The Lifetime Sequence of Returns:
A Retirement Planning Conundrum

By

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Abstract

Individual investors are extremely vulnerable to the sequence of market returns experienced over their investing lifetimes. Individuals who behave exactly the same over their careers, saving the same percentage of the same salary for the same number of years, can otherwise experience very different outcomes based solely upon the specific sequence of investment returns which accompanies their career and retirement. The vulnerability reaches its peak at the retirement date, as this is the point in which a return to employment becomes increasingly difficult and a post-retirement market drop can be devastating. Actual wealth accumulations and sustainable withdrawal rates will vary substantially for different retirees, as these outcomes depend disproportionately on the shorter sequence of returns just before and after the retirement date.

Introduction

As individuals face heightened demands to make preparations for their own retirements, an important and difficult question regards determining how much to save. This article provides a simple model which demonstrates the surprising extent of the vulnerability individuals face when planning their retirement. The novelty in this article is to illustrate this vulnerability through the use of overlapping simulations from one series of Monte Carlo returns and also to quantify the degree of dependence between planning outcomes and market returns at different points in the lifecycle. This allows for a visual representation of the degree in which wealth accumulations and sustainable withdrawal rates may rise and fall over time, as the results are overly dependent on the returns experienced near the end of the working phase and the beginning of the retirement phase for individuals who otherwise behave the same and earn investment returns from the same underlying distribution. This variation is greater than one may suspect since it is the shorter sequence of returns before and after the retirement date which have the disproportionate impact on the overall results.

Individuals are vulnerable to what happens when their wealth is the largest in absolute terms. The sequence of returns creates significant risks for individuals. Cotton (2013)[1] notes that sequence risk is not rewarded by the markets and is not diversifiable at the individual level. Two investors may enjoy the same average return on the investments in their portfolio, but may still experience very different outcomes on account of the sequence in which these returns arrive. This can impact both those who are saving and contributing to their portfolio, and those who are withdrawing a constant stream of cash flows from their portfolio. After explaining these details, the emphasis shifts toward providing potential solutions within the realm of financial planning for sequence of returns risk.

Methodology

Though using historical simulations based on overlapping periods could be an alternative, the Monte Carlo simulation framework used here is designed to demonstrate the vulnerability individual investors face regarding the sequence of returns over their investing lifetime while ensuring that returns come from an indentical underlying distribution. Overlapping periods are analyzed for 500 individuals over a hypothetical 530 year timeframe. The only unknowns these hypothetical individuals face with regard to their retirement planning is what their specific sequence of returns will be. This simplifies from reality as individuals do not experience uncertainty with regard to their future employment status and salary. The underlying return distribution has an arithmetic average of 7% with a 20% standard deviation, corresponding roughly to the historical behavior of the U.S. S&P 500. The average compounding return is 5%.

The individual saves for retirement during the final 30 years of work, and he or she earns a constant real income in each of these years. A fixed savings rate of 15% is the fraction of this income saved at the end of each of the 30 years. The wealth accumulation achieved at retirement is defined as a multiple of this individual's constant real salary. In other words, if the wealth accumulation is 10, then the individual had savings equal to 10 times their salary upon reaching retirement. In this simplified world, individuals do not worry about health risks, disability, or potential involuntary job loss. They are able to continue work over the subsequent 30 years earning a constant inflation-adjusted salary.

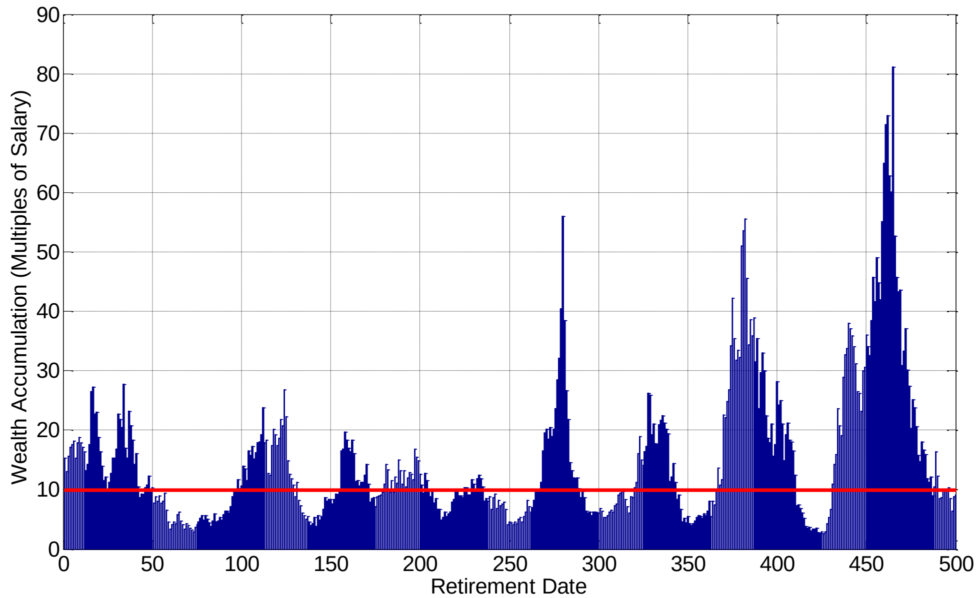
Retirement begins at the start of the 31st year, and the retirement period lasts for 30 years. Withdrawals are made at the beginning of each year during retirement. The withdrawal amount is defined as the percentage of retirement date assets withdrawn, and this amount adjusts for inflation in subsequent years. The maximum sustainable withdrawal rate over 30 years is the initial percentage of assets withdrawn in the first year, with that amount adjusted for inflation in subsequent years, such that the portfolio balance reaches zero at the end of the 30th year of retirement. Portfolio administrative and planning fees are not charged, and taxes are not deducted.

