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# The Only Spending Rule Article You'll Ever Need

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## Introduction

How much of your capital can you afford to spend each year? A great deal of effort has been expended on determining how to construct an efficient investment portfolio, how much risk to take, and how to accomplish many other valuable tasks on the accumulation side of the investment equation. But the body of useful thinking on the decumulation or spending side is pretty thin. Despite the best efforts of investment counselors, 401(k) providers, consultants, and a few scholars to determine rules and heuristics for spending one's money in such a way that one does not run out of it too soon, the investor is pretty much on his or her own in this endeavor.

Spending rules are, of course, vitally important. You don't want to run out of money before you die. You don't want to have to go back to work (thank you for shopping at Walmart! Did you find everything you needed today?). And, since you can't take it with you, you don't want to be too miserly either. Living at a low standard due to fear of penury is not quite as bad as running out of money, but it's no picnic.

## Calculating a Spending Rate is, at its Heart, an Annuitization Problem

In this article, we tie back to long-standing and widely accepted research asserting that the purpose of investment policy for the individual is to support consumption, providing an annuity of payments in some form for one's remaining life. Our insight is that constructing a spending rule is itself an annuitization problem at heart, and we discuss how to implement this observation. An annuity converts a principal sum into a set of payments of equivalent present value, to be made periodically over some time. When we think of annuities in the general sense, we usually think of an insurance company life annuity, a set of car payments, or a mortgage; it is conceptually no different to think of converting one's savings into an annuity of future consumption payments made to oneself.

The idea that an annuity is the right structure for converting current capital to future income has been out there almost forever. The classic literature on asset allocation and investment strategy, going back at least as far back as the works of Merton [1975, 1977] and Rubinstein [1976], is consistent with the consensus today that a real (inflation-adjusted) life annuity that begins payments when you retire is, from the retiree's point of view, the risk-free asset.

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But, to secure an income in old age, not everyone wants to buy *literal* annuities — from insurance companies — for various reasons: they are concerned about insurance company counterparty risk and may also want the higher expected returns from risky assets. These reasons alone have, more than likely, kept practitioners from taking advantage of the annuitization concept. So, in light of the fact that most people are going to hold mixed portfolios having volatile returns, how can we think about spending while staying true to the concept of annuitization?

The answer: through *periodic re-annuitization*, a principle introduced in Waring and Whitney [2009, at p. 123] (and echoed in Sexauer and Siegel [2013]), and that we present and elaborate in more complete detail here. We call a portfolio managed according to this principle an *annually recalculated virtual annuity* or ARVA — "virtual" because the investor does not have to buy an actual annuity to reap many of the benefits of annuity thinking.

Specifically, the first year's payout of a level-payment, real (inflation-adjusted) annuity is what the investor can afford to spend this year and still be as well off at the end of the year as at the beginning,[2] keeping in mind that he or she is one year older at the end of the year and thus has one year's less consumption to pay for. (We'll discuss "shapes" of the payout plan, including bequests and payment shapes other than level payments, at a later point in this essay.)

If the investor pursues a riskless strategy, or as near to one as can be achieved with existing securities — which, for a U.S. dollar consumer, is a laddered portfolio of inflation-indexed Treasury bonds (TIPS), with cash flows matched to his or her planned consumption — then the payment will be the same in real terms every year. That is, the recalculated annuity "payment" or spending amount will be the same as the originally calculated annuity payment; it's been locked in safely.

If, however, the investor pursues a strategy that includes risky assets (equities, credit bonds, hedge funds, and any other assets that do not directly hedge consumption), the portfolio's value will have changed at the end of each year as a result of ordinary market movements, good or bad. In this case, the recomputed ARVA will vary, adjusting the current spending amount to reflect gains or losses on the risky investment portfolio (as well as changes in the real interest and inflation rates used to price the virtual annuity).

We'll recalculate the annuity payment each period, recognizing that, if perfectly hedged, we would get the same payment every period whether we calculated all payments ahead of time in the traditional manner — or repetitively after seeing investment results at the end of each period. This is the insight that that informs our observation that we also get the right answer if we recalculate in each period for investors whose asset pool supporting the annuity is not perfectly hedged, thus containing unhedged risky assets and experiencing volatile investment returns. An annuity need not be calculated once for all time, to be a proper annuity.

[2] As well off *in level-consumption terms*, that is, in terms of being able to continue to consume at the real (inflation-adjusted) level at which one has been consuming.

If a properly designed annuity is ultimately the correct risk-free asset for protecting consumption, then the ARVA is the right vehicle for those who, for whatever reason, don't actually purchase an annuity. This is because the payment on an annuity varies directly with the annuity purchase price, and the assets of the investor in an ARVA act implicitly as that price (time horizon and discount rates being otherwise held constant).

In other words, the problem is not to find the correct single constant spending rate for the entirety of one's retirement, as many practitioners seem to assume. *There is no such rate* — unless the entire portfolio is engineered to perfectly hedge planned consumption (and all spending goes as planned!). The problem is to recognize that, with any other investment strategy — one that includes unhedged risky assets — spending must vary as total asset values and interest rates fluctuate; there is no other way to meter spending so that there is *no* danger of the money running out.

Whether or not a given investor buys actual annuities, then, *annuity thinking* is what's required to arrive at a simple, effective answer to the question of how much to spend each period. This essay applies annuity thinking to the practical problem of asset decumulation, particularly in retirement.

## First, How Much Money do you Need? "What's your *Number?*"

While we call this paper a spending rule article, there is another, parallel discussion that gets a lot of attention: how large an asset pool does one needs to accumulate for retirement? This latter question is directly posed in a small book by Lee Eisenberg, *The Number,* which reached the *New York Times* best seller list in 2006. One of us has also written on this topic (Sexauer and Siegel [2013]), referring to a Retirement Multiple, or number by which to multiply the annual income requirement to arrive at the savings goal, "the number." The spending rate and the Retirement Multiple are, of course, reciprocals of one another, and are thus different ways of having the same discussion.

## *The Number*, The Road to Monte Carlo, and other prior approaches

Many prior researchers have tried to determine a "safe" spend-down rate. Perhaps the best known is Bengen [1994].[3] He determined the highest spending rate that did not deplete the portfolio over the range of historical experience in the U.S. since 1926. (It's 4%.) Soon after, the "Trinity Study" of Cooley, Hubbard, and Walz [1998] used simulations to determine, for each spending rate, the chance that the portfolio would be exhausted before the intended time.[4]

Current practice tends to follow the Trinity approach, choosing a spending rate that produces no more than an *x%* chance of ruin, where *x* is the risk of ruin a particular investor believes he can tolerate. The exact approach varies from one practitioner to another.

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[3] A slightly earlier work, Bierwirth [1994], covers similar territory; and a Trinity University study (Cooley, Hubbard, and Walz [1998]) supported the use of a 4% rate.

[4] The Trinity study, like many such works, only covered a 30-year holding period, which, as we'll show later, is too short to represent the planning horizons of most individuals at retirement.

This contrasts with our method. While a simulation approach tries to balance the desire for higher spending against the *chance* that the investor will run out of money, we want an approach that *guarantees* that the portfolio will not be depleted, even if one is holding risky assets.[5] Adjusting one's spending is tolerable; ruin is not; therefore we present an alternative to the probabilistic approach. This is important in theory as well as in practice: In the literature, the possibility of running out of money is said to have *infinite disutility*, meaning that any non-zero probability of ruin should be avoided entirely. This simply makes sense, even in a country such as the U.S. where there is a Social Security safety net.

These approaches have spawned a cottage industry of retirement-income planning software and advice as well as *The Number* and other popular literature. The answer is usually a spending rate of something like 4% or its reciprocal, resulting in a "number" (asset accumulation target) equal to some 25 times one's intended annual spending. Recently, with short-term interest rates at zero and long-term interest rates at historic lows, researchers have challenged the 4% rule. Finke, Pfau, and Blanchett [2013] propose 3%.

The 4% spending rule has achieved wide, although not universal, acceptance among planners, advisors, 401(k) advice providers, and others charged with the responsibility of helping employees save and live on their retirement savings. Nonetheless it is not supported by any hard logic, and after a reading of this paper one will see that a universal 4% or 3% answer is necessarily in error — except for a few specific combinations of interest rates and time horizons. At best it is a heuristic usable only for certain combinations of specific retirement horizons and real interest rates — a fact that is obvious once stated but that is left out of much of the advisor literature.

