Perfect Withdrawal in a Noisy World: Investing Lessons with and without Annuities while in Drawdown between 2000 and 2019

by

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Abstract

We show how the relatively new concept of Perfect Withdrawal Rate can be used in assessing the appropriate sustainable withdrawal amounts from a pot of wealth. This can be applied equally to private retirement funds, endowments, charities, and indeed any context requiring regular withdrawals from an initial pot. The subject of estimating sustainable withdrawal rates usually falls back on describing the likely minimum safe withdrawal possibilities for various portfolio constructions over different decumulation periods. This analysis uses either a long period of historical data or a recombination of the data in the form of Monte Carlo simulations. Here, to illustrate the power of the Perfect Withdrawal concept, we consider the case of someone who started their retirement journey on 1st January 2000, aged 65 and, with the benefit of actual investment returns, consider their investment and withdrawal rate options and the lessons we can learn from this experience. We also introduce the concept and a methodology for purchasing, a delayed annuity, such that at age 85 on December 31st 2019, our retiree had fully transitioned from investment income to annuity income for the rest of their life, no matter how long that may be.

Key words:

Sequence Risk; Longevity Risk, Withdrawal Risk, Delayed Annuities, Adaptive Withdrawals

1. Introduction

How would someone who retired in the United Kingdom on 1st January 2000 at age 65 with a pension pot of £500,000 have actually fared over the last 20 years, considering the various investment and income withdrawal options?

The last 20 years have seen two major equity market downturns, two recoveries and a bull market. Meanwhile, interest rates have been volatile, though generally declining, so increasing the cost of annuities with which to respond to longevity risk. This period is therefore not only an interesting case study in and of itself but is of great relevance to many who are still in the decumulation phase of life and are dealing with the legacy of these recent volatile market returns.

Nearly all the research in this area assumes a constant annual portfolio return (see, e.g. Estrada, 2017b, fn 9) on a portfolio over a period of decumulation whereas in practice the variability and ordering of returns plays a crucial role in the withdrawal possibilities for the retiree (see Clare et al, 2017 for the US, and Clare et al, 2021, for the UK). This is known as Sequence Risk - or 'Sequence of Returns' risk - and is recognised by practitioners although it has not really penetrated academic research in this area. This may well be because it is, quite simply, hard to calibrate, although see Clare et al (2020) for recent suggestions.

The construction of investment portfolios for both accumulation and decumulation phases of life has been relatively neglected in the study of retirement planning, leading to them being described as the 'known unknowns' (Merton, 2014). Indeed, the study of long-term accumulation and decumulation usually treats the two processes as completely separate phenomena. For the former, the emphasis is on changing the riskiness of portfolios over the working lifecycle, especially as retirement beckons. This is usually de-risking in the form of glidepath or target-date investing, by raising the proportion in bonds and reducing the percentage in equities, (e.g. see Blanchett et al, 2016, Estrada, 2017). For the latter, the issue is what percentage of wealth can be withdrawn for consumption each year in a world with uncertain life expectancy and stochastic returns (see Bengen, 1994, Blanchett et al, 2016).

Sometimes, of course, the glidepath glides through the retirement date and becomes the decumulation portfolio, though most discussions distinguish between the two for investing purposes. In this paper we analyse the decumulation phase following retirement. We consider different withdrawal rate strategies and find that a constant withdrawal rate strategy results in wildly differing outcomes. We propose the adoption of an adaptive withdrawal rate strategy which, while increasing the volatility of annual income, provides greater final outcome certainty, particularly for a retiree who wishes to retain a residual value at the end of their planning horizon with which to purchase a delayed annuity to resolve longevity risk.

Withdrawals can be either fixed or variable, nominal or real, within the literature by far the most attention is given to fixed, real withdrawals. This is since Bengen (1994) showed that an initial withdrawal rate of 4%, with annual withdrawals subsequently adjusted by inflation, was 'safe'. This was in the sense that, historically, this strategy never depleted a portfolio in the US in less than 30 years, using the real-world data of much of the 20th century. The chosen portfolio was 50% US equity and 50% bonds.

Subsequent research has shown that over the 115 years between 1900 and 2014, a 60-40 portfolio of U.S. stocks and bonds had a failure rate of 4.7%, and portfolios with at least 70% in U.S. stocks had an even lower (3.5%) failure rate. However, in other national markets much higher failure rates have been experienced with the 4% rule (see Pfau, 2010, Blanchett et al, 2016), while some researchers are troubled by current (e.g. 2020) market conditions that suggest lower than historic expected returns for stocks and bonds going forward (Crook, 2013) and therefore increased risk of failure. The debate on the pros and cons of the 4% rule, and on fixed real withdrawals more generally, is alive and well.

Variable withdrawals encompass a broad set of strategies in which withdrawals are adjusted based on changing life expectancy (Dus et al, 2005), changing market conditions (Estrada, 2016b), or both (Stout and Mitchell, 2006). Withdrawals depending on market conditions, in particular, are the subject of extensive study (see references in Suarez et al, 2015 and Clare et al, 2017), for example. A further development would be to consider optimal withdrawal rates based on an assumed utility function as in the treatment of longevity risk by Milevsky and Huang (2011).

If we forego fixed withdrawals then of course income variability becomes a very practical concern. To help reduce the volatility of annual income, we consider different investment options, including various equity/bond portfolios with, and without, trend following as proposed by Clare et al (2017) to help mitigate sequence risk. The addition of increasingly popular multi-asset portfolio solutions is shown to have little impact on our results (see Clare et al, 2021).

A particular feature of portfolio construction in retirement involves adjusting the changing allocation of percentages between less risky assets (e.g. bonds) and more risky assets (e.g. equities) as the target date is approached, hence the term 'target date funds' (TDF). These have attracted widespread criticism, especially since the Global Financial Crisis: in the period 2008-2010 the three largest TDF funds lost 30% just prior to their target date. The intuitively appealing glidepath towards less risky assets as one ages has been challenged by a range of researchers (e.g. Shiller, 2005 and Basu and Drew, 2009, 2011). The logic being that as individuals live longer and longer, harvesting the equity market risk premium for more years makes sense. However, this type of analysis is the typical wealth accumulation/investment returns story and rarely includes regular withdrawals which, of course, is a feature of the real world. Sequence of returns risk has dramatic effects on the withdrawal possibilities, and that is our focus here.

Glidepath towards a target, of course, begs the question of the impact of longevity risk; but it really makes little sense to worry about this target independent of the stream of withdrawals which, after all, are the ultimate purpose of the pot of assets. In particular, as we converge on some target date and a target sum of wealth it becomes increasingly difficult to precisely hit a target as we run out of time for corrective adjustments. Here, we consider a methodology to minimise withdrawal risk in the final years of decumulation, when an adverse market return can lead to a very poor outcome, as there remains no time to recover or readapt. We envisage the target sum after say, 20 years, as being used to buy an annuity to protect against longevity risk from that age onwards. Of course, one could consider deferred annuities (purchased at retirement aged, say, 65) if such products were more widely available (see Chen et al, 2016).

Finally, we note that given delayed annuity prices change, then planning for a set amount of annuity income in later life is like hitting a moving target.

2. Background

The move away from defined benefit (DB) towards defined contribution (DC) and personal savings for pensions is well underway for a wide variety of reasons, comprehensively described in the OECD Pensions Outlook, 2016. This, of course, means that both investment and longevity risk rest with the individual. OECD data on assets and members in DB and DC plans from 2000 to 2015 confirm the increasing prominence of DC plans in many OECD countries and, to the extent new schemes have been introduced in recent decades, they have almost entirely been DC schemes, though the exact arrangements differ between countries, (OECD, 2016). However, assets in occupational DC plans together with those in personal plans exceeded assets in DB plans in most reporting countries. In the United States, around half of private sector employees have no pension saving, only 2% have DB plans with 33% having DC; around 11% have both DB and DC.

3.Withdrawal experience UK, 2000-2019

Our data runs from 1970 to 2019, inclusive with the first year being used for various calculations and all values are quoted in real terms. Throughout this paper we will consider the example of decumulating over a period of 20 years starting at the beginning of 2000 and ending on 31st December 2019. The initial starting pot will be £500,000 and it is assumed the retiree is 65 years old on 1st January 2000.

We can consider both constant and variable withdrawal amounts, although we note that agents tend to prefer the predictability of constant withdrawals[1].

(i) Constant Withdrawal Amounts

The first method of withdrawal we consider is to take a constant amount per annum for the entire decumulation period. For the purposes of illustration and simplicity of exposition, we assume to begin with that the investment pot is entirely invested in UK equities, throughout. To determine the amount to be withdrawn we use Monte Carlo simulations based on the known returns prior to the start of decumulation. Each simulation draws 20 returns with replacement from the set and calculates the Perfect Withdrawal Rate (PWR) for these (see Suarez et al, 2015). The PWR is the constant withdrawal rate per annum assuming that the individual has perfect foresight of the future 20-year returns. We run 50,000 simulations and Figure 1 shows the distribution of the withdrawal rates. The figure is marked with lines to indicate various percentiles. Choosing a higher percentile equates to a higher withdrawal rate but also a higher probability of failing to achieve it. These can thus be thought of as levels of risk.

[1] We could adopt a specific utility function to capture this preference but we focus on the stream of income rather than utility for generality.

Figure 1.

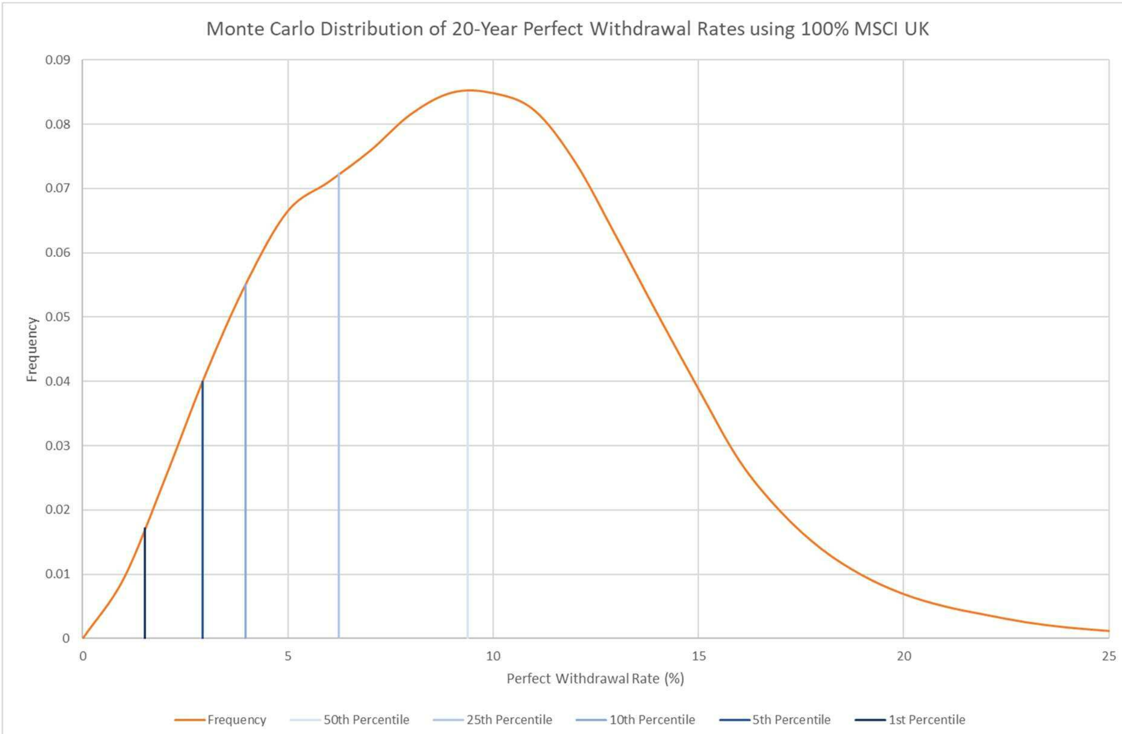
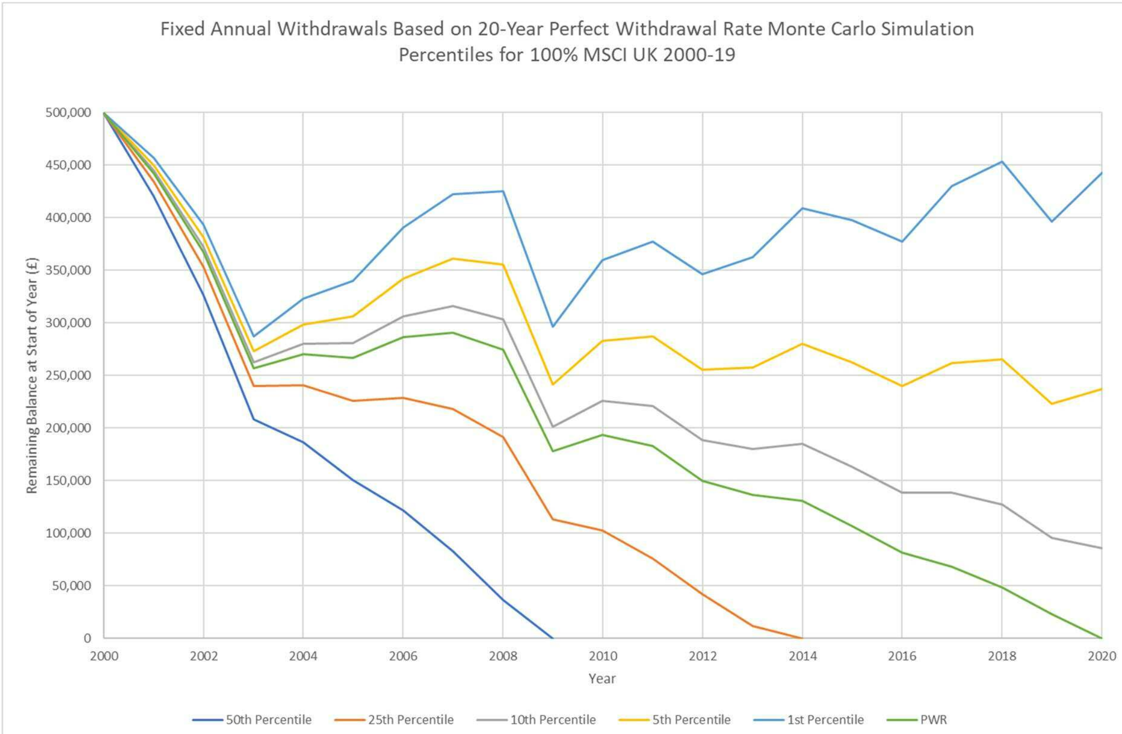


