

Tactical Asset Allocation Using Daily Data

Stefano Marmi
Scuola Normale Superiore di Pisa
s.marmi@sns.it

W. Adrián Riso
University of Siena
risso@unisi.it

Introduction

A portfolio combining different assets can produce larger return and less volatility. However, this is not a new idea; the Talmud even mentions the advantages of asset allocation (real estate, commodities and cash) approximately 2000 years ago¹. One can think about many strategies that combine these assets. Recently, Faber (2006) proposed a very simple quantitative market-timing model. In words, it consists in portfolio composed by US assets, foreign assets, commodities, real estate and bonds in equal parts. The strategy is to study the trend of each element, maintaining the position the asset if the trend is growing. However, if the trend is going down we sell the asset and buy cash.

The purpose of the present work is to apply the strategy developed in Faber (2006) using daily data of US stocks, European stocks, commodities, bond funds and cash for the period March 1st, 1994 and May 25, 2008.

The work is organized as follows. In the next section the methodology developed by Faber (2006) is briefly explained. Section 3 shows the results of the tactical asset allocation compared with the assets and the simple asset allocation. In section 4, we analyze the statistics of the portfolio in case we decide to withdraw a monthly percentage of the gains. In section 5 we study the sensibility of two strategies, the simple asset allocation (AA) and the tactical asset allocation (TAA). In particular, we start the AA portfolio in 255 different days and the TAA portfolio in 21 different days, analyzing different statistics such as the maximum in the set of 21 maximum drawdowns. Finally, we draw some conclusions.

2) Methodology and Portfolio construction

Faber (2006) proposed a portfolio aiming to reduce the risk measured as volatility and drawdown. As mentioned, the portfolio is composed with 25% of US stocks, 25% of European stocks, 25% commodities and 25% bond funds. The strategy is described by two rules.

The buy rule is the following:

We buy the asset when the daily price is larger than the 10-month (200 days) Simple Moving Average (SMA).

The sell rule is the following:

We sell the asset and move to cash when the daily price is less than the 10-month (200 days) SMA.

Three considerations should be mentioned:

- 1) All entry and exit prices are on the day of the signal at the close.
- 2) All data series are total returns including dividends.
- 3) Cash returns are estimated with the 13-weeks treasure bills.

¹ “Let every man divide his money into three parts, and invest a third in land, a third in business, and a third let him keep in reserve.”
–Talmud (1200 BC – 500 AD).

We check the portfolio every 21 days. The evolution of the cumulated returns for the Portfolio is measured using daily data. We consider S&P 500 (US stocks), Eurostoxx 50 (European stocks), CRB Index (Commodities) and Treasure Bonds (Bond Funds). In order to estimate the Treasure Bonds we consider two Bond Funds titles the BTTNX and the BTTTX using the first until December 31, 1999 and then using the BTTTX, Table I shows the annual returns, variance and drawdown of the bond funds.

Table I: Treasure Bonds Proxies

Proxies for the Fund Bonds from 1/3/1994 to 21/5/2008			
Title	Annual Ret.	Variance	Drawdown
BTTTX	14.38%	18.47%	-29.56%
BTTNX	10.67%	10.50%	-21.56%
Bond Fund ⁽¹⁾	12.91%	14.45%	-21.69%
(1) using combination of BTTTX and BTTNX			

3) Tactical Asset Allocation (TAA)

Figure 1 shows the cumulated returns of the TAA portfolio, the AA portfolio and the assets (S&P 500, Eurostoxx 50, CRB and Bond Funds).

Note that the bond Fund presents the largest cumulated return in the period and the TAA portfolio has the second best. On the other hand, the S&P 500 and the Eurostoxx 50 present the worst cumulated returns in the period 1994 and 2008.

