QS Investors

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QS DRIVE: Your Roadmap in Retirement

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"The man who dies rich, dies disgraced"
Andrew Carnegie

EXECUTIVE SUMMARY

- The historical fear of running out of money in retirement is real. Yet retirees that have prudently planned for their retirement typically do not come close to running out of money, even twenty years into their retirement.[2]
- This points to a problem: the paralysis caused by the fear of running out of money prevents retirees from maximizing spending and fully enjoying their retirement.[3]
- QS Dynamic Retirement Investment Vehicle ("DRIVE") provides a personalized retirement strategy comprising an asset allocation and spending recommendation, recognizing the interconnectivity between these two outputs.
- Investors behave in biased ways that typically lead to suboptimal outcomes – for instance, derisking when markets are down and adding risk when they are up. The systematic nature of DRIVE does the opposite, thus limiting these behavioral shortcomings.
- DRIVE's dynamic framework has the ability to update its results after accounting for evolving market conditions and changes to one's life circumstances, such as a change in wealth or unexpected healthcare costs. DRIVE's allocation and spending advice is therefore adjusted to each retiree's real-life personal circumstances, as they occur. This is a powerful combination!

A classic Jerry Seinfeld joke observes that people's greatest fear in life is public speaking, and that their second greatest fear is death. Thus, the joke concludes, people would rather be in the casket than giving the eulogy! In reality, surveys conclude that a retiree's greatest fear is not death, but running out of money before death.[4] The increasing cost of health and elder care,[5] coupled with the well-known fact that people are living longer today than in the past, suggest that the fear of running out of money is well founded. At the core of this fear, which is referred to as *longevity risk*, is the frightening proposition of either becoming a financial burden to loved ones – typically a retiree's children or even grandchildren – or simply having no resources. In contrast to the concern of running out of savings, individuals in retirement also desire to maximize the enjoyment of their post-retirement years. Living longer, healthier lives should be coupled with an increased ability to maintain an active lifestyle that likely includes travel, strengthening familial relationships, and pursuing passions and interests.

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[2] Source: Employee Benefit Research Institute ("EBRI") estimates based on Health & Retirement Study (HRS, 1992-2014). Consumption and Activities Mail Survey (CAMS, 2005-2015).

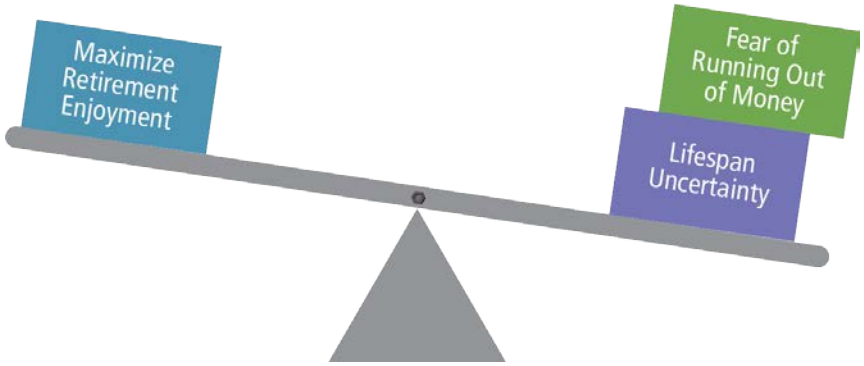
[3] Numerous retirement studies exist that have reached a variety of conclusions regarding retirement outcomes. We find the EBRI study persuasive and note that this outcome – refraining from spending savings when fearing wealth depletion – is a natural expectation of retiree behavior.

[4] https://www.aicpa.org/press/pressreleases/2019/going-broke-remains-top-concern-in-retirement.html.

[5] Elder care encompasses everything from assisted living and nursing care to adult day care, home care, and even hospice care.

Thus, the retiree's challenge ultimately results from the tension among three main features of retirement: 1) the desire to maximize one's enjoyment in retirement; 2) the daunting uncertainty around our lifespan; and 3) the fear of running out of money before one's death. These three factors play a critical role in determining how an individual spends his or her assets during retirement – a process known as decumulation.

EXHIBIT 1: THE RETIREMENT CHALLENGE



Very few of us know how much to spend or how to invest during retirement. DRIVE helps to solve these problems.

