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Empirical Problems Using the Efficient Frontier to Find Optimal Weights in Asset Classes

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Abstract

This study documents the transitory nature of "efficient" weights in six commonly employed asset classes, going beyond a simple stock and bond classes and using a 30 year data window. We review the literature on asset class diversification, including its failures during the recent credit crisis. Results show that asset class diversification benefits are inconsistent and, contrary to common academic wisdom before recent times, historical asset class covariances (even estimated with decades of data) are poor estimates of future values.

Introduction

The efficient frontier (the highest expected return for a given standard deviation), holds a sacred place in academic finance and has driven much of the world's movement towards increased diversification. Further, diversification across broad asset classes (stocks, bonds, cash, commodities and real estate for example) is commonly believed to account for the vast majority of long-term portfolio returns and picking the right assets within asset classes for only a smaller proportion. Given the means, standard deviation and covariance's of the asset classes, linear programming can solve for the weights in the asset classes for different levels of risk tolerance (portfolio standard deviation) so the portfolio is "optimized" (has the highest return/risk profile).

A central issue for this research is that asset class weights calculated using the efficient frontier are ill-behaved and startlingly different depending on the length of time and time period chosen to estimate the inputs (asset class mean return, standard deviation, and covariance). Many efficient portfolios have zero weights in most asset classes and huge weights in others, seemingly contradictory for a theory that touts diversification. Further, even small changes in estimated inputs yield wide swings in weights, so it follows that weights change dramatically depending on the length of time (five years, ten years etc.) used to estimate the inputs.

These issues are well documented in a vast academic literature, but much of the published research in this area considers only stock diversification or stock/bond diversification issues, not the more practical problem of portfolio weights across a broader, commonly-employed spectrum of asset classes. The emphasis for this study is to document the transitory nature of "efficient" weights for commonly employed asset classes.

By utilizing index returns for the last thirty years, the change in correlations across asset class returns as well as change in efficient combinations of classes is documented for the entire period compared to a variety of sub-periods. The results highlight the difficulty inherent in using the historical returns to set target weights for portfolio construction going forward.

Literature Review

Portfolio optimization techniques are commonly used by sophisticated money managers as a first step in the process of creating a portfolio for new clients. Given the investor's risk tolerance, portfolio optimization solves for the weights in various asset classes so that the overall portfolio has the highest expected return for the given standard deviation. Optimization techniques are seldom, if ever, employed at the level of individual assets; the resulting large covariance matrices are cumbersome without some serious computing power and many believe covariances for individual assets are too transitory for the past to be reasonable estimates of the future. Common academic wisdom is that asset class weights are far more important than picking the right individual assets, though that contention is not without debate (Ibbotson and Kaplan 2000; Hood 2005). In practical applications, the asset class weights derived from the optimization calculations are called "strategic" or long-term weights, which are then adjusted by "tactical" or short-term rationales based on over/under valued asset class metrics or the forecast for the macro economy and associated sensitivities of the asset classes (Haugen 2001 pp. 177-194). Many financial advisors attempt to sell their ability to predict the future with expensive tactical allocation strategies.

The finance literature has long documented the extreme sensitivity of asset class weights to changes in input variables (asset class means and the covariance matrix). For example, "A surprisingly small increase in the mean of just one asset drives half the securities from the portfolio. Yet the portfolio expected return and standard deviation are virtually unchanged." (Best and Grauer 1991 p. 315) The current literature often concentrates on high-powered econometric methods (Bayesian statistics and "shrinking" the covariance matrix) to estimate the inputs. Despite the extra mathematical rigor, overall results show that these strategies do not consistently outperform the simple strategy of allocating 1/N to each asset class (DeMiguel, Garlappi and Uppal 2007).

Even though optimization methodologies are relatively quantitative in nature there seems to be little consensus about which are the appropriate asset classes; they range from the simple stocks versus bonds to 15-25 different classes that might parse domestic stocks into nine different classes with bond classes also stratified by term and credit risk. Real estate, commodities and venture capital are often separate asset classes. Evidence from professional investors is scant since they like to hedge their pronouncements and seldom provide hard strategic asset allocation targets. Target date (or lifestyle) mutual funds supply some evidence about the diffuse nature of professional advice, however, since they are designed to be an investor's entire portfolio and automatically switch from relatively risky assets (usually stocks) to safer assets (mostly bonds) as the "target" date approaches (commonly called a "glide path"). Evidence from target date funds shows little consensus for the appropriate asset classes and wild variations in the optimal asset class weights for different funds with the same target date (Maher, White and Schooley 2010).

Asset class diversification has received extra scrutiny in the last few years for a bad reason; it generally failed to help avoid large portfolio losses in the 2008-2009 liquidity crisis and its aftermath. Two different problems have been posited as key contributors to the poor results. First, correlations between asset classes change dramatically when stock markets have large gains (low correlations) versus when they have large losses (high correlation). Secondly, returns distributions are fat-tailed with far more extreme losses/gains than predicted by the normal distribution. The correlation issue is commonly classified as the "new normal" with "risk off" (good market conditions) and "risk on" (bad) regimes (Page and Taborsky 2010). There are several corollaries to the fat-tailed returns distribution argument, including volatility clusters and return distribution skewness (different sized positive/negative tails) (Stoyana et. al. 2011).

Even sophisticated diversification strategies such as the "Yale model" cracked under the pressure of the 2008-2009 economic downdraft. In the 2000s, the Yale University endowment leader, Dave Swensen, became the guru of investing into a wide range of alternative assets, including illiquid assets like hedge funds, natural resources and private equity. The basic arguments were that liquidity was overpriced for long-term investors and alternative investments provide low correlations (and increased diversification benefits) for standard asset classes like stocks and bonds (Leibowitz, Bova and Hammond 2010). Though the Yale endowment performed admirably over the entire decade through 2009, it lost almost 25% in the year ending June 30, 2009. Basically, correlations between asset classes increased dramatically in the liquidity crisis (Page and Taborsky 2010) and endowment portfolios traded like the traditional 60 % stock / 40% bond fund in the boom and then were more volatile in the bust (Coggan 2011).