Figure 1: Comparison among Portfolio and the other assets

Cumulative Returns of the TAA Portfolio, AA, S&P 500, Eurostoxx 50, CRB and Funds Bond ($v=200$, controlling each 21 days) from 1994 to 2008

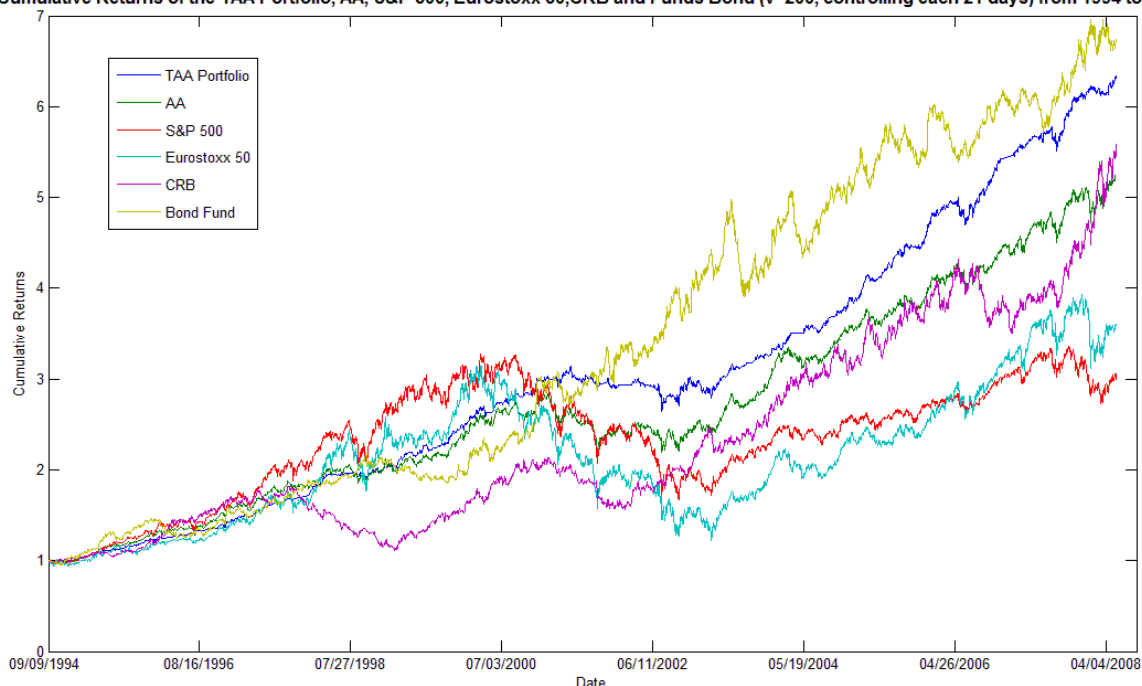


Table II shows a series of statistics in order to compare the performance of the portfolio with the different assets. Note that the TAA portfolio has the second best annualized return (14.21%) after the Bond Fund with 14.77%. On the other side, the simple AA portfolio is in the fourth position after the CRB, according to the annualized return. Note also that the worst day in the TAA is the least comparing the group of asset.

Analyzing the risk, we note that the TAA widely reduces the drawdown. As known, the maximum drawdown (MDD) is the largest percentage drop in your account between equity peaks. In other

words, it's how much money you lose until you get back to breakeven. According to this measure, S&P 500 presents a MDD of -49.15% in the period; however, the TAA portfolio presents the lowest MDD with -15.78%. The annualized standard deviation and the annualized downside deviation (it means, considering only the negative returns) is also the minimum in the group, with 6.74% y 6.53%, respectively.

Table II: Performance of the Portfolio and the different assets

PERFORMANCE STATISTICS*						
	TAA Port	AA	S&P500	BondF	CRB	Eurostoxx50
Total Cumulative Return	529.52%	423.53%	198.30%	574.07%	459.77%	258.21%
Annualized Rate of Return	14.21%	12.70%	8.21%	14.77%	13.24%	9.65%
Average Daily Return	0.05%	0.05%	0.04%	0.06%	0.05%	0.04%
Median Daily Return	0.02%	0.06%	0.04%	0.03%	0.04%	0.06%
Best Day	3.78%	3.83%	5.73%	13.52%	4.65%	7.60%
Worst Day	-2.37%	-2.59%	-6.87%	-4.15%	-5.24%	-8.23%
% of Positive Days	61.78%	54.56%	53.60%	53.65%	53.31%	53.14%
Average Daily Gain	0.27%	0.46%	0.74%	0.63%	0.70%	0.93%
% of Negative Days	38.22%	45.44%	46.40%	46.35%	46.69%	46.86%
Average Daily Loss	-0.30%	-0.44%	-0.77%	-0.60%	-0.68%	-0.96%
Excess Kurtosis	7.27	2.02	3.42	27.28	1.26	3.25
Skewness	0.40	-0.04	-0.03	1.91	-0.13	-0.03

