

Stocks, Bonds, Bills and Long-Run Returns for Retirement Portfolios

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A USA Today article, “Investors Look Back on a Decade of Grim Stock Returns,” summed up returns for the first decade of the 21st century—grim. This paper shows the wealth relative, or future value interest factor, for this decade was worse than for the depression years. The other periods of this study are positive. These unpleasant results were nothing that most investors didn’t already ‘feel’. The purpose of this study is to examine various retirement horizons to see how they fared since 1926 with the ups and downs of the stock market.

LITERATURE REVIEW, METHODOLOGY AND DATA

Past studies have looked at this very question. Levy (1978), Reichenstein (1986), and Butler (1991) used a single sum, not periodic contributions for various holding periods. They concluded that stocks outperform Treasury bills. Butler & Domian (1992) used Ibbotson’s real returns and sampling with replacement, to form returns for various retirement holding periods from 1926 to 1990. They conclude that the stock market is the better choice for long-term retirement investing. A paper by Hickman, Hunter, Byrd, Beck, & Terpening, (2001) uses a sample with replacement technique to examine the difference in returns between different retirement asset classes for the period. Unlike Butler and Dominan’s work their data isn’t inflation adjusted. They find big penalties for not being in risky assets (common stocks) for long-term investment horizons. They do find marginal support for several switching strategies for investors with shorter investment horizons.

Decade-long wealth relatives (decade-ending price level/ decade-beginning price level) were calculated for all decades, starting in 1930 (1930-1939) through 2010 (2000-2010), and for 1926 to 1929 and 2010-2013. Wealth relatives for the period 1926-1929, 2010-2013, and 1926-2013 are calculated. The purpose of these calculations was to estimate one time, or single sum, investments.

Besides single-sum wealth relatives, we calculated future value interest factors for investors who make payments into a retirement plan yearly. One of the additions that differentiate this paper from Butler & Domian (1992) is adjusting the invested amount by the prior year’s rate of inflation. This adjustment serves as a cost of living adjustment for one’s salary. The investor is assumed to be a wage earner that contributes a fixed proportion of salary, indexed for the prior year’s inflation, each year over a retirement savings period. The Ibbotson Inflation Index serves as the retirement plan contribution inflator. The plan contributions are invested in one of four portfolios. Returns for the four portfolios are based on: the Ibbotson Large Company Total Returns portfolio, the Ibbotson T-bill Total Returns portfolio, the Ibbotson T-bond Total Returns portfolio, and the Ibbotson Large Company Total Returns with a switch to the Ibbotson T-bill Total Returns portfolio at the beginning of the fifth year, five years before retirement.

These data come from the 2014 Ibbotson SBBI Classic Yearbook. The purpose of the switching portfolio is to examine the merit of shifting from risky to safe assets as one approaches retirement.

For the five year savings period the calculation would be:

$$\begin{aligned}
 & \$1.00_{-5}(R_{-5t0-4})(R_{-4t0-3})(R_{-3t0-2})(R_{-2t0-1})(R_{-1t00}) \\
 & + \$1.00_{-5}(I_{-5t0-4})(R_{-4t0-3})(R_{-3t0-2})(R_{-2t0-1})(R_{-1t00}) \\
 & + \$1.00_{-5}(I_{-5t0-4})(I_{-4t0-3})(R_{-3t0-2})(R_{-2t0-1})(R_{-1t00}) \\
 & + \$1.00_{-5}(I_{-5t0-4})(I_{-4t0-3})(I_{-3t0-2})(R_{-2t0-1})(R_{-1t00}) \\
 & + \$1.00_{-5}(I_{-5t0-4})(I_{-4t0-3})(I_{-3t0-2})(I_{-2t0-1})(R_{-1t00})
 \end{aligned}$$

Where R is $1+r$, and I is $1+i$. r is the return for the year in question, and i is the inflation rate from the prior year. The subscripts for R and I represent the period relative to the end of the holding period. The future value ‘Due’ situation is assumed—investing starts at the beginning of the period, and no cash-flow at the end of the holding period. Since one dollar is the initial annual contribution, results will be for every dollar invested. This same logic is applied to every time horizon in this study.

