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The Retiree's Dilemma: The Deckards

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Waterloo
September, 2017

ABSTRACT

We introduce the Deckards who are just starting their retirement. Like many retirees, they are concerned about how best to structure withdrawals from their investments to fund their retirement. Step by step, we move away from a risky and unstainable initial strategy to one that has a greater chance of success. The key change is to allow both the withdrawals and the portfolio asset allocation to adapt according to changing market conditions, while ensuring that income does not fall below a minimum level.

The result is that retirement investments are used more efficiently and the risks of prematurely running out of money, or withdrawals falling to an unacceptable level, are reduced. An additional benefit is that the portfolio asset allocation: the allocation to equities and how the bond allocation is structured, arises naturally from the Deckards' income needs.

This report was written by Graham Westmacott, PWL Capital Inc. The ideas, opinions, and recommendations contained in this document are those of the author and do not necessarily represent the views of PWL Capital Inc.

Graham Westmacott, *Portfolio Manager*, PWL Capital Inc. *"The Retiree's Dilemma: The Deckards".*

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1 Prelude

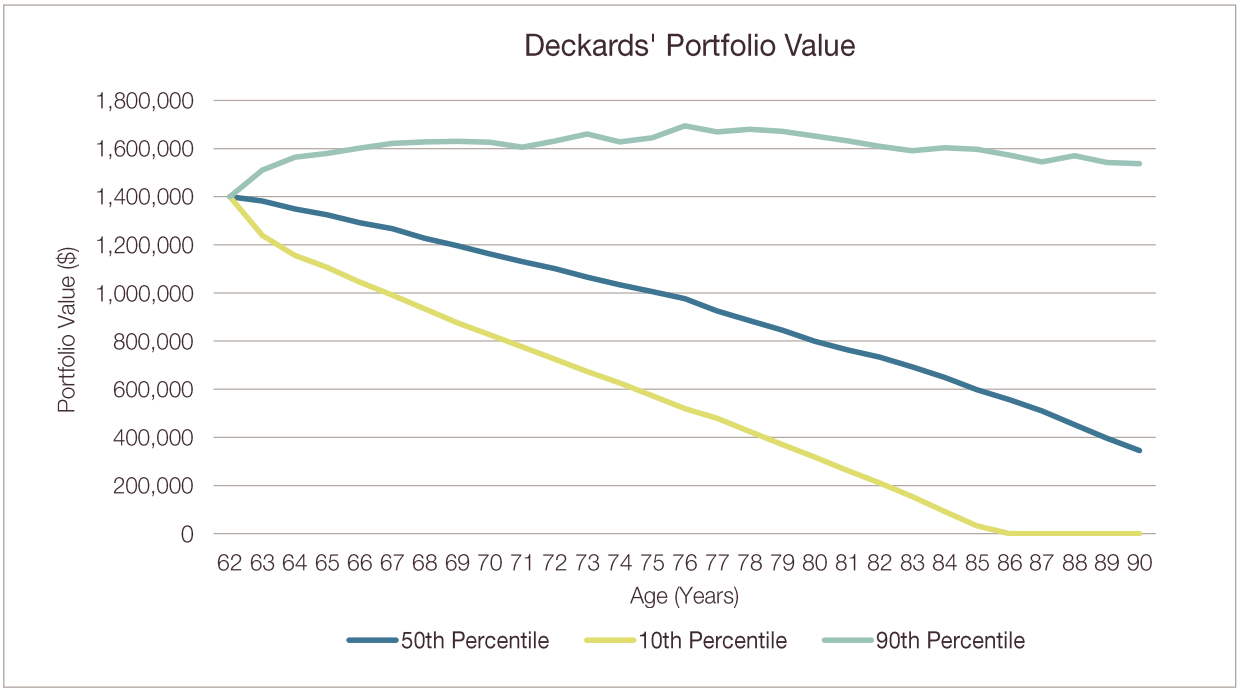
Rachael and Rick Deckard are both 62 and have been retired for 2 years. They have investment capital of $1.4 million. Both their children are well established in good careers, and they have no need, or desire, for an inheritance. Aside from government pensions, the Deckards' investment capital is their sole source of retirement income. The Deckards' investments are in a well-diversified portfolio of 70% stocks (or equities) and 30% bonds. They are withdrawing[1] $60,000 annually from their investments and want to know whether they risk running out of money and if so, what changes they should make.

2 There Be Dragons

Are the Deckards going to run out of money? We start our review with financial projections using their current withdrawal rate and asset allocation, plus some reasonable assumptions about future market returns, and the variability of those returns[2]. At the start of every year we withdraw $60,000 adjusted for inflation.

All the projections are computed in today's (or real) dollars, meaning that future spending power is preserved. As an example, a projection of a real value of $100,000 in 10 years with inflation at 2% would be equivalent to a nominal value of $121,899 in 10 years. For our purposes, we will assume that the general rate of inflation is a good enough inflation measure for retirees.

Figure 1



Source: PWL Capital

[1] Throughout we will use *withdrawal* when referencing the income provided by the Deckard's portfolio to distinguish from their *income* which refers to all sources of income, including government benefits and portfolio withdrawals.

[2] Appendix A is a summary of the model assumptions used in this paper.

Figure 1 shows that there is an approximately 10% chance of running out of money by age 86. The model also calculates the probability of running out of money at age 90 is 28%. For a couple, both 62 years old, there is a 50% chance that one of them would be alive at age 90, leaving the Deckards feeling uneasy about their current withdrawal rate.

