Financial Services Review
Financial Services Review 28 (2020) 201–221

Selecting a Social Security age to balance consumption and risk

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Abstract

This article uses Monte Carlo simulation to determine the maximum consumption given retirement at age 62, initial wealth, risk tolerance, and Social Security take decision. Coile et al. (2002) argue for a delay, because the payment increases seven percent for each year. Focusing on maximizing the expected present value of benefits may be misguided. This article shows that, conditional on retirement at age 62, initial consumption is always maximized by taking Social Security no later than age 63; it also results in the highest simulated ending wealth at death, and the lowest amount of simulated time (if any) living on just Social Security. © 2020 Academy of Financial Services. All rights reserved.

Keywords: Social Security; Consumption; Monte Carlo simulation

1. Introduction

Everyone is faced with several major questions in life, such as: which college to attend, who to choose as a spouse, when to have children, and of course, when to take Social Security? Unlike many of life's other choices, the decision about when to claim Social Security is irrevocable; therefore, it is one that fills people with much uncertainty. This article will attempt to guide future retirees in their choices of when to begin receiving Social Security benefits and how much to consume throughout their retirement. Building upon the insights provided by Alderson and Betker (2017), this article uses a Monte Carlo simulation model to show that the decisions regarding when to claim Social Security and how much to consume during retirement are ultimately questions of risk tolerance. To be more specific,

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"What level of confidence does a person require as it pertains to the possibility of exhausting their wealth before they die?" The answer to this question affects the level of consumption that a person can pursue in their retirement years, how much wealth they possess when they die, and how long they may have to live at a minimal consumption level if their savings is exhausted.

Alderson and Betker (2017), in keeping with Modigliani's (1966) theory of consumption smoothing, presume that individuals want to maintain constant real consumption across their lifetime. They asked the question, "Does a person that postpones taking Social Security get adequately compensated for doing so?" To answer this question, they calculated the probability of exhausting tax-deferred savings given a person's retirement age and the age they decide to take Social Security. This article addresses a fundamentally different, but similar question: "What is the maximum amount of real consumption a person can choose, given their risk tolerance and the age at which they take Social Security?" Monte Carlo simulation helps to reveal the maximum amount of consumption that is consistent with a person's risk tolerance.

The questions posed by Alderson and Betker (2017) and this article are different than previous research. Heretofore, most research that focused on when to claim Social Security did so with the intent to maximize the expected present value of the stream of benefits. Coile, Diamond, Gruber, and Jousten (2002) use simulations to show the optimal delay for both individuals and one-earner married couples using both the expected present value under financial calculations and a utility maximization model. They find that it is optimal to postpone, with delay times that ranged from months to years, in a large number of circumstances. Docking, Fortin, and Michelson (2012) solve for the optimal retirement age given gender and race for single individuals. They find the decision is invariant to race and gender; individuals should either retire at age 64 if they retire early, or they should retire at age 67. Similarly, Shoven and Slavov (2014a) calculate expected present value of benefits for a number of different situations and find that individuals who expected to live according to the average mortality tables should delay taking Social Security past their full retirement age unless the real interest rate is four percent (or higher). Shoven and Slavov (2014b) show that the benefit from delaying Social Security has risen over time, with someone born in 1951 (close to the baseline for this article) gaining 12.7% if they delay claiming until age 69. There is lots of evidence to suggest delaying receipt of Social Security; the popular press would summarize by saying, "wait as long as you can."

Munnell and Chen (2015) report that, in 2013, after adjusting for growing changes in the size of Social Security cohorts, 36% of men who claim Social Security benefits are aged 62. Shoven, Slavov, and Wise (2018) conduct a survey to assess people's attitudes pertaining to their decision to claim Social Security. Seventy seven percent are happy with their decision to claim at age 62, while 90% are happy with their decision to claim at the full retirement age. The main reason cited for claiming before the full retirement age is a need for the money, and 23% of respondents state they use savings to finance the gap between retirement expenditures and Social Security income (61% stated they relied upon an employer-sponsored pension). This article aims to guide the decision regarding when to collect Social Security, as well as how much to spend during retirement, given an individual's risk tolerance for failure. Here it is important to stress the definition of failure. Failure is defined as

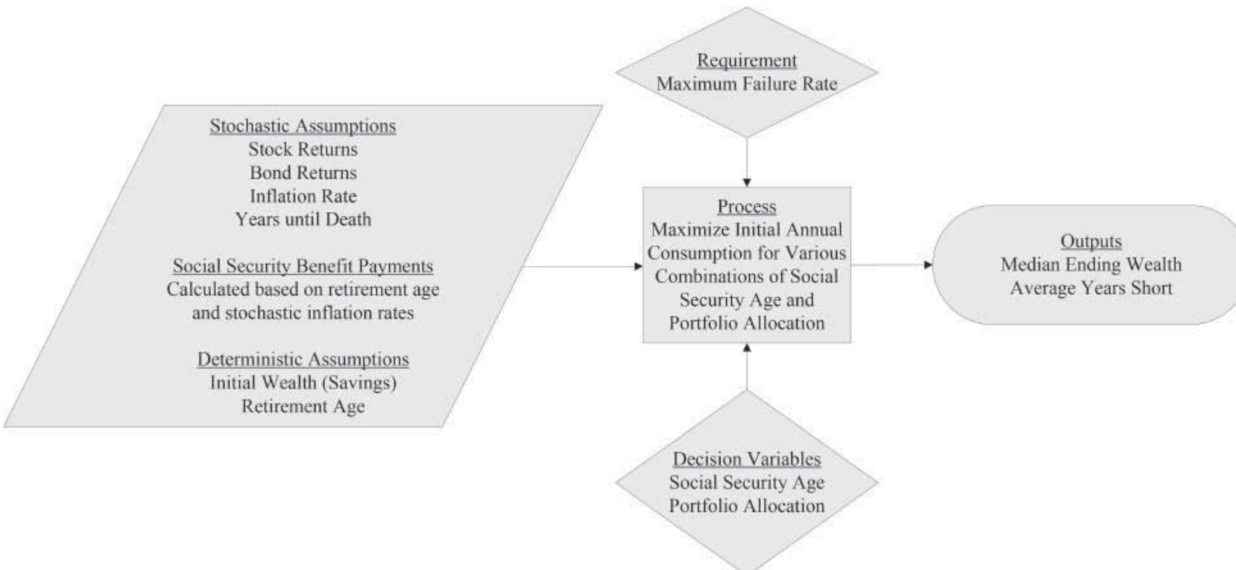

Fig. 1. Structure of the retirement portfolio model.

fully exhausting the initial stock of wealth such that the individual must live only on their Social Security benefits. According to a report by the U.S. Government Accountability Office (GAO) (2019), 48% of households aged 55 and over have no retirement savings, but may have a defined benefit plan. Twenty nine percent of households have neither. The GAO gathered this information from the 2016 Survey of Consumer Finances. Thus, in this model, failure is defined in accordance with the state of wealth accumulation that is consistent with almost a third of American households, and possibly as many as 50% of households.