Savings and investment periods of 5, 10, 15, 20, 25, 30, 35 and 40 years were examined starting in 1926 and all subsequent years through the beginning of 2009. The year 2009 is the last year one could start a five holding period, given these data. These results are realized, not simulated, returns. Furthermore, since every holding period overlaps, the summary statistics will be biased. This bias isn’t considered a problem. The purpose of this study is to determine how a typical pensioner would have fared investing for retirement starting every year, from 1926 to 2009, assuming various holding periods, with a salary adjustment based on inflation.

One last examination of the data is a simple test of Stochastic (state-by-state) dominance for each investment strategy in every holding period.

RESULTS

Table 1 reports annual returns for Large-Company Stocks Total Returns by decade for the study period 1926 through 2013. The first row of data is the wealth relatives for the period in question. These statistics show that the first decade of the 21st century was the worst decade for investing, even surpassing the decade of the great worldwide depression. This result may surprise some. Many articles, using the Dow Jones Industrial average, have appeared stating that it took decades to recover from Black Tuesday in 1929. This study uses total returns, which include reinvested dividends. In any given year, dividends can account for 30% of the total return. This fact affects the holding period returns for the various retirement-saving horizons starting in the 1960s, a fact that has implications for many who read this.

TABLE 1
SUMMARY STATISTICS FOR YEARLY RETURNS BY DECADE
WEALTH RELATIVES ARE THE PRODUCT OF YEARLY $I+r$

	2009-2000	1999-1990	1989-1980	1979-1970	1969-1960	1959-1950	1949-1940	1939-1930	1929-1926	2013-1926	2013-2010
WR	0.909	5.328	5.039	1.768	2.121	5.866	2.405	0.995	2.018	4676.4	1.804
Mean	0.012	0.190	0.182	0.075	0.087	0.208	0.103	0.053	0.211	0.118	0.086
Stdev	0.211	0.142	0.127	0.192	0.144	0.198	0.165	0.347	0.241	0.202	0.092
Range	0.657	0.407	0.374	0.637	0.370	0.634	0.480	0.973	0.520	0.973	0.129
Min	-0.370	-0.031	-0.049	-0.265	-0.101	-0.108	-0.116	-0.433	-0.084	-0.433	0.021
Max	0.287	0.376	0.325	0.372	0.269	0.526	0.364	0.540	0.436	0.540	0.151
% + ret	60%	90%	90%	70%	70%	80%	70%	40%	75%	73%	100%

Tables 2A-2D report summary statistics for retirement period wealth-relatives for the four portfolios and various retirement saving periods. Table 2A reports the results for the Ibbotson Large Company portfolios. For these returns; there are no holding period horizons where you ‘lose it all.’ However for the 10-year horizon holding periods, for the years starting in 1999, one would have been better off not investing the inflation-adjusted contributions. For the five-year horizons, one would have been fared better being out of the market in the years 1927-1930, 1936, 1937, 1970, 1998, and 2004. The poor performance in the 1920s through the 1930s was due to deflation and negative stock returns. Deflation occurred in 1926-1928, 1930-1932, and in 1938-1939. The poor performance in the decade from 2000-2009 is from returns that were worse than exhibited in the late 1920s and throughout the 1930s. Inflation (CPI-U from Ibbotson) for the first decade of the second millennium was below the long-term average. Of course, the pay reduction was much worse than inflation would indicate during the depression, as well as the period after 2008, for those who became unemployed.

