REVISITING RETIREMENT WITHDRAWAL PLANS AND THEIR HISTORICAL RATES OF RETURN

Chris O'Flinn
Felix Schirripa, FSA

INTRODUCTION

This paper takes a fresh look at the historical record of the most popular financial planning device retirees encounter, the so-called 4% rule (Spiegelman-Schwab 2006) (Vanguard-2008). The rule provides for a sustainable annual spending plan or withdrawal plan that is kept real for inflation for a period of 30-35 years. The initial annual withdrawal equals 4% of retirement savings. Subsequent annual withdrawals equal the initial dollar plus cumulative inflation.[1] In this paper, we label this withdrawal plan "4R". Other real withdrawal plans are also labeled by their initial percentage withdrawal, for example, 5R.

One might question the value of another historical study on this subject. On the one hand, many financial planner and authors accept the 4% rule as the best rule of thumb available for the purpose (Updegrave, 2007). On the other hand, many academic writers consider the historical record to be of limited value, preferring instead risk analysis models (Spitzer/Strieter/Singh 2007), some of which are available free to the public (T. Rowe Price, 2008).

But revisiting the historical record using the latest available data provides an informative and useful check on risk analysis methodology and assumptions. Mindful of the researchers mistrust of limited historical data, our methodology maximizes the number of historical retirements examined and updates withdrawals, earnings and asset mix monthly. Our results include rates of success and failure as well as charts showing the timing and breadth of the outcomes. Finally, we comment on the drivers of the outcomes and illustrate some hypothetical asset allocations involving fixed annuities that may improve the outcomes.

Our findings indicate that a 4R plan carries an historical risk of failure for a long retirement that is much higher than generally acknowledged. For example, 15% of the historical 35-year retirements failed when funded with equal parts of stocks and bonds. The "real" withdrawal plans that generated no historical failures were all less than 4%, sometimes far less, when retirements exceeded 25 years. The failure rates for a 5R plan are higher than a 4R plan by a factor of at least three for all retirement periods.

The historical failures are not random. Rather they occur in clusters of years in which the majority of new retirement withdrawal plans fail. A key driver of these failures was a rapid, significant and lasting increase in the rate of inflation - - this event increased withdrawals and contributed to a declining real rate of return that was ultimately unable to support the withdrawal plan.

Our review of the prior literature and a detailed description of the methodology used in the study appear at the end of the paper, after the Summary and Conclusions section.

[1] For example: $1,000,000 in savings produces income of $40,000 in the first year of retirement. If inflation runs at 3% per year, the second year payments would be $41,200, the third $42,440, and so on.

Important Disclosures

The historical rates of return on stocks and bonds are considered on a net basis - that is the returns are as reported by Ibbotson Associates (2009). Because fees vary, we thought it useful to establish an historical baseline of success and failure assuming no fees. In reality, investments in stocks and bonds involve fees and will lower the return experienced. Such lower returns would of course increase the failure rates for the historical 4R and 5R plans examined in this paper.

Similarly, the income from the hypothetical inflation-adjusted income annuities is used on a net basis; but, these annuities are usually quoted by insurers on a net basis and typically do not carry any additional fees.

We made no adjustment for taxes, so results could differ depending on tax bracket, tax rates, and how much of the assets are in tax-deferred accounts, such as 401(k)s. Again, the full methodology is described at the end of the paper.

The authors prepared this material for educational purposes only. It is not intended as advice for any individual or firm. Although we worked diligently, we cannot guarantee the accuracy or completeness of this material.

The opinions and conclusions herein are exclusively those of the authors and do not necessarily represent the positions of the authors' current or former employers.

Acknowledgements

We thank the many people who contributed valuable comments on this work and made it better than it would be otherwise. We would especially like to acknowledge Howard Fluhr, Stewart Lawrence, Tirthraj N. Singh, and Irwin Tepper, all of Segal, for their extensive and insightful comments on an early draft. In addition, Scott Macey, John Vine, and John Markson provided excellent guidance on organization and focus. The errors and omissions in this current version of the paper remain entirely our own.

FINDINGS

Historical Failure Rate of 4R and 5R Withdrawal Plans (1926-2009)

Table 1

	Plan Period (Yrs)	Summary Statistics "4R" Withdrawal Plan			Summary Statistics "5R" Withdrawal Plan	
		Average Annual Nominal IRR*	Times Plan Failed		Average Annual Nominal IRR*	Times Plan Failed
100%	*20*	*10.8%*	*1%*		*10.5%*	*8%*
Stocks	*25*	*10.6%*	*2%*		*10.1%*	*17%*
0%	*30*	*10.3%*	*4%*		*9.6%*	*24%*
Bonds	*35*	*10.0%*	*8%*		*9.2%*	*30%*
75%	20	9.8%	0%		9.6%	7%
Stocks	25	9.6%	0%		9.2%	16%
25%	30	9.3%	4%		8.8%	25%
Bonds	35	9.0%	8%		8.4%	33%
50%	20	8.5%	0%		8.3%	9%
Stocks	25	8.3%	2%		8.0%	20%
50%	30	7.9%	8%		7.5%	36%
Bonds	35	7.6%	15%		7.1%	51%
*Taxes, fees and expenses are assumed to be zero and the internal rates of return are stated on a net basis.						

Real IRR Needed for Success of a 4R and 5R Plan

The real internal rate of return needed to sustain the 4R and 5R plans can be calculated mathematically, if we assume that the portfolio earnings will be adjusted for inflation at the same time the withdrawal amount is adjusted for inflation. Chart 1 shows these internal rates of return for 4R and 5R plans.

Mathematically, if we let "w" represent the constant real amount withdrawn at the end of each month, W_t the nominal amount withdrawn at the end of month t, V_t the nominal value of the portfolio at the beginning of month t, R_t the **nominal** total return of the portfolio for month t, r_t the **real** total return of the portfolio for month t, and CPI_t the rate of inflation for month t, we have the following relationships:

$$r_t = R_t / (1 + CPI_t)$$

$W_1 = w(1 + CPI_1)$

$W_{t+1} = W_t(1 + CPI_{t+1})$ (but never more than the portfolio can support at time t+1)

$V_1 = 1000(1 + R_1) - W_1$

$V_{t+1} = V_t(1 + R_{t+1}) - W_{t+1}$ (but never less than 0)

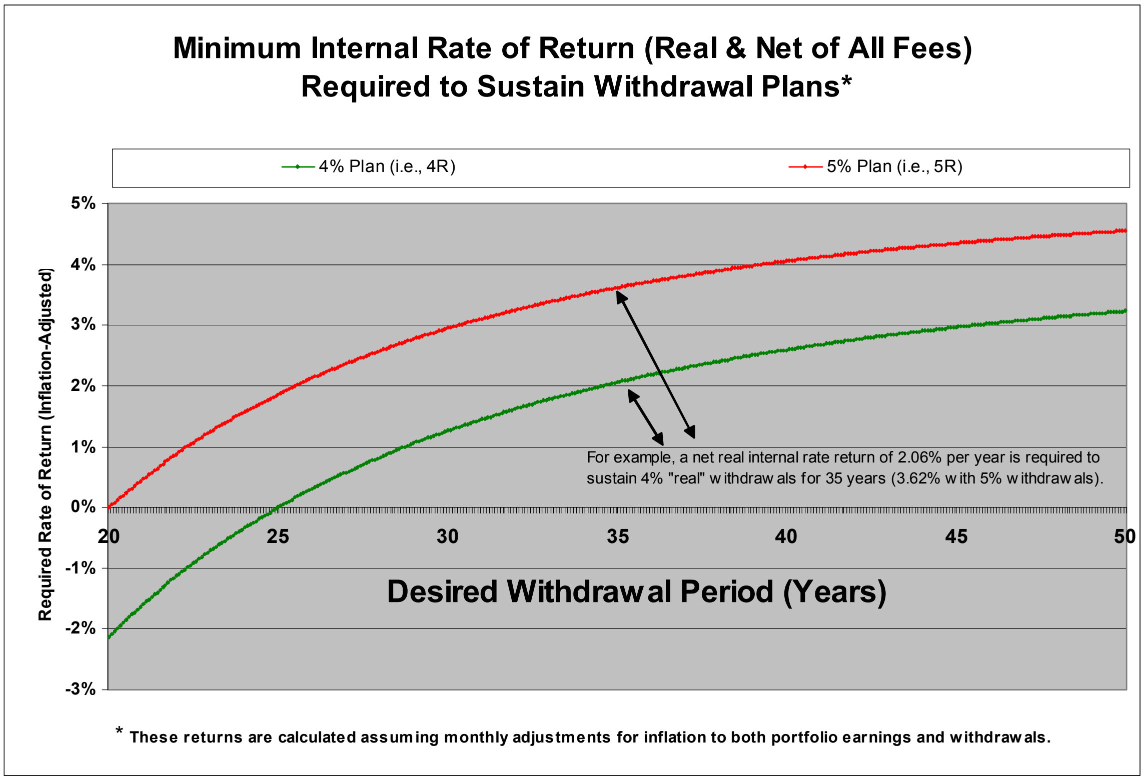
In addition, we have the following recursion relationship:

$V_{t+1} = V_t(1 + r_t) - w$

Therefore, to solve for the level annual real internal rate of return needed to support the 4R Plan, for example, for 30 years (360 monthly payments), we start with funds of \$1000, w = (.04/12)x1000, and, using numerical methods, solve for $r = r_t = r_{t+1}$ such that v_{360} = \$0. Then, we convert this real monthly total return to the real annual total return by solving the equation: $(1+r)^{12}-1$. These annual returns were then plotted and shown in Chart 1.

The chart shows that a real rate of return of <u>2.06% per year</u> is needed to support 35 years of 4% inflation-adjusted withdrawals (the 4R Plan). The comparable real internal rate of return for the 5R Plan is <u>3.62% per year to sustain withdrawals for 35 years</u>.

Chart 1

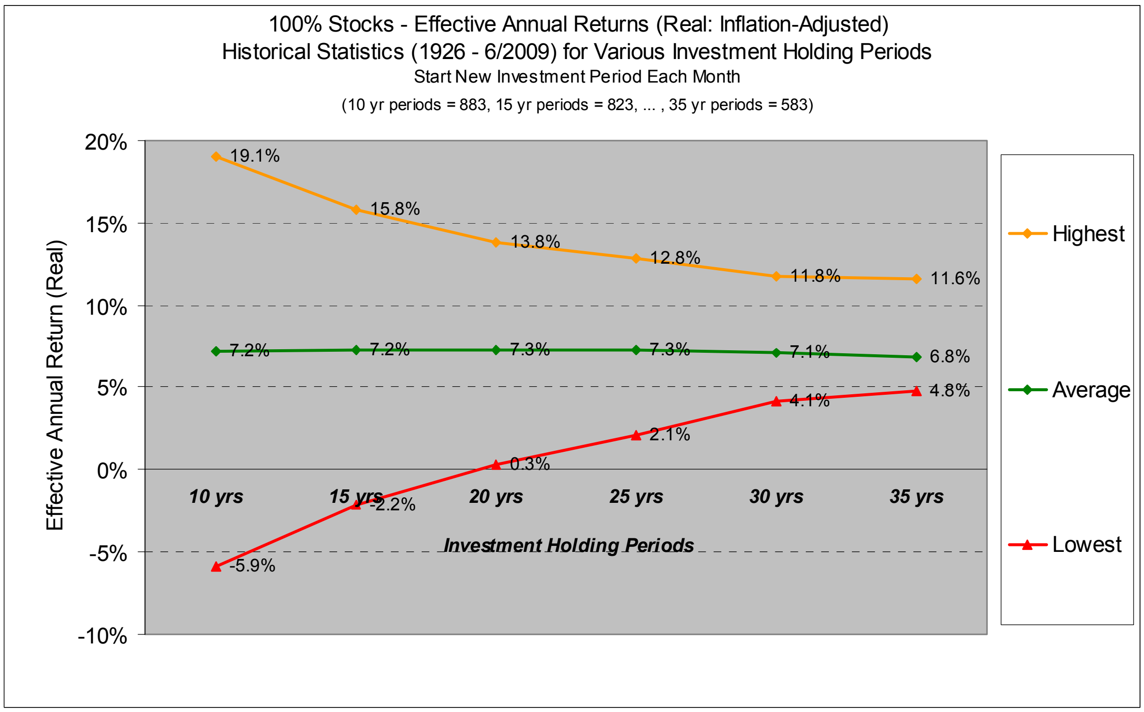


In many descriptions of historical real rates of return for asset classes, there is an implicit assumption that no withdrawals are being made. Thus, the historical rate of return figure in financial literature often has a different meaning than the mathematically derived real rate of return in Chart 1, which anticipates pre-defined levels of monthly inflation-adjusted withdrawals.

