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Reality check: The implications of applying sustainable withdrawal rate analysis to real world portfolios

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Abstract

This paper brings portfolio sustainability research closer to practical application by examining how common practitioner investment and withdrawal strategies impact sustainability. The results suggest that the application of a multiasset portfolio model may improve sustainability success rates relative to simple two-asset models illustrated in previous research, and the advantage becomes more pronounced with higher withdrawal rates and longer time horizons. We also find that a "bonds first" withdrawal strategy appears to be superior to a constant allocation strategy as both time horizon and withdrawal rate rise. Most notably, the results of our analysis suggest that there is no single optimal retirement asset allocation, but rather a continuum of ideal allocations that become increasingly equity-weighted as the investor's required withdrawal rate and/or expected time horizon increase.

JEL classification: G11; G29

Keywords: Asset allocation; Retirement portfolio; Sustainable withdraw rate; Bootstrapping

1. Introduction

The great wave of retiring Baby Boomers has made lifetime income sustainability one of the most important topics in financial planning. Since the early 1990s, a considerable amount of research has been devoted to this subject and has significantly evolved the way in which financial planning practitioners approach the decumulation phase of the investing lifecycle.

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Whereas retirement spending strategies were once based deterministically upon the expected rate of return of the portfolio, recognition of the dangers posed by serial returns risk and longevity risk led many researchers to apply stochastic analyses to develop strategies that might enable investors to endure significant negative returns early in retirement and still last throughout a 20–30+ year retirement life expectancy (Hopewell, 1997).[1] A survey of the ever expanding body of published income sustainability literature finds that researchers have approached the subject from a number of different perspectives. Although much early research was devoted to determining the theoretical maximum sustainable withdrawal rate (MSR) for a given portfolio, more recent studies have tended to focus on increasing the MSR and improving success rates for a range of time horizons and withdrawal rates through the application of various dynamic decision-based asset allocation and withdrawal strategies.

Although the importance of the recent advancements in retirement income planning should not be understated, more work needs to be done to translate them into implementable portfolio management solutions for financial planning practitioners and investors. For example, there is an obvious need for empirical guidance on the relative efficacy of the various withdrawal allocation strategies that practitioners and investors commonly employ. Among the most common withdrawal strategies at the practitioner level are the traditional glide-path (a.k.a. "lifecycle") approach in which the equity portion of the portfolio is reduced throughout retirement, and the annual rebalancing approach in which the investor maintains a constant allocation throughout retirement. In terms of improving the sustainability success rates, which is better? Additionally, a preponderance of the widely cited studies on income sustainability have based their conclusions on analyses of two-asset models comprised simply of the S&P 500 index as a proxy for equities and a standard fixed income benchmark, such as the 10-year Treasury Bond or Salomon Brothers High Grade Bond Index, as a proxy for bonds. However, in reality, most mainstream practitioners implement far more broadly diversified asset allocation models based upon principles of Modern Portfolio Theory (MPT). Such asset allocation models might include as many as a dozen or more asset classifications including large-, mid-, and small-cap U.S. equities; international equities; emerging markets equities; real estate investment trusts (REITs), commodities; international bonds; high yield bonds; and intermediate and long-term government and/or corporate bonds. Clearly, it would be useful to gain a better understanding of the impact diversification may have on sustainability as well.

Although these topics have been addressed individually in a handful of papers, a practical empirically supported platform for guiding retirement asset allocation and withdrawal strategy decisions is lacking. This paper seeks to bridge the gap between academic research and portfolio management at the practitioner level by comparing the effectiveness of a multiasset portfolio model to a standard two-asset stock/bond portfolio model when both are paired with common, easily implemented real withdrawal strategies. Consistent with prior research methodologies, this study applies a bootstrapping algorithm to both models over a range of standard stock/bond allocations and withdrawal rates for 10, 15, 20, 25, and 30-year retirement periods.

Broadly speaking, the analysis confirms that equity diversification appears to improve sustainability success rates, especially for investors who require high initial withdrawal rates and have long anticipated retirement periods. With respect to evaluating simple withdrawal strategies, the results indicate that a strategy in which the bond portion of the portfolio is spent first appears to be superior to the constant allocation approach and, by inference, to popularly touted glide-path strategies. Although these two findings confirm and extend previous research, perhaps the most important finding to emerge from this study is that, contrary to financial planning mythology, there does not appear to be a single "optimal" retirement allocation. Instead, the ideal asset allocation for a given investor upon retirement appears to be a continuum, with the ideal equity allocation increasing as both the required withdrawal rate and expected time horizon increase. Together, these three findings represent an important step toward developing a basic framework for guiding investment planning decisions upon retirement.

The remainder of this paper is organized as follows: the next section reviews the literature that motivated this study. Section 3 describes the model design, data selection, and methodology. Section 4 presents our results and their implications. Section 5 concludes the paper by placing this analysis in the context of current professional discussion and debate.

2. Literature review

As noted above, this paper simultaneously considers the impact of equity diversification and withdrawal strategy choice on retirement income sustainability to provide practical insight into the strategies that are regularly used by planning practitioners and investors in "the real world." Our study builds upon a few key papers.[2]

Although a number of previous studies consider the impact of including individual equity classes beyond just the S&P 500 Index, one paper that realistically considers the impact of multiple asset classes on retirement income sustainability is Guyton (2004).[3] In this paper, the author examines a 65% equity allocation and an 80% equity allocation in which the equity portion of the portfolio is divided among large cap value stocks, large cap growth stocks, small cap growth stocks, small cap value stocks, international stocks, and REITs in proportions that are roughly consistent with the MPT-based models many planning practitioners use. Using this basic model, Guyton "stress-tests" withdrawal rates through the extremely harsh ("perfect retirement planning storm") 30-year period from 1973 to 2003, and finds that the 65% equity portfolio would have sustained a 4.7% withdrawal rate, whereas the 80% equity portfolio would have sustained a 5% withdrawal rate. Although these sustainability rates are significantly higher than the theorized 4% MSR suggested in previous research, Guyton's results are based upon the application of three strict "Portfolio Management Decision Rules" and the degree to which the asset allocation mix contributes to the results is unclear. In a subsequent paper, Guyton and Klinger (2006) further refine Guyton's original strategy by adding two more decision rules and subjecting MPT based asset allocation models to testing using Monte Carlo simulations. The authors conclude that initial withdrawal rates as high as 5.2%–6.0% are sustainable at the 99% confidence levels for 30 years for the 65% and 80% equity portfolios respectively. Perhaps equally notable, in this study, the authors attempt to isolate the impact of including multiple asset classes versus single equity portfolios. Using the decision rules, the authors find that the multiclass portfolios have significantly higher withdrawal rates for every given sustainability rate.