The recent failure of asset class diversification strategies has led to new research attempting to link systematic risk and asset allocation. The key empirical properties on contagion (systematic risk) are developed, but practical implications for asset allocation are scarce. One approach is to "diversify trends" by linking expectations of different asset classes to macroeconomic variables (Fabozzi and Focaardi 2010). Another is to employ risk factors (yield curve variables, commodities, credit quality spreads, swap spreads etc.) rather than asset classes. Research shows the risk factors are less correlated with equity markets than asset classes, especially in market downturns (Page and Taborsky 2010). But effective diversification across risk factors still involves a crystal ball into the future, a prospect less appealing given the spectacular collective failures to foresee the future revealed over the past decade.

Data and Methodology

To examine the relative stability of the correlations and resulting optimal mix of assets over different time periods, the monthly returns on six asset class indices were obtained from Morningstar's ENCORR database for the period January 1979 to May 2010. The indices are the Russell 1000 large cap stock index, the Russell 2000 small cap stock index, the S&P GSCI Index broad based commodities index, the BarCap Aggregate Bond Index of bond returns, the MSCI EAFE Index of international stock returns, and the FTSE NAREIT All REIT Index of real estate returns. All indices are total returns monthly for the time period.

The data was analyzed over the entire period and then divided into sub-periods to examine how the results changed as the time period changed. The sub-periods examined included three ten year periods – the 1980's, the 1990's and the 2000's, and the two twenty year periods at the beginning and the end of the thirty-year overall period. The monthly returns data was used to calculate the correlation coefficients for all the combinations of assets for each of the time periods. The results are shown in Tables I-VI.

The Optimizer program in Morningstar's ENCORR database was then used to generate the efficient investment frontier for the combinations of the index returns for each to the time periods. The portfolio statistics were calculated for different levels of standard deviation for each of the time periods. These portfolio statistics are also presented in Tables I-VI.

Table I
Correlation and Portfolio Statistics for Entire Thirty-Year Period

Correlations - 1/1979 - 5/2010

	N Periods	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	377	1.0000	0.8525	0.1426	0.2384	0.6378	0.5887
Russell 2000 TR USD	377	0.8525	1.0000	0.1600	0.1409	0.5749	0.6714
S&P GSCI TR	377	0.1426	0.1600	1.0000	-0.0118	0.2153	0.1365
BarCap US Agg Bond TR USD	377	0.2384	0.1409	-0.0118	1.0000	0.1757	0.2388
MSCI EAFE USD	377	0.6378	0.5749	0.2153	0.1757	1.0000	0.4484
FTSE NAREIT All REITs TR	377	0.5887	0.6714	0.1365	0.2388	0.4484	1.0000

Portfolio Statistics - 1/1979 - 5/2010

	Standard Deviation 3.0	Standard Deviation 4.0	Standard Deviation 5.0	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	36.95	53.12	9.43	100.00	0.00	0.00	0.00	0.00	0.00
Russell 2000 TR USD	3.87	3.98	62.65	0.00	100.00	0.00	0.00	0.00	0.00
S&P GSCI TR	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
BarCap US Agg Bond TR USD	33.51	5.74	0.00	0.00	0.00	0.00	100.00	0.00	0.00
MSCI EAFE USD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
FTSE NAREIT All REITs TR	25.67	37.16	27.92	0.00	0.00	0.00	0.00	0.00	100.00
Expected Return	0.90	0.99	1.05	1.00	1.07	0.71	0.70	0.68	1.00
Standard Deviation	3.02	4.01	5.01	4.52	5.75	5.64	1.70	5.04	4.94
Sharpe Ratio	0.30	0.25	0.21	0.22	0.19	0.13	0.41	0.13	0.20

Table II
Correlations and Portfolio Statistics for the 1980's

Correlations - 1/1979 - 12/1989

	N Periods	**Russell 1000 TR USD**	**Russell 2000 TR USD**	**S&P GSCI TR**	**BarCap US Agg Bond TR USD**	**MSCI EAFE USD**	**FTSE NAREIT All REITs TR**
Russell 1000 TR USD	132	1.0000	0.9025	0.2012	0.3099	0.4739	0.6987
Russell 2000 TR USD	132	0.9025	1.0000	0.2067	0.2163	0.4543	0.7585
S&P GSCI TR	132	0.2012	0.2067	1.0000	-0.0598	0.2799	0.2160
BarCap US Agg Bond TR USD	132	0.3099	0.2163	-0.0598	1.0000	0.2248	0.3827
MSCI EAFE USD	132	0.4739	0.4543	0.2799	0.2248	1.0000	0.4133
FTSE NAREIT All REITs TR	132	0.6987	0.7585	0.2160	0.3827	0.4133	1.0000

Portfolio Statistics - 1/1979 - 12/1989

	Standard Deviation 3.0	Standard Deviation 3.5	Standard Deviation 4.0	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	**BarCap US Agg Bond TR USD**	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	30.81	39.30	46.44	100.00	0.00	0.00	0.00	0.00	0.00
Russell 2000 TR USD	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00
S&P GSCI TR	15.88	13.02	5.35	0.00	0.00	100.00	0.00	0.00	0.00
BarCap US Agg Bond TR USD	22.17	8.24	0.00	0.00	0.00	0.00	100.00	0.00	0.00
MSCI EAFE USD	31.13	39.45	48.21	0.00	0.00	0.00	0.00	100.00	0.00
FTSE NAREIT All REITs TR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Expected Return	1.29	1.38	1.45	1.45	1.49	1.08	0.93	1.50	1.18
Standard Deviation	3.01	3.51	3.99	4.72	5.94	4.10	2.43	4.93	3.95
Sharpe Ratio	0.43	0.39	0.36	0.31	0.25	0.26	0.38	0.30	0.30