For example, the following chart derived from Ibbotson data indicates that, assuming no withdrawals, the <u>real effective</u> rate of return for stocks during the historical period we examined was <u>at least</u> 4.8% per year for all the 35-year periods and 6.8% per year on average. Yet, as table 1 shows, 30% of the 35-year 5R historical withdrawal plans tested using a 100% stocks portfolio failed to sustain the 5R Plan. That is, they failed to deliver the minimum required real IRR of 3.62% per year for 35 years in 30% of the cases in which withdrawals were added to the calculation.

We note that there are now two prominent investments that do offer real rates of return that closely track the annual movements in inflation: Treasury Inflation-Protected Securities (TIPS) and inflation-adjusted income annuities issued by insurance companies. Some economists conclude that TIPS offer an ideal investment opportunity for the retiree seeking both relatively high sustainable real income and low risk (Bodie 2003). Later on in this paper, we will illustrate the potential usefulness of inflation adjusted fixed annuities

Chart 2



Nominal IRR Required to Sustain a 4R and 5R Plan in the 1926-2009 Period

Most retirees and their advisors are used to seeing returns on assets expressed in nominal terms. We therefore calculated the nominal internal rates of return required by the 4R and 5R plans during the historical period. These are charted below and contrasted to the nominal IRR actually achieved.

In order to determine these IRRs, we first determined the actual monthly inflation and its impact on withdrawals for all the historical retirements tested. Using this data, we then determined the nominal internal rate of return required to support withdrawals for the retirement periods tested.

Chart 3

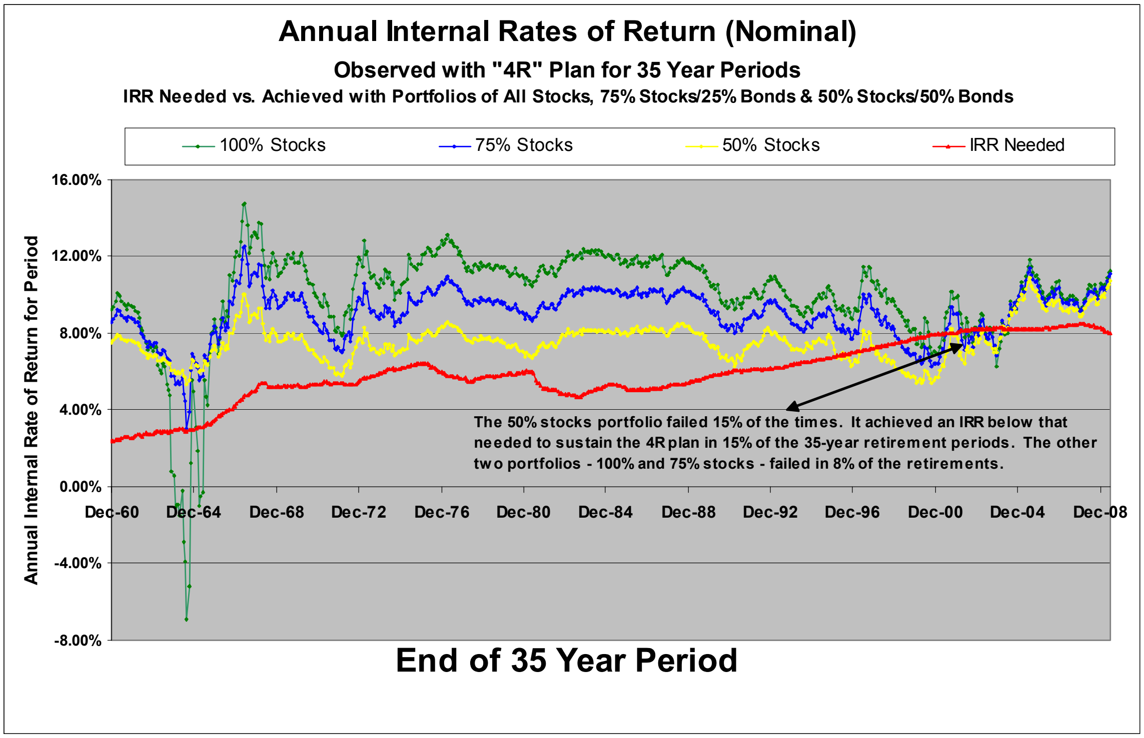


Chart 4

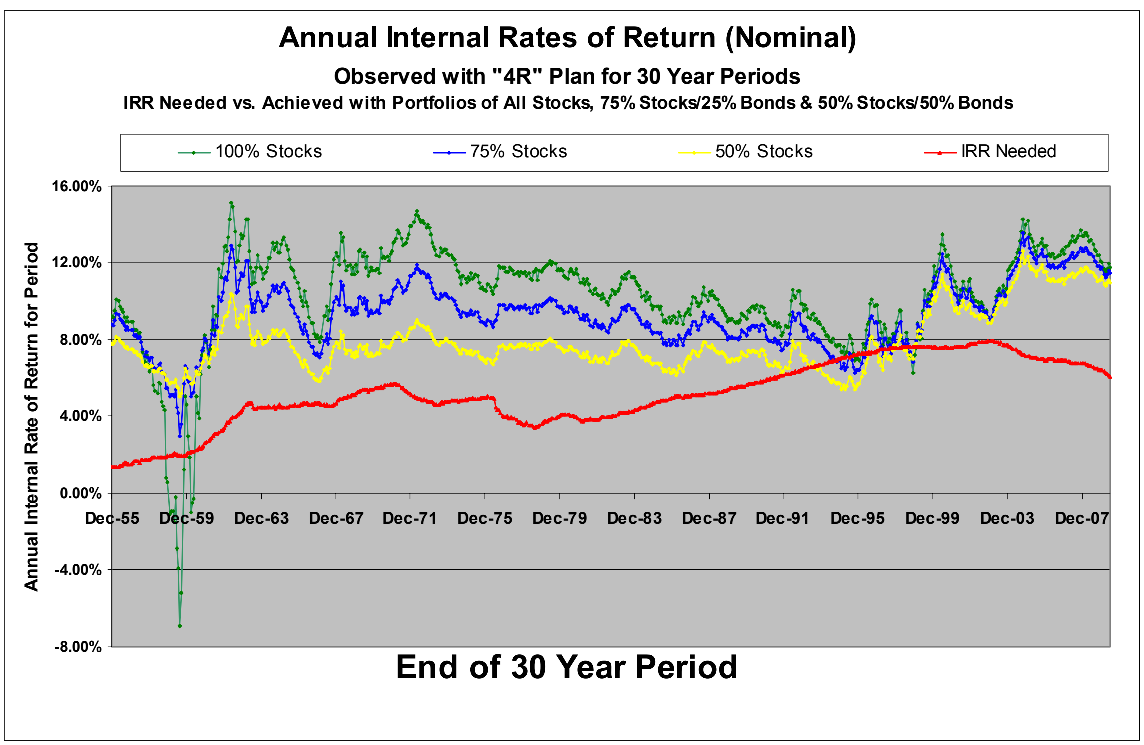


Chart 5

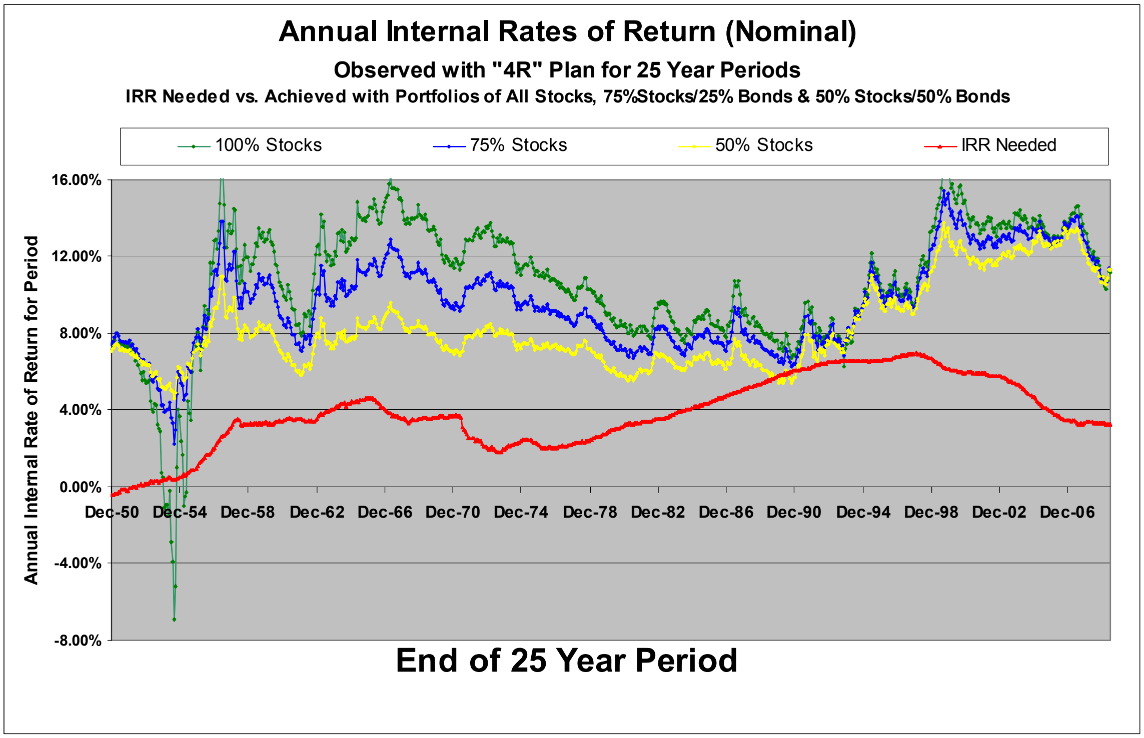
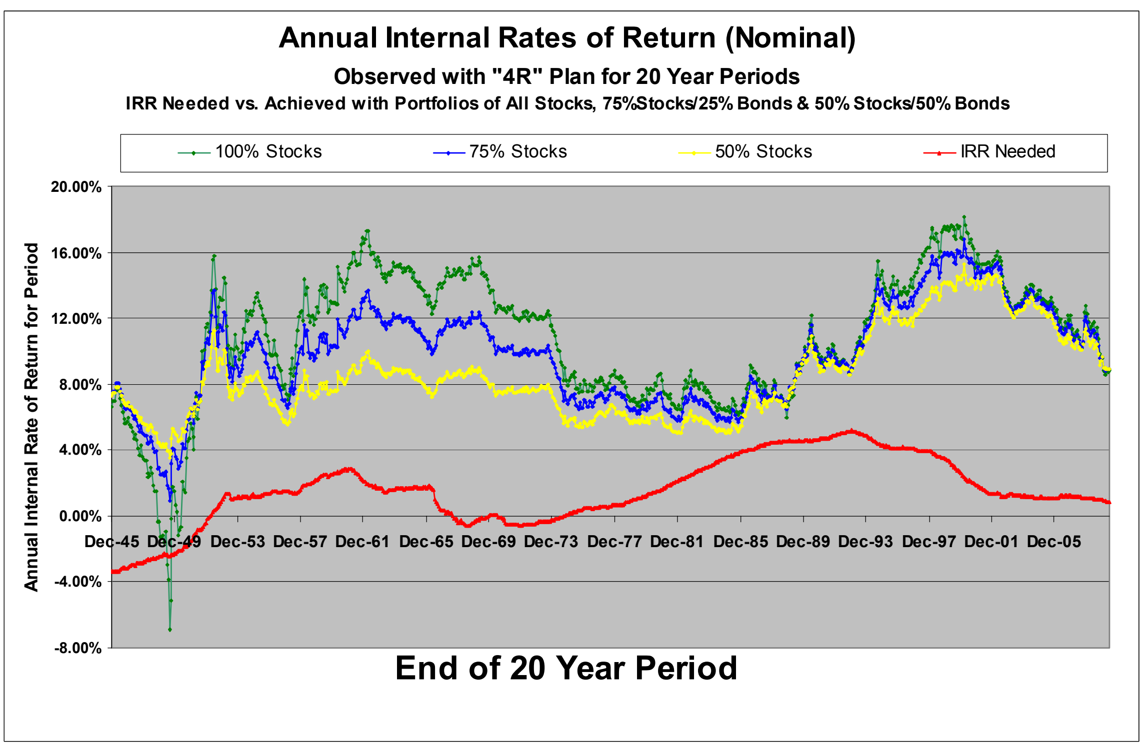


