Retirement withdrawals: Preventive reductions and risk management

John B. Mitchell

Department of Finance and Law, Central Michigan University, Mt. Pleasant, MI 48859, USA.

Abstract

This paper builds on Stout and Mitchell (2006), Stout (2008), Spitzer (2008), and Blanchett and Frank (2009) by creating a preventive approach to withdrawal management. Proactive strategies, reducing the withdrawal rate before there are insufficient funds, are shown to significantly reduce the probability of ruin while maintaining the median withdrawal rate. Subpopulation effects of strategy changes and improvements in reporting of results are explored. Data covers 1926–2008 and the life table is extended to 108 years. Optimization yields a 6.04% median withdrawal rate and 0.2% probability of ruin. © 2011 Academy of Financial Services. All rights reserved.

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1. Introduction

We use proactive management strategies throughout our lives because we recognize that anticipating adverse events and taking corrective action increases our chances of avoiding larger more catastrophic problems. The same logic can be applied to managing retirement withdrawals. Retirees who quickly react to a declining portfolio by reducing their withdrawals are less likely to run out of money. The pain of reduced income can be smoothed over a period of time and the traumatic and life-changing impact of ruin may be avoided or at least deferred.

This paper builds on the withdrawal rate management work of Stout and Mitchell (2006),

Corresponding author. Tel.: +1-989-774-3651; fax: +1-989-774-6456.
E-mail address: mitch1jb@cmich.edu.

Stout (2008), Spitzer (2008), and Blanchett and Frank (2009). Stout and Mitchell use a set of control limits to manage the withdrawal process and Monte Carlo simulation of security returns and mortality. Stout optimizes the process. Both Spitzer and Blanchett and Frank, using a bootstrapping approach, recommend that retirees act proactively to manage withdrawals based on an implied probability of ruin.

This paper adds to the literature by creating proactive individual-specific withdrawal rate adjustments, extending the life table to age 108, updating security returns through 2008, and by examining the withdrawal rate and probability of ruin distributions in more detail.

2. Literature review

Stout and Mitchell (2006) demonstrate that withdrawal rate management techniques can provide substantial improvements in the withdrawal rate while simultaneously reducing the probability of ruin. Stout and Mitchell find that a fixed real withdrawal rate of 4.5% for 30 years results in a 13.44% chance of ruin based on a 65/35 large-cap stock and intermediate term bond portfolio, 60 year-old retiree, and data from 1926 to 2004. Mortality reduces the probability of ruin to 7.16%. Management of the withdrawal rate process further reduces ruin to 4.43% while increasing the average withdrawal rate to 6.63% and leaving an average legacy 1.07 times the initial portfolio; more than a 50% increase in income at comparable risk to a 4% fixed real withdrawal rate. Stout (2008) updates data through 2006 and demonstrates that the risk of ruin can be reduced to 3.75% by optimizing control limits and portfolio allocation.

Controls, as used by Stout and Mitchell (2006) and Stout (2008) introduce uncertainty in the form of variability in the real withdrawal rate and make it more difficult for retirees to understand the decumulation process. However, such rules are essential (Stout and Mitchell, 2009) to reducing failure and preventing excess accumulations.

Numerous authors explore withdrawal rate management. Most relevant to this research, Blanchett and Frank (2009) add to the literature by exploring a proactive strategy based on annually managing the probability of ruin. Like, Spitzer, Strieter, and Singh (2008), they use bootstrapping of data, fixed withdrawal rate adjustments, and do not directly incorporate mortality. Spitzer (2008) also demonstrates benefits from adjusting withdrawals (and possibly portfolio allocation) periodically.

Existing studies of withdrawal rate management indicate benefits in terms of an improved risk-return relationship and therefore motivate the search for improved methods. This paper demonstrates one such improvement, a Monte Carlo simulation-based proactive withdrawal rate adjustment model incorporating mortality and tailored to the individual situation.

3. Motivation for research

This paper contributes to improved withdrawal rate strategies by using adjustment rules that maintain more than the amortized amount of expected withdrawals, extrapolating the Centers for Disease Control and Prevention (CDC) life table to age 108, updating return data

to 2008 to include recent market instability, and by studying both individual simulation iterations and additional moments of the distribution to determine how many retirees are affected by a particular withdrawal rate strategy.

Most withdrawal rate management studies use fixed, often 30-year, planning horizons. Fixed planning horizons overstate the probability of ruin for older retirees with shorter remaining life spans and understate the probability of ruin for younger retirees. In contrast, this research randomly samples from the life table in the same manner as Stout and Mitchell (2006). However, the life table is extrapolated to age 108 to more conservatively approximate the percentage of superannuated retirees who suffer financial ruin.

Many studies, recently Blanchett and Frank (2009), Spitzer (2008), and Spitzer, Strieter, and Singh (2008), use a bootstrapping technique in which returns are drawn from a historic distribution. Bootstrapping effectively truncates the distribution based on historic experience. If 2008 taught us nothing else, it drove home the point that the future can change very quickly and may bear little resemblance to the past. This research uses the same Monte Carlo simulation technique used in Stout and Mitchell (2006). In Monte Carlo events more extreme than those historically experienced may occur. However, heteroskedasticity may render the distributions built into any model obsolete (Taleb, 2007).