Juxtaposed with a concern about running out of money was the possibility of leaving a considerable portion of their retirement savings unspent, which seemed a waste. As we have discussed in an earlier **paper**, simply lowering the withdrawal only raises the possibility that a significant portion of retirement assets are unspent. The Deckards' close friends are teachers and they envied the income certainty from their defined benefit pension plans.

The Deckards also expressed concern about the volatility of a portfolio with 70% invested in equities – they wondered whether they would have the stomach for losses during a market downturn. They had been through the Great Recession of 2008, and seen their portfolio value decline by 23% over 12 months. This had been stressful enough when they were still earning, but their retired friends had had an even tougher time.

3 Flex when the wind blows

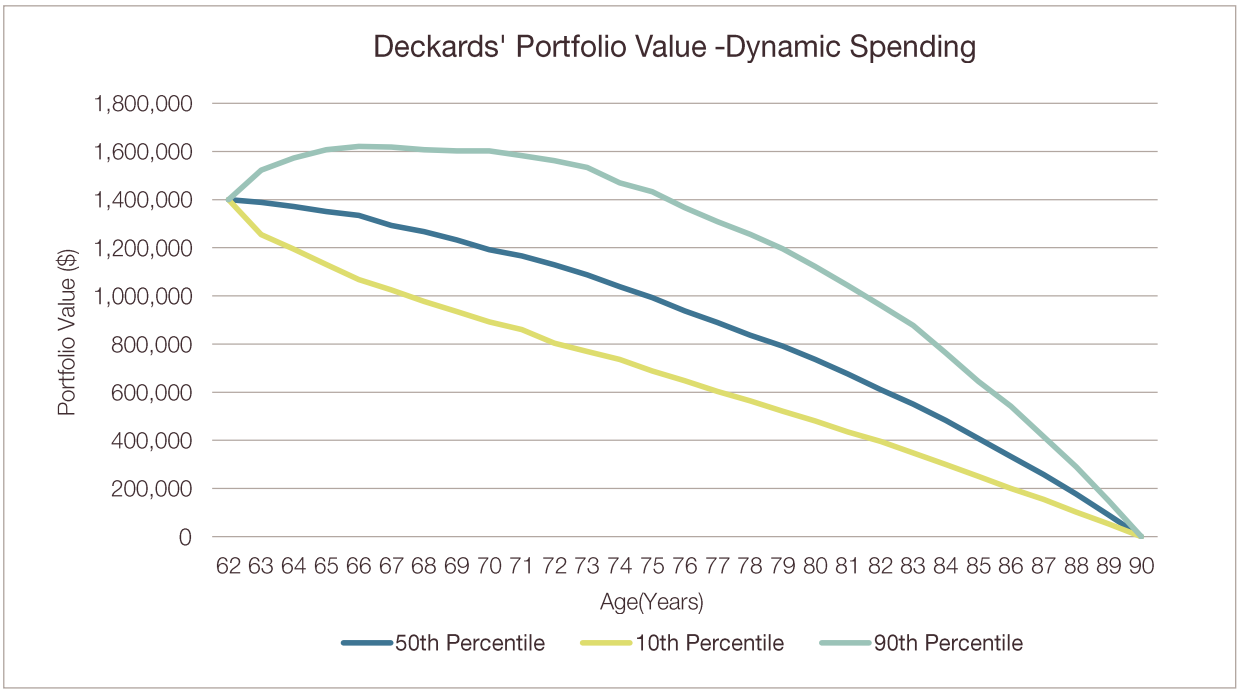
We take a multi-step approach to addressing the Deckard's concerns. Our first step is to look at a dynamic spending rule (ARVA) that flexes according to the market conditions. We have discussed this strategy in detail **elsewhere**. The key points are:

- The withdrawal in any year is calculated so that the portfolio provides a constant real income throughout retirement which is similar to how much an investor would receive if they bought a fixed term annuity. The withdrawal is recalculated every year. Hence the name ARVA: Annually Recalculated Virtual Annuity.
- The withdrawal in any year varies according to the investment returns in the past year, and current interest rates for bonds across the yield curve that corresponds to the range of maturities needed to match the withdrawal period.

As a simple example, in a world of zero real interest rates, fees and taxes, if an investment of $1 million was required to provide income for 20 years then the withdrawal in the first year would be $50,000 ($1,000,000/20). After the first year, we assume the remaining portfolio of $950,000 has grown to $970,000, so the income for the second year would be $51,053 ($970,000/19). The process continues until after 20 years the portfolio is exhausted. This produces a variable stream of income depending on market volatility over the 20 years.