Table III
Correlations and Portfolio Statistics for 1990's

Correlations - 1/1990 - 12/2000

	N Periods	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	132	1.0000	0.7419	-0.0927	0.3780	0.5520	0.3871
Russell 2000 TR USD	132	0.7419	1.0000	0.0116	0.1949	0.4529	0.5099
S&P GSCI TR	132	-0.0927	0.0116	1.0000	0.0242	-0.0764	-0.0558
BarCap US Agg Bond TR USD	132	0.3780	0.1949	0.0242	1.0000	0.2057	0.2573
MSCI EAFE USD	132	0.5520	0.4529	-0.0764	0.2057	1.0000	0.2084
FTSE NAREIT All REITs TR	132	0.3871	0.5099	-0.0558	0.2573	0.2084	1.0000

Portfolio Statistics - 1/1990 - 12/2000

	Standard Deviation 2.5	Standard Deviation 3.0	Standard Deviation 3.5	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	56.84	71.47	86.68	100.00	0.00	0.00	0.00	0.00	0.00
Russell 2000 TR USD	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00
S&P GSCI TR	12.42	14.58	13.32	0.00	0.00	100.00	0.00	0.00	0.00
BarCap US Agg Bond TR USD	28.00	11.35	0.00	0.00	0.00	0.00	100.00	0.00	0.00
MSCI EAFE USD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
FTSE NAREIT All REITs TR	2.74	2.60	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Expected Return	1.03	1.12	1.21	1.29	1.08	0.73	0.65	0.39	0.83
Standard Deviation	2.50	3.01	3.51	4.05	5.32	5.30	1.10	4.88	3.55
Sharpe Ratio	0.41	0.37	0.35	0.32	0.20	0.14	0.59	0.08	0.23

Table IV
Correlations and Portfolio Statistics for the 2000's

Correlations - 1/2001 - 5/2010

	N Periods	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	113	1.0000	0.8964	0.2702	-0.0543	0.8945	0.6774
Russell 2000 TR USD	113	0.8964	1.0000	0.2431	-0.0895	0.8173	0.7583
S&P GSCI TR	113	0.2702	0.2431	1.0000	-0.0057	0.4027	0.1915
BarCap US Agg Bond TR USD	113	-0.0543	-0.0895	-0.0057	1.0000	0.0398	0.1532
MSCI EAFE USD	113	0.8945	0.8173	0.4027	0.0398	1.0000	0.6401
FTSE NAREIT All REITs TR	113	0.6774	0.7583	0.1915	0.1532	0.6401	1.0000

Portfolio Statistics - 1/2001 - 5/2010

	Standard Deviation 3.0	Standard Deviation 4.0	Standard Deviation 5.0	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
Russell 2000 TR USD	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00
S&P GSCI TR	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
BarCap US Agg Bond TR USD	59.28	43.89	28.83	0.00	0.00	0.00	100.00	0.00	0.00
MSCI EAFE USD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
FTSE NAREIT All REITs TR	40.72	56.11	71.17	0.00	0.00	0.00	0.00	0.00	100.00
Expected Return	0.70	0.78	0.85	0.13	0.57	0.25	0.49	0.06	1.00
Standard Deviation	3.02	4.03	5.04	4.72	6.01	7.33	1.11	5.28	7.00
Sharpe Ratio	0.23	0.19	0.17	0.03	0.10	0.03	0.44	0.01	0.14

Table V
Correlations and Portfolio Statistics for the First Twenty-Year Period

Correlations - 1/1979 - 12/1999

	N Periods	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	252	1.0000	0.8676	0.0598	0.3213	0.4941	0.6124
Russell 2000 TR USD	252	0.8676	1.0000	0.0982	0.2012	0.4473	0.7148
S&P GSCI TR	252	0.0598	0.0982	1.0000	-0.0277	0.0966	0.1166
BarCap US Agg Bond TR USD	252	0.3213	0.2012	-0.0277	1.0000	0.2070	0.3423
MSCI EAFE USD	252	0.4941	0.4473	0.0966	0.2070	1.0000	0.3437
FTSE NAREIT All REITs TR	252	0.6124	0.7148	0.1166	0.3423	0.3437	1.0000

Portfolio Statistics - 1/1979 - 12/1999

	Standard Deviation 2.5	Standard Deviation 3.0	Standard Deviation 3.5	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	47.77	62.58	77.62	100.00	0.00	0.00	0.00	0.00	0.00
Russell 2000 TR USD	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00
S&P GSCI TR	10.42	8.78	7.12	0.00	0.00	100.00	0.00	0.00	0.00
BarCap US Agg Bond TR USD	41.81	28.64	15.26	0.00	0.00	0.00	100.00	0.00	0.00
MSCI EAFE USD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
FTSE NAREIT All REITs TR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Expected Return	1.11	1.21	1.31	1.46	1.34	0.77	0.79	1.05	0.96
Standard Deviation	2.52	2.99	3.51	4.34	5.50	4.59	1.93	4.95	3.74
Sharpe Ratio	0.44	0.40	0.37	0.34	0.24	0.17	0.41	0.21	0.26

Table VI
Correlations and Portfolio Statistics for the Second Twenty-Year Period

Correlations - 1/1990 - 5/2010

	N Periods	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	245	1.0000	0.8215	0.1213	0.1691	0.7269	0.5551
Russell 2000 TR USD	245	0.8215	1.0000	0.1448	0.0578	0.6395	0.6482
S&P GSCI TR	245	0.1213	0.1448	1.0000	0.0107	0.1923	0.1151
BarCap US Agg Bond TR USD	245	0.1691	0.0578	0.0107	1.0000	0.1276	0.1803
MSCI EAFE USD	245	0.7269	0.6395	0.1923	0.1276	1.0000	0.4672
FTSE NAREIT All REITs TR	245	0.5551	0.6482	0.1151	0.1803	0.4672	1.0000