This research studies the effects of withdrawal rate management changes on subgroups of the population. A change in withdrawal management strategy may help some retirees reduce ruin and increase withdrawal rates. However, other retirees, who never experienced ruin, may be penalized with a lower withdrawal rate. These subpopulation effects include studying percentiles of the distribution to identify the fraction of retirees who may not ruin but do suffer potentially disastrous low withdrawal rates. The median, as opposed to the mean, is emphasized because of significant skewness and kurtosis in the distribution of withdrawal rates.

The four modifications of the Stout and Mitchell (2006) and Stout (2008) research: higher downward thresholds, extrapolated life table, updated data, and studying subpopulation effects; provide a more conservative and detailed view of the risk-return relationship. This paper builds upon Spitzer (2008) and Blanchett and Frank (2009) by tailoring withdrawal rate adjustments to individual circumstances including specific consideration of expected life and portfolio value.

4. The withdrawal rate management model

The control variables for managing withdrawals include upward and downward thresholds, maximum and minimum withdrawal rates, and upward and downward adjustment rates.

The upward (UT) and downward (DT) thresholds are multiples of the present value at time (t) at historic rates of return (r) for all time periods equal to expected remaining life span (L).

$$\text{If } PORT_t > (UT \times PVIFA_{DUE(L,r)} \times PORT_0 \times WR_{t-1}) \tag{1}$$

$$\text{then } WR_t = PORT_t / (UT \times PVIFA_{DUE(L,r)} \times PORT_0). \tag{2}$$

$$\text{Similarly, If } PORT_t < (DT \times PVIFA_{DUE(L,r)} \times PORT_0 \times WR_{t-1}) \tag{3}$$

Table 1   Moments of the distributions of remaining lifespan and historic returns (1926–2008) for 65% large-cap stock and 35% intermediate-term government bond portfolio

Age	Remaining lifespan		Historic returns (%)	
	M	SD	M	SD
60	22.51	10.12	5.64	2.10
65	18.69	9.15	5.68	2.67
70	15.15	8.10	5.70	3.19
75	11.95	6.99	5.77	3.62
80	9.15	5.88	5.76	4.11
85	6.83	4.78	5.68	4.60
90	4.99	3.77	5.65	5.52
95	3.60	2.88	5.72	6.42
100	2.60	2.09	5.90	7.68
101	2.40	1.92	6.10	9.88
102	2.20	1.74	6.10	9.88
103	2.10	1.54	6.10	9.88
104	1.90	1.30	6.10	9.88
105	1.60	1.02	6.10	9.88
106	1.30	0.67	6.41	13.72
107	0.80	0.26	6.41	13.72
108	0.00	0.00	6.41	13.72

Note.   Returns from *Stocks, bonds, bills, and inflation* (2009). Remaining lifespan from Centers for Disease Control and Prevention (2007).

$$\text{then } WR_t = PORT_t/(DT \times PVIFA_{DUE(L,r)} \times PORT_0). \tag{4}$$

$$\text{Otherwise, } WR_t = WR_{t-1}. \tag{5}$$

This research differs from Stout and Mitchell (2006) and Stout (2008) by allowing the DT to exceed a value of 1. A DT of 1.5, for example, requires a 50% excess over the discounted value of expected withdrawals. It is this higher DT that constitutes the proactive aspect of the withdrawal management strategy. Retirees are required to anticipate the need to reduce their withdrawals. DT above 1 are mentioned in Stout and Mitchell, but not pursued. The higher DT is similar to the technique used by Blanchett and Frank (2009) in which the implied probability of ruin controls when changes in the withdrawal rate occur.

The mechanism in this research also requires an adjustment individually tailored to a retiree's portfolio and their expected remaining life. Blanchett and Frank (2009) reduce the planning horizon by one year for each year of life. However, expected remaining life decreases less rapidly (see Table 1). For example, a 60-year old has an expected remaining life of 22.51 years while at age 70 expected remaining life is 15.15 years, only 7.36 years less.

The maximum (MAX) and minimum (MIN) withdrawal rates are the highest and lowest withdrawal rates (WR_t) allowed for an individual retiree. The MIN may be violated only in the year of ruin, as the retiree takes remaining funds from the portfolio.

UR and DR adjustment rates are the fraction of available increase or decrease taken during a particular period. For example, if a retiree amortizes their portfolio over their expected remaining life span at historic rates of return and finds the portfolio could sustain a 10%

withdrawal rate (WR_{PRELIM}) as compared to a current 6% withdrawal rate, a 40% UR would allow them to only increase the withdrawal rate to 7.6% that is ($6\% + [.4 \times \{10\% - 6\%\}]$).

$$\text{If } WR_{PRELIM} > (WR_{t-1} + (UR \times (WR_{PRELIM} - WR_{t-1}))), \tag{6}$$

$$\text{then } WR_t = (WR_{t-1} + (UR \times (WR_{PRELIM} - WR_{t-1}))), \tag{7}$$

$$\text{Similarly, if } WR_{PRELIM} < (WR_{t-1} - (DR \times (WR_{t-1} - WR_{PRELIM}))), \tag{8}$$

$$\text{then } WR_t = (WR_{t-1} - (DR \times (WR_{t-1} - WR_{PRELIM}))). \tag{9}$$

