Seeing the RMD in a New Light:
The Required Minimum Distribution and its
Implications for Retirement Portfolio Design

The required minimum distribution (RMD) may often be viewed in a harsh light by investors who are forced to make the annually specified withdrawals. In reality, the RMD is a well designed withdrawal protocol that mathematically guarantees that a portfolio cannot be liquidated prior to the age of 116. In light of that, retirees with money in accounts which are governed by RMD guidelines should consider a broadly diversified, growth oriented asset allocation during their retirement years. This article analyzes the performance of four retirement portfolios ranging from no-risk to moderate risk during 25 rolling 25-year periods as RMD-based annual withdrawals were extracted. Based on this analysis, there is strong support for a growth oriented asset allocation during the post retirement years.

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INTRODUCTION

Retirement portfolios are exposed to a variety of potentially hazardous conditions. Survival of the portfolio is a function of its design and how it is managed.

One hazard is known as "sequence-of-returns" risk and/or inadequate portfolio returns. If the portfolio experiences large losses in the early years (a bad initial sequence-of-returns) and/or overall poor performance, the longevity of the portfolio can be compromised. A powerful tool to manage this particular hazard is building a broadly diversified retirement portfolio that enlists a variety of asset classes that tend to have low correlation with each other. In this way, a "sequence-of-returns" spectrum is created among the various components of the portfolio. One of the primary goals, therefore, of portfolio diversification is to minimize the probability that all of the portfolio ingredients will simultaneously experience a poor sequence-of-returns AND hopefully ensure that the portfolio performance is adequate to meet the needed income demands of the retiree.

Another hazard is too much money being withdrawn by the retiree (an over-aggressive withdrawal rate). This is often the result of the portfolio being too small—leading the retiree to use a potentially unsafe rate of withdrawal (such as 10% or 12%) that will likely lead to premature insolvency. Or, it's possible the retiree is simply unaware of what constitutes a "reasonable" withdrawal rate and errs on the high side.

Interestingly, the RMD (Required Minimum Distribu-

tion) can serve as a guide to a reasonable withdrawal rate—at least during the first 10-15 years. Moreover, the mathematics of the RMD (using the Uniform Lifetime Table) virtually guarantee that a portfolio—regardless of performance—cannot be fully liquidated in less than 47 years. Understandably, if the portfolio experiences large losses, the annual RMD-based withdrawals may become increasingly smaller but the portfolio account still will not go to zero prior to the age of 117 (based on the RMD-based withdrawals starting at age 70).

Understanding the mathematical nature of the RMD and the rate at which it depletes a retirement portfolio can inform financial advisors and individual investors as they build retirement portfolios that take the RMD into account. In short, retirement portfolios that are too conservative ignore the natural safety net that is part of the design of the RMD. Retirees should spend less time worried about whether or not their retirement portfolio will run out of money and focus more attention on whether or not the RMD-based annual withdrawals will be adequate to meet their needs.

ASSESSING THE DESIGN OF THE RMD

For retirees or those nearing retirement, the real test of a portfolio and the asset allocation model that drives it occurs when money is being systematically withdrawn. This is sometimes called the "distribution phase" of a portfolio. Very simply, it is a portfolio torture test. The sequence-of-returns experienced by the portfolio becomes critical during this period since negative returns in the early years of withdrawals can impact the amount of money that can be withdrawn. However, the required minimum distribution (or RMD) is a natural defense against portfolio failure. The RMD may be viewed by many retirees as a burden and annoying. The analysis presented here may change that perception.

The following is the IRS language regarding what types of accounts are governed by the RMD: "*The RMD rules apply to all employer sponsored retirement plans, including profit-sharing plans, 401(k) plans, 403(b) plans, and 457(b) plans. The RMD rules also apply to traditional IRAs and IRA-based plans such as SEPs, SAR-SEPs, and SIMPLE IRAs. The RMD rules also apply to Roth 401(k) accounts. However, the RMD rules do not apply to Roth IRAs while the owner is alive.*"

Clearly, a vast host of retirees have investment accounts that are impacted by the RMD rules. Here's the amazing part: the mathematics of the RMD guarantee that a portfolio cannot be liquidated within 47 years IF only the RMD amount is withdrawn each year and nothing beyond that amount. The required minimum withdrawal may be inadequate to meet the needs of the retiree in the later years, but that is a different matter. If speaking only in terms of retirement portfolio survival, the RMD accomplishes this objective for 47 years as shown in Table 1. The analysis presented here will be using the RMD withdrawal rates as stipulated in the Uniform Lifetime Table (which applies to retirees whose spouse is not more than 10 years younger than themselves).