Portfolio Statistics - 1/1990 - 5/2010

	Standard Deviation 2.5	Standard Deviation 3.5	Standard Deviation 4.5	Russell 1000 TR USD	Russell 2000 TR USD	S&P GSCI TR	BarCap US Agg Bond TR USD	MSCI EAFE USD	FTSE NAREIT All REITs TR
Russell 1000 TR USD	3.38	6.08	8.69	100.00	0.00	0.00	0.00	0.00	0.00
Russell 2000 TR USD	8.92	10.54	12.10	0.00	100.00	0.00	0.00	0.00	0.00
S&P GSCI TR	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
BarCap US Agg Bond TR USD	52.78	30.90	9.75	0.00	0.00	0.00	100.00	0.00	0.00
MSCI EAFE USD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
FTSE NAREIT All REITs TR	34.91	52.48	69.47	0.00	0.00	0.00	0.00	0.00	100.00
Expected Return	0.72	0.79	0.86	0.76	0.84	0.51	0.58	0.24	0.91
Standard Deviation	2.51	3.51	4.50	4.40	5.64	6.31	1.11	5.06	5.41
Sharpe Ratio	0.29	0.23	0.19	0.17	0.15	0.08	0.52	0.05	0.17

Results

The correlation coefficients in Table I indicate that for the entire thirty year time period relative high positive correlations (generally greater than .5) exist between the two domestic stock indices, the real estate index, and the international stock index. The commodity index and the bond index have lower correlations with the stock and real estate indices as well as with each other, potentially providing significant diversification benefits for possible portfolios.

The portfolio statistics presented in Table I provide asset allocations, expected returns, and Sharpe ratios for three different levels of standard deviation of returns. The standard deviation levels picked are 3%, 4% and 5% based on monthly returns. These levels were selected to provide some perspective along the frontier depicted in Figure 1. The data reveal the optimal portfolios are dominated by four of the six asset classes over the range of risk levels chosen. The real estate index is a prominent part of all three points on the frontier. The shift in asset class as the risk level changes occurs between the mix of stocks and bonds and from large to small cap stocks. The Sharpe ratio indicates the relative slope of the frontier and the tradeoff between risk and return as the investor moves along the frontier. The thirty year results are the long term base case that are compared to the other time periods to examine how the make-up and tradeoffs change along the frontiers generated by different sets of data.

The results from dividing the data into three decades within the overall thirty year time period are presented in Tables II, III, and IV. The first sub-period is from January 1979 to December 1989, The second covers the period January 1990 to December 2000, and the third covers the period January 2001 to May 2010. The efficient frontiers are shown in Figures 2, 3, and 4. The results show some interesting differences from the results for the entire period and from each of the decades.

The decade of the eighties is characterized by a relatively steeply sloped efficient frontier (Figure 2) giving the investor a better risk return tradeoff than any other time period studied. The real estate asset class and small cap stocks have zero weights at all the monthly standard deviations shown in Table II (3%, 3.5% and 4%). The optimal portfolios are spread between the other four asset classes, depending on risk level, with international stocks and large cap stocks dominating the portfolios at higher risk levels. Table II also indicates correlations were somewhat higher across asset classes for the 80s compared to later decades.

The decade of the nineties is characterized by lower correlations of the commodity index to all of the other asset class indices; providing potential diversification benefits (Table III). The efficient frontier for the 90s is steeply sloped (though not as steep as the 80s) providing investors with favorable risk return tradeoffs (Figure 3). The optimal portfolios at the 2.5%, 3% and 3.5% levels are dominated by large cap stocks, bonds, and the commodity asset class (providing that diversification benefit indicated by the correlations). Real estate enters the risk portfolios only marginally, and small caps and foreign stocks not at all.

