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STRATEGIC ASSET ALLOCATION FOR FIXED INCOME AND FIXED INCOME-LIKE SECURITIES IN ANTICIPATION OF A BEAR MARKET

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Executive Summary

This study uses mean variance optimization to estimate a set of optimal asset allocation portfolios for a mixed portfolio of fixed income and fixed income-like securities in combination with equities (as measured by the S&P 500) in anticipation of a market contraction (i.e., “bear market”). It is an empirical study for the period May 1998 - December 2015. During this period, two recessions occurred. This data is studied in comparison with periods of economic growth (i.e., “bull markets”).

Section 1: Introduction

Warren Buffett’ s first part of the quotation “Be fearful when others are greedy and greedy when others are fearful” warns people to be cautious when the market is overly inflated by nothing but people’s optimism (2004).[1] Psychology plays a large part in the market, contributing to inefficiency, market volatility, and potentially recession. Lack of transparency in the market, noise trading, and excess greed creates bubbles such as the tech bubble of 2001 and the Great Recession of 2007-2009. When such recessions happen, most investors become concerned about how to protect their investment portfolios. Considering a traditional investor whose portfolio consists of stock and bond holdings, he/she could sell some or all of their equity securities to hold all cash in their portfolio, or try to achieve a better-than-market performance by combining prudent fixed-income investments with equity securities.

In a market contraction, it is often beneficial to actively manage fixed income and fixed income-like portfolio via strategic asset allocation. Many fixed income securities tend to outperform equities during market contractions owing to their fixed payment streams, lower volatility, and higher position in capital structure. Central bank’s monetary policy typically seeks to stimulate aggregate demand during recessions by increasing the money supply, lowering interest rates, which tend to increase bond prices.

This study seeks to estimate a set of optimal asset allocation portfolios in anticipation of recessions empirically using historic inflation-adjusted data. It does so in a three-part process. First, using NBER start- and end-dates for recessions, I apply mean-variance optimization to identify three model portfolios of risky assets based upon three hypothetical investors: conservative; moderate risk taker; and aggressive. These portfolios are examined in three scenarios: strategic long-term; growth; and recession. Tests performed include correlation, variance, and covariance analysis. Second, for each scenario, I calculate optimal expected return and standard deviation for each model asset allocation. The primary tool used in this process is the Solver Add-In in Microsoft Excel. Third, I compare three scenarios (portfolio performance in strategic, recession and non-recession).

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[1] Buffett, Warren. 2004. *2004 Chairman’s Letter.* Retrieved in 4/22/2016 (http://www.berkshirehathaway.com/letters/2004.html).

This paper finds that although it is more difficult to obtain high returns in the recession period than the other scenarios, it is certainly possible to outperform not only the S&P 500 but even the Barclays Aggregate Bond Index ("Barclays") benchmark covering the entire fixed income market. Further, the study suggests that it is possible to generate positive total returns with less risk even in a recession and corresponding declining stock market.

This study contributes to the literature in three ways: First, it shows that it is possible to outperform the market and achieve positive risk-adjusted returns, even in recession period. Second, it provides a useful optimal asset allocation tool that can be employed by investors and money managers using ETFs that mimic indexes included in this study. Third, the study gives an unbiased model based on empirical studies using historic returns of market indexes. In the process, it provides a disciplined way of applying portfolio management that sweeps out emotion that typically confounds the investment process.

The rest of the paper proceeds as follows. Section 2 describes the relevant literature. Section 3 summarizes study design, sample selection, and variables. Section 4 lists results. Section 5 discusses and concludes.

Section 2: Relevant Literature

Peiling (2004) discusses the importance of asset allocation in achieving superior return.[2] He states that Standard & Poor's shows asset allocation contributes to 90% of the variability of average total returns earned by mutual funds and pension plans over time. In bear markets, fixed income becomes the asset class of choice. Portfolio managers generally seek optimal portfolios with different level of risks for different clients' needs. Several fixed income instruments exist that can be used to maximize returns and/or minimize risks.

Gignilliat (2003) discusses survival in a sluggish stock market in the U.S. with low interest rates.[3] The author emphasizes that junk bonds are considered a top-performing fixed income asset class during bear markets. He later introduces the top two junk bond funds and bid prices of the top eight active junk-bond issues.

Rowe (2016) discusses high quality fixed income instruments as a hedge against equities in a high volatility stock market.[4] He recommends investing in AA and above fixed income securities, staying away from high yield, and focusing on fundamental analysis, especially on size and balance sheet, on individual securities.

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[2] Peiling, L. (2004). Asset allocation proves its worth. *Asiamoney, 15*12-13.

[3] Gignilliat, L. (2003). How to survive a bear market: Part VI – Junk bonds. Pure Fundamentalist, 12(5), 4.

[4] Hedging Against Equities with High-Quality Fixed Income Assets. (2016). Wall Street Transcript, 1-4.

Section 3: Study Design, Sample Selection and Variable Definition:

a. Study Design

As discussed in the introduction, this study involves three steps. First, I use mean-variance optimization to identify model portfolios for three hypothetical investors **(conservative, moderate, aggressive)** in strategic long-term, growth, and recession periods. Second, I compute the portfolio expected return, standard deviation, and associated optimal asset allocation for each scenario. Third, I compare results of different hypothetical investors, and conclude by generating optimal asset allocations for recessions.

The study goes one step further by analyzing the long-term and the non-recession strategic asset allocations and compares scenario expected returns (i.e., central tendency, as measured by geometric total return), and risks (i.e., dispersion about the mean, as measured by standard deviation of total returns).

b. Sample Selection

The study selects the following indexes as the components (and the responding abbreviations included for the purpose of this study) for portfolio allocation:

1.	US Treasury 3-month T-bill Index	T-bill
2.	S&P 500 Index	SP500
3.	Barclays Municipal Bond Index	Muni AA
4.	Barclays US Agency Index	Agy
5.	Barclays US Government Long Bond Index	Govt Long
6.	Barclays US Government Intermediate Bond Index	Govt Intrm
7.	Barclays Capital US Treasury Inflation-Protected Securities Index	TIPS
8.	Barclays US Corporate High Yield Bond Index	Corp HY
9.	Barclays US Long-term Corporate Bond Index	Long Corp
10.	Barclays US Credit/Mortgage Bond Index	Credit Mtg
11.	Barclays US Government/Mortgage Bond Index	Govt Mtg
12.	Barclays US Agency Intermediate Bond Index	Agy Intrm
13.	Bank of America Merrill Lynch (BofAML) New Zealand Government Index - NZ	
14.	BofAML Swiss Government Index	Switzerland
15.	BofAML Italian Government Index	Italy
16.	BofAML German Federal Government Index	Germany
17.	BofAML Pan-Europe Government Index	PanEu
18.	BofAML Canadian Government Index	Canada
19.	BofAML Japanese Government 5-10 Year Index	Japan
20.	BofAML Preferred Stock Fixed Rate Index	Pref Stock
21.	Alerian MLP Index	MLP
22.	US BLS CPI All Urban NSA 1982-1984 **(for indexes’ real return)**	CPI

c. Variable Definition

ER: Expected Return of the Security. It is defined as “the average expected probability of various different rates of return that are possible on a given asset. Factors in this determination include different market conditions as well as an asset’s beta” (source: www.businessdictionary.com). In the study, we will use the term ER to refer to the arithmetic average of a variable’s historical returns over a targeted period.