But none of this earnest effort to establish a single constant spending rate is necessary. A nearly riskless and stable spending rule, the ARVA strategy, can be derived from an annuity payout calculation, repeated each period; simulations and other fancy techniques are not required.

This ARVA strategy, of course, gives a completely stable real spending rate only if one invests in the nearly riskless TIPS ladder, the true risk-free asset allocation policy. If one doesn't invest in a ladder of TIPS bonds to hedge spending but instead chooses to invest (some or all) in equities and other volatile assets, the unhedged risk will pass directly through to the amount that can be spent on consumption as the ARVA is recalculated each year.

In our view, the discussion should not be about whether 3% or 4% is correct, nor should it be about whether to tolerate a 10% or 20% possibility of failure in a simulation (both are still failure). Rather, it should be acknowledged that, with risky investments, there is risk to one's wealth, and in the presence of such risk there *cannot* be a fixed spending rate. So the discussion should be about how to recalculate the proper level of spending each year as one's portfolio value and time horizon evolve.

[5] See also Rudd and Siegel [2014].

While others calculate probabilities of failure, then, we are not interested in failure. Running out of money before running out of life is a catastrophe! It isn't something we want an investor to do, even with a low probability. We want an approach that guarantees the desired income right down to the last payment, not just settle for some small but significant probability that it will not be achieved. This must be the starting point for any discussion on this topic. We all know that spending has to be adjusted to wealth and remaining years of consumption. Let's do that.

## Additional Prior Work

The core literature on annuities and their use in retirement planning stems from Yaari [1965]. Milevsky [2013] contains an extensive and valuable literature review on this topic. The literature on sustainable spending rates for individuals and institutions is reviewed in Milevsky and Robinson [2005]. Chen, Ibbotson, Milevsky, and Zhu [2006] and Ibbotson, Milevsky, Chen, and Zhu [2007] treat annuities as part of an integrated approach to lifelong financial planning. Zvi Bodie, with various co-authors [2003, 2011], sets forth the idea of a laddered portfolio of TIPS as a kind of self-made, fixed-term annuity, but without showing how to adjust consumption when the investor doesn't rely solely on that ladder.

Scott, Sharpe, and Watson [2009] attack the 4% strategy, showing that it is suboptimal in that, while it still has an appreciable probability of failure, it produces less spending than an option-based approach would. Their approach involves varying spending when the investments are risky and generating variable asset values, a characteristic in common with our solution (but much more complicated and requiring access to securities that are, at this time, hypothetical).

However, as briefly noted at the outset, Robert Merton [1975, 1977] and Mark Rubinstein [1976] both suggested, long ago in their early work on strategic asset allocation policy, that the riskless asset is a default-free, inflation-adjusted life annuity, rather than "cash."[6] Our riskless solution proceeds directly from this concept, then we abstract from it to arrive at our general solution for a spending rule, the ARVA.

The idea of protecting consumption has sometimes been formalized by academics by framing consumption as an "economic liability," treating the present value of the cash flow stream of expected future consumption as an economic balance sheet item. This "consumption liability" terminology, however, has been around for a while, possibly originating with Breeden [1979] in connection with his work on the Consumption CAPM (which in turn owes its foundations to Merton [1973]). And it is Merton [2012, 2014] who has provided perhaps the most eloquent defense of

[6] We're being a bit generous to Merton in characterizing his solution as including a real life annuity, and to Rubinstein, who actually described a nominal, rather than a real life annuity — but they were both forgivably — and brilliantly — close, given the times: Merton showed a five-fund investment policy solution, one of the funds being, of course, risky assets. But the other four are recognizable, in hindsight and taken together, as constituting something very similar to a real life annuity; we'll give full credit, as TIPS were not then available — likely explaining why he needed a four-part solution when a ladder of TIPS would have served. Rubinstein, unlike Merton, had the insight to explicitly use the term "annuity" as the risk-free asset, and we're confident that had TIPS then been available, he would have framed it in real terms; again worth full credit under the circumstances. Both were ahead of their time. Their works were influential in the two-fund CAPM theory for investors with multi-period spending plans of Waring and Whitney [2009], on which this present essay is in its turn based.

focusing on risks to consumption rather than simply risks to the assets, in an article that should be read by every investor and investment advisor.

## The Only Spending Rule You'll Ever Need, For Riskless and Risky Portfolios

Annuity-based spending rules depend critically on the investor's time horizon. The solution is easy for a fixed horizon, harder for the unknown amount of time that a retiree needs to make her money last until she dies — so we'll solve the easy problem first, then move to the general case where the time horizon is not known in advance. The spending rate question for perpetual endowments such as universities and foundations is related but different, and is covered by its own literature.[7]

If protecting consumption over a fixed horizon is what matters, then a level-payment *real* annuity with payments extending over the relevant time horizon is the financial instrument that should be emulated to set the spending rule.[8] (The initial payout in a real annuity is much less than in a nominal annuity because, given the same capital outlay, the later payouts are larger due to inflation.) While the general case is to protect a would-be retiree's consumption for the rest of his or her life, an amount of time that is unknowable, we'll start with a fixed time horizon and generalize later. Because the TIPS market only enables us to lock in cash flows for about 30 years,[9] we'll arbitrarily consider 30 years to be the relevant time horizon in this fixed-term section.

Investors have preferences for different levels of investment risk, which, in our framework, translates to consumption risk. Let's look at two types of investors, sticking for the moment with our fixed 30-year horizon.

The "Riskless Investor" has prepaid (and hedged) his or her consumption liability over our 30-year time period by using his or her assets to buy a laddered portfolio of TIPS large enough and with coupon and face payments such that the portfolio covers planned spending needs in each future period.[10] The other type is the "Risky Investor," who is more typical. This investor, who holds a mix of equities, bonds, and other risky assets (as well as perhaps some TIPS as a partial hedge), has cash inflows that are therefore not perfectly hedged to his consumption liability but are instead best thought of as "risky" in that context.

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[7] See, for example, Sedlacek [2011] and Garland [2013].

[8] See also Rudd and Siegel [2013, 2014].

[9] A few corporate bonds have longer maturities but these markets are not deep; and, furthermore, they add credit risk to the consumption funding plan, a risk which must be explicitly accepted—because defaults can happen.

[10] We use scare quotes because no investment is truly riskless. Moreover, TIPS are not available with maturities longer than 30 years, so hedging one's consumption liability beyond 30 years requires sophisticated techniques involving swaps or other derivatives. While we can't all the way to a full consumption-liability hedge in today's market, we can get much, much closer than in current practice! (For investors outside the U.S., replace "TIPS" with inflation-indexed bonds that pay off in the investor's consumption currency, if available.)

A single generalized spending rule fits the needs of both the Riskless and the Risky investors:

> Spending in the current period should not exceed the payout that would have occurred in the same period if the investor had purchased, at the beginning of the period, a fairly priced level-payment real fixed-term annuity with a term equal to the investor's consumption horizon.

(We'll show later that the annuity needn't be real, and that it needn't be level-payment; the shape of the desired spending payout might be adjusted by changing these parameters or others. Moreover, it needn't be for a fixed term. But it must be thought of as an annuity that has a present value (of all the future payments) equal to the investor's asset balance.[11]

Now, let's apply this to the two categories of investors, riskless and risky.

### 1. Riskless investor (portfolio fully hedged to the consumption liability)

Assume that the investor has $1 million in economic net worth available for retirement. That is, $1 million is the present value of all economic assets (invested assets plus human capital) less all non-retirement economic liabilities (spending prior to retirement). Moreover, the investor has a 30-year planning horizon and will be withdrawing a constant (in real dollars) spending amount each year starting today. The first year's spending, $S_1$, is given by standard time value of money equations, generally familiar to our readers, so we'll use the shortcut of expressing these in the handy abbreviated format of a spreadsheet function (here, in Excel™):[12]

$$S_1 = pmt(r_0, 30, 1000000, , 1) \quad (1)$$

where $r_0$ is the average real rate across the ladder of TIPS at the present time (time 0) required to synthesize a 30-year real level-payment annuity, 30 is the payout time horizon in years, 1000000 is the initial capital, and 1 is Excel notation indicating that the payment comes at the beginning of the period, or today, not the end (we're withdrawing funds for spending during the year at the beginning of each year).[13]

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[11] Including amounts that the investor has not yet saved but will save by the time she retires.