Figure 1
Efficient Frontier 1/1979 – 5/2010

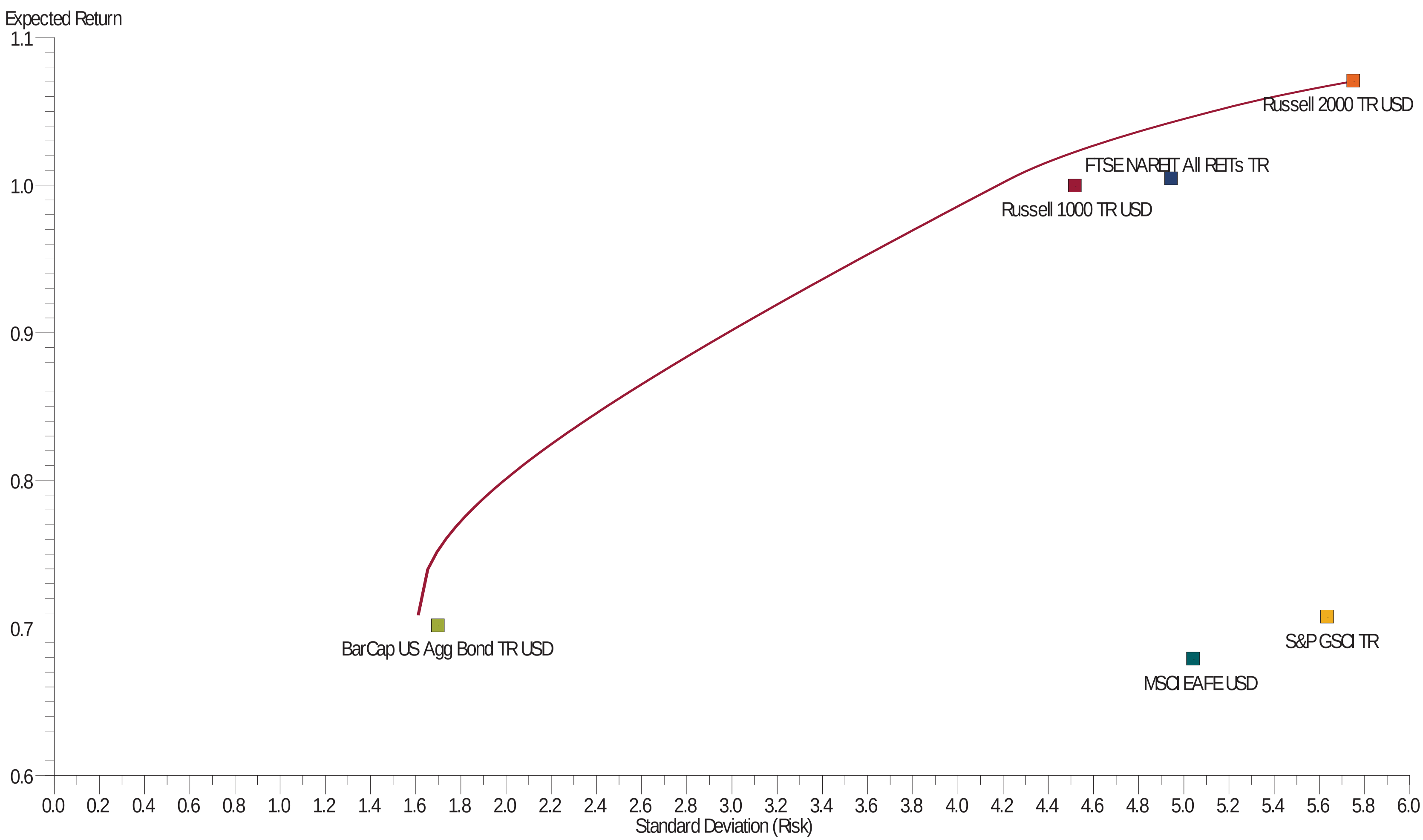


Figure 2
Efficient Frontier 1/1979 – 12/1989

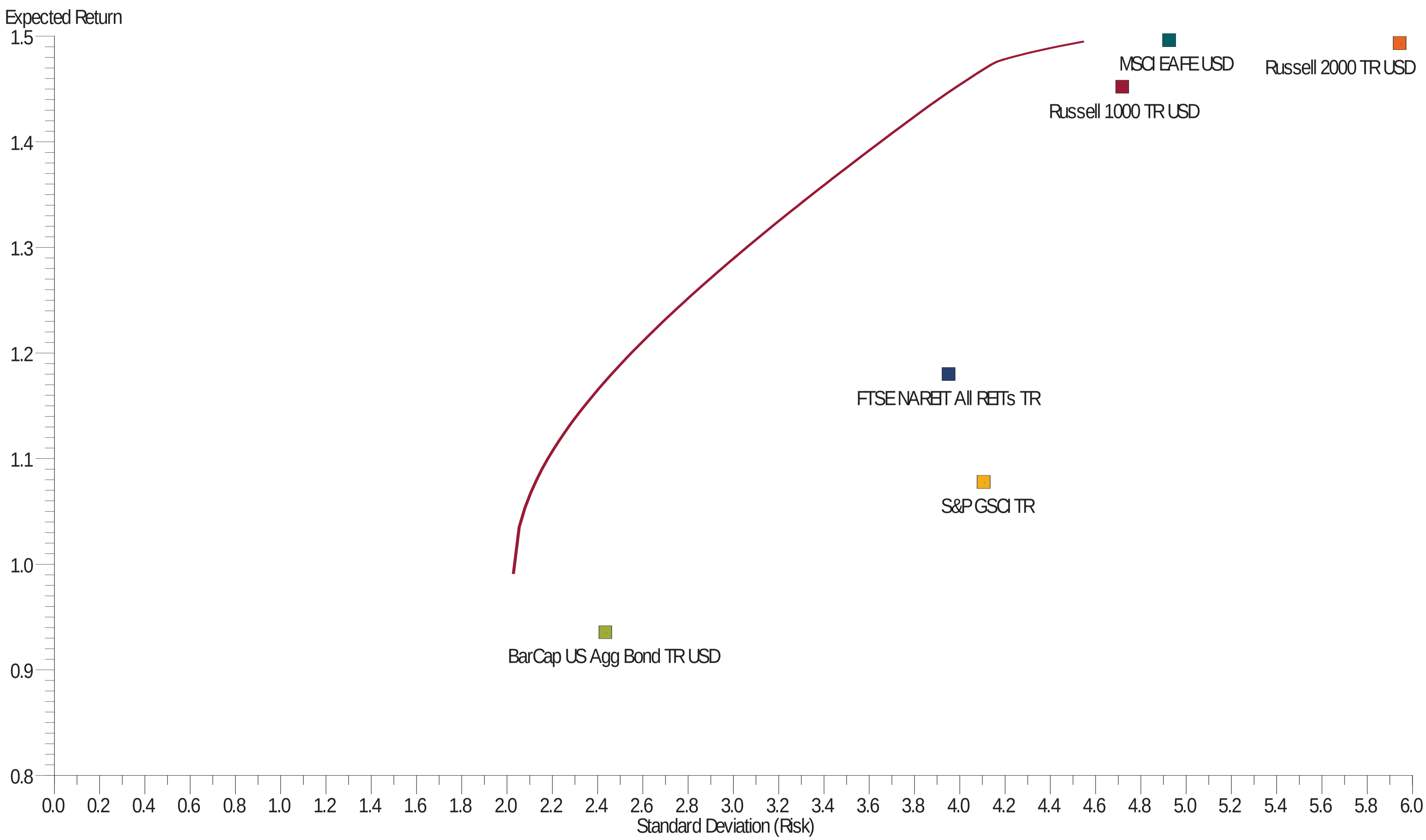


