Asset Valuations and Safe Portfolio Withdrawal Rates

by

David Blanchett, CFA, CFP®
Head of Retirement Research
Morningstar Investment Management
david.blanchett@morningstar.com

Michael Finke, Ph.D., CFP®
Professor and Ph.D. Coordinator at
the Department of Personal Financial
Planning at Texas Tech University
Michael.Finke@ttu.edu

Wade D. Pfau, Ph.D., CFA
Professor of Retirement Income
at the American College
wadepfau@gmail.com

Abstract

Bond yields today are well below and stock market valuations are well above their historical average. There are no historical periods in the United States where comparable low bond yields and high equity valuations have occurred simultaneously. Both current bond yields and stock values have been shown to predict near-term returns. Portfolio returns in the first decade of retirement have an outsize impact on retirement income strategies. Traditional Monte Carlo simulation approaches generally do not incorporate market valuations into their analysis. In order to simulate how retirees will fare in a low return environment for both stocks and bonds, we incorporate the predictive ability of current valuations to simulate its impact on retirement portfolios.

We estimate bond returns through an autoregressive model that uses an initial bond yield value where yields drift in the future. We use the cyclically adjusted price-to-earnings (CAPE) ratio as an estimate of market valuation to predict short-run stock performance. Our simulations indicate that the safety of a given withdrawal strategy is significantly affected by the initial bond yield and CAPE value at retirement, and that the relative impact varies based on the portfolio equity allocation. Using valuation measures current as of April 15, 2013, which is a bond yield of 2.0% and a CAPE of 22, we find the probability of success for a 40% equity allocation with a 4% initial withdrawal rate over a 30 year period is approximately 48%. This success rate is materially lower than past studies and has sobering implications on the likelihood of success for retirees today, as well as how much those near retirement may need to save to ensure a successful retirement.

Asset Valuations and Safe Portfolio Withdrawal Rates

The growth in defined contribution savings and low rates of private annuitization mean that retirees must estimate how best to allocate savings over an uncertain lifetime. The primary risk of depleting a stock of assets in order to generate income is that the retiree will outlive their savings – also known as shortfall risk. Estimating the risk of running out of money involves projecting idiosyncratic longevity risk and portfolio returns. For portfolio returns, projections are centered around their historical averages. This ignores current asset valuations, which may be a valuable predictor of near-term returns.

There are two common approaches to estimating shortfall risk. One is to look back at historical rolling periods and estimate a withdrawal rate that would have been low enough to prevent a shortfall (e.g. Bengen, 1994, Cooley, Hubbard, and Walz, 1998, Pfau, 2010). The other is to simulate failure rates based on the historical distribution of stock and bond return characteristics (average returns, standard deviation, correlations) through a Monte Carlo analysis (e.g. Milevsky, Ho, and Robinson, 1997, Pye 2000, Spitzer, Strieter, and Singh, 2007). The traditional Monte Carlo methodology assumes the returns an investor is able to achieve are equally likely over the entire retirement period.

Assuming that future real returns on assets will equal the real returns experienced by investors in the past ignores current state information. This is particularly important if, as in the current period, there is a unique state where real bond yields are negative for durations of 10 years or less and stock valuations are much higher than the historical average. It is possible, however, to use state information from the past to estimate expected distributions of possible returns from market conditions that most closely resemble those that exist today in order to estimate the expected path of future returns. Rather than assuming the future will look like the average of all historic periods, we can instead assume that the future will resemble historic periods where asset valuations were most similar to those we see today.

In this paper we use a model that incorporates information about expected stock and bond returns today rather than assuming random returns from mean historical valuations. We estimate bond returns through an autoregressive model that uses an initial bond yield value where yields drift into the future. For stock returns, we use the cyclically adjusted price-to-earnings (CAPE) ratio as an estimate for market valuation. While our approach uses a Monte Carlo (stochastic) model, we vary the expected returns over the retirement period rather than using the same mean for all years.

We find that the safety of a given withdrawal strategy is significantly affected by the initial bond yield and CAPE value upon retirement, and that the relative impact varies based on the portfolio equity allocation. Using parameters close to the respective values as of April 15, 2013, which is a bond yield of 2.0% and a CAPE of 22, we find a 48% probability of success using a 40% equity allocation with a 4% initial withdrawal rate over a 30 year period. This success rate is materially lower than past studies. Our results suggest that including current high assets valuations, and the low expected future yields based on these valuations, imply a much greater risk of running out of retirement wealth when following a traditional investment-based withdrawal strategy. Current valuations can be a valuable tool allowing individuals and institutions to better project sustainable asset decumulation.

Retirement Income Research Models

Annuities are not widely used in the United State despite the theoretical benefits from purchasing an annuity[1]. This unwillingness to annuitize has been noted as a "puzzle" (Modigliani, 1986). Brown (2001), Milevsky and Young (2007), Purcal and Piggott (2008) have each noted the relatively low

[1] See Yaari (1965), and Davidoff, Brown, and Diamond (2005)

voluntary annuitization rate, and 54 percent of Americans aged 44-75 express distaste for the word annuity (Bhojwani, 2011).

Since they do not annuitize, a significant portion of retirees with accumulated defined contribution wealth will have to determine how much to withdraw from their retirement portfolio each year to fund consumption during retirement. A common research assumption is that retirees will maintain a constant level of inflation-adjusted (real) consumption over the retirement period. For example, the commonly applied 4-percent rule assumes that retirees will withdraw $40,000 each year from a $1 million portfolio (or 4% of the initial balance) and these withdrawals will increase each year by the rate of inflation. For example, if inflation were 3% in the first year, the withdrawal for the second year would be $41,200 ($40,000 * 1.03 = $41,200). These inflation-adjusted withdrawals are deducted from the portfolio balance until retirement assets are exhausted.

Recent studies by Stout and Mitchell (2006), Milevsky and Huang (2011), and Blanchett and Frank (2009), among others, have introduced more dynamic withdrawal strategies where the withdrawal amount is modified depending on realized investment returns and retiree expected longevity. However, the majority of financial advisors continue to use a constant, or static, lifetime withdrawal rate. Given the popularity of the fixed, inflation-adjusted withdrawal strategy among advisors, we model a static, inflation-adjusted retirement income strategy in this paper. We add to the literature by incorporating current asset valuations in order to more accurately predict the likelihood that a long-lived retiree will deplete their retirement savings.

Incorporating Valuation

Asset return assumptions have an important impact on projected retirement income sustainability. Most studies draw from 20th century U.S. bond and equity return data. While these historical returns are used to estimate returns, significant differences exist in their application. Two primary simulation techniques are 1) actual rolling historical periods and 2) taking the general attributes of the historical asset classes (returns, standard deviations, and correlations) and simulating a sequence of retirement returns through Monte Carlo analysis. Disadvantages of using rolling historical periods are that the study is constrained to the limited amount of periods, and the implicit assumption that events will unfold as they have in the past (including historical mean reversion, bond/stock correlations, and bounded extreme returns). Bengen (1994), Cooley, Hubbard, and Walz (1998), among others, use this approach when estimating safe portfolio withdrawal rates.