[12] One can remind oneself of the time value of money functions at https://en.wikipedia.org/wiki/Time_value_of_money. To get the formula for payments, set up the formula given for the time value of a growing annuity (due), and solve for the payment, getting (where inflation is the relevant growth rate) PMT=PV/(((1+nominal)/(nominal-inflation))* (1-(((1+inflation)/(1+nominal))^term))). However, it is easier to simply use the real interest rate in the standard Excel payment formula in place of the nominal rate! You get the correct result if your real rate is the geometric difference between the nominal rate and the inflation rate.

[13] Note that this is simply the formula for calculating a mortgage payment, applied in reverse. Reverse mortgages have such a bad reputation that we're reluctant even to use the word and expect to be taken seriously. But a (self-constructed) reverse mortgage is exactly the right way to think about spending down capital (even if many of today's reverse mortgages are not based on fair market terms). A mortgage involves getting an endowment of capital now and paying for it in installments over time; a reverse mortgage, or an asset drawdown, involves giving up an endowment of capital now and getting it back in installments over time. The dangers come from the third party offering to "help" with the standard reverse mortgage.

Note that *r*, which we've called the average real rate for the sake of simplicity, is actually the single real interest rate on the *portfolio* of TIPS constituting the ladder; this single interest rate is the present value-weighted average of the yields on the constituents. (Equivalently, your authors have simplified the problem by assuming a level real rate curve.)

Because the Riskless investor has a riskless TIPS portfolio, laddered and fully hedged to his consumption liability, $S_1$ is also the real spending amount in every subsequent year, regardless of subsequent rate changes: $S_1 = S_2 = \cdots = S_{30}$. In the thirtieth year, the investment balance goes to zero. In the meantime the payment will change regularly with inflation, protecting spending at the same level each year in real terms.

Let's put some numbers to this formula, first at a zero real interest rate, then at a more typical (higher) level of interest rates. At a zero real interest rate across all maturities, a condition that, roughly speaking, we've seen in recent memory in the U.S., the 30-year calculation in equation (1) simplifies to:

$$S_1 = \frac{\$1{,}000{,}000}{30} = \$33{,}333, \tag{2}$$

or 3.33% of initial principal.

But zero real rates are an aberration. The historical average real interest rate is somewhat above 2%. If, at some point in time, the real rate on TIPS were to be 2% for all maturities, then, according to equation (1), the first year's spending is

$$S_1 = \$43{,}774, \tag{3}$$

or 4.38% of initial principal.

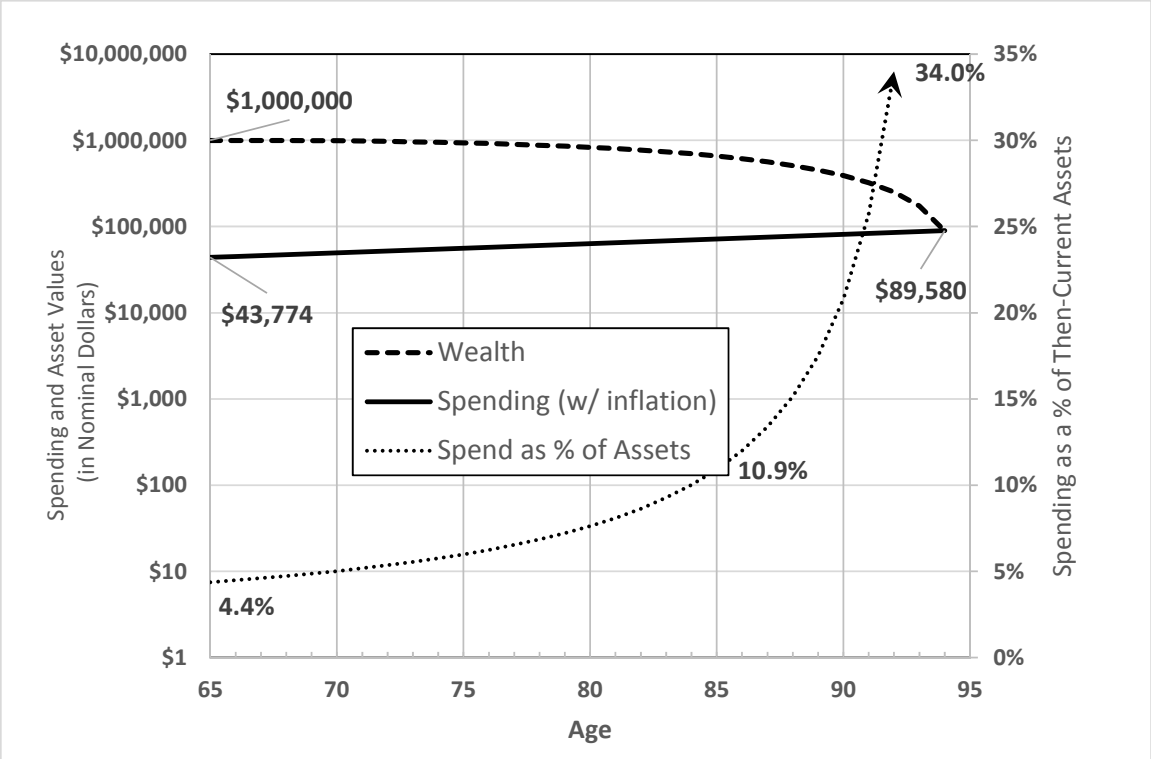
In both of these examples, assuming that the consumption liability has been hedged perfectly against changes in the real interest rate over our horizon of 30 years, these annual payments would remain fixed in real terms over that time horizon, with no risk to the retiree's consumption. And one can see, in each case, how the results would vary dramatically depending on the spend-down horizon as well as on interest rates.

Note that our riskless investor, in the spirit of ARVA, could repeat this process each year, calculating the available payment for her remaining horizon, instead of calculating the real payment just the one time initially as done in the above Excel formula. Because the portfolio is fully hedged to her consumption, *either way she'll calculate the same spending amount in each period*. For the Risky investor this observation is nontrivial, and we'll use it in a moment.

Exhibit 1 shows annual payouts, asset values, and the ratio of payouts to asset values for a hypothetical investor who has fully hedged her consumption liability by buying laddered TIPS at age 65. We assume a real return of 2%, an inflation rate of 2.5%, and a 30-year time horizon (first payment today at the beginning of year 1; the last year's payment in 29 years at the beginning of year 30). There is no bequest in this example; if there were it would be a final payment in the amount of that bequest.

EXHIBIT 1

30 YEARS OF SPENDING AND ASSET VALUES WITH RISKLESS PORTFOLIO EARNING 2% REAL




The spending amounts shown in the exhibit are in nominal terms, the level growing with inflation. The assets decline until equal to the final year's spending, so all of the assets are used up in 30 years, with no shortfall and no "waste" (assets left over at the end of the term). This is a utility-maximizing strategy for the fixed-term investor who wishes to hold the minimum consumption-variance portfolio (no tolerance for consumption risk).

### 2. RISKY INVESTOR (PORTFOLIO UNHEDGED OR NOT FULLY HEDGED TO THE CONSUMPTION LIABILITY)

Where the investment portfolio includes risky assets such as equities, instead of or alongside an approximately riskless ladder of TIPS bonds, you can still use annuity thinking — the ARVA — to calculate the yearly payout, and in fact you must. This is because, unlike for the riskless investor, the principal amount is changing as it is recalculated each year given the volatile returns on the risky assets. In addition, the discount rate is changing (not being already locked in, as it is in the TIPS ladder held

by the riskless investor). Thus, spending in the first year is the same in either the risky or the riskless case; ARVA spending in the *second* year for the risky investor will reflect the new current discount rate and a different portfolio value, as well as one less year of time remaining:

$$S_2 = pmt(r_1, 29, V_1, , 1) \tag{4}$$

where

$r_1$ = TIPS interest rate (present-value-weighted average interest rate across the TIPS ladder) at the beginning of the second year, that is, at time 1

t = (30 - 1 = 29) = years remaining in the payout stream, and

$V_1$ = the asset balance at time 1, after prior (first) year's spending and prior (first) year's investment returns.

This process would be repeated each year until the beginning of the thirtieth year (the end of the 29th year), when remaining t = (30-29) = 1, at which point the final period's payment is made.