Figure 3
Efficient Frontier 1/1990 – 12/2000

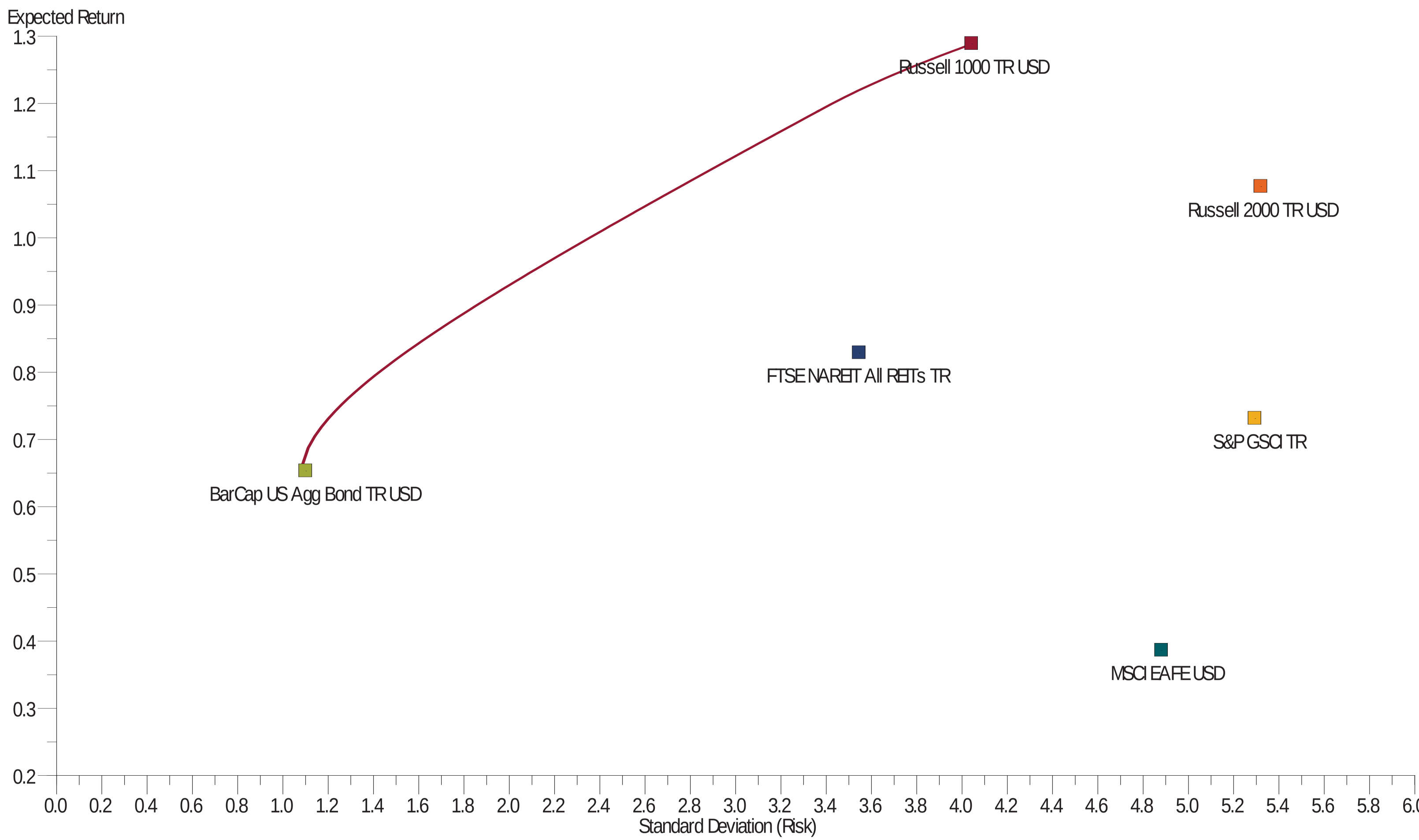


Figure 4
Efficient Frontier 1/2001 – 5/2010

