

# Long-Run Returns for Retirement Portfolios Using Different Ibbotson Portfolios'

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## Introduction:

A USA Today article entitled “Investors Look Back on a Decade of *Grim* Stock Returns” (Wagonner, 2010) summed up investment returns for the first decade of the 21<sup>st</sup> century—grim. Our research shows the wealth relative for the Ibbotson Large Company Total Returns (LCSTR) was 0.909 for the period 2000-2009. This was worse than the depression decade (1930-1939) with a wealth relative of 0.995. All other decades for the period of this study (1926-2011) had a positive return, a wealth relative greater than one. These grim results were nothing that most investors didn't already ‘feel’. Certainly it was cause for numerous conversations amongst faculty at our university and I am confident at other universities as well. Another interesting question for us, with a retirement horizon of 5 to 10 years, is how this last decade affected retirement accounts and how these returns compare with prior decades. The purpose of this study will attempt to answer this question.

## Literature Review, Methodology and Data:

The fundamental tenets of traditional retirement planning include disciplined and systematic savings over one's working years and the deployment of those savings into investment vehicles that will expectedly grow with the underlying economy. In practice, retirement savers are often advised to emphasize domestic equities as a cornerstone of their investment portfolios. While it is a simple matter to observe historical returns on bullet investments held over any finite period, the relative returns accruing to a systematic savings and investment plan are less transparent. In this paper we examine the recent and longer-term performance histories of systematic savings and investment strategies that employ a broadly-based United States equities index.

Past studies have looked at this very question. (Levy, 1978), (Reichenstein, 1986), and (Butler K. C., 1991), used a single sum, not periodic contributions for various holding periods. They concluded that stocks outperform Treasury bills. (Butler & Domian, 1993) use 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 clever 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 huge penalties for not being in risky assets (common stocks) for long 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

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& 2011. Wealth relatives for the period 1926-1929; for 2010 & 2012; and the 1926 through 2011 were also calculated. The purpose of these calculations was to estimate bullet investments.

Besides single sum wealth relatives we calculated wealth relatives for investors who make payments into a retirement plan yearly. Our hypothetical investor is assumed to be a wage earner who contributes a fixed proportion of salary, which is 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 then invested in an equities market index fund with the Ibbotson Large Company Total Returns (LCSTR) serving as the investment proxy. For a 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 time 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. One of the assumptions that differentiate this project from (Butler & Domian, 1993) is that the inflation adjustment for the invested amount is the prior year's inflation. The reasoning is that pay increases are based on a cost of living adjustment using prior year's inflation.

If \$1.00 is the initial annual contribution, this yearly installment will be indexed up or down as price levels change. The indexed installment will be invested at the then current equity market level and the resultant portfolio value will subsequently reflect both market performance and the saver's wage level assuming the wages are indexed to inflation (with a lag of one year). Savings and investment periods of 5, 10, 15, 20, 25, 30, 35 and 40 years are evaluated for participants who start saving in 1926 and all following years. \$1.00 was used so that results will be for every dollar invested.

These results based on actual, not simulated, returns. The holding periods are started for EVERY year between 1926 through 2011. So every holding period overlaps the one next to it. For example, the 1926 forty year holding period overlaps the 1927 forty year holding period by 39 years. Likewise the 1928 forty year holding period overlaps the 1927 and forty year holding period by 39 years, etc. We recognize the fact that summary statistics will be biased, but we were interested in how a pensioner would have fared investing for retirement, assuming various holding periods and a salary contribution adjustment based on inflation. Thus the results will show this for all various holding periods beginning in 1926.

The data used are from the 2013 Ibbotson SBBI Classic Yearbook. The data are yearly Large Company Stocks Total Returns (LCSTR), Small Company Stocks Total Returns (SCSTR), U.S. Treasury Bills Total Returns (TbTR), and Inflation (I). We also looked at a switching portfolio where the stock portfolio was shifted to T-bills 5 years before retirement. The purpose for this portfolio is to examine if there is merit in shifting from risky to safe assets as one approaches retirement.

There were three investment strategies for each holding period, being long the large company stocks (or small company stocks), being long T-bills, and being long the large company stocks (or small company stocks) with a switch to T-bills for the final five year period before retirement.

Results reported at this point are only for yearly Large Company Stocks Total Returns (LCSTR), (SCSTR), U.S. Treasury Bills Total Returns (TbTR), and Inflation (I) through 2011:

Table 1 report annual returns for Large Company Stocks Total Returns by decade for the study period 1926 through 2011. The first row of data is the wealth relatives for the period in question. These statistics show that the first decade of the 21<sup>st</sup> century was the worst decade for investing, even surpassing the decade of the great worldwide depression. This fact will affect the holding period returns for the various retirement saving horizons starting in the 1960's. There are some other periods throughout the years of this study that have negatively affect retirement results.