RISK STATISTICS						
	TAA port	AA	S&P500	BondF	CRB	Eurostoxx50
Maximum Drawdown (MDD)	-15.78%	-22.89%	-49.15%	-21.69%	-38.67%	-61.16%
Duration of the MDD (in days)	303	165	656	873	347	778
Time to Recovery (in days)	229	445	1195	978	320	951
Annualized Standard Deviation	6.74%	9.57%	16.98%	14.26%	14.46%	21.09%
Annualized Downside Deviation	6.53%	9.62%	17.02%	12.97%	14.27%	21.27%
Daily Modified VaR $\alpha=5\%$	-0.53%	-0.92%	-1.65%	-0.37%	-1.45%	-2.05%

RISK ADJUSTED PERFORMANCE						
	TAA port	AA	S&P500	BondF	CRB	Eurostoxx50
Sharpe Ratio	1.66	1.01	0.31	0.83	0.71	0.32
Sortino Ratio	1.72	1.01	0.31	0.91	0.72	0.31
Omega Ratio	1.44	1.23	1.09	1.19	1.16	1.09
Calmar Ratio	0.90	0.55	0.17	0.68	0.34	0.16

* The period goes from 12-Sep-1994 to 21-May-2008

MAR=3% annual

As known, the Value at Risk (VaR) is a limit loss in a determined interval of time (a day in this work). If we give a confidence of 5%, a loss equal or greater than the VaR happens 5 times over 100 days. The Modified VaR (MVAR) considers kurtosis and skewness, measuring the risk of a portfolio with nonnormally distributed assets. According to this statistic, our TAA portfolio has the second best MVAR (-0.53%) after the Bond Fund (-0.37%).

In order to measure the risk adjusted performance we use four different statistics. 1) The classical Sharpe ratio, measured as the ration between the average return discounted by the free risk asset return (13 weeks Treasure bonds) and the standard deviation; 2) The Sortino Ratio is similar to the

Sharpe Ratio, considering the downside standard deviation; 3) The Omega ratio is defined as the ratio of probability-weighted gains to probability-weighted losses; 4) The Calmar Ratio is the ratio between the annualized return and the maximum drawdown. Note that according to all these statistics, the TAA presents the best performance in the group. For three statistics the second place is obtained by the AA portfolio, giving some evidence that asset allocation is a good strategy in order to improve return and risk.

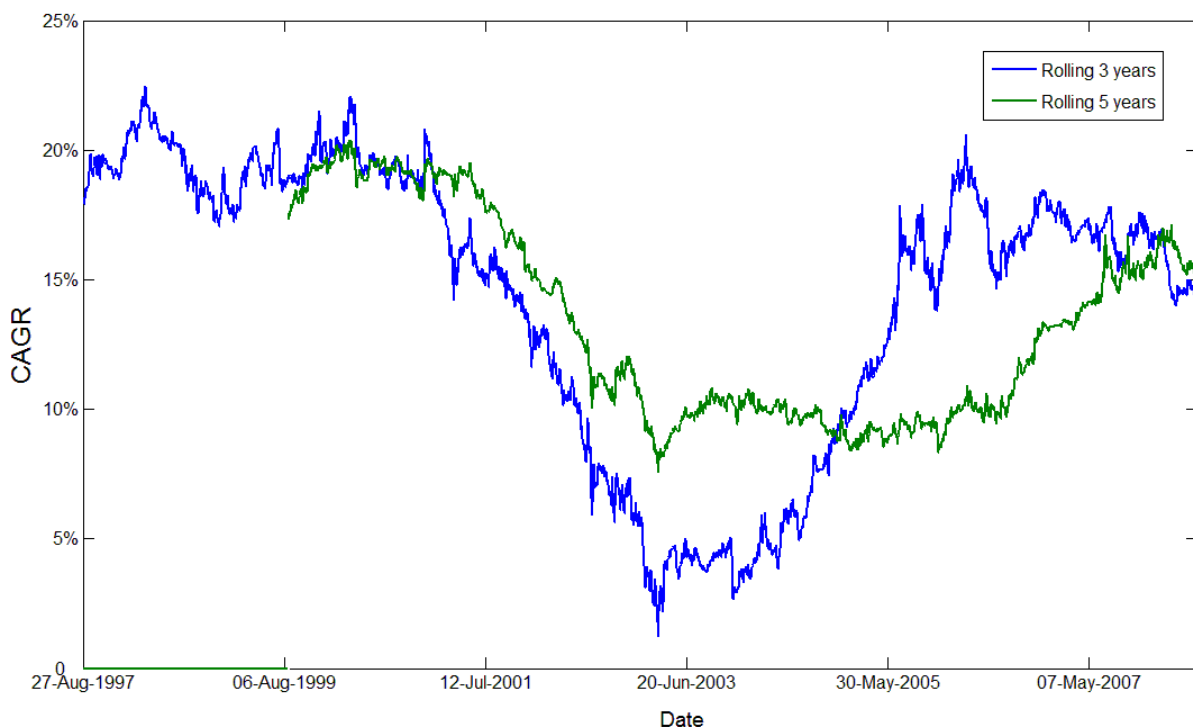
The Table III presents the number of switches realized every 21 days according to the rule described above. Note that for each asset, we have switched approximately the 50% of the total number of controls.