That's it. We're done. The investor will receive 30 years of payments of varying size. The portfolio has no chance of being depleted until the end (but it is depleted at the end, so there was no waste). The only risk was to the size of each payment, which will vary primarily with investment results (and secondarily with varying interest rates).

## What is Risk? Risk Tolerance for the ARVA Investor

The ARVA strategy has the advantage of connecting the dots between risk and return in the most meaningful possible way — investment risk translates directly into consumption risk. More equities and other risky assets and less hedging of consumption means more volatility — uncertainty — of consumption. Living standards will go up and down unpredictably to the extent of the unhedged risk in the portfolio.

In a conventional (third party) annuity or in a riskless hedged ARVA, the discount rate and the payment level are locked in for the horizon as of the time of purchase, so consumption is as initially expected. In an ARVA where the assets are not hedged to consumption, both the asset portfolio and the discount rate are subject to market movements. And these market movements change the value of the portfolio funding retirement spending, which means that this year's spending amount — this year's recalculated ARVA payment — will vary. This variation is possible here because, unlike in a commercial annuity, there is no opposing party with rights to protect: the asset owner and annuity payor is also the annuity beneficiary, and is motivated (by the fear of eventual penury) to accommodate his or her spending to the reality of the portfolio's changing value.

In fact, the payment will vary *precisely* proportionally to the change in the asset value (for a given discount rate). Think about the last time you bought a car on time payments: the $40,000 car that you considered had a payment exactly twice that of the $20,000 car. Principal and payment are two sides of the same coin.

It is thus easy to see that spending volatility is the risk — the only risk — you care about when setting your investment policy. And it is controlled by the volatility of the portfolio chosen in the asset allocation process: *The standard deviation of the portfolio's investment strategy is also (for a constant discount rate) the standard deviation of consumption.* Hold that thought; you'll use it over and over again when considering spending rules and investment policies.

As a result, in considering the degree of aggressiveness in one's risky asset holdings (that is, where to be on the surplus efficient frontier as described by Sharpe [1990] or, with a more specific link to consumption, as in Waring and Whitney [2009]), one's risk tolerance for the investment portfolio is equivalently one's risk tolerance for spending volatility.

Here's the deal: If you can't take large hits to spending several years in a row, perhaps you should be considering a more closely consumption-hedged investment policy, with fewer non-hedged risky assets. Many people are probably invested more aggressively in their retirement than they might be if they thought this through.

One may not like consumption volatility — we'd like to have our aggressive risky asset portfolio "cake," and eat it smoothly also, as the old saying (almost) goes, holding lots of equities and other risky assets. But — this is a reality check — the "tough love" lesson of this paper, worth repeating: Consumption volatility directly follows from investment and discount rate volatility, and *is what risk is*. Embrace it; remember it. *Manage it* with your investment policy; don't take risk the downside of which would be unhappy for you.

### Smoothing as a Risk Control Device? Not!

It is worthwhile pointing out here that many who read this will instinctively want to "solve" the problem of consumption variability by smoothing asset values or consumption payouts (the same thing, really). However, this is the actuarial mistake that has caused so much difficulty for pension plans: Risk to the value of a portfolio accumulates over time, rather than going away. This is contrary to the wishful thinking of many in the investment business who like to believe that stocks, for example, are completely mean-reverting over long periods, despite all evidence to the contrary (a triumph of hope over experience).

Smoothing works fine in the many periods when down returns are regularly cancelled by up returns. But the sense of security is false: a pretty good model of the markets (not perfect, but pretty good) is that stock movements are a random walk. In any random process there can be cancelling movements but also there can be long runs of up or of down returns. If one smoothed consumption during a long

run of market underperformance, one would massively overspend, depleting principal and thus forcing a significant curtailment of future levels of consumption.[14]

If this isn't immediately apparent, review the discussion and the lower percentile lines on the exhibit in Waring [2011], pp. 17-20. Even with smoothing, the true underlying, unsmoothed risk is realized whenever there is a long period of disappointing returns. This happens quite often — think of 2000 through 2011, when the S&P 500 total return averaged less than 1% for 12 years, way below the average returns of 7 to 8 percent that were widely expected! If one believes that the random walk model is a reasonably good model of the markets, the possibilities of ruinous long-term underperformance can't be ignored.

Control consumption risk with investment policy, not with accounting tricks like smoothing.

### So you Want to Spend More than this Method Suggests? Aspiring to Higher Spending Levels Introduces Additional Risk

The only possibility of establishing a risk-free consumption schedule, then, is to fully hedge it with a ladder of risk-free bonds, inflation-protected bonds if protecting real consumption, nominal if protecting nominal consumption. To do this, one's balance sheet must be in balance, with assets equal to the value of that hedging portfolio: the present value of spending can't exceed the value of the available assets (including economic assets such as human capital). The good news is that you're always "fully funded," in an accounting sense, for your personal pension plan — the bad news is that you may not like the size of the benefit promise!

Advisors often suggest to clients that if they "need" $50,000 per year, and they have only, say, $600,000 available, an amount insufficient to provide for that much spending, they should compute the internal rate of return needed to make the assets provide the desired cash flows, and then they should invest in a strategy with that expected return. The risk side of this suggestion is seldom explored, but it means that you may end up with lower consumption, not higher, and perhaps *much* lower.

Another way of viewing this approach is as creating an additional "aspirational liability" consisting of that part of the present value of proposed spending which can't be supported risk-free by the assets actually in hand. The investor is then treating herself as if she were underfunded. There is no risk-free means of generating assets to fund this aspirational liability through investment strategy alone: one must seek higher expected returns, taking on greater risk.[15]

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[14] In some of the advanced academic literature of consumption investment policy, a variant known as Epstein-Zin utility suggests that there may be an "intertemporal elasticity of substitution" — in plain English that one might do a small amount of smoothing. See Campbell and Viceira [2002] at page 42 for the technical discussion. If an investor does smooth consumption, however, the amount must literally be small, because too much spent today means clearly that a corresponding amount must be forgone tomorrow — with interest. And you never know when a few bad periods will turn into an extended period of disappointing returns. Epstein-Zin utility thus has very little utility.

[15] Another approach to resolving the problem of having less money than you intend to spend is to consider that one will have to keep working. Part of one's expected future earnings, or human capital, will be converted to financial capital and added to one's asset balance in the future. One's personal

But — assets with high *expected* returns do not always generate high *realized* returns. In fact those realized returns can be abysmal, and can disappoint for very long periods of time. No present value is created by taking on more risk; the present value of a dollar of cash is the same as the present value of a dollar of equities; by aspiring to spend more than what one has, you create an artificial deep hole to climb out of, and it only happens if you get lucky and actually achieve those higher expected returns — 50-50 at best.

What happens if your luck is bad? We alluded to it a moment ago: Remember our discussion of what risk is. As a result of this investor reaching for his aspiration by taking on greater risk, the assets might earn less than the risk-free return and, if they do, consumption will be *lower* than what this investor could have had risklessly with a ladder of TIPS worth his actual asset value, $600,000! Lower, not higher, completely defeating the aspirational effort. And perhaps much lower.

Aggressive investment strategies that have the aim of increasing spending beyond one's apparent means, then, generate a significant probability that the investor will be worse off, not better off. You can count on what you have (if invested correctly); but aspiring to do better by taking on additional investment risk may, or may not, end well.

### Longevity Risk: The Problem is more Complicated than a Fixed 30-Year Term!

So far, we've developed a strategy for hedging consumption for a fixed term of 30 years, the maximum maturity of a TIPS bond. What about the rest of one's life? This is the true retirement horizon, not our arbitrary 30-year period. In effect, we've been ignoring — intentionally — a non-market-related risk, the uncertainty of our life span over which we need to provide for our consumption with our assets. Being a non-market-related, or non-beta risk, we can't hedge it directly, in the markets, but there are ways to deal with it.[16] We address those ways in this section and the one following.

People are living longer, and while some are also working longer, others retire as young as 55. The Social Security minimum benefit age of 62 (when a partial benefit becomes available to those who are not disabled) is the most popular age to retire. Of course, retiring later is getting to be a popular way of improving one's retirement consumption — there is both greater time for asset accumulation and a lesser time remaining of one's maximum possible life span in which to consume them. Meanwhile, the Social Security annuity tables show nonzero probabilities of being alive out to age 120! From these facts one could conclude that many retirees face the risk of having to live off their investments for somewhere between 58 and 65 years.