Chart 6



Nominal IRR Required to Sustain a <u>5R</u> Plan in the 1926-2009 Period

Chart 7

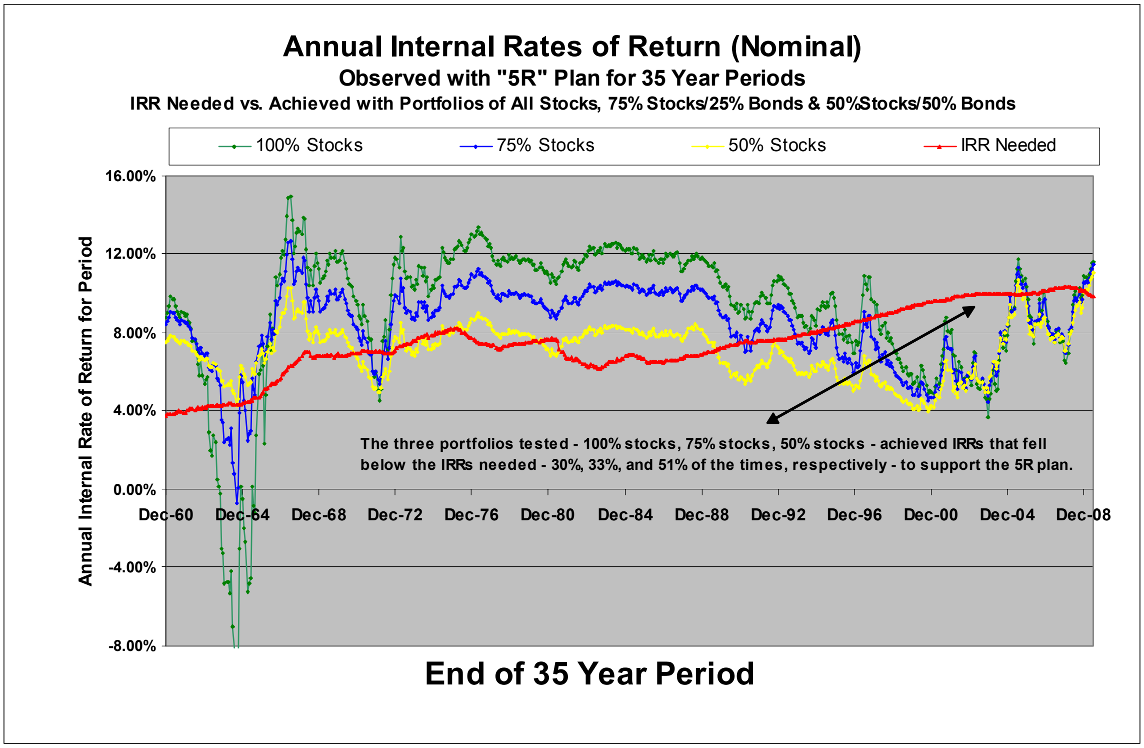
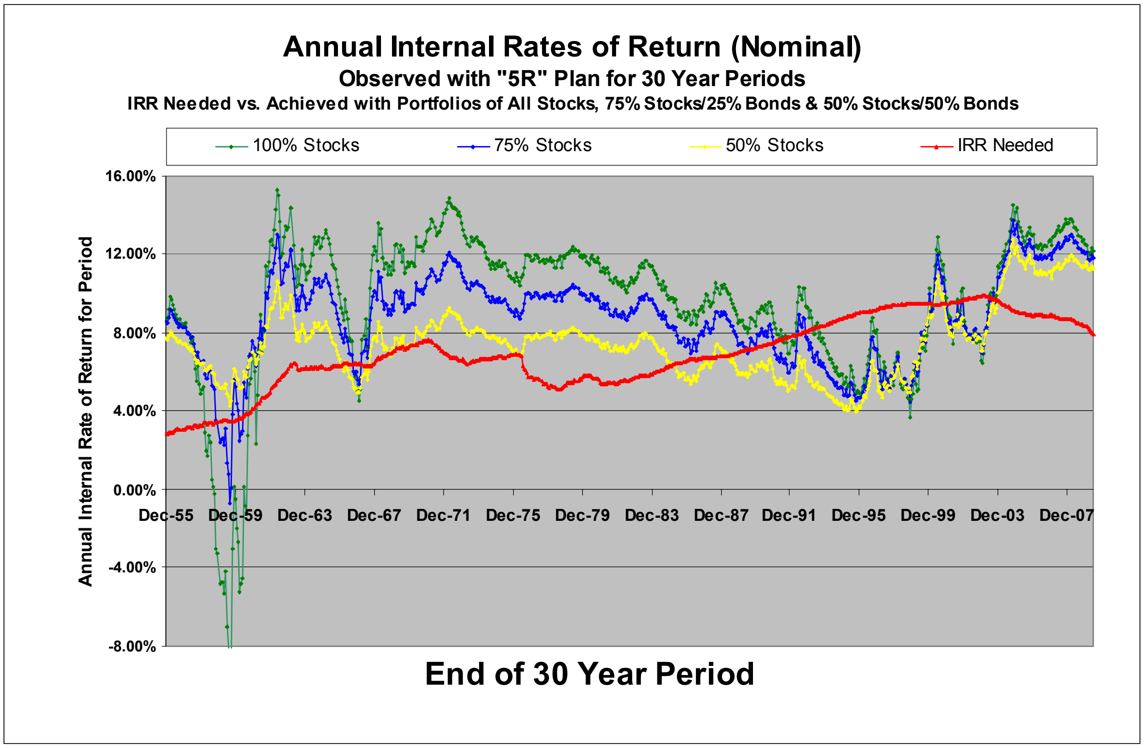


Chart 8



Annual Internal Rates of Return (Nominal)
Observed with "5R" Plan for 30 Year Periods
IRR Needed vs. Achieved with Portfolios of All Stocks, 75% Stocks/25% Bonds & 50% Stocks/50% Bonds
100% Stocks
75% Stocks
50% Stocks
IRR Needed
16.00%
12.00%
8.00%
4.00%
0.00%
-4.00%
-8.00%
Dec-55
Dec-59
Dec-63
Dec-67
Dec-71
Dec-75
Dec-79
Dec-83
Dec-87
Dec-91
Dec-95
Dec-99
Dec-03
Dec-07
Annual Internal Rate of Return for Period
End of 30 Year Period

Chart 9

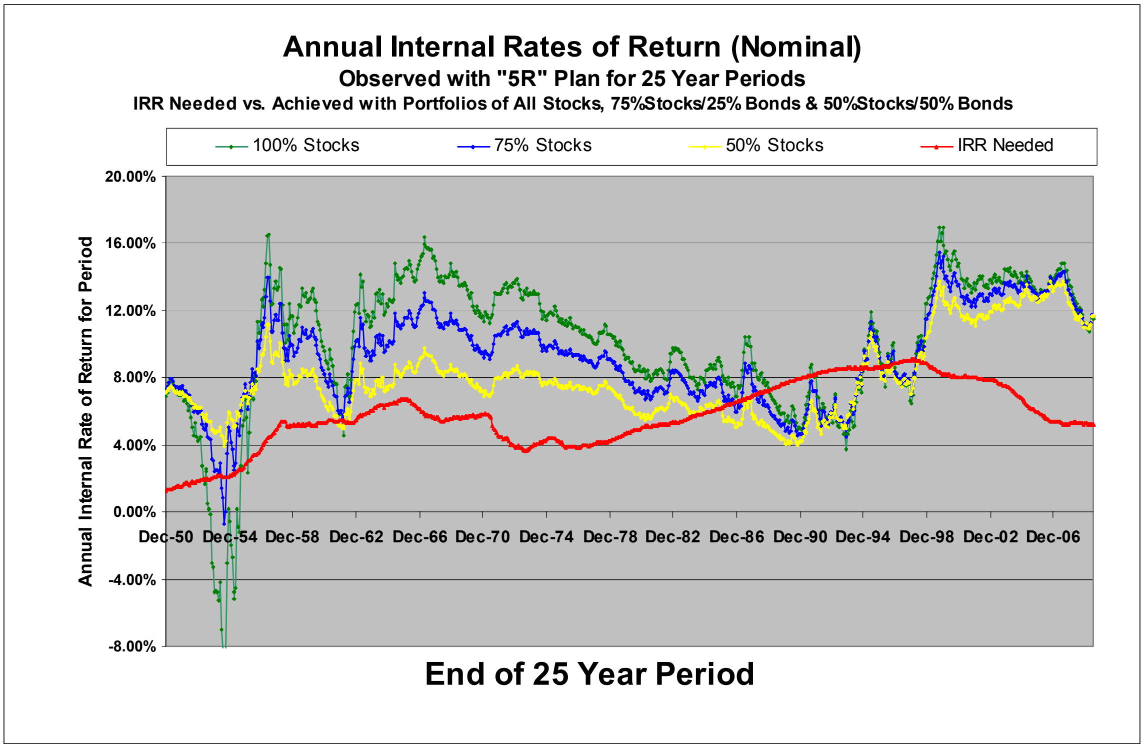
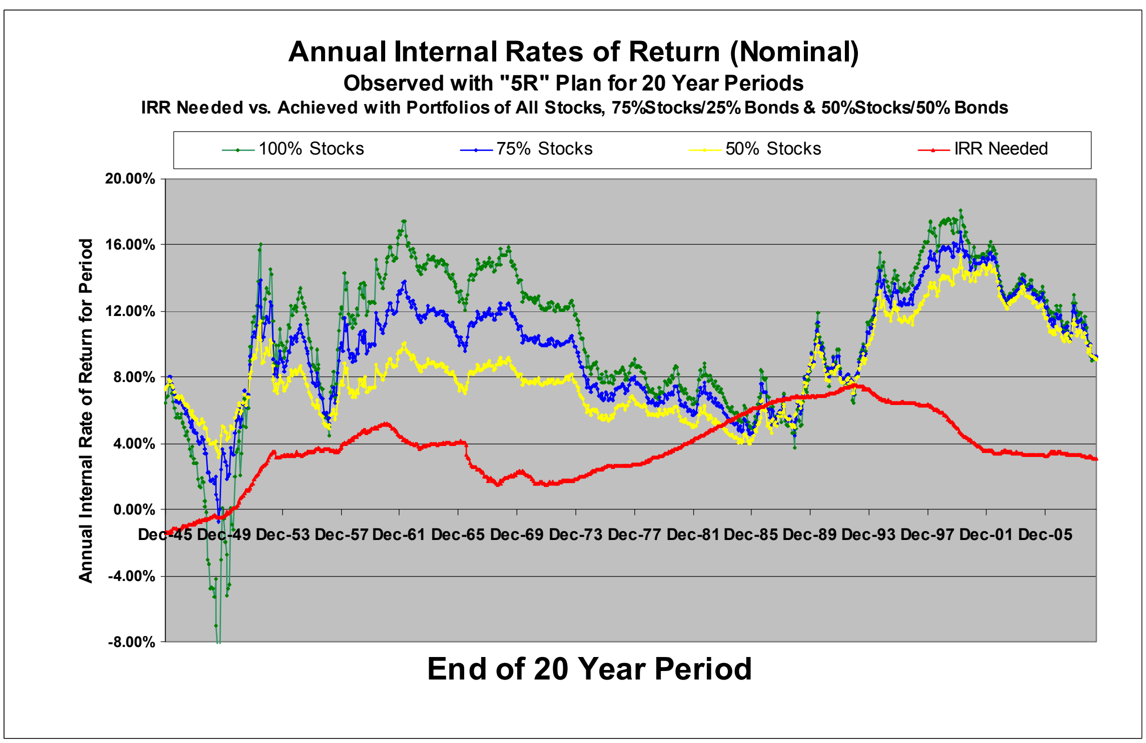


Chart 10



COMMENTARY

3% Nominal IRR Succeeds and 7% Fails

Chart 3 shows that the 1930 retiree, who ended a 35-year retirement in 1965 would have succeeded in a 4R Plan by earning a 3% nominal IRR. In fact, such a retiree with a portfolio of 50/50 stocks/bonds more than succeeded, returning a nominal IRR of about 6%. On the other hand, a 1965 retiree who invested entirely in stocks fell short of success by the year 2000 while having earned a nominal IRR of about 7%. A nominal IRR of about 8% was required to succeed during the 1965-2000 withdrawal period.