Figure 2 shows the decumulation paths for a variety of different risk levels whereby a constant withdrawal is taken annually. Amounts vary from £7,537 for the 1st percentile, which leaves a surplus of £443,000 after 20 years, to £46,886 for the 50th percentile, where the pot is exhausted by 2009, leaving over 10 years remaining with no income. The green line shows the PWR, constructed with the benefit of hindsight, that the optimum amount to withdraw was £22,823 (see Clare et al, 2017, for year-by-year examples). This allows for 20 equal withdrawals and leaves exactly zero pounds remaining after the decumulation period. Clearly, it is impossible to know this in real time and thus the best one can hope to achieve is get somewhere close to it.

Figure 2.



To provide some context to the calculations, in the period prior to the beginning of decumulation the average annual MSCI UK equity return was 7.8%. Over the following 20 years, it was just 1.4%. Anyone assuming that the past was set to be repeated would have withdrawn far too much from their pot, too early and run out of money using a constant withdrawal (see the 50^{th} and 25^{th} percentiles in Figure 2).

The first takeaway from our results is thus that one needs to be conservative in withdrawal approaches. Taking a bit less annually and finishing with a small surplus is likely to have far fewer negative consequences, like running out of money too early. This asymmetry in outcomes imposes a certain discipline on withdrawals. That said, taking too little in annual withdrawals, such as in the 1^{st} and 5^{th} percentiles, would lead to a substantially lower standard of living and thus has a negative effect also. Of course, there are a range of solutions that get a little closer to an acceptable compromise, as we show below.

(ii) Adaptive Withdrawal Amounts

Whilst one might like to have a constant stream of withdrawals, we have already seen that this either entails taking a very low annual amount or else risk running out of money before the end of decumulation. It would appear a much more sensible approach to periodically reassess the size of the remaining pot and consider whether withdrawals should be revised accordingly. An annual re-evaluation, perhaps as part of a meeting with a financial advisor, is probably a reasonable time frame.

To create a withdrawal profile using an adaptive approach we start off using the same distribution as for the constant withdrawal method for a 20-year PWR and assuming a risk level (percentile) and conduct an analysis, very much along the lines of a conventional conversation with an adviser, regarding annual withdrawn income and risk of ruin. After one year, we now use a new Monte Carlo simulation to create a distribution of 19-year PWRs. This reflects having one less year of decumulation remaining, but also benefits from having an additional piece of information in one additional year of returns. Similar calculations follow for subsequent years.

For the sake of our examples, we assume that our retiree maintains a constant risk tolerance, e.g. one always uses the 50th or 25th percentile withdrawal rate, but one of course could alter this if circumstances change. This PWR is then applied to the balance remaining in the investment pot after the first year of decumulation and a new withdrawal amount is generated. If the first year had high investment returns, then the withdrawal amount will likely go up and vice versa. This process is repeated each year with a new distribution based on one year less of decumulation remaining and one more year of investment returns to incorporate into the simulation.

Table 1 shows a worked example of the decumulation path for someone maintaining a 100% UK equity portfolio and withdrawing at the 50th percentile level. At the beginning of each year, the withdrawal amount is taken, and the remaining balance earns the investment return.

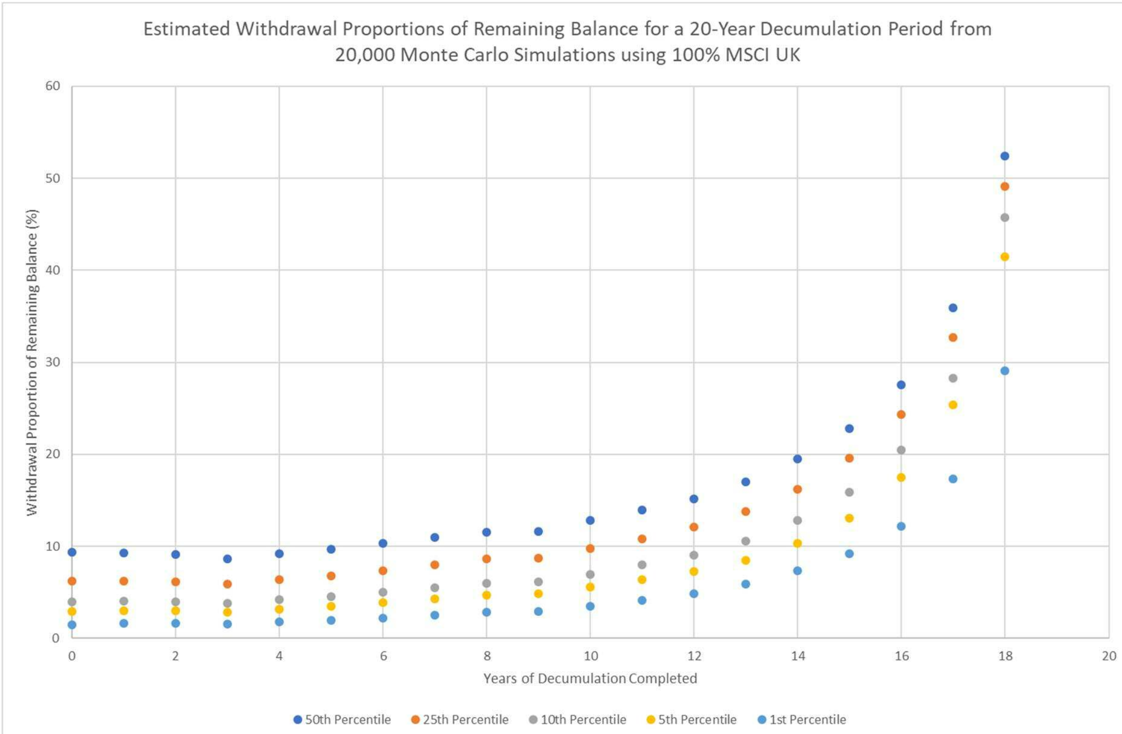
The withdrawal percentage changes each year as the new value is calculated from the distribution which reflects the lower number of years of decumulation remaining and then this is applied to the new balance. As time elapses one would expect the withdrawal percentage to naturally increase as the pot tends towards zero. This is demonstrated in Figure 3.

Table 1

Adaptive Withdrawal Rates at the 50th Percentile for Decumulation using 100% UK Equity

Calendar Year	Years Remaining	Real Return (%)	Withdrawal Rate (%)	Start (£)	Withdrawal (£)	End (£)
2000	20	-7.27	9.38	500,000	46,886	420,195
2001	19	-12.39	9.29	420,195	39,043	333,922
2002	18	-25.56	9.10	333,922	30,382	225,959
2003	17	15.53	8.66	225,959	19,579	238,421
2004	16	7.73	9.22	238,421	21,988	233,166
2005	15	17.49	9.64	233,166	22,487	247,522
2006	14	10.34	10.31	247,522	25,530	244,946
2007	13	2.42	10.94	244,946	26,808	223,425
2008	12	-29.12	11.57	223,425	25,845	140,036
2009	11	24.66	11.63	140,036	16,283	154,275
2010	10	7.11	12.80	154,275	19,741	144,100
2011	9	-6.31	13.94	144,100	20,090	116,188
2012	8	6.93	15.16	116,188	17,620	105,401
2013	7	15.39	16.97	105,401	17,890	100,975
2014	6	-1.06	19.52	100,975	19,712	80,400
2015	5	-3.32	22.79	80,400	18,321	60,016
2016	4	16.34	27.55	60,016	16,533	50,587
2017	3	7.36	35.94	50,587	18,183	34,789
2018	2	-11.16	52.46	34,789	18,250	14,694
2019	1	13.94	100.00	14,694	14,694	0

Figure 3.



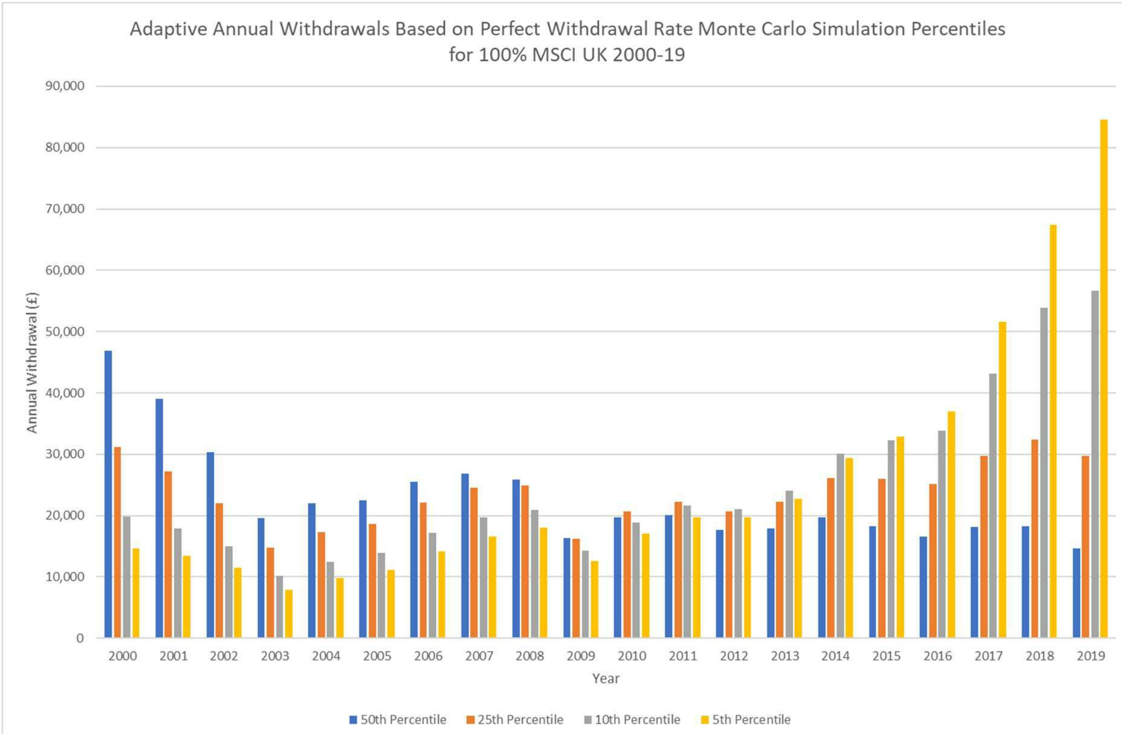
It is worth noting here that using an adaptive withdrawal approach, the pot no longer runs out of money before the decumulation period has finished, as was the case with the constant withdrawal method at the 50th percentile level.