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balance sheet is then in balance (as it always must be), but can only be seen to be in balance by including human capital. In effect, one has an option to make one's human capital larger or smaller by retiring later or earlier.

[16] There have been some halting efforts at creating a mortality risk market. See, e.g., Wessel [2010].

A quick reality check shows that the risk is small. According to the Social Security table, the probability of being alive at age 110 is 0.017% for women and 0.002% for men. The corresponding probability for age 105 is 0.357% for women and 0.074% for men.

Thus, the risk of having to fund life from age 110 to 120 can perhaps be ignored by those willing to live only on Social Security in the event that they do happen to live beyond that age (in the U.S.) — although life expectancies have been rising, and living to 120 may not be so farfetched by the time those now saving for retirement are much older. Whatever one's view on the likelihood of living to extreme old age, it seems prudent to provide for oneself to at least age 105 if male or 110 if female, meaning (if one works to age 65) 40 to 45 potential years of retirement. Some people may want their hedge to last even longer than that — after all, if one happens to be one of the few lucky ones, it would be good to have some investments left over with which to improve one's quality of life. Whether 105 or 120, that's still a long time horizon for any prospective retiree.

How can one achieve such long-tailed payouts? Retirees have generally hedged longevity risk — the risk of outliving one's money — through a mixture of Social Security, defined-benefit pensions, adjusting one's standard of living on an *ad hoc* basis, and moving in with children. Life annuities have also proven to be a useful tool for some retirees. We'll return to some of the alternatives in a moment; in the meantime let's review how an ARVA strategy can solve this problem in a thoughtful manner.

## Do-It-Yourself Insurance against Longevity Risk: Providing for One's Maximum Possible Life Span using the ARVA Methodology

Many would like to maintain investment control over their portfolio, and manage the problem themselves; they have reasons for not turning their wealth over to an annuity insurance company. But this means providing not just for the shorter term of one's statistical life expectancy, as in a life annuity, but for the longer term of one's maximum possible life — which with any luck can be quite long.

But that potential length is sobering when one considers the effect on consumption expectations. Except at high real interest rates, plugging in (let's say) 45 years instead of 30 years as the time horizon in equation (1) yields a distressingly low initial spending rate if we think in level payment terms: 2.22% of initial capital at a zero real interest rate (way below the 4% rule), or 3.32% at a 2% real interest rate. (The corresponding exhibit is left out to save space. It resembles Exhibit 1 closely, with roughly three-quarters as much spending each year.) It will be even lower for 55 or 60 years!

In our experience, a self-insurance strategy out to the limit of one's possible life span is very difficult for most investors to embrace, as it takes a much larger amount of money to provide for a longer term than for a shorter term; and it seems that most people are short on retirement savings to begin with and are anxious to persuade themselves that their need is less than it really is. Even otherwise thoughtful investors seem spring-loaded to reject, out of hand, the need to provide for one's entire life. Yet, they do indeed worry about the risk of running out of money!

So, the facts must be faced. Longevity risk must be addressed, either through self-insured funds or through an annuity or one of the other alternatives discussed below. If it is ignored, then it should be ignored with full appreciation of what the risks are!

It's also difficult to hedge consumption for that long; for practical purposes it's impossible, at least today, to achieve anything like an accurate or close hedge. In many countries there are no inflation-protected bonds and, in all countries where they are available, there is an insufficient span of available durations. Markets are simply not sufficiently complete to provide very-long-duration consumption hedging, even in the most highly developed countries. There are sophisticated duration extension techniques that might help — in theory. But, in practice, the risks and costs of these make them impractical for providing complete protection at this point in time, especially for the individual investor.[17]

Before despairing about the lack of longer-term TIPS, remember that *any* amount of hedging, even if incomplete, does reduce risk, leading to a far more optimal consumption-protection position than is ever obtained with today's typical unhedged investment policies. In other words, it is extremely valuable to hedge what one can. As for the longer term, imperfectly hedgeable portion: it is good to remember the mantra, "no solutions? Then no problems!"

Mechanically, a maximum-life ARVA with constant real spending is the same as the 30 year Risky investor ARVAs discussed earlier but with a longer time frame, and there is no need to work another example — because the term is longer, annual consumption is less, and the hedging opportunities will always be incomplete.

It takes a lot of money to provide an ARVA for one's maximum life, and the likelihood is that much of it will go to one's heirs. One might have a higher spending rate with a commercial life annuity priced on one's life expectancy (see the section below discussing them), but our ARVA annuity for one's entire life may be viewed by many as the more secure alternative.

### Reconfiguring the *Shape* of the Payout: More Earlier, Less Later?

Perhaps there is another way to avoid a commercial annuity and also to spend more, at least during the more active portion of one's retired life. The ARVA need not provide for a constant real spending level, but might have some other, perhaps front-loaded, shape.

Because more than half of women die before age 85 (age 80 for men), their heirs will often be substantial beneficiaries of a self-insurance strategy pursued to the limit of one's life span, given that we will probably not live that long. This may motivate a desire to spend a bit more, earlier, and a bit less, later, at least for those not having strong bequest intentions. Regardless of the strength of one's bequest motives,

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[17] One can however, do the next best thing, perhaps budgeting for a remainder amount to be available at age 95 (the end of one's hedging capability at age 65), making it possible to do additional consumption hedging at age 95. Of course, this imperfect consumption hedging introduces interest-rate risk. Another approach might be to set up an ARVA using the growing annuity formula to create payments that grow at the *expected* rate of inflation; this would leave the investor unprotected only against the *unexpected* portion of inflation.

most retirees wish to consume more in their own actual, and likely shorter, lifetimes than they could by spreading their spending evenly over their maximum possible life span. Perhaps one might want to set aside money for a specific bequest, or to keep a certain sum set aside for the unforeseen emergency, a contingency fund of some sort.

One way to do these things is to modify the *shape* of the payout, the relative amounts spent over time; there is nothing special about equal payments (equal in either nominal or real terms) other than their resemblance to car payments or mortgage payments and their ease of calculation on a spreadsheet or financial calculator.

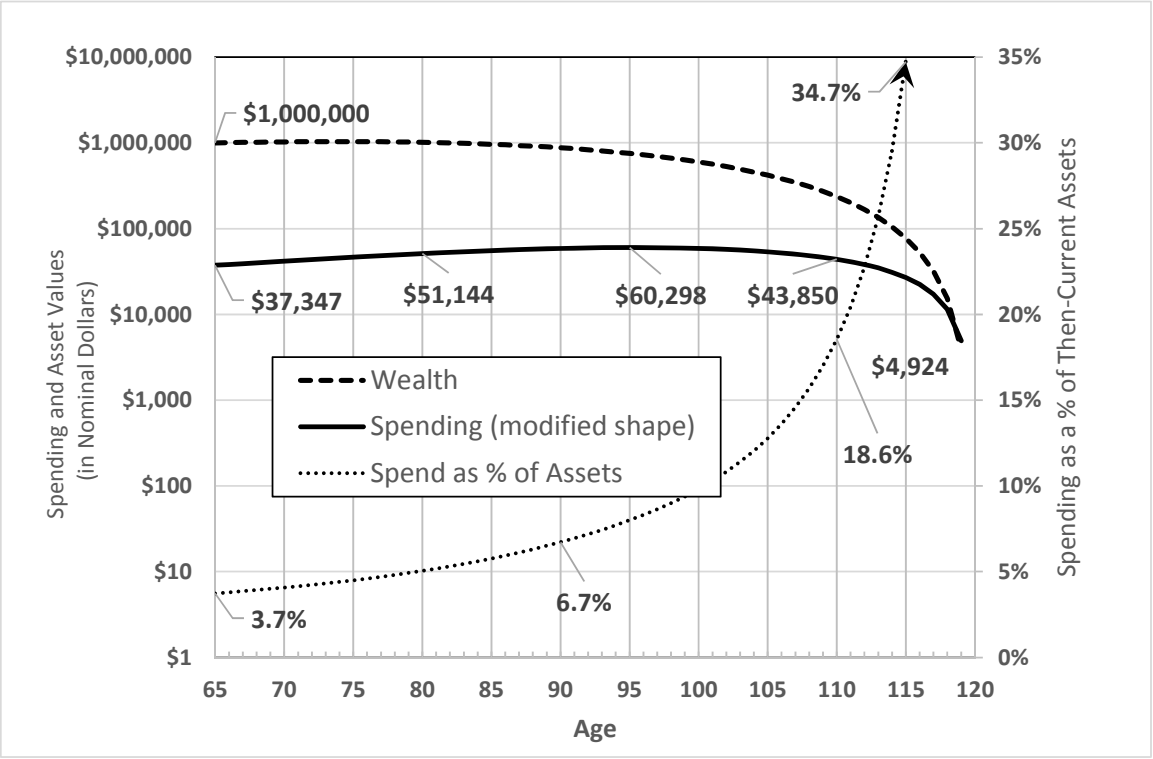
As with any stream of cash flows, the "shape" of the cash flow payouts to a retiree can be engineered to be anything the retiree wants, as long as the various cash flow payouts have the same present value, on a risk-free real interest rate basis, as the available assets (the ARVA annuity value, economically a liability, is necessarily equal to the original investment plus the present value of any additional funds expected to be received).