2. The model

The basic decision is a function of gender, wealth, annual level of consumption, the age at which an individual begins collecting Social Security, the portfolio's asset allocation, and the annual return an asset earns. Gender is not a factor in the model; results are simulated for males and females separately. Thus, gender affects the probability of death. A retiree's wealth, W_t, is modeled in year t as

$$W_t = (W_{t-1} + P_t - C_t) \cdot (1 + \alpha E_t + (1 - \alpha) B_t) \quad (1)$$

where P_t is the Social Security payment in year t; C_t is the consumption in year t; α is the percentage invested in stocks, with stock (equity) and bond returns denoted by E_t and B_t, respectively. Fig. 1 depicts the structure of the simulation model utilized to evaluate the retirement portfolio that includes Social Security payments.

The elements of the model and the components of (Eq. 1) are described in the remainder of this section.

2.1. Stochastic assumptions

The retiree divides wealth among investments in stocks and bonds. Total returns from the S&P 500 are used to model stock returns, and total returns on 10-year Treasury Bonds represent the bond returns. Both series range from 1928 to 2018 and were retrieved from Professor Aswath Damodaran's website (Damodaran, 2019). The article uses this site due to the long history and the singular source. These data span the Great Depression, several wars including World War II, and several extremely volatile periods for stocks. Additionally, accurate total return series for bonds are hard to access, especially across such a long history. Professor Damodaran calculates the price return for a 10-year Treasury Bond and adds that to the coupon received for the 10-year Treasury Bond. Therefore, these data give us average returns for both series and good correlation between the two.

Random variables are established by creating probability distributions for annual stock and bond returns, and these returns are correlated within each year. Stock returns in each year are modeled as normally distributed with a mean of 11.5% and a standard deviation of 19.6%. Bond returns are normally distributed with a mean of 5.2 percent and a standard deviation of 7.7 percent. Returns are uncorrelated across years, but the stock and bond returns within each year are modeled with a correlation coefficient of –0.0276.

Alderson and Betker (2017) use a bootstrapping approach and randomly sample an actual observation of investment returns to calculate the simulated returns for a given year (e.g., for year one their simulation might randomly select the historical return from 2010, in which case their model will use the total return for stock and bonds from 2010). In contrast, the portfolio model in this study defines the distributional parameters and then uses Monte Carlo simulation to sample both stock and bond total returns.

Inflation is estimated using the difference between the yield to maturities for Treasury Inflation-Protected Securities (TIPS) and the yield to maturity for similarly dated Treasury securities matched for maturity dates from 2019 through 2029, with the smallest one-year difference being 1.705 percentage points and the largest being 1.959 percentage points. These inflation estimates from 2019 through 2029 are used to develop a normally distributed variable with a mean (1.88 percent) and standard deviation (0.277 percent) that follows from the projected inflation rate across these 11 years. Correlation between inflation and bond and stock returns is estimated by calculating the correlation between the Consumer Price Index (CPI) and bond and stock returns across the entire time period of the sample. This inflation rate is used to maintain constant real consumption for an individual, while also adjusting the level of Social Security benefits that will be paid in the future.

On each simulation trial, a random number of years (L) until death is selected. This random variable is created using current Social Security life span assumptions. This is accomplished by running 10,000 simulation trials from the Actuarial Life Table (Social Security Administration, 2018) and then compiling results for conditional remaining life span given that an individual (male or female, as appropriate) obtains age 62. At the age of 62, a female is projected to live 2.82 years longer than a male. The average male life expectancy in the model is 19.44 years, which would suggest that a male that retires at age 62 will live to be approximately 81.44 years old, while a female will live to be approximately 84.26 years old after an average life expectancy of 22.26 years. The oldest person in any simulation was

108. These numbers are in line with, but longer than, the Cohort Life Expectancy published by the Social Security Administration in Table 5.A5 of the 2019 Annual Report of the Board of Trustees of the Old Age and Survivors Insurance and Federal Disability Insurance Trust Funds (2019). Using calendar year 1955 (one year before the latest birth year of 1956), males are expected to live an additional 13.1 years past 65 (78.1 years), while females are expected to live 16.7 years past 65 (81.7 years).

2.2. Social security benefit payments

The retirement portfolio model assumes that an individual retires at the earliest opportunity to claim Social Security, which is currently age 62. Unlike in Alderson and Betker (2017), who use the online Social Security benefits estimator, the model calculates the Social Security benefit using the process in Appendix D from the Annual Statistical Supplement to the Social Security Bulletin for 2018, released May 2019 (Social Security Administration, 2019). The model assumes that an individual who begins working at age 18 and works until age 62 earns at least the maximum amount of income that is subject to Social Security tax in the highest 35 years of their working life. The initial benefit S_A is then estimated to coincide with the age, A, at which they start to collect Social Security. The benefit is adjusted for stochastic inflation, I_t, in each year so that the Social Security payment P_t in each year is determined as

$$P_t = R \cdot S_A \cdot \prod_{u=1}^{t-1} (1 + I_u) \tag{2}$$

where R is an indicator variable that is equal to 1 if $t < A–61$ and 0 otherwise. For simplicity, it is assumed that someone turning 62 will retire and begin collecting benefits at some point in the following month; however, someone choosing their benefits at the age of 70 will have stopped working eight years earlier.

This monthly retirement benefit is based on income earned through the end of 2018. Individuals experience a reduction in the full benefit for taking their Social Security benefit before they reach their maximum retirement age. For example, the person that turns 70 (born in 1948) would experience a 25% reduction to their monthly benefit, while a person that turns 62 (born in 1956) would experience a 26.67% reduction. Thus, the monthly benefit ranges from $S_A = \$2,150$ for a 62-year old to $S_A = \$3,565$ for a 70-year old. An individual would need to earn $128,400 in 2018 to earn the maximum income that is subject to Social Security taxation; as of tax filing year 2017, the latest statistics released by the IRS (2019), only 17.1% of households earned more than $100,000 in Adjusted Gross Income. Purcell (2018) shows that the mean and median wage for males between 25 and 59 years old, in 2014 dollars, are $64,200 and $45,000, respectively. Much like the IRS data, a male earning above $100,000 would put them somewhere in the upper teens in terms of percentile earners. To increase applicability, the model is also used for an individual that only earned half of the maximum income ($64,200 in 2018) that is subject to Social Security taxation. These payments range from $S_A = \$1,552$ for a 62-year old or $S_A = \$2,538$ for a 70-year old.

Similar to Alderson and Betker (2017), the model considers accumulated initial wealth (W_0) in \$100,000 increments up to \$1,000,000; thus, the results apply to retirees at a wide range of savings levels. Because individuals are assumed to retire and stop saving at age 62, waiting longer to claim Social Security does not directly, positively affect your accumulated wealth in the model, though it would add to the possible Social Security benefit.