The second method is to use some kind of Monte Carlo simulation where return assumptions are based on either historical data and relationships or future market expectations. This is the most common return modeling approach in current research since it allows the author more control over the input assumptions. There have been significant differences in the return assumptions used within various Monte Carlo approaches, but in each case the assumed mean return for the portfolio is constant across all years. For example, if the return on stocks is assumed to be 10%, this is the average expected return on stocks across all years of the simulation. The actual return in a given year of a given run will vary randomly, but the average return is 10%.

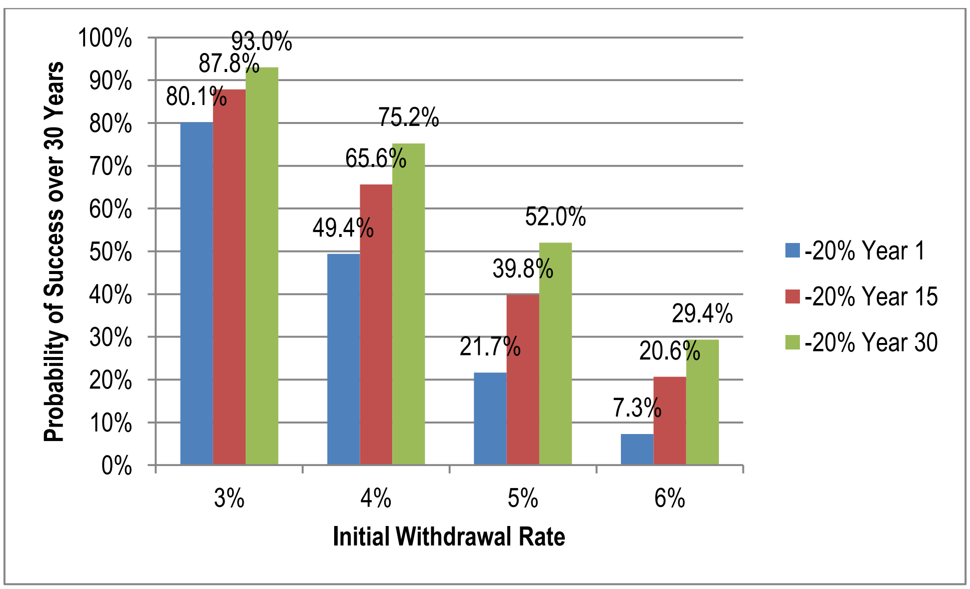
Using the same average return for each year is not an unreasonable assumption, but, as we demonstrate, doing so paints an incomplete picture of the return expectations of an investor when he or she retires. For example, current bond yields are highly correlated with the future returns experienced by bond investors over prolonged periods. While the long-term average annual return on intermediate government bonds from 1926 to 2012 might have been approximately 5.5%, the current yield on intermediate government bonds is considerably less. An analysis that assumes an investor can earn a yield of 5.5% on intermediate government bonds is not relevant to a retiree investing in a market with much lower or higher current returns. If today's returns predict near-term future returns (which have been shown to have an outsized impact on portfolio sustainability (Milevsky and Abaimova, 2006)), a more accurate simulation would incorporate more realistic estimates based on current asset valuations.

In this paper we introduce models that include valuation-based simulations to better capture expected returns. We measure valuation using current bond yields and the cyclically adjusted price-to-earnings (CAPE) ratio for stocks. These models incorporate the historical relationships between these values as well as future return expectations. We vary the input parameters to provide insight into the relative importance of the values when determining the safety of an initial withdrawal rate,

Sequence Risk

Retirement income portfolios are sensitive to poor portfolio returns early in retirement, a concept known as sequence risk. Figure 1 illustrates this effect. Within Figure 1 the average assumed real return of the portfolio is 4.0% with a 12.0% standard deviation. The only change to the returns is we assume a return of -20.0% for one year during the simulation, either the first year, the 15th year, or the final year. We see that when the negative return occurs has a significant impact on the likelihood of success. For example, the probability of success for a 4% initial withdrawal rate is only 49.4% if the portfolio loses 20% in year 1, but increases to 75.2% if the 20% loss is experienced in the final year of the simulation.

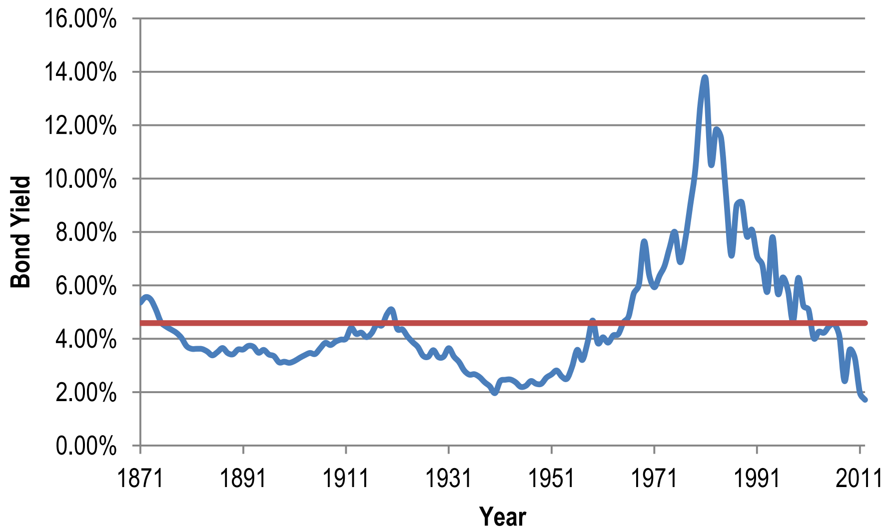
Figure 1: Sequence Risk



Bond Yields

While the average annual arithmetic return on the Ibbotson Intermediate-term Government Bond Index from 1926 to 2012 has been approximately 5.5%, the yield on an intermediate-term government bond today is closer to 2.0%. This is 3.5% lower than the historic average. An analysis that assumes an average bond return of 5.5% in the first year (with a 6.5% standard deviation) will significantly overestimate early retirement portfolio returns available to bond investors. Figure 2 demonstrates the long-term average historical bond yields.