TABLE 2A
SUMMARY STATISTICS FOR SAVINGS PERIODS’ WEALTH RELATIVES FROM 1923-2013

Retirement Saving Periods								
	40	35	30	25	20	15	10	5
Mean	2681.43	1345.45	677.28	327.46	147.63	62.50	24.60	7.77
Stdev	916.11	520.89	316.02	170.73	73.02	28.79	9.00	2.13
Range	4282.64	2400.78	1475.88	783.17	275.35	105.65	31.47	9.60
Min	1265.51	731.32	295.00	118.93	49.01	15.68	9.67	2.33
Max	5548.15	3132.11	1770.88	902.10	324.36	121.33	41.13	11.93
Count	49	54	59	64	69	74	79	84

These relatives are for lagged inflation and Ibbotson large company total returns.

Table 2B reports results for the Ibbotson Treasury Bill Total Returns portfolios. At the 15-year horizon, you do have years where you would have ended with less than if you had taken your contributions and put them into a safety deposit box. This happened in the holding periods that started in 1926 and 1927. For ten-year horizons, this occurs in the years from 1926 through 1931. For the five-year horizon, for the years 1928 through 1932. It is clear that you sacrifice the potential for much larger gains in your retirement account, and you don’t remove the downside risk. In fact, the number of times you wind up with less than if you had done nothing is greater, thirteen versus ten times for Large-Company portfolios.

TABLE 2B
SUMMARY STATISTICS FOR SAVINGS PERIODS’ WEALTH RELATIVES FROM 1926-2013

Retirement Saving Periods								
	40	35	30	25	20	15	10	5
Mean	465.49	286.89	171.99	100.84	57.50	31.35	15.74	6.21
Stdev	234.83	162.54	103.72	59.92	30.91	13.78	4.89	1.07
Range	667.07	458.18	301.93	173.96	99.02	50.34	20.88	5.63
Min	95.64	72.59	53.66	39.61	24.41	14.38	8.96	4.13
Max	762.70	530.77	355.59	213.57	123.43	64.72	29.84	9.76
Count	49	54	59	64	69	74	79	84

These relatives are for lagged inflation and Ibbotson treasury bill total returns.

Table 2C reports results for the Ibbotson Treasury Bond Total Returns portfolios. There are no holding period horizons where you ‘lose it all. Furthermore, there are no holding periods where it would have been better to put your contributions into a safety deposit box.

TABLE 2C
SUMMARY STATISTICS FOR SAVINGS’ PERIOD WEALTH RELATIVES FROM 1926-2013

Retirement Saving Periods								
	40	35	30	25	20	15	10	5
Mean	192.26	133.36	90.63	60.36	39.15	24.25	13.63	5.86
Stdev	69.48	49.78	33.33	20.62	11.51	5.57	2.12	0.48
Range	194.01	137.88	93.68	58.72	33.73	17.12	7.20	1.75
Min	79.69	60.25	45.44	34.85	25.75	18.03	11.32	5.34
Max	273.70	198.13	139.12	93.56	59.48	35.15	18.52	7.09
Count	49	54	59	64	69	74	79	84

These relatives are for lagged inflation and Ibbotson T-bond total returns.

Table 2D reports results for the Ibbotson Large Stock Total Returns series with a switch to Ibbotson Treasury Bill Total Returns returns in the last five years. There are no holding period horizons where you ‘lose it all.’ However, when you get to the ten-year horizons you do wind up with less than if you had taken your contributions and put them into a safety deposit box; this occurred in the holding periods starting in 1928 and 1929. The five-year horizon is the same for Table 2B since you are in T-bills. You do sacrifice the potential for much larger gains in your retirement account, and you don’t remove the downside risk. The number of times that you would have been better off doing nothing is nine, ten and thirteen for the Switch portfolio, Large Stock Total Returns, and T-bills respectively.

TABLE 2D
SUMMARY STATISTICS FOR SAVING PERIODS’ WEALTH RELATIVES FROM 1926-2013

Retirement Savings Periods								
	40	35	30	25	20	15	10	5*
Mean	2155.24	1071.52	512.01	232.67	102.41	43.84	17.90	6.21
Stdev	598.76	364.27	207.58	91.46	38.76	14.80	5.18	1.07
Range	3026.10	1861.76	1011.69	370.44	161.36	59.22	24.53	5.63
Min	1003.56	419.06	152.95	65.29	26.25	15.93	7.16	4.13
Max	4029.66	2280.82	1164.64	435.73	187.61	75.15	31.68	9.76
Count	49	54	59	64	69	74	79	84
* Note that the last column is the same as for Table 2b								

These relatives are for lagged inflation and Ibbotson large stock total returns with a switch to Ibbotson T-bill total returns for the last five years.