The motivation for analyzing the effectiveness of unmanaged (i.e., no complex or proactive decision rules) inflation-adjusted withdrawal strategies stems from three recent research papers. Spitzer and Singh (2007) examine the importance of simple decision rules in withdrawal strategies. Their study applies temporal order analysis and bootstrapping simulations to stock (S&P 500) and bond (long term U.S. Treasury) return data from 1926 to 2003 to examine the rates of success and shortfalls as well as the likelihood and magnitude of balances remaining over a 30-year retirement period for five different portfolio management and withdrawal rules. These rules consist of rebalancing the stock/bond ratio at the end of each year to maintain a constant allocation, withdrawing from the asset that performed the best in the previous year, withdrawing from the asset that performed the worst in the previous year, withdrawing from the stock portion of the portfolio first, and withdrawing from the bond portion of the portfolio first. Surprisingly, the authors find that the constant allocation ("Rebalancing") withdrawal strategy, perhaps the most commonly adopted withdrawal method in practitioner designed asset allocation models, provides no significant benefit to portfolio longevity, and may even increase the rate of shortfalls. Instead, the authors find that the strategy of harvesting the bond portion of the portfolio model first is the most successful of the five strategies in terms of minimizing shortfalls over all periods studied. Consistent with prior studies, the authors also find that asset allocations of at least 70% stocks lead to higher rates of success. However, the comparative superiority of the bonds first results, lead Spitzer and Singh to question the efficacy of both constant allocation and increasingly popular glide-path (a.k.a. "lifecycle") portfolio management strategies that gradually shift the portfolio allocation from equities to bonds as the investor ages. In a follow up paper, Spitzer and Singh (2008) compare the glide-path strategies touted in popular "lifecycle" retirement income funds against the bonds first withdrawal strategy and again find that the bonds first approach leads to higher success rates.

Similarly, Blanchett (2007) applies bootstrapping simulations to four different glide-path distribution strategies and a constant allocation withdrawal approach for a variety of broad allocations of large cap U.S. Stocks, international stocks, intermediate term bonds, and cash. The author examines distribution periods from 20 to 40 years and uses withdrawal rates of 3% to 8%. Contrary to the author's expectations, but consistent with Spitzer and Singh, the constant allocation portfolios have lower failure rates relative to the declining equity glide-path strategies in all of the test scenarios longer than 20 years. The author specifically concludes that, "a balanced static allocation, such as 60% equity and 40% fixed income/cash, is likely one of the most efficient portfolio allocations for retirees." Although Blanchett, like Guyton, includes multiple asset classes in his portfolio design, he does not attempt to isolate the benefit of his model relative to the more commonly illustrated two-asset class model.

To summarize, our analysis builds on and synthesizes the work of Guyton (2004), Blanchett (2007), and Spitzer and Singh (2007, 2008). As in the Guyton studies, one of our objectives is to build and test a reasonably realistic asset allocation model consisting of multiple equity asset classes. Although our portfolio design is slightly different, we believe it will be instructive to see if our results affirm Guyton's finding that the inclusion of multiple equity classes improves the rate of sustainability. Unlike Guyton, we do not incorporate complex decision rules into our withdrawal strategy, because, as some authors have noted [e.g., Blanchett (2007), Pye (2000)], the likelihood that the practitioner and/or his client will be able to consistently follow such rules over 30 years or more is questionable. Instead, the constructs of our model are intentionally simple and are intended to replicate as closely as possible the actual withdrawal strategies that many practitioners implement for their clients today. To this end, by isolating and comparing the relative influence of a constant allocation withdrawal strategy to a bonds first approach, this study effectively extends the work of Blanchett (2007) and Spitzer and Singh (2007, 2008).

3. Model design, data selection, and methodology

Because one of the primary goals of this study is to provide insight into whether the selection of an MPT-based allocation enhances the likelihood of withdrawal sustainability, the analysis compares four two-asset class (1 equity + 1 bond) allocation models to four models in which the equity component of the portfolios is more broadly diversified. The four standard broad allocations that we compare consist of 100% stocks: 0% bonds, 75% stocks: 25% bonds, 50% stocks: 50% bonds, and 25% stocks: 75% bonds.[4] The bond component in both models consists of the 10-year Treasury Bond. For the two-asset class models, the S&P 500 Index is the sole equity component. The equity component for the diversified models consists of 45% S&P 500 Index, 30% Russell 2000 Index, and 25% MSCI EAFE Index. Although still somewhat prototypical, this four-asset (3 equity + 1 bond) model generally replicates the core structure of the equity portion of many practitioner-designed MPT-based models. It is also roughly similar to the model design chosen by Guyton (2004) and to the general structure of increasingly popular lifestyle (constant allocation) and lifecycle (glide path) "fund of funds" mutual fund portfolios. There is a fair amount of academic justification for these weightings. Clarke and Tullis (1999) state, "According to estimates of volatility and correlation from market history, we suggest that a long-run allocation of 20% to 30% in foreign equity would not be unreasonable." Similarly, the 30% allocation to mid- and small-cap stocks is consistent with the recommendations of Bengen (1997) and Tezel (2004).

In terms of the raw data, we used monthly return data from January 1970 to December 2007 for all indices in the CRSP and Datastream databases. The 1970 start date corresponds to the inception of the MSCI EAFE Index. Although the EAFE Index is arguably the most popular and widely followed international equity index, its relative newness is a likely reason why there is a paucity of research exploring the influence of international diversification on sustainability. Kizer (2005) asserts the same. In our opinion, concerns over the limited sample size and a potentially optimistic bias may have carried some validity in the 1990s. However, we believe that in 2007, with 38 years of monthly return data that includes the two worst bear markets (1972–1973 and 2000–2002) since the Great Depression, it is reasonable to begin using the EAFE data in Monte Carlo and bootstrapping simulations.[5] It is also important to note that the Russell 2000 Index was not established until 1978. As a proxy for the data from 1970 to 1978, we have used total return data for the bottom quintile market cap stocks in the NYSE Index. This is the proxy for small- and mid-cap stocks that is chosen by Siegel (2007), and we believe it is a reasonable choice here as well.

Because a second objective is to consider the impact of real world advisor management strategies on sustainability, a concerted effort is made to make the withdrawal and portfolio management conditions as true to the actual practitioner/retiree experience as possible. The first part of the analysis compares the four-asset class (3 equity classes + 1 bond class) model to the two-asset class (1 equity class + 1 bond class) model under a constant allocation management and withdrawal strategy. Under this scenario, the portfolio is rebalanced at the end of each year. After our annual rebalancing, to avoid the transactions costs of monthly rebalancing, we transfer an amount equal to the next year's withdrawals to a cash account, withdrawing proportionally from each asset class. Because it is understood that most retirees prefer and require monthly income, our analysis simply assumes that monthly portfolio withdrawals are distributed to the investor from this cash account. We believe this methodology is both practical and realistic.[6] Withdrawals are adjusted annually for inflation, with the inflation rate for each year consisting of the product of the 12 monthly CPI-U rates corresponding to each of the randomly sampled monthly returns. The second part of the analysis compares the four-asset model to the two-asset model under a bonds first withdrawal strategy. Under this scenario, the initial stock:bond allocations become increasingly equity weighted over time as the bond portion of the portfolio is exclusively used to fund annual distributions until it is depleted. However, during this time, the equity portion of the four-asset class model is rebalanced annually. Once the bond portion of the portfolio is depleted, withdrawals are made from the equity portion. Annual rebalancing of the remaining three equity classes continues until either the portfolio is depleted or the time period ends. The inflation calculation is the same as in the constant allocation withdrawal strategy illustration. For the purposes of this analysis, we assume that the portfolio is held in a tax-deferred account. We believe that this is a reasonable assumption because tax deferred retirement accounts, such as IRAs and 401(k) accounts, typically comprise the largest portion of investors' retirement savings. This assumption is also consistent with the aforementioned works of Guyton and Klinger (2006), Blanchett (2007), and Spitzer and Singh (2007, 2008).[7] We do not account for advisory fees.