ERP: Expected Return of the Portfolio. It is defined as “the combination of the expected returns, or averages of probability distributions of possible returns, of all the assets in an investment portfolio” (source: www.investorwords.com).

STDEV: Standard Deviation of the Portfolio/Index. It is defined as “a measure of the dispersion of a set of data from its mean. The more spread apart the data, the higher the deviation. […] In finance, standard deviation is applied to the annual rate of return of an investment to measure the investment’s volatility. Standard deviation is also known as historical volatility and is used by investors as a gauge for the amount of expected volatility (source: www.investopedia.com).

Efficient Frontier: A set of optimal portfolios that offers the highest expected return for a defined level of risk or the lowest risk for a given level of expected return. Portfolios that lie below the efficient frontier are sub-optimal, because they do not provide enough return for the level of risk (source: www.investopedia.com).

Strategic Period: The period of May 1998 – December 2015 grabbed for sample for the purpose of this study.

Recession Period: The combined period of March 2001 – November 2001 and December 2007 – June 2009 in which NBER defines as the period when the US economy contracts and goes from peak to trough. Often times, the bear stock market occurs in the contracting period.

Growth Period: The strategic period excluding the recession period in which NBER defines as the period when the US economy expands and goes from trough to peak. Often times, the bull stock market occurs in the expansion period.

Section 4: Empirical Results

a. Descriptive Statistics:

In Table 1, the sample's average mean is 4.2% annual return with a standard error of 60 bps and the standard deviation of 9.2%. The average maximum possible return is 32.9% and the average minimum return is -18.8%. The expected returns range anywhere between near 0% and 13.7% between asset classes, and the dispersion around means (standard deviation) also varies greatly from 0.019 to 0.214. The skewness of the variables fluctuates between -0.628 and 1.363, and their kurtoses range from -1.188 to 8.240. This information indicates that not all variables are normally distributed – if they were, skewness would be approximately zero and kurtosis would be 3. This shows one of the limitations of the study – I assume the asset classes as normally distributed variables, even though Table 1 indicates that not all variables used are normally distributed.

Table 1
Strategic Period (May 1998 – December 2015)
The following table contains descriptive summary statistics for each index's geometric annual returns for the period May 1998 – December 2015.

Strategic	Mean	Standard Error	Median	Standard Deviation	Sample Variance	Kurtosis	Skewness	Minimum	Maximum
T-bill	0.000	0.001	-0.006	0.019	0.000	-1.188	0.235	-0.036	0.037
SP500	0.058	0.012	0.088	0.174	0.030	0.238	-0.628	-0.434	0.504
Muni AA	0.028	0.003	0.029	0.039	0.002	-0.077	0.052	-0.060	0.166
Agy	0.027	0.003	0.021	0.038	0.001	-0.581	0.418	-0.045	0.131
Govt Long	0.056	0.006	0.053	0.088	0.008	0.313	0.159	-0.146	0.293
Govt Intrm	0.024	0.002	0.022	0.035	0.001	-0.844	0.247	-0.041	0.115
TIPS	0.038	0.004	0.039	0.054	0.003	0.036	-0.186	-0.100	0.173
Corp HY	0.052	0.009	0.035	0.128	0.016	4.785	1.363	-0.318	0.620
Long Corp	0.053	0.006	0.057	0.094	0.009	1.829	0.440	-0.252	0.464
Credit Mtg	0.035	0.003	0.035	0.039	0.001	0.286	0.278	-0.050	0.176
Govt Mtg	0.030	0.003	0.026	0.037	0.001	-0.670	0.106	-0.046	0.117
Agy Intrm	0.024	0.002	0.017	0.035	0.001	-0.555	0.547	-0.038	0.123
NZ	0.062	0.010	0.072	0.147	0.022	-0.528	0.242	-0.263	0.421
Switzerland	0.047	0.007	0.042	0.109	0.012	0.740	0.282	-0.198	0.375
Italy	0.045	0.009	0.055	0.125	0.016	-0.471	0.141	-0.192	0.397
Germany	0.036	0.008	0.031	0.111	0.012	0.389	0.360	-0.194	0.392
PanEu	0.040	0.007	0.046	0.107	0.011	0.258	0.326	-0.179	0.380
Canada	0.043	0.006	0.037	0.088	0.008	-0.078	0.087	-0.190	0.268
Japan	0.010	0.007	0.017	0.109	0.012	-0.683	-0.003	-0.231	0.277
Pref Stock	0.033	0.009	0.050	0.136	0.019	8.240	-0.125	-0.536	0.763
MLP	0.137	0.015	0.123	0.214	0.046	0.127	0.204	-0.391	0.718

In Table 2, the sample's average mean is 1.3% annual return with a standard error of 170 bps and the standard deviation of 9.2%. The average maximum possible return is 16.4% and the average minimum return is -14.7%. The statistics are substantially lower than those of the strategic period, with the exception of the average minimum return being higher than the strategic model's minimum figure. The sample is not normally distributed with a majority of the variables' kurtoses below -1 and the skewness numbers lie within -1.238 and 1.319.

Table 2

Recession Period (March 2001 – November 2001, and December 2007 – June 2009)

The following table contains descriptive statistics of each index's geometric annual returns during the recession periods.