Let's say that an investor puts a premium on income received in the early part of retirement, when she is likely to travel and have other expensive consumption goals; and that she has Social Security as well as full insurance coverage for health care costs, including late-in-life care. She would benefit from a spending rule that is front-loaded, so her income will be lower when she is older, but at a level that still provides a guarantee of never running out of money during her lifetime. Such shape issues can be provided for. Here, we'll illustrate a couple of simple shape modifications, using ARVAs, in order to show that there is the opportunity to modify consumption to maximize personal timing preferences.

We experimented with a number of potential front-loading rules as alternative to a real level pay rule. The simplest and perhaps most intuitive to many is to take one's remaining life *expectancy* conditional on having lived to one's present age (instead of the maximum possible life span) as the time horizon, apply equation (1) for a riskless portfolio (if hedging instruments were available) or equations (1) and (4) for a risky one, and update the life expectancy each year (each year of life extends one's life expectancy). This is a very appealing approach because one's remaining life expectancy does get longer as one lives longer, and one might think it would work out well. But when examined it provides a payout shape so front-loaded that (for a female) spending is robust only until age 83, is cut in half by age 91 (in nominal terms!), and then plummets further. Some retirees might find this degree of front-loading acceptable, but we are extremely averse to longevity risk, and we know many 83-year-olds who are trekking in exotic lands, so we don't recommend this approach.

EXHIBIT 2

55 YEARS OF SPENDING AND ASSET VALUES WITH RISKLESS PORTFOLIO (ANNUITY TIME HORIZON UPDATED EACH YEAR TO EQUAL THE AVERAGE OF REMAINING LIFE EXPECTANCY AND LIFE SPAN)




What about a blend of life expectancy and maximum life as one possible compromise, supporting higher spending earlier, and lower but perhaps sufficient spending later? Exhibit 2 shows spending, the wealth level, and spending as a percentage of wealth for a rule that takes the *average* of the remaining life expectancy (from Social Security tables) and the maximum possible life span as the time horizon, and then updates the calculation each year as one's life expectancy slowly extends. (In the exhibit, we use 120 as the maximum possible life span. The chart is deterministic, with constant rates of return for the inflation-protected hypothetical risk-free hedging portfolio; if risky assets are held, then the assets, and consumption, will reflect the unhedged volatility.)

The resulting spending curve gives a great deal of real income protection well into one's eleventh decade, while increasing spending by a full 26% at age 65, and by 19% at age 80, relative to a level-real-payment-to-age-120 spend-down (it pays more until age 93, which is past life expectancy for most; then pays less thereafter — 16% less at age 100, and 51% less at age 110). Many might see an approach such as this as a sensible way to spend a bit more money earlier in one's retirement when one can enjoy the spending, while still protecting modest but helpful amounts against the potential of an extended life span.[18] In many ways it has the benefits of a third party annuity, without the risks.

[18] Another means of shifting spending earlier would be set up a nominal, rather than a real, ARVA. This strategy, protecting spending only in nominal terms, may be the only one available for many investors, particularly outside of the few countries that offer inflation-protected bonds. While this strategy does

To fully generalize the flexibility of the ARVA approach, the investor can accommodate any desired shape of his or her anticipated consumption. We have focused on regular periodic consumption, but consumption planning can include nonrecurring items including providing for the children's college expenses, contingency reserves, and specific bequests. The only limitation is that the sum of the present values of these future payments, along with the desired consumption spending annuity in whatever shape, be equal to the assets available (economic assets and liabilities must be equal!). Choose an approximate horizon for, say, the college fund, and price a zero coupon inflation-protected bond against it. Repeat for any other special allowances. Subtract from the available assets (including appropriately discounted and decremented expected future additions to one's assets), and the remainder is what is available to create the basic consumption annuity.[19]

## Other Ways of Managing Longevity Risk

An ARVA strategy is not the only way of providing spending during one's retirement, protecting consumption for one's entire life — even though we think it is a very good strategy, and in many cases the best. Here are some other options:

1. Annuitize it all through life insurance company commercial annuities
2. Create a blend of deferred life annuities and conventional investing using an ARVA strategy
3. Insurance riders for lifetime income: guaranteed withdrawal life benefit (GWLB), ruin-contingent life annuity (RCLA)
4. A still-hypothetical riskless insurance company annuity, on terms we propose here.

Let's briefly examine each of these approaches.

### 1. Annuitize it all using commercial life annuities (and/or deferred life annuities) from life insurance companies

Why not take advantage of the "insurance principle" (small contributions by many will pay the large losses of an unlucky few, through pooling of longevity risk) and just dump the whole longevity risk problem on a commercial insurance company by buying a life annuity from them?[20] Using such an annuity, one can spend for his or her entire life as if one was only going to live to the age of one's life expectancy at the time of buying the annuity; on its face this is a very good deal. In earlier work (Waring and Siegel [2007]), we calculated that this might decrease one's assets required for a given spending level by 35%, equivalent to raising one's spending

work to shift spending to earlier from later, it is not a well-controlled strategy in that the investor leaves to chance the possibility that later spending might be more substantially diminished by unexpected large inflation rates than had been hoped for.

[19] There are some subtleties to the discount rates for uncertain expectations of future assets, and for the spending that corresponds to them, but we gloss over that here. A different article is needed to address that question.

[20] Formally, the insurance principle is just the law of large numbers: "The average outcome for many independent trials of an experiment will approach the expected value of the experiment." Our version, borrowed from Deane Waldman, http://www.americanthinker.com/2014/02/healthcare_and_the_insurance_principle.html, is more revealing.

level for a given level of assets by 53%. If it is such a good deal, we need to look at it more seriously.[21] Are there any concerns?

Yes. Among the concerns are: (1) life annuities consume all of the investor's liquidity, so that if you need extra money for emergencies or just want to have it available, you're out of luck; (2) you cannot direct your own investment choices, and the annuity issuer will invest conservatively (so-called variable life annuities are not a good answer to this objection); (3) it is hard to figure out whether you're getting a fairly priced deal, so you're probably not; and (4) the annuity contract is subject to counterparty risk, the possibility that the insurance company won't pay.

Any of these concerns can be a deal killer for the individual seeking to secure his or her retirement. The literature on the "annuity puzzle" asks why, if annuities are such a good deal, takeup is so poor.[22] We'd respond that the four concerns cited above are reason enough. It's not much of a puzzle.

A compromise solution that works for some investors is to put only part of one's savings into commercial annuities, leaving the rest for discretionary investment and spending. (One particular such method is highlighted in the next section.) It also seems prudent (to us) in such a strategy to diversify among issuers, hoping they don't all go bankrupt at the same time, although the experience of 2008 suggests that default risk among financial institutions tends to cluster, making diversification less effective than it otherwise would be. There are many states with insurance guarantee funds, but these funds typically have low payout caps, and if defaults were clustered or large, these could be quickly exhausted.

### 2. Blend of conventional investments and deferred annuities

In a series of articles with various co-authors, Stephen Sexauer proposes a retirement decumulation benchmark consisting of a portfolio of laddered TIPS plus deferred life income annuities (DIAs) designed to start paying many years after retirement, held in a ratio designed to provide a smooth consumption path.[23] DIAs are surprisingly inexpensive, for reasons made clear below. A nominal (non-inflating) annuity that pays $100,000 in annual income starting at age 85 can be purchased by a 65-year-old male today for $203,046.[24]

Some very risk-averse retirees, corresponding roughly to our Riskless investor, will hold the benchmark in an index fund-like configuration. But Sexauer *et al.* do not recommend this mix to everyone. Instead, they make the point that the TIPS-plus-DIA blend is a passive, essentially risk-minimizing reference point or benchmark that investors (resembling our Risky investors) can use for making active portfolio decisions if they want to try to earn a higher return or different payout pattern.