Figure 2: Historical Bond Yields



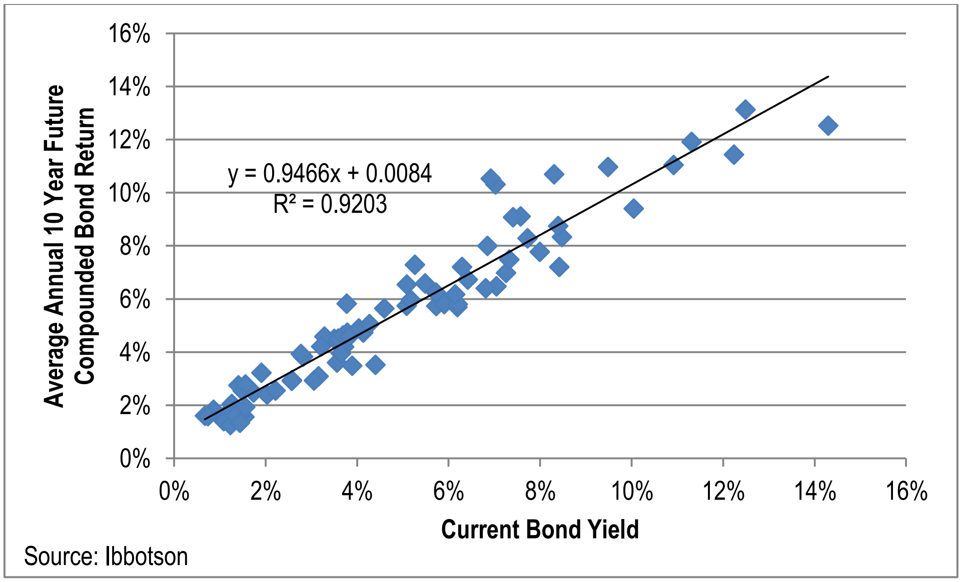
Source: Robert J. Shiller

Low yields on bonds appear to be the result of excess demand fueled both by the demographics of an aging population and the growth of economies with higher average savings rates (Arnott and Chaves, 2011). As populations continue to age, it is likely that demand for fixed-income securities and equities will continue to be strong (Bakshi and Chen, 1994). Governments have also increased the supply of bonds, adding to national debt among many developed countries. Any rise in nominal rates as a result of increased government borrowing, however, will likely be accompanied by inflation rather than real yields.

An investor may reject the hypothesis that demographic and macroeconomic factors will keep real rates low. Beyond this, there is little empirical evidence that bond yields do tend to revert back to the mean. An early model theory of bond mean reversion introduced by mathematician Oldrich Vasicek (1977) suggests that interest rates tend to bounce around a mean historical long-run trend. There are three components of this model – the long run trend itself, drift, and dispersion. Retirees today should be most interested in the drift concept. Think of the historical interest rate average as a magnet attracting extreme interest rates back to the central tendency. Each year interest rates vary according to some random effect, the size of which is part of the process and can be estimated with an historical standard deviation, but generally move back in the direction of the mean. The drift component means that tomorrow's interest rates are likely to look exactly like today's interest rates within a band of randomness. But the general direction of that drift is likely going to be toward the mean. Our best guess of tomorrow's interest rates is whatever they are today, plus or minus a certain amount of random movement, but in the general direction of the historical average.

In a recent review of the evidence on interest rate mean reversion using 200 years of data across four countries including the U.S. (van den End, 2011), there appears to be little evidence that bonds consistently revert back to their historical average in any predictable manner. In other words, interest rates can be higher or lower than the average for long periods of time and it is impossible to predict when they will return to the mean. Evidence of the persistence of nominal bond rates can be found by simply comparing the relation between current yields and subsequent returns in the United States. Figure 2 shows the relationship between bond yields and the future average annualized return on bonds using the Ibbotson Intermediate-Term Government Bond (ITGB) index as a proxy for bonds.

Figure 3: Relationship Between Bond Yields and Future Average Annualized 10 Year Return



The historical relationship between bond yields in one period and the future average annualized total return of bonds has been quite strong, with a coefficient of determination (R^2) of 92%. This means that the current yield on bonds can describe 92% of the average annual 10-year future compounded bond total return. While rising bond yields would result in higher returns for new bond investors, it would negatively affect those currently holding bonds as the values of their low-yield bonds decline. One method to approximate the impact of a change in interest rates on the price of bonds is to multiply the bond's duration by the change in interest rates times negative one. For example, if interest rates increase by 2%, a bond with a duration of five years (the approximate current duration of the Barclays Aggregate Bond Index) would decrease by 10%. The impact on bonds with longer durations would be even more extreme.

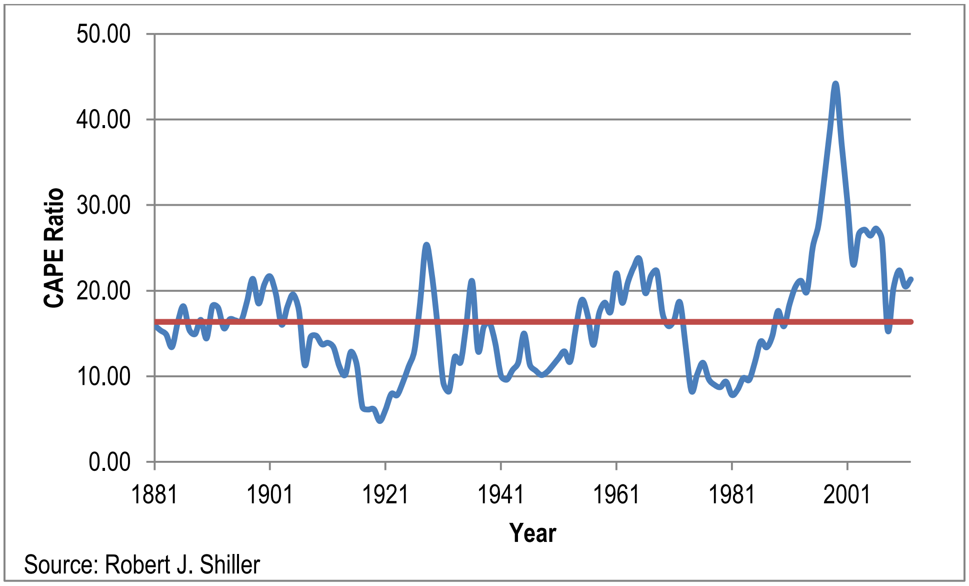
Stock Market Valuation

There is no perfect valuation measure for the stock market. One relatively well-known (and often cited) measure is the price-to-earnings ratio, or P/E ratio. The P/E is estimated by dividing the market price per share by the annual earnings. This measure effectively tells you how many dollars you receive in earnings for each dollar invested in a given company or index. The most commonly cited P/E is that for the S&P 500, which is a stock market index based on the market capitalizations of 500 leading companies publicly traded in the U.S. stock market, as determined by Standard & Poor's.

While the "price" component of the P/E equation (the numerator) is well specified (e.g., the current price of the S&P 500) the definition of what to use for earnings is far more fluid. There are different definitions of earnings (operation or total), time periods (forecast or trailing), and over different potential periods. One popular P/E metric is known as the cyclically adjusted price-to-earnings (CAPE) ratio, which is also called the Shiller P/E. The earnings portion of the CAPE equation is the inflation-adjusted average of 10-year trailing earnings.