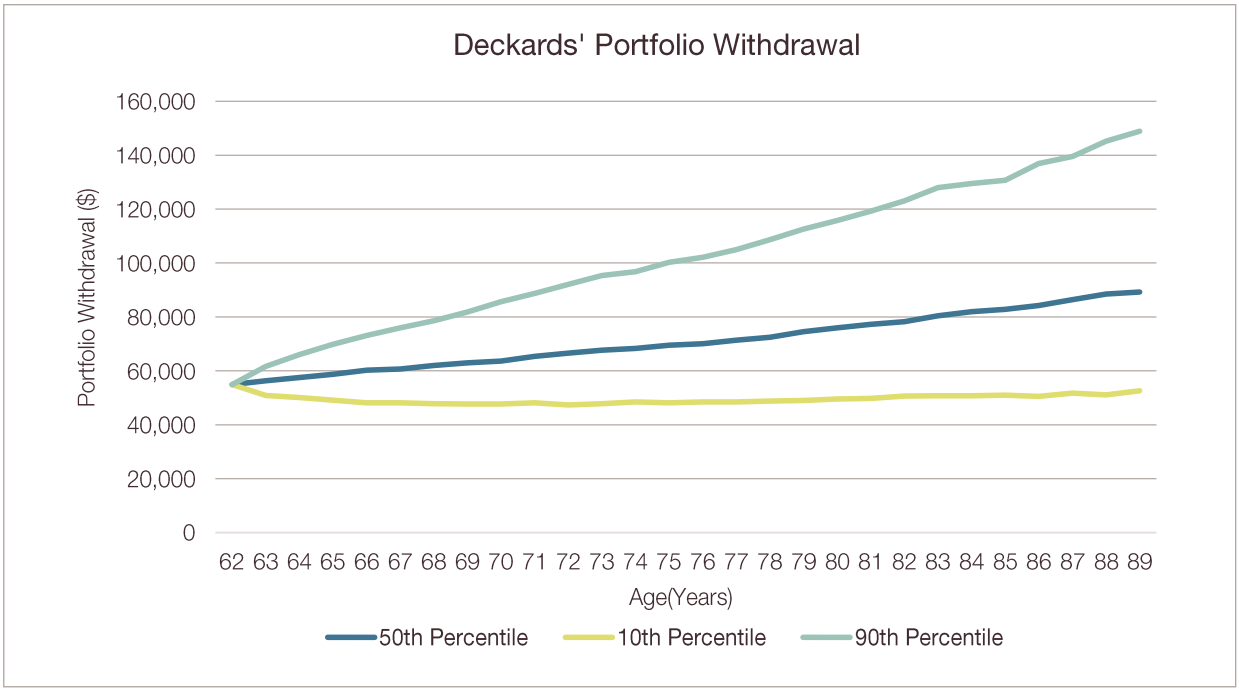
Figure 2 highlights the impact of the dynamic spending rule, ARVA. The portfolio value may vary according to investment returns but the portfolio always depletes to zero at the end of the period. We show the 10th percentile and the 90th percentile so that 80% of portfolio values lies between the two curves. The Deckards would be confident of not prematurely running out of money, but the trade-off is apparent from Figure 3. The Deckards income now varies with age, depending on market conditions. The real income starts at $54,911, less than their current (but unsustainable) withdrawal. In 50% of cases it rises above $60,000 by age 66.

Figure 2



Source: PWL Capital

Figure 3



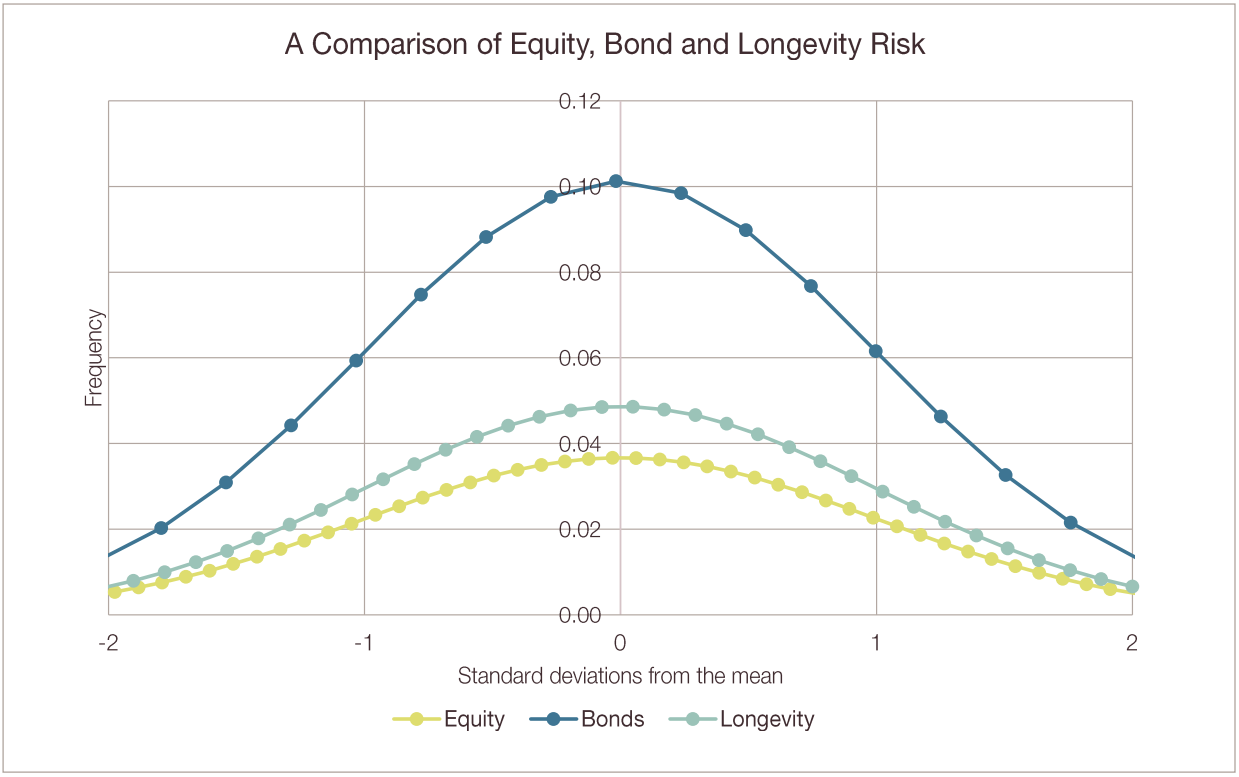
Source: PWL Capital

The Deckards are willing to accept the trade-off of a slightly lower initial expenditure for the peace of mind of not running out of money before age 90. However, they are still stuck with a risky portfolio, with a 70% equity allocation. They also wonder what would happen if either or both of them lived beyond 90. In the next sections we move away from the simple assumption that retirees all live to a certain age and introduce realistic data about the mortality of men, women and couples. We can then consider whether the Deckards can reduce their equity risk.