The adaptive method still takes too much, with the benefit of hindsight, in the first couple of years relative to the remainder but the adjustment process still allows for a stream of withdrawals to take place. It should also be noted that returns in the first three years of decumulation are notably low by historical standards[2].

Figure 4 shows the annual withdrawals from the 50th percentile in context with other risk levels. In all cases, due to the adaptive method, the final balance is exactly zero at the end of the period. One can see that as the risk level is lowered so the initial withdrawals decreased reflecting the more conservative approach. Near the end of decumulation this leaves larger balances remaining, however, and thus the final withdrawals are relatively large. With the benefit of hindsight, the 25th percentile withdrawal rate probably gives the most acceptable spread of payments.

[2] See Clare et al (2017), amongst others, for more discussion on the concept of sequence risk in retirement portfolios.

Figure 4.



4.Decumulation to a Residual Balance: Managing Longevity Risk

Thus far we have assumed a 20-year decumulation period with the goal to have exhausted the pot entirely by, but not before, the end of the time frame. The situation in real life is, of course, more complex.

There is longevity risk; in that if one survives past the age of 85 then under these calculations there are no funds remaining. To this extent a variety of options exist. One is to decumulate at a lower rate, e.g. assume the investment pot will have to last 30 years rather than 20. Another is to simply buy an annuity, inflation protected or otherwise, at age 65 and not worry about decumulation. In this case one is giving up flexibility and almost certainly accepting a lower rate of return in exchange for the guaranteed income. We know from behavioural economics that there are various biases pushing individuals away from annuities (Chen et al, 2016).

A third strategy is to spend a small portion of the investment pot at aged 65 on a deferred annuity and decumulate the rest of the pot over say the next 20 years (see Chen et al, 2016), as in our earlier examples. The deferred annuity will pay a regular income at aged 85 and thus longevity risk is insured against, (see Sexauer et al, 2012). This makes the decumulation portion of the method a much simpler task. The downside to this is that currently, deferred annuities are not widely available products in the United Kingdom and hence the overall strategy is infeasible currently.

A fourth approach is to decumulate the investment pot using the principles described earlier but instead of targeting a value of zero after 20 years, ensure that a significant portion remains and then buy a conventional annuity at this point. We refer to this as a *delayed annuity*. This strategy has the advantage of flexibility in the early years of retirement with the ability to access all of the investment should unforeseen circumstances arrive but also hedge longevity risk towards the end. A complexity is that one must estimate what income will be received in the future from the delayed annuity and adjust withdrawals from the investment pot to arrive safely at an amount such that the instrument can be purchased at the appropriate time.

Table 2 shows a worked example of the annual withdrawals of an adaptive withdrawal strategy that leaves a positive balance. We have assumed that a delayed annuity is anticipated to cost £150,000 at the end of the 20-year period. This equates to 30% of the initial £500,000 investment pot. Monte Carlo simulations are run in the same fashion as in the earlier adaptive withdrawal example except that this time a residual balance is factored into the calculation (see Suarez et al, 2015, for the minor adjustment to the PWR formula). This is expressed as the final balance required divided by the balance at the start of that particular annual period (this is the Annuity Cost (%) in Table 2).

For the purposes of the example, we have assumed the investment pot remains 100% invested in UK Equities and the chosen risk level is the 25th percentile.

Table 2

Adaptive Withdrawal Rates at the 25th Percentile for Decumulation to 30% of Initial Balance using 100% UK Equity

Year	Years Remaining	Real Return (%)	Annuity Cost Estimate (£)	Annuity Cost (%)	Withdrawal Rate (%)	Start (£)	Withdrawal (£)	End (£)
2000	20	-7.27	150,000	30.00	5.35	500,000	26,750	438,868
2001	19	-12.39	150,000	34.18	5.06	438,868	22,207	365,032
2002	18	-25.56	150,000	41.09	4.53	365,032	16,536	259,424
2003	17	15.53	150,000	57.82	3.07	259,424	7,964	290,500
2004	16	7.73	150,000	51.64	3.76	290,500	10,923	301,193
2005	15	17.49	150,000	49.80	4.05	301,193	12,198	339,532
2006	14	10.34	150,000	44.18	4.85	339,532	16,467	356,470
2007	13	2.42	150,000	42.08	5.33	356,470	19,000	345,649
2008	12	-29.12	150,000	43.40	5.46	345,649	18,872	231,604
2009	11	24.66	150,000	64.77	3.21	231,604	7,434	279,459
2010	10	7.11	150,000	53.68	4.73	279,459	13,218	285,172
2011	9	-6.31	150,000	52.60	5.34	285,172	15,228	252,918
2012	8	6.93	150,000	59.31	4.86	252,918	12,292	257,305
2013	7	15.39	150,000	58.30	5.55	257,305	14,280	280,416
2014	6	-1.06	150,000	53.49	7.46	280,416	20,919	256,738
2015	5	-3.32	150,000	58.43	7.83	256,738	20,103	228,776
2016	4	16.34	150,000	65.57	7.76	228,776	17,753	245,498
2017	3	7.36	150,000	61.10	11.99	245,498	29,435	231,967
2018	2	-11.16	150,000	64.66	16.68	231,967	38,692	171,712
2019	1	13.94	150,000	87.36	9.64	171,712	16,553	176,792
2020			150,000	84.85		176,792		

As with our earlier example, the initial withdrawals in this case prove to be high and have to be scaled back as the investment pot suffers three negative years in a row. Indeed, after Year 3 has been completed the pot has only slightly above half its initial value remaining due to the combination of withdrawals and investment losses. As one follows the progress over time, it becomes apparent that above average returns lead to the ability to take more out the following year and vice versa. The variation in annual cash flows might be intolerable for many retirees but that is, to an extent, a function of the investment being purely in equity. We revisit this later in the paper with strategies that mitigate some of the volatility.

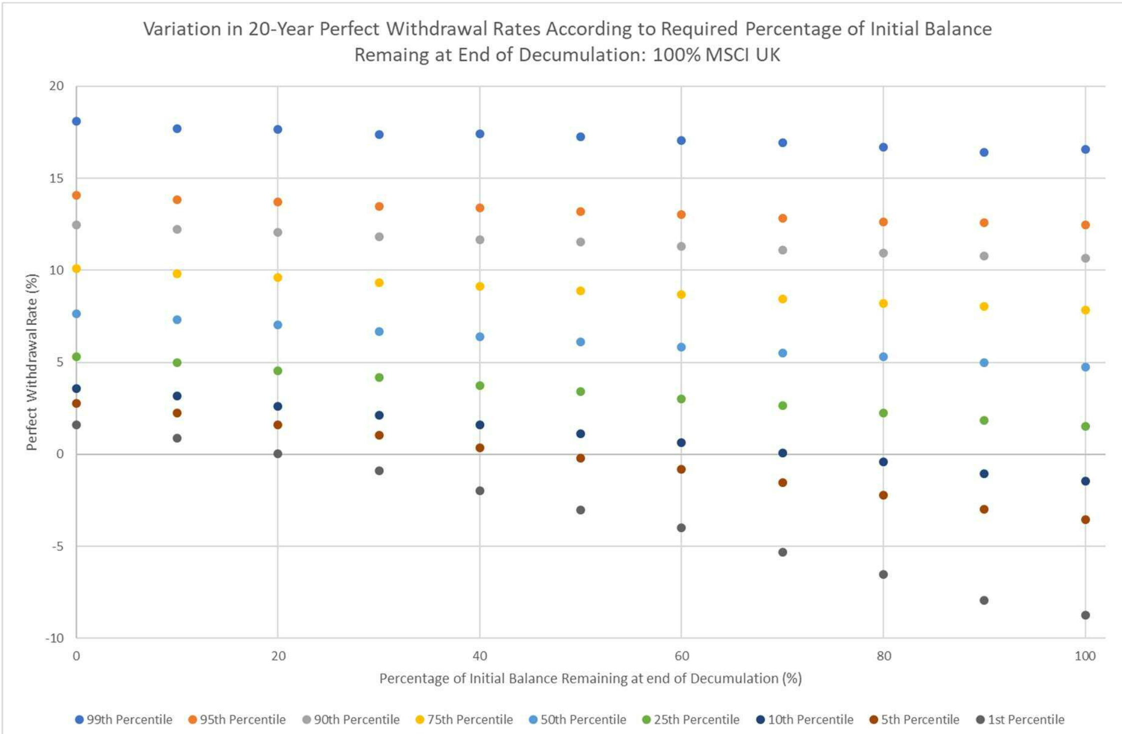
An important difference between Tables 1 and 2 is in the last couple of lines. Since in this example we are decumulating to a target in order to purchase a delayed annuity, the residual balance will not be zero. In fact, the final balance is £176,792 providing a surplus of nearly £27,000 above the targeted value. Part of this can be attributed to the risk percentile chosen but it is mainly due to the final return being 13.9%. This is well above the budget and hence a surplus is created. Whilst this is a favourable outcome in the context of our example, it would ***not*** be very pleasant if the final year shows a substantial negative return. There would be insufficient to buy the full amount of annuity desired and hence a lower standard of living would be in prospect in subsequent periods.

A final point we draw attention to from Table 2 is that the variation in cash flows in the example is considerably more than that attributable to the 25th percentile level in Figure 4 where the pot is completely exhausted. In the case of the latter, the withdrawals vary between £14.7k and £32.3k whereas when a 30% remaining balance is targeted the range was £7.4k to £38.7k***. This is an important consideration when constructing a decumulation path.***

If we seek to target a non-zero decumulation sum after a number of years then we can expect a more varied year-to year (Perfect) Withdrawal Rate.

Figure 5 demonstrates how 20-year PWRs vary according to the proportion of initial balance required at the end based on Monte Carlo simulations. The extremes shown on the chart are complete exhaustion, as in the Table 1 example, and 100% of the balance remaining where one requires the initial and final balances to be equal. A negative PWR value indicates that one should be adding money to the investment pot rather than withdrawing. Clearly this a circumstance that needs to be avoided. What we observe is that there is considerably greater variation in PWRs as the required remaining balance increases. Based on the returns sample in our simulations, the risk appears skewed towards a small number of particularly low outcomes. When the proportion of the pot to be retained is large relative to the amount available to take withdrawals from, then the investment returns on the whole amount can impact severely on the ability to take a cash sum.

Figure 5.