The CAPE ratio provides a smoother perspective on market valuation than when using shorter time periods, such as trailing one year earnings. The idea of smoothing earnings goes back to famed value investors Benjamin Graham and David Dodd who noted in their classic text Security Analysis to look at profits for "not less than five years, preferably seven or ten years." Figure 4 provides some perspective on historical CAPE Ratios from 1881 to 2012.

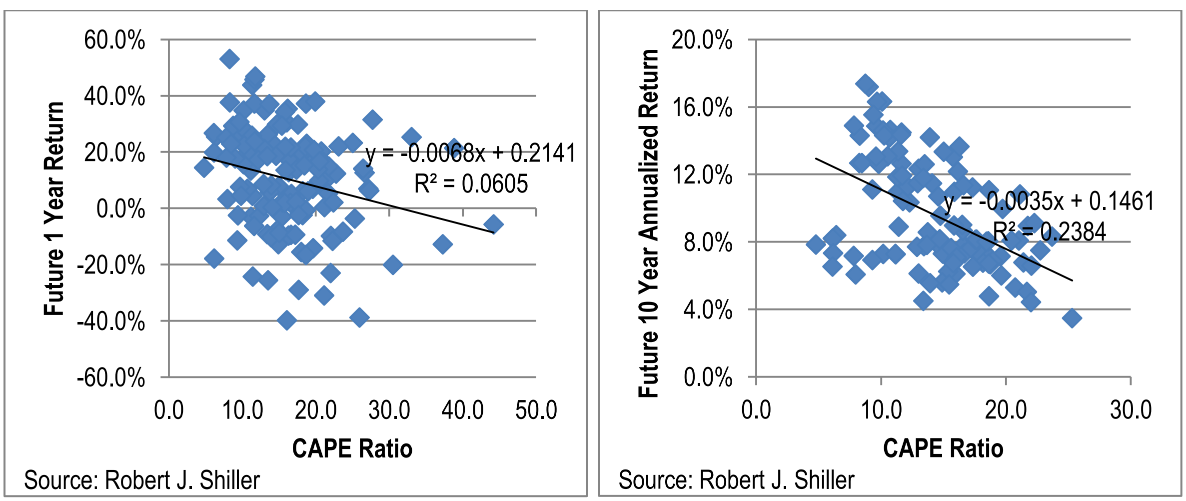
Figure 4: Historical CAPE Ratio: 1881-2012



The average CAPE ratio from 1881 to 2012 has been 16.4, although it has been slightly higher since 1960, averaging 19.5. There has been a relatively strong relationship between CAPE ratios and future stock returns. We demonstrate this effect in Figure 5, which includes the future 1 year returns (Panel A) and future 10 year returns for various historical CAPE ratios.

Figure 5: CAPE and Future Returns

Panel A: CAPE and Future 1 Year Returns **Panel B: CAPE and Future 10 Year Returns**



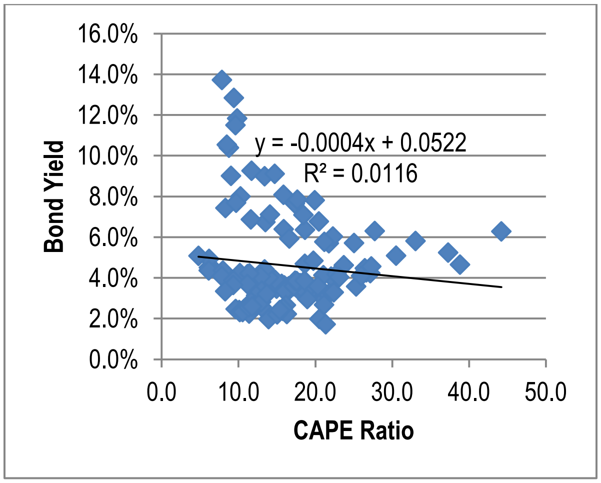
While the coefficient of determination (R^2) between the CAPE ratio and the future one year return (Panel A) may seem relatively weak (6%) the t statistic is -2.88, which is statistically significant at the 1% level. The R^2 over the following 10 year period (Panel B) is much stronger, at nearly 24% with a t statistic of -7.65.

Within the context of this research it is worth noting the historical relationship between CAPE ratios and bond yields. We demonstrate this in Figure 6, where Panel A is the historical relationship between CAPE ratios and bond yields and Panel B is the historical relationship between the change in CAPE ratios and the change in bond yields. We see that there is very little relationship between CAPE ratios and bond yields over the entire period.

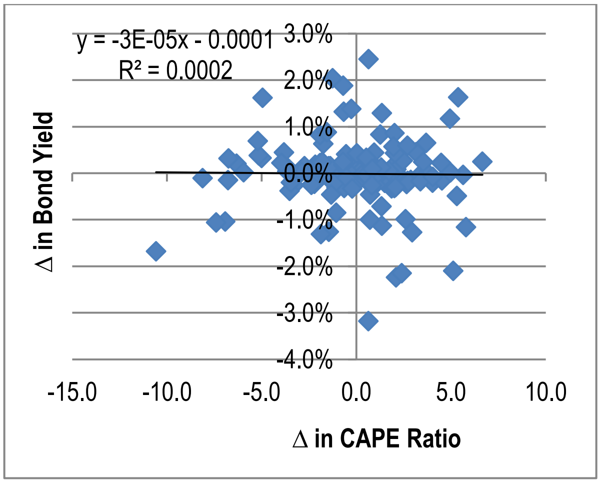
If we truncate our historical period from 1881 to 2012 to 1960 to 2012 we note a higher (negative) relationship between CAPE ratios and bond yields, with an R^2 of 35.6%. However, the relationship between changes in CAPE and changes in bond yields is still the same, effectively zero. This suggests that bond yields have historically been higher when CAPE values are lower, but that future changes between the two measures are unrelated.

Figure 6: Relationship Between CAPE and Bond Yields

Panel A: CAPE Ratio and Bond Yield



Panel B: Change in CAPE Ratio and Change in Bond Yield



Putting Today In Perspective

Figure 2 and Figure 4 put today into some perspective, not only are bond yields well below historical averages, but today's CAPE ratio is well above the historical average. This is therefore not a great time for investors in light of history. It is common to use historical rolling periods when testing the likelihood of a given withdrawal strategy lasting over a given period.

While most research uses all available periods, this is not necessarily a reasonable approach given the current market environments. We can look back, though, and determine how many market periods had the attributes we are seeing today: low bond yields and above-average CAPE values. We do this by segmenting the historical CAPE ratios and bond yields in approximate quartile groups, and include the results in Table 1.