Table 1

Summary Statistics for yearly returns by decade unless otherwise specified											
Wealth Relatives are the product of yearly $1+r$											
	2011- 2010	2009- 2000	1999- 1990	1989- 1980	1979- 1970	1969- 1960	1959- 1950	1949- 1940	1939- 1930	1929- 1926	2011- 1926
WR	1.174899	0.908832	5.32817	5.039133	1.768424	2.120725	5.865618	2.404711	0.994798	2.018359	3045.081
Mean	0.085859	0.01212	0.18991	0.18191	0.07517	0.08684	0.20839	0.10299	0.05339	0.21075	0.117697
Standard I	0.064741	0.066763	0.044779	0.040098	0.060836	0.045493	0.062588	0.052205	0.109626	0.120299	0.021888
Median	0.085859	0.052	0.22	0.2011	0.10435	0.11755	0.21195	0.1225	-0.00925	0.24555	0.13375
Standard I	0.091557	0.211122	0.141605	0.126801	0.19238	0.143861	0.197921	0.165085	0.346668	0.240599	0.202979
Sample Va	0.008383	0.044572	0.020052	0.016079	0.03701	0.020696	0.039173	0.027253	0.120179	0.057888	0.041201
Kurtosis	#DIV/0!	-0.49625	-1.37114	-0.60142	-0.33877	-1.71313	-0.67103	-1.2348	-1.45812	-2.60464	-0.0263
Skewness	#DIV/0!	-0.45548	-0.32386	-0.55974	-0.38196	-0.21122	0.00774	-0.02651	0.065745	-0.50918	-0.36777
Range	0.129482	0.6568	0.4068	0.3742	0.637	0.3695	0.634	0.4803	0.9733	0.5203	0.9733
Minimum	0.021118	-0.37	-0.031	-0.0492	-0.2647	-0.1006	-0.1078	-0.1159	-0.4334	-0.0842	-0.4334
Maximum	0.1506	0.2868	0.3758	0.325	0.3723	0.2689	0.5262	0.3644	0.5399	0.4361	0.5399
Sum	0.171718	0.1212	1.8991	1.8191	0.7517	0.8684	2.0839	1.0299	0.5339	0.843	10.12192
Count	2	10	10	10	10	10	10	10	10	4	86
%pos	100%	60%	90%	90%	70%	70%	80%	70%	40%	75%	72%

\*The wealth relative is not a monthly calculation but simply the decade closing price divided by the decade opening price. The data in the rest of the table are summary statistics for monthly returns.

Table 2a gives the summary statistics of retirement period wealth relatives generated by increasing each year's nominal contribution rate by the Inflation series in Ibbotson (lagged one year) and investing in the 'market' as defined by the Large Company Stocks Total Returns series from Ibbotson. There are no holding period horizons where you 'lose it all.' However when you get to the 10 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 period starting in 1999. The same is true for the 5 year horizons. The years where this happens are 1927-1930, 1936, 1937, 1970, 1998, and 2004. At first glance this seems odd given that the decade from 2000-2009 had worse returns than the 1930s but the fact that deflation occurred from 1926-1928, 1930-1932, and in 1938-1939 biased the results down. Of course the pay reduction was much worse than inflation would indicate during the depression.

Table 2a								
Summary Statistics for various Retirement Saving Period Wealth Relatives from 1926-2011								
These relatives are for lagged inflation and returns on Ibbotson Large Company Total Returns								
	Retirement Savings Periods							
	40	35	30	25	20	15	10	5
Mean	2699.76	1362.24	689.60	333.50	150.19	63.41	24.78	7.77
Standard Error	135.71	72.61	41.65	21.58	8.86	3.38	1.03	0.24
Median	2720.28	1193.10	630.09	319.69	136.62	59.10	22.60	7.70
Standard Deviation	930.36	523.58	314.42	169.91	72.54	28.66	9.05	2.15
Sample Variance	865572	274137	98860	28869	5262	821	82	5
Kurtosis	1.36	2.78	2.75	2.21	-0.64	-1.08	-1.24	-0.30
Skewness	1.03	1.67	1.53	1.31	0.53	0.27	0.21	-0.24
Range	4282.64	2400.78	1475.88	783.17	275.35	105.65	31.47	9.60
Minimum	1265.51	731.32	295.00	118.93	49.01	15.68	9.67	2.33
Maximum	5548.15	3132.11	1770.88	902.10	324.36	121.33	41.13	11.93
Sum	126888.58	70836.64	39307.33	20677.01	10062.96	4565.39	1908.11	636.77
Count	47	52	57	62	67	72	77	82

Table 2b gives the summary statistics of retirement period wealth relatives generated by increasing each year’s nominal contribution rate by the Inflation series in Ibbotson (lagged one year) and investing in the ‘market’ as defined by the T-Bill Total Returns series from Ibbotson. There are no holding period horizons where you ‘lose it all.’ However when you get to the 15 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 period starting in 1927 and 1928. For 10 year horizons this occurs from 1926 through 1931. For the 5 year horizon this occurred in 1928 through 1932. You do 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 larger, thirteen vs. ten times.