This wildly different result - 3% succeeds while 7% fails - is largely due to the impact of inflation. Inflation raises withdrawals, so the nominal rate of return on assets must increase to make up for higher withdrawals. Charts 11 and 12 show the nominal IRR needed for a 4R and 5R historical withdrawal plan to attain a high historical probability of success. For example, for a 35-year 4R plan Chart 11 shows that an IRR of 8% (net of expenses) is needed to reach the 85th success percentile.

Chart 11

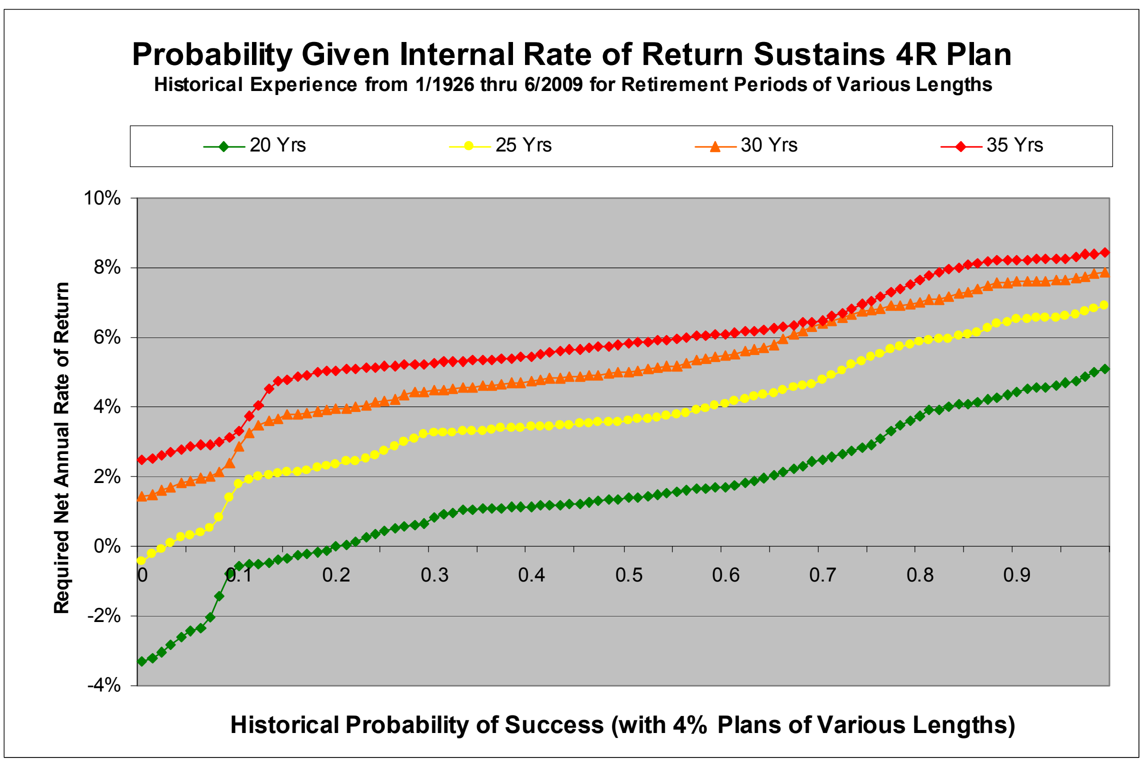
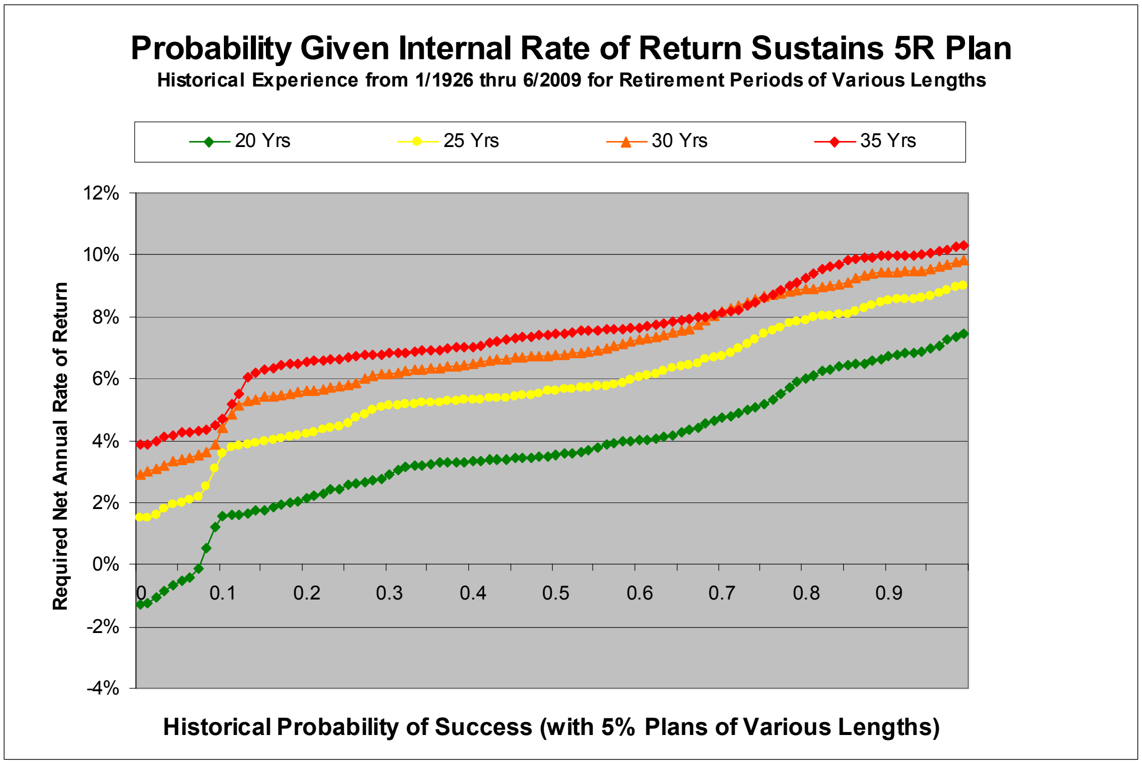


Chart 12

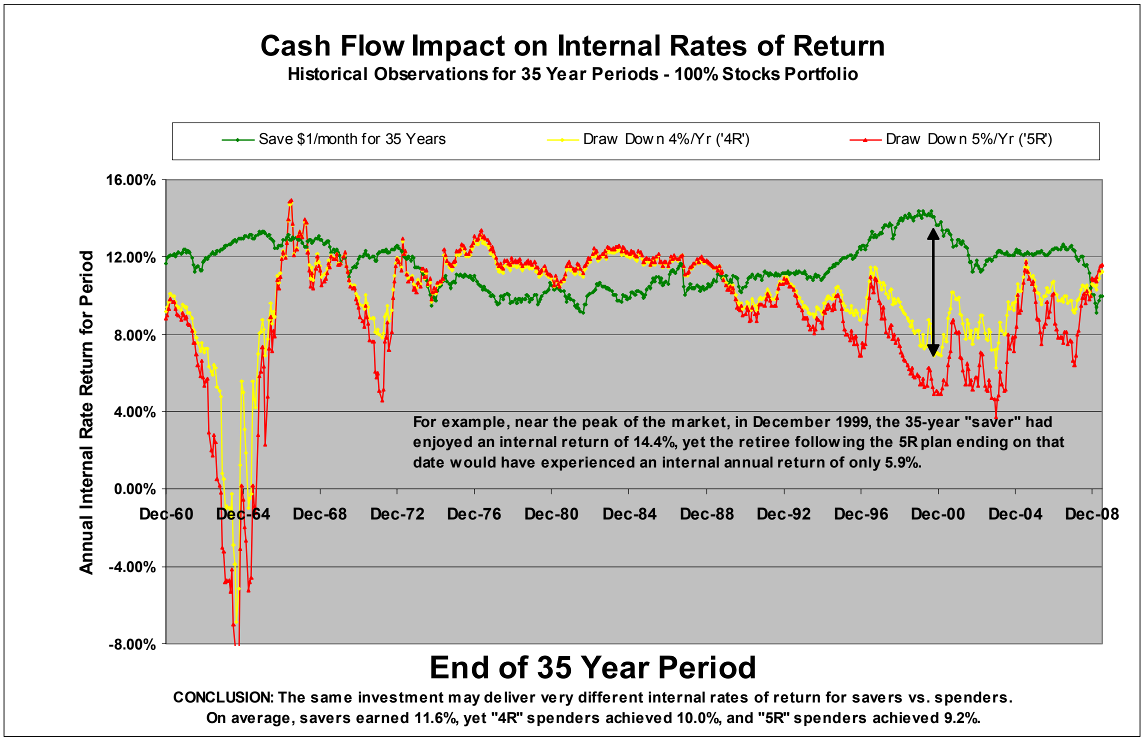


Achieving the Nominal IRR Necessary for Success

Charts 3 through 10 show that failed 4R and 5R plans are clustered in certain periods. For example, many 30 to 35-year withdrawal plans started in the 1960s and invested solely in stocks failed. However, those who started saving for retirement at the same time and in the same way did very well.

The cash flow to and from a portfolio can have a huge impact on the nominal internal rate of return for that portfolio. For example, the portfolio cash flows for the “savers” and “withdrawers” illustrated in Chart 13 generated tremendous differences in their respective nominal IRRs. It confirms that the historical IRRs experienced by “savers” investing in equities are not reliable indicators of the historical IRRs experienced by withdrawers using either a 4R or 5R plan during the same period.