Table III: Number of Switch made for each asset

	S&P 500	CRB	FundBond	Eurostoxx 50	Total
Switchs	84	87	74	70	315
Controls	168	168	168	168	672
Total Days	3532	3532	3532	3532	3532

Figure 2 shows the Compound Annual Growth Rate (CAGR) considering returns from 1994 to 2008. Notice that rolling 5-years we obtain a minimum annual return of 7.56% and a maximum of 20.30%. On the other hand, notice that the worst scenario is 1.24% and the best is 22.44% when rolling 3-years.

Figure 2: Compound Annual Growth Rate (CAGR) for the TAA portfolio, rolling 3 and 5 years.



4) Imposing an annual withdrawal to the TAA Portfolio

In the present section we assume that we decide to withdraw a certain percentage over the annual returns (1%, 2%,...,10%). In addition, we consider if there is an important difference by withdrawing in a particular month of the year. Therefore, we study the feasibility of this strategy in terms of returns and risk.

Table IV: Average performance of the TAA portfolio assuming different annual withdrawals

PERFORMANCE STATISTICS*										
Annual Withdrawal %:	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
Total Cumulative Return	451.78%	383.00%	322.22%	268.57%	221.28%	179.65%	143.06%	110.94%	82.78%	58.12%
Annualized Rate of Return	13.12%	12.040%	10.96%	9.880%	8.79%	7.710%	6.62%	5.530%	4.45%	3.36%
Average Daily Return	0.049%	0.046%	0.042%	0.038%	0.034%	0.031%	0.027%	0.023%	0.019%	0.016%
Median Daily Return	0.0217%	0.0216%	0.0216%	0.0216%	0.0216%	0.0216%	0.0216%	0.0216%	0.0216%	0.0216%
Best Day	3.76%	3.76%	3.76%	3.76%	3.76%	3.76%	3.76%	3.76%	3.76%	3.76%
Worst Day	-2.37%	-2.37%	-3.02%	-4.04%	-5.07%	-6.09%	-7.12%	-8.15%	-9.17%	-10.20%
% of Positive Days	61.44%	61.41%	61.41%	61.41%	61.41%	61.41%	61.41%	61.41%	61.41%	61.41%
Average Daily Gain	0.27%	0.270%	0.27%	0.270%	0.27%	0.270%	0.27%	0.270%	0.27%	0.27%
% of Negative Days	38.56%	38.59%	38.59%	38.59%	38.59%	38.59%	38.59%	38.59%	38.59%	38.59%
Average Daily Loss	-0.31%	-0.32%	-0.33%	-0.33%	-0.34%	-0.35%	-0.36%	-0.37%	-0.38%	-0.39%
Excess Kurtosis	7.09	7.10	9.60	16.70	28.84	44.89	63.07	81.81	99.96	116.86
Skewness	0.38	0.17	-0.41	-1.37	-2.60	-3.95	-5.29	-6.56	-7.70	-8.71