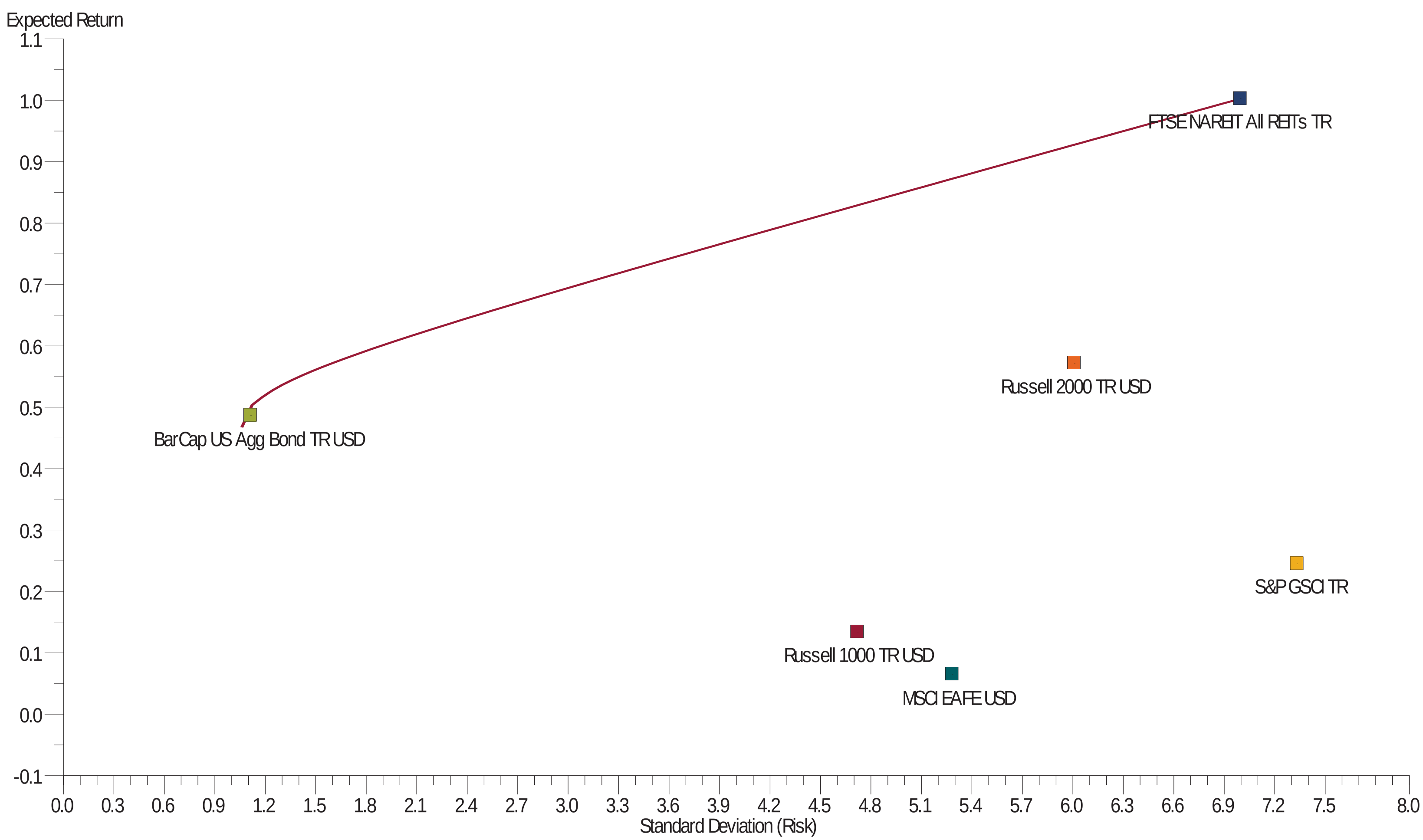


Figure 5
Efficient Frontier 1/1979 – 12/1999

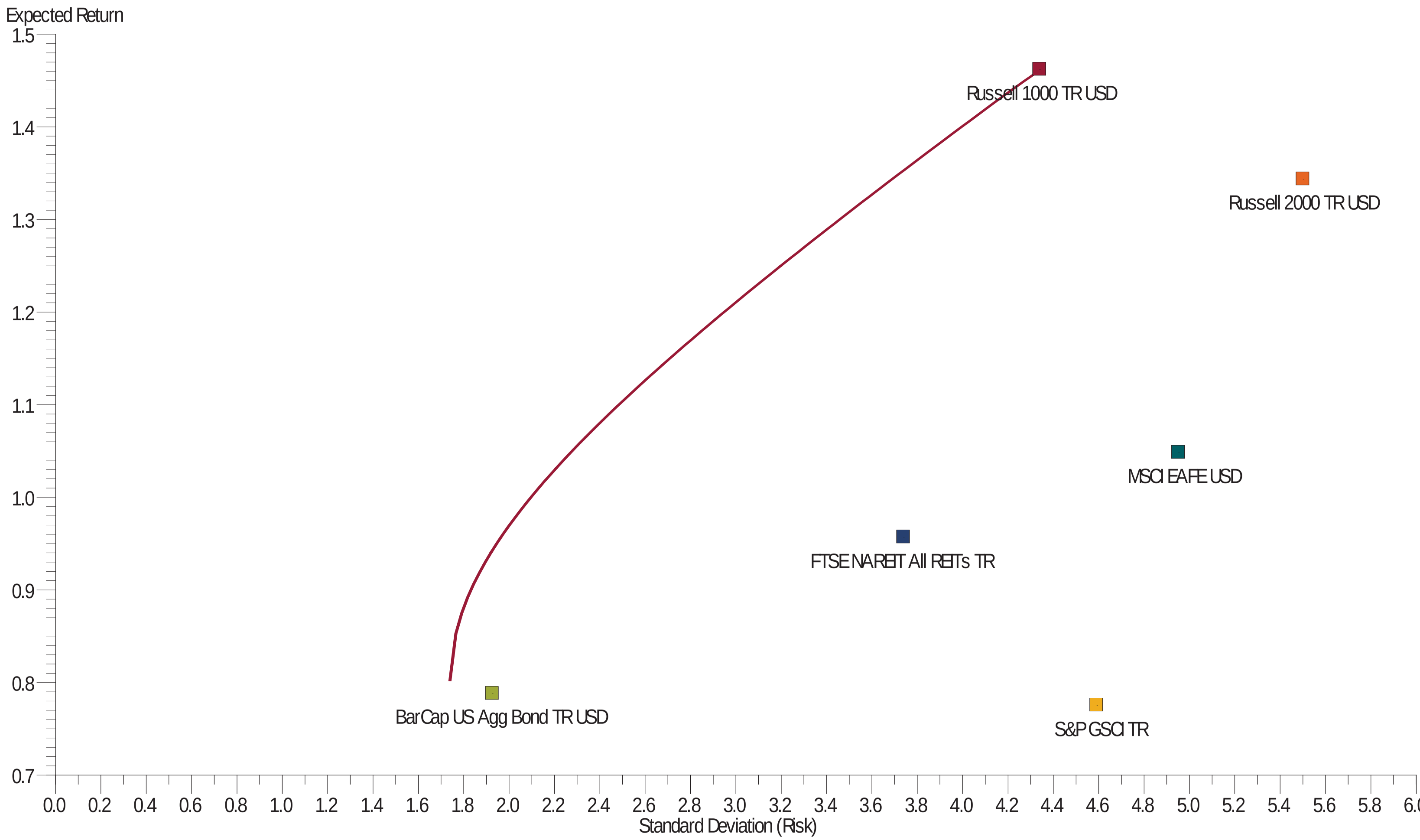
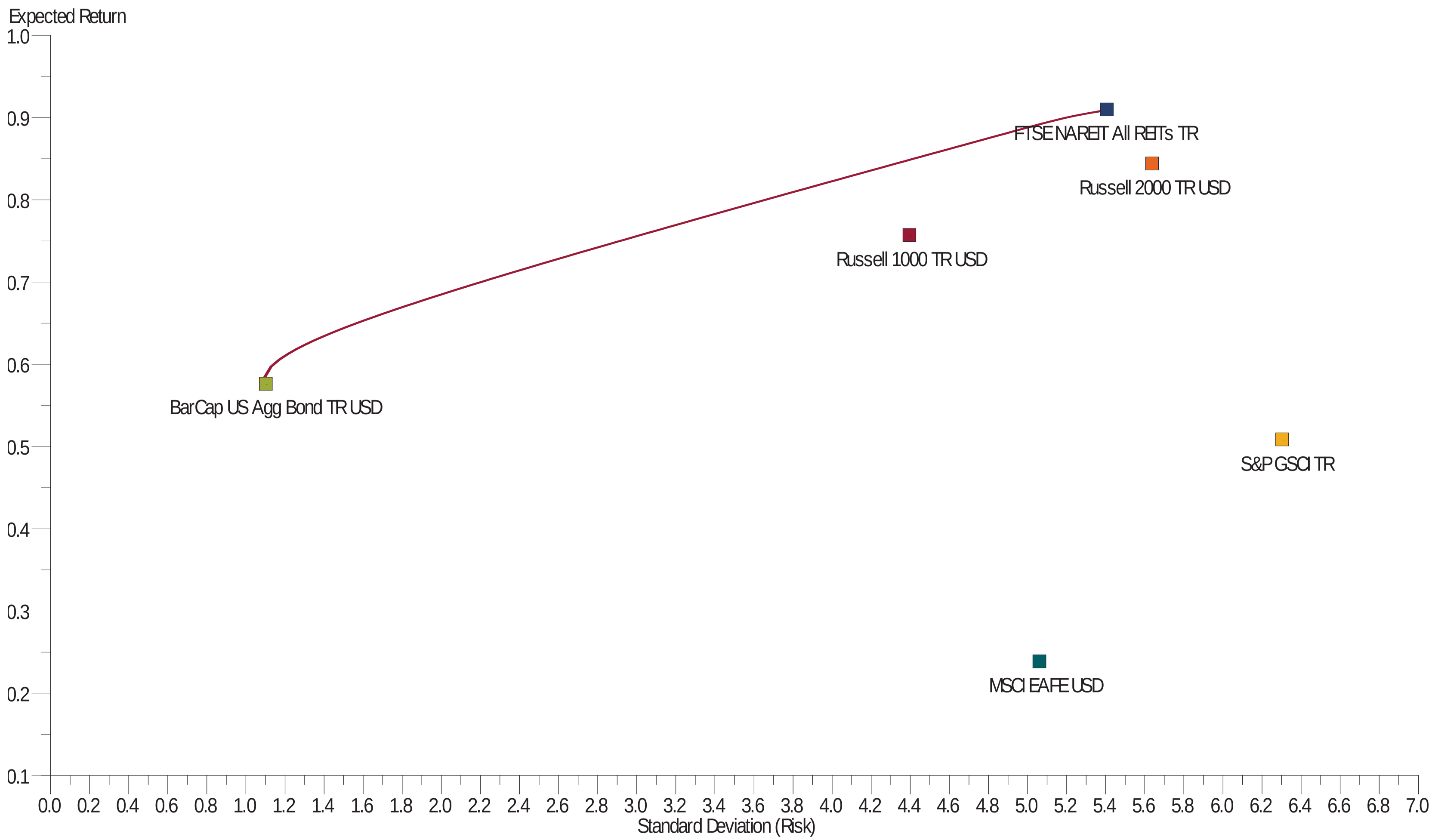