2.3. Decision variables

The retiree makes two choices in the model: (1) the age, A, to begin Social Security payments, and (2) the percentage of the portfolio allocated to stocks, α. Consumption, C_1, in the first year of retirement is maximized subject to these choices. Dimmock, Wang, and Yang (2019) derive, using values attributed to the U.S. stock market, how Modern Portfolio Theory can justify a 60/40 split between stocks and bonds, typically used to represent endowments. This model, similar to Alderson and Betker (2017), sets $\alpha = 60\%$ for stocks and $1–\alpha = 40\%$ for bonds, acknowledging that this allocation might expose individuals to an unacceptable level of Beta risk as they age. Someone in their Seventies may be comfortable with a 25% chance of outliving their wealth, but uncomfortable with the possibility of losing significant wealth in any given year. Since 1928, there have been 24 years with negative returns, and the average negative return is (13.7%). An individual with a 60% allocation is risking almost 10% of their portfolio in any given year based on historical data. To account for potential risk in the 60/40 allocation, this article also considers the “Rule of Thumb” portfolio (ROT), where an individual allocates 120 minus their current age as the percentage invested in stocks.

One other portfolio allocation considered is the “Bridge fund” portfolio. An investor who decides to delay taking their Social Security benefit until after age 62 may want to limit the exposure of some portion of their wealth to the risk from bonds only. The portion of wealth for the Bridge fund is calculated as the present value of a growing annuity, where the annuity is the annual payment to fund the foregone Social Security and the growth is equal to the expected inflation rate. This present value is invested only in bonds and is “used” to fund consumption until the individual begins drawing Social Security. At that time, any funds remaining in the Bridge fund are then invested at the allocation rate for the portfolio, either 60/40 or the ROT. It should be noted that it is also possible that the Bridge fund will be exhausted before the individual begins to draw Social Security, as bond returns are stochastic.

Consumption adapts throughout the investor’s life to stay constant in real terms because the initial consumption, C_1, adjusts with the stochastic inflation rate (I_t) each year. Thus, consumption in year t is defined as

$$C_t = C_1 \cdot \prod_{u=1}^{t-1} (I + I_u) \tag{3}$$

for year 2 and beyond. Based on these choices, the model simulates a distribution of results for the retiree’s ending wealth at death, and the average years the retiree lives after exhausting all savings.

2.4. Solution process

The objective of this study is to advise a potential retiree on a consumption amount that is consistent with their risk tolerance. The investor chooses as a requirement of the portfolio that "failure" only occurs a set percentage of the time – the Maximum Failure Rate. Failure in this context means that savings are exhausted and the individual lives on Social Security payments alone. In contrast, Alderson and Betker (2017) consider a number of consumption strategies: (1) a retiree who chooses to spend *1/N* of their accumulated wealth, where *N* is the median number of years remaining in their life, plus the projected Social Security benefit for the age at which they take the benefit, all adjusted for inflation; (2) a retiree who follows a similar strategy but sets *N* as the number of remaining years until they are 100 years old; (3) a retiree that purchases longevity insurance; and (4) a retiree that sets aside the equivalent amount spent on longevity insurance, excluding it from accumulated wealth when calculating consumption (i.e., somewhat analogous to the current model's Bridge fund).

It is important to emphasize the difference between the approach in this study and the one that Alderson and Betker (2017) pursue. The previous study calculates the probability of failure given the age at which you select Social Security and the method of consumption an individual pursues. Alderson and Betker (2017) realize this on page 43 when they note that "The spending strategy with the lowest failure probability was not necessarily the "optimal" strategy . . . . Any given retiree might well prefer a higher failure rate when balanced against higher consumption today." Given this admission, this model considers failure rates of five percent and 25% for both males and females, and determines the highest level of annual consumption that meets those failure rates, conditional on the age at which an individual takes Social Security and their initial level of wealth. This allows the individual to select, within some parameters, their comfort level, their consumption level, and the age at which they take Social Security.

3. Results

The case of selecting sustainable consumption at an acceptable level of risk is considered. For a 62-year old with tax-deferred savings of between $100,000 and $1,000,000, the retirement portfolio is simulated for beginning Social Security ages of 62 through 70 in one-year increments for male individuals and female individuals. We do not pursue joint decisions for married couples due to the number of simplifying assumptions required. The goal is to maximize current beginning consumption, while still meeting the failure threshold. Charnes (2012) finds that much of the reduction in the standard error of estimates in Monte Carlo simulation models occurs when utilizing at least 2,000 simulation trials. In keeping with this convention, the model uses 2,000 simulation trials for each combination to identify the combinations that achieve the maximum consumption without exceeding the maximum allowable rate of failure for the portfolio, and the model simulates results for approximately 130 possible consumption levels for each Social Security age and initial wealth before there was no improvement in consumption. Failure is defined as the percentage of time the retirement

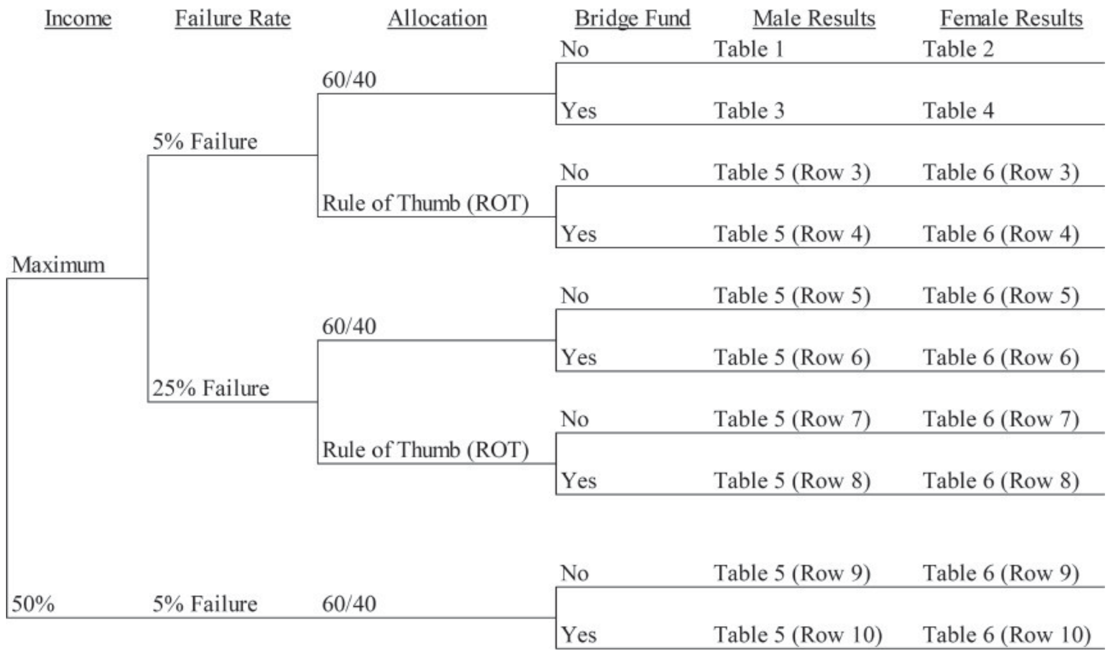

Fig. 2. Scenarios considered in the simulation results.

portfolio is exhausted before death, thus resulting in the investor living strictly on Social Security income for the remainder of his or her lifetime.

The solution process is applied to scenarios for each combination of assumptions as depicted in Fig. 2, which also lists the tables at the end of the article where numerical results are reported. Maximum consumption for males and females when considering a five percent failure rate is determined for the 60/40 and ROT portfolios assuming an individual earned 100% of the maximum income for Social Security. Each of these scenarios is also considered in combination with an initial Bridge fund. Results of these simulations are reported for all initial wealth levels in Tables 1 through 4.