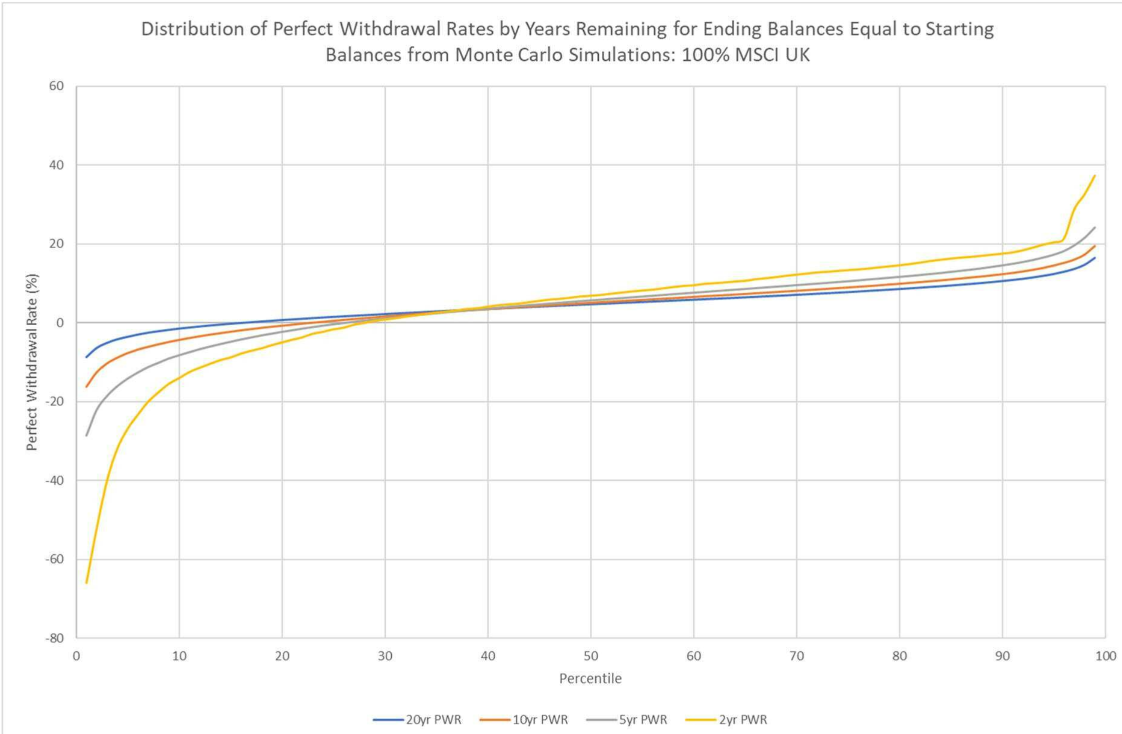


For example, suppose a retirement pot has £200,000 invested with the aim of taking say £20,000 for the next two years to leave £160,000 (80% of the initial balance) for a delayed annuity. The £20,000 withdrawal is made at the start of the first year but the investment earns a return of -25% in the next 12 months leaving a remaining balance of (£200,000 – £20,000) × (1 – 0.25) = £135,000. This is already insufficient to purchase the delayed annuity and there is still another year of decumulation to go with a further required withdrawal of £20,000 to be made. Money actually needs to be paid in to get back on track, but this is not possible.

If the investment pot is initially £400,000 though, with the same £160,000 target (but now only 40% of the starting balance), and the annual withdrawal is set at £120,000 then a 25% loss is more manageable. The balance after the first 12 months is now (£400,000 – £120,000) × (1 – 0.25) = £210,000. Our retiree can still take a cash payment of say £40,000 in the second year and have enough for the delayed annuity assuming more normal investment returns in the final period. This highlights how the proportion of the required residual balance relative to the initial investment pot affects the sensitivity of withdrawals to asset returns. It is not just the percentage of initial balance targeted as a residual value that affects the sensitivity of withdrawals to asset returns.

Figure 6 plots the full distribution of PWRs for a range of different decumulation periods for the, albeit extreme, example of requiring a final balance equal to the initial balance. We observe that as the remaining years decreases so the variation in withdrawal rates increases. This is not a linear relationship. The difference between the 2-year and 5-year lines is much more marked than that between the 10-year and 20-year lines. It is this heightened risk near the end of the decumulation period that motivates the use of ***glidepath*** strategies. We return to this later in the paper.

Figure 6.



For now, though, we have observed various areas of risk. A series of negative returns near the start of decumulation is a form of sequence risk, which will affect the overall level of withdrawals that a strategy can provide. Large negative returns near the end of a period of decumulation can have only a small impact on the overall sums taken but a very significant impact on the final withdrawals as there is no remaining time to recoup losses. Finally, the size of residual balance required also increases the volatility of withdrawals as the investment returns on the whole pot can swamp the relatively small amount available to take cash from.

We now extend these findings to include more diversified investment strategies which will be less volatile and represent popular investing experiences.

5.Adding Different Asset Classes and Strategies

Up to this point we have always assumed that the investment pot is 100% invested in UK equities (UKEQ) in order to demonstrate how various decumulation methods may work. We now introduce other asset classes and strategies to see how different risk and return characteristics affect the decumulation profile. Included are gilts (GILTS) which will allow us to work with the popular equity/bond portfolios such as those used by Bengen (1994) and most other strategists, e.g. the famous 60/40 portfolio. However, we add a 'smoothed (trend-adjusted) equity index as well to show the efficacy of a trend following version of UK equity (UKEQTF) in reducing Sequence Risk and enhancing withdrawal possibilities. The latter adjustment uses a simple trading rule as described in

Clare et al (2017) which has historically delivered equity-type returns but with around two-thirds of the volatility and only half or less of the maximum drawdown.

Table 3 shows the returns of the various assets prior to the start of the decumulation example, i.e. what was known at the beginning of the period (end-December 1999), and then the returns over the subsequent 20 years. Gilts returned the same across both periods whilst equities had much lower returns in the final 20-year time frame; a mere *fifth* of the return pre-2000. Clearly extrapolating the past would lead to misleading and potentially unsustainable withdrawal behaviour here. On the other hand, the trend following strategy performed rather better than the conventional equity portfolio and with lower volatility. We examine whether employing the trend following strategy allows higher withdrawals in practice. In addition, we show cash as an indication of what the risk-free rate achieved.

Table 3

Summary Statistics for Asset Class Returns

	UK Equity	UK Equity with TF	Gilts	Cash
1971-1999				
Annualised Real Return (%)	7.8	7.4	2.5	1.4
Annual Real Volatility (%)	26.0	14.5	14.4	4.4
2000-2019				
Annualised Real Return (%)	1.4	2.9	2.5	-0.5
Annual Real Volatility (%)	14.4	10.3	5.2	2.5

Figures 7a and 7b show the 20-year PWR distributions based on Monte Carlo simulations for decumulating to a zero balance and 30% of initial balance respectively, based on information known at the start of the example. The higher return of equities leads to a mode that is to the right of that for gilts but the lower volatility of UKEQTF and gilts result in a less variable distribution. This lower variation is helpful when trying to produce more stable cash flows in a decumulation process. One could produce very stable cash flows if cash was the main asset class used but the, essentially risk - free return has historically been low and is very low in the post-2008 period. The stability would then likely come at the cost of a shortfall in withdrawal amounts. Note also the greater variation in the PWR distribution in Figure 7b compared to Figure 7a. This shows the effect of withdrawing to leave a balance described earlier; indeed there is a small chance of achieving a negative PWR with a couple of the strategies in this case.

Comparing the brown line (100% equity portfolio) with the blue line (smoothed equity) shows clearly why smoothing as described by Clare et al (2017, 2021) is powerful in enhancing the chance of a good retirement experience: basically, it reduces the chance of very bad returns, i.e. it manages Sequence Risk. The area under the blue curve to the left of the 5% withdrawal rate is much greater than that of the brown line: hence bad withdrawal experiences are far more likely with raw, unsmoothed equity portfolios.

In Figure 7b we target a pot of 30% of the original wealth remaining after 20 years, which could be used to buy an annuity for example; it is no surprise that this shifts the withdrawal distributions to the left suggesting that savers cannot spend as much in the years leading up to age 85.

Figure 7a.

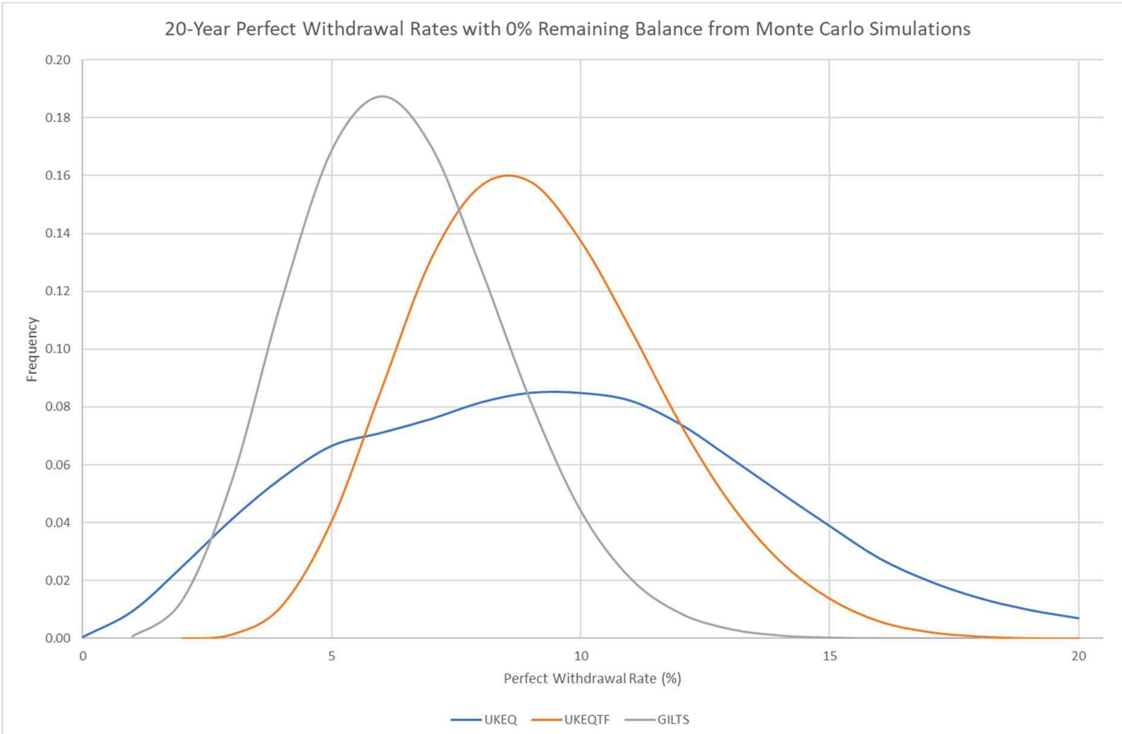


Figure 7b.

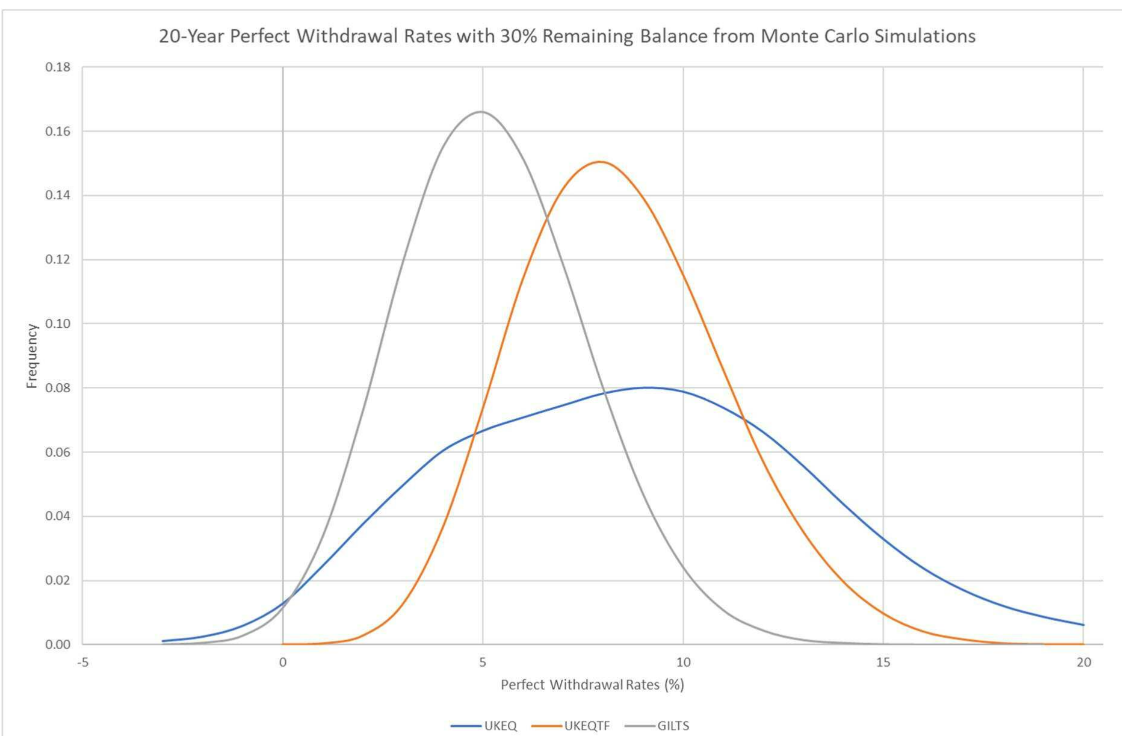


Table 4 shows a worked example of the decumulation process previously followed in Table 2 except this time with a 100% gilts investment, i.e. using the 25th percentile risk level and a target residual balance of 30% of the initial pot.