Table 2b								
Summary Statistics for various Retirement Saving Period Wealth Relatives from 1926-2011								
These relatives are for lagged inflation and returns on Ibbotson T-bill Total Returns								
	Retirement Savings Periods							
	40	35	30	25	20	15	10	5
Mean	471.55776	291.71005	175.0287	102.3842	58.20879	31.64265	15.83139	6.229341
Standard Error	34.704792	22.707499	13.805569	7.652337	3.797949	1.633384	0.560129	0.118216
Median	540.4539	299.47102	145.45735	76.70472	43.51307	25.25158	14.14594	5.964701
Standard Deviation	237.92407	163.7461	104.22976	60.25456	31.08755	13.85972	4.91511	1.070492
Sample Variance	56608	26813	10864	3631	966	192	24	1
Kurtosis	-1.4266497	-1.5653228	-1.4575035	-1.113206	-0.524771	0.227131	1.067737	1.949411
Skewness	-0.331986	0.0338322	0.3701168	0.68351	0.969802	1.16826	1.253235	1.138879
Range	667.06776	458.18317	301.92932	173.9563	99.02459	50.33801	20.88363	5.630518
Minimum	95.637099	72.590108	53.66455	39.61309	24.40659	14.38156	8.961274	4.133957
Maximum	762.70486	530.77328	355.59387	213.5694	123.4312	64.71957	29.8449	9.764475
Sum	22163.215	15168.922	9976.6358	6347.821	3899.989	2278.271	1219.017	510.806
Count	47	52	57	62	67	72	77	82

Table 2c gives the summary statistics of retirement period wealth relatives generated by increasing each year’s nominal contribution rate by the Inflation series in Ibbotson (lagged one year) and investing in the ‘market’ as defined by the Large Stock Total Returns series from Ibbotson with a switch to T-bill returns in the last five years. There are no holding period horizons where you ‘lose it all.’ However when you get to the 10 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 period starting in 1926-1929. The 5 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, it is better than being in T-bills. 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.

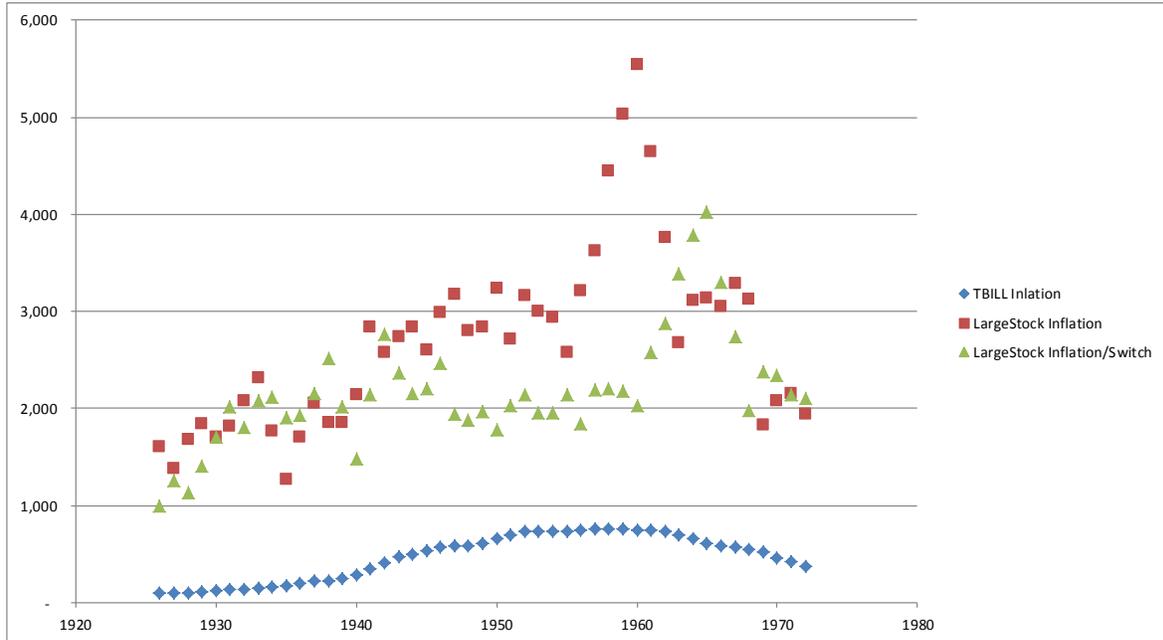
Table 2c								
Summary Statistics for various Retirement Saving Period Wealth Relatives from 1926-2011								
These relatives are for lagged inflation and returns on Ibbotson Large Stock Total Returns								
with a switch to T-bills for the last five years								
	Retirement Savings Periods							
	40	35	30	25	20	15	10	5
Mean	2183.083	1089.038	522.2586	237.2099	104.2341	44.50398	18.05836	n/a
Standard Dev	85.922	49.59973	26.92278	11.32088	4.616696	1.699629	0.585739	n/a
Median	2117.097	1013.388	486.3332	227.081	100.3965	41.71002	17.56213	n/a
Standard Error	589.0515	357.6687	203.2626	89.1407	37.78929	14.42183	5.139842	n/a
Sample Variance	346981.7	127926.9	41315.67	7946.065	1428.03	207.9891	26.41798	n/a
Kurtosis	2.367762	2.795044	2.201309	-0.55787	-0.6882	-0.61896	0.650719	n/a
Skewness	1.072517	1.452245	1.245516	0.355817	0.103345	0.191673	0.517599	n/a
Range	3026.1	1766.275	988.4503	350.1397	161.363	57.9932	24.52677	n/a
Minimum	1003.563	514.5427	176.1894	85.59046	26.25012	17.1591	7.156015	n/a
Maximum	4029.663	2280.818	1164.64	435.7302	187.6132	75.1523	31.68278	n/a
Sum	102604.9	56630	29768.74	14707.02	6983.684	3204.287	1390.494	n/a
Count	47	52	57	62	67	72	77	n/a