Table 1 shows the RMD divisors which are used to calculate each year's distribution (*i.e.*, withdrawal) from the portfolio. In year one (age 70), for example, the divisor is 27.4 (which is equivalent to a withdrawal rate of 3.65%). If the account balance was $1,000,000 at the end of the prior year, the required minimum distribution would be calculated as $1,000,000 / 27.4 = $36,496. Then, in year two (using the fixed 5% annual return scenario) the distribution would be the balance at the end of year one ($1,013,504) divided by 26.5 which determines the required distribution of $38,245, and so on. The RMD divisor in year two of 26.5 is equivalent to a withdrawal rate of 3.77 percent.

Regardless of the annual returns, a retirement portfolio simply cannot be exhausted prior to age 117 if withdrawing ONLY the amount of money mandated by the RMD. Granted, the size of the withdrawals in the latter years may be very small if, for example, the portfolio experiences a return of -5% each year (as demonstrated in Table 1), but the portfolio still stayed intact. The math of the RMD is designed to preserve the portfolio for 47+ years.

If we assume a 5% fixed annual return in the portfolio over a 47-year period (age 70 to 116 for the retiree) a retirement portfolio that began with $1,000,000 had $2,418 remaining when the retiree was 116 years old. A total of $2,527,806 was withdrawn over the entire 47-year period (the annual RMD withdrawal is based on the account balance at the end of the prior year). The year-to-year withdrawals and year-end account balances are shown graphically in Figure 1 (for a portfolio that a fixed 5% annual return).

Table 1: The Mathematics of the RMD

Analysis of how portfolios survive over a 47-year period when experiencing RMD-based withdrawals

Year	Age of Retiree	RMD Divisor from Uniform Lifetime Table	RMD Equivalent Withdrawal Rate %	$1,000,000 Portfolio with a 5% Annual Return		$1,000,000 Portfolio with a Negative 5% Annual Return	
				End of Year Annual Withdrawal	Portfolio Balance	End of Year Annual Withdrawal	Portfolio Balance
1	70	27.4	3.65	36,496	1,013,504	36,496	913,504
2	71	26.5	3.77	38,245	1,025,933	34,472	833,357
3	72	25.6	3.91	40,076	1,037,155	32,553	759,136
4	73	24.7	4.05	41,990	1,047,022	30,734	690,445
5	74	23.8	4.20	43,993	1,055,381	29,010	626,912
6	75	22.9	4.37	46,086	1,062,063	27,376	568,191
7	76	22.0	4.55	48,276	1,066,891	25,827	513,954
8	77	21.2	4.72	50,325	1,069,910	24,243	464,013
9	78	20.3	4.93	52,705	1,070,701	22,858	417,955
10	79	19.5	5.13	54,908	1,069,328	21,434	375,624
11	80	18.7	5.35	57,183	1,065,611	20,087	336,756
12	81	17.9	5.59	59,531	1,059,361	18,813	301,105
13	82	17.1	5.85	61,951	1,050,378	17,608	268,441
14	83	16.3	6.13	64,440	1,038,456	16,469	238,550
15	84	15.5	6.45	66,997	1,023,382	15,390	211,232
16	85	14.8	6.76	69,147	1,005,404	14,272	186,398
17	86	14.1	7.09	71,305	984,369	13,220	163,859
18	87	13.4	7.46	73,460	960,127	12,228	143,437
19	88	12.7	7.87	75,601	932,532	11,294	124,971
20	89	12.0	8.33	77,711	901,448	10,414	108,308
21	90	11.4	8.77	79,074	867,446	9,501	93,392
22	91	10.8	9.26	80,319	830,499	8,647	80,075
23	92	10.2	9.80	81,421	790,603	7,851	68,221
24	93	9.6	10.42	82,354	747,778	7,106	57,704
25	94	9.1	10.99	82,173	702,994	6,341	48,477
26	95	8.6	11.63	81,743	656,400	5,637	40,417
27	96	8.1	12.35	81,037	608,183	4,990	33,406
28	97	7.6	13.16	80,024	558,568	4,396	27,340
29	98	7.1	14.08	78,672	507,825	3,851	22,122
30	99	6.7	14.93	75,795	457,421	3,302	17,714
31	100	6.3	15.87	72,607	407,686	2,812	14,017
32	101	5.9	16.95	69,099	358,971	2,376	10,940
33	102	5.5	18.18	65,267	311,652	1,989	8,404
34	103	5.2	19.23	59,933	267,302	1,616	6,368
35	104	4.9	20.41	54,551	226,115	1,300	4,750
36	105	4.5	22.22	50,248	187,173	1,056	3,457
37	106	4.2	23.81	44,565	151,967	823	2,461
38	107	3.9	25.64	38,966	120,599	631	1,707
39	108	3.7	27.03	32,594	94,035	461	1,160
40	109	3.4	29.41	27,657	71,079	341	761
41	110	3.1	32.26	22,929	51,704	245	477
42	111	2.9	34.48	17,829	36,461	165	289
43	112	2.6	38.46	14,023	24,260	111	163
44	113	2.4	41.67	10,108	15,365	68	87
45	114	2.1	47.62	7,317	8,816	41	41
46	115	1.9	52.63	4,640	4,617	22	17
47	116	1.9	52.63	2,430	2,418	9	7
TOTAL AMOUNT WITHDRAWN OVER 47-YEAR PERIOD				2,527,806	---	510,487	