5. Data and simulation procedure

There are 50,000 iteration simulations, all with the same seed, performed in GoldSim 10.0 (Goldsim, 2009) utilizing the same procedure as Stout and Mitchell (2006) and Stout (2008). Return data are from Ibbotson SBBI (Ibbotson Associates, 2009) for the period 1926–2008. Portfolios are limited to a single combination of the Large-cap Stock (65%) and Intermediate-term Government Bond (35%) indexes; chosen to mimic the recommendation for 60-year olds in Stout. Average arithmetic real return and (standard deviation) are: Large-cap Stocks 8.47% (20.57%) and Intermediate-term Government Bonds 2.57% (6.86%). Natural logs are used to normalize the distribution. Ruin is defined as the year in which a retiree (iteration) falls below MIN. Years of ruin are calculated until death. The average withdrawal rate is the average over all years to death, including years of ruin. The portfolio is assumed to be rebalanced each year at zero cost and withdrawals are calculated on a before-tax basis, consistent with most studies.

Table 1 contains expected remaining life span and its standard deviation at ages 60 through 108 based on the 2004 Life Table (Centers for Disease Control and Prevention, 2007). The CDC life table annual death rate is extrapolated linearly from age 98–99 and carried forward until the age (108) at which truncation of the table reproduces the expected life span for age 100. Stout and Mitchell (2006) and Stout (2008) truncate the distribution at age 100. The extrapolated life table more accurately reflects risk for the oldest and most vulnerable retirees.

Historic average returns, and standard deviations, for holding periods equal to expected remaining life span are also reported in Table 1. Holding period returns behave in a somewhat random manner, although shorter holding periods do have higher standard deviations.

6. Results

6.1. Comparison to previous research

Stout and Mitchell (2006) report, for example, for a 4.5% Initial Withdrawal Rate (INIT), 2.4 UT and 1.0 DT (equivalent to the 1.4 and 0.0 reported in Stout and Mitchell), 0.2 UR and 1.0 DR, 40% MAX and 3% MIN. These controls yield a 6.63% average withdrawal rate, 4.33% probability of ruin to age 100, and average ending portfolio 1.07 times the beginning

Table 2   Effects of downward threshold (DT) on initial withdrawal rate (INIT), average withdrawal rate (AWR), average ending portfolio, and probability and length of ruin

DT	INIT	AWR		Ending portfolio		Probability of ruin at age		Ruin (years)	
		M	SD	M	SD	108	100	First	Maximum
1.0	5.00	6.47	3.04	.86	1.05	10.31	9.65	13	29
1.1	5.00	6.45	3.05	.87	1.04	8.54	7.88	13	28
1.2	5.00	6.42	3.05	.89	1.04	7.02	6.28	13	28
1.3	5.00	6.40	3.06	.91	1.04	5.80	5.05	13	27
1.4	5.00	6.37	3.08	.94	1.04	4.79	4.12	13	27
1.5	4.82	6.34	3.12	.97	1.05	4.01	3.43	13	26
1.6	4.52	6.30	3.17	1.01	1.06	3.40	2.90	14	25
1.7	4.25	6.26	3.21	1.04	1.07	2.92	2.54	14	24
1.8	4.02	6.22	3.24	1.08	1.08	2.59	2.25	14	24
1.9	3.81	6.19	3.27	1.11	1.11	2.33	2.04	14	24
2.0	3.62	6.15	3.28	1.13	1.13	2.17	1.93	14	24

Note. A 40% maximum withdrawal rate (MAX), 3% minimum withdrawal rate (MIN), 2.734 upward threshold (UT), 0.312 upward adjustment rate (UR), and 1.0 downward adjustment rate (DR) for retiree age 60.

amount based on 1926–2004 data. The same controls, updated to 2008, yield a 6.47% average withdrawal rate, 8.68% probability of ruin to age 100 (9.38% to age 108), and average ending portfolio 0.88 times the beginning amount. Recent returns, particularly 2008, require an increased perception of risk and make comparison to earlier studies difficult.

Stout (2008) reports that a 60-year old retiree with a 5% INIT, no MAX, 3% MIN, 2.734 UT, 1.0 DT, 0.312 UR, and 1.0 DR experiences an average withdrawal rate of 6.25%, average ending portfolio of 1.19, and a 5.88% probability of ruin. Updating to 2008, and limiting MAX to 40%, yields a 6.47% average withdrawal rate, ending portfolio of 0.86, and 10.31% probability of ruin to age 108 (9.65% at age 100).

Note that the controls proposed in Stout and Mitchell (2006) yield better results, updated to 2008, than the optimal solution proposed by Stout (2008). The average withdrawal rate is the same (6.47%) while the probability of ruin to age 100 is lower by 0.97% (8.68% vs. 9.65%). What is optimal today may not be tomorrow; presumably because of heteroskedasticity.

Blanchett and Frank (2009) is difficult to compare to because of differences in controls, treatment of mortality, and the return sampling process (Monte Carlo vs. bootstrapping). Blanchett and Frank, like Stout (2008), does not include 2008 data that understates the probability of ruin. Their 4% INIT results in a 2.65% probability of ruin with 8.83% average withdrawal rate in the final (30th) year. This research finds that a 4.02% INIT (DT of 1.8) yields a 1.35% probability of ruin and 12.88% average withdrawal rate in the 30th year. Despite differences in methods, the proactive model in this paper appears to provide more return with less risk.