Recession	Mean	Standard Error	Median	Standard Deviation	Sample Variance	Kurtosis	Skewness	Minimum	Maximum
T-bill	0.011	0.003	0.014	0.016	0.000	-0.307	-0.807	-0.023	0.031
SP500	-0.211	0.025	-0.175	0.130	0.017	-0.988	-0.013	-0.434	0.033
Muni AA	0.021	0.009	0.011	0.046	0.002	-1.320	-0.234	-0.060	0.079
Agy	0.063	0.006	0.056	0.034	0.001	-1.030	0.109	0.010	0.131
Govt Long	0.083	0.008	0.081	0.042	0.002	3.491	1.319	0.009	0.222
Govt Intrm	0.065	0.005	0.067	0.025	0.001	-0.796	-0.053	0.022	0.115
TIPS	0.052	0.012	0.080	0.066	0.004	-0.573	-0.905	-0.081	0.121
Corp HY	-0.091	0.017	-0.058	0.091	0.008	0.411	-1.238	-0.318	0.004
Long Corp	-0.014	0.019	-0.038	0.101	0.010	-0.307	-0.152	-0.252	0.155
Credit Mtg	0.042	0.008	0.028	0.044	0.002	-0.909	0.079	-0.050	0.118
Govt Mtg	0.064	0.006	0.065	0.029	0.001	-1.280	-0.113	0.019	0.117
Agy Intrm	0.061	0.006	0.054	0.032	0.001	-1.091	0.044	0.010	0.123
NZ	-0.031	0.023	-0.049	0.124	0.015	-1.181	-0.145	-0.263	0.150
Switzerland	0.065	0.014	0.044	0.076	0.006	-1.140	0.253	-0.059	0.206
Italy	0.022	0.019	0.000	0.101	0.010	-1.373	-0.059	-0.137	0.184
Germany	0.036	0.018	0.040	0.093	0.009	-1.429	0.055	-0.098	0.197
PanEu	0.016	0.018	-0.002	0.096	0.009	-1.375	-0.054	-0.137	0.173
Canada	0.016	0.021	0.005	0.113	0.013	-0.716	0.063	-0.190	0.225
Japan	0.059	0.022	0.076	0.117	0.014	-1.045	-0.180	-0.152	0.277
Pref Stock	-0.132	0.040	-0.116	0.211	0.045	-1.167	-0.244	-0.536	0.137
MLP	0.073	0.066	-0.093	0.351	0.123	-1.373	0.547	-0.368	0.641

In Table 3, the sample's average mean is 4.6% annual return with a standard error of 60 bps and the standard deviation of 8.6%. The average maximum possible return is 32.3% and the average minimum return is -14.2%. This period's return is higher than that of the strategic period while the risk level is lower. The sample is not normally distributed with a kurtosis range of -1.036 – 18.483 and a skewness range of -0.464 – 3.154.

Table 3
Growth Period (May 1998 – February 2001, December 2001 – November 2007 and July 2009 – December 2015)
The following table contains descriptive statistics of each index's geometric annual returns during the growth periods.

Growth	Mean	Standard Error	Median	Standard Deviation	Sample Variance	Kurtosis	Skewness	Minimum	Maximum
T-bill	-0.002	0.001	-0.007	0.019	0.000	-1.036	0.396	-0.036	0.037
SP500	0.099	0.010	0.119	0.140	0.020	0.712	-0.464	-0.270	0.504
Muni AA	0.029	0.003	0.030	0.038	0.001	0.167	0.155	-0.055	0.166
Agy	0.022	0.003	0.018	0.036	0.001	-0.461	0.489	-0.045	0.104
Govt Long	0.052	0.007	0.045	0.093	0.009	0.102	0.245	-0.146	0.293
Govt Intrm	0.018	0.002	0.015	0.033	0.001	-0.776	0.328	-0.041	0.090
TIPS	0.036	0.004	0.033	0.052	0.003	0.415	-0.059	-0.100	0.173
Corp HY	0.074	0.009	0.055	0.119	0.014	5.824	2.093	-0.105	0.620
Long Corp	0.063	0.007	0.065	0.089	0.008	2.129	0.791	-0.109	0.464
Credit Mtg	0.034	0.003	0.036	0.038	0.001	0.594	0.295	-0.048	0.176
Govt Mtg	0.025	0.003	0.022	0.035	0.001	-0.587	0.160	-0.046	0.107
Agy Intrm	0.018	0.002	0.013	0.032	0.001	-0.450	0.613	-0.038	0.095
NZ	0.076	0.011	0.077	0.145	0.021	-0.638	0.257	-0.188	0.421
Switzerland	0.044	0.008	0.042	0.113	0.013	0.692	0.321	-0.198	0.375
Italy	0.049	0.009	0.060	0.128	0.016	-0.485	0.123	-0.192	0.397
Germany	0.036	0.008	0.031	0.114	0.013	0.452	0.382	-0.194	0.392
PanEu	0.043	0.008	0.047	0.109	0.012	0.341	0.344	-0.179	0.380
Canada	0.047	0.006	0.039	0.083	0.007	-0.063	0.224	-0.146	0.268
Japan	0.003	0.008	0.013	0.106	0.011	-0.640	-0.021	-0.231	0.246
Pref Stock	0.059	0.007	0.053	0.100	0.010	18.483	3.154	-0.216	0.763
MLP	0.146	0.014	0.139	0.184	0.034	0.700	0.254	-0.391	0.718

b. Bivariate Statistics and Efficient Frontier:

Strategic (Long Term) Period – Efficient Frontier:

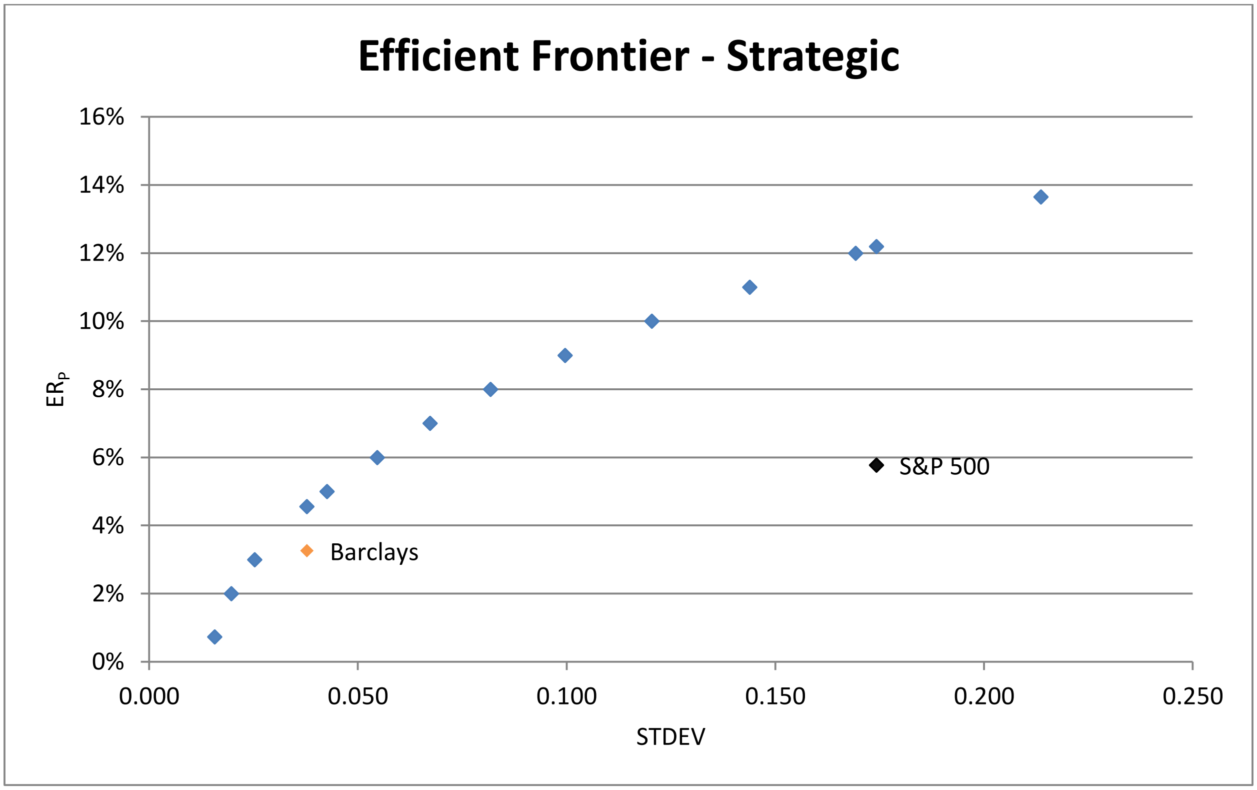
In Table 4 and Figure 1, the first two columns are the S&P 500 and Barclays Aggregate Bond Index benchmarks' annual performance (expected return of the portfolio and standard deviation). The following four columns are the return and standard deviation of the portfolio given each of the following conditions: maximum return, minimum standard deviation, maximum return with S&P 500's standard deviation and maximum return with Barclays's standard deviation. The remaining columns are the minimum standard deviation responding to an expected return target.