In this paper, we help retirees find a custom solution for this challenge. Our systematic approach limits the influence of behavioral biases in this critical financial decision by offering a dynamic, customized asset allocation and an annual spending recommendation. The dynamic nature of the DRIVE framework has the flexibility to incorporate inevitable changes to life circumstances such as a change in wealth or unexpected healthcare costs.

Furthermore, research has shown[6] that a retiree's health and longevity are strongly tied to factors such as community involvement and sociability. Thus, the objectives that underpin our framework, maximizing spending potential while maintaining resources throughout life, may extend beyond consumption for its own sake. In particular, when the ability to spend during retirement drives engagement and purpose-filled living, it may have the added effect of improving cognitive health, reducing illness, and increasing the ability to thrive during retirement.

What is Decumulation?

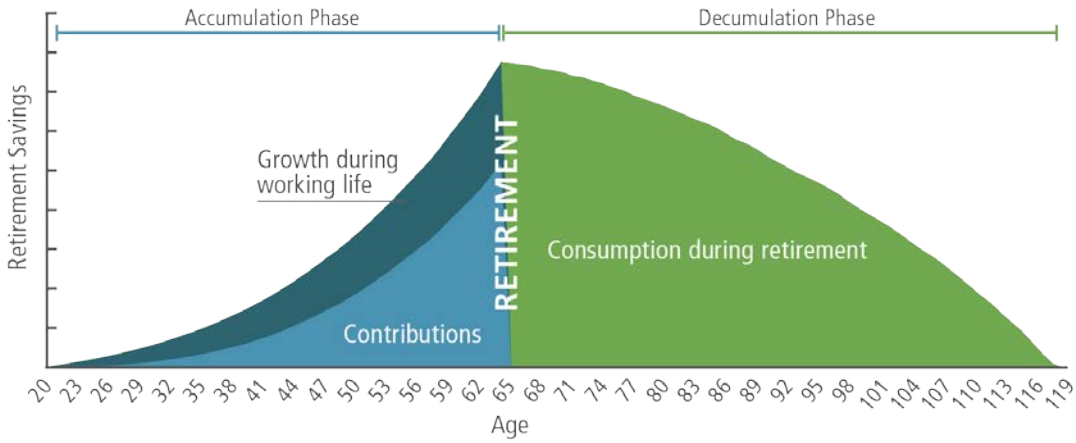
Decumulation, in the context of retirement investing, refers to the process of converting lifetime savings into income and spending this income during retirement. It is quite literally the opposite of the accumulation phase, which refers to the period of saving and investment up to the point of one's retirement. A comprehensive decumulation plan should go beyond spending one's nest egg – it should also include a prudent plan to continue to generate income post retirement.

Prior to retirement, the accumulation phase of investing dominates our attention – and rightly so, we should be concerned about adequately saving for our retirement. However, the decumulation challenge is equally critical and in some ways more perplexing than the accumulation objective. While most of us know

[6] Stanford Center for Longevity. https://www.nytimes.com/2018/01/29/upshot/early-retirement-longevity-health-wellness.html.

the approximate age we will likely retire from work, very few know how long we will live in retirement and how much money we will need to sustain living standards during retirement.

EXHIBIT 2: ILLUSTRATIVE EXAMPLE OF ACCUMULATION VS. DECUMULATION



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Why Does the Decumulation Problem Exist Today?

The current generation of American retirees is the first to rely on a DC plan as their primary means for retirement spending.

Decumulation is a challenge prior generations of retirees faced less frequently, or not at all. Changes in the workplace, in addition to significant reforms in the pension system, have led to the decline of the defined benefit ("DB") pension plan. Coupled with the rapid increase in life expectancy[7] that has occurred over the past thirty years, decumulation has risen to the forefront of challenges facing all individuals. In 1960, the average American male entering retirement at the age of 65 expected to live for another thirteen years.[8] They typically received sufficient guaranteed income from social security and DB pension plan payments until the time of their death. With the creation of the defined contribution ("DC") plan in 1978, the popular 401k plan has since dominated the retirement landscape. Today, only 17% of Americans have access to a defined benefit pension plan,[9] and we expect this decline to continue as plan sponsors find their liabilities harder to manage. This makes the current generation of American retirees the first to rely on a DC plan as their primary means for retirement spending.