Results

With a fixed 5% compounded return and no volatility, the 15% savings rate would result in retirement date wealth equal to 10 times salary. Figure 1 shows the amounts which 500 individuals accumulate after 30 years with the overlapping market return data generated by Monte Carlo simulations. Though they could expect wealth equal to 10x their salary, the outcomes ranged from a minimum of 2.6x to a maximum of 81.1x. The median accumulation was 11.2x and the mean, being pulled upwards by positive outliers, was 15x. These are very different outcomes, again, for individuals who otherwise behaved the same and earned returns from the same underlying distribution.

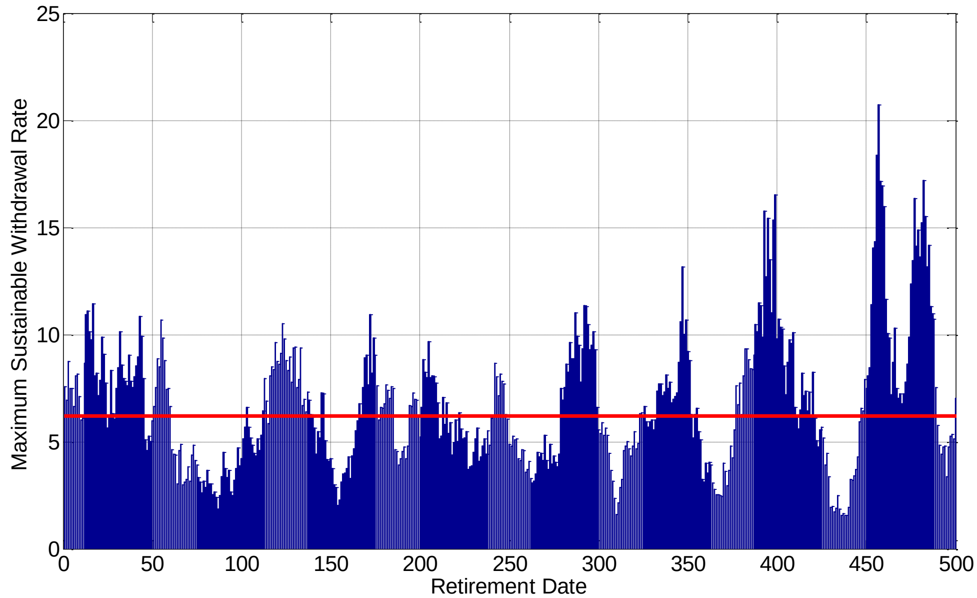
Furthermore, individuals whose careers largely overlap may still experience very different outcomes, as can be seen by following the course of accumulations in Figure 1. The figure shows an almost cyclically pattern over time, and this can be explained by the random appearance of large positive or negative returns which play an increasing role as they arrive later in careers. Bernstein (2012)[2] introduced the idea of waterfalls to describe the large drops in wealth accumulations that may follow wealth peaks, explaining how some individuals might unwittingly just miss their opportunity to reach their wealth target after 30 years, and subsequently may find that working for 50 or 60 years does not get them to where they had hoped to be. This is sequence of returns risk in the context of the accumulation phase, as people are more vulnerable to the returns experienced when their portfolios are larger. A given percentage change has a bigger impact on absolute wealth, and a large drop in the portfolio value could counterbalance all of the capital gains earned for most of the early part of one's career.