Results corresponding to those in Tables 1 through 4 for a 25% required failure rate are only reported for an individual (male or female) that has $500,000 in initial wealth. Full results are omitted because they do not differ meaningfully in consumption, ending wealth, or the unconditional number of years a person may fall short with the results in Tables 1 through 4; however, these results are available upon request. Similarly, when considering an individual that earned 50% of the maximum income for Social Security, we show the 60/40 allocation, both with and without the Bridge fund, for males and females with $500,000 in initial wealth in the summary tables, but only for a five percent required failure rate.

3.1. Results for maximum social security income without Bridge fund

Table 1 considers a male who has earned the maximum amount of income subject to Social Security taxation throughout his working life. Given a five percent chance of failure, Table 1 displays the age at which an individual takes Social Security and the initial wealth they possess when they retire. Keep in mind the assumption that everyone retires at age 62. The table reports the maximum initial consumption values, the median ending wealth at

Table 1 Male, maximum social security income, five percent failure, 60/40 split, no Bridge fund

Initial wealth		Social Security age								
		62	63	64	65	66	67	68	69	70
100K	Consumption	30,000	31,000	31,000	30,000	23,000	18,000	15,000	13,000	11,000
	End wealth	227,346	168,668	128,001	120,773	578,475	866,412	1,008,864	1,094,929	1,180,918
	Years short	0.06	0.05	0.02	0.03	0.05	0.03	0.03	0.04	0.02
200K	Consumption	36,000	36,000	36,000	36,000	36,000	35,000	31,000	26,000	23,000
	End wealth	340,196	344,065	302,688	227,717	196,173	216,408	437,454	746,710	918,135
	Years short	0.27	0.13	0.10	0.20	0.23	0.02	0.05	0.04	0.04
300K	Consumption	41,000	42,000	42,000	41,000	41,000	41,000	40,000	40,000	35,000
	End wealth	516,628	458,597	416,506	401,752	372,772	322,215	326,921	301,605	602,834
	Years short	0.26	0.28	0.27	0.20	0.19	0.29	0.30	0.73	0.04
400K	Consumption	46,000	47,000	47,000	46,000	46,000	46,000	45,000	45,000	45,000
	End wealth	690,779	633,906	592,547	577,210	544,983	499,291	495,981	461,905	438,425
	Years short	0.25	0.27	0.26	0.21	0.19	0.23	0.22	0.30	0.49
500K	Consumption	51,000	52,000	52,000	51,000	51,000	51,000	51,000	51,000	50,000
	End wealth	866,100	811,858	767,910	751,087	722,944	672,664	611,816	576,276	600,697
	Years short	0.25	0.26	0.26	0.21	0.20	0.22	0.30	0.36	0.33
600K	Consumption	56,000	57,000	57,000	56,000	57,000	56,000	56,000	56,000	56,000
	End wealth	1,042,082	985,738	942,385	924,873	843,955	845,777	785,713	752,747	708,849
	Years short	0.25	0.26	0.25	0.22	0.28	0.22	0.28	0.30	0.38
700K	Consumption	61,000	62,000	62,000	62,000	62,000	62,000	61,000	61,000	61,000
	End wealth	1,216,531	1,159,490	1,116,663	1,050,556	1,015,408	968,864	960,315	925,109	885,739
	Years short	0.24	0.25	0.25	0.28	0.27	0.29	0.26	0.28	0.32
800K	Consumption	67,000	67,000	67,000	67,000	67,000	67,000	66,000	66,000	66,000
	End wealth	1,340,530	1,335,424	1,291,828	1,224,819	1,192,443	1,144,475	1,136,586	1,099,630	1,060,327
	Years short	0.29	0.25	0.25	0.28	0.26	0.28	0.25	0.26	0.29
900K	Consumption	72,000	72,000	73,000	72,000	72,000	72,000	71,000	71,000	71,000
	End wealth	1,512,509	5,150,493	1,414,843	1,396,536	1,370,857	1,318,537	1,310,611	1,280,497	1,237,447
	Years short	0.29	0.25	0.29	0.27	0.26	0.27	0.24	0.26	0.27
1,000K	Consumption	77,000	78,000	78,000	77,000	77,000	77,000	77,000	77,000	76,000
	End wealth	1,692,182	1,631,522	1,591,102	1,568,350	1,549,103	1,489,189	1,441,130	1,402,722	1,413,952
	Years short	0.28	0.29	0.29	0.27	0.26	0.26	0.30	0.31	0.26

Table 2 Female, maximum social security income, five percent failure, 60/40 split, no Bridge fund

Initial wealth		Social Security age								
		62	63	64	65	66	67	68	69	70
100K	Consumption	30,000	31,000	31,000	30,000	23,000	18,000	15,000	13,000	11,000
	End wealth	258,028	193,814	153,703	158,557	794,228	1,204,154	1,405,145	1,559,647	1,706,147
	Years short	0.12	0.10	0.03	0.03	0.05	0.03	0.03	0.04	0.02
200K	Consumption	35,000	36,000	36,000	35,000	36,000	35,000	31,000	26,000	23,000
	End wealth	456,403	390,207	344,701	337,319	229,823	274,411	598,715	1,034,741	1,294,828
	Years short	0.26	0.27	0.21	0.08	0.38	0.02	0.05	0.03	0.03
300K	Consumption	39,000	40,000	41,000	40,000	40,000	40,000	40,000	39,000	35,000
	End wealth	727,823	661,167	543,306	533,913	510,337	455,438	391,375	466,783	812,766
	Years short	0.18	0.17	0.30	0.19	0.14	0.19	0.42	0.04	0.05
400K	Consumption	44,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	44,000
	End wealth	929,792	863,232	820,674	730,343	703,100	643,768	579,212	557,300	612,426
	Years short	0.24	0.24	0.21	0.27	0.22	0.24	0.35	0.43	0.39
500K	Consumption	49,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
	End wealth	1,126,611	1,059,723	1,018,609	931,701	901,226	847,434	775,448	741,882	707,927
	Years short	0.28	0.28	0.26	0.31	0.27	0.28	0.35	0.38	0.48
600K	Consumption	54,000	55,000	55,000	54,000	55,000	55,000	54,000	55,000	54,000
	End wealth	1,324,291	1,258,919	1,211,536	1,203,638	1,099,258	1,048,123	1,053,980	931,053	984,231
	Years short	0.31	0.31	0.30	0.25	0.30	0.31	0.25	0.37	0.29
700K	Consumption	58,000	59,000	60,000	59,000	59,000	59,000	59,000	59,000	59,000
	End wealth	1,597,411	1,531,660	1,407,756	1,400,909	1,372,680	1,320,685	1,247,519	1,211,241	1,173,606
	Years short	0.26	0.26	0.32	0.28	0.25	0.25	0.28	0.28	0.30
800K	Consumption	63,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000
	End wealth	1,796,240	1,728,616	1,692,536	1,597,537	1,572,895	1,519,853	1,445,537	1,403,833	1,359,980
	Years short	0.28	0.29	0.27	0.30	0.28	0.28	0.30	0.30	0.31
900K	Consumption	68,000	69,000	69,000	69,000	69,000	69,000	69,000	69,000	69,000
	End wealth	1,992,844	1,927,894	1,881,118	1,792,621	1,765,725	1,711,837	1,652,616	1,604,545	1,556,312
	Years short	0.30	0.30	0.29	0.32	0.30	0.30	0.32	0.31	0.32
1,000K	Consumption	73,000	74,000	74,000	73,000	74,000	74,000	73,000	74,000	74,000
	End wealth	2,196,688	2,131,322	2,079,948	2,075,739	1,968,960	1,914,315	1,919,237	1,801,473	1,760,415
	Years short	0.32	0.32	0.31	0.28	0.32	0.32	0.27	0.33	0.33