The flexible nature of DC plans gives individuals a great amount of control over their retirement savings but also generates unique problems, namely:

- Lack of a fixed, guaranteed, recurring payment provided throughout an individual's lifetime
- Dramatically varying individual account balances at retirement driven by:
    1. Differing annual contribution rates
    2. Volatility in investment performance due to the timing of plan investment, asset allocation decisions, and underlying fund or manager results

[7] U.S. Census Bureau.
[8] OECD (Organisation for Economic Co-operation and Development).
[9] U.S. Bureau of Labor Statistics.

Thus, while the evolution of retirement planning from DB to DC plans may have its benefits, it has also resulted in varying states of retirement readiness among participants.

REVIEW OF EXISTING DECUMULATION SOLUTIONS: (February 2020)

There is no shortage of accumulation savings products in the retirement market. Dozens of target date fund solutions exist alongside numerous variable and fixed annuity products. However, there are far fewer stand-alone decumulation investment products than those specifically targeting accumulation. A survey of this landscape returns a fragmented picture that includes a combination of the following tools and features:

▪ Retirement Calculators	▪ Managed Payout Funds	▪ Managed Accounts
▪ De-risking Model Portfolios	▪ Deferred and Immediate Annuities	▪ Target Date Funds
▪ Insurance-Based Riders such as GMWBs (guaranteed minimum withdrawal benefits)		

While many of these features have merit, there are relatively few comprehensive offerings that are adaptive to the market, tailored to an individual's unique circumstances, and offer recommendations for asset allocation and spending.

What are the Existing Market Solutions?

The most well-known decumulation methodology in today's retirement planning landscape is known as the 4% rule. This rule recommends a retiree withdraw 4% of their initial retirement balance each year during retirement, however long this period may be.

The 4% rule is simple to understand and execute, but it has a number of shortcomings. It takes a "rule of thumb" approach that is designed to meet the needs of an "average" investor. As a result, it is engineered to provide a satisfactory outcome only when we experience an "average" investment outcome. The 4% rule lacks any consideration for longevity expectations and also suffers from a static approach that does not adapt to changes in the retiree's wealth over time. Additional drawbacks include:

- Does not consider an individual's wealth and guaranteed income (i.e., social security, annuity, and defined benefit payments)
- Not customized to an individual's risk preferences
- Does not incorporate utility theory (see Technical Note below)
- Does not adjust to changes in market performance

Another frequently used decumulation tactic is called the replacement ratio. To determine an appropriate retirement income target, retirees attempt to generate 70% of their final pre-retirement earnings. For example, if an individual earned $100,000 annually in his or her final working years, he or she would hope to maintain $70,000 per year in retirement income. We can supplement this aspirational goal by informing a retiree what is realistically attainable in retirement and provide a roadmap for a retiree who may currently fall short of retirement savings goals such as 70% income replacement.

A Better Approach: Our Proprietary DRIVE Decumulation Methodology

DRIVE stands for **Dynamic Retirement Investment Vehicle**. It is an asset allocation and spending framework designed to help retirees get the most out of their retirement. It does so by dynamically adjusting the investor's asset allocation and spending recommendations in order to maximize his or her consumption over time. This goal is distinctly different from the concept of wealth maximization, which emphasizes only wealth generation, harkening back to the famous Andrew Carnegie quote "the man who dies rich, dies disgraced."

Technical Note:

Dynamic Programming

We employ dynamic programming and a multi-period optimization to solve for the optimal consumption and asset mix. The framework solves this optimization problem recursively. For each age and wealth level, an optimal combination of consumption, equity, bond, and cash allocations is determined such that the cumulative utility from age t to 120 is maximized.* It is also integral to ensure that outcomes adhere to intuitive, real-world preferences that also respect neoclassical economic theory.