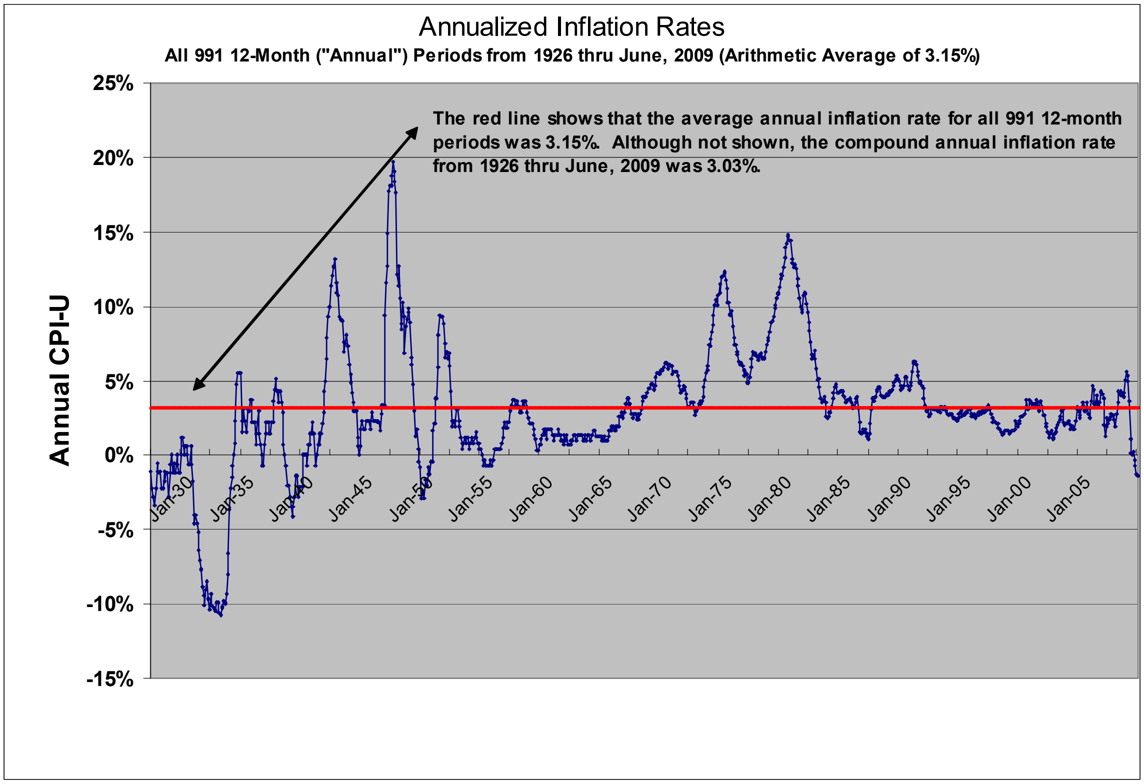
Chart 13



INFLATION

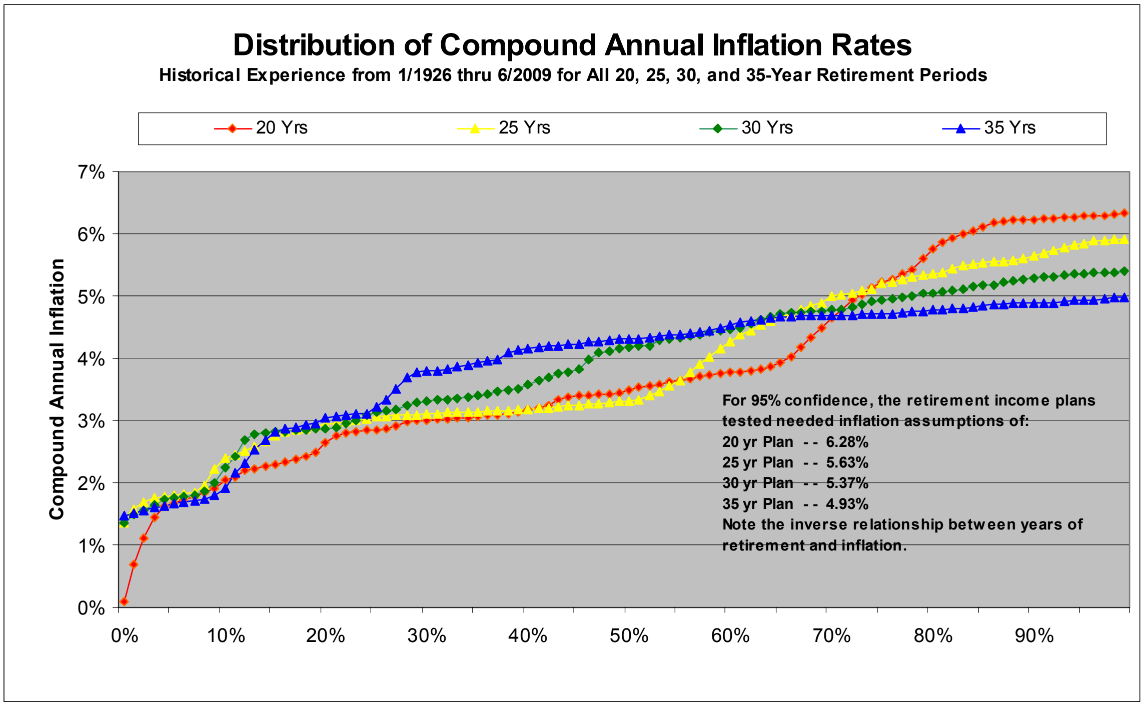
The nominal IRR required for a successful 35-year 4R plan in the 1926-2009 period ranged from just below 3% to just above 8% (see the red line in Chart 3). There are comparably disparate ranges of IRR for all successful withdrawal plans in the testing period, as shown in Charts 3 through 10. The wide range of nominal IRRs required for success is due to the rate of inflation and the volatility of that inflation. Both the rate and the volatility of inflation affect the monthly amounts required by the withdrawal plan. The historical inflation rates in our study drove the relatively high nominal IRRs required for a plan to have a high probability of success (Charts 11 and 12). Chart 14 illustrates these historical rates of inflation.

Chart 14



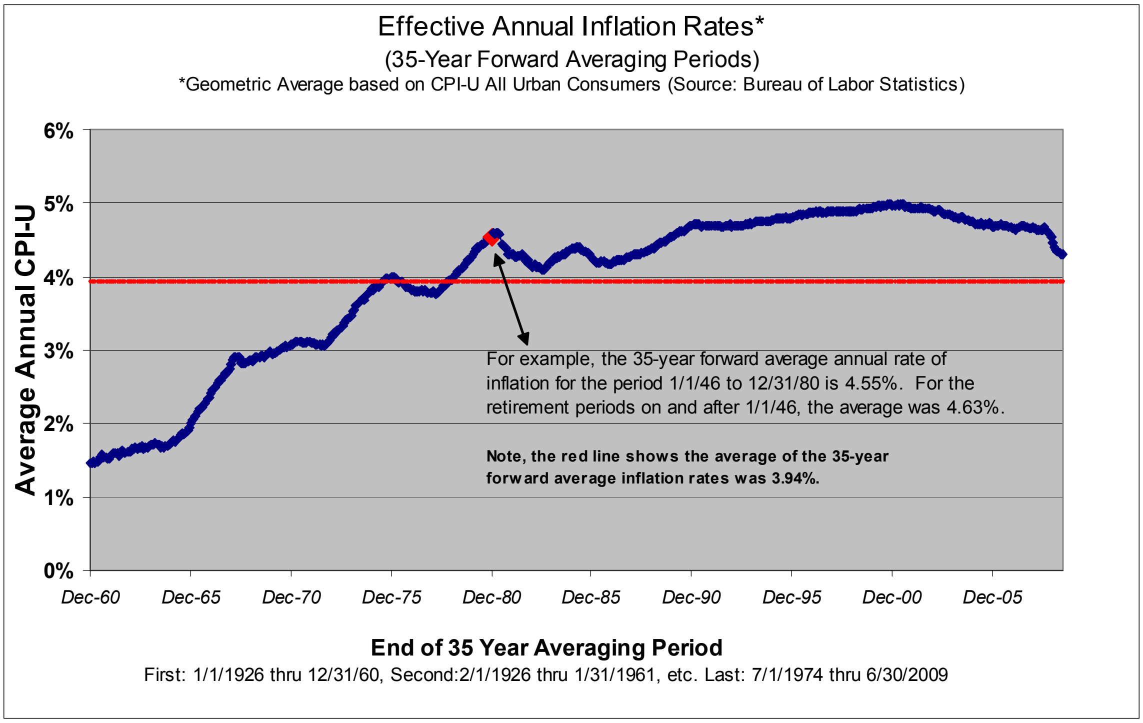
The effective rate of inflation experienced by a particular withdrawal plan depends on when the plan starts and how long it lasts. Chart 15 shows the historical probability of a given effective rate of inflation for a given withdrawal plan. A 20-year plan shows the greatest variability in the effective rate of inflation, from 3.5% at the 50th percentile to 6.2% at the 90th percentile.

Chart 15



Because of this variability, inflation during 1926-2009 can be quite different from the arithmetic annual average of 3.15% shown above. For this reason, Chart 16 plots the 35-year forward average for all of the 35-year historical retirements tested.

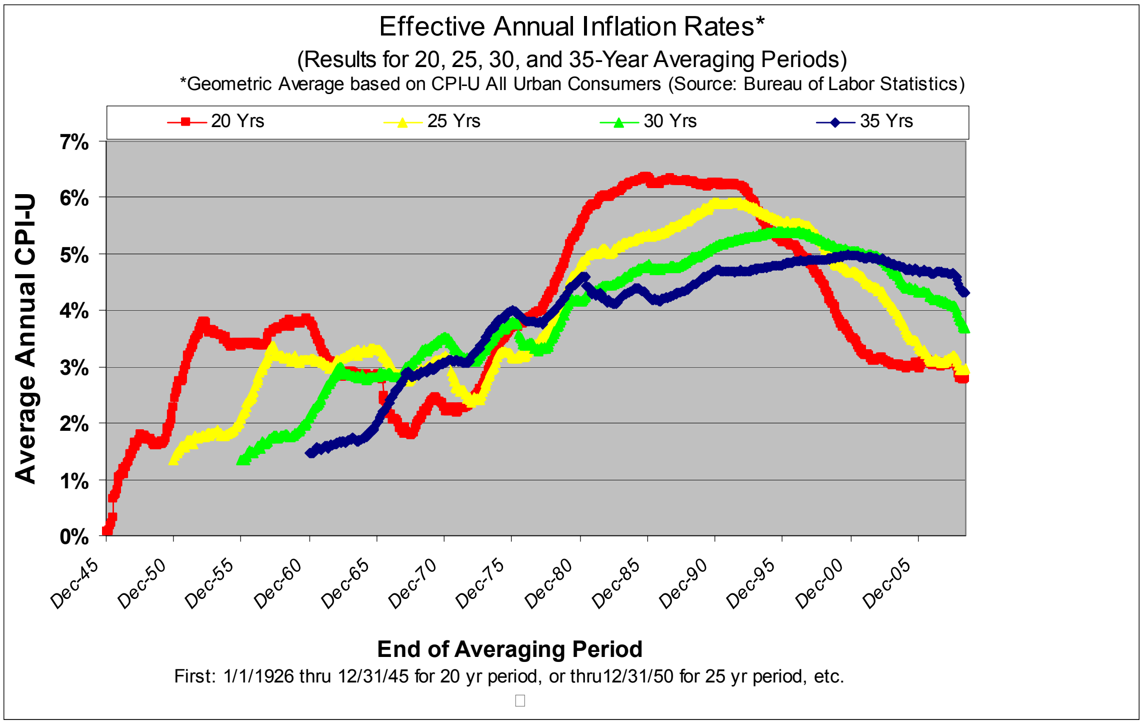
Chart 16



Note that the last 35-year retirement to experience inflation of 3% or less, ended in 1973!

The effective annual inflation rate for all retirements tested is as follows:

Chart 17



Effective Annual Inflation Rates*
(Results for 20, 25, 30, and 35-Year Averaging Periods)
*Geometric Average based on CPI-U All Urban Consumers (Source: Bureau of Labor Statistics)
20 Yrs
25 Yrs
30 Yrs
35 Yrs
Average Annual CPI-U
7%
6%
5%
4%
3%
2%
1%
0%
Dec-45
Dec-50
Dec-55
Dec-60
Dec-65
Dec-70
Dec-75
Dec-80
Dec-85
Dec-90
Dec-95
Dec-00
Dec-05
End of Averaging Period
First: 1/1/1926 thru 12/31/45 for 20 yr period, or thru12/31/50 for 25 yr period, etc.

Withdrawal Plans with 100% Historical Success (1926 - 2009)

Given the failure rates of the 4R and 5R plans indicated in Table 1, we solved for the inflation-adjusted withdrawal plan that produced 100% historical success, i.e., no failures.

Table 2

Portfolio	Plan Period (Yrs)	Withdrawal Plan @ 100% Historical Certainty	Average Nominal IRR* Actually Achieved
100%	*20*	*3.4R*	*11.0%*
Stocks	*25*	*3.1R*	*11.0%*
	30	*2.9R*	*10.8%*
	35	*2.9R*	*10.6%*
75%	20	4.4R	9.7%
Stocks	25	4.0R	9.6%
	30	3.7R	9.4%
	35	3.6R	9.2%
50%	20	4.3R	8.5%
Stocks	25	3.8R	8.3%
	30	3.5R	8.1%
	35	3.4R	7.9%

***Taxes, fees and expenses are assumed to be zero and the internal rates of return are stated on a net basis.**

Withdrawal Plans from Table 2 Can Be Combined With Income from a CPI-Adjusted Annuity to Provide Both More Income and Less Historical Risk

There is extensive research supporting the usefulness of fixed income annuities in retirement (Babel/Merrill 2007).

Today, several large insurers offer fixed income annuities that are indexed to growth in the Consumer Price Index (CPI). As with all life annuities, they provide income enhanced by mortality “credits” to those who live longer due to the forfeitures created by annuitants who die earlier. The advent of fixed income annuities with benefits indexed to growth in the CPI allows for a simple illustration of how the CPI adjusted annuity could be combined with an inflation adjusted withdrawal plan.

Charts 18 thru 25 show how much of an initial portfolio would have to be paid into an inflation-adjusted life annuity to maintain total income at the level of a 4R or 5R plan. In this way, the total available for spending comes from: (a) a withdrawal plan with 100% historical success (i.e., Table 2 amount) and (b) a commercial inflation-adjusted annuity. Note that the typical inflation-adjusted income annuity in the market place today adjusts for inflation annually, not monthly; so the combination does not exactly track our definition of a monthly-adjusted 4R or 5R plan. This explains the asterisk (*) in the charts.

For example, a 75/25 stock/bond portfolio is selected to fund a 30-year 5R Plan. Table 2 above indicates that 3.7R would come from the portfolio of stocks and bonds. Chart 21 below indicates what portion of the portfolio would be used to buy an inflation-adjusted income annuity to make up the difference between 3.7R and the 5R desired. If the inflation-adjusted annuity is paying an annual benefit equal to, say, 7.5% of the premium, we find that 34% of the portfolio would need to be spent on the annuity.