6.2. The efficacy of higher downward thresholds

Table 2 provides results for DT 1.0 through 2.0. DT 1.5 and higher limits the INIT because the DT multiplied by the $PVIFA_{DUE}$ for the expected life (initially 23 years) and the 5%
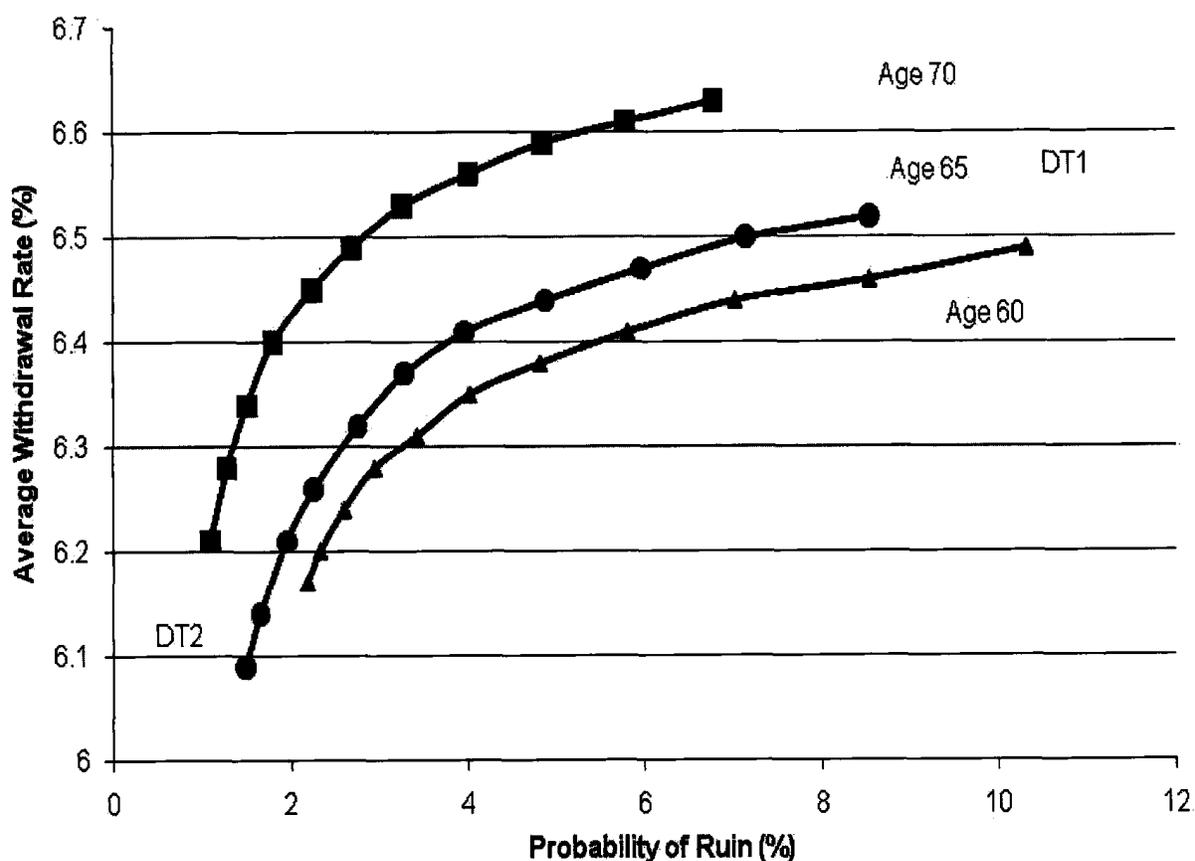
Fig. 1. Effects of downward threshold (DT) on average withdrawal rate (AWR) and probability of ruin for ages 60, 65, and 70; 40% maximum withdrawal rate (MAX), 3% minimum withdrawal rate (MIN), 2.734 upward threshold (UT), 0.312 upward adjustment rate (UR), and 1.0 downward adjustment rate (DR).

intended INIT exceeds the Initial Portfolio. Therefore, Table 2 shows the effective (maximum) Initial Withdrawal Rate for each DT.

Table 2 demonstrates that a DT greater than 1 is effective at preventing ruin. A decrease of 0.32% in the average withdrawal rate (6.47% to 6.15%), a 4.9% rate of decrease, is offset by more than an 8% (10.31% to 2.17%) decrease in the probability of ruin, a 79% rate of decrease. The slightly lower withdrawal rate experienced at higher DT is reflected in a slightly higher ending portfolio. The higher DT is not successful, however, in significantly extending the time until first ruin or longest time in ruin, both of which represent a worst case scenario rather than averages. Average years in ruin decreases from 0.49 to 0.09 (not shown in table) as the DT increases from 1 to 2. Time in ruin is concentrated on a relatively few individuals who may endure close to 30 years of ruin at the lower DT. Those few retirees who continue to experience ruin benefit from a decrease from 4.71 years to 4.20 years. In summary, far fewer experience ruin at the higher DT and those who do ruin suffer for a shorter period of time.

Fig. 1 incorporates the data from Table 2 for retirees at age 60 (bottom line) and similar results for ages 65 middle line) and 70 (top line). DT 1 anchors the right end of the curve.