Calculations by author

Figure 1: Retirement Portfolio Slopes

$1,000,000 portfolio earning 5% annually with RMD-based annual withdrawals

Portfolio Balance over Time
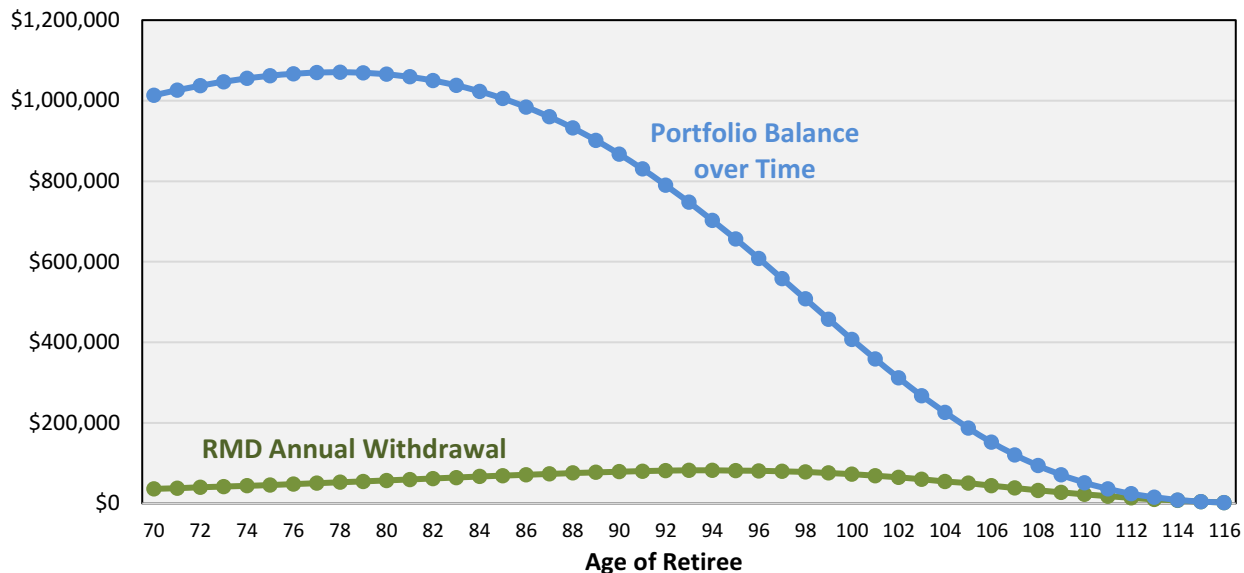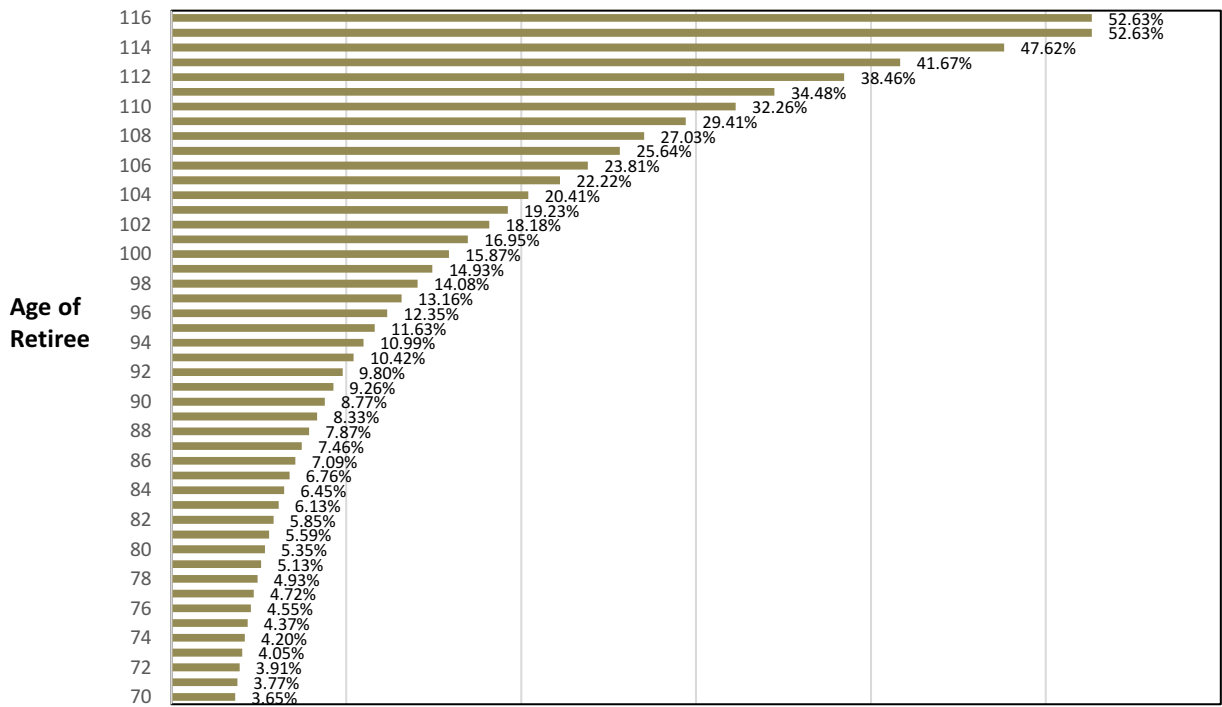
RMD Annual Withdrawal