This time the first three years of returns are a positive sequence of 5.64%, 2.31% and 6.12%; recall that the from Table 3 we saw that average returns were only 2.5% per annum both before and after 2000. As a result, the withdrawals taken under the adaptive method rise. These payments then remain steady for the next few years before rising again towards the end of decumulation. Indeed, the last three years see the biggest overall distributions.

This is a result of the conservative approach taken by operating at the 25th percentile risk level. We have seen from Table 4 that gilt returns were the same prior in both periods and so withdrawals were taken at a below average rate throughout. There was also a surplus over the target of around £11,000.

Table 4

Adaptive Withdrawal Rates at the 25th Percentile for Decumulation to 30% of Initial Balance using 100% Gilts

Year	Years Remaining	Real Return (%)	Annuity Cost Estimate (£)	Annuity Cost (%)	Withdrawal Rate (%)	Start (£)	Withdrawal (£)	End (£)
2000	20	5.64	150,000	30.00	3.54	500,000	17,700	509,511
2001	19	2.31	150,000	29.44	3.82	509,511	19,463	501,369
2002	18	6.12	150,000	29.92	3.97	501,369	19,904	510,932
2003	17	-0.69	150,000	29.36	4.29	510,932	21,919	485,649
2004	16	3.01	150,000	30.89	4.41	485,649	21,417	478,185
2005	15	5.59	150,000	31.37	4.65	478,185	22,236	481,420
2006	14	-3.07	150,000	31.16	5.05	481,420	24,312	443,090
2007	13	1.18	150,000	33.85	5.06	443,090	22,420	425,618
2008	12	11.73	150,000	35.24	5.34	425,618	22,728	450,138
2009	11	-3.48	150,000	33.32	6.10	450,138	27,458	407,980
2010	10	2.32	150,000	36.77	6.24	407,980	25,458	391,380
2011	9	10.26	150,000	38.33	6.73	391,380	26,340	402,485
2012	8	-0.39	150,000	37.27	7.74	402,485	31,152	369,874
2013	7	-6.45	150,000	40.55	8.28	369,874	30,626	317,361
2014	6	12.03	150,000	47.26	8.33	317,361	26,436	325,934
2015	5	-0.64	150,000	46.02	10.38	325,934	33,832	290,220
2016	4	7.42	150,000	51.68	11.43	290,220	33,172	276,110
2017	3	-2.80	150,000	54.33	14.53	276,110	40,119	229,379
2018	2	-1.24	150,000	65.39	16.20	229,379	37,159	189,827
2019	1	4.37	150,000	79.02	18.70	189,827	35,498	161,071
2020			150,000	93.13		161,071		

We now follow the same approach for UKEQTF in Table 5. Comparison of Tables 3 and 5 shows that higher, as well as smoother withdrawals can be achieved by employing smoothing in equity investments. Firstly, the initial withdrawal is higher than that of gilts reflecting the previously observed higher returns. The first year of returns is well below the average though, resulting in the next payment being approximately 25% lower. Returns in the years 2 and 3, whilst still negative, are much higher than those for conventional equity shown in Table 2. The investment pot declines at a considerably slower rate as a result. Withdrawals remain fairly constant for most of the following years until we reach close to the end of the decumulation period. In 2018 the payment from the pot is £31,800 at the start of the year but the investment return is very low at -10.3%.

Table 5

Adaptive Withdrawal Rates at the 25th Percentile for Decumulation to 30% of Initial Balance using 100% UK Equity with Trend Following

Year	Years Remaining	Real Return (%)	Annuity Cost Estimate (£)	Annuity Cost (%)	Withdrawal Rate (%)	Start (£)	Withdrawal (£)	End (£)
2000	20	-12.20	150,000	30.00	6.58	500,000	32,900	410,106
2001	19	-1.91	150,000	36.58	6.04	410,106	24,770	377,987
2002	18	-3.73	150,000	39.68	5.91	377,987	22,339	342,368
2003	17	15.07	150,000	43.81	5.68	342,368	19,446	371,577
2004	16	7.73	150,000	40.37	6.17	371,577	22,926	375,606
2005	15	17.49	150,000	39.94	6.45	375,606	24,227	412,827
2006	14	10.34	150,000	36.33	7.06	412,827	29,146	423,355
2007	13	2.42	150,000	35.43	7.45	423,355	31,540	401,311
2008	12	-5.95	150,000	37.38	7.62	401,311	30,580	348,677
2009	11	22.49	150,000	43.02	7.39	348,677	25,767	395,518
2010	10	5.39	150,000	37.92	8.45	395,518	33,421	381,617
2011	9	-10.02	150,000	39.31	8.91	381,617	34,002	312,800
2012	8	-0.16	150,000	47.95	8.46	312,800	26,463	285,872
2013	7	15.39	150,000	52.47	8.51	285,872	24,328	301,785
2014	6	-2.82	150,000	49.70	10.01	301,785	30,209	263,917
2015	5	-8.44	150,000	56.84	10.03	263,917	26,471	217,416
2016	4	14.58	150,000	68.99	8.66	217,416	18,828	227,550
2017	3	7.36	150,000	65.92	11.85	227,550	26,965	215,350
2018	2	-10.29	150,000	69.65	14.77	215,350	31,807	164,664
2019	1	4.34	150,000	91.09	5.38	164,664	8,859	162,571
2020			150,000			162,571		

Bearing in mind that UKEQTF has a lower volatility than UKEQ, this is more of an outlier in the risk spectrum that the Monte Carlo distribution presents. The consequence of this low return is that the final withdrawal at the start of 2019 is just £8,900.

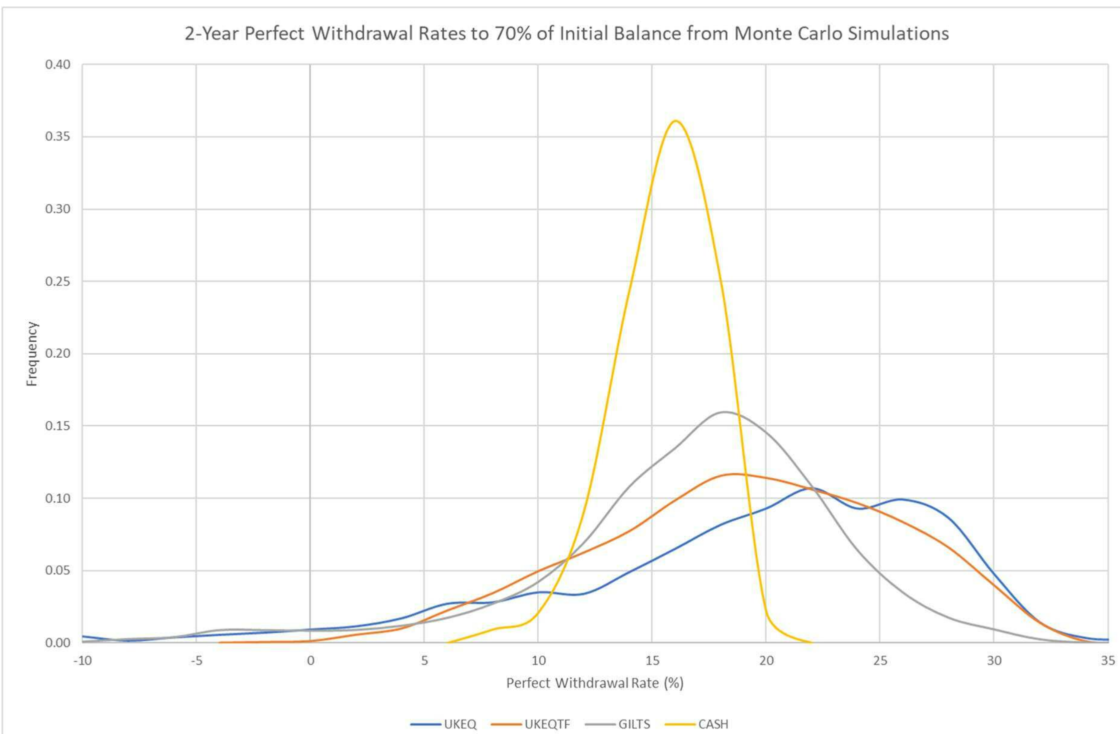
This is a very good example of the risk described earlier that low returns near the end of decumulation can have a substantial effect on the final payments. The overall amount withdrawn from the investment pot appears reasonable in the context of 20 years, but the last payment is very low and could cause financial distress. A strategy to try and mitigate this risk is the subject of the next section.

6.Motivating Glidepath Investment Strategies

The previous section demonstrated how a perfectly acceptable decumulation profile can come badly unstuck in the last few years if a low probability, significantly negative return is encountered. This would seem to suggest a possible motivation for a popular range of strategies discussed earlier, namely Glidepath or Target Date Funds or similar risk reducing strategies. The role of TDFs and the associated Glidepath investing strategies is attracting substantial research attention of late (e.g. see Shoven and Walton, 2020, Parker, et al, 2020, amongst others).

As a motivation we begin with Figure 8 which provides an illustration of this with the distribution of 2-year PWRs from Monte Carlo simulations assuming one is decumulating to 70% of the starting balance (i.e. over 2 years). This reflects the fact that a large portion of the decumulation has already taken place in our previous examples where one was targeting a final 30% balance over 20 years. The chart shows the three previous asset classes/strategies but this time we have also plotted the distribution for cash. Firstly, note how the range of outcomes is much wider than for our earlier examples over 20 years. The point of real concern, though, is the left-hand tails of the distributions.

Figure 8.



In the UKEQTF example shown in Table 5, the withdrawal percentage in the final year was 5.4% which gave rise to a very small payment. Even if it had been 10%, the withdrawal amount would still have been the lowest in the entire 20-year period. In Figure 8, both UKEQTF and GILTS have around a 10% chance of producing a single-digit withdrawal percentage whilst UKEQ is higher still.

Gilts as an asset class may be considered less volatile but there were several years during the 1970s when inflation was rampant such that double-digit negative annual returns were encountered. Furthermore, these were also at a time when UK equities were also suffering big losses. There was little bond-equity diversification to be had at that time. The only asset class that really provides insulation against an unpleasant left-tail outcome is cash.

Table 6 gives some further detail by describing the PWR distributions for 5, 2 and 1-year decumulation periods to 50%, 70% and 90% targets of the starting balance. Firstly, we again note that variation in PWRs is higher the closer the target is to the initial starting balance. The more volatile the underlying strategy, the more extreme the range of PWR outcomes *ceteris paribus*. At the 25th percentile level, the PWRs for cash are not dissimilar to the other assets. One is giving up the possibility of the big positive outcomes to avoid the small probability of big negative outcomes. The final point we observe is that ***the range of outcomes increases as the time of decumulation reduces.***

It is particularly acute in the last couple of years and this is where most focus should be placed on mitigating risk. This would seem to suggest a powerful *raison d'etre* for using Glidepath strategies if they genuinely reduce such variability.