Chart 18

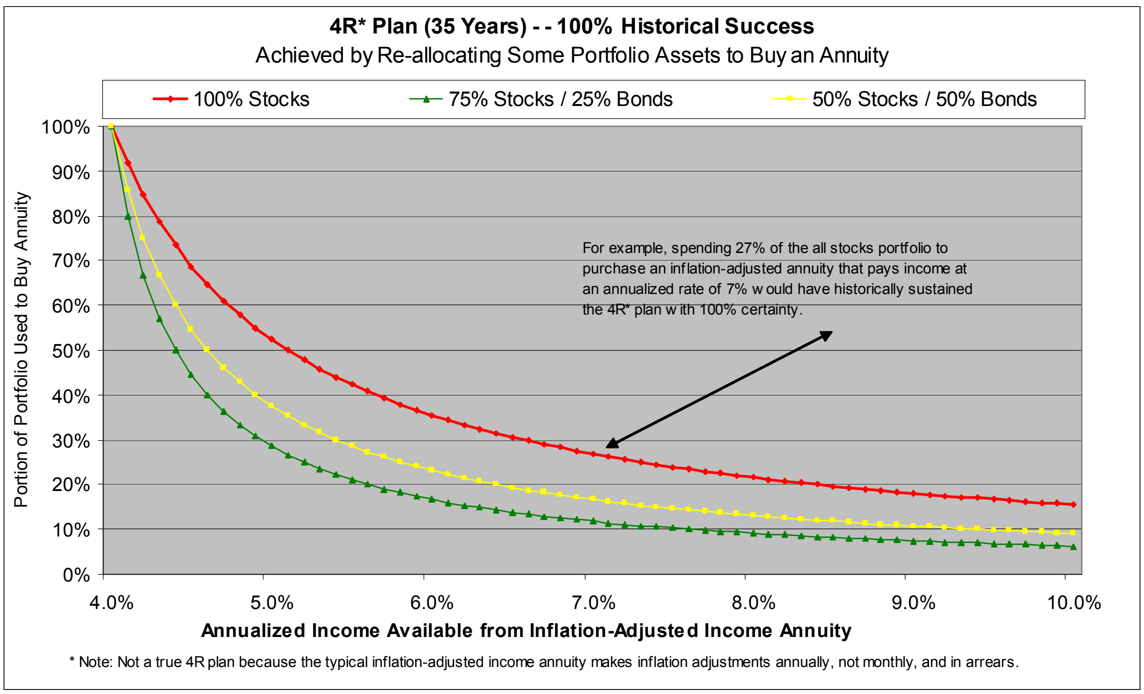


Chart 19

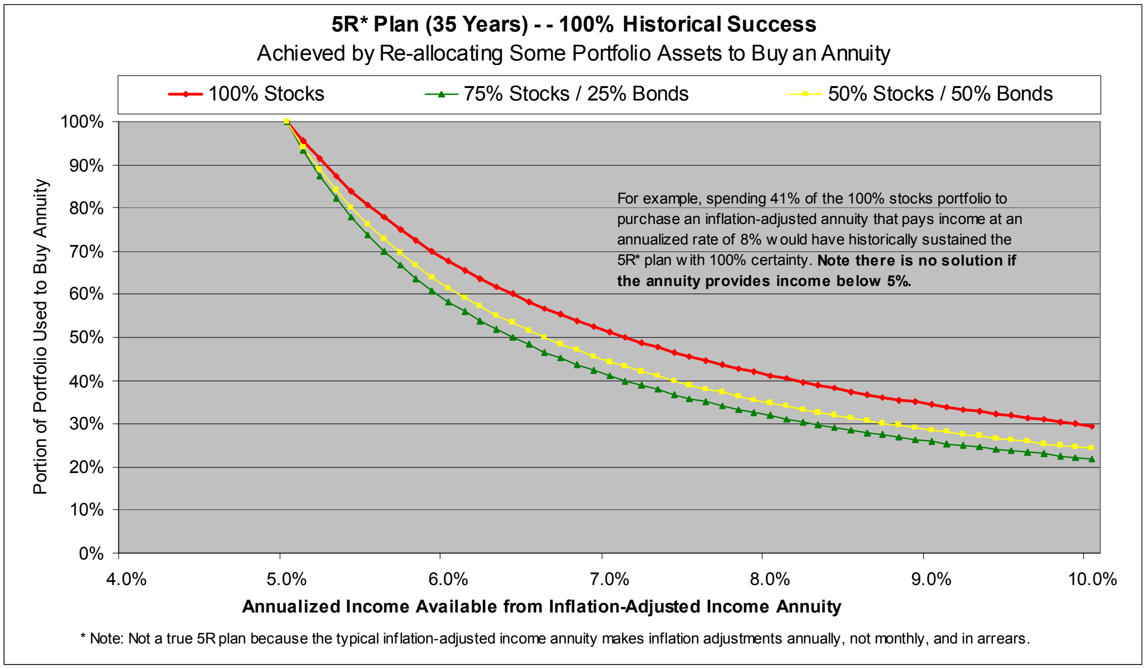


Chart 20

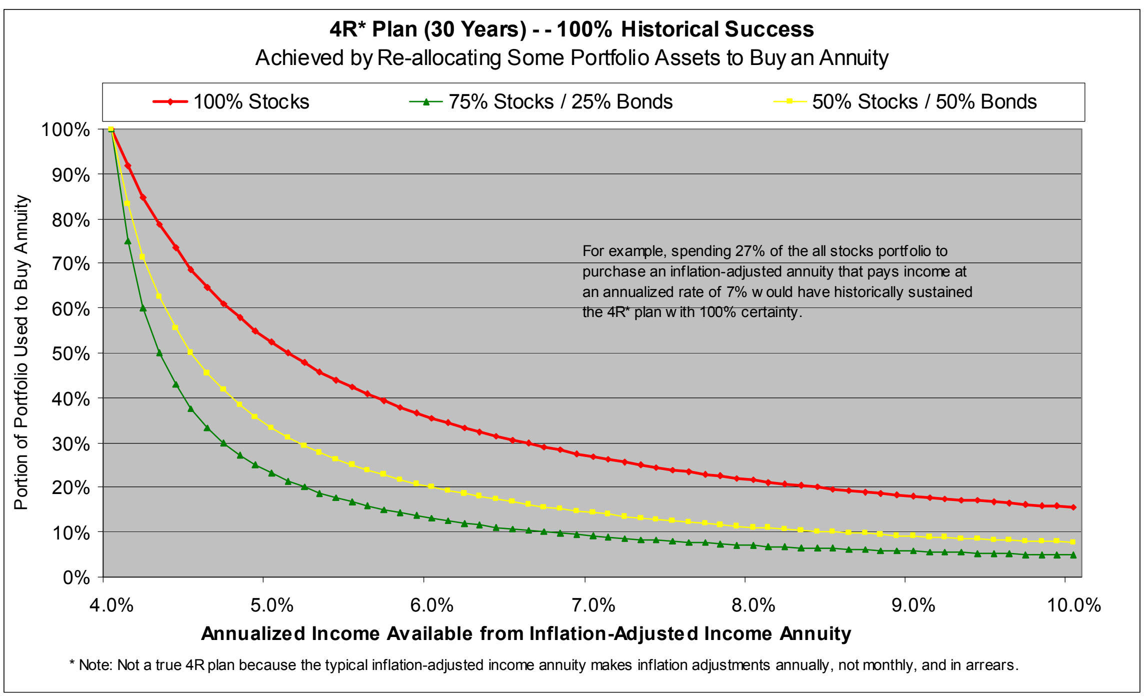


Chart 21

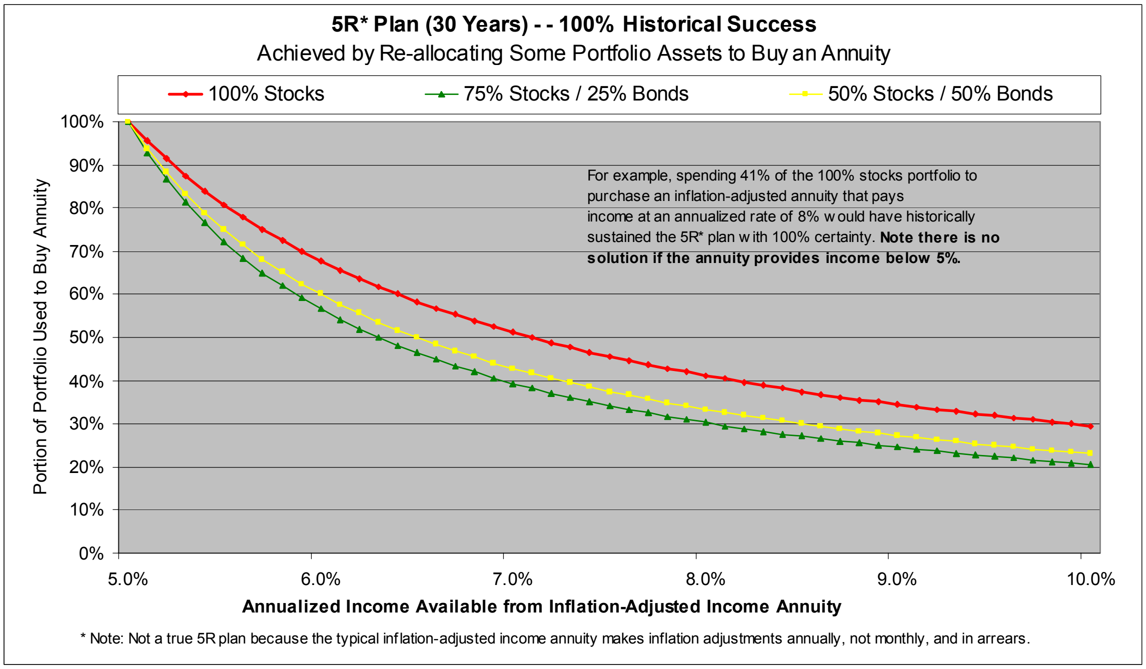


Chart 22

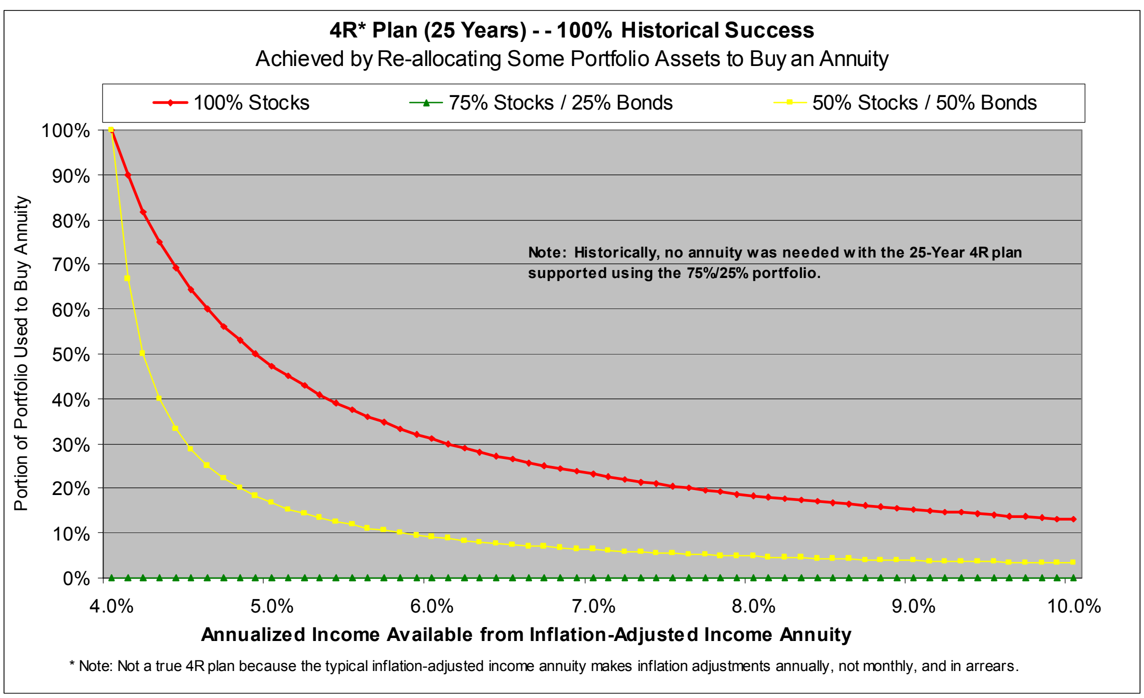


Chart 23

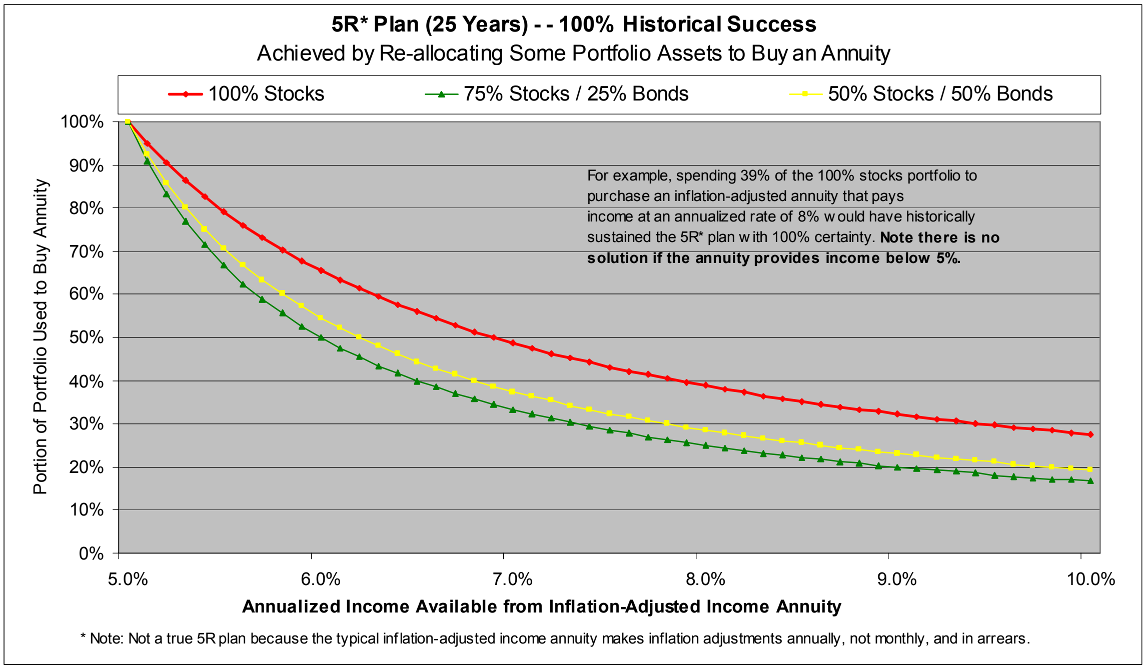


Chart 24

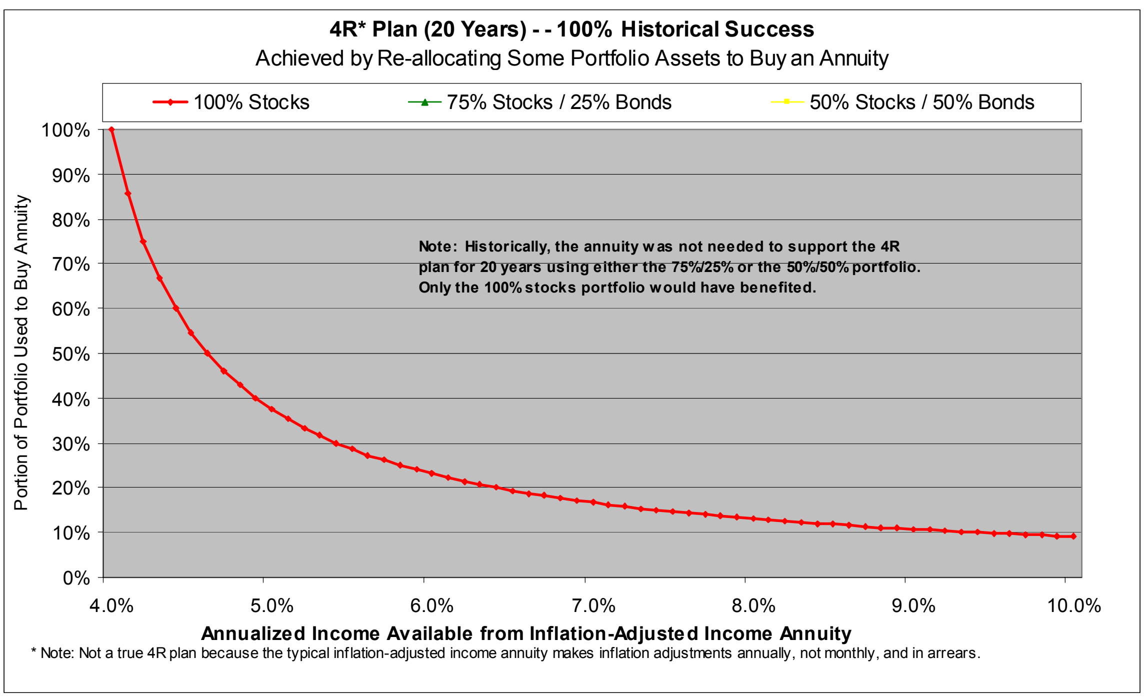
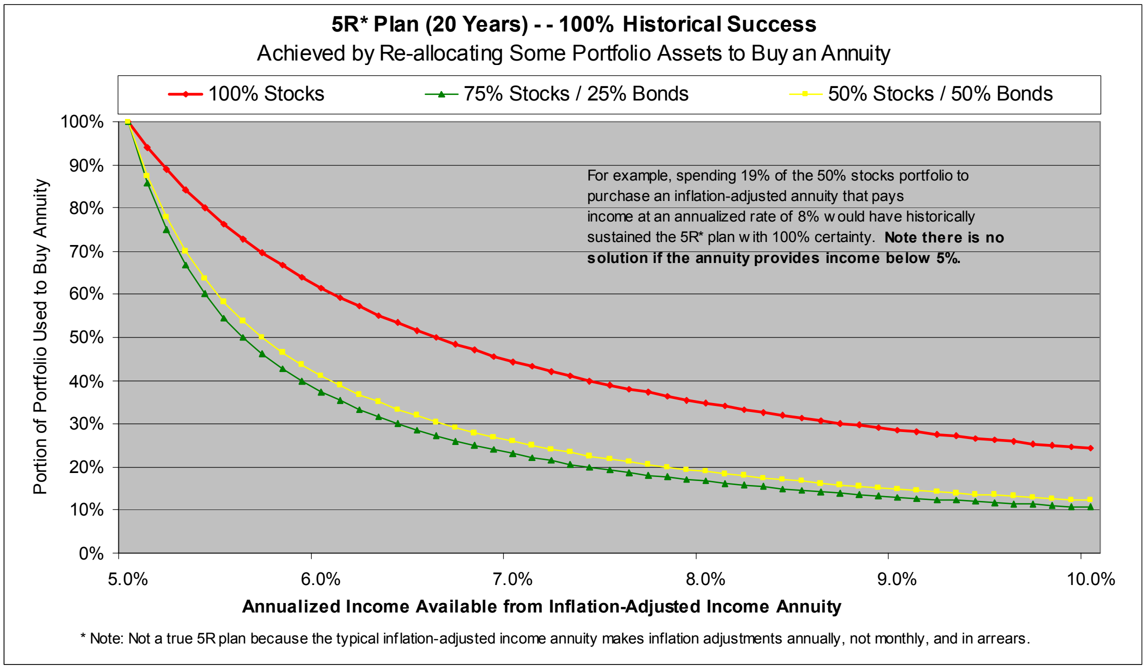


Chart 25



The graphs indicate that, theoretically, at the right price, income from an inflation-adjusted annuity combined with payouts from a 100% historically successful withdrawal plan can achieve higher total retirement income at potentially lower risk than a plan without an annuity component.

Many other authors have documented the usefulness of annuities without an inflation adjustment (Ameriks, 2001; Brown, 2001; Mitchell/McCarthy, 2002). Still others have modeled the optimal time at which to purchase a fixed annuity (Chen/ Ibbotson/ Milevsky/Zhu 2006). In publishing the graphs above, we hope to demonstrate the practical value of a partial allocation to an inflation-adjusted annuity at the beginning of retirement. We believe this simple demonstration will motivate others to conduct further analysis in this area.

Inflation-adjusted life income annuities may not be appropriate for some retirees, particularly those with health issues. In addition, the impact of an annuity allocation on short-term and long-term bequests needs to be quantified and analyzed. Finally, there are investments that may combine with an annuity that might yield better historical outcomes than we illustrated here (VanDerhei, 2006). These considerations are beyond the scope of this paper.

SUMMARY AND CONCLUSIONS

Failure Rates and Clusters

The study found significant rates of historical failure for both the 4R and 5R withdrawal plans for typical retirement planning periods, for the asset allocations indicated.

Table 3

	Plan Period (Yrs)	**Summary Statistics “4R” Withdrawal Plan**		**Summary Statistics “5R” Withdrawal Plan**	
		Average Annual Nominal IRR*	**Times Plan Failed**	**Average Annual Nominal IRR***	**Times Plan Failed**
100% Stocks	***30***	***10.3%***	***4%***	***9.6%***	***24%***
	35	***10.0%***	***8%***	***9.2%***	***30%***
75% Stocks	**30**	**9.3%**	**4%**	**8.8%**	**25%**
	35	**9.0%**	**8%**	**8.4%**	**33%**
50% Stocks	**30**	**7.9%**	**8%**	**7.5%**	**36%**
	35	**7.6%**	**15%**	**7.1%**	**51%**
***Taxes, fees and expenses are assumed to be zero and the internal rates of return are stated on a net basis.**					

Failures tended to cluster in certain periods, rather than run random (see charts 3 through 10). For example, 86 of the108 35-year 4R withdrawal plans that began from 1961 through 1969 failed when funded with 50/50 stocks/bonds. Similarly, 225 of the 228 35-year 5R plans that began from 1955 through 1973 failed, when funded in the same way. Previous historical studies (Bengen, 1994, Cooley/Hubbard/Walz1998) were too early to consider all retirements in the decade of the 1960s.