Table 3 list the Coefficients of Variation (CV) for the three portfolio types in this study. The Coefficient of Variation is defined as the standard deviation divided by the mean. Some interesting results present themselves here. Using the CV as our measure of risk the Inflation/Large Stock Returns portfolio is safer than being in Inflation/T-bills until you get to the fifteen or less retirement horizon. The Switch portfolios have a lower CV than all of the other combinations.

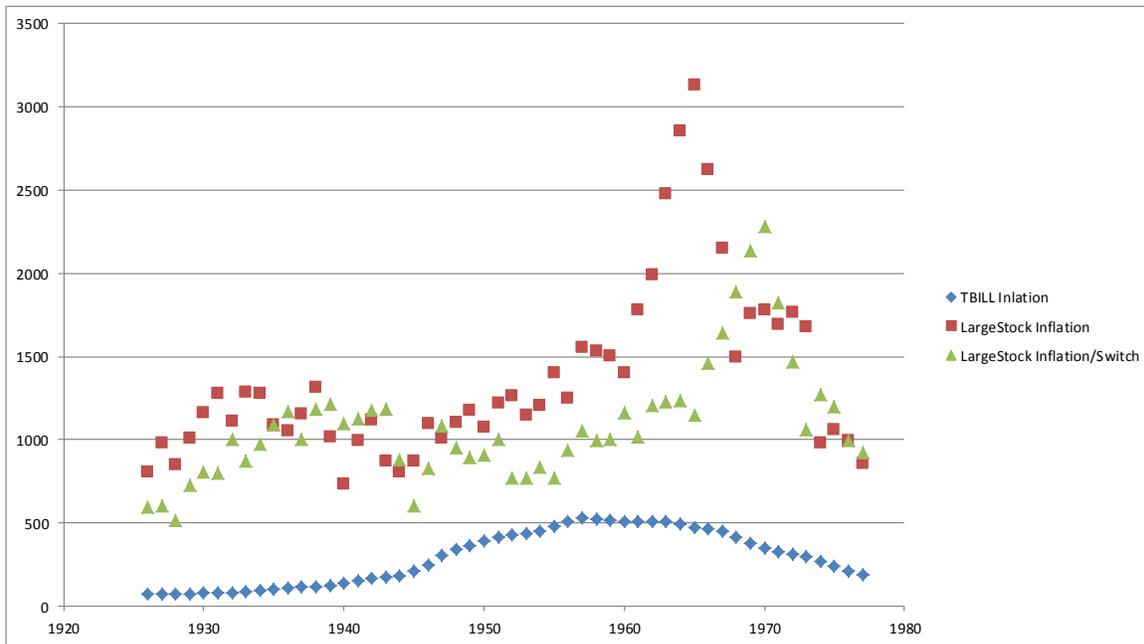
Table 3								
Coefficient of Variation (Stdev/Mean) from 1926-2011								
CV T-bills is for the inflation and T-bill portfolios, CV Lg stk is for the inflation & Large Stock series								
and CV Switch is for for the inflation & Large Stock series with a switch to T-bills for the last five years								
	Retirement Savings Periods							
	40	35	30	25	20	15	10	5
CV T-bills	0.499	0.556	0.590	0.584	0.530	0.435	0.308	0.171
CV Lg stk	0.341	0.381	0.452	0.505	0.479	0.449	0.363	0.275
CV Switch	0.267	0.325	0.386	0.373	0.360	0.322	0.283	0.171

