment. The paper shows that the perceived risk taken by an investor at each age range increases gradually as a percentage of total return – but that this is a behavioural bias because the perceived risk increases precisely as the amount of returns 'banked' increase. Samuelson (1963) predicts this outcome.

An important variation of this approach is that this model investigates the lifecycle of a typical investor during both the accumulation and decumulation phases and it is this difference in analysis that allows the paper to argue that lifecycle investing cannot be supported on a pure investment principle.

Following from this, the paper questions whether the prevailing canons and practices of lifecycle investing owe more to a behavioural response than to sound investment practice. The paper does not question changes in investor risk tolerance; this is a notion that has been questioned by many papers. Rather the paper argues that framing – the notion that people's decisions are biased by the framework within which they are presented – is more likely to be the cause of investor acceptance of lifecycle investment than good calculation.

A framework is proposed in which a typical investor perceives risk as the dollar variation of returns relative to the sum of past and expected future returns rather than relative to the lifetime compound investment value (Livanas 2006).

Method

The model is set up to reflect a typical Australian superannuation investor who contributes a set proportion of their income into a fund that provides a stochastic risky asset. At retirement (defined as age 65), the investor draws down from the fund until age 100 or until the money runs out. Contribution is set at 9% of average weekly earnings. The rate of the drawdown in the decumulation phase is indexed to inflation and calibrated such that, at an imputed 7% annual return, there will be nil available for distribution at age 83.

The purpose of the model is not to determine individual maximisation of utility (for example, the Ramsey model (Arrow 1980)), but to assess the variations of risk and return at each age group. This measure could almost be termed the 'age risk density'. The model starts off by modelling the behaviour of fund with normally distributed returns assuming the standard deviation of a typical balanced portfolio. The assumptions for standard deviation and for mean of return are based in part on information provided by SuperRatings Pty Ltd.

Let the aggregate wealth of an investor in the accumulation phase be defined as:

$$W_{iR} = \prod_{t=1}^{R}(1 + \tilde{g}_t)(W_{it-1} + Y_{it}) \quad (1)$$

where W_i^R is the wealth of investor i at retirement who has made a series of contributions Y_{it} at each time period t and whose contributions have been afforded investment returns at time t of $\tilde{g}_t$, with these returns normally distributed around $\bar{g}$.

Let the wealth of an individual in the decumulation phase at time t > R, who draws down Z_{it-1} at s, be defined as:

$$W_{is} = \prod_{t=R}^{s}(1 + \tilde{g}_t)(W_{it} - Z_{it-1}) \mid W_i^s > Z_{it-1}) \quad (2)$$

Assuming a zero bequest motive, return $\tilde{g}$ and drawdown Z_t is calibrated such that at t=D, where D=death, $W_{iD}=0$ when $\tilde{g} = \bar{g}\ \forall t$.

In order to add reality to the model, the various parameters are calibrated against current norms from the following set (3) below:

$Y_{it} = 9\% * AWOTE_t$[1]
Age at start of contributions (t=0) → 24
Age at Retirement (t=R) = 65
Death D=83
Inflation is a constant over the period= 3%
The mean of investment return $\tilde{g}$ = 7.00% with $\bar{\sigma}$ = 5.20%[2].

Assuming stochastic returns $\tilde{g}$, there will be $W_i^{t>D}$ such that $W_i^{t>D} > 0$. The implication of this is that the investor will have experienced returns above the average

TABLE 1: Summary results of chosen iteration of Monte Carlo simulation of 120 scenarios

	Baseline	Average of Iterations
1. Age at Retirement:	65	65
2. Achieving the fund mean return of:	7.00%	7.02%
3. Expected Bequest, ε, (Terminal Value at Death)	\$0	\$0
4. Expected Age at death of:	83	83
5. No capacity to rely on age pension or additional income		
6. Actual Terminal value at age 83 is[3] :	\$0	\$509,866
6. Actual Terminal value at age 83 (in today's \$) is:	\$0	\$89,137
7. Economic Deflator (Inflation Proxy) of:	3%	3%
8. Annualised Standard Deviation ($\bar{\sigma}_t$) of:	5.20%	5.19%
9. Required consumption Z_{it-1} at t–1=R to achieve \$0 bequest motive	-\$41,139	-\$41,139
10. Age at which money runs out:	83	83.2
12. Risk-free Rate	5.50%	

expected and, as a result, there will be residual funds available after death. The model continues calculating these returns until the funds equal zero, or an implied age = 100. This residual amount is defined as ε.

