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Retirement explainer series

Sequencing risk

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Brief synopsis: This explainer discusses how the sequence in which returns are experienced matters for portfolios that are incurring cash flows. For portfolios in outflow such as in the retirement phase, experiencing good returns earlier and poor returns later leads to better outcomes, all else being equal. The converse holds for portfolios in inflow, such as during accumulation. These sequencing effects can give rise to sequencing risk in retirement, which is amplified by higher investment risk and larger drawdowns, including any lump sum withdrawals early in retirement. Sequencing risk manifests as income volatility under percentage drawdown rates, and exhaustion of balance and hence income when drawing fixed amounts. These concepts are illustrated through simple examples. Superannuation (super) funds might consider managing sequencing risk by limiting potential for portfolio drawdowns, although the impact on expected returns should be taken into account.

Questions addressed:

1. What are sequence-of-return effects and sequencing risk?
2. When does the sequence of returns matter?
3. What determines the nature and magnitude of sequencing effects?
4. How does sequencing risk impact during retirement?

Key terms: Sequence-of-return effects, sequencing risk; investment risk; portfolio cash flows; drawdowns

Who should be interested? Chief Investment Officers, portfolio managers, investment committees, retirement specialists, retirement leads, product designers, financial advisers, regulators, people wanting a career in the retirement income space.

Introduction

This explainer discusses why and how the sequence of returns may matter, and how it manifests in a superannuation and retirement context. We commence by outlining the concepts, including highlighting the role of portfolio cash flows and how they interact with investment risk to generate sequencing risk. The concepts are then illustrated through some worked examples. We close by commenting on the need to be wary of sacrificing too much expected returns to limit sequencing risk.

What are sequence-of-return effects

Sequence-of-return effects refer to situations where the sequence in which returns are experienced matters. Consider multiple return series of equivalent risk that generate the same *compound* return over a period of investment. What would deliver better outcomes? A series where the good returns occur earlier and poor returns later in the investment period? A series where the poor returns

occur earlier and the good returns later? Or does the sequence of returns not matter at all?

It turns out that the sequence of returns matters where portfolio cash flows are involved, and not otherwise. The sequence of returns is irrelevant for a portfolio experiencing no cash flows over the investment period. Consider a simple example where returns over two consecutive years are either +25% and –20%. Start with $1.00 invested, and you will end up with $1.00 at the end of the second period regardless of the sequence in which these two returns are experienced. That is:

$1.00(1 + 0.25)*(1 – 0.20) = $1.00*

$1.00(1 – 0.20)*(1 + 0.25) = $1.00*

Introduction of cash flows impacts on the amount invested at differing points of time, with the implication that it now matters *when* returns of particular levels are experienced. If cash *inflows* are involved, it is better to earn lower returns earlier before the cash is invested and higher returns afterwards. If cash *outflows* are involved, it is better to earn higher returns before the cash is withdrawn and lower returns afterwards, than the converse[1].

Sequencing effects in super

Super fund members invest contributions during accumulation and then draw down their assets during retirement. This has various implications for how sequencing effects might be viewed in a superannuation context.

- Younger members would be better off earning lower returns earlier and higher returns later. Young members typically have low balances; and the most relevant consideration is the return they will receive on future contributions rather than return on their current balance[2].
- Exposure to sequencing effects is greatest nearing retirement and early in retirement. This is the point at which the balance is prone to be highest, and the returns experienced have the greatest impact on the amount that can ultimately be drawn. In this 'risk zone', the member is much better off earning higher returns and is more exposed to poor returns and thus sequencing risk.
- Exposure to sequencing effects and hence sequencing risk reduces over the course of retirement as the assets are drawn down. Indeed, incurring any lower returns later in retirement can make little difference if higher returns were experienced earlier and support the building up of a sizable balance to fund future income.

Sequencing risk at and in retirement

We note above that exposure to sequencing risk is greatest upon entering retirement and early in retirement and diminishes as drawdowns are made. Here the pattern and nature of drawdowns has an influence, specifically how early in retirement assets are utilised. Sequencing risk is heightened if larger drawdowns occur earlier in retirement in the form of either taking higher income or drawing a lump sum. Exposure to sequencing risk is also exacerbated if a significant lump sum is drawn and spent upon retirement. Many members choose to take lump sums to support immediate spending such as going on a holiday, home renovations, and so on; or repay debt. Purchasing a fixed lifetime income stream (i.e. fixed annuity; see Explainer #9) is another action that crystallises the value of the assets.