Figure 1
Wealth Accumulation After a 30-Year Career



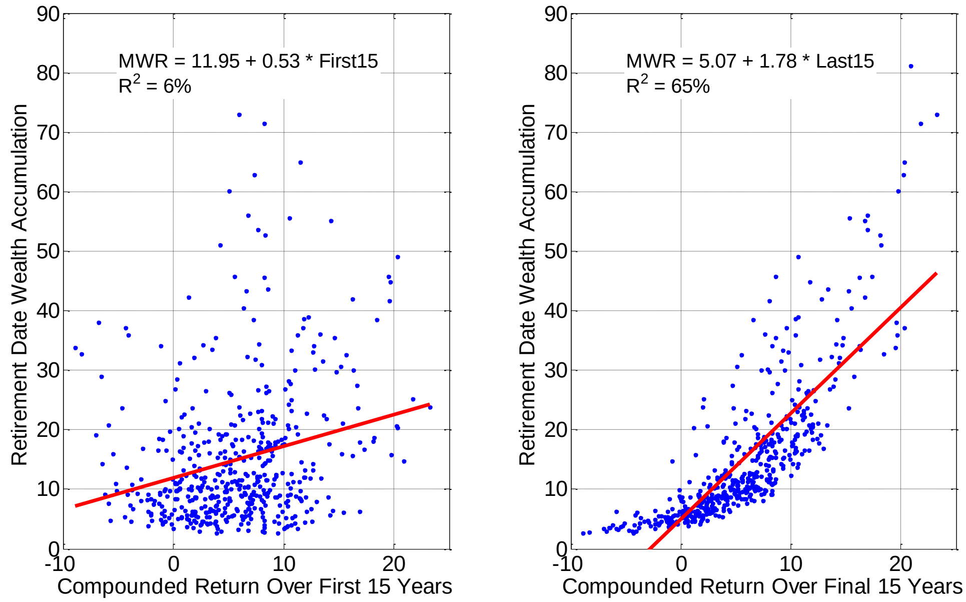
The sequence of returns problem also applies in retirement, perhaps even more strongly, if retirees are using a constant inflation-adjusted withdrawal strategy. With compounded returns of 5%, a retiree could expect to withdraw 6.2% of their retirement date assets, adjust this for inflation, and have their wealth last for precisely 30 years. But because of return volatility, the actual maximum sustainable withdrawal rates experienced vary greatly over time. In Figure 2, sustainable withdrawal rates for these 500 individuals ranged from 1.6% to 20.7%, with a median of 6.3% and a mean of 6.7%. These vastly different sustainable withdrawal rates for different retirees experienced over 30-years varied so greatly for reasons based simply on the luck of the draw regarding the post-retirement return sequence.

Figure 2
Maximum Sustainable Withdrawal Rates Over 30-Year Retirement Periods



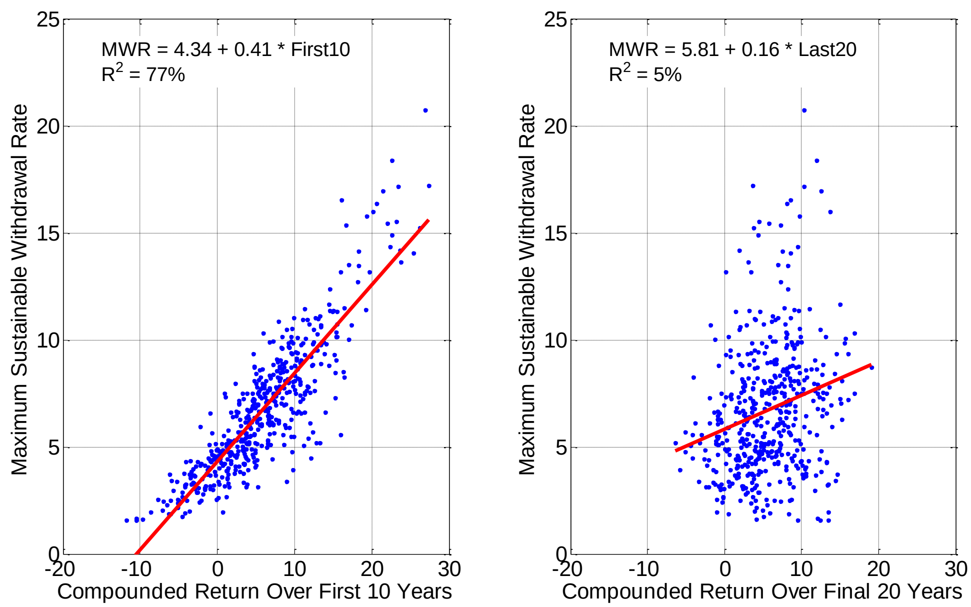
The next set of figures attempt to illustrate more clearly about how sequence of returns risk impacts both the accumulation and distribution phases. These figures are based on simple regressions which determine how much of the outcome (wealth accumulation or sustainable withdrawal rate) can be explained by the returns experienced over different sub-periods within the 30-year timeframes. In Figure 3, the compounded return experienced in the first 15 years and the compounded return experienced in the last 15 years are both plotted against the retirement date wealth accumulations for the 500 simulations shown in the previous figures. A fitted regression line is included, and what we observe is that the compounded return in the first 15 years explains 6% of the final wealth accumulation, while the compounded return in the last 15 years explains 65% of the wealth accumulation.