Diminishing Marginal Utility

Critically, we place significance on how the law of diminishing marginal utility informs the concept of balanced spending over time. Diminishing marginal utility dictates that each additional dollar spent on similar items or services provides less utility (or value). Since marginal utility decreases as one's consumption increases, we recognize the benefit in having relatively stable consumption patterns over time in real dollars. In other words, to maximize lifetime utility, rather than overspending today, one should save some consumption for the future. These concepts are cornerstones of modern economic theory but are often overlooked in the popular decumulation frameworks, highlighting another way in which over-simplification yields a sub-optimal and unintuitive result.

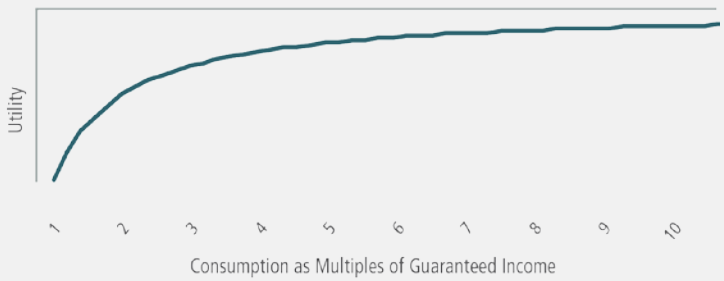
Maximize Power Law Utility

$$U_t = \frac{C_t^{1-\lambda}}{1-\lambda}$$

$$U_{bequest,t} = \frac{W_{t+1}^{1-\lambda}}{1-\lambda}$$

Where:
C_t = consumption at time t
W_t = remaining wealth at time t

Marginal Utility Decreases with Additional Dollars Spent



*While our research does not assume that most individuals will reach the age of 120, we utilize this age based on the observation of maximum lifespan.

In addition to an optimal asset allocation recommendation, DRIVE also provides an annual spending recommendation. The framework strives to maximize consumption while minimizing the likelihood of portfolio exhaustion. Its benefits versus existing, commonly used decumulation methodologies are twofold. First, DRIVE is customized to account for critical variables including age, gender, current wealth, and current sources of guaranteed income including social security, annuities, and DB plans. Secondly, DRIVE is dynamic, meaning the framework adjusts regularly not only to changes in a person's circumstances but also to external events, namely market volatility. Through DRIVE, retirees can enjoy a superior, personalized retirement strategy that can be tailored to their unique circumstances.

As one might expect, the combination of attention to individual circumstances and how these change over time dramatically elevates the certainty of attaining one's goals during one's post-retirement years.

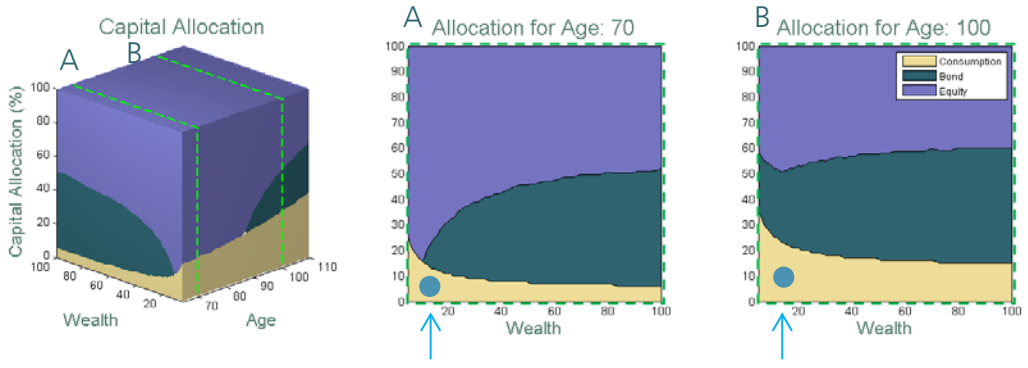
The framework strives to maximize consumption while minimizing the likelihood of portfolio exhaustion.

What are DRIVE'S Key Takeaways?

DRIVE maps an individual's age and wealth to the optimal equity allocation and spending amount. This is an enhancement to the traditional glide path, which bases an asset allocation solely upon age. The charts below demonstrate the optimal consumption and asset allocation output across age and wealth resulting from hypothetical portfolio simulations. The two-dimensional charts are cross sections of the three-dimensional charts, holding age constant (top charts) and wealth constant (bottom charts).