Table 3 Male, maximum social security income, five percent failure, 60/40 split, Bridge fund

Initial wealth		Social Security age								
		62	63	64	65	66	67	68	69	70
100K	Consumption	30,000	31,000	31,000	31,000	30,000	32,000	32,000	34,000	36,000
	End wealth	227,346	168,668	121,020	33,076	148,084	135,208	195,648	204,535	213,875
	Years short	0.06	0.05	0.01	0.37	0.00	0.05	0.01	0.01	0.01
200K	Consumption	36,000	36,000	36,000	36,000	36,000	36,000	35,000	34,000	36,000
	End wealth	340,196	344,065	293,669	204,739	154,578	78,564	93,287	204,535	213,875
	Years short	0.27	0.13	0.10	0.16	0.09	0.35	0.01	0.00	0.00
300K	Consumption	41,000	42,000	42,000	41,000	41,000	41,000	41,000	40,000	40,000
	End wealth	516,628	458,597	408,487	380,345	330,983	249,987	156,336	142,312	117,928
	Years short	0.26	0.28	0.27	0.19	0.15	0.17	0.35	0.31	0.04
400K	Consumption	46,000	47,000	47,000	46,000	46,000	46,000	46,000	46,000	45,000
	End wealth	690,779	633,906	583,222	555,105	506,844	427,924	331,634	249,034	217,269
	Years short	0.25	0.27	0.26	0.20	0.17	0.18	0.26	0.33	0.21
500K	Consumption	51,000	52,000	52,000	51,000	52,000	52,000	51,000	51,000	51,000
	End wealth	866,100	811,858	761,959	734,080	630,515	560,138	528,837	451,531	370,829
	Years short	0.25	0.26	0.25	0.21	0.28	0.30	0.22	0.21	0.25
600K	Consumption	56,000	57,000	57,000	57,000	57,000	56,000	56,000	56,000	56,000
	End wealth	1,042,082	985,738	935,690	846,686	801,488	778,356	684,100	599,742	501,274
	Years short	0.25	0.26	0.25	0.30	0.28	0.20	0.24	0.24	0.27
700K	Consumption	61,000	62,000	62,000	62,000	62,000	62,000	61,000	61,000	61,000
	End wealth	1,216,531	1,159,490	1,110,349	1,027,461	975,121	901,826	858,630	774,285	676,378
	Years short	0.24	0.25	0.25	0.28	0.27	0.28	0.24	0.24	0.25
800K	Consumption	67,000	67,000	67,000	67,000	67,000	67,000	66,000	66,000	66,000
	End wealth	1,340,530	1,335,424	1,285,471	1,201,601	1,152,458	1,077,024	1,033,278	954,186	852,837
	Years short	0.29	0.25	0.25	0.27	0.26	0.27	0.24	0.23	0.24
900K	Consumption	72,000	72,000	73,000	72,000	72,000	72,000	71,000	71,000	71,000
	End wealth	1,512,509	5,150,493	1,406,166	1,378,386	1,329,252	1,252,134	1,208,633	1,126,576	1,026,835
	Years short	0.29	0.25	0.29	0.27	0.26	0.27	0.24	0.23	0.24
1,000K	Consumption	77,000	78,000	78,000	77,000	77,000	77,000	77,000	76,000	76,000
	End wealth	1,692,182	1,631,522	1,583,096	1,553,497	1,503,759	1,425,587	1,336,042	1,301,884	1,202,771
	Years short	0.28	0.29	0.29	0.26	0.26	0.26	0.29	0.23	0.24

Table 4 Female, maximum social security income, five percent failure, 60/40 split, Bridge fund

Initial wealth		Social Security age								
		62	63	64	65	66	67	68	69	70
100K	Consumption	30,000	31,000	31,000	31,000	30,000	32,000	32,000	34,000	36,000
	End wealth	258,028	193,814	144,212	36,067	207,367	191,240	283,211	299,439	315,659
	Years short	0.12	0.10	0.02	0.50	0.00	0.05	0.00	0.00	0.01
200K	Consumption	35,000	36,000	36,000	35,000	36,000	36,000	35,000	34,000	36,000
	End wealth	456,403	390,207	337,178	310,657	178,463	93,937	129,077	299,439	315,659
	Years short	0.26	0.27	0.20	0.06	0.18	0.52	0.01	0.00	0.01
300K	Consumption	39,000	40,000	41,000	40,000	40,000	40,000	40,000	40,000	40,000
	End wealth	727,823	661,167	533,567	506,871	455,065	370,098	257,100	178,087	168,491
	Years short	0.18	0.17	0.30	0.18	0.11	0.09	0.15	0.37	0.04
400K	Consumption	44,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
	End wealth	929,792	863,232	810,674	706,151	649,761	562,369	451,132	363,643	254,634
	Years short	0.24	0.24	0.21	0.26	0.19	0.18	0.22	0.18	0.28
500K	Consumption	49,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
	End wealth	1,126,611	1,059,724	1,005,818	903,433	851,556	757,151	650,770	558,518	446,637
	Years short	0.27896	0.2826	0.26281	0.30749	0.259375	0.25452	0.29118	0.2536	0.2475
600K	Consumption	54,000	55,000	55,000	54,000	55,000	55,000	54,000	55,000	55,000
	End wealth	1,324,291	1,258,919	1,202,552	1,178,749	1,051,768	960,001	921,518	758,023	643,392
	Years short	0.31	0.31	0.30	0.24	0.30	0.30	0.21	0.31	0.30
700K	Consumption	58,000	59,000	60,000	59,000	59,000	59,000	59,000	59,000	59,000
	End wealth	1,597,411	1,531,660	1,406,064	1,374,865	1,324,577	1,229,669	1,123,650	1,029,768	917,170
	Years short	0.26	0.26	0.32	0.28	0.24	0.24	0.25	0.22	0.21
800K	Consumption	63,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000
	End wealth	1,796,240	1,728,616	1,676,599	1,572,416	1,523,029	1,436,545	1,324,981	1,228,207	1,114,986
	Years short	0.28	0.29	0.28	0.30	0.27	0.27	0.29	0.27	0.25
900K	Consumption	68,000	69,000	69,000	69,000	69,000	69,000	68,000	69,000	69,000
	End wealth	1,992,844	1,927,894	1,870,238	1,778,303	1,719,125	1,632,217	1,589,536	1,431,653	1,315,246
	Years short	0.30	0.30	0.29	0.32	0.30	0.30	0.24	0.30	0.29
1,000K	Consumption	73,000	74,000	74,000	73,000	73,000	73,000	73,000	73,000	74,000
	End wealth	2,196,688	2,131,322	2,073,840	2,047,292	1,992,894	1,906,969	1,798,125	1,697,728	1,519,924
	Years short	0.32	0.32	0.31	0.28	0.26	0.26	0.27	0.25	0.31

death associated with that decision, and the average length of time that someone who does fail would need to live on their Social Security benefits alone. Consider the specific example of a 62-year old with $500,000 in tax-deferred savings. An initial consumption value of $52,000 is the maximum initial payout that allows the male investor to meet the five percent failure rate on average, and this occurs when starting Social Security payments as early as age 63. Fifty-two thousand dollars is only the initial consumption at age 63; this amount is indexed by inflation in each subsequent year.