With the 1970–2007 total return data and the rest of the aforementioned modeling parameters, a bootstrapping algorithm is applied to each of the five asset allocation models for withdrawal rates of 3%, 4%, 5%, 6%, and 7% for time horizons of 10, 15, 20, 25, and 30 years. There are 5,000 simulations run for each of the 500 different scenarios that are examined. Each bootstrapping iteration draws a random sample with replacement from the 456 months of data, relying on the empirical distribution of historical data. For each of our 500 different scenarios (all together we have five stock:bond allocations, five time horizons, five withdrawal rates, two portfolios, and two withdrawal strategies), our bootstrapping algorithm iterates 5,000 random samples of months; to maintain the normal cross-sectional correlations between stocks, bonds, and inflation, if a month is selected we draw the monthly returns for the S&P 500 Index, the Russell 2000 Index, the EAFE Index, and the 10 year Treasury Bonds, plus the monthly rate of inflation as measured by the CPI-U for the randomly selected month. For example, one bootstrapping iteration with a 20-year time horizon randomly chooses, with replacement, 240 months from our historical distribution, and then uses the corresponding monthly returns and inflation rates in the computation of portfolio balances and inflation-adjusted withdrawal amounts.

Table 1 Descriptive statistics for monthly returns

	S&P 500	Russell 2000	EAFE	10 Year treasury	CPI-U	Diversified equity
Mean	0.9815%	1.5371%	1.0266%	0.7100%	0.3796%	1.1595%
Median	1.2023%	1.3380%	1.0659%	0.6277%	0.3174%	1.4702%
Standard deviation	4.3618%	10.6952%	4.7057%	2.3284%	0.3169%	5.0517%
	Two-asset portfolio			Four-asset portfolio		
	Bonds 25%	Bonds 50%	Bonds 75%	Bonds 25%	Bonds 50%	Bonds 75%
Mean	0.9137%	0.8458%	0.7779%	1.0471%	0.9348%	0.8224%
Median	0.8755%	0.7423%	0.6647%	1.1032%	0.8777%	0.7075%
Standard deviation	3.4396%	2.6768%	2.2425%	3.9103%	2.9209%	2.2895%

This table reports the mean, median, and standard deviation of monthly returns for the three equity indices: the S&P 500 Index, the Russell 2000 Index, and the MSCI EAFE Index, as well as the 10 year U.S. Treasury Bonds, and inflation as measured by the CPI-U, the All-Urban Index. The Diversified Equity Index consists of 45% invested in the S&P 500 Index, 30% invested in the Russell 2000 Index, and 25% invested in the MSCI EAFE Index. The two-asset portfolio consists of the shown percentage invested in 10 year U.S. Treasury Bonds and the rest invested in the S&P 500 Index. The four-asset portfolio consists of the shown percentage invested in 10 year U.S. Treasury Bonds and the rest invested in the Diversified Equity portfolio. The sample period is from January 1970 to December 2007.

4. Results and implications

Table 1 shows the descriptive statistics for our three equity indices: the S&P 500 Index, the Russell 2000 Index, and the MSCI EAFE Index, the 10 year U.S. Treasury Bonds, and the inflation measure, the CPI-U, as well as our various two-asset and four-asset portfolios. Across the five different asset allocations, the four-asset portfolios consistently generate a higher mean and median return than the two-asset portfolios, with a lesser increase in the standard deviation of returns. On the average, the four-asset portfolio, on an annualized basis, generates a mean return of 11.22%, and a standard deviation of 11.43%, compared to the two-asset portfolio's mean return of 10.15%, and standard deviation of 10.43%.[8]

Table 2 compares sustainability success rates for the four-asset model to the traditional two-asset model using the constant allocation real withdrawal strategy. Table 3 compares the two-asset model to the four-asset model under the bonds first withdrawal strategy. With respect to the impact of diversification, the output reveals that the four-asset portfolio produces appreciably higher success rates than the two-asset portfolio for all long term (25 and 30 year) time horizons and for all withdrawal rates of 4% and higher. The advantage of additional equity diversification appears to increase as both time horizon and withdrawal rate are extended.[9] Panel B of Tables 2 and 3 shows, when averaging across the five bond allocations, the five retirement horizon periods, and the five annual withdrawal rates, the four-asset portfolio's success rates of 89.74% and 90.48% exceed the two-asset portfolio's success rates of 86.86% and 87.28%, for the constant bond to stock allocation strategy and the bonds withdrawn first strategy, respectively. These results are unambiguous and indicate that the application of MPT may be just as important in retirement as it is in the accumulation phase of the investment cycle. The results are also consistent with Guyton and Klinger (2006)

Table 2 Portfolio success rates with inflation-adjusted monthly withdrawals and constant bond:stock allocation

Panel A: Individual scenarios

Percent of bonds	Horizon period	Portfolio 1 (two assets)					Portfolio 2 (four assets)				
		Annual withdrawal rate					Annual withdrawal Rate				
		3.00%	4.00%	5.00%	6.00%	7.00%	3.00%	4.00%	5.00%	6.00%	7.00%
100%	30 Years	99.22%	90.16%	60.72%	29.84%	8.98%	99.22%	90.16%	60.72%	29.84%	8.98%
	25 Years	99.92%	96.88%	79.48%	49.30%	19.94%	99.92%	96.88%	79.48%	49.30%	19.94%
	20 Years	100.00%	99.74%	95.22%	77.60%	45.40%	100.00%	99.74%	95.22%	77.60%	45.40%
	15 Years	100.00%	100.00%	99.82%	98.22%	87.90%	100.00%	100.00%	99.82%	98.22%	87.90%
	10 Years	100.00%	100.00%	100.00%	100.00%	99.96%	100.00%	100.00%	100.00%	100.00%	99.96%
75%	30 Years	99.96%	96.84%	78.10%	45.28%	19.60%	99.94%	98.18%	85.42%	58.08%	27.20%
	25 Years	100.00%	99.16%	90.46%	64.32%	33.88%	100.00%	99.46%	94.06%	73.66%	43.34%
	20 Years	100.00%	99.90%	98.34%	87.48%	61.16%	100.00%	99.98%	99.06%	90.78%	69.70%
	15 Years	100.00%	100.00%	99.96%	99.32%	93.96%	100.00%	100.00%	100.00%	99.60%	95.68%
	10 Years	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
50%	30 Years	99.92%	96.50%	82.16%	58.32%	32.16%	99.98%	98.24%	90.04%	71.08%	50.12%
	25 Years	100.00%	98.88%	91.42%	72.26%	45.48%	100.00%	99.42%	94.96%	81.90%	61.88%
	20 Years	100.00%	99.86%	97.76%	88.42%	68.14%	100.00%	99.92%	98.92%	92.80%	78.72%
	15 Years	100.00%	100.00%	99.90%	99.00%	93.34%	100.00%	100.00%	99.96%	99.48%	95.96%
	10 Years	100.00%	100.00%	100.00%	99.98%	99.98%	100.00%	100.00%	100.00%	100.00%	100.00%
25%	30 Years	99.04%	94.28%	81.70%	62.44%	41.86%	99.52%	97.08%	90.42%	77.14%	59.28%
	25 Years	99.60%	97.42%	89.02%	73.20%	52.86%	99.80%	98.62%	93.98%	83.72%	67.76%
	20 Years	99.94%	99.52%	95.92%	85.86%	70.22%	99.94%	99.56%	97.66%	91.50%	79.96%
	15 Years	100.00%	99.98%	99.64%	97.20%	90.12%	100.00%	100.00%	99.62%	98.36%	93.50%
	10 Years	100.00%	100.00%	100.00%	100.00%	99.82%	100.00%	100.00%	100.00%	99.98%	99.82%
0%	30 Years	97.28%	91.22%	77.98%	63.42%	46.82%	99.06%	94.82%	88.08%	76.52%	63.32%
	25 Years	98.66%	94.64%	84.42%	71.78%	55.48%	99.52%	96.74%	91.50%	81.54%	69.58%
	20 Years	99.50%	97.96%	92.68%	82.04%	68.78%	99.88%	98.72%	95.28%	88.40%	78.40%
	15 Years	100.00%	99.64%	98.10%	93.82%	85.88%	99.98%	98.76%	98.90%	96.12%	90.56%
	10 Years	100.00%	99.98%	99.98%	99.80%	98.80%	100.00%	100.00%	99.98%	99.70%	99.10%