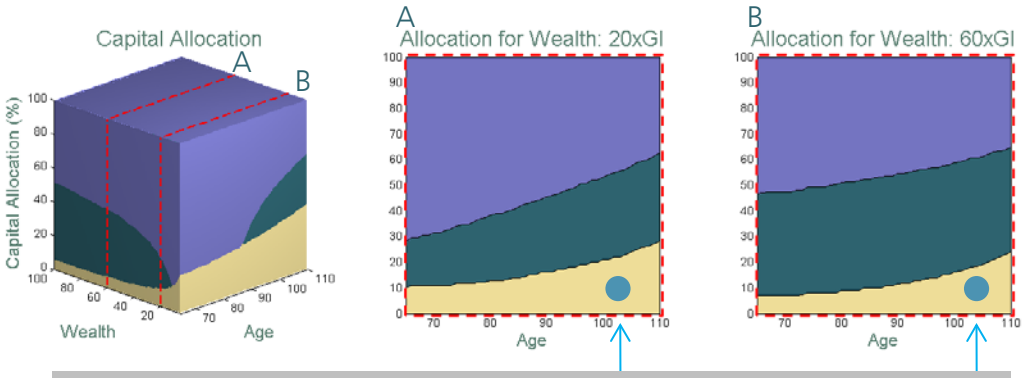
In DRIVE, we define wealth as a retiree's ratio of total wealth to annual guaranteed income.[10] Thus, an individual who has $400,000 of total wealth and receives $20,000 of annual guaranteed income has a wealth level of 20.

EXHIBIT 3: SIMULATED CONSUMPTION AND ASSET ALLOCATION ACROSS AGE AND WEALTH



At lower levels of wealth to guaranteed income, DRIVE calls for higher relative equity exposure. This allocation to equities balances an investor's higher relative exposure to the stability of guaranteed income. This may help those who have struggled to meet adequate savings goals to continue to grow their assets. As a retiree's wealth to guaranteed income ratio rises, DRIVE recommends decreasing levels of consumption as a percentage of their wealth.

[10] Sources of guaranteed income include social security, annuity and defined benefit payments.



As a person approaches the end of his or her life expectancy, a more conservative asset allocation is often appropriate, all else equal. As the present value of future guaranteed income drops, an increase in bonds balances this decrease in embedded stability.

Asset Allocation Calls to Action:

Through DRIVE, we find that individuals with lower wealth to guaranteed income should have a greater allocation to risky assets, such as equities, compared to a wealthier individual, all else equal. Guaranteed income serves as a safe haven asset. Therefore, as guaranteed income comprises a larger proportion of a lower wealth individual's overall financial profile, such individuals can afford to take more investment risk. For an individual with higher wealth to guaranteed income, the opposite applies. These individuals have less guaranteed income as a proportion of their overall financial profile and therefore must increase allocations to bonds in order to strike the right balance between financial risk and stability.

We challenge retirement "conventional wisdom" – the notion that retirees should hold modest equity allocations. Individuals with low savings who rely primarily on guaranteed income to meet their spending needs should consider higher equity allocations as the expected volatility of their *lifetime wealth* (which includes guaranteed income) is relatively low. This exposure to the higher return potential of equities may benefit these individuals, as they may spend 35 years or more in retirement.[11]

DRIVE calls for a higher allocation to fixed income and cash for older investors, all else equal. As the investor advances in age, the present value of his or her guaranteed income declines; the portfolio responds to this change by reducing equity exposure in favor of fixed income. This result conforms to traditional glide path approaches: as an individual's life expectancy declines, the need for an asset allocation capable of generating higher returns (i.e., a stock-based portfolio) declines as well.

Consumption Calls to Action:

Holding age constant, the framework dictates that a less wealthy individual should spend more as a percentage of his or her investable wealth. Lower wealth to guaranteed income individuals derive a greater amount of their lifetime consumption from predictable, guaranteed income payments, resulting in a greater proportion of wealth (including guaranteed income) to be spent each year. An individual with more wealth to guaranteed income has a greater budget to grow, rather than spend his or her assets.