RISK STATISTICS										
Annual Withdrawal %:	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
Maximum Drawdown	-16.75%	-17.74%	-18.89%	-20.30%	-21.87%	-23.59%	-25.46%	-27.30%	-29.14%	-31.15%
Annualized Standard Deviation	6.75%	6.91%	7.20%	7.60%	8.10%	8.68%	9.33%	10.03%	10.77%	11.55%
Annualized Downside Deviation	6.58%	6.93%	7.54%	8.37%	9.35%	10.45%	11.62%	12.86%	14.14%	15.45%
Daily Modified VaR $\alpha=-5\%$	-0.54%	-0.58%	-0.67%	-0.76%	-0.82%	-0.83%	-0.78%	-0.67%	-0.50%	-0.29%

RISK ADJUSTED PERFORMANCE										
Annual Withdrawal %:	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
Sharpe Ratio	1.50	1.31	1.11	0.91	0.72	0.54	0.39	0.25	0.13	0.03
Sortino Ratio	1.54	1.30	1.06	0.82	0.62	0.45	0.31	0.20	0.10	0.02
Omega Ratio	1.40	1.35	1.31	1.27	1.24	1.20	1.17	1.14	1.11	1.08
Calmar Ratio	0.78	0.68	0.58	0.49	0.40	0.33	0.26	0.20	0.15	0.11

Maximum DrawDown										
Annual Withdrawal %:	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
Average (of the 12 months)	-16.75%	-17.74%	-18.89%	-20.30%	-21.87%	-23.59%	-25.46%	-27.30%	-29.14%	-31.15%
Standard Deviation	0.31%	0.62%	0.89%	1.08%	1.15%	1.10%	1.03%	1.10%	1.27%	1.30%
Maximum (abs. values)	-17.43%	-19.07%	-20.70%	-22.31%	-23.90%	-25.47%	-27.03%	-28.57%	-30.49%	-32.80%
Minimum (abs. values)	-16.60%	-17.43%	-18.26%	-19.12%	-19.96%	-21.31%	-22.98%	-24.62%	-26.25%	-28.54%

* The whole period goes from 1994 to 2008. Statistics are the average by withdrawing in different months inside the year.

MAR=3% annual

Note in Table IV that even withdrawing 10% of the yearly returns, we obtain a positive annual return of 3.36%. Of course, as we take a larger percentage from the returns the statistics get worse. In particular, note that for a withdrawal of 10% the Sharpe and Sortino ratios are almost equal to zero.

The last part of Table IV shows a particular study of the effects of the withdrawals in the Maximum Drawdown. Note that the more we take the greater the maximum drawdown gets. It is in average -

16.75% when we take 1%, but it becomes -31.15% in average when we take 10%. On the other hand, when the withdrawal is larger, the Maximum Drawdown is more volatile, note that the standard deviation increases as the withdrawal increases. It means that the decision of withdraw in a particular month of the year could be more important as the withdrawal is large.