Table 3 Effects of downward threshold (DT) on average withdrawal rate (AWR) of lowest x% of retirees and percentage of retirees not reaching withdrawal rates of 2–5%

DT	AWR of lowest x% of distribution of retirees							% of retirees not reaching x% AWR			
	Median	5%	4%	3%	2%	1%	.1%	5%	4%	3%	2%
1.0	5.15	3.63	3.48	3.28	2.95	2.63	1.92	49.30	8.69	2.02	.14
1.1	5.19	3.61	3.49	3.32	3.05	2.66	1.92	48.73	9.46	1.88	.14
1.2	5.23	3.57	3.47	3.33	3.10	2.68	1.92	47.93	10.48	1.75	.14
1.3	5.27	3.52	3.43	3.32	3.14	2.69	1.92	47.10	11.80	1.66	.14
1.4	5.29	3.47	3.39	3.29	3.16	2.71	1.93	46.36	13.41	1.59	.14
1.5	5.31	3.41	3.33	3.25	3.15	2.72	1.93	45.16	15.35	1.52	.14
1.6	5.31	3.34	3.28	3.21	3.12	2.73	1.93	44.87	17.64	1.47	.14
1.7	5.27	3.28	3.32	3.16	3.09	2.74	1.92	45.07	20.17	1.42	.14
1.8	5.23	3.22	3.17	3.12	3.07	2.75	1.91	45.86	23.03	1.40	.14
1.9	5.19	3.17	3.12	3.08	3.05	2.75	1.90	46.79	26.96	1.37	.14
2.0	5.16	3.12	3.09	3.06	3.03	2.76	1.89	47.41	27.38	1.37	.14

Note. A 40% maximum withdrawal rate (MAX), 3% minimum withdrawal rate (MIN), 2.734 upward threshold (UT), 0.312 upward adjustment rate (UR), and 1.0 downward adjustment rate (DR) for retiree age 60.

As DT rises, both the withdrawal rate and the probability of ruin fall. Data for ages 65 and 70 is compiled using the same controls as for age 60 so as to preserve comparability between ages. The fact that the age 65 and 70 curves are higher and to the left of the age 60 curve indicates that individuals who delay retirement can achieve higher withdrawal rates with less risk, as shown in other studies. The close to parallel curves in Fig. 1 indicate a similar risk-return effect from any modification of DT. Higher DT are effective at all three ages.

Table 3 contains moments of the distribution of the average withdrawal rate. The median is, on average, 1.09% below the mean. The distribution of average withdrawal rate is skewed because of some retirees approaching the 40% MAX in as little as 12 years. Therefore, the median is more appropriate to report, than is the commonly reported mean, because the median better reflects what retirees can expect as individuals. Note in Table 3 that the median withdrawal rate increases as DT increases (to 1.6). Therefore, the typical retiree will actually experience an increase in their withdrawal rate at higher DT, in contrast to the evidence provided by the mean.

Reducing MAX (as a way to reduce skewness and kurtosis) does not significantly affect the probability of ruin (Mitchell, 2009). The population likely to experience ruin, those with underperforming portfolios, is not likely to be affected by MAX.

Table 3 provides the average withdrawal rate that distinguishes the lowest (x%) of the distribution. At DT 1.0 the lowest 5% of retirees average a 3.63% withdrawal rate while the lowest 4% average 3.48% withdrawals. The DT has very little impact on the average withdrawal rate for the lowest 0.1% of retirees and modest impact until reaching the 4th to 5th percentiles of retirees. Note also that DT 1.5 is tied with 1.6 for the highest median but has slightly higher withdrawal rates for the lower percentiles. A higher DT saves some retirees from ruin without significantly affecting the withdrawal rate. At DT 1.0 the 10.31% (Table 2) probability of ruin means that all (or virtually all) retirees with a 3.63% average withdrawal rate (lowest 5% of retirees), and most likely some with higher rates, do even-

Table 4   Selected moments of the distribution of average withdrawal rate (AWR)

Age	Downward threshold 1.0						Downward threshold 1.5					
	Mean	5%	25%	Median	75%	95%	Mean	5%	25%	Median	75%	95%
60	5.00	5.00	5.00	5.00	5.00	5.00	4.82	4.82	4.82	4.82	4.82	4.82
65	5.17	3.92	4.53	5.08	5.71	6.75	4.67	3.23	3.76	4.41	5.31	6.99
70	5.93	3.34	4.24	5.40	7.08	10.31	5.63	3.12	3.76	4.88	6.75	10.67
75	6.99	1.91	4.16	6.42	9.23	14.02	6.92	1.73	3.99	6.31	9.23	14.24
80	8.39	1.33	4.10	7.37	11.68	18.96	8.53	1.43	4.27	7.55	11.83	19.01
85	9.78	.94	4.04	8.31	14.18	23.67	10.16	1.27	4.63	8.89	14.50	23.45
90	11.64	.69	4.18	9.76	17.55	28.91	12.37	1.25	5.39	10.93	18.10	28.41
95	13.35	.50	4.23	11.18	20.91	33.12	14.42	1.24	6.15	12.99	21.55	32.32
100	16.12	.58	5.42	14.42	25.81	36.74	17.63	1.32	7.70	16.75	26.97	36.68
108	20.82	1.84	10.31	21.18	31.54	38.71	23.39	3.00	13.53	24.88	34.13	39.33

Note. A 40% maximum withdrawal rate (MAX), 3% minimum withdrawal rate (MIN), 2.734 upward threshold (UT), 0.312 upward adjustment rate (UR), and 1.0 downward adjustment rate (DR) for retiree age 60.

tually ruin. At the other extreme, DT 2.0 has a probability of ruin of only 2.17% (Table 2) and therefore retirees with even a 3.06% average withdrawal rate, lowest 3% of retirees, probably avoided ruin. It is difficult to change the average withdrawal rate except by keeping retirees 'in the game.' The goal must be to help retirees have reasonable expectations and a mechanism for avoiding overspending.