Although the failure rates found may be unacceptable to many retirees, the study also showed that when the withdrawal plans succeeded, which they did in the majority of cases, they generated additional assets that could increase residual assets or finance higher withdrawals in the remaining years of the withdrawal plan.

Historically Safe Withdrawal Plans (100% Success)

The study found that, of the three asset allocations examined, the highest level of sustainable income (100% success) came from 75% Stocks and 25% Bonds.

Portfolio	Plan Period (Yrs)	Withdrawal Plan @ 100% Historical Certainty
100% Stocks	30	2.9R
100% Stocks	35	2.9R
75% Stocks/ 25% Bonds	30	3.7R
75% Stocks/ 25% Bonds	35	3.6R
50% Stocks/ 50% Bonds	30	3.5R
50% Stocks/ 50% Bonds	35	3.4R

Inflation Experience for Post WW II Retirees has Averaged 5% (not 3%)

Rapidly rising inflation for an extended period was an indicator of a failure cluster in the period studied. For example, withdrawal plans that started in the 1960s, when inflation hovered about 2% per year, were severely damaged by the much higher rates of inflation in the 1970s and 1980s (see charts 14 thru 17). For all 30 to 35 year retirements completed since World War II, a prudent assumption for future inflation would have been 5% per year, which is far above the 3% per year average experienced during the past 80+ years.

Internal Rates of Return Impacted by Withdrawals

Chart 13 shows that the nominal internal rate of return achieved by a 35-year “saver” does not accurately predict the return realized by a retiree, following the 4R or 5R withdrawal plan, even when investing with the same portfolio for the same period. This is because the cash flow to and from the portfolio and differences in starting portfolio values ($0 for the “saver”, $1000 for the “withdrawer” in our Chart 13) impact the realized IRR.

During the historical period illustrated, either the saver or retiree could have a better IRR than the other, but the retiree proved to be vulnerable to a far lower return than the saver. This observation suggests that a description of historical earnings of a particular investment or investment class, which is intended for retirees, should take into account the impact of withdrawals on the IRR.

New Investment Alternatives for Retirees

Two investment options available today, TIPS and CPI-adjusted income annuities, are too new to include in an historical test because they have insufficient historical data. But their existence is relevant to the study's conclusion that a portfolio with returns that closely track inflation is a key to a successful withdrawal plan. While others have commented on the usefulness of TIPS in this regard (Bodie, 2003), we observe the potential usefulness of CPI-adjusted income annuities. At certain price levels, these insurance contracts can be combined with portfolios of stocks and bonds to produce more income than the historical "no failure" withdrawal rates, while also adding an insurance company guarantee.