Table 1: Number of Different Bond Yield and CAPE Ratio Environments

Panel A: Number of Periods

Panel B: Percentage of All Available Periods

		10 Year Government Bond Yield			
		<3.3%	3.3% - 3.8%	3.8% - 5.1%	>5.1%
CAPE Ratio	<11	6	2	9	10
	11-16	15	11	8	8
	16-20	5	16	5	6
	>20	7	3	12	9

		10 Year Government Bond Yield			
		<3.3%	3.3% - 3.8%	3.8% - 5.1%	>5.1%
CAPE Ratio	<11	4.5%	1.5%	6.8%	7.6%
	11-16	11.4%	8.3%	6.1%	6.1%
	16-20	3.8%	12.1%	3.8%	4.5%
	>20	5.3%	2.3%	9.1%	6.8%

Across the 132 different years with available data there are only 7 periods where the CAPE was above 20 and the yield on 10 year bonds was below 3.3% (1898, 1900, 1901, 1936, 2010, 2011, and 2012). Of these 7 periods only 4 occurred long enough ago so that we can test the sustainability of a retirement income strategy. We could, for example, use January 1937 as a proxy for what could happen, but this implicitly assumes a World War would commence roughly three years into the period. If we further restrict our bond yield to below 2.5% we only have two periods, 2011 and 2012, therefore we are definitely in relatively uncharted territory in terms of the potential implications of the impact for retirees.

Forecasting Models

We use three different forecasting models for bond returns, stock returns, and inflation in our analysis. In this section we overview each model.

Bond Return Model

The first step in our bond return model is to select an initial bond yield (i.e., seed value) for the simulation. This is the bond yield that exists that the beginning of the retirement simulation. For someone retiring today this would be based on current yields, which is the approach we use here. Given an initial bond yield, the yields for the subsequent years are based on equation 1, where $\varepsilon_{\mathrm{Yld}}$ is a independent white noise that follows a standard normal distribution with a mean of 0% and a standard deviation of 1.25%. The resulting annual bond yield ($\mathrm{Yld_t}$) is assumed to be bounded between a minimum of 1.0% and a maximum of 10.0%.

$$Yld_t = .25\% + .95Yld_{t-1} + \varepsilon_Y \quad [1]$$

After we determine the bond yield for a given year we estimate the bond return using equation 2, where ε_{b} is assumed to have a mean of 0.0% and standard deviation of 1.5%.

$$r_b = 0.0\% + 1.0Yld_t + -5.0(Yld_t - Yld_{t-1}) + \varepsilon_b \quad [2]$$

It is worth noting the 1.5% standard deviation for the error term (ε_{b}) is not the assumed standard deviation for the asset class (bonds in this case), rather the standard deviation for the errors around the regression estimates. The actual standard deviation of bond returns is 6.0%. The actual standard deviation is higher because other factors (such as the yield and the change in yield) are affecting the actual variability of returns. The long-term bond yield is assumed to be 5.0% within this model (i.e., this is the yield that it converge towards throughout the simulation).

Stock Return Model

Our stock return model is starts with an estimate of the CAPE. Once an initial CAPE value has been selected the CAPE value is assumed to drift based on equation 3, where $\varepsilon_{\mathrm{CAPE}}$ is assumed to have a mean of 0% and a standard deviation of 4.0. The CAPE value is assumed to be bounded between a minimum of 5.0 and a maximum of 45.0.

$$CAPE_t = 2.11 + .87CAPE_{t-1} + \varepsilon_{CAPE} \quad [3]$$

After the CAPE value has been determined the total return for stocks (r_s) is based on equation 4, where the standard deviation of ε_s is 20.0%.

$$r_s = 24.0\% + -.83\%CAPE_t + \varepsilon_s \quad [4]$$

The long-term stationary CAPE value is 16.4, whereby the return on stocks would be approximately 10.0% per year with a standard deviation of 20.0%. The implied annual arithmetic equity risk premium is 5.0% while the annual geometric equity risk premium is approximately 3.0%.

Our long-term assumed equity return of 10.0% is lower than the long-term arithmetic historical average for the U.S. stock market, which has been approximately ~12.0%. We assume a lower average return in light of the relative historical performance of the U.S. stock market versus other countries. From 1900 to 2012 the average annual real geometric return in the United States has been 1.92% higher than the other 19 countries included in the Dimson, Marsh, and Stauton dataset (6.26% versus 4.34%). Therefore, our reduction of approximately 2.0% makes the expected return on U.S. stocks more consistent with the past performance of other countries.

Inflation Model

Our inflation model is based on the historical relationship between CAPE values and bond yields from 1960 to 2012. This model has an adjusted R^2 of 55.3% with historical inflation. Including both CAPE and bond yields is superior to a model based solely on bond yields and bond yield changes (adjusted R^2 of 47.7%) and a model based solely on CAPE and CAPE changes (adjusted R^2 of 29.8%). Our inflation model is noted in equation 5 where ε_s is assumed to have a mean of 0.0% and a standard deviation of 1.50%.

$$r_i = 2.50\% + .48Yld_t + .76\Delta Yld + -.09\%CAPE_t + .-.15\%(CAPE_t - CAPE_{t-1}) + \varepsilon_i \quad [5]$$

The long-term inflation rate at equilibrium (CAPE of 16.4 and bond yield of 5.0%) is 3.5% with a standard deviation of 2.5% This implies a real bond return of 1.5% at equilibrium and a real arithmetic return on stocks of 6.5% and a real compounded return on stocks of approximately 4.5%. Since all income needs are in real terms, the inflation-adjusted returns are more important than the nominal returns for the purposes of our analysis.

Analysis

Each scenario in the analysis is based on a 10,000 run Monte Carlo simulation. Taxes and Required Minimum Distributions (RMDs) from the portfolio are ignored. The analysis assumes a base investment management fee of 50 bps. While the majority of research on retirement income has failed to include a fee, investing is not, and has never been, “free.” While low cost ETFs can be purchased today for as low as 10 bps for some asset classes, the buyer must still pay commissions and a bid/ask spread. Going back in time, though, the costs of investing increase significantly. For example, the expense ratio of the Vanguard 500 index (VFINX) in 1976 was 43 bps (versus 17 bps today) and according to Eisenach and Miller (1981), the average commission on stock trades in April 1975 for individual investors was 1.73% of the principal values versus .84% for institutions.

The primary metric used to relay the risk of different initial withdrawal rates is the probability of success. The probability of success is the percentage of runs that are able to successfully achieve the target cash flow for the respective period. While the probability of success is an imperfect measure because it does not provide information about the magnitude of failure, it is the most prominent metric in withdrawal rate research and relied upon by advisors to illustrate the risk of a given withdrawal rate and retirement portfolio strategy.