The model is set up as 120 scenarios, with each scenario drawing their specific return randomly from the set defined in (3). The scenarios are run simultaneously, and a number of iterations are attempted in order to establish the model stability with regard to the average mean and standard deviation of the scenarios.

The model baseline parameters and the average of the model iterations are set out in Table 1. Even limited to 120 runs, the model achieves the baseline constants on average.

Analysis

The model has been constructed assuming a fund with many members, each of whom contributes a set percentage of earnings. The analysis is done at an aggregate (or fund)[4] level, without considering the individual investor returns. The model identifies a variation in the performance of the fund for the typical investor and demonstrates a number of characteristics of the accumulation–decumulation process. These include the observation that for some investors above-average returns will result in unintended bequests; that the VAR is concentrated around retirement, and that the ratio of the standard deviation of returns as a percentage of total returns increases over time.

Unintended bequests

The model identifies a residual average value of $\varepsilon>0$ as shown in Figure 1. This is due to the model being calibrated such that the average of all bequests at age 83 is zero. Where the returns are above average, the residual money stays in the fund until it is drawn down or until an imputed age = 100. Where the returns are below average, the investor runs out of money before death and cannot borrow against the fund.

Figure 1 shows the numbers and amounts of the unintended bequests for each run of the model. In terms of the fund itself, it presents the interesting possibility of accessing part of this 'unintended bequest' as a source of insurance and this theme was raised in Livanas (2006).

The effect of a variation in investment return is more important around retirement than at any other time.

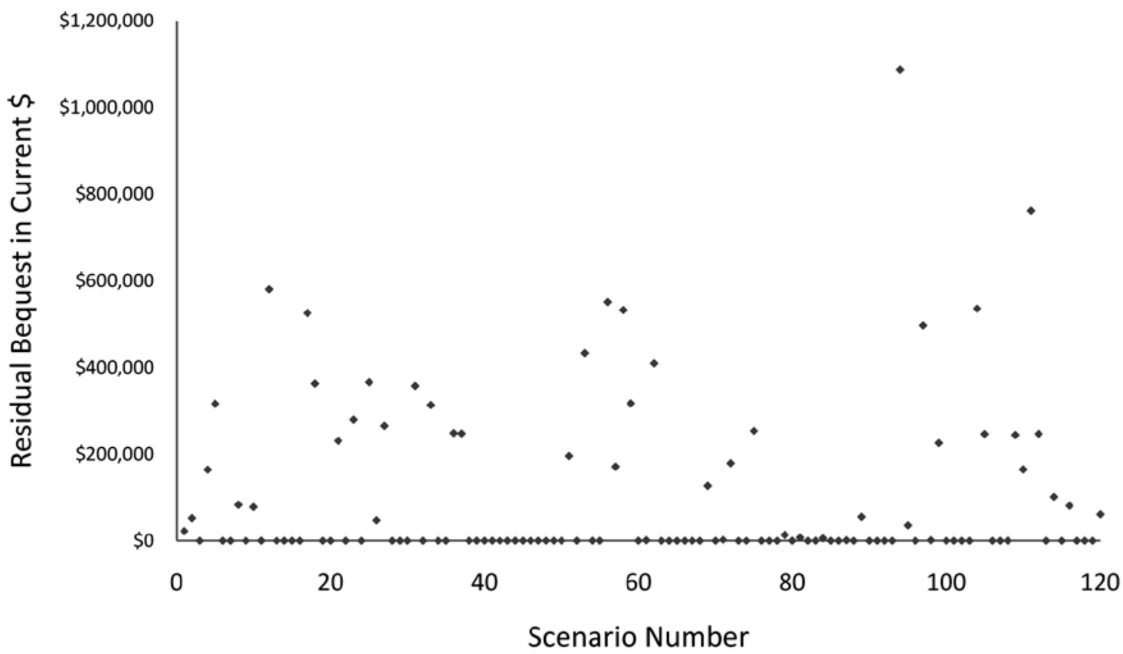
Over the lifecycle of the investor's accumulation and decumulation phases, the total wealth of the investor gradually increases and then reduces more sharply after retirement. However, the percentage of peak wealth (at a maximum at retirement) that is contributed by the investment returns at any particular age is more complex to assess. The impact of the variation of investment returns at a specific age on the aggregate of subsequent wealth creation must be assessed.