Table 3 lists the Coefficients of Variation (CV) for the three portfolio types in this study. Some interesting results are present. This measure of risk indicates the Inflation/Large Stock Returns portfolio is safer than being in Inflation/T-bills portfolio until fifteen or fewer years remain until retirement. The

Inflation/T-Bond portfolio is safer than the Inflation/T-Bill portfolio for all periods. The Switch portfolios have a lower CV than all the other combinations, except for the Inflation/T-Bond portfolio.

TABLE 3
CV T-BILLS IS FOR INFLATION & T-BILL PORTFOLIOS, CV LG STK IS FOR INFLATION & LARGE STOCK SERIES, CV T-BILL IS FOR THE INFLATION AND T-BOND PORTFOLIOS AND CV SWITCH IS FOR THE INFLATION & LARGE STOCK SERIES WITH A SWITCH TO T-BILLS FOR THE LAST FIVE YEARS

Retirement Savings Periods								
	40	35	30	25	20	15	10	5
CV T-bills	0.504	0.567	0.603	0.594	0.538	0.439	0.311	0.172
CV T-bonds	0.361	0.373	0.368	0.342	0.294	0.230	0.156	0.081
CV Lg stk	0.342	0.387	0.467	0.551	0.495	0.461	0.366	0.274
CV Switch	0.278	0.340	0.405	0.393	0.378	0.338	0.289	0.172

The following figures have two panels. The left side is plots of the Wealth Relatives (FVIF). Each point represents the ending WR for the holding period starting in that year. This illustrates the combined impact of disciplined, systematic retirement savings with raises (and givebacks) based on the Ibbotson Inflation series and the market performance of the Ibbotson Large Stock Total Returns series, the Ibbotson T-Bill Total Returns series, and the Large Stock Ibbotson Total Returns series with a switch to T-Bills in the remaining five years of the holding period respectively, starting in 1926. Unfortunately for most who are reading this paper we didn't do nearly as well as those who started their careers earlier. You can *see* that the best time to retire (for all holding periods) would have been about the year 2000. The 1950's and the years during the Reagan/Clinton bull market were truly phenomenal.

The right panel for all the figures are plots of the stochastic (state-by-state) dominance tests of the four portfolios, for all holding periods, are as follows:

40, 35, 30, 25, and 20 Year Holding Periods: the Large-Stock with inflation portfolio is dominant. The switch portfolio dominates the T-Bill and T-Bond (with inflation) portfolios.

15, 10, and 5 Year Holding Periods: None of the portfolios are dominant. However, The Large-Stock with inflation portfolio performs better in most instances.