Panel B: Average scenarios

Percent of bonds	Horizon period	Portfolio 1 (two assets)					Portfolio 2 (four assets)				
		Annual withdrawal rate					Annual withdrawal rate				
		3.00%	4.00%	5.00%	6.00%	7.00%	3.00%	4.00%	5.00%	6.00%	7.00%
100%	Average	99.83%	97.36%	87.05%	70.99%	52.44%	99.83%	97.36%	87.05%	70.99%	52.44%
75%	Average	99.99%	99.18%	93.37%	79.28%	61.72%	99.99%	99.52%	95.71%	84.42%	67.18%
50%	Average	99.98%	99.05%	94.25%	83.60%	67.82%	100.00%	99.52%	96.78%	89.05%	77.34%
25%	Average	99.72%	98.24%	93.26%	83.74%	70.98%	99.85%	99.05%	96.34%	90.14%	80.06%
0%	Average	99.09%	96.69%	90.63%	82.17%	71.15%	99.69%	97.81%	94.75%	88.46%	80.19%
Average	30 Years	99.08%	93.80%	76.13%	51.86%	29.88%	99.54%	95.70%	82.94%	62.53%	41.78%
Average	25 Years	99.64%	97.40%	86.96%	66.17%	41.53%	99.85%	98.22%	90.80%	74.02%	52.50%
Average	20 Years	99.89%	99.40%	95.98%	84.28%	62.74%	99.96%	99.58%	97.23%	88.22%	70.44%
Average	15 Years	100.00%	99.92%	99.48%	97.51%	90.24%	100.00%	99.75%	99.66%	98.36%	92.72%
Average	10 Years	100.00%	100.00%	100.00%	99.96%	99.71%	100.00%	100.00%	100.00%	99.94%	99.78%
Average	Average	99.72%	98.10%	91.71%	79.96%	64.82%	99.87%	98.65%	94.12%	84.61%	71.44%
Average	Average	Average annual withdrawal rates				86.86%	Average annual withdrawal rates				89.74%

This table reports the sustainability success rates for the four-asset model and the traditional two-asset model using the constant allocation withdrawal strategy. Panel A shows the individual scenarios under five different allocation schemes (100%, 75%, 50%, 25%, and 0% in bonds), five annual withdrawal rates (3%, 4%, 5%, 6%, and 7%), and five retirement horizons (10, 15, 20, 25 and 30 years). The bond component in both models consists of the 10-year Treasury bond. For the two-asset model, the S&P 500 Index is the sole equity component. The equity component in the four-asset model consists of 45% S&P 500 Index, 30% Russell 2000 Index, and 25% MSCI EAFE Index. Panel B reports averages of individual scenarios across the five different allocation schemes (100%, 75%, 50%, 25%, and 0% in bonds) or the five retirement horizons (10, 15, 20, 25 and 30 years), or the five annual withdrawal rates (3%, 4%, 5%, 6%, and 7%). or combinations of those averages as indicated.

Table 3 Portfolio success rates with inflation-adjusted monthly withdrawals and bonds withdrawn first

Panel A: Individual scenarios

Percent of bonds	Horizon period	Portfolio 1 (two assets)					Portfolio 2 (four assets)				
		Annual withdrawal rate					Annual withdrawal Rate				
		3.00%	4.00%	5.00%	6.00%	7.00%	3.00%	4.00%	5.00%	6.00%	7.00%
100%	30 Years	99.22%	90.16%	60.72%	29.84%	8.98%	99.22%	90.16%	60.72%	29.84%	8.98%
	25 Years	99.92%	96.88%	79.48%	49.30%	19.94%	99.92%	96.88%	79.48%	49.30%	19.94%
	20 Years	100.00%	99.74%	95.22%	77.60%	45.40%	100.00%	99.74%	95.22%	77.60%	45.40%
	15 Years	100.00%	100.00%	99.82%	98.22%	87.90%	100.00%	100.00%	99.82%	98.22%	87.90%
	10 Years	100.00%	100.00%	100.00%	100.00%	99.96%	100.00%	100.00%	100.00%	100.00%	99.96%
75%	30 Years	99.86%	96.82%	82.54%	57.60%	34.36%	99.90%	98.40%	90.42%	73.36%	50.82%
	25 Years	99.98%	99.04%	91.64%	70.60%	46.90%	99.98%	99.40%	95.52%	82.80%	61.82%
	20 Years	100.00%	100.00%	98.28%	88.74%	68.02%	100.00%	99.92%	99.36%	93.16%	79.18%
	15 Years	100.00%	100.00%	99.92%	99.38%	93.14%	100.00%	100.00%	99.98%	99.68%	96.10%
	10 Years	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
50%	30 Years	99.54%	94.52%	82.28%	63.84%	42.00%	99.94%	97.42%	90.78%	77.36%	60.32%
	25 Years	99.94%	97.82%	89.60%	73.94%	52.52%	100.00%	98.74%	94.78%	83.84%	67.90%
	20 Years	100.00%	99.62%	96.66%	86.66%	68.32%	100.00%	99.76%	98.10%	91.56%	80.16%
	15 Years	100.00%	100.00%	99.90%	97.76%	90.78%	100.00%	99.98%	99.82%	98.54%	94.30%
	10 Years	100.00%	100.00%	100.00%	100.00%	99.86%	100.00%	100.00%	100.00%	99.98%	99.98%
25%	30 Years	98.00%	91.62%	79.46%	63.34%	46.32%	99.00%	95.88%	88.30%	76.34%	63.38%
	25 Years	99.12%	94.96%	86.04%	72.22%	55.14%	99.56%	97.64%	91.88%	81.82%	69.90%
	20 Years	99.86%	98.36%	93.34%	82.92%	68.72%	99.94%	99.20%	95.82%	89.52%	78.78%
	15 Years	100.00%	99.72%	99.02%	94.96%	87.94%	100.00%	99.90%	99.08%	97.30%	91.44%
	10 Years	100.00%	100.00%	99.98%	99.90%	99.50%	100.00%	100.00%	100.00%	99.88%	99.52%
0%	30 Years	97.28%	91.22%	77.98%	63.42%	46.82%	99.06%	94.82%	88.08%	76.52%	63.32%
	25 Years	98.66%	94.64%	84.42%	71.78%	55.48%	99.52%	96.74%	91.50%	81.54%	69.58%
	20 Years	99.50%	97.96%	92.68%	82.04%	68.78%	99.88%	98.72%	95.28%	88.40%	78.40%
	15 Years	100.00%	99.64%	98.10%	93.82%	85.88%	99.98%	98.76%	98.90%	96.12%	90.56%
	10 Years	100.00%	99.98%	99.98%	99.80%	98.80%	100.00%	100.00%	99.98%	99.70%	99.10%