Results

As noted in the Literature Review section, there is considerable research noting the safety of a 4% initial withdrawal rate. We find the relative safety of a 4% initial withdrawal rate varies materially based on the initial market conditions for a retiree. Table 2 includes the probabilities of success for a 4% initial withdrawal rate over a 30 year period for different equity allocations, initial bond yields, and initial CAPE ratios.

Table 2: Probability of Success for a 4% Initial Withdrawal Rate Over 30 Years for Different Equity Allocations, Initial Bond Yields, and Initial CAPE Values

20% Equity Allocation							
	Initial CAPE Ratio						
Initial Bond Yield	5	10	15	20	25	30	35
1.0%	31.1%	23.9%	19.0%	12.7%	8.8%	5.8%	3.8%
2.0%	42.7%	37.0%	29.2%	22.1%	16.9%	11.9%	7.7%
3.0%	56.8%	49.6%	42.4%	34.5%	27.2%	20.5%	15.3%
4.0%	71.4%	64.2%	56.8%	48.0%	40.4%	32.2%	24.4%
5.0%	81.8%	77.0%	70.4%	63.2%	54.4%	46.2%	37.4%
6.0%	89.9%	86.3%	82.0%	75.8%	68.8%	60.9%	52.4%
7.0%	94.7%	92.8%	89.6%	86.1%	80.1%	73.4%	65.9%
8.0%	97.8%	96.8%	94.9%	93.0%	89.4%	84.0%	79.4%

40% Equity Allocation							
	Initial CAPE Ratio						
Initial Bond Yield	5	10	15	20	25	30	35
1.0%	74.8%	67.1%	58.1%	46.8%	35.4%	26.1%	17.7%
2.0%	78.0%	71.6%	62.3%	51.0%	41.6%	29.7%	21.9%
3.0%	81.4%	75.4%	66.5%	55.9%	45.6%	34.8%	25.7%
4.0%	84.9%	78.3%	70.8%	62.1%	50.2%	38.3%	29.5%
5.0%	86.8%	82.1%	74.0%	65.2%	54.7%	43.7%	32.6%
6.0%	89.8%	85.0%	78.4%	69.1%	60.3%	49.0%	37.1%
7.0%	91.4%	87.4%	81.6%	73.2%	63.4%	51.2%	41.8%
8.0%	93.1%	89.8%	84.3%	77.2%	67.2%	56.8%	46.4%

60% Equity Allocation							
	Initial CAPE Ratio						
Initial Bond Yield	5	10	15	20	25	30	35
1.0%	83.2%	77.5%	68.1%	57.6%	45.6%	34.4%	24.7%
2.0%	84.4%	78.3%	70.3%	59.5%	48.5%	36.4%	26.4%
3.0%	85.5%	79.4%	71.7%	60.7%	48.9%	37.3%	26.4%
4.0%	85.7%	80.1%	71.5%	62.3%	50.1%	39.7%	28.7%
5.0%	86.9%	80.8%	73.2%	62.8%	52.5%	40.8%	29.8%
6.0%	86.9%	82.3%	73.5%	64.1%	52.6%	41.1%	30.1%
7.0%	88.4%	82.1%	74.4%	65.1%	54.8%	42.3%	30.4%
8.0%	88.0%	82.9%	75.6%	65.6%	55.5%	43.2%	32.6%

80% Equity Allocation							
	Initial CAPE Ratio						
Initial Bond Yield	5	10	15	20	25	30	35
1.0%	85.4%	79.2%	70.3%	60.7%	48.6%	37.2%	26.5%
2.0%	85.5%	80.1%	71.0%	60.1%	50.2%	37.1%	26.9%
3.0%	85.9%	79.4%	71.1%	60.7%	49.1%	38.6%	27.0%
4.0%	84.9%	79.0%	70.9%	60.4%	48.7%	36.4%	26.3%
5.0%	85.1%	79.4%	70.5%	59.9%	48.4%	36.3%	26.1%
6.0%	84.1%	78.8%	70.4%	58.5%	48.3%	36.4%	26.0%
7.0%	84.1%	77.9%	69.3%	58.6%	47.1%	35.3%	25.0%
8.0%	83.1%	77.1%	68.8%	58.2%	46.9%	35.1%	24.5%

Results from Table 2 indicate that there is a significant deviation in the resulting probabilities of success across different equity allocation, initial bond yield and CAPE ratio environments. The vast majority of success probabilities are less than the ~90% probability of success commonly noted for a 4% initial withdrawal over a 30 year period. If we run a simulation with a 50% equity portfolio, an initial bond yield of 5%, an initial CAPE ratio of 16.5 and no investment management fee we would estimate a probability of success of 77.5%. If we then increased the return on equities by 2%, the resulting probability of success would further increase to 87.4% (note it would be 83.1% even if we added back a 50 bps fee). Therefore, our differences are a result of assumptions that we feel are more likely to persist into the future and better capture the actual reality faced by retirees.

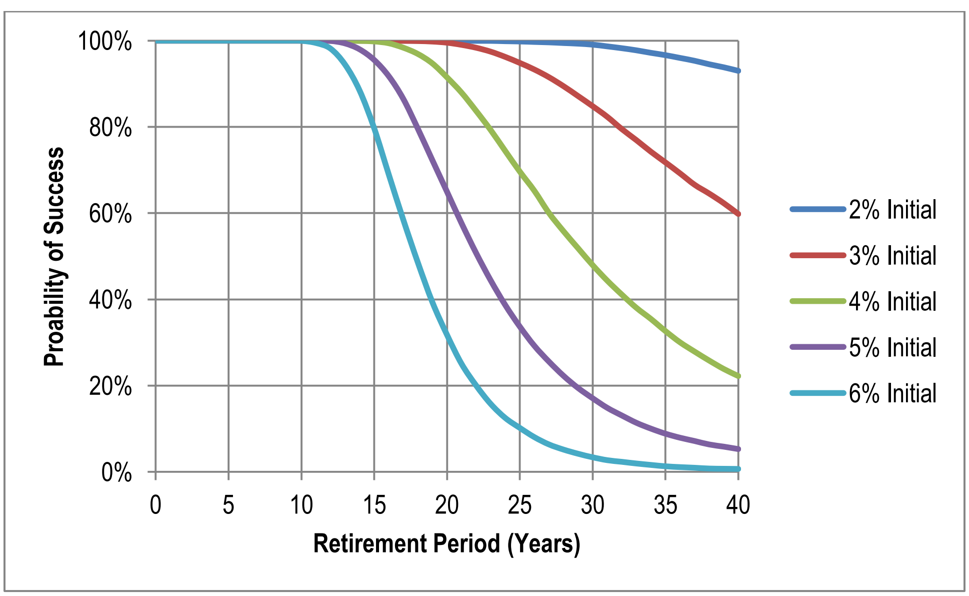
We also find that the probabilities of success actually decrease at higher initial bond yields for the 80% equity allocation. This occurs because our estimate of inflation is based on both bond yields and the CAPE ratio; therefore, an assumed 8.0% initial bond yield will result in a higher initial assumed level of inflation (on average) than a lower initial bond yield. Since the majority of the return for the 80% equity portfolio comes from the stock portion, although the higher bond returns improve the return the increase is offset by the higher expected inflation (on average).