Holding wealth constant, DRIVE calls for greater annual consumption, in percentage terms, as one ages. With fewer years left to live and lower account balances remaining, the framework encourages

[11] These simulations have the goal of maximizing lifetime consumption. For information on how DRIVE can incorporate goals such as leaving an inheritance, please see the note in this paper titled "Inheritance and Unexpected Costs: Special Challenges in Retirement."

an individual to spend a greater portion of his or her remaining wealth as both the risk of portfolio depletion and future spending needs declines.

Inheritance and Unexpected Costs: Special Challenges in Retirement

Leaving an inheritance and dealing with unexpected financial burdens, especially related to healthcare, are important topics in retirement planning.

DRIVE can incorporate an inheritance goal into a retiree's consumption recommendation in multiple ways. The framework can define the inheritance expectation as part of consumption or an individual can segregate inheritance assets from the primary portfolio intended to sustain the retiree throughout his or her retirement. Either of these actions can allow a retiree to maximize consumption while still fulfilling an inheritance goal.

Significant, unexpected costs, which for retirees typically include treating a health issue and the long-term care associated with it, is viewed in the DRIVE framework as an unknown future expense. Similar to longevity risk (addressed in greater detail in our next white paper), we recommend hedging these risks by converting unknown future costs into known costs today. This can be accomplished through purchasing specialty insurance, such as long term care or chronic illness insurance.

Without insuring these risks, DRIVE still offers distinct value. Following a significant financial burden such as a hospitalization, DRIVE dynamically adjusts future consumption to account for this expense in the same way it does for market drawdowns.

DRIVE takes into account a person's preference to bequeath his or her assets.

Benefits Over a Lifetime: An Illustration of the Retirement Experience from 1983 – 2017

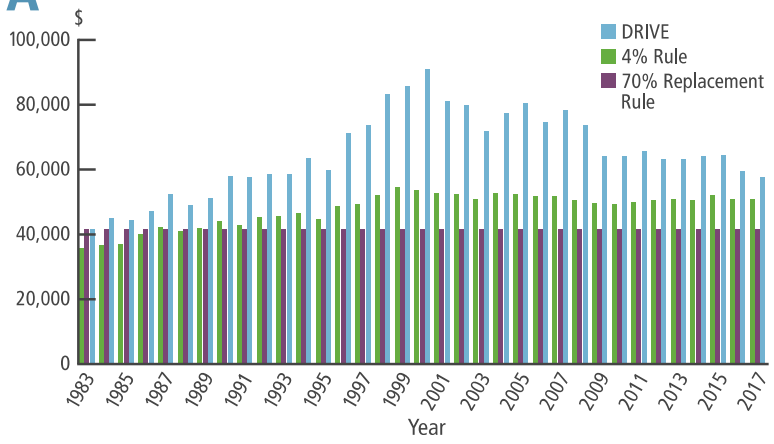
The long-term benefits of the DRIVE approach come to life in this historical case study. In the charts below, we analyze the output for a hypothetical individual utilizing the DRIVE methodology versus the 4% rule and the 70% replacement ratio rule. Our backtest analyzes **Barbara**'s retirement roadmap, a woman who spent 35 years in retirement beginning at the age of 65 in 1983. Barbara retired with $400,000 in retirement savings and received guaranteed income of $20,000 annually from social security benefits. Below we examine how DRIVE would have shaped her asset allocation and spending in retirement versus alternative decumulation strategies. All results presented are in inflation adjusted, real-dollar values.

EXHIBIT 4: HYPOTHETICAL DRIVE SOLUTION CASE STUDY: PERIOD 1983–2017*

BARBARA

AGE IN RETIREMENT	INITIAL WEALTH	BENCHMARK CONSUMPTION RULES
65-100	$400,000	4% Rule & 70% Replacement Rule
GENDER	**GUARANTEED ANNUAL INCOME**	**SALARY AT RETIREMENT**
Female	$20,000	$60,000