The Wealth Relative graphs below are 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 Total Returns series, the Ibbotson Total Returns series, and the Ibbotson Total Returns series with a switch to T-Bills in the remaining five years of the holding period, and investing in a safe asset T-Bill for 8 savings horizons (e.g. 25 years) initiated at each year 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. One can *see* that the best time to retire (for all holding periods) would have been about the year 2000. The 1950's and the period during the Reagan/Clinton bull market was truly phenomenal.

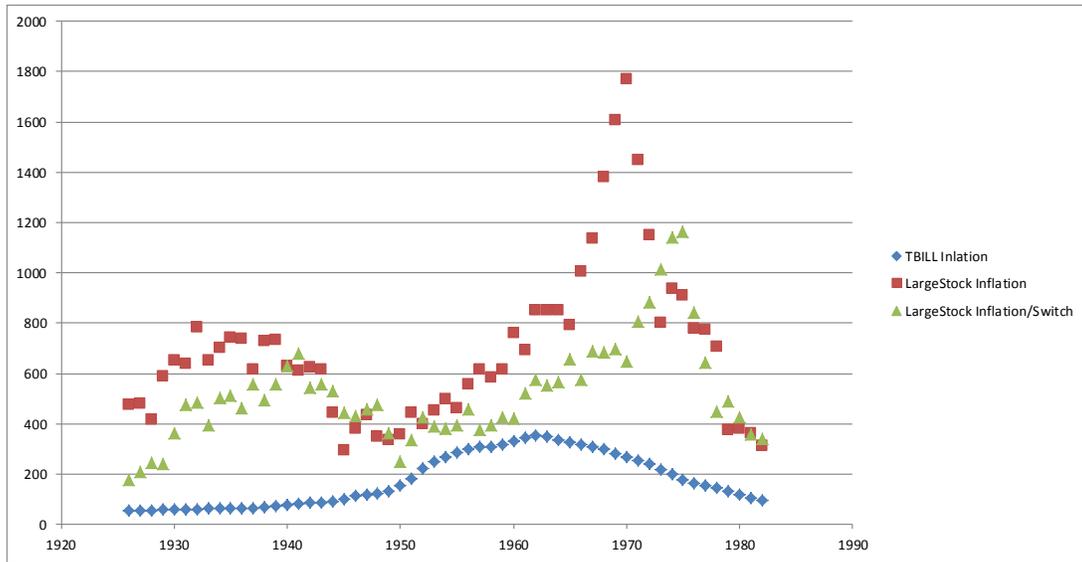
### 40 Year



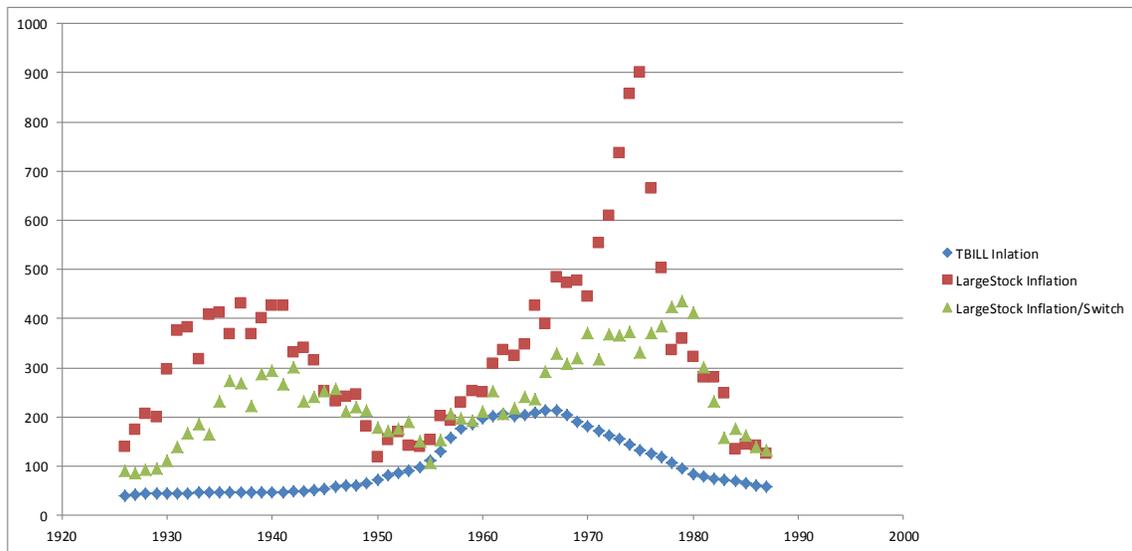
### 35 Year



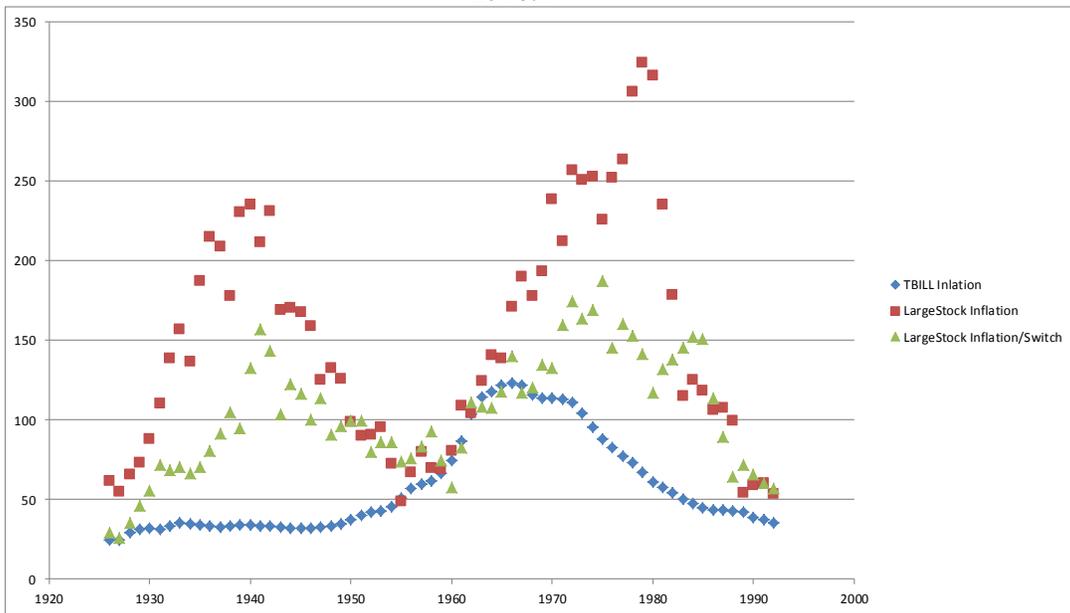
30 Year



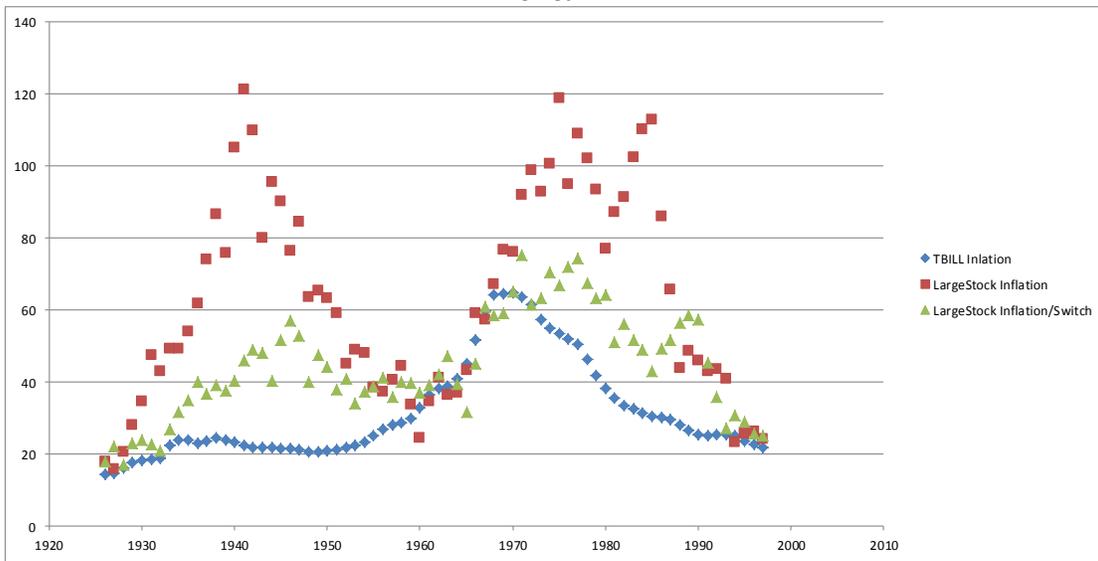
25 Year

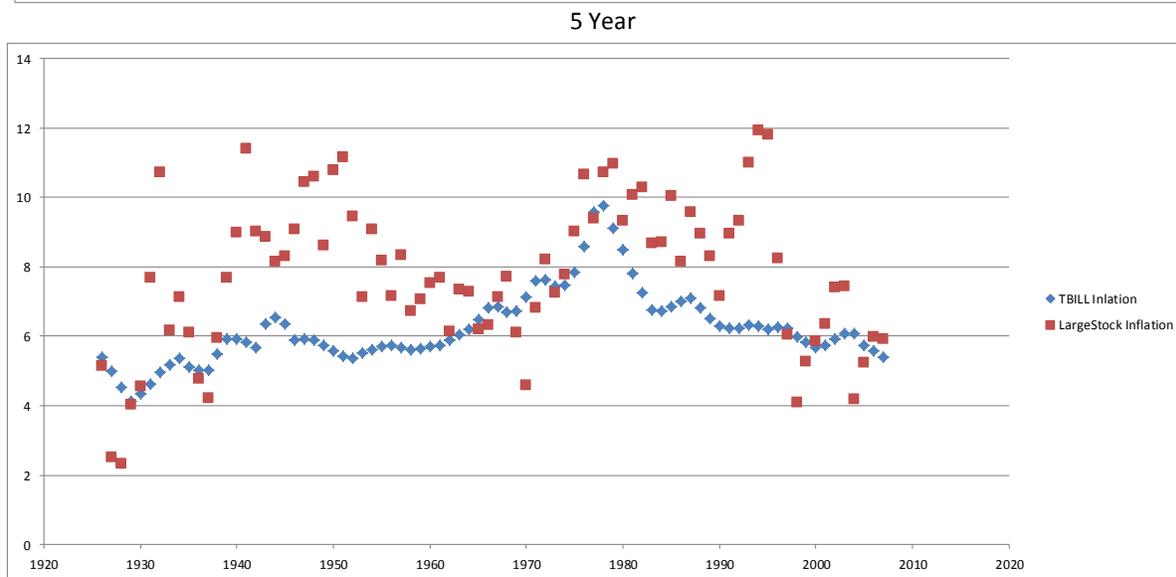
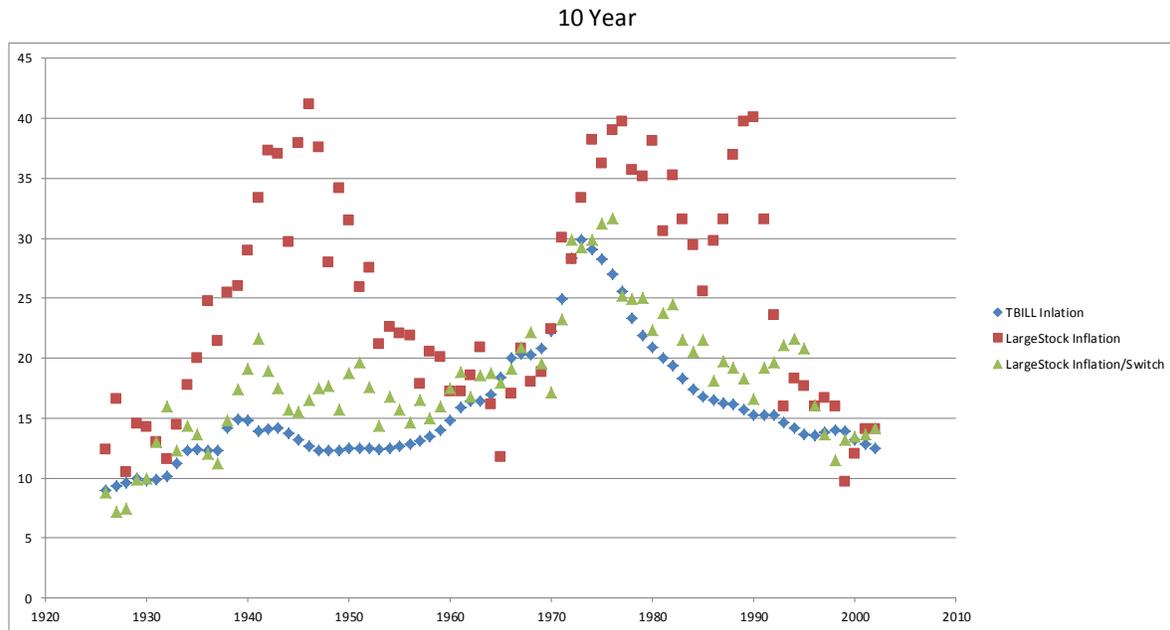


20 Year



15 Year





**Summary:**

Tables 1 shows that the decades of 1930 and 2000 were the worst decades for the time period of this study. Table 1 also shows the decades of 1950, 1980 and 1990 were the best decades for the time period of this study. For many readers of this paper we have had the two best and the worst decades for our retirement accounts. Table 2a and b, and the graphs suggest that for normal retirement saving horizons (15 years or more) one would have done fine. Even with the terrible 2000s nothing suggests that we shouldn't save for retirement-