5 Year Holding Period: No portfolio dominates. Having said that, the Large-Stock with inflation.

FIGURE 1A
ENDING WEALTH RELATIVE AND STOCHASTIC (STATE-BY-STATE) DOMINANCE TEST
PLOTS 40YR HORIZONS

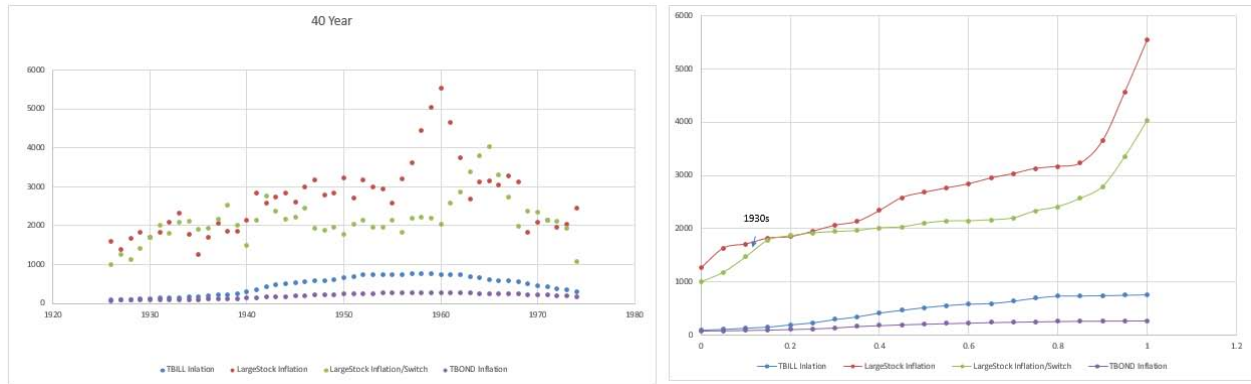


FIGURE 1B
ENDING WEALTH RELATIVE AND STOCHASTIC (STATE-BY-STATE) DOMINANCE TEST
PLOTS 35YR HORIZONS

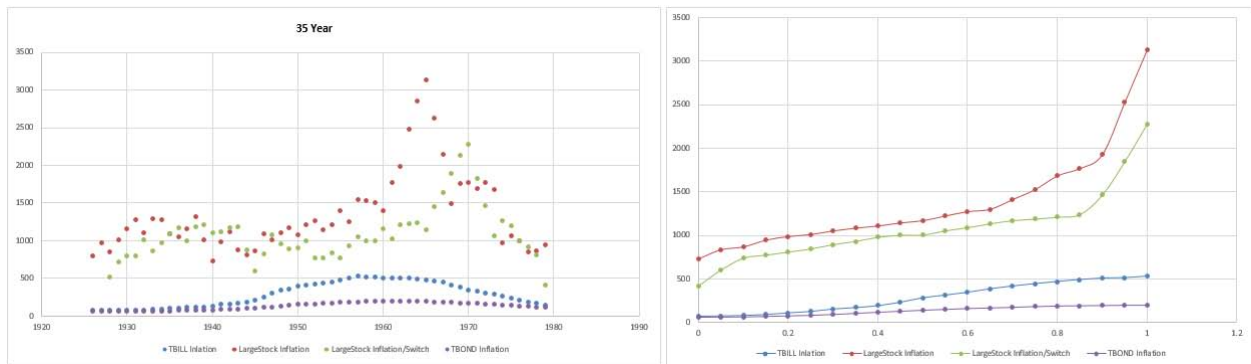