Panel B: Average scenarios

Percent of bonds	Horizon period	Portfolio 1 (two assets)					Portfolio 2 (four assets)				
		Annual withdrawal rate					Annual withdrawal rate				
		3.00%	4.00%	5.00%	6.00%	7.00%	3.00%	4.00%	5.00%	6.00%	7.00%
100%	Average	99.83%	97.36%	87.05%	70.99%	52.44%	99.83%	97.36%	87.05%	70.99%	52.44%
75%	Average	99.97%	99.17%	94.48%	83.26%	68.48%	99.98%	99.54%	97.06%	89.80%	77.58%
50%	Average	99.90%	98.39%	93.69%	84.44%	70.70%	99.99%	99.18%	96.70%	90.26%	80.53%
25%	Average	99.40%	96.93%	91.57%	82.67%	71.52%	99.70%	98.52%	95.02%	88.97%	80.60%
0%	Average	99.09%	96.69%	90.63%	82.17%	71.15%	99.69%	97.81%	94.75%	88.46%	80.19%
Average	30 Years	98.78%	92.87%	76.60%	55.61%	35.70%	99.42%	95.34%	83.66%	66.68%	49.36%
Average	25 Years	99.52%	96.67%	86.24%	67.57%	46.00%	99.80%	97.88%	90.63%	75.86%	57.83%
Average	20 Years	99.87%	99.14%	95.24%	83.59%	63.85%	99.96%	99.47%	96.76%	88.05%	72.38%
Average	15 Years	100.00%	99.87%	99.35%	96.83%	89.13%	100.00%	99.73%	99.52%	97.97%	92.06%
Average	10 Years	100.00%	100.00%	99.99%	99.94%	99.62%	100.00%	100.00%	100.00%	99.91%	99.71%
Average	Average	99.64%	97.71%	91.48%	80.71%	66.86%	99.84%	98.48%	94.11%	85.70%	74.27%
Average	Average	Average annual withdrawal rates				87.28%	Average annual withdrawal rates				90.48%

This table reports the sustainability success rates for the four-asset model and the traditional two-asset model using the "bonds first" withdrawal strategy. Panel A shows the individual scenarios under five different allocation schemes (100%, 75%, 50%, 25%, and 0% in bonds), five annual withdrawal rates (3%, 4%, 5%, 6%, and 7%), and five retirement horizons (10, 15, 20, 25 and 30 years). The bond component in both models consists of the 10-year Treasury bond. For the two-asset model, the S&P 500 Index is the sole equity component. The equity component in the four-asset model consists of 45% S&P 500 Index, 30% Russell 2000 Index, and 25% MSCI EAFE Index. Panel B reports averages of individual scenarios across the five different allocation schemes (100%, 75%, 50%, 25%, and 0% in bonds) or the five retirement horizons (10, 15, 20, 25 and 30 years), or the five annual withdrawal rates (3%, 4%, 5%, 6%, and 7%). or combinations of those averages as indicated.

and may be good news to practitioners, as it suggests that previous studies employing simple two-asset models may understate the likelihood of sustainability, especially for higher withdrawal rates. Because the four-asset model used in this study is prototypical relative to the model used by Guyton and Klinger (2006) and to those employed in many of today's lifestyle model portfolios, further research may reveal that more sophisticated asset allocations lead to even greater improvements in portfolio sustainability.

The head-to-head comparison of the bonds first withdrawal method to the constant allocation method necessitates comparisons of the results from Table 2 to Table 3. Interestingly, the results do not show much difference in success rates for withdrawal rates of 5% or less, or for time horizons of 20 years or less. However, for withdrawal rates of 6% and 7% and for 25 and 30-year retirement horizons, the bonds first approach emerges as the more successful of the two. Again, Panel B of Tables 2 and 3 shows, when averaging across the five bond allocations, the five retirement horizon periods, and the five annual withdrawal rates, the bonds withdrawn first strategy's success rates of 87.28% and 90.48% exceed the constant bond to stock allocation strategy's success rates of 86.86% and 89.74%, for both the two-asset portfolio and the four-asset portfolio, respectively.

A comparison of the median remaining balance results under the constant allocation withdrawal method to the bonds first withdrawal method is presented in Table 4 for the four-asset portfolios only. The median remaining balance is computed per $100 of initial retirement wealth, and is computed for all 5,000 bootstrapping samples, using zero dollars as the remaining balance for any failed sample where the retirement funds are exhausted before the retirement horizon period ends. Here the bonds first strategy produces a higher median remaining portfolio balance for every time period and every withdrawal rate for each of the three models comprised of both equities and bonds. The absolute advantage increases as both time horizon and equity allocation are increased. Table 5 shows the quintile remaining balances for the 30-year retirement horizon only, as computed per $100 of initial retirement wealth for all 5,000 bootstrapping samples, using zero dollars as the remaining balance for any failed sample where the retirement funds are exhausted before the 30-year retirement period ends. The quintile remaining balances show more dramatic advantages than the median remaining balances for the bonds first strategy over the constant allocation strategy, especially in the 60th, 80th, and 100th percentiles.