While maximum initial consumption is the same when beginning Social Security payments at either age 63 or 64, the amount "left on the table" in median ending wealth differs between these two possible alternatives, with the male investor ending with about $44,000 in additional wealth when payments begin at age 63 as opposed to age 64. Acknowledging that median ending wealth is a tertiary goal, it should be viewed as a tiebreaker when considering similar consumption levels and rates of failure. Shoven, Slavov, and Wise (2018) identify reasons why an individual might claim immediately that generally center around the desire to retire coupled with a lack of liquidity. The results in Table 1 suggest that it may be a consumption-maximizing decision. Table 2 displays the results for a female investor. Much like males, females maximize their consumption by claiming as early as age 63. Starting Social Security payments at age 63 also maximizes median ending wealth relative to all other claiming ages with the same level of consumption.

These results differ from traditional research regarding when to take Social Security benefits. Many previous studies are concerned with ensuring the individual (or couple) maximizes the expected present value of their Social Security benefits. Coile, Diamond, Gruber, and Jousten (2002) answer this question and find that a male that retires at age 62 with $200,000 in initial wealth should wait three years to earn almost $11,000 (in 1992 dollars, which would be just over $20,000 in today's dollars using the change in CPI over this time period) in expected present value. Table 1 above shows that a male with $200,000 that waits three years to claim Social Security instead of claiming at age 62, assuming a five percent risk of failure, would be able to consume the same amount, $36,000, but they would die with about $112,000 less in median ending wealth. Consider that Dushi, Iams, and Trenkamp (2017) use data from the redesigned CPS survey and find that half of all people aged 65 or older use Social Security for at least 50% of their family income and almost 25% of the population used Social Security for 90% of their income (the percentages are slightly lower for males only, which would be the most directly comparable to this scenario). They compare this to spending from assets (public and private pensions as well as IRAs), which only represent 21% of income. Table 1 confirms that delaying Social Security does not increase consumption; it only lowers ending median wealth. Thus, delaying Social Security to collect an additional $11,000 in expected present value is not a utility-maximizing decision.

Considering the risk-averse individual, the tables also identify the implications of the five percent failure rate, as they provide the mean amount of time a person would need to live on just their Social Security payment. This is calculated by taking the conditional number of years short times the probability of actually falling short. The individuals (male and female) possessing $500,000 in initial wealth that retire at age 62, begin consuming $52,000 (male) or $50,000 (female) a year, and begin drawing Social Security at age 63 will fail, or draw down their initial wealth, five percent of the time. On average, the individual spends just over one-fourth of the last year of their life living solely on their Social Security payment, and is most likely to die with assets totaling either $811,858 (male) or $1,059,723 (female). Specifically, for the male retiree, there is a 95% probability that wealth is not exhausted before death; whereas on the five percent of trials that failure occurs, this person spends an average of 5.2 years living strictly on Social Security (for an average years short of 5.2 times five percent, or 0.26 years). For this retiree, the first year spent living on Social Security payments typically occurs at age 84 years.

3.2. Results for maximum social security income with Bridge fund

How does the possibility of contributing to the Bridge fund change the results? Table 3 reports the results for a male that earns 100% of the Social Security income requirement, has a risk tolerance level that supports a five percent failure rate, and maintains a 60/40 portfolio allocation. Notice that consumption guidance is virtually unchanged, with maximum consumption still occurring at age 63 for initial wealth levels of $300,000 and above. Ending wealth is slightly lower when using the Bridge fund when Social Security payments are delayed until age 64 or beyond.

This pattern is repeated for female investors as displayed in Table 4. When establishing a Bridge fund, females also maximize consumption at age 63 ($50,000) with no decrease in ending median wealth. The considerable wealth remaining at death, whether or not an individual establishes a Bridge fund, is primarily due to precautionary consumption to ensure that their savings is only exhausted five percent of the time.

The fact that consumption and ending median wealth do not change by establishing the Bridge fund suggests that individuals could conceivably consider less risk and still achieve their goals. This pattern does not hold as the time between retirement and Social Security claiming increase. A male with $500,000 in initial wealth who retires at age 62 and claims Social Security at age 70 will have $230,000 less in median ending wealth, while a female under the same assumption will have $261,000 less. The Bridge fund supports the same or slightly higher consumption, but the lower portfolio return while the Bridge fund is active generates significantly less wealth.

3.3.Results for additional scenarios

To illustrate the effect of varying portfolio allocations and failure requirements, a male (Table 5) or a female (Table 6) that has $500,000 in initial wealth is considered. For these investors, maximum consumption is determined in the following scenarios: (1) Bridge fund and no Bridge fund versions of the ROT portfolio allocation at the five percent level of failure; (2) Bridge fund and no Bridge fund versions of the 60/40 allocation at the 25% level of failure; (3) Bridge fund and no Bridge fund versions of the ROT allocation at the 25% level of failure; and finally (4) Bridge fund and no Bridge fund versions of the 60/40 allocation, assuming the investor earns only 50% of the maximum Social Security income across their lifetime, with a five percent probability of failure. These results allow a comparison with the same individual, the retiree with $500,000 in initial wealth, across a wide variety of differing