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[21] Although most life annuities are nominal, real life annuities (those with a payout that is adjusted for inflation) are also available, albeit much less widely.

[22] See Milevsky (2013).

[23] Sexauer, Peskin, and Cassidy [2012]; Sexauer and Siegel [2013].

[24] The source is Allianz Global Investors' http://www.DCDBBenchmark.com, which provides a variety of data on the TIPS-plus-DIA benchmark. Annuity quotes represent a survey of insurers and Allianz is not one of the insurers surveyed. The quote shown here was updated in April 2014.

The reasons for the large conditional rate of return (that is, conditional on surviving to get it) are: (1) the long wait before receiving any benefit (while the insurance company is earning interest on your money), (2) the likelihood — probably less than 50% — that a buyer will live long enough to collect at all, and (3) the fact that most of those who do live long enough to collect will die within a few years. Let's add (4), default risk — the possibility that the insurer is promising a higher payout than it can provide safely, with all risks hedged, so the promised payout includes a credit risk premium.

In Sexauer *et al.*'s design, the conventional investment portfolio portion can be "riskless" or risky.[25] In his base case the conventional assets are riskless (fully hedged to the consumption liability and thus consisting of laddered TIPS), and are equivalent to a riskless ARVA in our nomenclature. If the conventional asset portfolio is risky, equivalent to a risky ARVA, it has the same implications for variable spending as those we describe above (Sexauer *et al.* refer to the resulting variation in spending as requiring a "personal fiscal adjustment," or PFA).

The appeal of the plan is that it is much less expensive than self-insurance to a very old age, and enables the individual to focus on the earlier part of retirement, when he believes he is likely to be alive and healthy enough to engage in discretionary consumption — instead of giving up when faced with the prospect of saving for a 45-year retirement. By making the final years of life (should they occur) the insurance company's problem, the plan makes retirement investing feel more manageable.

This benefit, of course, comes at a price: the DIA, as acknowledged by Sexauer *et al.*, is subject to the same default risk problems as those discussed above with "immediate" (non-deferred) life annuities; perhaps greater. Commercial annuity providers aren't known to precisely hedge their long-term obligations, and their promises to us might easily extend out for 40 or 50 years. That's a long time and a lot of market events through which they must remain solvent. One can try to mitigate the risks of the DIA portion of the Sexauer plan through insurer diversification, reliance *in extremis* on state insurance funds (up to their caps), and leaving some surplus funds in the conventional portfolio as a reserve against insurance-company default in the DIA payout years.

### 3. Insurance riders providing longevity protection

In its seemingly boundless desire to offer something — anything — to appeal to longevity-risk hedgers without providing safe (properly hedged), simple, transparent, and fairly priced life annuities, the insurance industry has designed a number of strategies that guarantee a lifetime income (subject to the insurer's continued solvency). The best known such product is the guaranteed withdrawal life benefit (GWLB), a rider attached to a variable annuity that allows the annuitant to continue to withdraw a pre-specified income amount even if the annuitant's portfolio has become worthless due to withdrawals and/or poor market performance. (Variable annuities are essentially high-fee mutual-fund portfolios convertible at some future point into life annuities based on then-available pricing, but otherwise having little in common with the immediate or deferred life annuities discussed above.)

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[25] "Riskless" is in quotes because no investment is ever completely riskless.

Ruin-contingent life annuities (RCLAs) represent a similar promise by an insurance company but are structured somewhat differently.[26] They do not need to be attached as a rider to a variable annuity program, but can be marketed independently and overlaid on a conventional investment portfolio. The insurer needs to police withdrawals and investment risk.

GWLBs, RCLAs, and similar products need to be evaluated carefully for their default risk, explicit and hidden fees, and conditions under which the guarantee does not apply. Again, the industry could do a better job of making all these longevity risk-pooling opportunities safe, transparent, and cross-comparable.

## 4. Riskless longevity insurance: A challenge to the industry

Why is guaranteeing a lifetime income such a thorny problem? In principle, longevity risk pooling is simple and obvious. Can't insurance companies hedge their risks so that investors don't have to worry about default and the many other headaches we've been discussing?

We believe the answer could be yes. We'd like to challenge the life insurance and annuity community to create a highly competitive, index-fund-like annuity structure, with the intent of capturing a large share of the huge overhanging demand for life annuities. Suppose a life-annuity-only insurance company were set up with the following characteristics:

- Separate corporate structure, insulated from financial exposure to affiliated companies. All reserves held in default-free Treasury bonds and TIPS and properly hedged to the liability as closely as is possible, at all times. That is, minimize inflation risk, real interest rate risk, and all other risky asset risk.
- Use the life expectancy tables thought to be the "best estimates" of true mortality risk, and identify the table used.
- Participating policies, such that any longevity surprises in the population are charged against (or added to!) benefits, so that the insurer does not need to add a risk charge.
- Very broad participation so there is little adverse selection

In addition, we'd all benefit from transparent and standardized annuity contracts, but these are not strictly necessary for annuity security, only for fair pricing. Because the company only issues life annuities, risk from other insurance lines does not affect the asset reserves.

The resulting annuity business, which we call Riskless Longevity Insurance (RLI), looks a little like a bond index fund on its investment side and in its revenue model, with an annuity payout benchmark, and is fully funded by the participants and offered by private enterprise.[27] Would-be retirees could then hedge longevity risk fully, over as long a time horizon as Treasury securities exist, and with much-diminished risk for longer horizons. (On this large scale, the skillful use of leverage and derivatives,

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[26] RCLAs were proposed by Huang, Milevsky, and Salisbury [2014]. Only one RCLA has been issued that we know of, ARIA from Transamerica, http://www.ariaforadvisors.com.

[27] It even looks a little like a privatized version of U.S. Social Security. See Goetzmann [2008].

coupled with duration matching in place of cash flow matching, makes it possible to hedge longer periods.) While participants still face a small amount of risk to spending from longevity adjustments, default risk — a much bigger risk and a much bigger obstacle to adoption — has been all but eliminated.

The business case for this radical reform of annuity product is historically proven: As happened with the large index fund providers, fees head down fast, but the winners of the most market share do very well, with low costs and high margins, making this an attractive proposition for the life insurance company willing to pioneer the product line.[28] Similarly, when options went from being negotiated instruments to standardized instruments, volume — and profits of the CBOE — went through the roof. Insurers arise!

Most investors would want to blend life annuities and conventional investing, both because they want liquidity (essentially, the option to spend sooner) and expected returns higher than those that Treasury bonds provide. But they would not have to. They could build their entire retirement portfolio out of these idealized annuities, for a riskless (but rigid) consumption plan. We will provide further detail on such an annuity company design in a future article.

## Conclusion

A spending rule for retirement is, at its heart, an annuitization problem. It doesn't require an actual annuity, but it does require annuity thinking. Investors should think of retirement spending as payouts from either an actual or, more likely, a virtual annuity, our ARVA spending rule. If the investments are "riskless," that is, hedged to the investor's consumption liability through laddered TIPS or similar holdings, then spending will be constant in real terms although at a relatively low level, reflecting the low risk in this strategy.

More likely, the investments will include risky assets and will be imperfectly hedged to consumption. If the investments involve risk, the recalculated annuity periodically adjusts spending to keep it appropriate to fluctuating portfolio values and interest rate levels; in this way, spending will always be sized appropriately to one's assets and the possibility of ruin can be avoided.

Risk tolerance must be set carefully when deciding the aggressiveness of the asset allocation strategy. Risk in the investment portfolio translates directly to risk in the investor's lifetime consumption stream: a 10% portfolio loss requires a 10% reduction in spending. It should be no surprise to anyone that the decision to seek higher expected returns in an effort to increase consumption means taking on greater expected risk — risk that realized returns, and thus consumption, might end up lower rather than higher.

One can do this on his or her own, providing for planned spending including a thoughtfully "shaped" consumption plan, and in doing so retaining control over one's portfolio and enabling the use of risky assets in the search for higher returns.

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[28] There will need to be some work done with insurance regulators, unfamiliar with modern concepts of surplus optimization and hedging, in order to keep regulatory accounting from getting in the way of the success of this economically proper solution.