The bonds first results may reflect retirees' needs for greater levels of equity exposure in their retirement portfolios, as the quintile remaining balances convey the benefits of higher average equity returns versus bond returns, without too large of a cost in portfolio volatility from the added equity exposure. Insofar as the differences in success rates between the two withdrawal methods may be regarded as insignificant for shorter time horizons and lower withdrawal rates, the median and quintile remaining balance results seem to support Spitzer and Singh's (2007) conclusion that the bonds first withdrawal method is the superior choice, particularly for those investors who require high withdrawal rates, have long retirement horizons, and/or are interested in building an estate for their heirs.[10] This concept may be troubling to some because it is exactly contrary to traditional financial planning dogma, which advises investors to become more "conservative" (i.e., bond weighted) throughout retirement. Under the bonds first approach, the equity portion of the retiree's portfolio increases over time as the bond allocation is spent down. However, as Spitzer and Singh

Table 4 Portfolio 2 (four assets) median remaining balances with inflation-adjusted monthly withdrawals

Percent of bonds	Horizon period	Constant bond:stock allocation					Bonds withdrawn first				
		Annual withdrawal rate					Annual withdrawal rate				
		3.00%	4.00%	5.00%	6.00%	7.00%	3.00%	4.00%	5.00%	6.00%	7.00%
100%	30 Years	$497.14	$288.28	$67.39	$0.00	$0.00	$497.14	$288.28	$67.39	$0.00	$0.00
	25 Years	$376.34	$253.45	$117.08	$0.00	$0.00	$376.34	$253.45	$117.08	$0.00	$0.00
	20 Years	$284.06	$214.72	$134.81	$67.24	$0.00	$284.06	$214.72	$134.81	$67.24	$0.00
	15 Years	$217.62	$179.58	$137.31	$100.62	$56.69	$217.62	$179.58	$137.31	$100.62	$56.69
	10 Years	$165.92	$148.12	$128.23	$111.18	$89.32	$165.92	$148.12	$128.23	$111.18	$89.32
75%	30 Years	$913.53	$615.18	$337.66	$68.94	$0.00	$1,331.74	$1,053.58	$742.79	$395.18	$16.75
	25 Years	$602.70	$439.81	$279.86	$128.57	$0.00	$787.44	$629.32	$479.67	$308.53	$104.18
	20 Years	$410.31	$318.56	$232.49	$148.43	$57.97	$484.94	$394.74	$326.32	$233.88	$137.89
	15 Years	$280.10	$235.58	$189.97	$144.44	$98.72	$307.57	$261.44	$225.81	$181.37	$135.77
	10 Years	$195.74	$174.36	$153.75	$133.70	$112.01	$202.87	$182.07	$164.21	$144.09	$124.19
50%	30 Years	$1,399.91	$1,041.21	$677.18	$311.52	$1.31	$1,977.31	$1,599.90	$1,233.75	$731.50	$272.73
	25 Years	$865.48	$667.39	$468.82	$267.46	$100.69	$1,114.75	$940.88	$732.49	$483.43	$248.60
	20 Years	$538.97	$436.96	$334.36	$228.28	$136.04	$632.81	$545.57	$451.88	$338.94	$210.70
	15 Years	$340.52	$291.86	$240.83	$186.77	$143.66	$371.95	$327.66	$288.36	$233.95	$178.08
	10 Years	$220.94	$199.21	$176.97	$152.70	$132.27	$227.88	$211.77	$190.48	$169.90	$146.94
25%	30 Years	$2,003.63	$913.53	$1,103.34	$643.75	$198.58	$2,381.93	$1,958.60	$1,367.02	$923.46	$433.05
	25 Years	$1,143.04	$602.70	$693.79	$449.99	$212.34	$1,325.40	$1,100.01	$819.76	$593.27	$341.51
	20 Years	$667.27	$410.31	$441.68	$324.28	$200.71	$756.76	$647.49	$504.53	$395.20	$260.68
	15 Years	$397.83	$280.10	$292.06	$237.15	$177.19	$429.28	$378.55	$317.18	$266.98	$206.76
	10 Years	$244.41	$195.74	$199.30	$173.65	$147.39	$253.37	$231.37	$208.66	$186.73	$161.07
0%	30 Years	$2,539.54	$1,963.65	$1,428.47	$974.08	$474.15	$2,539.54	$1,963.65	$1,428.47	$974.08	$474.15
	25 Years	$1,412.82	$1,132.42	$861.01	$626.52	$358.62	$1,412.82	$1,132.42	$861.01	$626.52	$358.62
	20 Years	$788.26	$672.61	$527.47	$404.92	$273.01	$788.26	$672.61	$527.47	$404.92	$273.01
	15 Years	$451.61	$399.68	$332.89	$278.78	$218.11	$451.61	$399.68	$332.89	$278.78	$218.11
	10 Years	$265.57	$241.19	$215.87	$191.12	$165.63	$265.57	$241.19	$215.87	$191.12	$165.63

This table reports the median remaining balance of the retirement portfolio for the four-asset model using the constant allocation and the "bonds first" withdrawal strategy, under five different allocation schemes (100%, 75%, 50%, 25%, and 0% in bonds), five annual withdrawal rates (3%, 4%, 5%, 6%, and 7%), and five retirement horizons (10, 15, 20, 25 and 30 years). The median remaining balance is computed per $100 of initial retirement wealth for 5,000 bootstrapped samples for each different scenario. A remaining balance of zero dollars is used for all failed retirement portfolios in computing the median.

(2007) note, whereas the traditional view may make investors feel better, "If minimizing shortfall risk is the retiree's ultimate goal, these results suggest that the life-cycle strategy—at least during the withdrawal phase—needs additional empirical justification."

Although the prospect of 80-year-old investors with 100% equity allocations is obviously controversial, the reason why the bonds first strategy seems superior may be attributable to the fact that it ameliorates serial returns risk better than either the glide-path or constant allocation strategies. As we have seen from the enormous volatility in the stock market in 2008, the impact on the equity portion of retirees' savings in a severe down market can be enormous.[11] Under the glide-path and constant allocation methods, investors who retired at the end of 2007 would be forced to sell stocks early in retirement when the market is dramatically down (i.e., at exactly the worst time). In contrast, under the bonds first strategy, newly retired investors effectively buy time for the stock market to recover. To the extent that these investors may be more exposed to sharp downturns later in retirement when the bond portion of the portfolio has been depleted, there are two factors that work to their advantage. First, presumably the equity portion of the portfolio has had time grow since the initial

Table 5 Portfolio 2 (four assets) quintile remaining balances with inflation-adjusted monthly withdrawals after 30 years