Where We Are Today

In the previous section we reviewed the impact of the different equity allocations, initial bond yields, and initial CAPE ratios on the probability of achieving a given portfolio withdrawal strategy. In this section we apply this model to current market conditions. As of April 15, 2013 the approximate yield on intermediate government bonds is 2.0% and the CAPE ratio is approximately 22. Therefore, we assume these values as the base assumptions for the remainder of this analysis.

It is important to note that within the context of the models used for forecasting bond yields and the CAPE ratio (and subsequent inflation) the actual future values drift randomly through time, with drift toward their mean. This means that in some scenarios the CAPE ratio may increase from 22 to 26 after the first year or go from 22 to 16. Likewise, the bond yield may increase from 2.0% to 4.0% in the first year or drop to 1.0% (note, 1.0% is the assumed minimum bond yield). In either case the initial values are used to proxy today's environment, the noise embedded in the model conveys the fact we do not know what is going to happen, but can at least factor in some "average" forecast.

Figure 7: Probabilities of Success for Various Initial Withdrawal Rates for a 40% Equity Portfolio, Assuming an Initial Bond Yield of 2.0% and an Initial CAPE Ratio of 22



Consistent with Table 2, we note significantly lower probabilities of success with an initial bond yield of 2.0% and a CAPE ratio of 22 relative to past long-term averages. For example, the probability of success of a 4% initial withdrawal rate over 30 years is approximately 48%.

Given the results shown in Figure 7, it is also possible to calculate what a safe initial withdrawal rate would need to be in a low return environment. In Table 3, we estimate the safe initial withdrawal rates with an initial bond yield of 2.0% and a CAPE of 22 for various equity allocations and retirement periods based on different success rate thresholds.

Table 3: Initial Withdrawal Rates for Various Equity Allocations, Retirement Periods, and Probabilities of Success Assuming an Initial Bond Yield of 2.0% and a CAPE of 22

20% Equity Allocation							
		Retirement Period (Years)					
		15	20	25	30	35	40
Probability of Success	99%	5.1%	3.8%	3.1%	2.6%	2.2%	1.9%
	95%	5.6%	4.2%	3.4%	2.8%	2.4%	2.2%
	90%	5.8%	4.4%	3.5%	3.0%	2.6%	2.3%
	80%	6.1%	4.6%	3.7%	3.2%	2.8%	2.5%
	50%	6.6%	5.1%	4.2%	3.6%	3.2%	2.9%

40% Equity Allocation							
		Retirement Period (Years)					
		15	20	25	30	35	40
Probability of Success	99%	4.4%	3.1%	2.5%	2.0%	1.7%	1.5%
	95%	5.1%	3.8%	3.0%	2.5%	2.1%	1.9%
	90%	5.5%	4.1%	3.3%	2.8%	2.4%	2.1%
	80%	6.0%	4.5%	3.7%	3.1%	2.8%	2.5%
	50%	7.0%	5.5%	4.5%	4.0%	3.5%	3.2%

60% Equity Allocation							
		Retirement Period (Years)					
		15	20	25	30	35	40
Probability of Success	99%	3.5%	2.4%	1.8%	1.4%	1.2%	0.9%
	95%	4.4%	3.2%	2.5%	2.0%	1.7%	1.5%
	90%	5.0%	3.7%	2.9%	2.4%	2.1%	1.8%
	80%	5.7%	4.3%	3.5%	3.0%	2.6%	2.3%
	50%	7.2%	5.7%	4.8%	4.2%	3.8%	3.5%

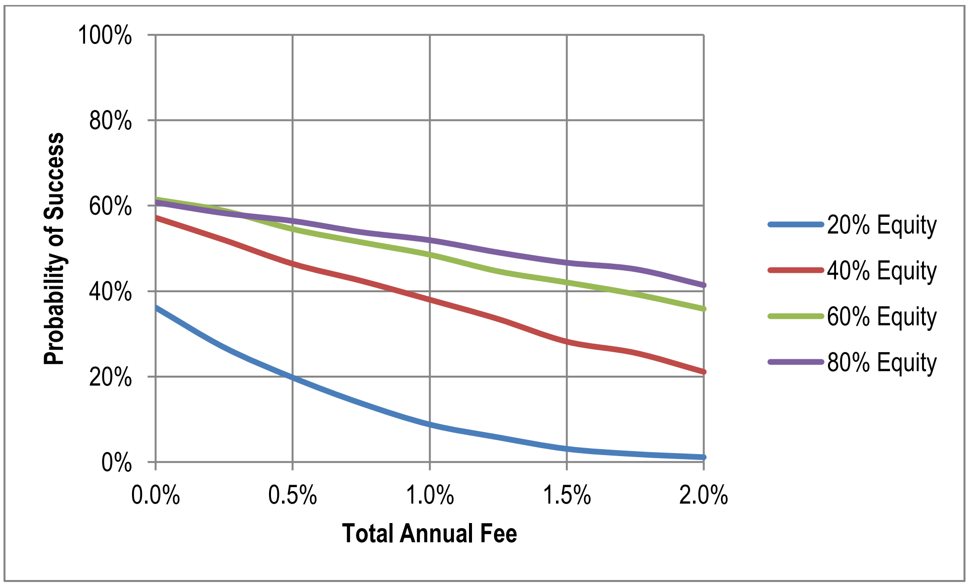
80% Equity Allocation							
		Retirement Period (Years)					
		15	20	25	30	35	40
Probability of Success	99%	2.7%	1.8%	1.2%	0.9%	0.7%	0.6%
	95%	3.8%	2.6%	2.0%	1.5%	1.3%	1.1%
	90%	4.5%	3.2%	2.5%	2.0%	1.7%	1.4%
	80%	5.4%	4.0%	3.2%	2.7%	2.3%	2.1%
	50%	7.4%	5.9%	5.0%	4.4%	4.0%	3.7%

Table 3 has important implications for both existing retirees and those approaching retirement. The reciprocal of the initial withdrawal rate is the amount an individual must have saved to achieve an income goal. For example, if a retiree wanted a 4% initial withdrawal rate, he or she would need a portfolio that was 25 times (1 / 4.0% = 25) the annual income he or she desires in retirement. In contrast, if the initial withdrawal rate decreases to 3.0%, then the amount the retiree must save in order to withdraw the same annual dollar amount as in the 4.0% example increases to 33.33 times the target income amount.