In other words, there is a belief that if an investor achieves an above-average return early in their investment life, this creates an asset that, even if subsequent returns are average, will benefit from the initial impetus. And, consequently, compounding on a larger starting asset would benefit the investor. Furthermore, a below average return later in life could not readily be recovered. This is, in part, the premise of lifecycle *investing*.

However, this enticing simplicity is an illusion.

Firstly, as Samuelson (1963) points out, while normally distributed returns converge to the average over time, the value of that variation diverges. So flipping a coin 100 times yields a 50% chance of heads on average.

FIGURE 1: **Incidence of unintended bequests by scenario**



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However, this cannot be translated to a compounding process, where although the percentage variation might tend to the average, the value of each variation increases as a result of the successive values of the investment getting larger.

Plus, in an accumulation–decumulation phase the effects of the variation in each year are in fact impacted by the dollars in the fund.

Percentages don't count, dollars do!

So, to test the effect of variation of returns at each age, the following question must be asked: 'What is the impact of a variation in investment returns at age = x on the overall investment returns generated?'.

Consequently we are interested in the forward cumulative effect of a variation in returns at age = x on the capacity of the investments to generate aggregate investment returns I_i. The model incorporates contributions and withdrawals, and allows us to model the variation of investment returns by value and readily calculate the forward cumulative effect of each variation.

The method of calculation was as follows.

The present value of investment return ($) $\tilde{g}$ at age x is defined as:

$$V_{ix} = [(g_x W_{ix}) \int_{t=x}^{E} e^{\tilde{g}t}\, dt]/(1 + c)^{E-x} \qquad (3)$$

where:

g_x is the actual investment return at age = x

c = the inflation rate assumed at 3%

x is the time period during which the specific investment return v_{it} is generated

E is age when $W_{it}=0$ and no further investment income can be generated

V_{ix} is the total investment return ($) generated at age x, which is then reinvested in the fund to earn a compounded rate of return until the value of the fund = 0.

Continual compounding was used to simplify the calculation but, in funds that are in growth phase, this is a very good approximation as in practice investment returns are continually reinvested.

It is impossible to determine whether dollar investment return generated at age = x was withdrawn at any specific time. However, given that we are interested in the proportionate impact of a specific investment return on the aggregate investment return, we can merely aggregate all possible investment returns for all ages until age = E, accounting for the increase and subsequent reduction in the value of the investment, and then determine the relative impact as follows.

FIGURE 2: **Proportion of investment returns by age to total (aggregated) investment returns**