FIGURE 1C
ENDING WEALTH RELATIVE AND STOCHASTIC (STATE-BY-STATE) DOMINANCE TEST
PLOTS 30YR HORIZONS

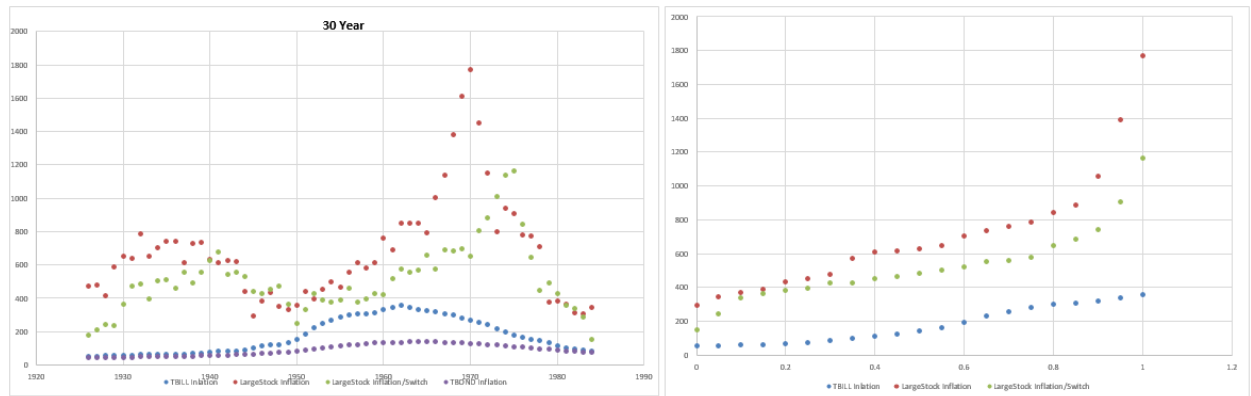


FIGURE 1D
ENDING WEALTH RELATIVE AND STOCHASTIC (STATE-BY-STATE) DOMINANCE TEST
PLOTS 25 YR HORIZONS

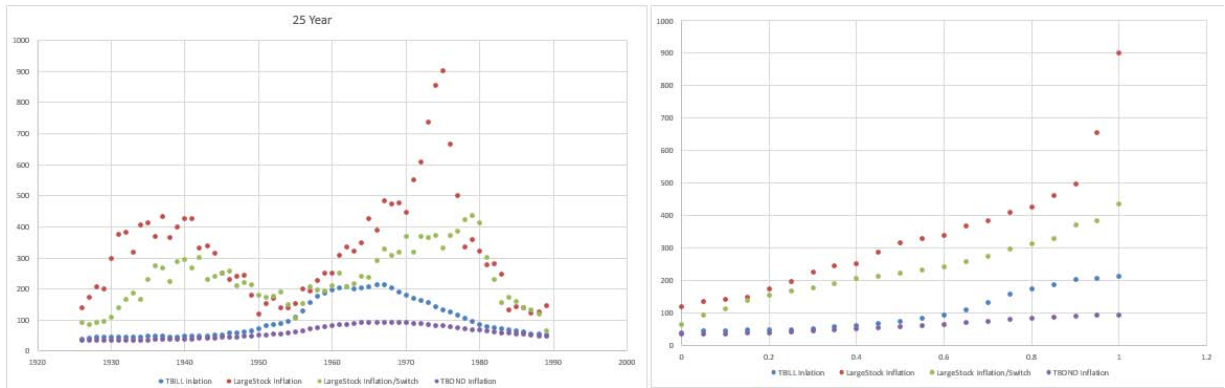


FIGURE 1E
ENDING WEALTH RELATIVE AND STOCHASTIC (STATE-BY-STATE) DOMINANCE TEST