4 Step 2: Going on and on

We are used to the idea that people live longer now than even a few decades ago, but we are less familiar with the uncertainty of mortality. To give some context, Figure 4 compares the uncertainty of life expectancy with the uncertainty of equity and bond returns[3].

Figure 4



Source: PWL Capital

The longevity curve is the variation from the mean of the life expectancy of a single male[4]. To aid comparison, all curves have been plotted with a zero mean and the deviation from the mean is measured in standard deviations (a risk measure). The conclusion from Figure 4 is that longevity risk is comparable to equity risk despite the relative lack of attention given to the topic when discussing retirement income strategies.

[3] We used 5 year U.S S&P 500 equity returns and Canadian Universe Bond Returns. The plot of Canadian equity returns over the same period, coincidentally, overlapped the longevity curve.

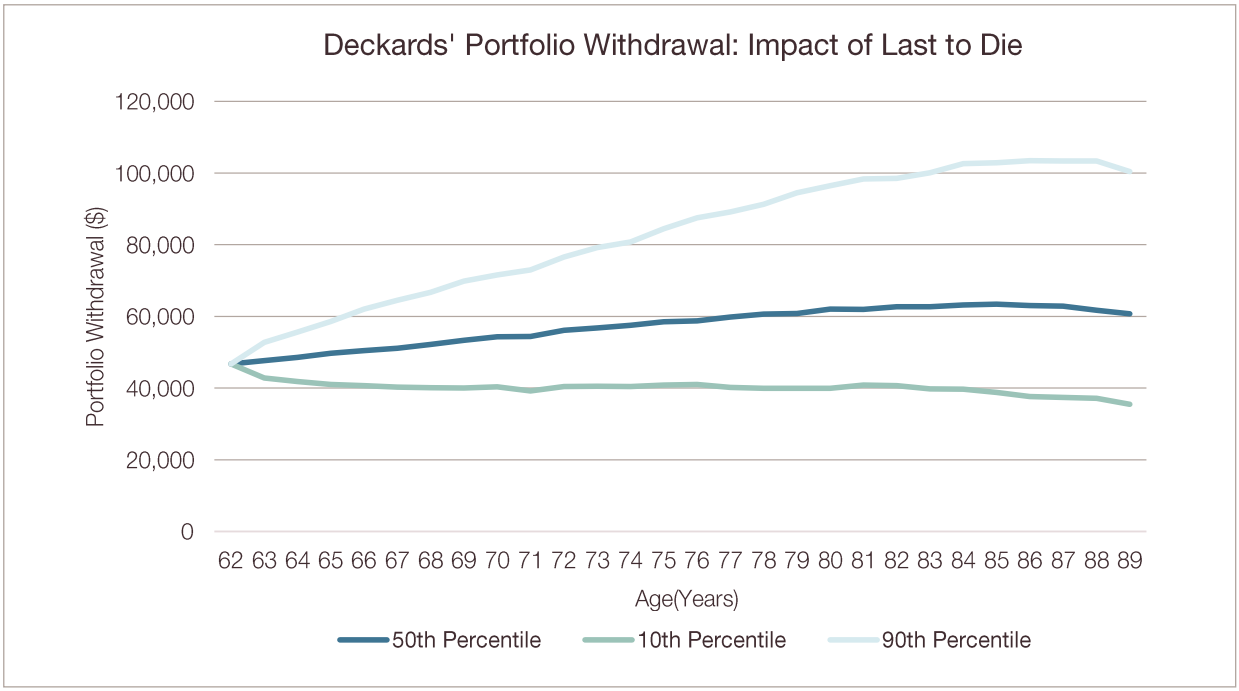
[4] 65 year old male with a life expectancy of 17.5 years and a standard deviation of 8.2 years (U.S. RP-2000 mortality tables). The normal curve shown is an approximation to the actual longevity distribution.

We chose our data to make a point, but some qualifying remarks are in order: just because longevity has a higher uncertainty than stock market returns, it does not necessarily follow that it has a higher impact on retirement income. First, we are only using one year equity returns rather than cumulative returns over years or decades. Second, in practice there is not a simple link between when you die and your (or your spouse's) wealth given the availability of life insurance and annuities.

We introduce longevity into our projections by modifying the spending rule so that the remaining assets at any time are distributed over the estimated longevity. We assume, as a default, that the retiree will have a lifespan that is in the top 20% of their cohort, or equivalently, that 80% of people die before the specified lifespan. A few people live a long time but it is very expensive for every retiree to plan for a retirement to 117 (the age of the oldest recorded Canadian[5]). We could base our planning on expected life expectancy (i.e. 50% of a cohort die before the expected life expectancy) but that seems too pessimistic, especially given that higher wealth is correlated with higher longevity. To give an example, 50% of Canadian men age 65 will have died within 17.7 years, 80% will have died within 25.7 years and 90% will have died within 29.1 years. The probability of surviving to a specific age increases with age so, for example, a 79 year old has a better chance of living to 80 than a 60 year old. Women have a higher longevity than men (although this difference is decreasing). For couples the longevity is based the probability of one or both surviving.[6] Assuming a low probability of survival raises the spending in the early years at the cost of reducing spending in the later years. Conversely, assuming a high probability of survival reduces initial spending as the investment assets are stretched out over a longer period.