Age of Retiree

Figure 2: RMD Equivalent Annual Withdrawal Rates from Age 70-116

(Instead of showing the RMD divisor this graph shows the equivalent % withdrawal rate from age 70-116)

Age of Retiree

Age	Rate
116	52.63%
116	52.63%
114	47.62%
112	41.67%
112	38.46%
110	34.48%
110	32.26%
108	29.41%
108	27.03%
106	25.64%
106	23.81%
104	22.22%
104	20.41%
102	19.23%
102	18.18%
100	16.95%
100	15.87%
98	14.93%
98	14.08%
96	13.16%
96	12.35%
94	11.63%
94	10.99%
92	10.42%
92	9.80%
90	9.26%
90	8.77%
88	8.33%
88	7.87%
86	7.46%
86	7.09%
84	6.76%
84	6.45%
82	6.13%
82	5.85%
80	5.59%
80	5.35%
78	5.13%
78	4.93%
76	4.72%
76	4.55%
74	4.37%
74	4.20%
72	4.05%
72	3.91%
70	3.77%
70	3.65%

The annual RMD divisors shown in Table 1 can also be expressed as withdrawal rate percentages. The annual RMD-based withdrawal percentages are shown below in Figure 2.

RETIREMENT PORTFOLIO SURVIVAL

We will now examine several different retirement portfolios and how they fared using RMD-based annual withdrawals. Each portfolio being evaluated utilized the actual historical returns of the indexes represented by the asset classes in the portfolio. The time period of the analysis is the 49-year period from 1970-2018.

The first portfolio being analyzed was assumed to have no investment return each year (a 0% annual return). The next portfolio was invested entirely in 90-day T-Bills (or 100% cash) from 1970-2018. The next portfolio was invested in a conservative 25%/75% portfolio (15% large US stock, 10% small US stock, 55% bonds, and 20% cash). The final portfolio was a diversified 7-asset portfolio consisting of 14.3% in each of the following: large cap US stock, small cap US stock, non-US stock, real estate, commodities, bonds, and cash. The starting balance was assumed to be $1 million at age 70 when the RMD applies to retirees. Both multi-asset portfolios were rebalanced annually. Two waves of analysis were performed. The first analysis did not account for any portfolio cost, that is, the raw index returns were used. The second wave of analysis accounted for 100 bps of portfolio cost (100 bps was subtracted from the returns of the raw indexes).