Sequencing risk also manifests differently when drawing a fixed *percentage*, such as under the minimum drawdown rules, versus drawing a fixed *amount* of income such as targeted level of income[3]. If a fixed percentage is being drawn, sequencing risk manifests through heightening income volatility. However, income is never totally exhausted as some residual balance always exists. If a fixed amount is being drawn, sequencing risk manifests as potential for exhaustion of the balance and hence income earlier in retirement.

The mechanism through which sequencing risk operates is that poor returns reduce the available balance from which income is being drawn. Under percentage drawdowns, the result appears as less

[1] One implication is that returns earned have the greatest impact after all funds have been invested, and before the assets are drawn down. A related perspective is that asset-weighted not time-weighted returns determine the wealth that is ultimately accumulated and the drawdowns that can be generated from that wealth. That is, cash flows drive a wedge between asset-weighted and time-weighted returns.

[2] Indeed, a young investor may be better off with initially poor returns that affords the opportunity to use contributions to buy assets cheaply, i.e. if the poor returns reflect asset prices falling due to a rise in expected returns (discount rate). Conversely, it can be detrimental for a young member to incur higher returns that lead to expensive asset markets offering lower expected returns looking forward, as subsequent contributions are more likely to generate low returns.

[3] We discuss income objectives in Explainer #2 and drawdown strategies in Explainer #5.

income being drawn from a lower balance. Under fixed drawdowns, this results in a larger portion of that balance being withdrawn, leading to faster erosion of the balance. These effects are illustrated further below.

Sequencing risk and investment risk

Exposure to sequence-of-return effects and hence sequencing risk increases with investment risk as well as the relative magnitude of portfolio cash flows. Indeed, sequencing risk might be considered an *interaction effect* between investment risk and cash flows rather than a standalone risk in its own right. Basically, greater potential for return variation raises the probability of incurring particularly poor returns when they can have the most impact, e.g. when nearing, and early in, retirement. Return variability thus acts to *amplify* sequencing risk.

Sequencing effects can be exacerbated by sustained investment losses, relative to situations where declines are short-lived and asset prices quickly bounce back. Measures of *drawdown risk* that focus on the magnitude of investment losses and the time frame over which they are experienced may thus be more informative of exposure to sequencing risk. By contrast, volatility-based risk measures such as standard deviation convey variation around a mean. They are agnostic to whether variation is due to higher or lower returns, noting that the former give rise to positive sequencing effects under cash outflows. They also say little about the potential for markets to bounce back quickly (i.e. mean-revert).

Illustrative examples

We illustrate the effects discussed above through a simple example and a simulation. The example is designed to isolate the influence of sequencing effects under differing drawdown strategies and levels of return variability. The analysis is based around a member with a $100,000 balance who draws income over a period of 3-years. We compare drawing either a fixed percentage of 6.4% and a fixed amount of $6,000, both of which are designed to generate a baseline 3-year average income of $6,000. Return assumptions are varied both in sequence and level of volatility while always delivering a compound return of 0%. The four return scenarios are detailed in Figure 1. These scenarios are compared against a baseline where returns are zero in each year, and hence there is no sequencing effects or return volatility.

Figure 1: Return scenarios

	Volatility	
Return sequence:	**Moderate**	**High**
High => low	Year 1: +7% Year 2: +3% Year 3: -9%	Year 1: +13% Year 2: +7% Year 3: -17%
Low => high	Year 1: -9% Year 2: +3% Year 3: +7%	Year 1: -17% Year 2: +7% Year 3: +13%
Compound return	0%	0%
Volatility	8%	16%
Vol. similar to:	*50/50 fund*	*Equities*

Returns reported are rounded to nearest percentage point.

Figure 2 (see over) compares the changes in 3-year average income and changes in the balance at the end of year 3 under the various scenarios against the baseline. Three observations emerge.

- Outcomes are better when returns go from *high => low* than *low => high*. Relative to the constant return baseline, under *high => low* returns the balance at year 3 is higher under fixed drawdowns while average income is higher under percentage drawdowns. The converse occurs under *low => high* returns. This arises due to the presence of sequencing effects.
- Sequencing risk manifests differently when drawdowns are fixed amounts versus based on a percentage drawdown rate:
  - *Percentage drawdowns* – The impact of sequencing effects emerges through income *volatility*, whereby income is lower on average over the 3-years when low returns are experienced earlier and vice versa. Meanwhile, there is no change in the balance at the end of year 3, leaving future income unaffected.
  - *Fixed drawdowns* – Income remains unchanged, and the impact of sequencing effects appears through the closing balance. The consequence of experiencing poor returns earlier is that the balance at the end of the period is lower, leaving less to fund future income, i.e. the impact is on the *sustainability* of income. This 3-year example obscures the potential impact of sequencing risk under fixed drawdowns, which tends to accumulate over time. Further below we use simulation analysis to show how sequencing effects may manifest over the course of retirement under fixed drawdowns.
- The spread of outcomes is larger under the high volatility scenarios than the low volatility scenarios. This illustrates how investment risk magnifies sequencing risk.