In the strategic period, the efficient frontier is a smooth curve with a maximum expected annual return of 13.65% and a standard deviation of 21.36%. The lowest risk the portfolio can obtain is a standard deviation of 1.57% and an expected return of 0.73%. With S&P 500's standard deviation of 17.43%, the portfolio yields 12.19% versus the S&P 500's 6%. With Barclays's standard deviation of 3.78%, the portfolio can yield a near 4.56% annual return in comparison to Barclays' 3.26%. The two benchmarks are well positioned below the efficient frontier of the portfolio suggesting that the portfolio can outperform the market during the strategic long-term period.

Table 4
Strategic Period – Efficient Frontier Table
The following table contains optimal expected returns and standard deviations of S&P 500, Barclays and the portfolio in the strategic period.

	SP500	Barclays	Max ER_P	Min STDEV	SP500 STDEV	Barclays STDEV							
ER_P	5.77%	3.26%	13.65%	0.73%	12.19%	4.56%	2.00%	3.00%	6.00%	7.00%	8.00%	10.00%	11.00%
STDEV	17.43%	3.78%	21.36%	1.57%	17.43%	3.78%	1.97%	2.52%	5.46%	6.73%	8.18%	12.04%	14.39%

Figure 1
Strategic Period – Efficient Frontier Graph
The following figure contains the portfolio's efficient frontier compared to S&P 500 and Barclays's performance in the strategic period.



Recession – Asset Allocation:

In Table 5 and Figure 2, the first two columns are the S&P 500 and Barclays Aggregate Bond Index benchmarks' annual performance (expected return of the portfolio and standard deviation). The following three columns are the return and standard deviation of the portfolio given each of the following conditions: maximum returns, minimum volatility and maximum return with Barclays' standard deviation. The remaining columns are the minimum standard deviation responding to an expected return target.

The portfolio's efficient frontier in recession has lower returns and lower standard deviation than the strategic period. The portfolio can yield the maximum possible expected annual return of 8.32% accompanied with a standard deviation of 4.18%. The portfolio's minimum standard deviation is 1.19% with an expected return of 0.75%. With Barclays's standard deviation of 3.97%, the portfolio can yield a near 8.18% annual return in comparison to Barclays' 4.64%. Meanwhile, the S&P 500 experiences a negative 21% return during the combined recession period with a standard deviation of 13.04%, which is much higher than our portfolio's highest standard deviation of 4.18%.

Table 5

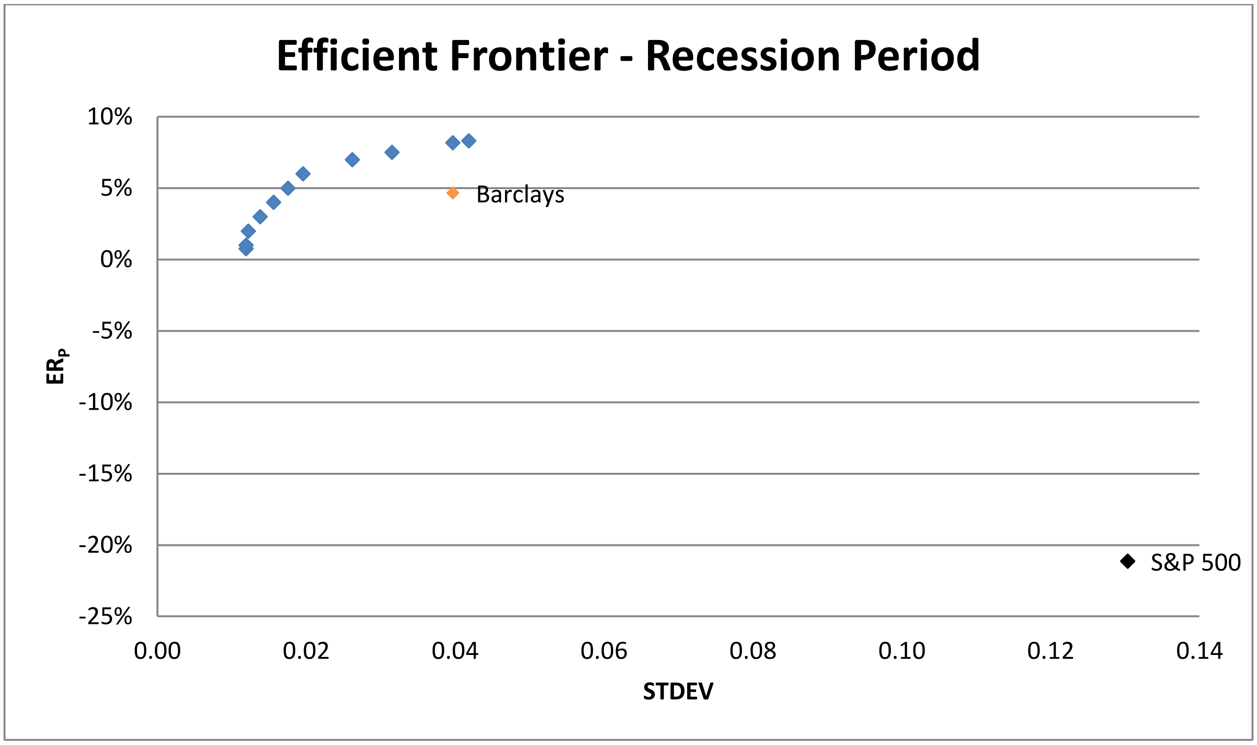
Recession – Efficient Frontier Table

The following table contains optimal expected returns and standard deviations of S&P 500, Barclays and the portfolio in the strategic period.