PRIOR LITERATURE

The popularly accepted 4% rule resulted from William Bengen's analysis, first published in October 1994. Bengen concluded that an annual inflation-adjusted withdrawal of 4% of investment assets at the start of retirement (using various combinations of stocks and bonds) is likely the maximum that could be sustained for 30 to 35 years. He built on earlier work by Larry Bierwirth, who found that certain withdrawal plans, deemed reasonable at the time, would have failed during historical market downturns.

Bengen ran a 4% real withdrawal plan on up to 51 hypothetical retirements beginning on the first day of every calendar year from 1926 to 1976. Assets were updated for earnings at year-end and withdrawals were then deducted for the full year after adjusting for the prior year's inflation. He ran similar tests with 5% and 6% plans (i.e., 5R and 6R plan). He found that 4R incurred very few failures in the 30 to 35 year period. Assuming a portfolio of 50% stocks and 50% bonds, Bengen found that 4R plans lasted for 30 years in all of the 38 cases he examined, and for 35 years in all but two cases (i.e., a 6% failure rate out of 33 plans examined). He found significant failures for 5R and 6R plans, prompting him to characterize them as "risky" and "gambling."

Bengen also looked for the best performing equity allocation. He found that allocating 50% to 75% to equities was the most successful way to minimize the failure of 30 to 35-year inflation-adjusted withdrawal plans. He concluded that 75% equity was optimal for a 4R plan.

Bengen's analysis changed the prevailing thinking on what constitutes prudent retirement withdrawals, which at the time allowed for much higher rates of withdrawal. His findings also supported the notion that retirement portfolios should be heavily tilted towards equities.

Although Bengen's study merely tested how long a level of real withdrawals could last, many have used his work as a guide for retiree spending. Economists have criticized this usage reasoning that optimal withdrawal (or spending) plans should be governed by the dictates of “consumption smoothing” - which takes into consideration much more than the assets available at the beginning of retirement , e.g., other sources of income, liabilities and taxes (Kotlikoff, Burns, 2008). In addition, because Bengen’s initial study used portfolio allocations of only stocks and bonds, some economists have noted that better outcomes are available with broader allocation strategies and hedges (Scott, Sharpe, Watson, 2009). Bengen himself authored several articles on alternative asset allocations (Bengen, 1997, 2001, 2006).

Bengen’s findings prompted an outpouring of studies using the latest risk analysis techniques to determine the probability that a given inflation-adjusted withdrawal plan and asset allocation would last for 30 to 35 years. For example, Monte Carlo computer simulations can evaluate any number of variations and specify a withdrawal plan and asset allocation that appears to accommodate any desired level of probable success. Some investment firms and professional societies offer their own such software to the public at no charge, for use in determining the withdrawal plan that matches the individual’s desired level of income certitude. Gauging sustainability of withdrawal rates using Monte Carlo analysis has prompted some controversy due to the wide disparity in results and has raised calls for agreement on procedures (Milevsky, Abaimova, 2006).

Notwithstanding these developments, interest in Bengen’s straightforward display of historical outcomes for hypothetical withdrawal plans has continued unabated in the 15 years since his initial study. In 1998 and 2001, three professors from Trinity College in San Antonio published two reports that have come to be known as the Trinity Studies (Cooley/Hubbard/Walz 1998, 2001). They expanded the analysis of withdrawal plans in four major ways:

1. Refining the analysis by using monthly withdrawals and asset earnings adjustments (although inflation adjustments were still made annually, in arrears).

2. Updating the testing period to 1997, thus increasing the number of tested annual retirements for a given 30-year withdrawal plan (4R) from 39 to 43.

3. Including tests for much higher real withdrawal rates, e.g., up to 12%.

4. Revising income portfolios to include returns from high-grade corporate bonds rather than the intermediate term Treasuries used by Bengen.

The Trinity authors found, as did Bengen, that a portfolio with at least 50% equities was needed to minimize failure in all the historical withdrawal plans tested at the 4R level. The only failures found for the 4R plan occurred in 30-year plans: a 5% failure rate using a 50/50 stock/bond portfolio, and a 2% failure rate using the 100% stock portfolio. Bengen had reported no failures for these combinations.

In the Trinity Studies, the failure rate for the 30-year 4R plan dropped to zero when the asset mix was 75% stocks and 25% bonds. This confirmed a Bengen finding that 75% stocks, 25% bonds had better success than a 100% stock portfolio.

The Trinity Studies have no 35-year findings, so there is no documentation of whether the updated methodology would have increased or decreased Bengen’s 4% failure rate for that period.

Most of the literature since Bengen and the Trinity studies have utilized risk analysis models to produce combinations of risk and outcomes. An extensive summary of that work can be found in Dus and Mitchell 2004.

METHODOLOGY

We examined the historical success of two "classical" withdrawal plans during the years 1926-2009:

1. 4% plan ("4R") - - Beginning with the first month, use monthly withdrawals equal to 1/12 of 4% of the initial retirement portfolio, adjusted monthly for cumulative inflation/deflation.

2. 5% plan ("5R") - - Beginning with the first month, use monthly withdrawals equal to 1/12 of 5% of the initial retirement portfolio, adjusted monthly for cumulative inflation/deflation.

In both cases, we accelerated the timing of withdrawals over those assumed by the previous studies mentioned to reflect inflation-adjustments at the end each month (instead of the end of each year).

The study assumed each withdrawal plan lasted for 35, 30, 25, or 20 years, with a new retirement beginning each month starting January 1926 and the last ending June 2009. Thus, our measurement period is an 83 1/2-year span (hereafter 1926-2009) and defines our use of the term "historical." During this testing period, there were 583 35-year retirements, 643 30-year retirements, 703 25-year retirements, and 763 20-year retirements. Of course, there are many overlapping periods.

We used the Bureau of Labor Statistics for monthly inflation data www.bls.gov and relied on cpi-u as the proxy for inflation.

Definition of Hypothetical Investment Portfolios

We used these three hypothetical portfolios:

1. **100% stocks**, with monthly total returns that track those of the S&P 500 Index (source: Ibbotson SSBI 2009 Classic Yearbook and SBBI Market Report June 2009).

2. **75% stocks and 25% bonds,** with monthly returns derived by assuming the asset mix was rebalanced to 75/25 at the end of each month, that stock returns matched the S&P 500 Index, and that the bond returns matched those of long-term corporate bonds (source: Ibbotson SSBI 2009 Classic Yearbook, and SBBI Market Report June 2009).

3. **50% stocks and 50% bonds,** with monthly returns determined as above for this allocation.

In each case, the portfolio value, which started at $1000, was projected forward to the end of the month using the monthly total returns. Then, at the end of each month, the amount required under the withdrawal plan was deducted, if sufficient funds were available. The withdrawal plan failed (i.e., was not sustainable) if, at some point prior to the end of the plan period, funds in the assumed portfolio were exhausted. Otherwise, the plan was sustainable and may have generated excess assets by the end of the plan period.

References

Ameriks, John, Veres, Robert and. Warshawsky, Mark J. 2001. "Making Retirement Income Last a Lifetime." *Journal of Financial Planning*, Article 6 (December): www.journalfp.net.

Babel, David F. Merrill, Craig B. August 2007, "Investing Your Lump Sum at Retirement",Wharton Financial Institutions Center, Policy Brief: Personal Finance, http://fic.wharton.upenn.edu/fic/policy%20page/whartonessay18.pdf

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

 1996. "Asset Allocation for a Lifetime." *Journal of Financial Planning*, vol. 9,
No. 4 (August):58-67.

 1997. "Conserving Client Portfolios During Retirement, Part III." *Journal of Financial Planning,* vol. 10, no. 6 (December):84-97.

□ 2001. "Conserving Client Portfolios During Retirement, Part IV." Journal *of Financial Planning*, vol. 14, no. 5 (May):110-119.

□ 2006a. "Baking a Withdrawal Plan 'Layer Cake' for Your Retirement Clients."
Journal of Financial Planning, vol. 19, no. 8 (August):44-51.

□ 2006b. "Sustainable Withdrawals." In Retirement *Income Redesigned: Master*
Plan for Distribution. Edited by Evensky, Harold and Katz, Denna B. New York: Bloomberg Press.

Bierwirth, L. (1994). "Investing for retirement: using the past to model the future." *Journal of Financial Planning*, 7(1), 14-24.

Bodie, Z., Clowes, Michael J. 2003. "Worry Free Investing: A Safe Approach to Achieving Your Lifetime Financial Goals" , Financial Times Prentice Hall:

Brown, J.R. 2001. "Private Pensions, Mortality Risk, and the Decision to Annuitize." *Journal of Public Economics*, vol. 82, no. 1 (October):29-62.

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

Cooley, Philip L., Hubbard, Carl M. and Walz, Daniel T.1998. "Retirement Savings: Choosing a Withdrawal Rate That Is Sustainable." *American Association of Individual Investors Journal*, vol. 20, no. 2 (February):16-21.

□ 1999. "Sustainable Withdrawal Rates from Your Retirement Portfolio." *Financial Counseling and Planning*, vol. 10, no. 1:39-47.

□ 2001. "Withdrawing Money from Your Retirement Portfolio Without Going Broke." *CCH Journal of Retirement Planning*, vol. 4, no. 4:35-41, 48.

□ 2003. "Does International Diversification Increase the Sustainable Withdrawal Rates from Retirement Portfolios?" *Journal of Financial Planning*, vol. 16, no. 1 (January):74-80.

□ 2003b. "A Comparative Analysis of Retirement Portfolio Success Rates: Simulation versus Overlapping Periods." *Financial Services Review*, vol. 12, no. 2 (Summer):115-29.

Dus, I., Maurer, R. and Mitchell, O.S. 2004. "Betting on Death and Capital

Markets in Retirement: A Shortfall Risk Analysis of Life Annuities versus Phased Withdrawal Plans." Proceedings of the 14th Annual AFIR Colloquium 1: 65-96.

Gerrard, R., Haberman, S. and Vigna, E. 2004. "Optimal Investment Choices Post-Retirement in a Defined Contribution Pension Scheme." *Insurance: Mathematics and Economics* 35(2): 321-42

Ibbotson Associates (2008). *"Stock, bonds, bills and inflation yearbook."* Ibbotson Associates, Chicago, IL.

Kotlikoff, Laurence J. and Burns, Scott. 2008. *Spend 'til the End: The Revolutionary Guide to Raising Your Living Standard - Today and When You Retire',* Simon & Schuster

Milevsky, Moshe A. and Abaimova, Anna. 2006b. "Will The True Monte Carlo Number Please Stand Up" Journal of Financial Planning. July 2006

Mitchell, Olivia S., Poterba, James M. , Warshawsky, Mark J. and Brown, Jeffrey R. 1999. "New Evidence on the Money's Worth of Individual Annuities" *American Economic Review*, vol. 89, no. 5 (December):1299-1318.

Mitchell, Olivia S., McCarthy, David. 2002. Annuities for an Ageing World. Working Paper 9092.http://www.nber.org/papers/w9092

Scott, Jason, Sharpe, William, Watson, John G "The 4% Rule-At What Price" .2009. Journal Of Investment Management (JOIM), Third Quarter 2009

Spiegelman, Rande. 2006. "Retirement Spending: The 4% Solution." Schwab Investing Insights®, Available at: http://www.schwab.com/public/schwab/research_strategies/market_insight/retirement_strategies/planning/retirement_spending_the_4_solution.html

Spitzer, John J., Strieter, Jeffrey C. and Singh, Sandeep. 2007. "Guidelines for Withdrawal Rates and Portfolio Safety During Retirement." *Journal of Financial Planning,* vol. 20, no. 10 (October): xx-xx.

T Rowe Price. 2008a. "Investment Guidance & Tools: Retirement Planning: Living in Retirement: A withdrawal rule of thumb." http://www.troweprice.com/commom/index3/0,3011,1np%253D10014%2526cg%253D1210%2526pgid%253D7549,00.html (accessed February 26, 2008).

□ 2008b. “Investment Guidance & Tools: Retirement Planning: Retirement Income Calculator.” http://www.3.troweprice.com/ric/RIC/

Updegrave, Walter. (2007). “Retirement: The 4 Percent Solution.” *CNN/Money.com* http://money.cnn.com/2007/08/13/pf/expert/expert.moneymag/index.htm

VanDerhei, Jack . 2006. “Measuring Retirement Income Adequacy: Calculating Realistic Income Replacement Rates”. EBRI Issue Brief. September 2006

Vanguard. 2008. “Planning & Education: Retirement: Managing Your Retirement: Tap Your Assets: Determine how much you can withdraw.” https://personal.vanguard.com/us/planningeducation/retirement/PEdretTapDetermineWDContent.jsp