Figure 2: Illustration of the nature and potential impact of sequencing effects

SCENARIO:	Year	Opening balance ($)	Return (%)	Return index	Income drawn ($)	Average income ($)	Closing Balance ($)	Change vs. baseline	
								Average income	Year 3 balance
6.4% drawdown rate									
Baseline	1	100,000	0%	1.000	-6,401		93,599		
	2	93,599	0%	1.000	-5,991		87,608		
	3	87,608	0%	1.000	-5,608	**6,000**	**82,000**		
High => low, moderate vol.	1	100,000	7%	1.070	-6,852		100,190		
	2	100,190	3%	1.103	-6,606		96,590		
	3	96,590	-9%	1.000	-5,608	**6,355**	**82,000**	**5.9%**	0.0%
Low => high, moderate vol.	1	100,000	-9%	0.907	-5,806		84,894		
	2	84,894	3%	0.934	-5,597		81,844		
	3	81,844	7%	1.000	-5,608	**5,670**	**82,000**	**-5.5%**	0.0%
High => low, high vol.	1	100,000	13%	1.131	-7,242		105,903		
	2	105,903	7%	1.211	-7,253		106,062		
	3	106,062	-17%	1.000	-5,608	**6,701**	**82,000**	**11.7%**	0.0%
Low => high, high vol.	1	100,000	-17%	0.826	-5,287		77,313		
	2	77,313	7%	0.884	-5,295		77,429		
	3	77,429	13%	1.000	-5,608	**5,397**	**82,000**	**-10.1%**	0.0%
Fixed drawdowns									
Baseline	1	100,000	0%	1.000	-6,000		94,000		
	2	94,000	0%	1.000	-6,000		88,000		
	3	88,000	0%	1.000	-6,000	**6,000**	**82,000**		
High => low, moderate vol.	1	100,000	7%	1.070	-6,000		101,042		
	2	101,042	3%	1.103	-6,000		98,073		
	3	98,073	-9%	1.000	-6,000	**6,000**	**82,952**	0.0%	**1.2%**
Low => high, moderate vol.	1	100,000	-9%	0.907	-6,000		84,700		
	2	84,700	3%	0.934	-6,000		81,241		
	3	81,241	7%	1.000	-6,000	**6,000**	**80,962**	0.0%	**-1.3%**
High => low, high vol.	1	100,000	13%	1.131	-6,000		107,145		
	2	107,145	7%	1.211	-6,000		108,645		
	3	108,645	-17%	1.000	-6,000	**6,000**	**83,741**	0.0%	**2.1%**
Low => high, high vol.	1	100,000	-17%	0.826	-6,000		76,600		
	2	76,600	7%	0.884	-6,000		75,962		
	3	75,962	13%	1.000	-6,000	**6,000**	**79,947**	0.0%	**-2.5%**

We further consider the implications of sequencing effects under fixed drawdown amounts by conducting simulations over a 30-year horizon (e.g. retirement period spanning age 65 to age 95). Results appear in Figure 3 (see over). To construct this chart, we generate a single 30-year return series that is designed to just exhaust a $100,000 retirement account in year 30 under fixed drawdowns of $6,000 per annum maintained in real terms[4]. To make this example a little more realistic, the return series has a compound expected real return of 2.85% per annum with standard deviation of 12%, not dissimilar to what might be expected for a balanced portfolio with 70%-75% growth exposure after allowing for costs. Sequencing effects are gauged by reordering the return series and