Table 3 also demonstrates that the percentage failing to average 5% is lowest (44.87%) at DT 1.6. There is a greater impact on the percentage failing to achieve 4% with lower DT being better. Higher DT trap some retirees at withdrawal rates between 3% and 4% when using a 3% MIN. Although this reduction in consumable income appears unfavorable, it protects those same retirees from ruin.

Table 4 provides select moments of the withdrawal rate distribution for DT 1.0 and 1.5. The mean and median withdrawal rates are lower for the higher DT (1.5 vs. 1.0) until age 80. The rising mean and median, especially at higher ages, raises questions from a life-cycle perspective about available funds for consumption. Retirees may prefer greater consumption at younger ages when they are more active, and therefore prefer the lower DT, at the expense of reduced consumption if they superannuate. The higher DT, however, is rewarded with increasing gains in both mean and median over time. These gains are made possible by the greater conservatism at younger ages.

MAX and MIN withdrawal rates are not shown in Table 4. The MIN of 3% is reached at age 63 (DT 1.0) and age 61 (DT 1.5). Note that DT 1.5 better prevents almost all retirees from experiencing ruin, as evidenced by higher sub-3% withdrawal rate values in the 5th percentile column. The MAX of 40% is reached at age 72 for both DT. The DT is virtually irrelevant, except for possibly affecting the INIT, near the upper end of the distribution. Retirees at the top end of the distribution are, as discussed before, essentially a different population.

Both DT keep the middle 50% of the population near, or above, a 4% withdrawal rate. DT 1.5, however, forces most retirees to reduce their withdrawal rate early in retirement as evidenced by the lower mean and median. This is the price for reducing the risk of ruin in old age.

Table 5   Sub-population effects based on a sample of 5,000 retirees

Panel A: Changing downward threshold (DT) from 1.0 to 1.5 at 3% minimum withdrawal rate (MIN)

Ruin	Average withdrawal rate increased			Average withdrawal rate decreased		
	Population affected (%)	AWR change (Bp)	Ruin change (Years)	Population affected (%)	AWR change (Bp)	Ruin change (years)
Increased	0	N/A	N/A	.02	−11	+1
Unchanged	26.54	+40	0	65.08	−39	0
Decreased	5.62	+32	−4.58	2.74	−16	−2.20
Totals	32.16			67.84		

Panel B: Changing minimum withdrawal rate (MIN) from 3% to 2% at 1.5 downward threshold (DT)

Ruin	Average withdrawal rate increased			Average withdrawal rate decreased		
	Population affected (%)	AWR change (Bp)	Ruin change (Years)	Population affected (%)	AWR change (Bp)	Ruin change (years)
Increased	0	N/A	N/A	0	N/A	N/A
Unchanged	2.78	+13	0	9.76	−13	0
Decreased	1.24	+15	−6.18	1.90	−11	−2.74
Totals	4.02			11.66		

Note. A 40% maximum withdrawal rate (MAX), 2.734 upward threshold (UT), 0.312 upward adjustment rate (UR), and 1.0 downward adjustment rate (DR) for retiree age 60.

The moments of the distribution shown in Tables 3 and 4 demonstrate the risk reduction benefits of a higher DT; and that those benefits come at the expense of reduced consumption early in retirement. Table 5 (Panel A) provides information about how many retirees are helped, or hurt, by switching from DT 1.0 to 1.5. Approximately 32% of retirees experience an increased average withdrawal rate. Of these, 26% have no reduction in ruin but benefit from a 40 basis point increase in withdrawals while approximately 6% experience both decreased ruin (average 4.58 years) and a 32 basis point increase in their withdrawal rate. Of the 68% of retirees with a decreased withdrawal rate, about 3% offset a 16 basis point withdrawal rate decrease with a 2.2 year decrease in ruin. The choice is subjective, but they likely would favor such a plan as having a small price for avoiding over two years of ruin. However, over 65% of retirees see, on average, a 39 basis point withdrawal rate decrease with no offsetting reduction in ruin and 0.02% of retirees (1 of the 5,000 sampled) have both an 11 basis point decrease in withdrawal rate and a one-year increase in ruin. Of course retirees do not know, ex ante, which group they will be in and must choose model parameters based on the typical 16 basis point increase in median withdrawal rate (Table 3) and 6.3% decrease in probability of ruin (Table 2) and their personal ability to withstand risk.

6.3. Living within one's means: Reducing the minimum withdrawal rate

Table 3 demonstrates that less than 2% of retirees fall below a 3% average withdrawal rate and almost no retirees (.14%) fall below 2%. Reducing MIN from 3% to 2% should allow even more retirees to survive ruin, albeit at low withdrawal rates.