ROLLING PERIODS TO ACCOUNT FOR SEQUENCE-OF-RETURNS RISK

To account for the variation in portfolio performance caused by different sequence-of-returns (one of the primary risks that retirement portfolios are exposed to) this analysis evaluated the performance of each portfolio over rolling 25-year periods. A 25-year retirement period takes the retiree from age 70 to age 95—which covers the anticipated life span of the vast majority of retirees. Between 1970 and 2018 there were 25 rolling 25-year periods: 1970-1994, 1971-1995, and so on. The amount of each annual withdrawal was determined by the age-based RMD guidelines. The starting balance

was $1 million.

The results of the rolling period analysis for each of the four portfolios are summarized in Table 2. Each portfolio survived for at least 25 years in every rolling period. But, we already knew that would be the case based on the mathematics of the RMD methodology. More relevant is the <u>average ending portfolio balance</u> at the end of each 25-year period; the average amount of the <u>annual withdrawal</u>; and the average <u>amount withdrawn in total</u> over each 25-year period. The results are not surprising: a diversified, growth oriented 7-asset portfolio was superior by every measure.

The RMD methodology is a safety net that retirees and financial advisors should not ignore. Building a retirement portfolio that is too conservative ignores the safety net that already exists for retirement accounts governed by the RMD. In other words, <u>if the retiree withdraws only the amount specified by the RMD each year</u>, they can stop worrying about driving their account balance to zero within their lifetime. That cannot happen if they only withdraw the amount of money specified by the RMD guidelines each year. As illustrated in Table 2, the average ending portfolio balance for a 95-year old (after 25 years of annual RMD withdrawals) was just under $3 million in the diversified 7-asset portfolio assuming no portfolio cost. Assuming 100 bps portfolio cost the average ending balanced was just over $2.3 million (assuming a starting balance of $1,000,000). The "worst-case" ending portfolio balance (which occurred during the 1994-2018 time period) was just over $1 million as shown in Table 3. The variation in the ending account balance in each 25-year rolling period is illustrated in Table 3.

Retirees need to focus on whether or not an RMD-based withdrawal will be sufficient to meet their needs each year. That, of course, is a function of two variables: (1) having a large enough retirement account balance at the start of retirement AND (2) building a portfolio that generates the needed return to prudently grow the portfolio. The first issue can't be fixed once a retiree hits retirement, but individual investors and financial advisors can certainly help their cause by assembling appropriate growth & income-oriented retirement portfolios that are built for the long-run—inasmuch as many retirees are

Table 2: Retirement Portfolio Test Over Rolling 25-Year Periods

Retirement Portfolio Asset Allocation Models **Analysis of 25 Rolling 25-Year Periods from 1970-2018** Annual Withdrawals from the Retirement Portfolio as Determined by RMD Starting Account Balance of $1,000,000	0-Asset Portfolio No Investment Return Portfolio invested in a non-interest bearing account	1-Asset Portfolio Ultra Conservative 100% Cash	4-Asset 25/75 Portfolio Conservative 20% Cash, 55% Bonds, 15% Large US Stock, 10% Small US Stock	7-Asset Portfolio Diversified Growth & Income Diversified 7-Asset Portfolio* with Equal Allocations (14.3% each)

Performance assuming no expense ratio (raw index returns)				
Retirement Portfolio **Success Rate** (How often did the portfolio last at least 25 years?)	100%	100%	100%	100%
Average **Ending Account Balance** at the end of each 25-Year Period	191,327	806,005	1,930,403	2,933,200
Average Amount Withdrawn **Each Year** over each 25-Year Period	32,347	74,520	122,976	<mark>164,960</mark>
Average **25-Year Total Amount** Withdrawn over each 25-Year Period	808,673	1,862,998	3,074,407	4,123,994
Performance assuming 100 bps expense ratio (raw index returns minus 100 bps)				
Retirement Portfolio **Success Rate** (How often did the portfolio last at least 25 years?)	100%	100%	100%	100%
Average **Ending Account Balance** at the end of each 25-Year Period	191,327	625,923	1,511,492	2,305,786
Average Amount Withdrawn **Each Year** over each 25-Year Period	32,347	64,980	106,047	141,780
Average **25-Year Total Amount** Withdrawn over each 25-Year Period	808,673	1,624,505	2,651,176	3,544,499

Raw data source: Steele Mutual Fund Expert, calculations by author.
Analysis completed by using the *Retirement Portfolio Survival Analyzer* Excel spreadsheet, developed by the author.