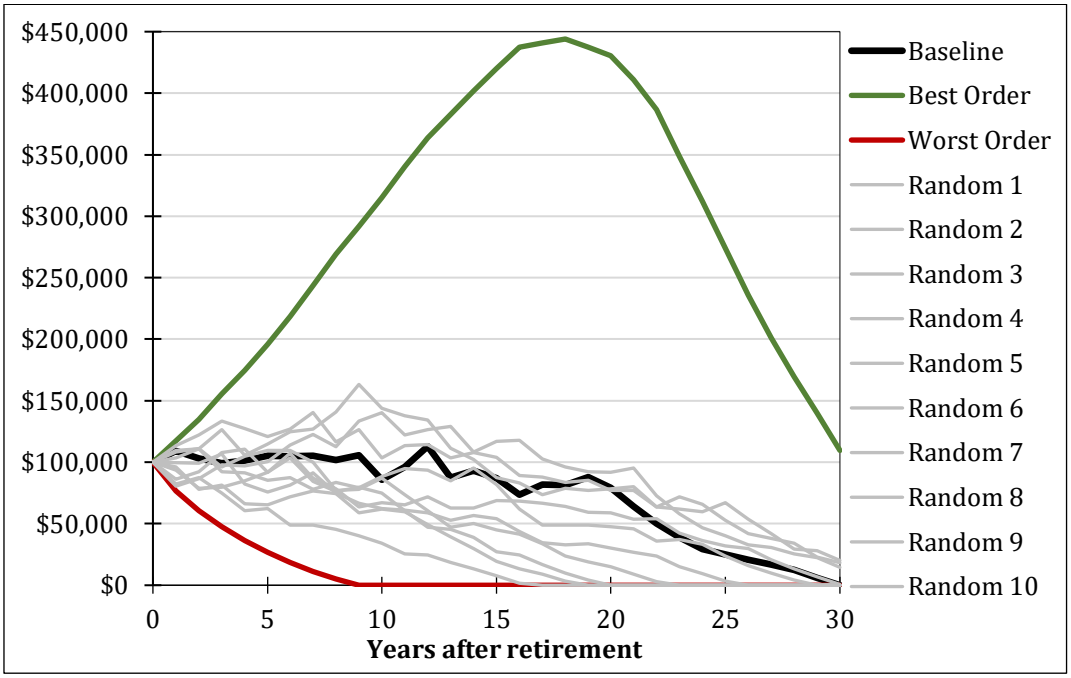
[4] This is a variation of the 'x% rule' or sustainable drawdown rate that is popular in the US (see Explainer #5), which we use here for simplicity.

recalculating the trajectory of the account balance, and thus the risk of being unable to sustain $6,000 in real income target over the full 30-years.

One series is created where the returns are re-sequenced from lowest in year 1 to highest in year 30, representing the worst possible return ordering. Here the account balance is exhausted in year 9 (red line). A best possible return ordering is also created, where returns are sequenced from highest to lowest. This results in a residual (real) account balance at year 30 of $109,000 or 109% of the initial balance (green line). Ten random re-sequencings are then generated for illustration, resulting in a spread of outcomes sitting between the worst ordering and the best ordering. Half of these random re-orderings result in the balance being exhausted between year 15 and year 25. Of course, once the balance is exhausted income then ceases.

In summary, the analysis demonstrates that sequencing risk stems from poor returns being experienced early in retirement. Further, it may be experienced through either balance and income exhaustion or income volatility, depending on the drawdown strategy being pursued.

Figure 3: Retirement balance under re-ordered return sequences



Our take: Sequencing risk should be managed with care, if at all

Sequencing risk matters to retirees, especially where the intent is to draw larger amounts earlier in retirement. However, reducing sequencing risk generally requires reducing investment risk. The conundrum is that it is often difficult to reduce investment risk without also reducing expected returns, which in turn reduces expected income (see Explainer #8). Thus, setting out to limit sequencing risk exposure can potentially be counterproductive.

One way to address this conundrum is to seek out ways to reduce portfolio risk without sacrificing too much expected return. Drawdown risk measures that convey the magnitude and horizon of potential losses may provide a better focal point than measures of return volatility – although the latter may also provide a reasonable guide.

Diversification seems the obvious route to managing sequencing risk, especially where diversifying assets can be found that reduce potential for portfolio drawdowns while offering competitive returns. Consideration may be given to mid-risk assets such as property and infrastructure, as well as floating rate credit as a fixed income alternative. Another route might be to engage in dynamic asset allocation while adopting a risk reduction lens. For instance, exposure might be reduced when markets look overextended and vulnerable to a decline, with the intent of re-entering when the danger has passed (ideally via market correction). However, dynamic portfolio management of this type requires skill and is difficult to implement. As such, it is no panacea.

In any event, the management of sequencing risk is a balancing act. It may well be that the best course of action is to accept the risk as a consequence of pursuing returns, rather trying to mitigate it.