In the Deckard's case we first looked at the impact of longevity as a couple. The results are in shown in Figure 5. The initial withdrawal is $46,538 and the median withdrawal rises to approximately $60,000.

Figure 5



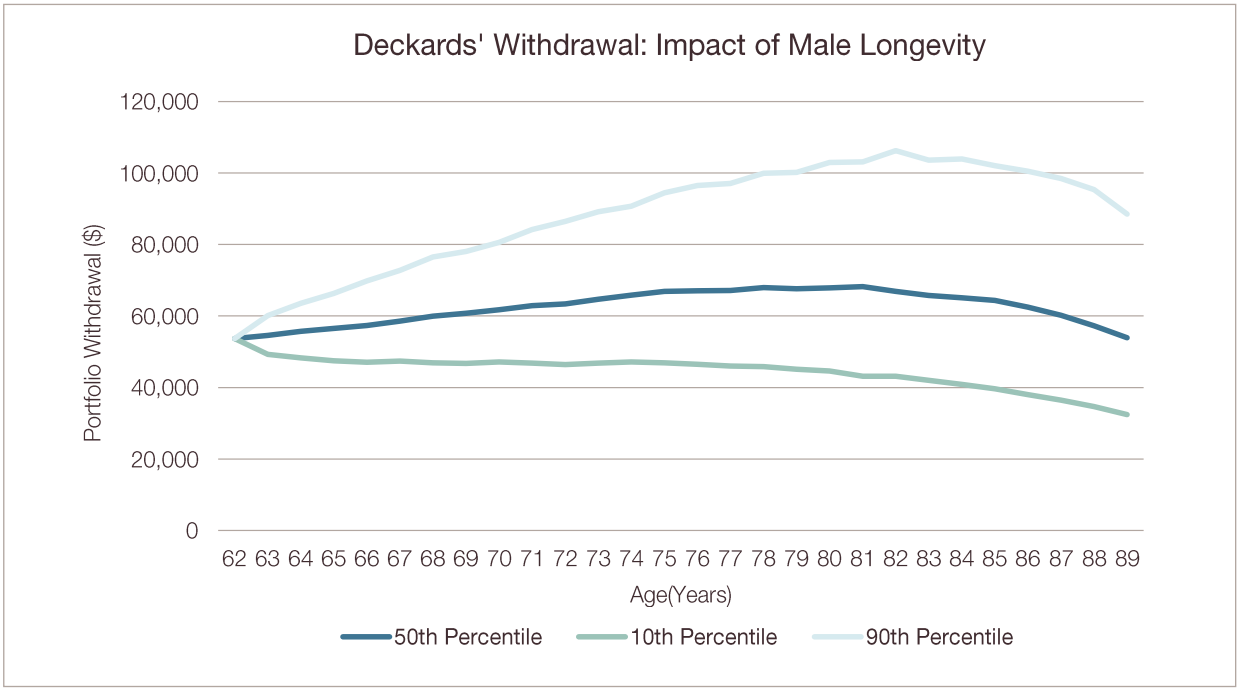
Source: PWL Capital

[5] https://en.wikepedia.org/wiki/List_of_Canadian_supercentarians

[6] Our choice life expectancy based on of 20% probability of survival is slightly more conservative than the guidelines issued by the Financial Planning Standards Council (FPSC).

After some discussion, the Deckards ask to see results based on male mortality only. Rick is a keen sailor and while they both enjoyed using the sailboat Rachael was adamant that if Rick passed away the boat would be sold and that would lower her expenses considerably. They realized that using the male mortality would boost their initial income when they would enjoy it most.

Figure 6



Source: PWL Capital

The impact of using male mortality was to boost the initial withdrawal from $46,538 to $53,683.

At this point the Deckard's are happy with the progress towards a sustainable withdrawal to fund their lifestyle, but the range of outcomes was very large due to the 70% allocation to equities. From our model 80% of their total withdrawals to age 90 falls within the range $1.3 million to $2.4 million. The Deckards express interest in trading some of the withdrawal upside for a more stable withdrawal and greater downside protection.

4 Step 3: The Safety Net

Specifically, the Deckards wanted a reassurance that their withdrawals didn't fall below $30,000 in any year, particularly in the early part of retirement.

The Deckards understood that the withdrawal from year to year fluctuated as the portfolio value fluctuated, and with a 70% equity allocation their portfolio risk would always be dominated by equity volatility. If they wanted to reduce the portfolio and withdrawal volatility how would this impact the amount they could withdraw? Our suggestion was to reverse this thinking and start with the minimum withdrawal requirement and calculate the impact on the equity asset allocation. The question then becomes: how much of their portfolio would be needed to fund a secure annual withdrawal of $30,000? For example, if interest rates were zero, then $300,000 would be needed to provide $30,000 for 10 years. Of course, interest rates are not zero and this has to be factored in estimating how much has to be set aside now to fund future needs. Since the Deckards want the withdrawal to be highly secure, the funds were invested in a high quality bond ladder, which we refer to as the Security Portfolio. The balance of the investments were allocated to a highly diversified portfolio of bonds and equities that were focused on long term growth (the Growth Portfolio). In our model we assumed that the Growth Portfolio had an allocation of 70% equities, corresponding to how the Deckard's were invested before they became concerned about the additional risks associated with retirement. This process of matching current assets against future liabilities is known as Asset Liability Management (ALM) and described in more detail in an earlier **paper**.