Past performance does not guarantee future performance. The multi-asset portfolios were rebalanced at the start of each year.

* **Equally-weighted 7-asset portfolio** consisted of S&P 500 Index, Russell 2000 Index, MSCI EAFE Index, Dow Jones US Select REIT Index, S&P Goldman Sachs Commodity Index, Barclays Capital US Aggregate Bond Index, and US TREASURY 90 Day T-Bill.

Table 3: Ending Portfolio Balance, Minimum and Average Withdrawal over each 25-year Period in the 7-Asset Diversified Portfolio as Affected by the First Year Return and the Overall 25-Year Return (1970-2018)

$1,000,000 assumed starting balance, RMD-based withdrawals

Rolling 25-Year Period	Portfolio Return in the First Year of the 25-Year Period	25-Year Average Annualized Return of Portfolio	Minimum Annual Withdrawal During 25-Year Period	Average Annual Withdrawal During 25-Year Period	Ending Portfolio Balance in Each 25-Year Period
1970-1994	4.42	12.21	36,496	198,073	4,063,291
1971-1995	16.00	12.80	36,496	211,447	4,679,415
1972-1996	17.07	12.88	36,496	203,914	4,776,782
1973-1997	1.54	12.64	34,739	195,834	4,522,808
1974-1998	(5.38)	12.62	34,328	217,527	4,458,670
1975-1999	20.18	13.53	36,496	257,198	5,518,444
1976-2000	20.03	13.15	36,496	238,582	5,045,481
1977-2001	11.07	12.07	36,496	221,240	3,883,813
1978-2002	16.29	11.53	36,496	218,667	3,395,676
1979-2003	23.10	11.86	36,496	204,178	3,702,426
1980-2004	21.81	11.56	36,496	181,750	3,467,319
1981-2005	1.56	11.09	36,496	164,120	3,111,943
1982-2006	17.26	11.57	36,496	178,588	3,479,811
1983-2007	20.16	11.11	36,496	167,981	3,123,601
1984-2008	7.76	8.88	36,496	153,413	1,768,669
1985-2009	23.61	9.32	36,496	151,781	1,979,308
1986-2010	19.57	8.94	36,496	131,139	1,820,281
1987-2011	6.71	8.18	36,496	117,519	1,510,129
1988-2012	18.58	8.31	36,496	117,729	1,565,737
1989-2013	17.49	8.11	36,496	105,956	1,499,338
1990-2014	(3.38)	7.53	35,081	96,525	1,300,624
1991-2015	18.27	7.48	36,496	107,196	1,273,243
1992-2016	6.33	7.09	36,496	95,987	1,160,425
1993-2017	11.02	7.26	36,496	95,860	1,215,709
1994-2018	2.38	6.53	36,496	91,791	1,007,068
AVERAGE over all 25 Rolling 25-Year Periods		**10.33**	**36,282**	**164,960**	**2,933,200**

living long lives.

SEQUENCE OF RETURNS

The issue of "sequence-of-returns" risk deserves a brief, but separate, discussion. Shown below in Table 3 are the minimum and average annual withdrawals from the 7-asset diversified retirement portfolio during each 25-year period. Also shown is the ending portfolio balance over all 25 rolling 25-year periods. The highlighted cells in blue indicate several instances in which the portfolio had low (or negative) annual returns during the first year of each 25-year withdrawal period.

For example, in 1973 the S&P 500 had a loss of 14.69%, US small cap stock lost 30.90%, non-US stock lost 14.92%, and the REIT Index lost 15.52 percent. The diversified 7-asset portfolio had other asset classes that counteracted those losses and was able to produce a 1.54% overall portfolio return in 1973 (while not a negative return, it was nevertheless a small positive return). Then, in 1974 equity-based indexes again suffered large losses (S&P 500 down 26.47%, US small stock was down 19.95%, and the MSCI EAFE Index lost 23.16%). In addition, the REIT Index was down 21.40 percent. The overall 7-asset portfolio suffered a loss of 5.38% in 1974. The annual returns of the three retirement portfolio models are shown in Appendix A, with rolling 5-year returns shown in Appendix B.