A ANNUAL CONSUMPTION



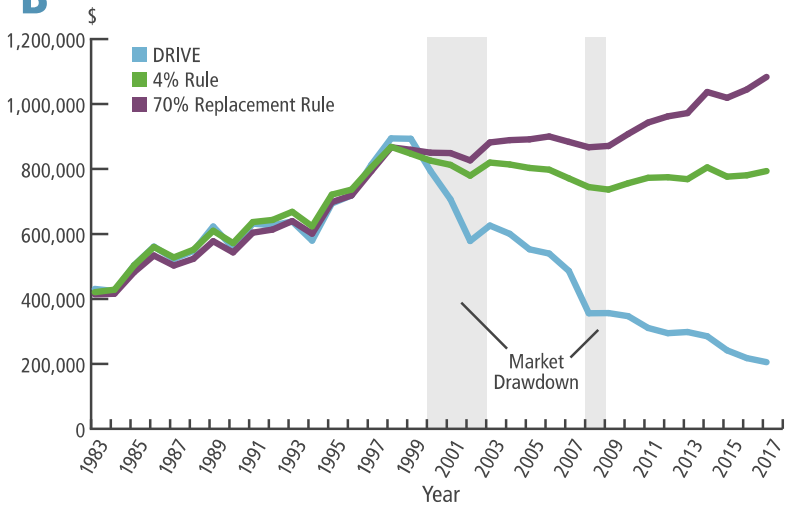
DRIVE offers a greater cumulative consumption over Barbara's retirement compared to the 4% rule and 70% replacement rule.

i. DRIVE: $2,291,320
ii. 4% Rule: $1,684,041
ii. 70% Replacement Rule: $1,470,000

Relative to the 4% Rule, DRIVE called for greater spending in the early years of Barbara's retirement (65 – 74 years old) — a time when she is likely more active and mobile.

i. DRIVE: $508,580
ii. 4% Rule: $409,881
ii. 70% Replacement Rule: $420,000

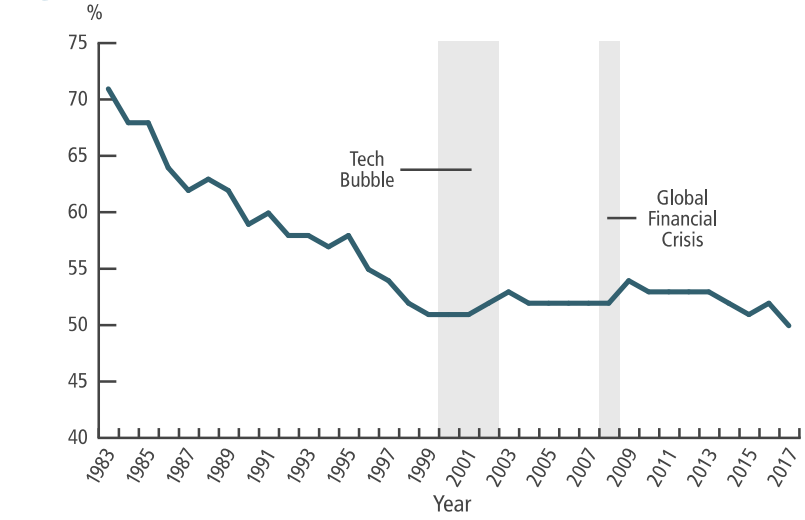
B PORTFOLIO VALUE



DRIVE managed to offer a substantially higher cumulative consumption than either the 4% rule or the 70% replacement rule during Barbara's retirement without approaching full portfolio depletion.

Both of the "rule of thumb" consumption frameworks called for spending recommendations that were far more modest than what Barbara could have afforded.