Table 6

Distributions of PWRs According to Years of Decumulation Remaining, Final Balance Target and Asset Class Using Monte Carlo Simulations

	50% Balance Target				70% Balance Target				90% Balance Target			
	UKEQ	UKEQTF	GILTS	CASH	UKEQ	UKEQTF	GILTS	CASH	UKEQ	UKEQTF	GILTS	CASH
5 Years Remaining												
99th Percentile	30.42	22.73	19.80	13.08	28.23	20.45	17.08	9.55	26.35	18.05	14.39	6.07
95th Percentile	23.31	20.56	17.55	12.53	21.33	17.88	14.59	8.92	19.09	15.29	11.63	5.32
90th Percentile	21.14	19.17	16.35	12.18	18.81	16.41	13.28	8.51	16.37	13.72	10.20	4.86
75th Percentile	18.09	16.78	14.42	11.53	15.32	13.74	11.05	7.78	12.51	10.77	7.76	4.02
50th Percentile	14.30	14.03	12.16	10.74	11.05	10.67	8.50	6.87	7.73	7.38	4.88	3.00
25th Percentile	9.49	11.27	9.54	9.86	5.56	7.58	5.51	5.86	1.58	3.86	1.47	1.85
10th Percentile	3.56	8.83	6.60	8.99	-1.23	4.76	2.15	4.82	-6.20	0.65	-2.50	0.69
5th Percentile	-0.10	7.45	4.78	8.42	-5.76	3.07	-0.10	4.17	-11.60	-1.29	-5.04	-0.07
1st Percentile	-7.69	4.91	1.17	7.27	-16.52	-0.02	-4.56	2.89	-24.49	-4.91	-10.28	-1.58
2 Years Remaining												
99th Percentile	52.00	38.36	37.18	28.48	46.33	31.34	29.48	19.31	40.22	24.33	22.09	10.15
95th Percentile	37.99	36.75	33.85	27.96	30.98	29.26	25.69	18.61	23.99	21.65	17.85	9.28
90th Percentile	36.46	35.25	32.17	27.53	28.99	27.57	23.83	18.17	21.42	19.76	15.52	8.79
75th Percentile	33.64	32.39	29.74	26.75	25.62	24.02	20.92	17.14	17.52	15.56	11.98	7.52
50th Percentile	29.57	28.55	27.03	25.58	20.72	19.34	17.51	15.69	11.73	10.19	8.09	5.82
25th Percentile	24.06	24.63	24.02	24.36	13.99	14.65	13.80	14.31	3.59	4.72	3.59	4.25
10th Percentile	16.01	20.94	20.10	23.18	4.24	10.03	9.09	12.69	-7.77	-1.01	-2.04	2.21
5th Percentile	8.63	19.08	16.17	22.47	-5.95	7.50	3.88	11.80	-20.95	-3.97	-8.07	1.19
1st Percentile	-9.66	15.96	8.64	20.14	-30.85	3.91	-4.84	9.19	-56.68	-8.61	-19.72	-2.03
1 Year Remaining												
99th Percentile	75.09	61.85	62.74	53.00	65.12	46.58	47.84	34.20	55.15	31.32	32.94	15.40
95th Percentile	60.58	60.42	58.91	52.95	44.81	44.58	42.47	34.13	29.04	28.75	26.03	15.31
90th Percentile	60.39	60.00	56.79	52.60	44.54	44.00	39.50	33.64	28.70	28.00	22.22	14.68
75th Percentile	57.44	57.04	54.65	51.96	40.42	39.86	36.62	32.74	23.40	22.00	18.51	13.11
50th Percentile	53.59	53.05	51.46	50.43	35.02	34.28	32.04	30.62	18.43	15.50	13.27	10.77
25th Percentile	47.45	48.06	48.56	48.89	26.43	25.57	27.98	28.44	5.40	6.51	7.41	8.00
10th Percentile	40.74	44.27	45.12	48.00	17.03	21.97	23.17	27.21	-6.68	-0.32	1.22	6.41
5th Percentile	29.45	43.05	40.06	47.85	1.24	20.27	16.09	27.00	-26.98	-2.51	-7.89	6.14
1st Percentile	-21.98	39.45	22.55	43.31	-70.78	15.23	-8.43	20.63	-119.57	-8.99	-39.40	-2.05

A glidepath investing strategy is one such method to mitigate this final year risk. Essentially this involves moving out of riskier assets into less risky assets in some preordained fashion over time (a 'rule') to offset the decrease in ability to absorb losses. In certain circumstances, say decumulating to a zero balance, the glidepath could be constructed between equities and bonds (see Clare et al, 2019), for discussion).

In the case of our scenario, where a targeted balance is required in order to purchase a delayed annuity, even this appears too risky based on the evidence we have accumulated so far. To this extent, we are going to examine applying a glidepath where the less risky asset is cash.

For the sake of our example we propose transitioning from the riskier asset (be it UKEQ, UKEQTF or GILTS) into cash when there are 5 years of decumulation remaining. We start with a 10% allocation to cash at this point, e.g. 90% UKEQ, 10% cash, and increase the cash allocation by 20% each year until the final year has a 90% weighting, e.g. 10% UKEQ, 90% cash.

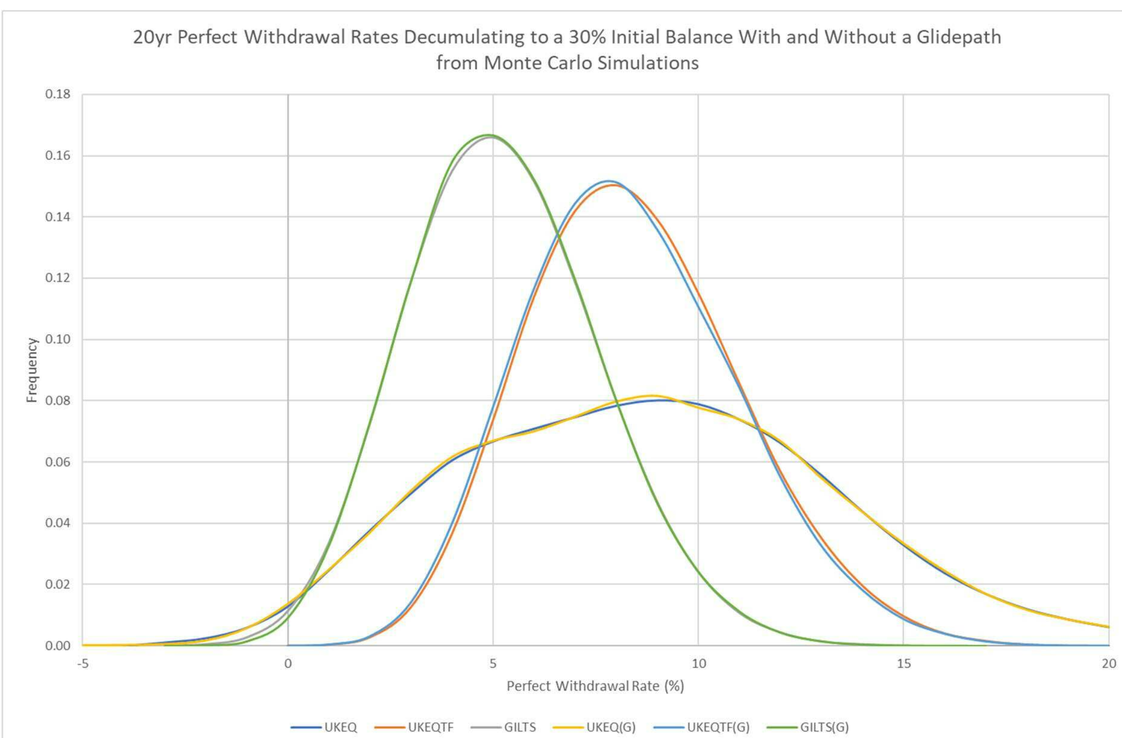
The optimal glidepath should almost certainly be non-linear based on the evidence presented in Table 8 but our example is more about examining whether some gliding is better than none at all.

From our earlier results in Tables 3 and 6 we know that by transitioning to cash we are giving up some withdrawal pounds in exchange for less volatility due to the lower returns on cash. The question thus becomes whether this is an acceptable trade off.

Figure 9 shows the 20-year decumulation to a target of 30% of the initial balance, plus PWR distributions for Monte Carlo simulations of our three asset classes both with a glidepath (indicated using the suffix (G)) and without.

The distributions appear almost identical irrespective in all three cases whether a shift towards cash takes place in the final years or not. This implies that one is giving up very little in total withdrawals through adopting a glidepath. The years which are most exposed to the lower returns of cash are at the end of the decumulation process where the pot is typically at its smallest. To this extent we conclude that there is no meaningful loss of overall value through the implementation of a glidepath of the type we have applied.

Figure 9.



As a practical example, Table 7 reprises our example from Table 5 for UKEQTF but this time using the glidepath in the final few years. Firstly, note that the initial withdrawal is £32,500 compared to £32,900 in the original version. This difference of £400 is the effect of the lower future returns estimated by the Monte Carlo simulations. To this extent, one may quantify the cost of the glidepath at a little over 1% of the withdrawal. The final few years are where we would expect to see most difference between the two strategies.

From Table 5, the last three withdrawals are £27,000, £31,800 and £8,900 compared to £26,000, £26,600 and £17,700 with the glidepath in Table 7. This has achieved the targeted aim in that there is considerably less volatility of the last few cash flows in the case of the latter. The penultimate return for UKEQTF was -10.3% compared to with the glidepath (30% UKEQTF, 70% Cash at that time) of -4.6% which explains the difference in the final year's withdrawals.

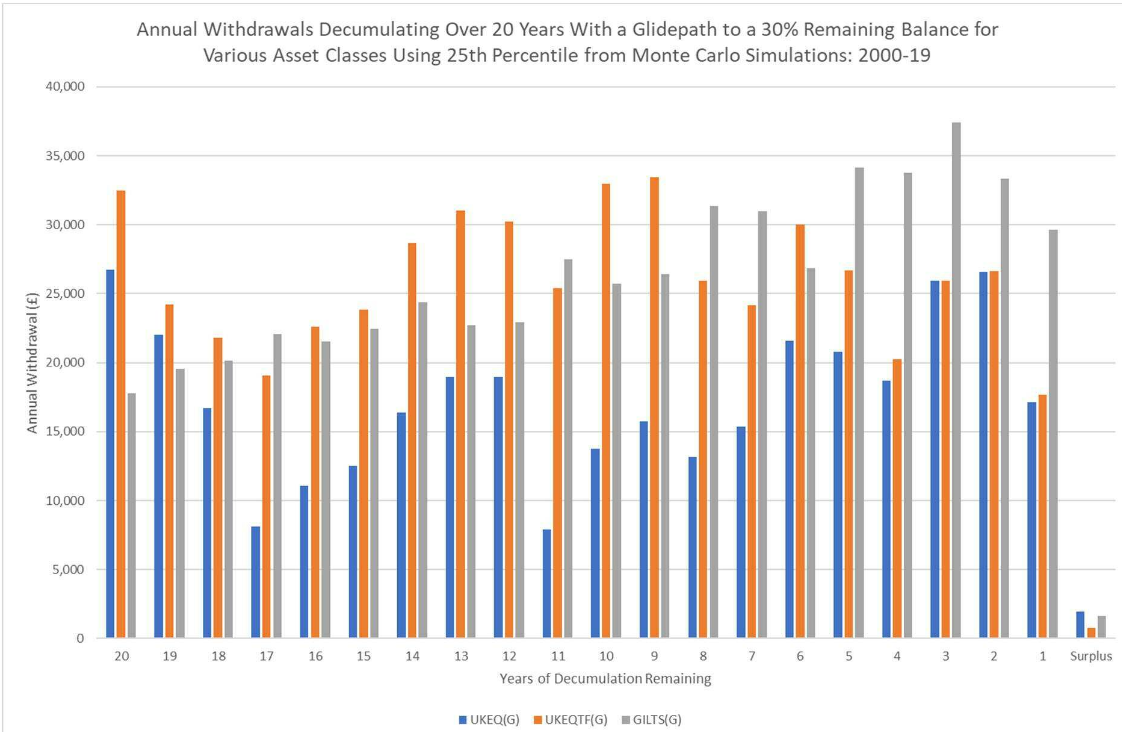
Table 7

Adaptive Withdrawal Rates at the 25th Percentile for Decumulation to 30% of Initial Balance using 100% UK Equity with Trend Following and a Glidepath