Table 5 Male, 500K initial wealth, multiple assumption comparison

		Social Security age								
		62	63	64	65	66	67	68	69	70
No Bridge, five percent, 60/40	Consumption	51,000	52,000	52,000	51,000	51,000	51,000	51,000	51,000	50,000
	End wealth	866,100	811,858	767,910	751,087	722,944	672,664	611,816	576,276	600,697
	Years short	0.25	0.26	0.26	0.21	0.20	0.22	0.30	0.36	0.33
Bridge, five percent, 60/40	Consumption	51,000	52,000	52,000	51,000	52,000	52,000	51,000	51,000	51,000
	End wealth	866,100	811,858	761,959	734,080	630,515	560,138	528,837	451,531	370,829
	Years short	0.25	0.26	0.25	0.21	0.28	0.30	0.22	0.21	0.25
No Bridge, five percent, ROT	Consumption	51,000	51,000	51,000	51,000	51,000	51,000	51,000	51,000	50,000
	End wealth	769,097	770,215	732,499	665,860	640,108	594,053	545,750	521,247	538,824
	Years short	0.26	0.19	0.18	0.22	0.21	0.23	0.31	0.35	0.30
Bridge, five percent, ROT	Consumption	51,000	51,000	51,000	51,000	51,000	51,000	51,000	51,000	51,000
	End wealth	769,097	770,215	726,651	646,915	601,408	531,354	448,229	373,917	287,582
	Years short	0.26	0.19	0.18	0.22	0.19	0.20	0.25	0.26	0.32
No Bridge, 25% 60/40	Consumption	60,000	61,000	60,000	59,000	59,000	58,000	57,000	57,000	56,000
	End wealth	437,773	391,137	387,748	370,309	340,936	340,927	336,929	304,486	321,224
	Years short	1.71	1.89	1.80	1.75	1.87	1.81	1.84	2.15	2.20
Bridge, 25%, 60/40	Consumption	60,000	61,000	60,000	59,000	59,000	58,000	56,000	55,000	54,000
	End wealth	437,773	391,137	380,963	348,497	301,347	272,314	269,715	236,487	188,883
	Years short	1.71	1.89	1.75	1.79	1.94	1.93	1.61	1.54	1.58
No Bridge, 25%, ROT	Consumption	60,000	60,000	60,000	59,000	58,000	58,000	57,000	56,000	56,000
	End wealth	378,012	371,778	332,684	319,644	332,505	290,184	288,269	309,578	277,518
	Years short	1.84	1.75	1.87	1.88	1.66	1.90	1.91	1.81	2.25
Bridge, 25%, ROT	Consumption	60,000	60,000	59,000	58,000	58,000	57,000	56,000	55,000	54,000
	End wealth	378,012	371,778	368,194	338,416	292,930	269,259	234,500	205,622	165,553
	Years short	1.84	1.75	1.59	1.61	1.73	1.67	1.73	1.64	1.68
No Bridge, five percent, 60/40, 50%	Consumption	44,000	44,000	44,000	44,000	44,000	44,000	44,000	44,000	43,000
	End wealth	858,926	858,460	824,636	769,532	748,323	706,956	667,120	642,986	657,665
	Years short	0.26	0.21	0.21	0.24	0.23	0.25	0.30	0.33	0.26
Bridge, five percent, 60/40, 50%	Consumption	44,000	44,000	44,000	44,000	44,000	44,000	44,000	44,000	43,000
	End wealth	858,926	858,460	820,388	754,110	719,007	661,320	592,708	528,938	517,624
	Years short	0.26	0.21	0.21	0.24	0.23	0.24	0.28	0.30	0.19

Table 6 Female, 500K initial wealth, multiple assumption comparison

		Social Security age								
		62	63	64	65	66	67	68	69	70
No Bridge, five percent, 60/40	Consumption	49,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
	End wealth	1,126,611	1,059,723	1,018,609	931,701	901,226	847,434	775,448	741,882	707,927
	Years short	0.28	0.28	0.26	0.31	0.27	0.28	0.35	0.38	0.48
Bridge, five percent, 60/40	Consumption	49,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
	End wealth	1,126,611	1,059,724	1,005,818	903,433	851,556	757,151	650,770	558,518	446,637
	Years short	0.28	0.28	0.26	0.31	0.26	0.25	0.29	0.25	0.25
No Bridge, five percent, ROT	Consumption	49,000	50,000	51,000	50,000	50,000	50,000	50,000	49,000	49,000
	End wealth	956,299	886,082	804,867	794,742	773,071	702,720	663,855	743,188	696,476
	Years short	0.25	0.31	0.31	0.32	0.34	0.36	0.36	0.31	0.37
Bridge, five percent, ROT	Consumption	50,000	50,000	50,000	49,000	50,000	50,000	50,000	50,000	50,000
	End wealth	883,021	876,133	859,422	827,061	717,753	643,975	563,042	474,566	374,958
	Years short	0.32	0.28	0.27	0.19	0.25	0.30	0.28	0.27	0.28
No Bridge, 25%, 60/40	Consumption	58,000	59,000	59,000	58,000	58,000	56,000	56,000	56,000	55,000
	End wealth	524,260	460,737	430,532	412,750	363,453	403,036	394,174	345,526	384,758
	Years short	2.01	2.18	2.28	2.13	2.30	1.91	2.18	2.52	2.45
Bridge, 25%, 60/40	Consumption	58,000	59,000	58,000	57,000	57,000	56,000	55,000	54,000	53,000
	End wealth	524,260	460,737	469,131	435,097	376,568	353,737	312,148	282,649	236,218
	Years short	2.01	2.18	1.98	1.97	2.08	1.96	1.96	1.76	1.65
No Bridge, 25%, ROT	Consumption	57,000	58,000	58,000	57,000	57,000	56,000	55,000	55,000	55,000
	End wealth	480,745	423,743	386,102	373,464	348,530	370,101	373,197	344,458	320,374
	Years short	1.84	2.00	2.10	2.06	2.13	1.97	1.90	2.11	2.51
Bridge, 25%, ROT	Consumption	57,000	58,000	57,000	57,000	56,000	56,000	55,000	54,000	53,000
	End wealth	480,744	423,734	431,607	351,901	360,306	291,400	260,491	236,509	201,136
	Years short	1.84	2.00	1.77	2.10	1.81	2.09	2.08	1.86	1.73
No Bridge, five percent, 60/40 50%	Consumption	42,000	42,000	43,000	42,000	42,000	42,000	42,000	42,000	42,000
	End wealth	1,111,084	1,118,511	1,006,326	1,023,673	998,777	959,934	903,409	872,828	845,266
	Years short	0.30	0.23	0.32	0.25	0.22	0.23	0.21	0.26	0.29
Bridge, five percent, 60/40, 50%	Consumption	42,000	42,000	43,000	42,000	42,000	42,000	42,000	42,000	42,000
	End wealth	1,111,084	1,118,511	1,005,326	1,003,925	967,122	900,351	816,695	743,911	663,135
	Years short	0.30	0.23	0.32	0.25	0.21	0.21	0.23	0.21	0.19

scenarios. Some scenarios introduce more risk of failure, such as the 25% maximum failure rate, while others exhibit more risk-averse behavior (ROT allocation). In all cases for both males and females, consumption is maximized no later than age 63, and sometimes as early as age 62, with no loss of ending median wealth and no significant increase in the number of years short.

Two examples illustrate the effect of changing these assumptions. A female that accepts a 25% probability of failure who does not establish a Bridge portfolio and maintains a 60/40 allocation can maximize initial consumption at $59,000 by claiming Social Security at age 63. She will still have a median ending wealth of $460,737, and she would accept the possibility of living an average of 2.18 years on just her Social Security payments (there is no shortage with 75% probability, with an average of 8.72 years short on the trials where failure occurs). As noted earlier (U.S. Government Accountability Office, 2019), at least 29% of households live entirely on Social Security throughout retirement, and there are likely a much larger percentage without personal savings that live entirely on Social Security plus defined benefit pension plans. The same male could consume $61,000 and would possess $391,000 in ending median wealth, with less time on Social Security if he fails (1.9 years; there is no shortage with 75% probability, with an average of 7.6 years short on the trials where failure occurs). The other example includes a male and female with $500,000 in initial wealth that earn just 50% of the maximum Social Security income. Assuming a five percent probability of failure and a 60/40 allocation, a male would maximize consumption of $44,000 by claiming at their retirement age of 62. Similarly, a female would maximize consumption of $43,000 also by claiming at age 64.