PLOTS 20YR HORIZONS

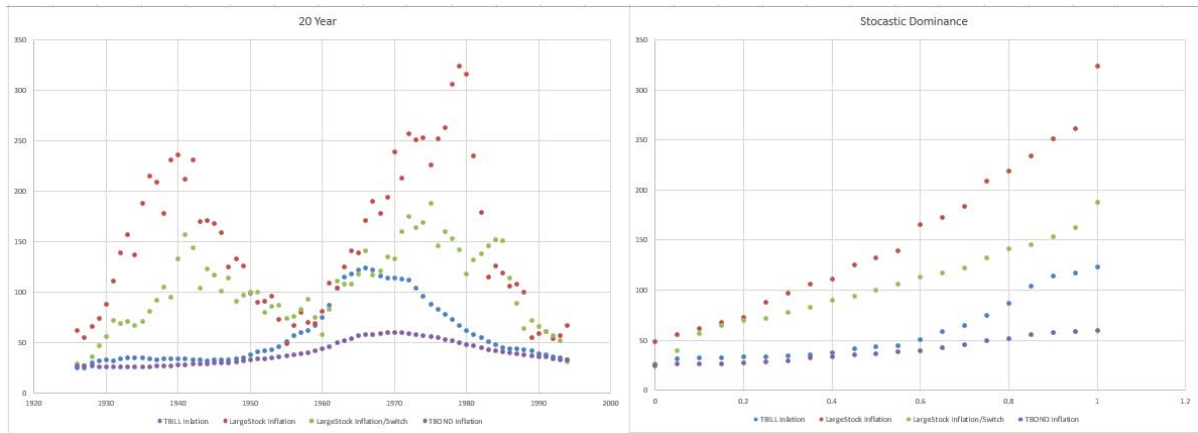


FIGURE 1F
ENDING WEALTH RELATIVE AND STOCHASTIC (STATE-BY-STATE) DOMINANCE TEST
PLOTS 15YR HORIZONS

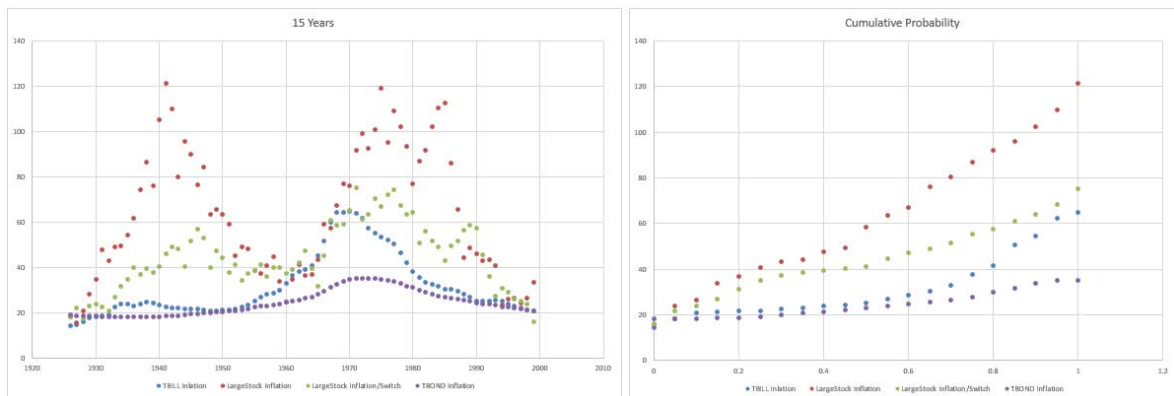


FIGURE 1G
ENDING WEALTH RELATIVE AND STOCHASTIC (STATE-BY-STATE) DOMINANCE TEST
PLOTS 10YR HORIZONS

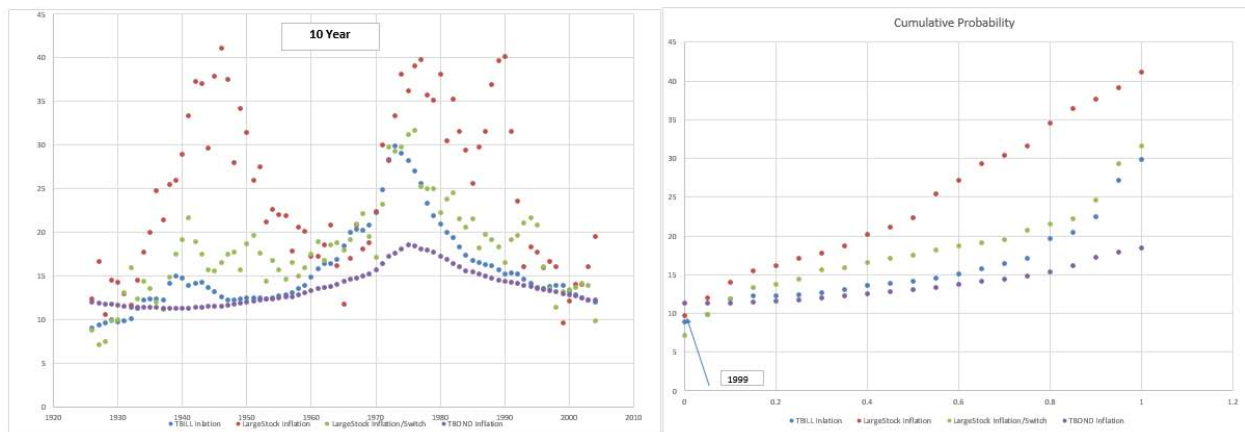
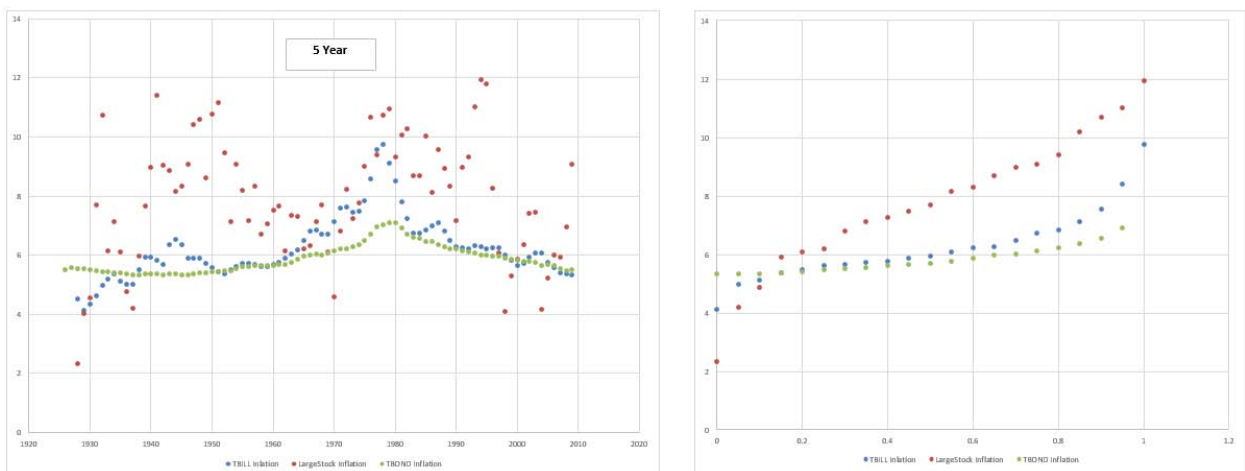