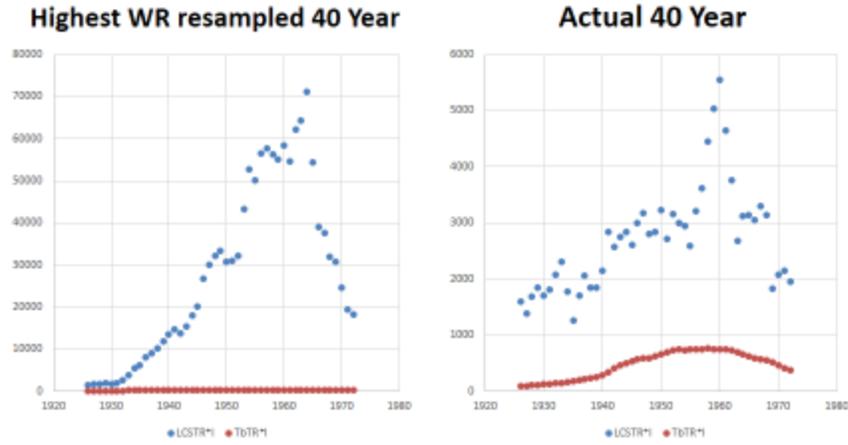
Tables 2a and 2b suggest that there may be some merit for shifting out of the risky asset into the riskless asset at five years.—Table 2c and Table 3 give additional evidence that this may be a sound tactic, but it does come at a cost of return.

The tables and the graphs indicate that for most saving horizons there is little 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). This is consistent with the works cited in this paper and an earlier version of this study that used the Dow 30.

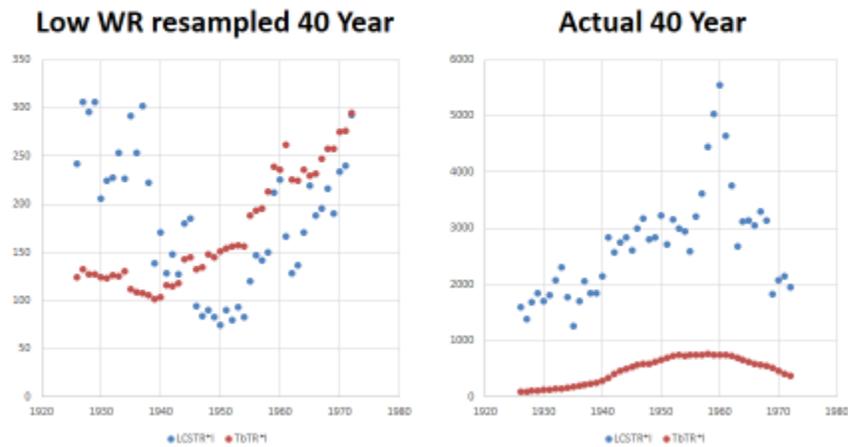
One surprising fact is that for holding periods of 20-40 years the inflation adjusted Large Stock Total Returns portfolios were the ‘safer’ than the inflation adjusted T-Bill portfolios using the coefficient of variation as a measure for risk. And in all cases the inflation adjusted Switch portfolio was the safest.

What follows are the EARLY results from our simulation using re-sampling.

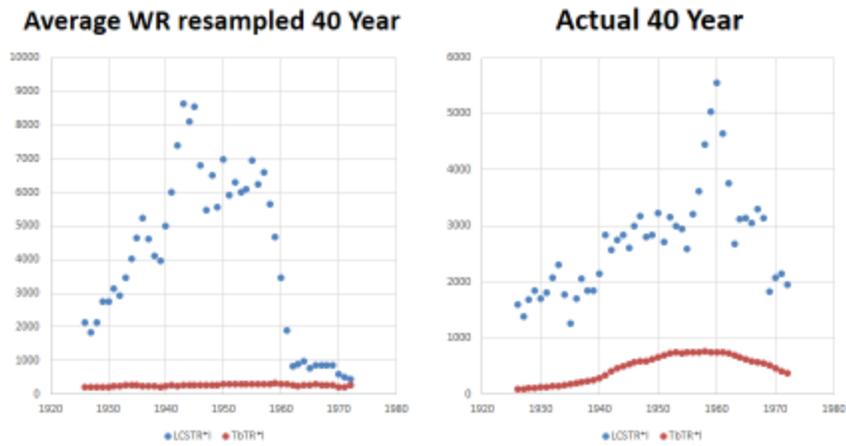
## Highest Wealth Relative



## Lowest Wealth Relative



## Average Wealth Relative



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