For the Deckards, the main attractions of ALM are:

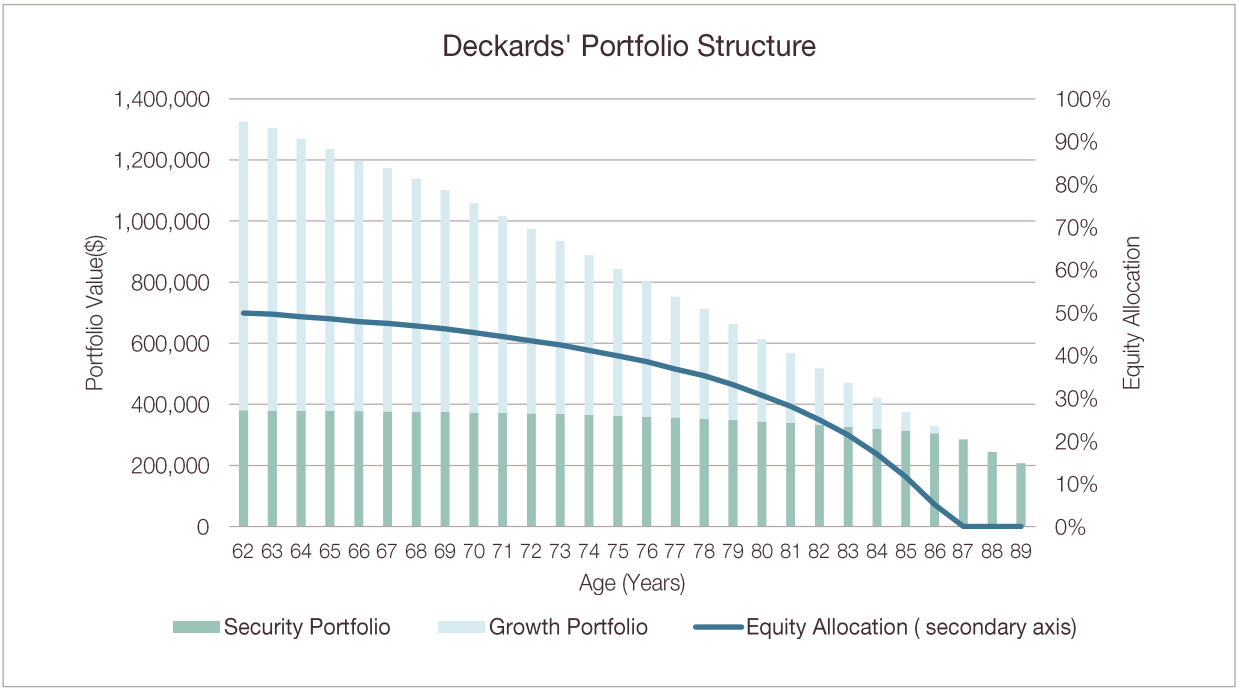
1. They have a way of systematically reducing the downside risk to their income.
2. The total liability to be matched by the Security Portfolio is the number of years multiplied by the desired withdrawal. They could choose to match a high withdrawal for a few years or a low withdrawal for their entire retirement. Either would be a partial hedge against their total withdrawal, but as we shall see, a partial hedge is better than none as a means of reducing income volatility and providing a minimum secure income.
3. The more the withdrawal liability is hedged, the higher the allocation to bonds, reducing the long term capital growth.
4. The bond portfolio can be designed so that the matching of current assets to future liabilities were, for the most part, unaffected by interest rate changes (a topic for a future paper).

After reviewing different scenarios, the Deckards settled on matching 13 years of withdrawals of $30,000 with a rolling horizon. This meant that at any point in retirement there was always sufficient assets in the Security Portfolio to match withdrawals of $30,000 for 13 years. This gave them confidence that there would be immediate downside protection until age 75, which was when they thought they would be pulling the boat out of the water for the last time.

ALM reduced the year-to-year withdrawal variability by 42%. Prior to implementing ALM the annual withdrawal variation was +/- $5,897 and this was subsequently reduced to +/-$3,406[7]. Hedging more of the future withdrawals by increasing the bond allocation would further reduce withdrawal variability, but at the expense of reducing the total withdrawals over the retirement period.

The existence of the Security Portfolio lowers the initial equity allocation. The ARVA withdrawal rule always works to deplete the portfolio to zero. In combination, the consequence is that the equity allocation ultimately falls to zero. This can be clearly seen from Figure 7 which displays the median values of the Security and Growth Portfolio alongside the equity allocation as a percentage of the total portfolio. Of course, this is exactly the behaviour that is appropriate for the Deckards, and most retirees, who will increasingly prefer income predictability today rather than capital growth tomorrow.