4. Conclusions

When examining the results of the study, some general trends emerge. Once past the lower levels of wealth accumulation (starting at $300,000), delaying receipt of Social Security payments beyond age 63, for both male and female, only decreases median ending wealth at death with effectively the same level of consumption in nearly all scenarios, and it has virtually no effect on the average years spent living on Social Security if you fail. The conclusion is that an individual that retires at age 62 should draw Social Security almost as soon as they retire. Because of this, when an individual takes Social Security has far less importance in terms of how much they can consume as compared with how much wealth they possess when they retire. At a five percent chance of failure, each additional $100,000 means $5,000 in additional initial annual consumption for both males and females.

The reason for this must be emphasized. If an individual retires and delays taking Social Security, then they obviously make sizable withdrawals from their initial wealth to fund their current consumption. Unlike Alderson and Betker (2017), who assume a constant level of consumption equal to the individual's initial wealth divided by their life expectancy, which is then added to their Social Security benefit, this article solves for the maximum amount of consumption that only exhausts the initial wealth level consistent with the chosen probability of failure. Using Alderson and Betker's formula, an individual that retires at age 62 with $500,000 in initial wealth would have initial consumption equal to approximately

$50,948. This model has a consumption level that roughly matches Alderson and Betker's consumption level assuming five percent failure; however, consumption is equal to $61,000 at a 25% level of failure.

At lower levels of income, the previous conclusion about when an individual should take their Social Security payment is magnified. An individual that retires at age 62 that has not accumulated much wealth must take their Social Security within the first few years of eligibility or else they must be willing to constrain their consumption to very small levels. For example, a male that has $100,000 in wealth that maximized their Social Security contributions that waits to take Social Security until age 67 can only safely consume $18,000 a year if they accept a five percent chance of failure and do not establish a Bridge fund. This is consistent with the evidence provided by Shoven, Slavov, and Wise (2018) that indicates a primary reason for starting early Social Security payments is the need to consume more than the income earned from a retirement nest egg. This individual would be able to consume considerably more by establishing the Bridge fund ($32,000), albeit with over $730,000 less in median ending wealth. While the individual fails five percent of the time, the average number of years that the male would fall short is very low, because consumption is severely restricted.

Adopting a more conservative allocation strategy such that the percentage invested in stocks is 120 minus an individual's current age did not meaningfully affect the results. Initial consumption was either the same or less under the "rule of thumb" portfolio across both five percent and 25% failure probabilities, and there was no discernable pattern in ending wealth or unconditional years short.

For any level of initial wealth beyond $300,000, the age Social Security payments begin does not meaningfully change the maximum level of consumption at the five percent level of failure; at the 25% level of failure, it only changes consumption by $5,000. Beyond an initial wealth level of $300,000, a $100,000 increase in your initial wealth level changes initial consumption by as much, if not more, than taking Social Security at the earliest opportunity. This suggests that advisors must continue to emphasize that it is as much about how much an individual chooses not to spend before retirement as it is about how much an individual makes in any given year.

The included tables help determine the amount of consumption a person can afford given their wealth and the tolerance for risk. While it is unlikely that an individual would completely maximize their Social Security income, using either Table 5 (males) or Table 6 (females) can help guide an individual. Once an individual has determined which scenario applies by matching their earnings profile to either of the two scenarios, the maximum income or 50% of maximum income, they can determine levels of consumption associated with their choice of establishing a Bridge fund, their asset allocation, and their accepted probability of failure. The respective table demonstrates the resulting levels of wealth and amount of time associated with failure. Thus, an individual can see the difference. For example, assuming maximum income earnings is the baseline, an individual that has $500,000 in retirement assets with no Bridge fund and a ROT allocation can take Social Security at 63 and consume, in real terms, $51,000 a year, assuming a five percent level of failure; this individual will likely die with almost $770,000 dollars in wealth. If this does not match the individual's needs (or wants) for current consumption compared with ending wealth, they can choose to accept a higher level of risk (25%) and take Social Security at age 62 and begin consuming $60,000 a year. The results suggest they will most likely still have $438,000 in wealth at death. Comparing the tradeoffs between consumption, Bridge fund, ending wealth, and possible years of failing will help form opinions about the relative risk aversion for each individual.

Simulations also show that the standard 60/40 endowment allocation provides results that are as good or better than a model that adjusts allocation as a client ages, when it comes to initial level of real consumption and ending wealth. There is a slight increase in the amount of time the average person that fails will live only on Social Security, but it is measured in days not month or years (at the five percentage level). This suggests, though it warrants further investigation, that it is the flow of funds into and out of the investment account, as opposed to making fine tuning adjustments to the asset allocation of the portfolio, that matter for retirement consumption. Likewise, a male investor that believes an average death at 81 is too young could always make their choices from the respective female table. Doing so would add approximately 2.75 years, or an additional 10% of years beyond the statistical death table for males.

Limitations

There are some limitations that must be identified. First and foremost, this article assumes that an individual retires at age 62. As reported by Munnell and Chen (2015), the current trend is to work longer. Also, the model uses Social Security actuarial tables, randomly sampling the age of death; however, many financial planners allow for gradients of life past the standard statistical tables. For instance, current financial planning software allows for a 10%, 20%, and 30% longer life span than projected by the Social Security tables, given a certain age. For this model, the average life expectancy is 19.47 years; extending this by 30% would add an additional 5.84 years of Social Security benefits, as well as consumption. We also only consider single individuals, although a reasonable way to follow the advice provided in this article would be to pool the couple's initial wealth and use guidance from the female results to select an appropriate consumption level.

For each age and wealth combination, approximately 130 simulations of various levels of initial consumption were attempted, each with 2,000 trials, before the highest consumption value where the failure requirement was met was assumed to be the optimal solution. There is no guarantee the solution is optimal, but all results presented are consistent with experiments where more simulation trials were used for comparison. Additionally, the selected returns for either stocks or bonds in actuality may not resemble the returns used in the simulations, or that the long-run correlation used in this simulation will hold going forward.

The model in this article assumes constant, real consumption. Both Social Security payments and consumption are indexed by inflation and the market's estimate of inflation may not be realized. Some retirees may wish to front-load their consumption while they are healthy enough to enjoy it. Additionally, some retirees will still have some expenses such as remaining house payments, and so forth, in the first few years of retirement. At a certain point, as mobility begins to decline and adverse health conditions start to increase, it is reasonable to expect spending to become less on discretionary items such as travel and more on nondiscretionary, such as health care. Thus, a non-linear consumption pattern may be more realistic and is worthy of further research. A retiree who anticipates this type of spending pattern could potentially increase the maximum failure rate (say from five percent to 25%) because Social Security payments would remain for the last few years of the person's life in the event savings is exhausted.

Finally, this research does not account for the effect of taxes. Geisler and Hulse (2018) look at the implications associated with portfolio drawdown strategies when including Social Security benefits pertaining to efforts to extend the life of the portfolio. They show that drawdown strategies do matter and can impact the life of the portfolio. However, as their research shows, assumptions must be made regarding the split between tax-advantaged accounts and those that are fully taxable, marital status, and deduction status (itemized vs. standard).

Acknowledgments

We thank three anonymous reviewers for comments and suggestions which greatly improved the article.

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