As MIN is reduced from 3% to 2% there is little impact on the average withdrawal rate

and ending portfolio (Table 6). However, the probability of ruin is greatly reduced both at DT 1.0 (10.31% to 6.67%) and at 1.5 (4.01% to 1.60%). This is because the 2% MIN specifically addresses the needs of those retirees unfortunate enough to experience very low portfolio returns. Retirees with underperforming portfolios have the unfortunate choice of maintaining a higher withdrawal rate until they finally reach ruin or living within their smaller means. At DT 1.5 the risk of ruin can be reduced to 0.1% if retirees are willing to accept a 0.41% MIN (not shown in table), while at DT 1.0 even a 0.01% MIN only reduces the probability of ruin to 0.26%. These withdrawal rates compare very unfavorably to the 4.15% SAFEMAX rate reported in Bengen (2006) because of differences in methodology and the time period studied. The problem of needing to satisfy the most extreme outlier is dealt with here by defining the SAFEMAX rate as having a probability of ruin of 0.1%, that is, the lowest 50 of 50,000 results are ignored (see Mitchell, 2009). The SAFEMAX fixed rate based on 1926–2008 data and 50,000 iterations is 1.96% for age 108 and 1.97% for age 100. The 0.01% difference is a small price for potentially eight years of additional protection.

The lower MIN also lengthens the time until first ruin (from 13 to 19 years at DT 1.5) and shortens maximum years of ruin (from 26 to 10 years at DT 1.5). With little cost in terms of withdrawal rate and ending portfolio, the likelihood of ruin is greatly reduced and its onset delayed.

Table 6 also compares the percentage of retirees who fail to reach average withdrawal rates of 2% to 5%. At DT 1.0 there is a slight increase in the percentage not reaching 4% to 5%, and a decrease in the percentage failing to reach 2% to 3%. The 2% MIN forces some retirees to reduce withdrawals, avoiding ruin, but does a better job than a 3% MIN at keeping retirees above a 3% average withdrawal rate. For example, while there is an increase in retirees failing to reach a 4% withdrawal rate at DT 1.5, close to zero (.08%) retirees fall below 2%.

Table 6 demonstrates that while the medians are unchanged, retirees at the very bottom of the distribution are actually helped by the lower MIN. The average withdrawal rate for the lowest 0.1% of the distribution rises for both DT 1.0 and 1.5 as those retirees are prevented from ruin for a longer period of time, although probably not entirely. At the lower DT even the bottom 2% of retirees are helped.

Table 5 (Panel B) reports on the subpopulation effects of changing from a 3% MIN to 2% at DT 1.5. Of the 3.14% with reduced ruin (based on a sample of 5,000 retirees); 1.24% save 6.18 years of ruin and gain 15 basis points of withdrawals, while the other 1.90% save 2.74 years of ruin but lose 11 basis points of withdrawals. Both groups are likely happy. Of the 96.86% with no change in ruin; 84.32% have no change in average withdrawal rate, 2.78% have a 13 basis point increase, and 9.76% experience a 13 basis point decrease in withdrawals. It is only this latter group that is, without question, harmed.

In summary, reducing MIN from 3% to 2% affects less than 16% of retirees. Significant gains in reduced ruin are achieved with small (11 to 15 basis point) changes in the average withdrawal rate. Most of those who ruin at a 3% MIN no longer do so.

6.4. Optimization of the model

Three aspects of the optimization process differ from Stout (2008). This model, as previously described, potentially includes a DT greater than 1, utilizes an optimization

Table 6 Effects of parameter changes on average withdrawal rate (AWR), ending portfolio, ruin, percent of retirees not reaching average withdrawal rates of 2% to 5%, and average withdrawal rates of lowest x% of retirees

DT	MIN	AWR	Ending portfolio	Ruin (%) at age		Ruin (years)		% of retirees not reaching x% AWR				AWR for lowest x% of retirees						
				108	100	First	Max	5%	4%	3%	2%	Median	5%	4%	3%	2%	1%	.1%
1.0	3	6.47	.86	10.31	9.65	13	29	49.30	8.69	2.02	.14	5.15	3.63	3.48	3.28	2.95	2.63	1.92
1.0	2	6.46	.86	6.67	5.96	17	22	49.31	9.34	1.89	.11	5.15	3.55	3.41	3.25	3.03	2.72	1.98
1.5	3	6.34	.97	4.01	3.43	13	26	45.16	15.35	1.52	.14	5.31	3.41	3.33	3.25	3.15	2.72	1.93
1.5	2	6.33	.98	1.60	1.07	19	10	45.15	15.46	2.61	.08	5.31	3.31	3.19	3.06	2.89	2.66	2.06
Optimal	.07	6.64	.68	0.002	0.000	43	2	29.88	11.08	2.09	.08	6.04	3.46	3.33	3.18	2.98	2.69	2.04

Note. A 40% maximum withdrawal rate (MAX), 2.734 upward threshold (UT), 0.312 upward adjustment rate (UR), and 1.0 downward adjustment rate (DR). Downward threshold (DT) 3 and minimum withdrawal rate (MIN) 3% (row 1) constitutes the same parameters as Stout (2008). Optimal solution 4.03% initial withdrawal rate (INIT), 23.33% MAX, 0.07% MIN, 1.908 UT, 1.000 UR, 1.465 DT, and 0.651 DR for retiree age 60.