Figure 7



Source: PWL Capital

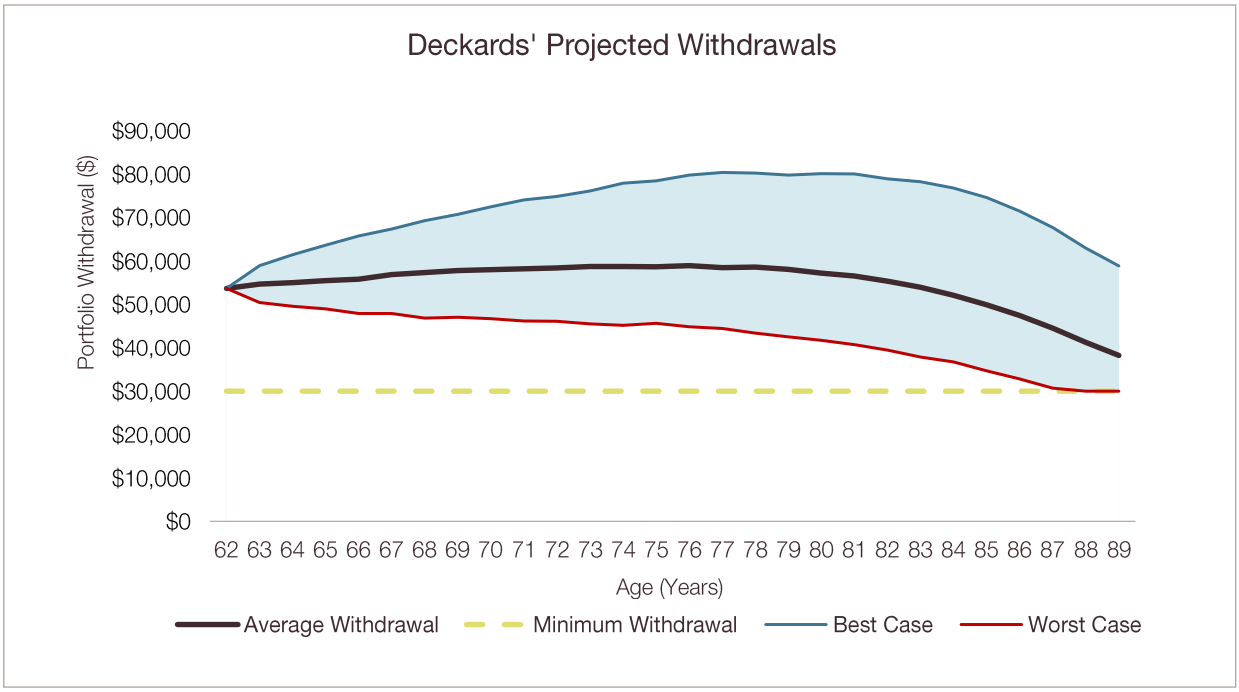
The Security Portfolio declines only slowly at first and then more quickly as the probability of mortality in later years becomes more significant. Eventually the future withdrawal liability can be met entirely by the Security Portfolio and the equity allocation falls to zero and the portfolio is converted into an annuity of laddered bonds.

A key point is that the equity allocation is dictated by the Deckard's requirements to manage income variability and downside risk and is a consequence of those decisions. This is in contrast to accumulation portfolios where the risk conversation is an entirely one dimensional discussion around equity allocation as the major contributor to portfolio volatility.

[7] Our estimate of withdrawal volatility is one standard deviation from the mean withdrawal. Each withdrawal track is fitted to a second order polynomial and the standard deviation of the residuals is averaged across all the simulation tracks. Assuming the residuals are approximately normally distributed, 68% of withdrawals would fall with +/- one standard deviation.

Figure 8 shows the final income projections for the Deckards. The Worst and Best Cases are the 10th and 90th percentile respectively, meaning 80% of outcomes are expected to fall within the shaded area. The lower bound is constrained by the $30,000 minimum withdrawal imposed by AML.

Figure 8



Source: PWL Capital

5 A Plan For All Seasons

Table 1 summarises the major changes to the Deckard's retirement income strategy. They have traded a constant, but unsustainable, portfolio withdrawal for a lower but sustainable variable withdrawal. Portfolio volatility has been reduced by using a lower initial equity allocation which reduces over time. The final strategy leaves, on average, a smaller portfolio value at age 90, but sufficient funds, to accommodate above average longevity. Imposing a minimum $30,000 withdrawal over a moving 13 year horizon provides an income floor.

Table 1

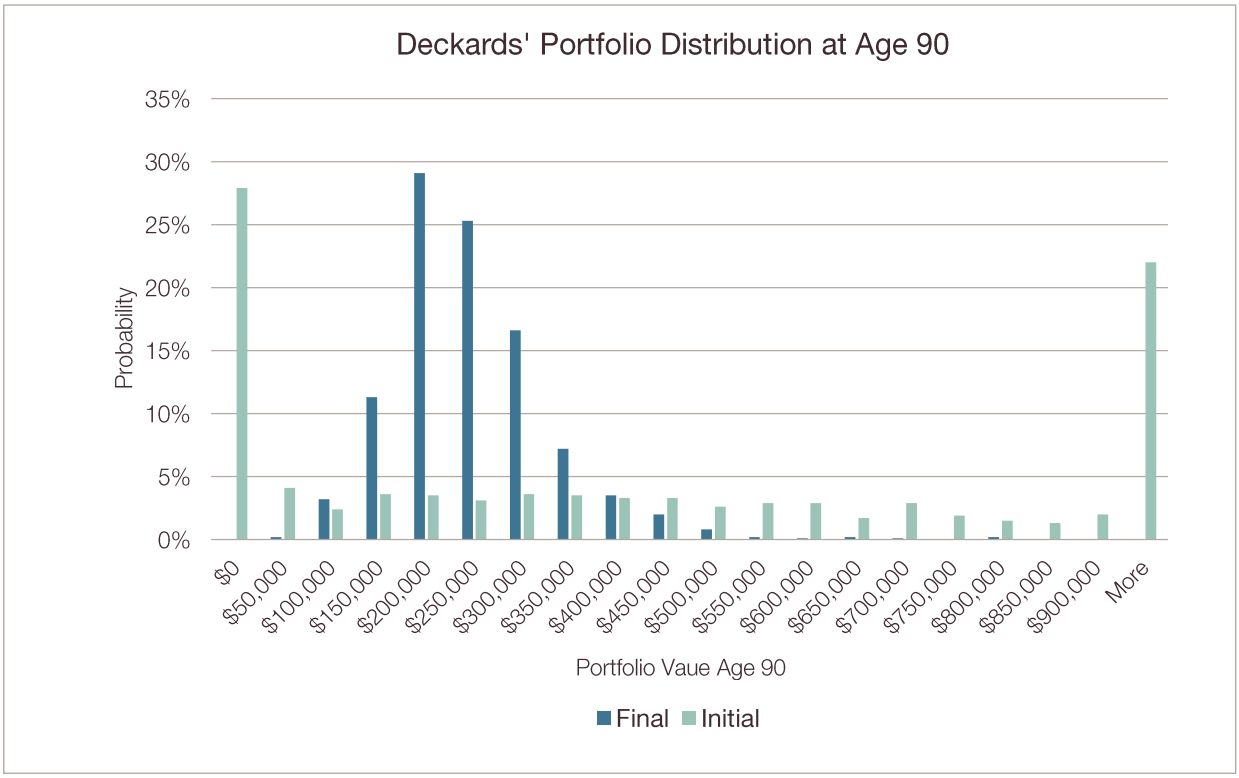
METRIC	INITIAL STRATEGY	FINAL STRATEGY
Initial withdrawal	$60,000	$53,683
Probability of running out of money by age 90	28%	0%
Income Worst Case to age 90	$0	$30,000
Median Portfolio Value at age 90	$1.02M	$211,348
Withdrawal Volatility	0[8]	$3,406
Initial Median Equity	70%	50%
Age 90 Median Equity	70%	0%