Figure 3
Wealth Accumulation: Explanatory Power of Early and Late Returns



Meanwhile, Figure 4 demonstrates how the situation reverses in the distribution phase. The compounded return in the first 10 years of retirement can actually explain 77% of the final retirement outcome, while the compounded return over the financial 20 years explains only 5% of the outcome.

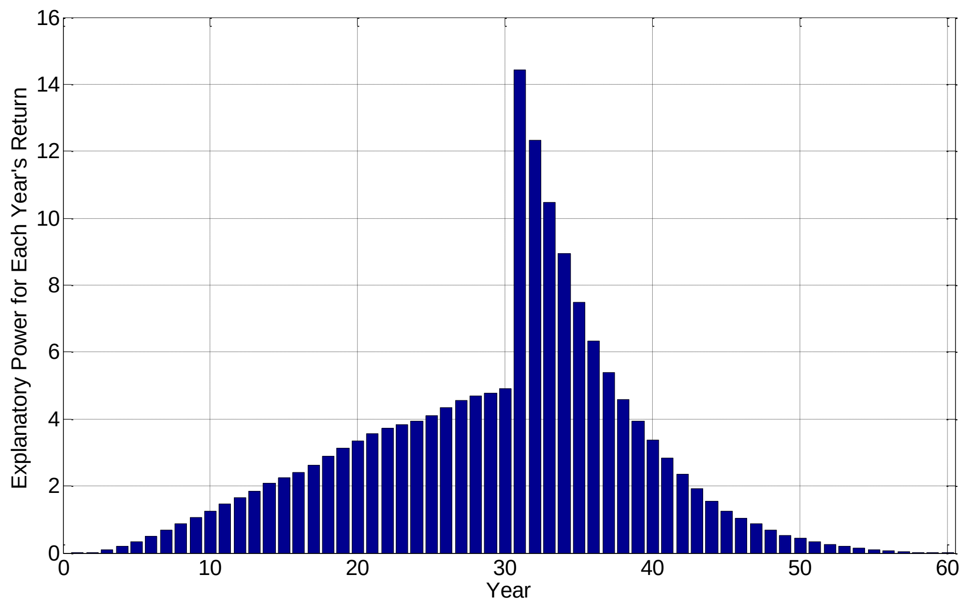
Figure 4
Withdrawal Rates: Explanatory Power of Early and Late Returns



Finally, Figure 5 further isolates the impact of each year's return on lifetime outcomes using a larger sample of 100,000 Monte Carlo simulations from the same distribution. For the first 30 years when individuals are saving, the percentage of the final wealth accumulation at the retirement date which can be explained by each annual investment return grows from year 1 through year 30. With wealth accumulations so low in the early part of one's career, the early returns have very little impact on the absolute level of wealth accumulated at the end of the savings period. But as retirement approaches, a given percentage return produces an increasing impact on the final wealth value in absolute terms, leaving individuals particularly vulnerable to these later returns.

As for years 31-60, the individual has entered the distribution phase, and the figure shows the impact of each year's return on the maximum sustainable withdrawal rate experienced by retirees. The return in year 31 represents the first year of retirement, and the result in this first year explains more than 14% of the final outcome for retirees. Retirees are very vulnerable to what happens just after they retire. This result would hold even more so in reality when we incorporate human capital considerations, as it becomes increasingly difficult to return to the workforce once one has retired. Sustainable withdrawal rates are disproportationately explained by what happens in the early part of retirement.

Figure 5
Lifetime Sequence of Returns Risk



Potential Solutions for Sequence of Returns Risk

In retirement, withdrawing a constant inflation-adjusted amount from a portfolio of volatile assets is an inefficient retirement income strategy. Numerous researchers have illustrated this point, including Milevsky and Huang (2010)[3], Sun and Webb (2012)[4], Pfau (2012)[5], and Blanchett, Kowara, and Chen (2012)[6]. An explanation for this inefficiency is that this strategy heightens exposure to sequence of returns risk which offers no potential reward to investors.