5) Starting the portfolio in a different date

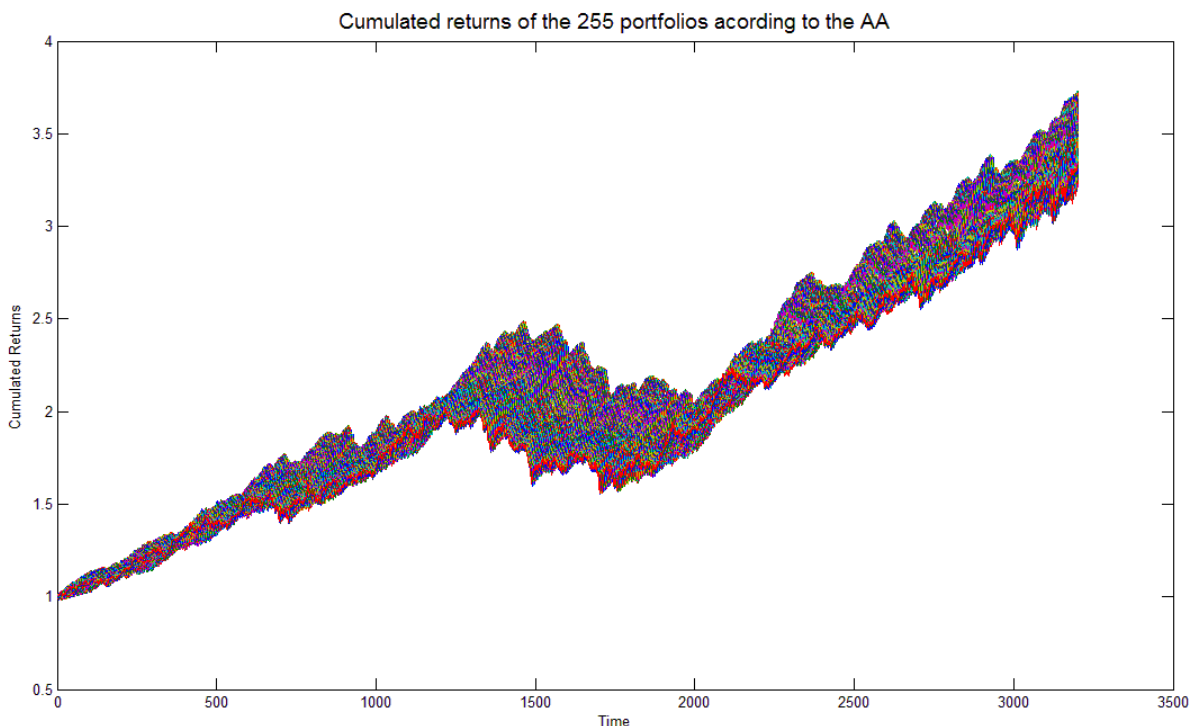
In this section we conduct an analysis of sensitivity in two strategies. First, we suppose that we start the AA portfolio in 255 different days and compute the different statistics. In second place, we conduct the same analysis for the TAA portfolio taking 21 different days.

1) Asset Allocation Portfolio

Figure 3 shows the evolution of the 255 AA portfolios and the Figure 4 shows the drawdown evolution of the portfolios.

Note in Table V that in average the strategy generates an annualized return of 10.34% which is still larger than the annualized returns of the S&P 500 and Eurostoxx 50 (see Table II), even the worst portfolio generates a annualized returns larger that the two assets (9.79%). On the other hand, in average, the maximum drawdown is -23.04% moving form a minimum of -23.54% to a maximum of -22.59%. These values are still less than the values corresponding to the S&P 500, CRB and the Eurostoxx 50 (see Table II). Considering the Modified VaR note that in the worst case we have a -0.63%, which is better than the AA, S&P 500, Eurostoxx 50 and CRB.

Figure 3: The 255 different AA portfolios



Studying the performance, we note that the Sharpe, Sortino and Calmar ratios are positive and larger than the corresponding ratios for S&P 500, CRB and Eurostoxx 50.