	SP500	Brcls	Max ER_P	Min STDEV	Brcls STDEV							
ER_P	-21.15%	4.64%	8.32%	0.75%	8.18%	1.00%	2.00%	3.00%	4.00%	5.00%	6.00%	7.00%	7.50%
STDEV	13.04%	3.97%	4.18%	1.19%	3.97%	1.19%	1.22%	1.38%	1.56%	1.76%	1.96%	2.62%	3.15%

Figure 2
Recession – Efficient Frontier Graph

The following figure contains the portfolio's efficient frontier compared to S&P 500 and Barclays's performance in recession.



Growth Period – Asset Allocation:

In Table 6 and Figure 3, the first two columns are the S&P 500 and Barclays Aggregate Bond Index benchmarks' annual performance (expected return of the portfolio and standard deviation). The following four columns are the return and standard deviation of the portfolio given each of the following conditions: maximum return, minimum standard deviation, maximum return with S&P 500's standard deviation and maximum return with Barclays's standard deviation. The remaining columns are the minimum standard deviation responding to an expected return target.

The portfolio in growth period yields higher returns given a specific amount of risk compare to the strategic period. The portfolio can achieve between 0.94% and 14.6% of expected annual return. The standard deviation varies between 1.54% and 18.36%. With the standard deviation of S&P 500 of 14.05% and Barclays of 3.71%, the portfolio outperform the two benchmarks with the returns of 12.81% compared to S&P 500's 9.87%, and with the return of 5.22% compare to Barclays' 3.04%. Therefore, Barclays and S&P 500 lie below the efficient frontier of the growth period.

Table 6

Growth Period – Efficient Frontier Table

The following table contains optimal expected returns and standard deviations of S&P 500, Barclays and the portfolio in the growth period.

	S&P 500	Barclays	Max ER_P	Min STDEV	SP500 STDEV	Brcls STDEV							
ER_P	9.87%	3.04%	14.62%	0.94%	12.81%	5.22%	2.00%	3.00%	6.00%	7.00%	8.00%	10.00%	12.00%
STDEV	14.05%	3.71%	18.36%	1.54%	14.05%	3.71%	1.80%	2.30%	4.39%	5.29%	6.22%	8.80%	12.43%

Figure 3

Growth Period – Efficient Frontier Graph

The following figure contains the portfolio’s efficient frontier compared to S&P 500 and Barclays’s performance in the growth period.

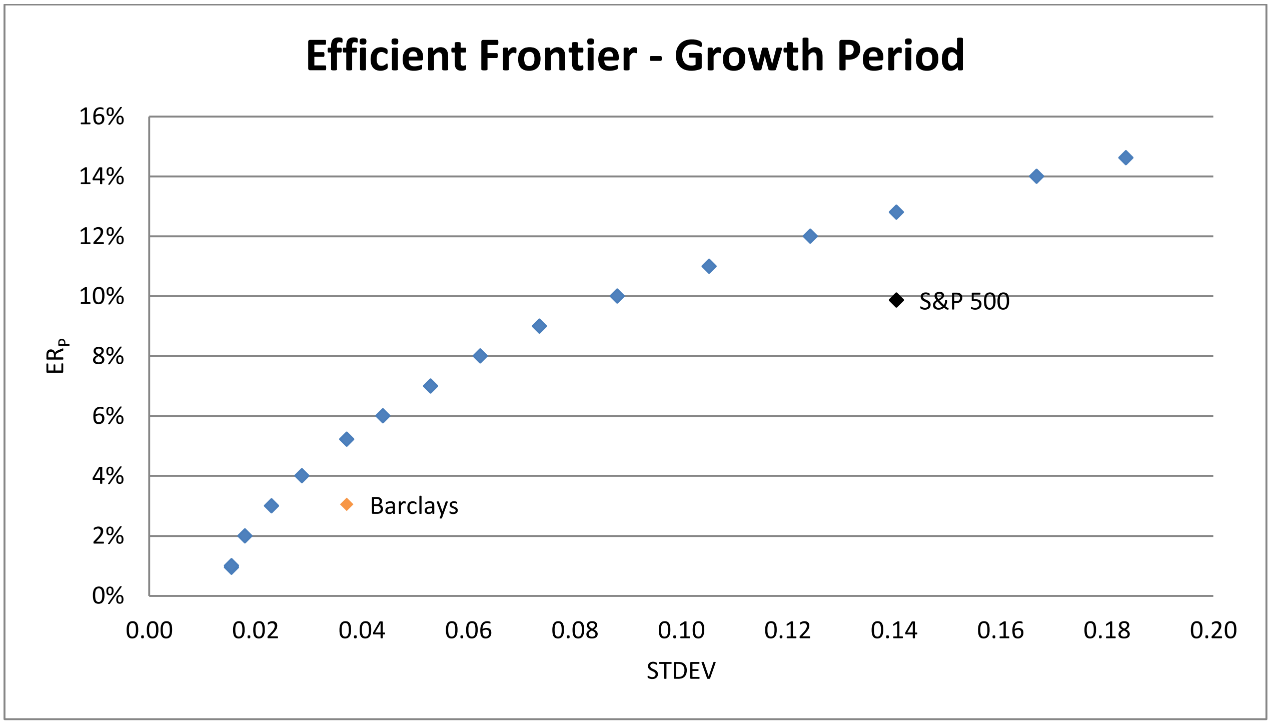


Chart of three scenarios’ efficient frontier – Comparison:

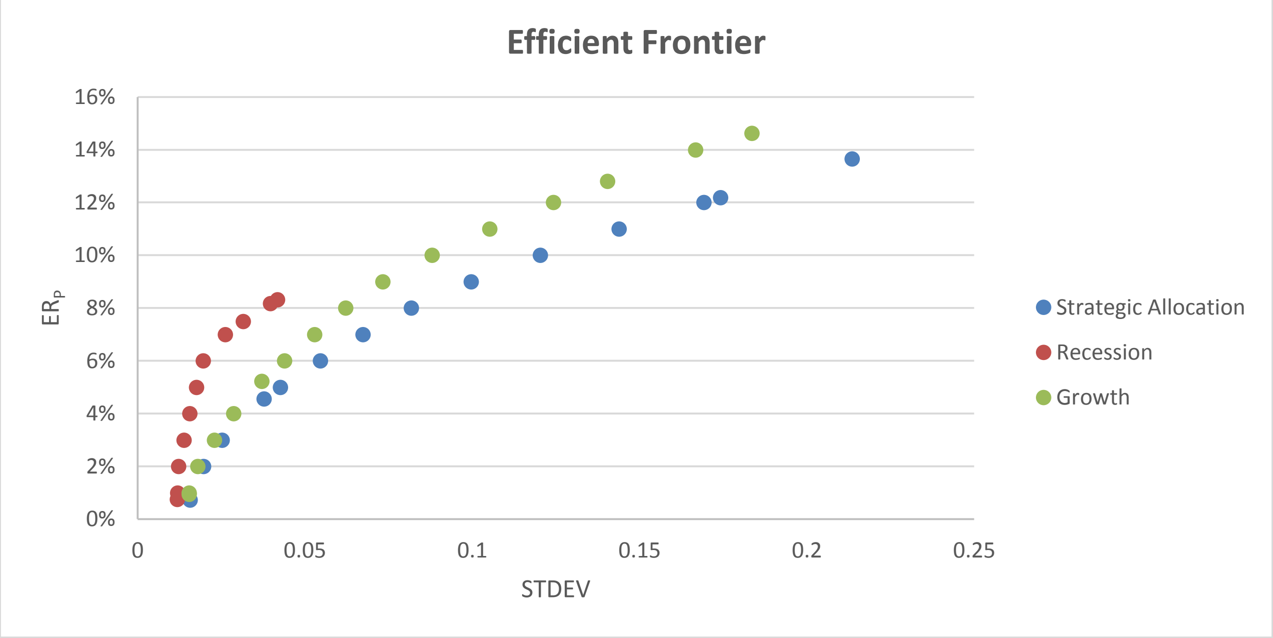
In Figure 4, at the lower end of the curve, the three scenarios yield relatively close results. However, when expected return is more than 2%, all three curves differ. Despite yielding the lowest maximum expected return of 8.32%, the recession’s efficient frontier has a much lower standard deviation for the same expected return compared to the other curves. Therefore, the optimal portfolio allocation in recession can achieve an expected return target with a much lower volatility risk compared to the other 2 frontiers.