Year	Years Remaining	Real Return (%)	Annuity Cost Estimate (£)	Annuity Cost (%)	Withdrawal Rate (%)	Start (£)	Withdrawal (£)	End (£)
2000	20	-12.20	150,000	30.00	6.50	500,000	32,500	410,457
2001	19	-1.91	150,000	36.54	5.90	410,457	24,217	378,874
2002	18	-3.73	150,000	39.59	5.76	378,874	21,823	343,719
2003	17	15.07	150,000	43.64	5.55	343,719	19,076	373,558
2004	16	7.73	150,000	40.15	6.05	373,558	22,600	378,091
2005	15	17.49	150,000	39.67	6.30	378,091	23,820	416,224
2006	14	10.34	150,000	36.04	6.89	416,224	28,678	427,620
2007	13	2.42	150,000	35.08	7.26	427,620	31,045	406,186
2008	12	-5.95	150,000	36.93	7.44	406,186	30,220	353,600
2009	11	22.49	150,000	42.42	7.19	353,600	25,424	401,969
2010	10	5.39	150,000	37.32	8.20	401,969	32,961	388,900
2011	9	-10.02	150,000	38.57	8.60	388,900	33,445	319,854
2012	8	-0.16	150,000	46.90	8.10	319,854	25,908	293,469
2013	7	15.39	150,000	51.11	8.23	293,469	24,152	310,753
2014	6	-2.82	150,000	48.27	9.66	310,753	30,019	272,817
2015	5	-7.67	150,000	54.98	9.79	272,817	26,709	227,239
2016	4	9.58	150,000	66.01	8.90	227,239	20,224	226,846
2017	3	1.79	150,000	66.12	11.44	226,846	25,951	204,494
2018	2	-4.55	150,000	73.35	13.02	204,494	26,625	169,781
2019	1	-0.87	150,000	88.35	10.41	169,781	17,674	150,789
2020			150,000	99.48		150,789		

Figure 10 shows UKEQTF(G) in context with the other asset classes plus a glidepath. An important point to note is the surplus set of bars on the far-right of the chart. Without a glidepath the surplus for UKEQ was £26,800, £11,100 for GILTS and £12,600 for UKEQTF. Now these values are much smaller with no surplus being in excess of £2,000. The effect of the glidepath is making it much easier to get close to the targeted balance. Whilst the large surpluses did no harm in our earlier examples, if one had been less fortunate and suffered a big investment return loss in the final year, then the final balance could have shown a deficit instead.

Figure 10.



As we alluded to earlier, one can tailor the glidepath to suit one's circumstances. Our straight-line method demonstrates the worth of the approach, but a more optimal version is almost certainly non-linear. The choice in real time may also be a function of how the preceding decumulation has been realised. We have shown earlier that volatility of final cash flows is a function of how high the targeted balance is as a percentage of the current balance. There could be a case that one should switch to higher proportions of cash in the glidepath if the investment pot has suffered more in earlier periods and the targeted final balance is a relatively larger proportion of the current balance than one might have hoped for. This is something that financial advisors may consider in conjunction with their clients according to their risk appetite.

7.Further Considerations

In our earlier examples, we have assumed that one is intending to purchase a delayed annuity and thus a balance is targeted at the end of decumulation which will be used to purchase said product. What is perhaps more realistic is that a retiree will work out how much income they desire from the annuity and this will determine the amount to be bought. This adds a further complication in that annuity prices are not like door numbers; they change over time. We thus have a situation where our delayed annuity can no longer be expressed as a fixed percentage of the initial decumulation pot but rather it is a moving target.

It is generally accepted that annuity rates are a function of interest rates and thus as the latter changes so will the former. Cannon and Tonks (2004, 2010) provide a history of the relationship in the UK, both for nominal and inflation-protected annuities. For the purposes of our examples we are not too worried about the exact pricing level, rather we are interested in the methodology one might adopt to hit a moving target.

Figure 11 shows how the 15-year gilt yield has varied between the start of 2000 to 2020. The trend has been very much towards lower yields over the whole period with a final value of just above 1% being most unusual historically. We are going to assume for our example that a real income of £20,000 is required from the delayed annuity purchase and that such an instrument will offer a yield of the 15-year gilt plus 8%. A further assumption is that current annuity prices are our best guide to future prices, i.e. the current annuity price will provide us with the amount to be targeted as the final decumulation balance. Thus, at the start of 2000, the gilt yield was 5.09% and hence it is anticipated that a sum of £20,000 ÷ (0.0509 + 0.08) = £152,788, will be required.

Figure 11 demonstrates how this sum changes over time as interest rates decline. By the start of 2020, the sum required has risen to over £218,000. This presents a further challenge.

Figure 11.

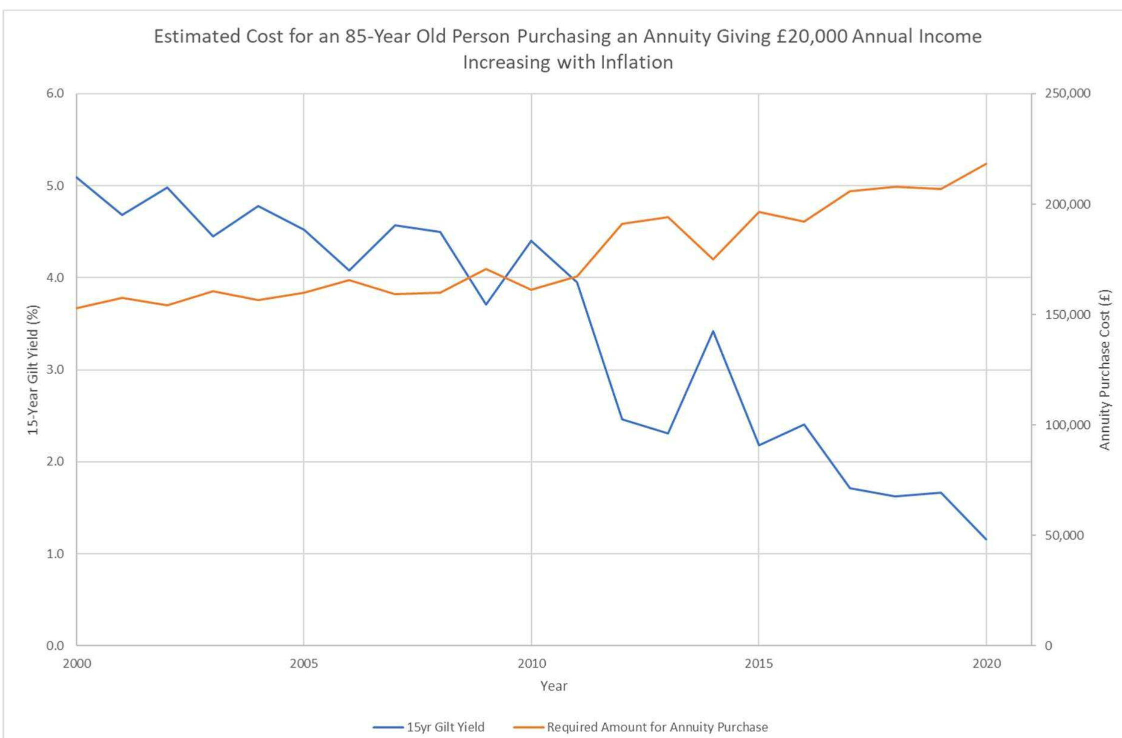


Table 8 provides a worked example of how the decumulation process might take place for a moving targeted balance. We use UKEQTF as the underlying investment strategy along with the glidepath described in the previous section. The risk level remains at the 25th percentile. At the beginning of each year we estimate what the new cost of the delayed annuity will be based upon our interest rate equation.

Note how the Annuity Cost Estimate (%) column now changes in the Table compared to previous examples where this amount was fixed at £150,000. The annuity cost is then expressed as a percentage of the balance at the beginning of the year and Monte Carlo simulations run accordingly with the 25th percentile being the adopted withdrawal rate.

Table 8

Adaptive Withdrawal Rates at the 25th Percentile for Decumulation to a Target of Purchasing £20,000 of Annual Real Income from an Annuity using 100% UK Equity with Trend Following and a Glidepath

Year	Years Remaining	Real Return (%)	Annuity Cost Estimate (£)	Annuity Cost (%)	Withdrawal Rate (%)	Start (£)	Withdrawal (£)	End (£)
2000	20	-12.20	152,788	30.56	6.43	500,000	32,150	410,764
2001	19	-1.91	157,729	38.40	5.85	410,764	24,030	379,360
2002	18	-3.73	154,083	40.62	5.75	379,360	21,813	344,195
2003	17	15.07	160,643	46.67	5.42	344,195	18,655	374,590
2004	16	7.73	156,495	41.78	5.96	374,590	22,326	379,500
2005	15	17.49	159,744	42.09	6.15	379,500	23,339	418,444
2006	14	10.34	165,563	39.57	6.67	418,444	27,910	430,916
2007	13	2.42	159,109	36.92	7.14	430,916	30,767	409,846
2008	12	-5.95	160,000	39.04	7.27	409,846	29,796	357,442
2009	11	22.49	170,794	47.78	6.78	357,442	24,235	408,131
2010	10	5.39	161,290	39.52	8.02	408,131	32,732	395,636
2011	9	-10.02	167,364	42.30	8.28	395,636	32,759	326,534
2012	8	-0.16	191,205	58.56	6.81	326,534	22,237	303,803
2013	7	15.39	193,986	63.85	6.53	303,803	19,838	327,655
2014	6	-2.82	175,131	53.45	8.86	327,655	29,030	290,203
2015	5	-7.67	196,496	67.71	7.34	290,203	21,301	248,285
2016	4	9.58	192,164	77.40	6.15	248,285	15,270	255,338
2017	3	1.79	205,975	80.67	6.69	255,338	17,082	242,524
2018	2	-4.55	207,792	85.68	6.91	242,524	16,758	215,500
2019	1	-0.87	206,924	96.02	2.50	215,500	5,387	208,292
2020			218,314			208,292		

To begin with the decumulation process does not look much different from Table 7 and the fixed target. The annuity cost estimate rises a little but after 5 years it has gone up by less than £10,000 which is manageable in the context of the example. Arguably, the first sign of the additional complexity comes during 2011. This was a poor year for the investment return at -10% but over the same time the annuity cost jumped from £167,400 to £191,200. This resulted in the following year's adaptive withdrawal declining from £32,800 to £22,200. A similar situation happened in 2015 when the investment return was -7.7% albeit the annuity declined slightly this time. At the beginning of 2016, this meant the targeted balance was £192,200 which was 77.4% of the current balance.

We have seen earlier that as this figure rises so future cash flows become more unstable. The most toxic combination is a low investment return and a rising annuity cost. For context, using the fixed target in Table 7, the annuity cost was only 66% at the same point in time.

By the beginning of 2018 the estimated annuity amount has risen further to £207,800 as interest rates continue their decline. This now represents 85.7% of the remaining balance with 2 further years of decumulation remaining. Even with the glidepath, a return of -4.5% puts a further dent in the pot such that the withdrawal for the final year is a paltry £5,400. Bear in mind this level of return was considered tolerable in the context of the example in Table 7 with the fixed target. The escalating cost of the annuity has caused the problem in this instance. Additional salt in the wound is provided with a further drop in interest rates seeing the annuity cost rise by over £11,000 to £218,300 in the final year. The final balance was only £208,300 and thus this only afforded the purchase of annual annuity income of £19,100 instead of the desired £20,000.

The takeaway from this example is that multiple layers of risk mitigation need to be built into a decumulation strategy in order to make it robust.

Along with this comes an acceptance that it might mean somewhat lower withdrawals earlier in the decumulation process and possibly a surplus of the desired target at the end. Given the asymmetry in peace of mind between having too little money and too much, this should be tolerable.

We have already shown risk reduction strategies by using more conservative withdrawals from lower risk percentiles, the utilisation of trend following rather than conventional buy-and-hold and the adoption of a glidepath to protect the withdrawals in the last few years.

In the case of our moving target annuity example, one needs to go further still. Given the uncertainty surrounding the cost of the annuity it might be prudent to assume a cost higher than the current value. For example, perhaps assume the final value will be say 10% higher than the estimate based on the existing price to allow for interest rate fluctuations. Alternatively, use a less aggressive risk percentile.