Figure 4: The 255 different drawdowns

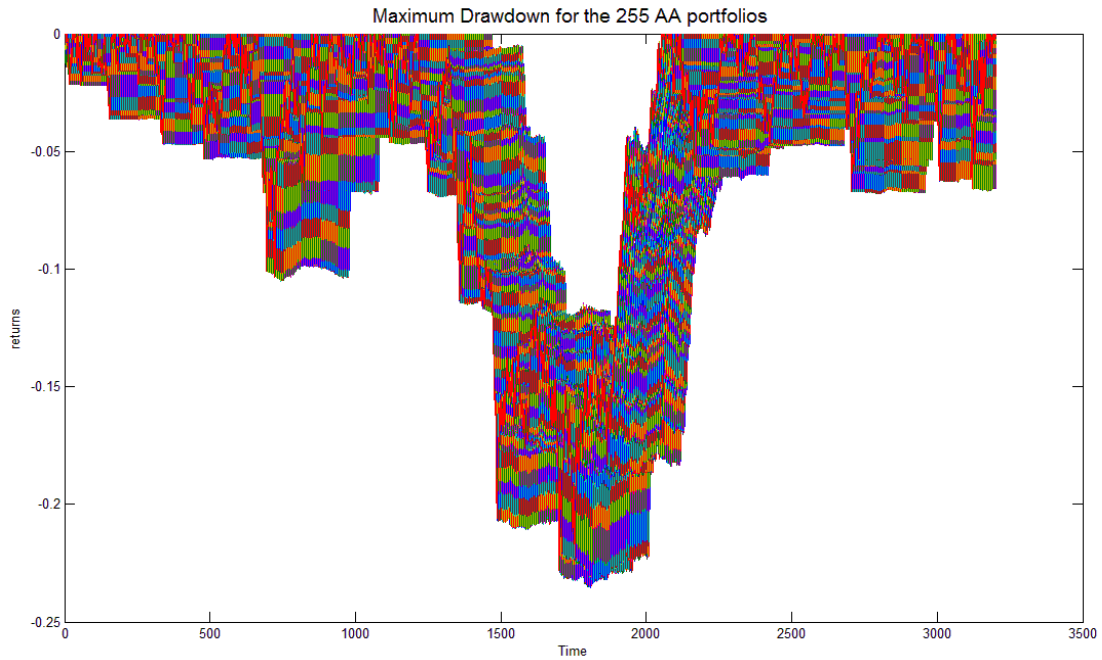


Table V: The performance of the 255 AA portfolios

PERFORMANCE STATISTICS*				
	Average	Standard Dev.	Minimum (1)	Maximum (1)
Total Cumulative Return	244.08%	12.22%	223.08%	271.88%
Annualized Rate of Return	10.34%	0.310%	9.79%	11.03%
Average Daily Return	0.04%	0.001%	0.04%	0.04%
Median Daily Return	0.05%	0.002%	0.05%	0.06%
Best Day	2.62%	0.083%	2.51%	2.82%
Worst Day	-2.35%	0.032%	-2.47%	-2.30%
% of Positive Days	54.33%	0.25%	53.94%	54.93%
Average Daily Gain	0.42%	0.007%	0.41%	0.43%
% of Negative Days	45.67%	0.25%	45.07%	46.06%
Average Daily Loss	-0.41%	0.007%	-0.43%	-0.41%
Excess Kurtosis	1.45	0.04	1.35	1.52
Skewness	-0.13	0.01	-0.14	-0.11

RISK STATISTICS				
	Average	Standard Dev.	Minimum (1)	Maximum (1)
Maximum Drawdown	-23.04%	0.21%	-23.54%	-22.59%
Annualized Standard Deviation	8.84%	0.14%	8.67%	9.10%
Annualized Downside Deviation	8.96%	0.14%	8.80%	9.22%
Daily Modified VaR $\alpha=-5\%$	-0.87%	0.01%	-0.90%	-0.86%

RISK ADJUSTED PERFORMANCE				
	Average	Standard Dev.	Minimum (1)	Maximum (1)
Sharpe Ratio	0.83	0.05	0.76	0.92

Sortino Ratio	0.82	0.05	0.74	0.91
Omega Ratio	1.20	0.01	1.19	1.22
Calmar Ratio	0.45	0.02	0.42	0.48

* The whole period goes from 1994 to 2008

MAR=3% annual

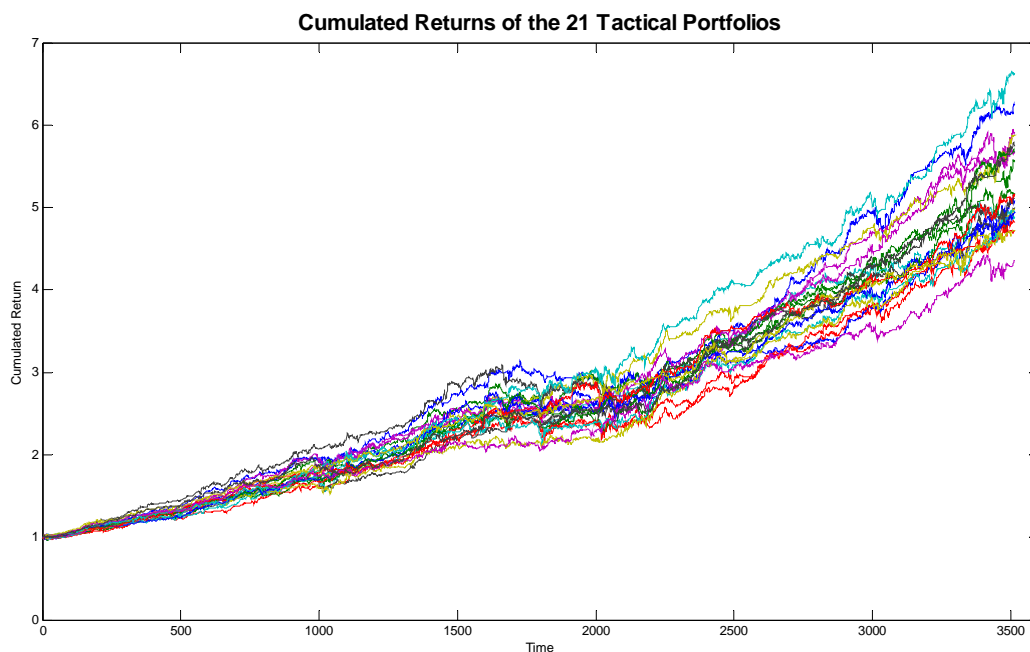
(1) Maximum and minimum respect to the 255 portfolios