The Value Proposition

For our analysis we assume a base portfolio fee of 50 bps. Fees are obviously a very important consideration that can materially affect the likelihood of a retiree accomplishing a goal over the long-term. Figure 8 shows the resulting probabilities of success for a 4% initial withdrawal rate over a 30 year period for different levels of fees and for different equity allocations, assuming an initial bond yield of 2.0% and an initial CAPE ratio of 22.

Figure 8: Impact of Fees on the Probability of Success of a 4% Initial Withdrawal Over 30 Years for Varying Equity Allocations, Assuming an Initial Bond Yield of 2.0% and an Initial CAPE Ratio of 22



Not surprisingly, there is a strong negative relationship between fees and the probability of a retiree accomplishing an income goal. It also important to judge overall welfare improvement relative to an unadvised retiree when considering fees. There are a significant number of activities a financial planner can provide that add value, such as goals planning, estate planning, retirement income advice, tax efficiency, rebalancing etc. Some of these benefits are noted in research by Blanchett and Kaplan (2013) in a concept they call "Gamma". They define Gamma as the potential value that can be achieved through making more intelligent financial planning decisions.

The Gamma concept attempts to demonstrate that, especially within the context of complex financial planning relationships such as achieving a retirement income goal, there is more to achieving a goal than the alpha (on selecting better investment funds/managers) and beta (asset allocation) decisions, and that these decisions provide significant value. While the potential value created through high quality financial planning are likely to vary, Blanchett and Kaplan (2013) demonstrate that it is possible to create what is effectively "alpha" in excess of 150 bps through quality financial planning.

Conclusions

Retirees who do not annuitize must estimate an appropriate rate of income to draw from investments. The existing literature on safe withdrawal rates models either simulates failure rates using the same average return for each year or uses a rolling sequence of returns which requires history to unfold exactly as it did in the past. Neither method takes current stock and bond valuations into account. These current valuations have been shown to predict near-term returns which have a much larger impact on withdrawal rate risk than returns later in retirement.

This paper introduced a model that takes into account bond yields and stock market valuation metrics when determining the probability of success for different initial withdrawal rates over different time periods. Both bond and stock models assume the future values drift over time, and are likely a better representation of what retirees today.

We find that the likelihood of success for a given withdrawal rate varies materially across different initial bond yield and initial cyclically adjusted price-to-earnings (CAPE) ratio environments. Given the current market environment with bond yields at approximately 2.0% and the CAPE ratio of 22, a 4% initial withdrawal rate has less than a 50% probability of success over a 30-year period with a 40% equity portfolio. This success rate is much lower than past studies, which have typically noted a probability of success above 80%, generally closer to 90%.

References

Arnott, Robert D., and Denis B. Chaves. 2011. "Demographic Changes, Financial Markets, and the Economy." *Financial Analysts Journal* 68, 1 (January/February): 23-46.

Bakshi, Gurdip S., and Zhiwu Chen. 1994. "Baby Boom, Population Aging, and Capital Markets." *Journal of Business* 67, 2: 165-202.

Bengen, William P. 1994. "Determining Withdrawal Rates Using Historical Data." Journal of Financial Planning, vol. 7: 171–180.

Bengen, William P. 2006. "Baking a Withdrawal Plan 'Layer Cake' for Your Retirement Clients." Journal of Financial Planning, vol. 19, no. 8: 44-51.

Blanchett, David and Paul Kaplan. 2012. "Alpha, Beta, and Now…Gamma." Working Paper. http://corporate.morningstar.com/ib/documents/PublishedResearch/AlphaBetaandNowGamma.pdf

Blanchett, David, Michael Finke, and Wade Pfau. 2012. "Low Bond Yields and Sustainable Withdrawal Rates." Morningstar White Paper: http://corporate.morningstar.com/ib/documents/MethodologyDocuments/ResearchPapers/LowBondYieldsWithdrawalRates.pdf.

Cooley, Philip L., Carl M. Hubbard, and Daniel T. Waltz. 1998. "Retirement Savings: Choosing a Withdrawal Rate that is Sustainable." Journal of the American Association of Individual Investors, vol. 20: 16–21.

Cooley, Philip L., Carl M. Hubbard, and Daniel T. Waltz. 2003. "A Comparative Analysis of Retirement Portfolio Success Rates: Simulation versus Overlapping Periods." Financial Services Review, vol. 16: 115–128

Ennis, Richard M., and John Peter Williamson. 1976. "Spending Policy for Educational Endowments: a Research and Publication Project of the Common Fund". Common Fund.

Finke, Michael, Wade Pfau, and David Blanchett. 2013. "The 4 Percent Rule is Not Safe in a Low-Yield World." Available at SSRN 2201323.

Graham, Benjamin, and David L. Dodd. 1934. Security Analysis: Principles and Technique. McGraw-Hill Book Company.

Jarrett, Jaye C. and Tom Stringfellow. 2000. "Optimum Withdrawals From an Asset Pool." Journal of Financial Planning, vol. 13 no 1: 80-93.

Kaplan, Paul. 2006. "Asset Allocation with Annuities for Retirement Income Management." The Journal of Wealth Management, vol. 8, no. 4 (Spring): 27-40.

Kitces, Michael E. 2008. "Resolving the Paradox - Is the Safe Withdrawal Rate Sometimes Too Safe?" The Kitces Report (May).

Milevsky, Moshe A., and Anna Abaimova. 2006. "Risk Management During Retirement." In Retirement Income Redesigned: Master Plans for Distribution, Harold Evensky and Deena B. Katz (eds). New York: Bloomberg Press.

Milevsky, Moshe, Kwok Ho Arye, and Chris Robinson. 1997. "Asset Allocation via the Conditional First Exit Time or How to Avoid Outliving your Money." Review of Quantitative Finance and Accounting, vol. 9, no.1: 53-70.

Pfau, Wade D. 2010. “An International Perspective on Safe Withdrawal Rates from Retirement Savings: The Demise of the 4 Percent Rule?" Journal of Financial Planning 23, 12 (December): 52–61.

Pfau, Wade D. 2011. “Can We Predict the Sustainable Withdrawal Rate for New Retirees?” Journal of Financial Planning, vol. 24, no. 8 (August):40–47.

Roy, Andrew. D. 1952. “Safety First and the Holding of Assets,” Econometrica: Journal of the Econometric Society, vol. 20: 431-449.

Spitzer, John, Jeffrey Strieter, and Sandeep Singh. 2007. “Guidelines for Withdrawal Rates and Portfolio Safety During Retirement.” Journal of Financial Planning 20, 10 (October): 52-59.

Tezel, Ahmet. 2004. “Sustainable Retirement Withdrawals.” Journal of Financial Planning, vol. 17, no. 7: 52–57.

van den End, Jan Willem. 2011. “Statistical Evidence on the Mean Reversion of Interest Rates. DNB Working Paper no. 284.

Vasicek, Oldrich. 1977. "An Equilibrium Characterisation of the Term Structure". *Journal of Financial Economics* 5, 2: 177–188.