Cotton (2013) notes, however, that much like a lump-sum investment in the accumulation phase, a strategy of withdrawing a constant percentage of remaining assets does not result in any sequence of returns risk. Alternatively, a portfolio which is not exposed to volatility does not create sequence of returns risk. Essentially, individuals should not expect constant spending from a volatile portfolio. Those who want upside (and, thus, accept volatility) should be flexible with their spending and should make adjustments. Individual solutions to sequence of returns risk in retirement include some combination of reducing portfolio volatility and allowing spending to vary in response to market performance.

As for varying spending in response to market performance, various approaches are discussed in Sun and Webb (2012), Pfau (2012), and Blanchett, Kowara, and Chen (2012). Possibilities include spending a constant percentage of remaining assets each year, and using the Internal Revenue Service percentage rules for Required Minimum Distributions. The most sophisticated approach is provided by Blanchett, Kowara, and Chen (2012), who describe a mortality updating constant probability of failure model in which the withdrawal percentage used each year is calibrated to maintain a constant probability of failure with regarding to the evolving remaining life expectancy as a retirement progresses.

Alternatively, there are various ways for retirees to reduce volatility, at least on the downside. Spending could be kept constant if the portfolio is de-risked. To really get constant spending, one should be looking to hold fixed income assets to maturity or to use risk-pooling assets like annuities. Other approaches which reduce the downside risk (volatility in the undesired direction) could also be considered. Financial derivatives or income guarantee riders can be used to put a floor on how low a portfolio may fall by sacrificing some potential upside. Pfau and Kitces (2013)[7] also describe how the use of a rising equity glidepath in retirement with an even lower than typically recommended (at least in the safe withdrawal rate research literature) equity allocation at the start of retirement can reduce the probability and the magnitude of retirement failures. This approach reduces vulnerability to early retirement stock market declines which cause the most harm to retirees.

In the accumulation phase, it is more difficult to protect from sequence of returns risk to the extent that people continue to save throughout their careers and are most likely unable to invest only a lump sum, or a constant percentage of their financial wealth instead of a constant percent of their salary. Individuals are most exposed to the largest absolute losses of wealth when their portfolios are the largest. In this regard, the declining equity glidepaths offered by lifecycle asset allocation funds provide a potential solution, and Pfau (2010)[8] and Pfau (2011b)[9] find evidence for their advisability for conservative individuals. Likewise, using financial derivatives to protect against portfolio declines in the final stages of an individual's career can provide an alternative solution as well.

Another possibility is to make the link between the pre- and post-retirement periods as is done in Pfau (2011a)[10] and Pfau and Kariastanto (2012)[11]. The "safe saving rate" approach focuses on using a consistent savings strategy and eliminates the need to worry about wealth accumulations and withdrawal rates. This strategy works better if there is a tendency for mean reversion in the markets, which is observable historically but is not incorporated into the Monte Carlo simulations. Low sustainable withdrawal rates tend to follow bull markets, and high sustainable withdrawal rates tend to follow bear markets, and by linking pre- and post- retirement together, the mean reversion cancels some of the sequence of returns risk. Low wealth accumulations will typically not be followed by low withdrawal rates, and vice versa.

A final relevant consideration is that defined-benefit pensions provide a way to pool the sequence of returns risk across separate birth cohorts, reducing this exposure for individuals. Individuals are entitled to benefits based upon their contributions into the system and not on the specific market performance that overlaps with their careers. With defined-benefit pensions, some individuals, who are otherwise the same in terms of their work efforts and contributions, will receive less than they could have otherwise earned by investing on their own, but other individuals receive more. In this regard, defined-benefit pensions are essentially a separate asset class which most investors should find very valuable, as the pension does provide a way to diversify their specific sequence of returns across time and to collect a benefit defined based more closely on the average returns over long periods. Reform of defined-benefit pensions, including Social Security, should be taken in terms of making sure their parameters are sustainable, and efforts to convert existing defined-benefit pensions into defined-contribution pensions should proceed with extreme caution.

Conclusion

Sequence of returns risk affect individuals over their entire investing lifetime. Individuals from different birth cohorts who otherwise behave in identical ways may still experience dramatically different wealth accumulations and sustainable withdrawal rates. These are outcomes which individuals will not know in advance. For these reasons, strategies to use a volatile portfolio to target a wealth accumulation goal or to sustain a constant spending strategy expose individuals to much greater risk than one might expect when looking at the case of someone investing over a sixty year time horizon.

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