Percent of bonds	Quintile	Constant bond:stock allocation					Bonds withdrawn first				
		Annual withdrawal rate					Annual withdrawal rate				
		3.00%	4.00%	5.00%	6.00%	7.00%	3.00%	4.00%	5.00%	6.00%	7.00%
100%	100th	$3,272.26	$7,578.43	$2,076.49	$2,079.45	$2,082.45	$3,272.26	$7,578.43	$2,076.49	$2,079.45	$2,082.45
	80th	$839.29	$603.44	$318.45	$96.37	$0.00	$839.29	$603.44	$318.45	$96.37	$0.00
	60th	$595.19	$373.06	$130.64	$0.00	$0.00	$595.19	$373.06	$130.64	$0.00	$0.00
	40th	$411.68	$218.05	$4.00	$0.00	$0.00	$411.68	$218.05	$4.00	$0.00	$0.00
	20th	$254.99	$80.79	$0.00	$0.00	$0.00	$254.99	$80.79	$0.00	$0.00	$0.00
75%	100th	$6,946.54	$4,531.92	$4,463.48	$4,731.29	$3,431.52	$32,806.38	$53,945.31	$46,994.69	$25,123.75	$22,462.99
	80th	$1,439.28	$1,102.90	$763.21	$439.58	$98.68	$2,621.31	$2,242.10	$1,964.34	$1,511.99	$959.21
	60th	$1,051.49	$743.19	$445.73	$166.15	$0.00	$1,632.96	$1,333.29	$1,017.93	$636.94	$210.99
	40th	$778.22	$509.38	$235.52	$0.00	$0.00	$1,115.91	$830.39	$535.76	$203.07	$0.00
	20th	$535.06	$297.52	$58.35	$0.00	$0.00	$687.29	$437.74	$176.67	$0.00	$0.00
50%	100th	$18,113.35	$10,911.57	$11,039.33	$12,197.89	$6,942.52	$60,003.29	$60,729.40	$84,031.69	$68,365.39	$39,598.81
	80th	$2,457.80	$2,002.34	$1,564.99	$1,047.57	$635.14	$4,426.89	$3,926.42	$3,519.92	$2,649.65	$1,936.16
	60th	$1,657.32	$1,287.10	$897.35	$494.91	$150.91	$2,520.51	$2,118.38	$1,701.27	$1,132.12	$580.12
	40th	$1,168.32	$827.45	$494.49	$163.52	$0.00	$1,554.24	$1,207.23	$851.75	$417.16	$8.73
	20th	$763.56	$451.62	$176.74	$0.00	$0.00	$860.13	$572.74	$281.70	$0.00	$0.00
25%	100th	$39,649.95	$6,946.54	$32,223.68	$27,252.62	$29,566.12	$97,340.55	$113,145.70	$120,377.61	$66,303.31	$61,002.72
	80th	$4,068.63	$1,439.27	$2,738.23	$2,061.31	$1,444.73	$5,717.39	$5,103.81	$4,097.79	$3,556.09	$2,503.26
	60th	$2,498.22	$1,051.49	$1,502.73	$980.48	$472.44	$3,116.73	$2,685.89	$1,965.31	$1,457.96	$885.59
	40th	$1,599.38	$778.22	$804.18	$378.36	$0.00	$1,771.71	$1,408.48	$922.68	$508.71	$92.88
	20th	$870.17	$535.06	$275.32	$0.00	$0.00	$859.85	$577.76	$260.69	$0.00	$0.00
0%	100th	$96,180.46	$102,181.82	$93,789.63	$90,119.52	$76,333.56	$96,180.46	$102,181.82	$93,789.63	$90,119.52	$76,333.56
	80th	$6,304.86	$5,404.80	$4,359.54	$3,625.28	$2,774.34	$6,304.86	$5,404.80	$4,359.54	$3,625.28	$2,774.34
	60th	$3,290.17	$2,661.17	$2,051.16	$1,528.19	$926.75	$3,290.17	$2,661.17	$2,051.16	$1,528.19	$926.75
	40th	$1,905.59	$1,441.48	$963.84	$544.35	$107.13	$1,905.59	$1,441.48	$963.84	$544.35	$107.13
	20th	$936.75	$602.69	$267.84	$0.00	$0.00	$936.75	$602.69	$267.84	$0.00	$0.00

This table reports the quintile remaining balances of the retirement portfolios for the four-asset model using the constant allocation and the "bonds first" withdrawal strategy, under five different allocation schemes (100%, 75%, 50%, 25%, and 0% in bonds), five annual withdrawal rates (3%, 4%, 5%, 6%, and 7%) for the 30 year retirement horizon only. The quintile remaining balances are computed per $100 of initial retirement wealth for 5,000 bootstrapped samples for each different scenario. A remaining balance of zero dollars is used for all failed retirement portfolios in computing the quintiles.

retirement date (or to recover from downturns early in retirement). Second, the time horizon has been shortened by the number of years that income was supported by the bonds. In this light, it seems clear that a benefit of the bonds first strategy is that it may minimize the risk of catastrophic portfolio failure. Although the success rate output does not suggest that the bonds first strategy reduces serial returns risk at the expense of longevity risk, it seems intuitive that during extreme retirement periods, failure in portfolios utilizing the bonds first approach will tend to occur closer to the end of the retirement period. Simply stated, portfolio depletion in year 19 of a 20-year time horizon is not as catastrophic as failure in Year 9. To the extent that the bonds first approach may help forestall depletion in extreme investment environments until the later retirement years, it may also place retirees in a better position to eventually replace portfolio income through the annuitization of home equity.[12]

In addition to confirming that equity diversification and the bonds first withdrawal strategy tend to improve sustainability, another interesting observation is that the highest success rates appear to shift from lower stock:bond allocations to higher stock:bond allocations as the withdrawal rate increases, especially for the 25 and 30 year time horizons. For instance, for the four-asset, 30 year time horizon, and bonds-first withdrawal in Table 3, at the 4% withdrawal rate, the highest success rate appears at the 25:75 allocation for the four-asset class portfolio model, whereas at the 5% and 6% withdrawal rates, the highest success rate occurs with the 50:50 allocation. At the 7% withdrawal rate, the highest success rates are at the 75:25 and 100% allocations (63.38% and 63.32%, respectively). Although many previous studies have suggested that there is a single ideal asset allocation that lies somewhere between 50:50 and 75:25 stocks:bonds, our results cast doubt on such a notion. Instead, like Stout (2008), this study suggests that the ideal asset allocation for any given retiree may depend upon both the age at retirement and the required withdrawal rate.

Conversely, it should also be noted that for withdrawal rates of 4% or less and for time horizons less than 20 years, there appears to be very little difference in success rates across the various asset allocations (i.e., all have high success rates). In fact, for the shorter illustrated time periods the equity-heavy allocations appear to have slightly lower success rates than the bond-heavy allocations. For example, under the four-asset portfolio, and constant allocation withdrawal in Table 2, a 100% stock allocation has a 98.72% success rate under a 20-year withdrawal period and a 4% real withdrawal rate. In contrast, the success rate is 99.74% for the 100% bond allocation and 99.56% for the 25%:75% stock: bond model. Similar results are observed by Ameriks, Veres, and Warshawsky (2001), Cooley, Hubbard, and Walz (2003), Spitzer and Singh (2007), Blanchett (2007), and may be regarded as intuitive, because the lower success rates for equity-weighted portfolios may be attributed to the greater volatility of stocks over short time horizons. This suggests that practitioners may have flexibility in portfolio design for clients whose circumstances fall within these parameters. Given that retirees tend to be risk averse, these results might tempt one to conclude that the optimal allocations in these scenarios should be heavily, if not exclusively, weighted toward bonds. However, it is important to keep in mind that two portfolios with identical sustainability success rates and dramatically different asset allocations will differ not just in terms of volatility but also in terms of expected rate of return (or the remaining balance). For retirees with near certain sustainability success rates, the asset allocation decision will depend to a large extent on the importance the client places on accumulating wealth for his heirs relative to minimizing portfolio volatility.