That negative return in 1974 is what led to the slightly lower minimum annual withdrawal during the 1973-1997 and 1974-1998 periods. In both cases, the minimum withdrawal occurred in 1975 because the RMD withdrawal is based on the portfolio account value as of December 31 of the prior year. The prior year was

1974—the year in which the portfolio had a loss of 5.38 percent. A similar result took place in the 1990-2014 period in which a negative portfolio return in 1990 caused a slight decline in the minimum annual withdrawal.

The average annual withdrawal over all 25 rolling 25-year periods was $164,960 (highlighted in yellow). This figure synchronizes with the same figure shown in Table 2. The average annual withdrawal and ending portfolio balance in each 25-year rolling period are both clearly linked to the corresponding 25-year average annualized return of the portfolio. Performance of the retirement portfolio matters.

But, in terms of portfolio survival, it is withdrawing only the amount specified by the RMD that has the bigger impact. A key observation about the RMD (see Table 1 and Figure 2) is that the first nine divisors generate annual withdrawal rate percentages that are less than 5 percent. This provides a valuable guideline for what represents safe withdrawal rates in the initial years of retirement. In other words, keep the annual withdrawal rate under 5% for the first decade. Or, more bluntly, the retiree needs to make it to age 80 without the portfolio getting hammered by a high withdrawal rate.

The point to be made here is this: sequence-of-return (more specifically, negative returns in the early years of a withdrawal period) is a genuine threat to a retirement portfolio. A logical defense against such a risk is to build a diversified portfolio that has a variety of asset classes that tend to have low correlation with each other.

A diversified 7-asset class portfolio is an example of that approach. The result was that the impact of the negative portfolio return in 1974 was minimized in terms of affecting the annual withdrawal. By comparison, if the retirement portfolio had been invested completely in large cap US stock (100% S&P 500 Index) the portfolio return in 1973 would have been -14.69% and in 1974 -26.47 percent. As a result, the minimum annual withdrawal would have plunged to $22,253 (compared to $34,739 in the diversified portfolio) during the 1973-1997 period and $26,371 during the 1974-1998 period (compared to $34,328 in the 7-asset portfolio). A lack of diversification makes a retirement portfolio much more susceptible to sequence-of-returns risk.

CONCLUSION

Contrary to the views of some, the RMD is not the enemy. Rather, it is a blueprint of how to liquidate a retirement portfolio in such a way that it cannot be exhausted prior to the age of 117. Clearly, its design is motivated by tax consequences in favor of the government. Nevertheless, it demonstrates a framework that, if followed, preserves a retirement portfolio for the life of the retiree. Obviously, if the starting balance of the retirement portfolio is too small the RMD received by the retiree each year will be inadequate to meet their needs. But, even so, they will receive that "inadequate" RMD until they are well past 100 years of age—should they live that long.

With the assurance that the investment portfolio cannot be liquidated prior to age 117 the retiree can worry less about their portfolio "surviving" and invest with more confidence and serenity. Specifically, the retiree can invest with a longer-term horizon and include asset classes in their portfolio that are more appropriate for a long-term investor—such as equities and diversifiers—along with their allocations to fixed income and cash. Put more bluntly, retirees can move from ultra conservative portfolios to broadly diversified asset allocations that are built for a 30-40 year time frame and which are naturally more resistant to the adverse impact of sequence-of-returns risk and the erosion of value caused by inflation.

Appendix A: Annual Returns of Index-based Retirement Portfolio Models
(net of any portfolio costs)