Some investors will want to take advantage of the insurance principle to pool some or all of their longevity risk with that of other investors in the form of commercial annuities, making it possible to consume more during one's lifetime for a given amount saved, of course conditional on there being no default during the extended payout period. No currently available strategy for doing so is without problems, but we can envision an insurance product that fully accomplishes that goal and we encourage the insurance industry to take up our challenge.

## REFERENCES


Bengen, William P. 1994. "Determining Withdrawal Rates Using Historical Data." *Journal of Financial Planning,* vol. 7, no. 4 (October): 171-180.

Bierwirth, Larry. 1994. Investing for Retirement: Using the Past to Model the Future. *Journal of Financial Planning*, Vol. 7, no. 1 (January): 14-24.

Bodie, Zvi, and Michael J. Clowes. 2003. *Worry-Free Investing: A Safe Approach to Achieving Your Lifetime Financial Goals.* FT Prentice-Hall, Upper Saddle River, NJ.

Bodie, Zvi, and Rachelle Taqqu. 2011. *Risk Less and Prosper: Your Guide to Safer Investing.* John Wiley & Sons, Hoboken, NJ.

Breeden, Douglas T. 1979. "An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunities." *Journal of Financial Economics* 7 (September), 265-296.

Campbell, John Y., and Luis M. Viceira. 2002*. Strategic Asset Allocation: Portfolio Choice for Long-Term Investors*. Oxford University Press, Oxford.

Chen, Peng, Roger G. Ibbotson, Moshe A. Milevsky, and Kevin X. Zhu. 2006. "Human Capital, Asset Allocation, and Life Insurance." *Financial Analysts Journal,* Vol. 62, no. 1 (January/February), pp. 97-109.

Cooley, Philip L., Carl M. Hubbard, and Daniel T. Walz. 1998. "Retirement Savings: Choosing a Withdrawal Rate that is Sustainable." *AAII Journal,* 1998, Volume XX, No. 2 (February), http://www.aaii.com/journal/article/retirement-savings-choosing-a-withdrawal-rate-that-is-sustainable

Eisenberg, Lee. 2006. *The Number: What Do You Need for the Rest of Your Life and What Will It Cost?* The Free Press, New York.

Finke, Michael, Wade D. Pfau, and David M. Blanchett. 2013. "The 4 Percent Rule Is Not Safe in a Low-Yield World." *Journal of Financial Planning* (June): 46-55. Available at SSRN 2201323.

Garland, James P. 2013. "Spending Rules for Endowments and Long-Lived Trusts." Working paper, submitted to the CFA Institute Research Foundation (April 27).

Goetzmann, William N. 2008. "More Social Security, Not Less." *The Journal of Portfolio Management*, Vol. 35, No. 1 (Fall): pp. 115-123.

Goldsticker, Ralph. 2007. "A Mutual Fund to Yield Annuity-like Benefits." *Financial Analysts Journal,* Vol. 63, no. 1 (January/February), pp. 63-67.

Huang, Huaxiong, and Moshe A. Milevsky. 2011. "Lifetime Ruin Minimization: Should Retirees Hedge Inflation or Just Worry About It?" *Journal of Pension Economics and Finance,* Volume 10, Issue 03 (July), pp 363-387, published online by Cambridge University Press 20 May 2011, http://milevsky.info.yorku.ca/files/2010/08/HM2011_JPEF.pdf.

Huang, Huaxiong, Moshe A. Milevsky and T. S. Salisbury. 2014. "Valuation and Hedging of the Ruin-Contingent Life Annuity (RCLA)." *Journal of Risk and Insurance.* Vol. 81, issue 2 (June), pp. 367–395.

Ibbotson, Roger G., Moshe A. Milevsky, Peng Chen, and Kevin X. Zhu. 2007. *Lifetime Financial Advice: Human Capital, Asset Allocation, and Insurance.* CFA Institute Research Foundation, Charlottesville, VA.

Merton, Robert C. 1973. "An Intertemporal Capital Asset Pricing Model." *Econometrica,* Vol. 41, no. 5. (September), pp. 867-887.

Merton, Robert C. 1975. "Theory of Finance from the Perspective of Continuous Time." *Journal of Financial and Quantitative Analysis,* Vol. 10 (November), pp. 373–413.

Merton, Robert C. 1977. "A Reexamination of the Capital Asset Pricing Model." In Bicksler, James, and Irwin Friend, editors, *Studies in Risk and Return,* Ballinger, Cambridge, MA.

Merton, Robert C. 2012. "Observations on Financial Education and Consumer Financial Protection." In Bodie, Zvi, Laurence B. Siegel, and Lisa Stanton, editors, *Life-Cycle Investing: Financial Education and Consumer Protection,* CFA Institute Research Foundation, Charlottesville, VA.

Merton, Robert C. 2014. "The Crisis in Retirement Planning." *Harvard Business Review* (July/August).

Milevsky, Moshe A. 2013. *Life Annuities: An Optimal Product for Retirement Income.* CFA Institute Research Foundation, Charlottesville, VA.

Milevsky, Moshe A., and Chris Robinson. 2005. "A Sustainable Spending Rate without Simulation." *Financial Analysts Journal*, Vol. 61, no. 6 (November/December).

Rubinstein, Mark E. 1976. "The Strong Case for the Generalized Logarithmic Utility Model as the Premier Model of Financial Markets." *Journal of Finance*, Vol. 31, no. 2 (May), pp. 551-571.

Rudd, Andrew, and Laurence B. Siegel. 2013. "Using an Economic Balance Sheet for Financial Planning." *The Journal of Wealth Management*, Vol. 16, no. 2 (Fall): pp. 15-23.

Rudd, Andrew, and Laurence B. Siegel. 2014. "Building Portfolios for Households with Multiple Investment Goals." In progress; available from the authors.

Sandidge, James B. 2012. "Do State Guaranty Associations Make Annuities Less Risky or More?" Unpublished and undated. Accessed at http://www.sandidgegroup.com/images/Paper%20on%20State%20Guaranty.pdf on August 3, 2012.

Scott, Jason S., William F. Sharpe, and John G. Watson. 2009. "The 4% Rule—At What Price?" *Journal of Investment Management,* Vol. 7, no. 3, pp. 31–48, http://www.joim.com

Sedlacek, Verne O. 2011. "Rethinking Endowment Foundation," presentation at the Foundation Leadership Forum, Hyatt Regency, Bonita Springs, FL, January 24, 2011. http://agb.org/sites/agb.org/files/u16/Sedlacek%20PDF.pdf

Sexauer, Stephen C., Michael W. Peskin, and Daniel P. Cassidy. 2012. "Making Retirement Income Last a Lifetime." *Financial Analysts Journal,* vol. 68, no. 1 (January/February).

Sexauer, Stephen C., and Laurence B. Siegel. 2013. "A Pension Promise to Oneself." *Financial Analysts Journal* (November/December).

Sharpe, William F. "Asset Allocation." In Maginn, John L., and Donald L. Tuttle, eds, *Managing Investment Portfolios: A Dynamic Process.* New York: Warren, Gorham & Lamont, 1990, chapter 7.

Waring, M. Barton. 2011. *Pension Finance: Putting the Risks and Costs of the Defined Benefit Plan Back Under Your Control.* John Wiley & Sons, Hoboken, NJ.

Waring, M. Barton, and Laurence B. Siegel. 2007. "Don't Kill the Golden Goose! Saving Pension Plans." *Financial Analysts Journal,* Vol. 63, no. 1 (January/February): pp. 31-45.

Waring, M. Barton, Laurence B. Siegel, and Timothy Kohn. 2007. "Wake Up and Smell the Coffee: DC Plans Aren't Working – Here's How to Fix Them." *Journal of Investing* (Winter).

Waring, M. Barton, and Duane Whitney. 2009. "An Asset–Liability Version of the Capital Asset Pricing Model with a Multi-Period Two-Fund Theorem." *Journal of Portfolio Management,* Vol. 35, No. 4 (Summer): pp. 111–130.

Wessel, Rhea. 2010. "Degrees of Longitude." *CFA Institute Magazine* (March/April): 36-39.

Yaari, Menahem E. 1965. "Uncertain Lifetime, Life Insurance and the Theory of the Consumer." *The Review of Economic Studies,* Vol. 32, no. 2 (month), pp. 137-150.