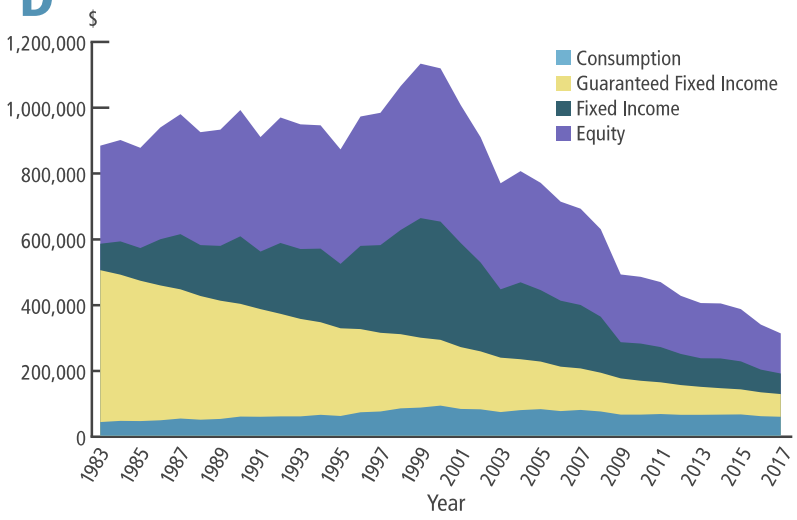
C OPTIMAL EQUITY ALLOCATION



DRIVE's dynamic nature is demonstrated as the framework calls for higher equity exposures following a substantial stock market loss or other financial stress, such as a major healthcare expense. Doing so will help a retiree rebuild her retirement savings.

DRIVE also calls for retirees with greater savings to hold less equity investment exposure than those with less wealth.

D OPTIMAL ALLOCATION ACROSS ASSETS



DRIVE views guaranteed income, such as social security payments, as an asset class alongside equities and fixed income.

*Stock Return is the annualized return of the S&P 500 Total Return Index and the Bond Return is the annualized return of the US 10-Year Treasury Total Return Index for the retirement period 1983 - 2017. Results are gross of any tax implications. The 4% rule and 70% replacement rule use asset allocation from the Fidelity Freedom Target Date Fund glidepath.

Chart A illustrates the annual consumption for each of the three methodologies over time.[12] DRIVE outspent both the 4% rule and the 70% replacement rule on average, and in cases of market declines, it underspent to avoid early depletion. Also of note, DRIVE allowed for higher spending in the early retirement years compared to the other methodologies. This result should benefit most retirees, who tend to be healthier and more active in the earlier part of their retirement.

Chart B demonstrates the portfolio value over her retirement, taking into account the annual consumption recommendation and the impact of the market. Chart B also establishes that the shortcomings of the alternative consumption rules are clear and dramatic: the conservative nature of the 4% rule and the 70% replacement rule left a great deal of accumulated wealth unspent at the end of this illustrative lifetime. We succeeded in finding a balanced approach by calling for greater

[12] All DRIVE simulations and backtests are presented in real dollar terms, adjusting for expected and historical inflation.

spending during retirement than the 4% rule but still providing a comfortable margin of safety to minimize the likelihood of depleting retirement savings before death.

Charts C and D demonstrate the framework's optimal allocation to equities, fixed income, consumption and guaranteed income over time. Chart C shows the adaptive nature of the methodology. During the period illustrated, two major financial crises occurred (the Dot-Com crisis starting in 2001 and the Global Financial Crisis in 2008) – each having the expected effect of depleting portfolio value due to equity market depreciation. Shortly after each of these events, DRIVE responded by increasing Barbara's relative investment in equities. This had the effect of positioning the portfolio to rebound in value and recoup lost wealth. The 4% rule does not have the ability to respond to market events and thus continues to recommend consumption that is indifferent to dramatic changes to individual wealth. Following DRIVE leads to a reduction in consumption following the Dot-Com and the Global Financial crises.

Chart D places the equity allocation in a more holistic context by including Barbara's exposure to fixed income, consumption and guaranteed income. When the present value of guaranteed income is larger earlier in life, Barbara has a greater ability to take equity risk in her investment portfolio.

Conclusion and Next Steps

The goals and desires of individuals in their retirement vary dramatically. Yet a commonality is the desire to lead a robust and fulfilled life through the retirement journey. Quite often, the fear of running out of money has a negative impact on retirees' decisions over asset allocation and spending, leading them to a less fulfilling and enjoyable retirement. DRIVE provides a comprehensive and systematic solution to post-retirement spending and saving decisions.

Both historical analysis and forward looking simulations suggest that DRIVE provides a better outcome than market standards because it is both customizable and adaptive. Its dynamic nature ensures flexibility to account for a person's inevitable changing life circumstances. It is designed to provide an individual with better foresight into how much they can afford to spend during retirement while minimizing the risk of portfolio exhaustion.

In the next installment on this topic, we extend the existing framework to include longevity annuities as another crucial component of the asset allocation solution. Longevity annuities are a form of insurance protecting against the tail risk event of living far longer than one expects. The key takeaways from this paper will set the foundation as we provide new insights that incorporate this useful financial planning tool.

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