Annual Returns of Retirement Portfolio Models	1-Asset Portfolio 100% Cash	4-Asset 25/75 Portfolio 20% Cash, 55% Bonds, 15% Large US Stock, 10% Small US Stock	7-Asset Portfolio Diversified 7-Asset Portfolio* with Equal Allocations (14.3% each)
1970	6.58	9.44	4.42
1971	4.42	9.47	16.00
1972	4.15	6.96	17.07
1973	7.26	(1.31)	1.54
1974	8.12	(1.21)	(5.38)
1975	5.93	16.36	20.18
1976	5.09	18.92	20.03
1977	5.40	4.21	11.07
1978	7.43	5.58	16.29
1979	10.55	10.27	23.10
1980	12.05	12.63	21.81
1981	14.96	5.89	1.56
1982	11.07	25.88	17.26
1983	8.94	12.68	20.16
1984	9.90	10.52	7.76
1985	7.73	21.57	23.61
1986	6.15	12.99	19.57
1987	5.96	2.62	6.71
1988	6.88	10.71	18.58
1989	8.39	16.05	17.49
1990	7.74	4.06	(3.38)
1991	5.54	19.08	18.27
1992	3.52	7.76	6.33
1993	3.07	9.37	11.02
1994	4.36	(0.72)	2.38
1995	5.66	19.77	19.13
1996	5.14	8.12	17.89
1997	5.20	13.59	11.13
1998	4.91	9.79	0.98
1999	4.78	5.79	15.94
2000	5.98	5.92	10.30
2001	3.34	3.78	(5.52)
2002	1.63	0.60	(1.57)
2003	1.03	11.49	25.22
2004	1.44	6.14	15.10
2005	3.25	3.18	9.72
2006	4.85	7.56	12.94
2007	4.44	5.39	5.95
2008	1.39	(5.77)	(27.60)
2009	0.16	9.98	19.06
2010	0.15	8.57	13.35
2011	0.06	4.22	0.27
2012	0.08	6.37	10.17
2013	0.06	7.64	13.15
2014	0.03	5.83	2.66
2015	0.05	0.08	(4.52)
2016	0.32	5.44	7.90
2017	0.93	6.87	10.79
2018	1.94	(1.37)	(6.47)
49-Year Average Annualized Return	4.80%	7.96%	9.48%
49-Year Standard Deviation of Return	3.53%	6.40%	10.23%

Appendix B: Rolling 5-Year Returns of Index-based Retirement Portfolio Models
(net of any portfolio costs)

5-Year Rolling Returns of Retirement Portfolio Models	1-Asset Portfolio	4-Asset 25/75 Portfolio	7-Asset Portfolio
	100% Cash	20% Cash, 55% Bonds, 15% Large US Stock, 10% Small US Stock	Diversified 7-Asset Portfolio* with Equal Allocations (14.3% each)
1970-1974	6.09	4.55	6.38
1971-1975	5.96	5.84	9.42
1972-1976	6.10	7.61	10.17
1973-1977	6.35	7.05	9.01
1974-1978	6.39	8.51	12.01
1975-1979	6.86	10.92	18.06
1976-1980	8.07	10.20	18.38
1977-1981	10.03	7.67	14.49
1978-1982	11.19	11.82	15.74
1979-1983	11.50	13.28	16.50
1980-1984	11.37	13.33	13.44
1981-1985	10.49	15.08	13.77
1982-1986	8.75	16.58	17.55
1983-1987	7.73	11.91	15.35
1984-1988	7.31	11.52	15.05
1985-1989	7.02	12.61	17.05
1986-1990	7.02	9.16	11.42
1987-1991	6.90	10.32	11.18
1988-1992	6.40	11.40	11.10
1989-1993	5.63	11.13	9.65
1990-1994	4.83	7.72	6.67
1991-1995	4.42	10.79	11.23
1992-1996	4.34	8.67	11.16
1993-1997	4.68	9.82	12.15
1994-1998	5.05	9.90	10.04
1995-1999	5.14	11.31	12.81
1996-2000	5.20	8.60	11.09
1997-2001	4.84	7.72	6.28
1998-2002	4.12	5.13	3.73
1999-2003	3.34	5.46	8.29
2000-2004	2.67	5.53	8.13
2001-2005	2.13	4.97	8.02
2002-2006	2.43	5.73	11.94
2003-2007	2.99	6.72	13.60
2004-2008	3.06	3.19	1.81
2005-2009	2.80	3.92	2.50
2006-2010	2.18	4.99	3.17
2007-2011	1.23	4.33	0.75
2008-2012	0.37	4.52	1.54
2009-2013	0.10	7.34	11.02
2010-2014	0.08	6.52	7.78
2011-2015	0.06	4.80	4.14
2012-2016	0.11	5.04	5.68
2013-2017	0.28	5.14	5.80
2014-2018	0.65	3.32	1.85
Average 5-Year Rolling Return	4.98%	8.26%	9.93%
Standard Deviation of Rolling 5-Year Return	3.22%	3.34%	4.81%