FIGURE 1H
ENDING WEALTH RELATIVE AND STOCHASTIC (STATE-BY-STATE) DOMINANCE TEST
PLOTS 5YR HORIZONS



SUMMARY

Table 1 showed that the decades of 1930 and 2000 were the worst decades for the period of this study. Table 1 also shows the decades starting in 1950, 1980 and 1990 were the best for the period of this study. For many readers of this paper, we have had the two best and worst decades for our retirement accounts. Tables 2A and B, and the figures suggest that for normal retirement saving horizons (15 years or more) one would have done fine. Even with the first decade of the second millennium, nothing suggests that we shouldn't save for retirement. Tables 2A, 2B, 2C, 2D, and 3 suggest that there is little merit for shifting all or some of your portfolios out of the higher-risk asset into a less risky asset—the Large Stock portfolio is better for most periods since 1926—there is hardly anything to be gained and much to be lost by being invested in something other than the stock market (using the Ibbotson Large Stock Total Returns series). These results are consistent with works cited in this paper. While many financial planners recommend that you should subtract your age from 100 (some recommend an age of

110 or 120) to determine the mix of stocks vs. bonds, some famous economist disagree. Paul Samuelson (69) concluded that switching to income producing portfolios as you get older doesn't hold. Recently, Eugene Fama stated in an interview with Barron's (22 September 2014): "I have a capitalization-weighted portfolio of all traded stocks. I don't fool around with bonds. I'm a tenured professor; the university issued me a bond." While most investors aren't tenured university professors, if they have a secure job and a defined-contribution plan, they are in a similar situation.

One surprising fact, shown by Table 3 and the figures (above), is the Inflation/T-Bill portfolio had more return than the Inflation/T-Bond portfolio.

Some have suggested that the period of this study is too long, and data before WWII aren't representative of today's world. I disagree with that assessment. The data from 1926-1950 are eerily similar throughout the time series starting 1996. The world's economy has had two run-ups in the stock market beginning in the mid-1990s, followed by two collapses; several periods of disinflation; and according to Pope Francis a piecemeal WWII. A quote attributed to Mark Twain is still true today, "History doesn't repeat itself, but it does rhyme."

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