The growth period’s model can yield the highest expected return of 14.62% with a standard deviation of 18.36%. However, this period’s efficient frontier is well positioned between the efficient frontiers of the strategic period and the recession. The strategic period has the higher standard deviation for any expected return outcome compared to the other two periods.

Figure 4

Efficient Frontiers Comparison

The following figure contains the three efficient frontiers of the three periods: Strategic, Recession and Growth.



c. Asset Allocation Model for Recession Period:

In Table 7, different expected return and standard deviation have different asset allocation. The US Treasury bill weighs more for the conservative investor, while the Long-term US Government bond weighs more for the aggressive investor. The most used securities in the model are US Treasury bill, US Government Long-term and Intermediate bonds

Table 7

Recession Asset Allocation

The following table contains the asset allocation for portfolios in the efficient frontier in recession.

				Conservative			Moderate				Aggressive	
ER_P	8.32%	0.75%	8.18%	1.00%	2.00%	3.00%	4.00%	5.00%	6.00%	7.00%	7.50%	
STDEV	4.18%	1.19%	3.97%	1.19%	1.22%	1.38%	1.56%	1.76%	1.96%	2.62%	3.15%	Total Weight (%)
	Weight											
T-bill	-	87.49%	-	86.28%	79.81%	60.90%	42.07%	23.23%	4.39%	-	-	3.84
SP500	-	3.46%	-	2.78%	-	-	-	-	-	-	-	0.06
Muni AA	-	-	-	-	-	-	-	-	-	-	-	-
Agy	-	-	-	-	-	-	-	-	-	-	-	-
Govt Long	100.00%	-	93.59%	-	-	-	-	-	-	37.56%	63.95%	2.95
Govt Intrm	-	-	-	-	-	17.57%	33.88%	50.26%	66.64%	45.03%	20.15%	2.34
TIPS	-	-	-	2.19%	10.26%	10.98%	11.36%	11.73%	12.11%	8.52%	8.43%	0.76
Corp HY	-	0.19%	-	-	-	-	-	-	-	-	-	0.00
Long Corp	-	-	-	-	-	-	-	-	-	-	-	-
Credit Mtg	-	-	-	-	-	-	-	-	-	-	-	-
Govt Mtg	-	-	-	-	-	-	1.64%	3.21%	4.78%	-	-	0.10
Agy Intrm	-	-	-	-	-	-	-	-	-	-	-	-
NZ	-	-	-	-	-	-	-	-	-	-	-	-
Switzerland	-	1.69%	-	0.99%	-	-	-	-	-	-	-	0.03
Italy	-	-	-	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-	-	-	-	-	-
PanEu	-	-	-	-	-	-	-	-	-	-	-	-
Canada	-	-	-	-	-	-	-	-	-	-	-	-
Japan	-	7.18%	5.38%	7.75%	9.93%	10.55%	11.06%	11.57%	12.08%	8.89%	7.44%	0.92
Pref Stock	-	-	-	-	-	-	-	-	-	-	-	-
Alerian	-	-	1.03%	-	-	-	-	-	-	-	0.03%	0.01

Table 8 illustrates the investors' portfolios in three scenarios. A conservative investor may look into a standard deviation range of 1.19%-1.97% in with an expected return between 1% and 2%. He/she would most likely invest heavily in US Treasury Bill. Government/Mortgage Bond index has the second largest weight in strategic model (27.27%) and TIPS has the second largest weight in the growth model. A moderate investor may look into a portfolio with a standard deviation ranging between 1.56%-6.73% and an expected return between 4-8%. He/she would invest heavily in Government Long bonds and S&P 500 for the strategic and growth periods, and US Treasury Bill and Government Intermediate bonds in recession. The aggressive investor would invest heavily in Alerian MLP and Government Long-term bond for strategic period, Government Long-term and Government Intermediate bonds in recession, and MLP and S&P 500 for the growth period.

Table 8

Relative Comparison Table – Expected Risk/Return and Asset Allocation

The following table contains comparisons of investors' portfolios in three scenarios.

	Conservative			Moderate			Aggressive		
	Strategic	Recession	Growth	Strategic	Recession	Growth	Strategic	Recession	Growth
ER_P	2.00%	1.00%	2.00%	7.00%	4.00%	8.00%	11.00%	7.50%	12.00%
STDEV	1.97%	1.19%	1.80%	6.73%	1.56%	6.22%	14.39%	3.15%	12.43%
T-bill	46.41%	86.28%	63.69%	-	42.07%	-	-	-	-
SP500	7.89%	2.78%	9.03%	13.82%	-	29.80%	-	-	29.09%
Muni AA	-	-	2.06%	-	-	0.00%	-	-	0.00%
Agy	-	-	-	-	-	-	-	-	-
Govt Long	1.73%	-	3.89%	52.88%	-	43.11%	33.08%	63.95%	13.14%
Govt Intrm	4.80%	-	-	-	33.88%	-	-	20.15%	-
TIPS	5.40%	2.19%	15.19%	-	11.36%	2.41%	-	8.43%	-
Corp HY	-	-	0.40%	-	-	-	-	-	-
Long Corp	-	-	-	-	-	-	-	-	-
Credit Mtg	-	-	-	-	-	-	-	-	-
Govt Mtg	27.27%	-	0.01%	4.14%	1.64%	0.01%	-	-	-
Agy Intrm	-	-	-	-	-	0.03%	-	-	-
NZ	-	-	1.32%	-	-	4.84%	-	-	-
Switzerland	3.19%	0.99%	3.64%	5.02%	-	0.01%	-	-	-
Italy	-	-	-	4.68%	-	5.53%	-	-	-
Germany	-	-	-	-	-	-	-	-	-
PanEu	-	-	-	-	-	-	-	-	-
Canada	3.30%	-	-	0.04%	-	-	-	-	-
Japan	-	7.75%	-	-	11.06%	-	-	7.44%	-
Pref Stock	-	-	-	-	-	-	-	-	-
MLP	-	-	0.76%	19.43%	-	14.24%	66.92%	0.03%	57.77%

a. Relative Comparison Charts

Table 9 and Figures 5, 6 and 7 compare each investor’s expected returns and standard deviations of the portfolios in three scenarios.