5. Conclusion

One of the main objectives of this paper has been to bring the state of professional research on retirement income sustainability closer to practical application. In particular, this paper seeks to examine the effectiveness of an MPT-based model strategy that is widely used at the practitioner level to a standard S&P 500/bond index model commonly used in the professional literature, and to compare the effects of two popular, simple portfolio withdrawal strategies on sustainability. The finding that broad equity diversification does indeed appear to appreciably increase the sustainability success rate, particularly for high withdrawal rates and long retirement horizons, is important because MPT-based asset allocation models have been widely adopted at the practitioner level. The finding that the bonds first withdrawal strategy is superior to constant allocation and glide-path withdrawal strategies have practical applications as well. Although the appeal of reducing equity exposure over time to generally conservative minded retirees is obvious, our results lead us to agree with Spitzer and Singh (2007) and Blanchett (2007) that practitioners may be wise to advise clients to eschew popular glide-path strategies, such as age-based lifecycle mutual funds, in favor of the bonds first approach. Lastly, our observation that the ideal allocation for a retiree upon retirement is dependent upon his age and required withdrawal rate, with the allocation becoming more equity oriented for initial withdrawal rates above 5% has important planning ramifications as well.

Together these findings constitute the beginnings of a blueprint for helping practitioners and investors make better retirement income planning decisions. Although much has been made over the years of the "magic" 4% safe withdrawal rule, the need for such a blueprint cannot be overstated because many Americans are behind in saving for retirement and will likely require withdrawal rates well north of 4% to maintain their standards of living. Although still prototypical, the illustration of the four-asset class model paired with the bonds first withdrawal strategy in Table 3 and the corresponding median and quintile remaining balances illustrated in Tables 4 and 5, are examples of the type of empirically divined matrices that may be useful in the field for helping investors quantify shortfall risk and better understand how to improve their sustainability success rates.

From a broader perspective, this analysis also sheds light on the effectiveness of real world practitioner guidance. This is important because some financial economists and academics have suggested that the retirement income strategies adopted at the practitioner level are suboptimal because they are naïve and heuristic in their investment allocations and in their adoption of popular withdrawal strategies (Sharpe, Watson, and Scott, 2007). In the opposing camp, the rationality of practitioner decision making is defended by Pye (2000) who expands on the economist/practitioner disconnect as follows: "In these [economic] models, it is necessary to explicitly specify the utility function for the withdrawals before any results can be obtained. For use in the practical world, this requirement appears to have been fatal. Neither endowment fund managers nor financial planners are using these models to help make decisions... For their purposes, practitioners have in effect tended to adopt a strong form of habit persistence to value withdrawals. Financial planners, for instance, assume that the objective of their clients after retirement is a sustainable standard of living and, to the extent possible, one comparable to what they had before."

In further contemplation of the practical value of this paper's findings, it should also be noted that a number of far more sophisticated retirement income planning models have emerged over the past few years. Many of these strategies appear to improve success rates beyond what we have illustrated. For example, Stout (2008) employs Monte Carlo analysis to compare an actively managed decision-based withdrawal approach to the common constant inflation-adjusted withdrawal stream adopted by most planners and retirees (and assumed in our analysis). His results indicate that shortfall risk can be reduced by employing certain decision rules that change the withdrawal rate over time. Interestingly, although Stout applies an entirely different methodology, consistent with our results, he also finds that, "Optimal equity composition and minimized probabilities of prematurely exhausting the portfolio increase with higher withdrawal rates and earlier retirements with both managed and unmanaged withdrawals." Other advanced dynamic allocation and withdrawal strategies that have been introduced include Pye (2000), Bengen (2001), Stout and Mitchell (2006), Spitzer (2008), the afore-referenced Guyton (2004), and Guyton and Klinger (2006) works, to name a few. Although each of these models refines our understanding of sustainability research and may have direct practical applications to certain sets of retirees, so far, there is little evidence that they are being widely adopted. Instead, as noted by Pye (2000), retirees seem to prefer withdrawal strategies that roughly mirror their income experience when they were working, that is, they generally prefer steady income that gradually rises with the cost of living over time. Similarly, practitioners seem to prefer strategies that can be easily implemented and maintained across an entire client base. This sentiment is echoed by Blanchett (2007) who opines, "Decision rules are relevant from a common-sense perspective: when faced with the possibility of financial ruin, it is likely a retiree will decrease consumption to ensure continued survival of savings. Yet while it is certainly advantageous to create decision rules, since markets and clients (as well as their advisors) can at times be equally irrational, the ability to consistently follow such decision rules over 30 years or more is questionable. Also, dynamic and sophisticated decision rules are not viable strategies for the generally unsophisticated investing public." Thus, although the strategies analyzed in this paper are undeniably simplistic, the results may be useful in extending our understanding of real world planning behavior and in providing baseline guidance upon which more sophisticated and dynamic models can build.

Notes

1. Serial returns risk refers to the risk of premature portfolio depletion because of the combination of withdrawals and significant negative returns early in retirement. Longevity risk refers to the threat of portfolio depletion because of longer than average lifespan.
2. This literature review includes only those papers that directly influenced this study.

For a more comprehensive review of the history of withdrawal sustainability research, readers are encouraged to peruse the literature review sections of the papers cited herein.

3. Ho, Milevsky, and Robinson (1999); Cooley, Hubbard, and Walz (2003); Ervin, Filler, and Smolira (2005); and Kizer (2005) all consider the impact of including international equities might have on sustainability. Bengen (1997) and Tezel (2004) consider how including small cap equities might affect sustainability.
4. As a baseline reference, a 100% bond model is included as well.
5. Clearly, the bursting of the housing bubble and the liquidity crisis resulting in 2008's severe declines in worldwide stock prices qualifies as one of the most severe bear markets since the Great Depression. It is not mentioned in the text, because our data includes 1970 through 2007.
6. To be conservative, we assume no interest is earned on the cash account.
7. Whereas the authors acknowledge sidestepping the additional complexity that tax considerations of distributions from non-qualified assets would bring to the discussion, assuming that the distributions are taken entirely from tax deferred retirement accounts has the benefit of closely replicating the retiree's wage experience, because both wages and retirement plan distributions are taxed as ordinary income. In addition, like most other sustainability studies, we focus on the pre-tax retirement distribution amounts because it is difficult to account for every person's individual tax situation under the U.S. federal individual tax code and the various state individual tax codes.
8. These numbers are obtained from the average of the corresponding numbers from five different asset allocations: 100% stocks: 0% bonds, 75% stocks: 25% bonds, 50% stocks: 50% bonds, 25% stocks: 75% bonds, and 0% stocks: 100% bonds. We multiply the monthly average return by 12, and standard deviation by square root of 12 to get the annualized mean return and standard deviation, respectively.
9. In addition to the sustainability results presented in Tables 2 and 3, the mean balance remaining results for both withdrawal strategies were similarly one-sided in favor of the four-asset portfolios. Although the mean balance remaining tables have not been included in this report, they are available from the authors upon request.
10. As in this study, Spitzer and Singh (2007) find little difference between the constant allocation and bonds first strategies for withdrawal rates of 5% or less. However, they consider only a 30-year time horizon. The ambiguity between the two strategies is more obvious in our study because we considered a broader range of time horizons.
11. This analysis was completed prior to the end of 2008. However, given the sample size (1970–2007 monthly return data), the inclusion of the 2008 monthly index return data would not be expected to alter the results dramatically.
12. It is well established that, for many retirees, their home is their biggest asset. Annuitization of this asset through a reverse mortgage is generally most attractive for older investors, because shorter life expectancies lead to higher payout ratios.

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