Table 9 shows the same example but now withdrawing at the 10^{th} percentile level. The early cash flows are much lower with the minimum total value being £14,600 taken in the fourth year. As a reward for this frugality, the final three years withdrawals are £27,100, £29,700 and £21,300. One should still note, however, that the final balance was still £5,200 short of the target (or just under £500 p.a. in annual income) due to the large increase in the annuity cost during 2019.

Realistically, only setting a target over and above the prevailing annuity price during decumulation would one be able to cover this. Hopefully, getting around 97.5% of the desired income would be considered satisfactory though!

Table 9

Adaptive Withdrawal Rates at the 10th Percentile for Decumulation to a Target of Purchasing £20,000 of Annual Real Income from an Annuity using 100% UK Equity with Trend Following and a Glidepath

Year	Years Remaining	Real Return (%)	Annuity Cost Estimate (£)	Annuity Cost (%)	Withdrawal Rate (%)	Start (£)	Withdrawal (£)	End (£)
2000	20	-12.20	152,788	30.56	5.10	500,000	25,500	416,603
2001	19	-1.91	157,729	37.86	4.46	416,603	18,580	390,432
2002	18	-3.73	154,083	39.46	4.40	390,432	17,179	359,315
2003	17	15.07	160,643	44.71	4.06	359,315	14,588	396,669
2004	16	7.73	156,495	39.45	4.62	396,669	18,326	407,594
2005	15	17.49	159,744	39.19	4.82	407,594	19,646	455,790
2006	14	10.34	165,563	36.32	5.37	455,790	24,476	475,913
2007	13	2.42	159,109	33.43	5.88	475,913	27,984	458,785
2008	12	-5.95	160,000	34.87	6.08	458,785	27,894	405,258
2009	11	22.49	170,794	42.14	5.66	405,258	22,938	468,288
2010	10	5.39	161,290	34.44	6.89	468,288	32,265	459,527
2011	9	-10.02	167,364	36.42	7.23	459,527	33,224	383,608
2012	8	-0.16	191,205	49.84	6.05	383,608	23,208	359,814
2013	7	15.39	193,986	53.91	6.07	359,814	21,841	389,974
2014	6	-2.82	175,131	44.91	8.47	389,974	33,031	346,877
2015	5	-7.67	196,496	56.65	7.71	346,877	26,744	295,587
2016	4	9.58	192,164	65.01	7.53	295,587	22,258	299,514
2017	3	1.79	205,975	68.77	9.06	299,514	27,136	277,258
2018	2	-4.55	207,792	74.95	10.71	277,258	29,694	236,306
2019	1	-0.87	206,924	87.57	9.02	236,306	21,315	213,130
2020			218,314			213,130		

The advantage of being cautious at the start of decumulation is that more flexibility is available at this point. For instance, if it looks like the first couple of years withdrawals might be a little low then perhaps there is still the possibility of engaging in some part-time employment.

Clare et al (2019) show that delaying the start of retirement can substantially increase the withdrawal amounts in subsequent years. Working an extra year might be enough to make the following years more comfortable financially.

It is close to a certainty that this is a more practical solution than realising money is tight at age 84 and seeking employment at this juncture. It should be noted that most of our examples thus far have suffered below average returns. In many 20-year periods prior to this, returns would have been much higher and there would have been more substantial cash flows available to retirees. Given the asymmetry previously discussed between too little and too much money, there always must be an erring on the side of conservatism.

To further demonstrate the inexact nature of the problem that one faces, we now replicate Table 8 but this time instead of using UKEQTF we replace it with World Equity with trend following (WEQTF) but still retain the glidepath.

This would intuitively appear to be a more diversified equity portfolio and closer to something used in practice. For context, the real return of WEQTF prior to 2000 was 6.9% and in the period of 2000-19 a somewhat lower 4.2%. Note that the difference between these two returns is considerably less than that of UKEQTF shown in Table 3.

The worked example in Table 10 using WEQTF withdraws at the 25th percentile level. This time we find that returns in the early years, although in aggregate are negative, are less negative than for UKEQTF. To this extent, there is lower drop off in withdrawal rates. There is, however, a big loss absorbed in 2008 which causes sharp decline in the cash flow from £28,400 to £16,100 in the subsequent year. This time the final few years of decumulation proceed relatively smoothly, aided by the glidepath, and there is no drop in withdrawals.

If anything, the last 5 payments are somewhat larger than the average of the previous 15 years. Once again, though, the final balance comes up short of the target. This time the deficit is around £9.8k, again highlighting that the moving cost of the final annuity is difficult to achieve.

Table 10

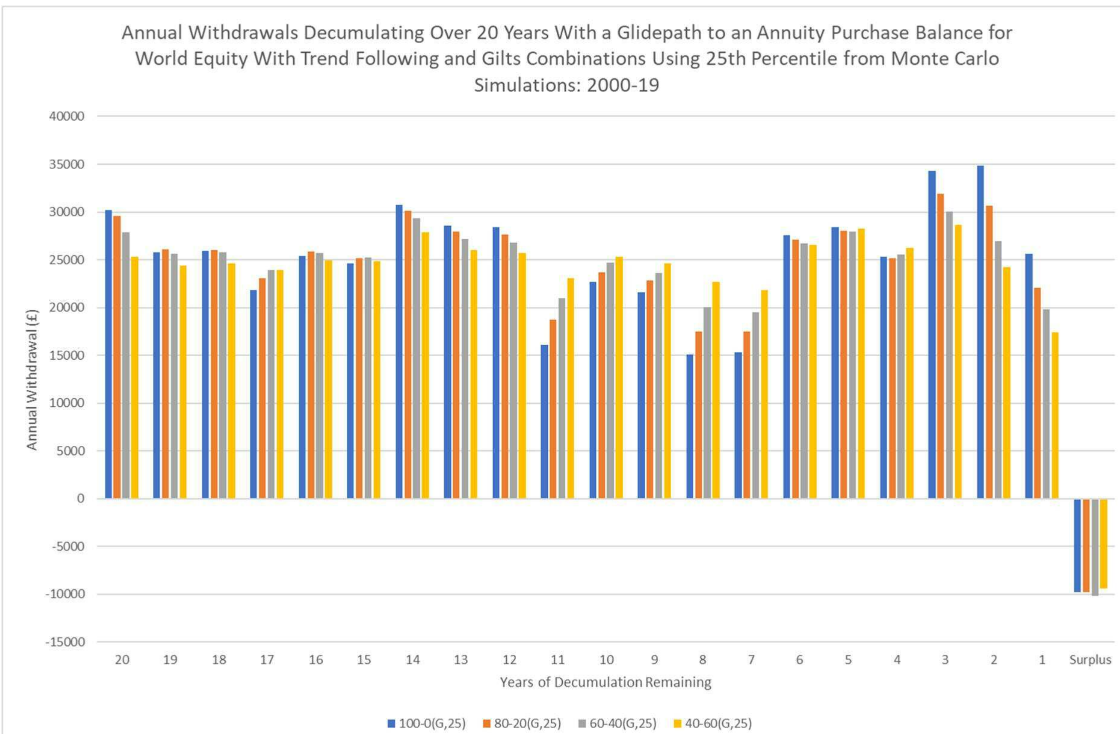
Adaptive Withdrawal Rates at the 25th Percentile for Decumulation to a Target of Purchasing £20,000 of Annual Real Income from an Annuity using 100% World Equity with Trend Following and a Glidepath

Year	Years Remaining	Real Return (%)	Annuity Cost Estimate (£)	Annuity Cost (%)	Withdrawal Rate (%)	Start (£)	Withdrawal (£)	End (£)
2000	20	-4.92	152,788	30.56	6.04	500,000	30,200	446,695
2001	19	4.15	157,729	35.31	5.77	446,695	25,774	438,397
2002	18	-5.04	154,083	35.15	5.91	438,397	25,909	391,705
2003	17	13.53	160,643	41.01	5.58	391,705	21,857	419,904
2004	16	2.62	156,495	37.27	6.05	419,904	25,404	404,855
2005	15	20.38	159,744	39.46	6.09	404,855	24,656	457,688
2006	14	-1.29	165,563	36.17	6.71	457,688	30,711	421,481
2007	13	3.54	159,109	37.75	6.77	421,481	28,534	406,843
2008	12	-20.82	160,000	39.33	6.98	406,843	28,398	299,647
2009	11	19.35	170,794	57.00	5.38	299,647	16,121	338,387
2010	10	2.40	161,290	47.66	6.70	338,387	22,672	323,299
2011	9	-5.43	167,364	51.77	6.67	323,299	21,564	285,363
2012	8	4.49	191,205	67.00	5.29	285,363	15,096	282,404
2013	7	21.74	193,986	68.69	5.42	282,404	15,306	325,177
2014	6	10.28	175,131	53.86	8.47	325,177	27,542	328,239
2015	5	-3.57	196,496	59.86	8.65	328,239	28,393	289,138
2016	4	16.56	192,164	66.46	8.75	289,138	25,300	307,535
2017	3	2.10	205,975	66.98	11.16	307,535	34,321	278,943
2018	2	-3.82	207,792	74.49	12.48	278,943	34,812	234,803
2019	1	-0.31	206,924	88.13	10.92	234,803	25,640	208,511
2020			218,314			208,511		

If one of the issues with this example is that lower interest rates cause a higher than anticipated annuity cost, then it is not unreasonable to consider that one way to partially hedge this risk is by owning some bonds. The downside, as we have seen earlier, is that historically they have offered a lower return than stocks, with or without trend following. That said, the correlation prior to 2000 between WEQTF and GILTS was only 0.27 so there are potentially diversification benefits available too. We have observed earlier that a lower volatility of the investment returns applied to the pot is beneficial in trying to target a balance.

Figure 12 shows the withdrawals for different portfolio combinations of WEQTF and GILTS. We keep the glidepath and the risk level at the 25th percentile. Larger proportions of WEQTF have higher cash flows at the start and end of the period but suffer in the middle portion. This is where larger allocations to bonds do better. As with all our examples, there remains a deficit at the end of accumulation.

Figure 12.



An interesting question that arises from looking at Figure 12 is which of the strategies, with the benefit of hindsight, is the best?

The notion that the total sum of all the withdrawals is a good indicator appears fallacious. If this was the case, then the best strategy would be one that takes no cash flows out along the way and then withdraws 100% at the end (as long as the investment returns were consistently positive). This would be useless as a decumulation strategy though, as the retiree would have no income. Another strategy could have a consistent pay out but if the amount is very meagre compared to that obtained with a small amount of risk then this appears inefficient also.

If the PWR is the ideal amount to take such that one has a consistent income, with the benefit of hindsight from a set of investment returns then deviation away from this path can be considered underperformance.

Achieving withdrawals above the PWR are of little concern and thus it is the values below the benchmark which are of most interest. A reasonable measure would thus be the strategy that has the highest minimum annual withdrawal across the period of decumulation.

Returning to Figure 12 we observe that the 100-0 portfolio has a minimum value of £15,100 with 8 years remaining. The 80-20 portfolio also has its low at this point with a withdrawal of £17,500. One year later the minimum for 60-40 is at £19,500 whilst the final year is the lowest for 40-60 at £17,400.

On this basis, one could make the case that the 60-40 portfolio with trend following was the best performing strategy. It did also have the highest deficit at the end, albeit this was a very small difference relative to the others. If one had chosen a different risk percentile, though, then it is possible another portfolio would have come out on top in terms of highest minimum withdrawal. This does at least provide a measure for comparing decumulation experiences, though.

8. Conclusions and Lessons Learned

We have shown how to use the Perfect Withdrawal Rate to describe sustainable withdrawal options during a turbulent real life 20-year decumulation experience from 2000 in the UK.

In particular, we have found that as risk appetite increases then so does volatility of Perfect Withdrawals. We explore the decumulation towards a fixed real sum after 20 years and show that the larger the sum, the more volatile the withdrawals possible in general and particularly for the last few years of decumulation. The solution we suggest to reduce such variability is to increase the percentage in cash gradually over the last 5 years or so, in the form of a glidepath and we show simulations to that effect.

Finally, instead of targeting a fixed real sum at the end of 20 years we target a delayed annuity purchase to generate a pre-set level of real income; this is a moving target as interest rates change over time. Again, there is interaction between risk appetite, the size of the annuity and volatility of withdrawals.

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