Figure 6
Efficient Frontier 1/1990 – 5/2010



The decade of the 2000's is characterized by a relatively flat efficient frontier indicating investors would need to take on larger amounts of risk for increases in return during the decade (Figure 4). The indication from Table IV is that the optimal portfolios are completely dominated by only two asset classes – real estate and bonds. The other four asset classes do not enter the optimal portfolio at any of the chosen risk levels. The Sharpe ratios for this decade are well below the other two decades examined except for the bond asset class. The results for this decade differ greatly from the results for any of the other time periods chosen.

The two twenty year sub-periods show very different results as well. The combination of the eighties and nineties reflect the relatively steep slope to the efficient investment frontier (Figure 5 and Table V) of those decades and the dominance of the large cap stock and bond asset classes with the diversification benefits of the commodity index. The other three asset classes do not appear in any of the optimal portfolios at the chosen levels of risk. The combination of the nineties and the 2000's reflects the influence of the last decade (Figure 6 and Table VI). Bonds and real estate dominate the portfolios with smaller allocations to both large and small cap stocks. The Sharpe ratios are much lower for this period than the other twenty year period examined.

This set of results indicates vastly different asset allocations depending on which historical period one examines to set target or strategic asset class weights. The portfolios in each time period are dominated by three asset classes and those asset classes shift depending on which decade of data one examines. Correlations, and diversification benefits, between asset classes shift significantly over the different decades. Taken together, results show that asset class diversification benefits are inconsistent and, contrary to common academic wisdom before recent times, historical asset class covariance's (even estimated with decades of data) are poor estimates of future values.

Conclusions

The historical returns for six broad asset class indices are used to indentify optimal portfolios at different levels of chosen risk across different time periods to highlight the difficulty in determining target asset class weights using historical return data. The results confirm that the efficient frontier shifts dramatically with relatively small changes in correlation coefficients between asset classes that occur in different time periods. The optimal portfolios encompass half or less of the six available asset classes examined in many time periods (including the thirty year period) with very different classes included in the optimal portfolios depending on which time period was examined.

This instability of the efficient frontier is problematic for even investment professionals, let alone individual investors, attempting to set target weights for different risk preferences. The targets are fluid and the investor should have little confidence that the future investment horizon will follow the historical data being used to construct the weights.

Diversification within asset classes has become a ubiquitous and standardized investment practice, with relatively cheap products like exchange-traded funds and index mutual funds easily available to even small investors. In contrast, diversification across asset classes, commonly believed to be the most important component of overall diversification strategies, is confusing and expensive with few common tenets or metrics.

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