The portfolios in growth period have lower standard deviation relative to those in strategic period. Conservative portfolios that have an expected return of 2% have a standard deviation of 0.02 in strategic period and 1.80% in growth period. Moderate portfolios that have an expected return of 8% have a standard deviation of 8.18% in strategic period and 6.22% in growth period. Aggressive portfolios that have an expected return of 12% have a standard deviation of 16.93% in strategic period and 12.43% in growth period. The more aggressive the portfolios are given the same expected return, the bigger the difference between the standard deviations in strategic and growth periods.

The portfolios in recession have much lower standard deviations relative to the expected returns than those in strategic and growth periods. The difference between standard deviations of strategic and recession portfolios within one investor widens the more aggressive the investor is. This observation shows that although the expected return of a portfolio in recession is low, the risk is also low relative to the portfolios in strategic and growth period.

Table 9
Relative Comparison Table – Expected Return and Standard Deviation
The following table contains investors’ expected return and standard deviation in three scenarios.

	Conservative		**Moderate**		**Aggressive**	
	ER$_P$	STDEV	ER$_P$	STDEV	ER$_P$	STDEV
Strategic	2.00%	1.97%	8.00%	8.18%	12.00%	16.93%
Recession	1.00%	1.19%	4.00%	1.56%	7.50%	3.15%
Growth	2.00%	1.80%	8.00%	6.22%	12.00%	12.43%

Figure 5

Relative Comparison – Conservative Investor

The following figure contains a comparison of conservative investor's expected return and standard deviation on three scenarios.

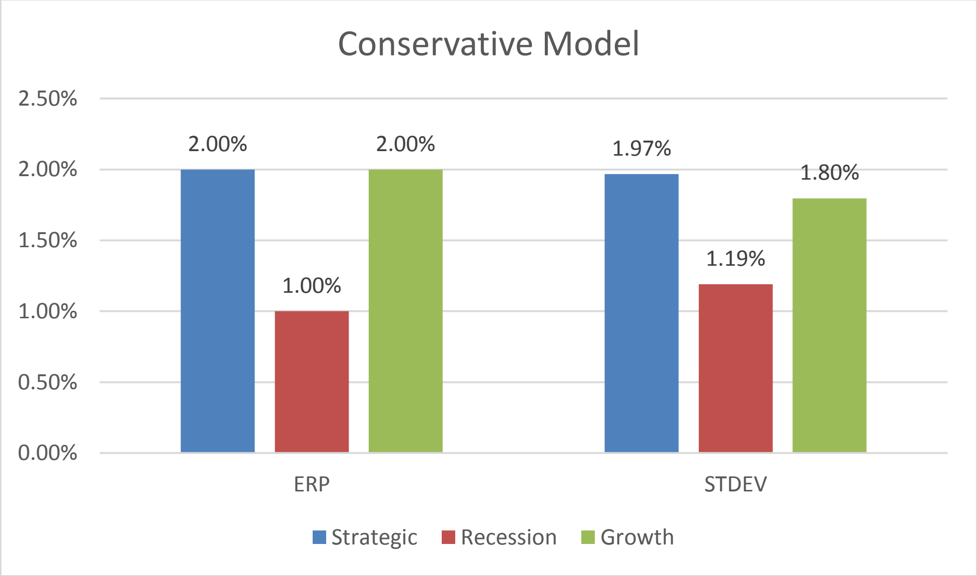


Figure 6

Relative Comparison – Moderate Investor

The following figure contains a comparison of moderate investor's expected return and standard deviation on three scenarios.

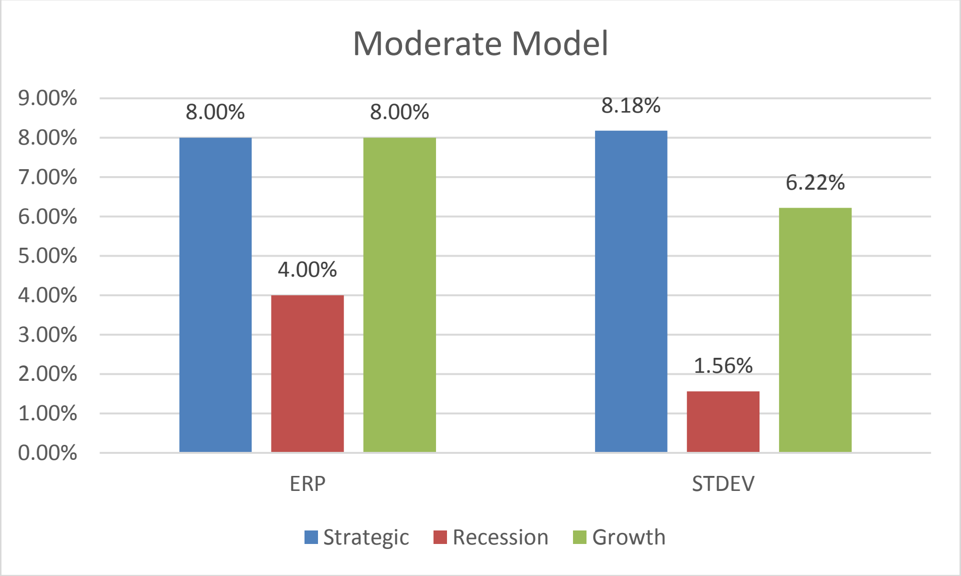
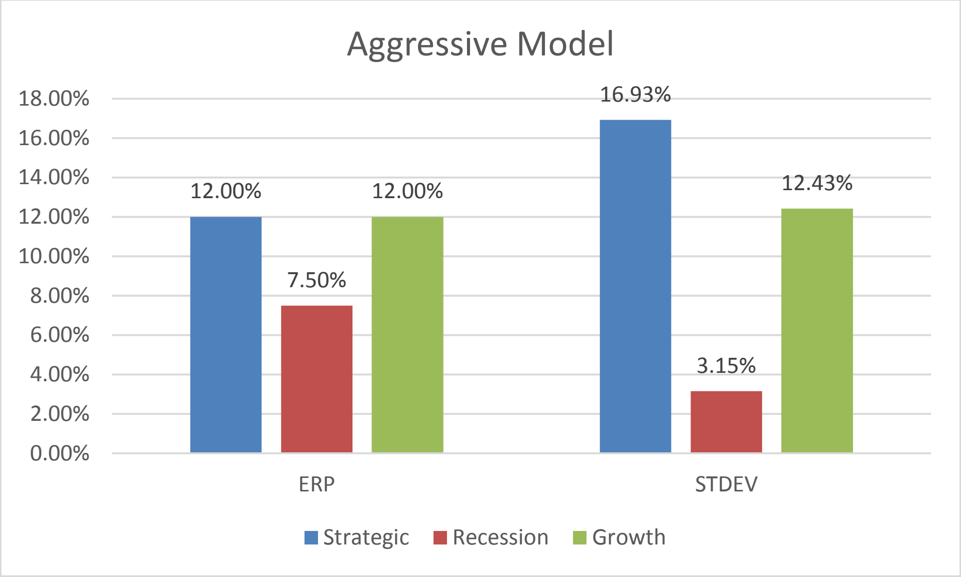