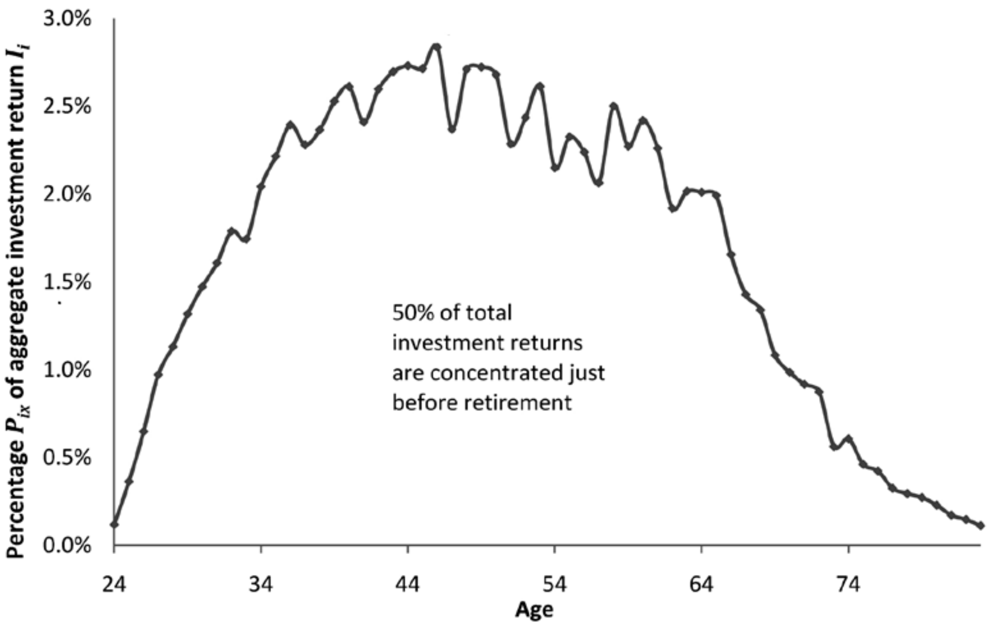
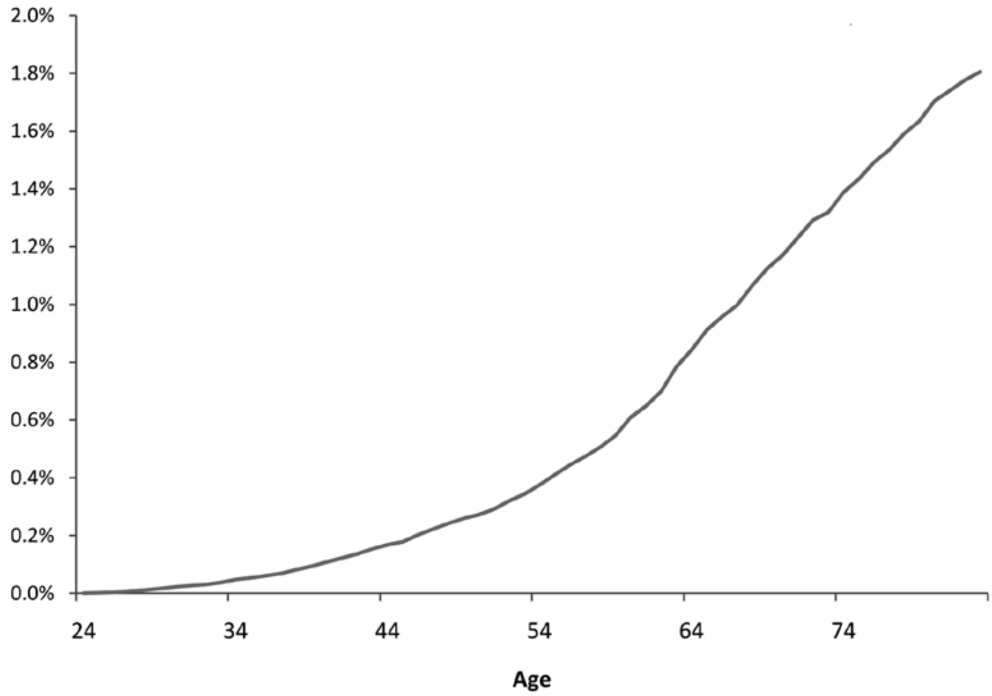


FIGURE 3: **Dollar risk assumed in each period as a proportion of aggregate return**



Define the aggregate return ($) that may be experienced by investor i as the sum:

$$I_i = \Sigma_t^X V_{it} \quad (4)$$

Then the contribution to the lifecycle wealth accumulation through investment returns for investor I at age = x can be thought of as:

$$\left(P_x = {}^{v_{ix}}/_{I_i}\right) \quad (5)$$

Figure 2 shows the investment returns made at each age as a proportion of the total investment returns over the entire investment period.

So, even if an investor experienced very strong investment returns at age 24, the lower investment balances in their superannuation account means that the actual dollar investment return has a quite small effect on the overall investment earned. It is important to stress that the model includes the compounding effect of any return for the duration of the investment cycle.