Source: PWL Capital

Figure 9 illustrates the dramatic difference in portfolio values at age 90. The initial strategy, with a constant $60,000 annual withdrawal, has a distribution of portfolio values at the extremes. As noted earlier, there is a 28% chance of running out of money, coupled with a 22% of exceeding $900,000 (approximately equivalent to another 15 years of income). Thus half the outcomes in the initial strategy either ran out of money, or generated funds that are unlikely to benefit the Deckard's retirement. By contrast, the final strategy, coupling a dynamic spending rule with asset liability management, has a much more certain range of outcomes, all positive.

[8] Of course, having zero withdrawal volatility is scant comfort if the portfolio value is zero.

Figure 9



Source: PWL Capital

The case study illustrates the translation of the Deckard's concerns and preferences about sustainable retirement portfolio withdrawals into a coherent portfolio design. Different clients would make different choices, so there is no generic optimal strategy. Indeed, it is to be expected that the Deckard's preferences will change with time along with portfolio values and interest rates. Updating the projections annually becomes an integral part of the Deckards' annual review and provides them with withdrawal guidelines, helping them budget comfortably.

The Deckards started with a withdrawal strategy that simultaneously had a significant probability of running out of money and a significant probability of leaving retirement assets unspent. Retirees don't appreciate this wide range of outcomes, preferring to trade these extreme outcomes for a greater certainty of a middle ground that provides a liveable, sustainable income for life. This was achieved by taking the Deckards spending preferences, both in term of amounts and volatility, and arriving at an appropriate and dynamic portfolio asset allocation that accounts for market conditions and their stage in retirement.

Appendix A: Model Assumptions

Inflation 1.6%

Yield Curve Table: Bank of Canada Benchmark Bonds as of 1st January 2017

YIELD CURVE	
MATURITY	**RATE**
1 Year	0.56%
2 Year	0.76%
3 Year	0.85%
5 Year	1.13%
7 Year	1.41%
10 Year	1.72%
30 Year	2.32%

Portfolio Structure

We constructed a six asset portfolio of ETFs. The estimation of the expected returns, standard deviations and correlations follows the methodology outlined here.

	ASSETS	TICKER	ESTIMATED RETURN	ESTIMATED STANDARD DEVIATION
1	iShares Core S&P 500	IVV	6.30%	12.40%
2	iShares Core S&P/TSX Capped Comp	XIC	7.10%	13.40%
3	iShares MSCI EAFE	EFA	7.20%	13.40%
4	iShares Canadian Universe Bond	XBB	3.30%	3.53%
5	iShares Canadian Short Term Bond	XSB	2.14%	1.70%
6	iShares Canadian Long Term Bond	XLB	3.52%	6.98%

Correlation Matrix

	1	2	3	4	5	6
1	1	0.49	0.8	0.11	-0.06	0.17
2	0.49	1	0.59	-0.02	-0.23	0.07
3	0.8	0.59	1	0.22	0.04	0.24
4	0.11	-0.02	0.22	1	0.79	0.95
5	-0.06	-0.23	0.04	0.79	1	0.63
6	0.17	0.07	0.24	0.95	0.63	1

Bond ETF Properties

	ASSET	DURATION (YEARS)	YIELD TO MATURITY
1 TO 5 YEARS	XSB	2.73	1.17%
5 TO 10 YEARS	XBB	7.5	1.82%
10 YEARS +	XLB	14.42	2.65%

We use Monte-Carlo sampling of portfolio returns from a normal distribution, using 1000 simulations.

Total investment Fees: 0.3% ETF Management Expense Ratio (MER), plus 1.0% advisory fee.

Life Expectancy tables at the 80% confidence level were assembled from https://www.aacalc.com/calculators/le which uses data from the U.S. Social Security Administration Actuarial Study No. 120. The simulation model is written in Matlab R2017, under license from Math Works Inc.

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