Figure 7

Relative Comparison – Aggressive Investor

The following figure contains a comparison of aggressive investor's expected return and standard deviation on three scenarios.



b. Same ER_P Comparison

Table 10 and Figure 8 illustrate portfolios' standard deviations given the same expected return target in three scenarios.

Given the same expected return, portfolios in recession have much lower standard deviations than those in strategic and growth periods, whereas strategic portfolios have the highest standard deviations. At an expected return of 3%, standard deviation of the strategic portfolio is 2.52%, that of the recession portfolio is 1.38%, and that of the growth portfolio is 2.30%. At an expected return of 5%, standard deviation of the strategic portfolio is 4.26%, that of the recession portfolio is 1.76%, and that of the growth portfolio is 3.71%. At an expected return of 7%, standard of the strategic portfolio is 6.73%, that of the recession portfolio is 2.62% and that of the growth portfolio is 5.29%. Standard deviations of the strategic portfolios increase at a much faster rate than those of the other two scenarios, while the opposite applies to the recession periods. Table 10 and Figure 8 show that the portfolios in recession are less risky and the standard deviations do not accelerate as fast as other portfolios in strategic and growth periods.

Table 10

Same ER_P Comparison Table

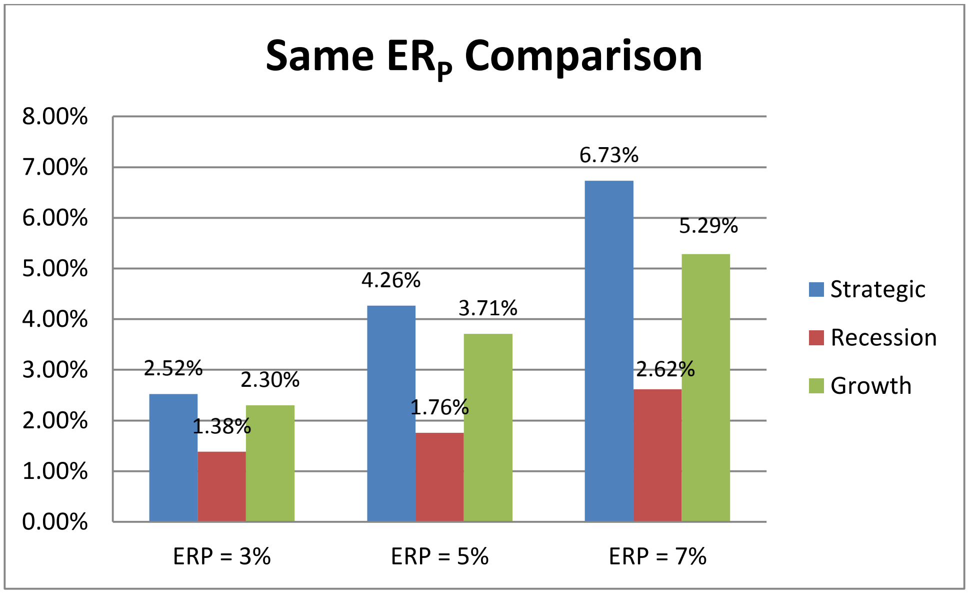
The following table contains the portfolio's standard deviations with a same expected return in three scenarios.

STDEV when ER_P at	ER_P = 3%	ER_P = 5%	ER_P = 7%
Strategic	2.52%	4.26%	6.73%
Recession	1.38%	1.76%	2.62%
Growth	2.30%	3.71%	5.29%

Figure 8

Same ER_P Comparison

The following figure contains investors' expected return and standard deviation in three scenarios.



Section 5: Discussion and Conclusion

a. Risk and limitation

This paper illustrates an analysis of historical performance on a set of sample, which cannot be promised as indicative of future performance. Also, the sample is not normally distributed partly due to its relatively short time horizon. The sample contains excessive international indexes that are concentrated in developed countries while not reflecting all available asset classes and hedging tools (i.e. gold and commodity indexes, REITs and VIX index). Further, the S&P 500 and Barclays indexes are not always correlated at a constant rate over time, which makes them less comparable in different time horizons. This paper does not show a method of deciding when the next recession will happen. Therefore, investors should use discretion when referencing this paper for investment purpose.

b. Conclusion

This study utilizes mean variance optimization to estimate a set of optimal asset allocation portfolios for a mixed portfolio of fixed income and fixed income-like securities in combination with S&P 500 Index as a measurement for equities in anticipation of a bear market. The data is sampled from the period May 1998 - December 2015 for the study.

This study uses historic inflation-adjusted data to empirically estimate a set of optimal asset allocation portfolios in anticipation of recessions via three following steps. First, using NBER start- and end-dates for recessions, I define three scenarios: strategic, growth and recession. I apply mean-variance optimization to identify three model portfolios of risky assets based upon three hypothetical investors: conservative; moderate risk taker; and aggressive, then compare them in three scenarios. Tests performed include correlation, variance, and covariance analysis. Second, for each scenario, I calculate optimal expected return and standard deviation for each model asset allocation using matrix function and Solver Add-In tool. Third, I compare portfolio performance in three scenarios.

This study contributes to the literature in three ways: First, it shows that it is possible to outperform the market and achieve positive risk-adjusted returns with lowest risk possible, even in recession period. Second, it provides a useful optimal asset allocation tool that can be employed by investors and money managers using ETFs that mimic indexes included in this study. Third, the study gives an unbiased model based on empirical studies using historic returns of market indexes. In the process, it provides a disciplined way of applying portfolio management that sweeps out emotion that typically confounds the investment process.

This paper finds that it is certainly possible to outperform the S&P 500 Index and the Barclays Aggregate Bond Index in all three scenarios. Additionally, the study suggests that although it is more difficult to obtain high returns in the recession period than the other scenarios, it is possible to generate positive total returns with less risk even in a recession and corresponding declining stock market.

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