Figure 2 indicates that 50% of investment return arises during a period only a few years before retirement. Getting it wrong early has less effect. But paradoxically, getting it wrong later also has less effect due to the confluence of the amount of money risked and the time remaining to allow for compounding peaks at around retirement. So, if one is to utilise some lifecycle risk variation strategy, one would really only need to focus on the period leading up to and just after retirement to have the maximum impact. And then, ironically, reducing risk during this period would be precisely the wrong thing to do if one wants to maximise potential retirement funding.

Behavioural finance clues as to why lifecycle investing provides comfort for investors: anchoring, loss aversion and framing

Nevertheless, investors don't necessarily enjoy the luxury of an accurate lifetime perspective of risk or investment return, and a behavioural finance perspective is required to determine the subjective response by investors.

We construct a framework in which an investor perceives the variation in returns as a proportion of a simple sum of investment returns reported and estimated over the life of the investment.[5]

We estimate the dollar standard deviation of investment returns at any specific age x, and calculate this as a ratio to the simple sum of the lifetime investment returns reported to date plus those estimated in the future, both discounted by inflation.

The rationale for this is that an investor will experience the dollar variation in returns at any one point in time and compare this to their memory of returns in dollars, and expectations of future returns, also in dollars. The framework is then defined as one of returns and their variation, rather than the total investment value and total lifetime value.

Formally then:

The dollar value of the risk experienced by investor i at age =x is defined as

$$\sigma_{ix} \quad (6)$$

The value of expected lifetime returns $\widehat{V}_i$ imputed by the investor is assumed as:

$$\widehat{V_t} = \Sigma_{t=1}^{D} \widehat{v}_{it} / (1 + c)^t \quad (7)$$

The proportion of single-period risk as a percentage of return generated by the investment over the aggregate of investment returns can then be calculated as:

$$\widehat{R_{ix}} = \sigma_{ix}\widehat{V_t} \qquad (8)$$

The results of this calculation for each age are shown in Figure 3.

Figure 3 clearly demonstrates the effect of this framework. Even when investors take inflation into account, a dollar lost at age 83 is perceived as having nearly twice the impact that the same real dollar lost at age 24. On this basis, it is clear than a lifecycle strategy to reduce risk over time results in a perception by investors of a more even spread of risk over the lifetime of investing, even though this may not necessarily be the optimum investment practice!

Conclusion

The paper presents a Monte Carlo simulation of the lifecycle of investment during both the accumulation and decumulation phases. The results of the model allow a more precise representation to be made of the impact of investment decisions on the retirement funding of investors, and show clearly that decisions taken just prior to retirement will have the most effect.

The model also shows that risks taken either well after retirement or early in the investor's accumulation phase actually have a relatively small effect on investment returns. In fact, the best time for the market to crash is either at the beginning or at the end of savings. It's the middle that's important. This brings into question the effectiveness of lifecycle investing as a risk optimisation strategy.

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When we explore investor perceptions such as loss-aversion, anchoring and framing, we show that the reasons for lifecycle investing can be better explained by behavioural finance than risk management. This allows us to argue that lifecycle investing in the Australian context is more about managing risk perceptions than optimising lifetime risk.

Notes

1 Full-time Adult Average Weekly Ordinary Time Earnings in Australia.
2 The mean and standard deviation used for the Monte Carlo engine is derived from the average of the universe of superannuation funds over a five-year period covered by SuperRatings.
3 The aggregate of Monte Carlo simulations will create a positive terminal value as the assumption is that drawdown occurs until age 100, after which a residual amount remains. This is an asymmetry in assumptions compared to the calibrated model where the entire amount is utilised by age 83.
4 A fund can be defined as a superannuation fund, or mutual fund.
5 A further frame could readily be created by arguing for some form of disposition effect whereby the investor 'forgets' the earnings to date and purely experiences the current period investment returns as a proportion of the investment returns likely to accumulate for the expected remaining period of investment. The results of this are likely to provide more evidence of behavioural bias. However, the analysis above readily explains the prevailing framework without necessarily requiring that investors forget history.

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