Table 7 Sub-population effects of optimal solution versus Stout (2008)

Ruin	Average withdrawal rate increased			Average withdrawal rate decreased		
	Population affected (%)	AWR change (Bp)	Ruin change (years)	Population affected (%)	AWR change (Bp)	Ruin change (years)
Increased	0	N/A	N/A	0	N/A	N/A
Unchanged	56.14	+82	N/A	35.48	−77	N/A
Decreased	4.54	+23	−7.41	3.84	−32	−3.83
Totals	60.68			39.32		

Note. Stout (2008) in parentheses. 4.03% (5.00%) initial withdrawal rate (INIT), 23.33% (40%) maximum withdrawal rate (MAX), 0.07% (3.00%) minimum withdrawal rate (MIN), 1.908 (2.734) upward threshold (UT), 1.000 (.312) upward adjustment rate (UR), 1.465 (1.000) downward threshold (DT), and 0.651 (1.000) downward adjustment rate (DR) based on a sample of 5,000 retirees age 60.

function based on the median, as opposed to mean, and constrains the probability of ruin to a value less than 0.1%.

Optimization yields a 4.03% INIT, 23.33% MAX, 0.07% MIN, 1.908 UT, 1.000 UR, 1.465 DT, and 0.651 DR for retirees age 60. Table 6 compares results for this model to updated results (row 1) based on Stout (2008). The new model increases the median withdrawal rate from 5.15% to 6.04%, increases the average withdrawal rate from 6.47% to 6.64%, and reduces the average ending portfolio from 0.86 to 0.68 per beginning dollar in real terms.

Ruin is difficult to compare between the two models because it is defined here as not maintaining a 0.07% withdrawal rate compared to the more restrictive 3% in Stout (2008). Ruin falls from 10.31% at age 108 to 0.2% (2.10% if the 3% minimum is applied). First ruin is delayed from 13 years to 43. Average time in ruin is reduced from 0.49 years to 0.0028. The 0.20% probability of ruin differs from the 0.10% used in the optimization process because of the different sample (50,000 vs. 5,000 iterations).

Of retirees, 70% experience at least a 5% average withdrawal rate, 89% at least 4%, 98% at least 3%, and 99.92% at least 2%. Stout (2008) has similar results with the exception of a higher, 91%, of retirees achieving 4% and a much lower 51% achieving 5%.

Table 7 reports subpopulation effects of changing from the optimal solution reported in Stout (2008) to the optimal solution found in this research; 8.38% of retirees experience reduced ruin, 4.54% experience a saving of 7.41 years and an increase in the average withdrawal rate of 23 basis points, while 3.84% save 3.83 years, on average, but lose 32 basis points of return. Of the other 91.62% with no change in ruin, 56.14% have an 82 basis point increase in the average withdrawal rate and 35.48% experience a 77 basis point decrease in average withdrawal rate.

In summary, changing from the solution proposed in Stout (2008) to the parameters proposed in this research virtually eliminates ruin while allowing over 60% of retirees to experience an increase in their withdrawal rate with over 70% achieving at least a 5% rate. If retirees can endure a 2% average real withdrawal rate, with less than 0.1% chance of occurrence, they can expect a withdrawal rate of approximately 6% with virtually no chance of ruin.

7. Conclusions

Results demonstrate that proactive withdrawal rate management, downward thresholds greater than 1.0, significantly reduce the probability of ruin. By increasing the downward threshold to 1.5 a 9.65% probability of ruin can be reduced to 3.43% with little reduction in average withdrawal rate and actually an increase in the typical (median) withdrawal rate. While extending the simulation to age 108 increases the probability of ruin to 4.01%, a reduction in the minimum withdrawal rate from 3% to 2% reduces the probability of ruin to 1.60%.

Researchers should be wary of comparing results from studies that utilize different time periods. Likewise, practitioners should be wary of creating client expectations based on historic distributions of security returns. The 4.33% probability of ruin reported by Stout and Mitchell (2006) based on data through 2004 becomes 8.68% using data thru 2008. Similarly, a 5.88% probability of ruin (Stout, 2008) becomes 9.65% when updated to 2008 data.

Subpopulation effects shed additional light on the choice of withdrawal rate strategies. Positive skewness, which result from the high maximum withdrawal rates necessary for many retirees to avoid excess accumulations, make reporting of the mean withdrawal rates misleading. Median withdrawal rates, not commonly reported in the literature, may be a more effective way of communicating expectations to clients. Study of the bottom portion of the distribution of withdrawal rates also helps gain an understanding of how changes in withdrawal rate strategies affect those retirees most likely to ruin. Averages are useful, but may lead to incorrect conclusions as to which withdrawal rate strategy will best help the largest number of retirees.

Optimization yields a 6.04% median withdrawal rate to age 108 at a 0.2% probability of ruin. This 50% improvement over the traditional 4% recommendation is produced with virtually no risk of running out of money even to age 108.

There is a continued need for research on acceptable risk levels among retirees, techniques that focus on underperforming portfolios and managing risk during the final years, and standards for effectively utilizing simulation and increasing the comparability of results across studies.

Acknowledgment

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