2) Tactical Asset Allocation

In the present subsection we generate the Tactical Asset Allocation portfolios starting in 21 different days. Note, that the average annualized return is 12.83% with a minimum of 11.28% in the worst scenario and a maximum of 14.72% in the best scenario. In all the cases, the return is better than the S&P 500 and the Eurostoxx 50.

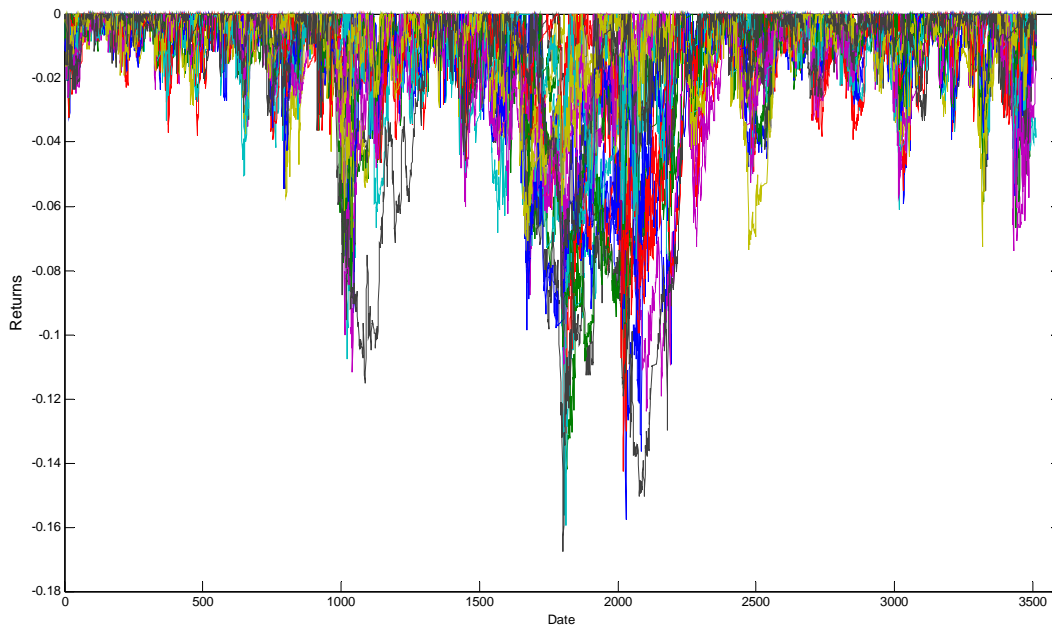
The maximum drawdown is in average -11.67% with -7.35% in the best scenario and -16.76% in the worst. Note that even in the worst scenario, the maximum drawdown is better than the corresponding MDD of AA, S&P 500, Bond Fund, CRB and the Eurostoxx 50 (see Table II).

Figure 5: The 21 different TAA portfolios



Note also that the TAA portfolio is very stable, in terms of annualized standard deviation is the best strategy. In the worst case the annualized standard deviation is 6.92%, however the S&P 500, Eurostoxx, CRB and Bond Fund have a standard deviation larger than the 14% (see Table II).

Figure 6: The Drawdown of the 21 different TAA portfolios



Due to the high performance in return and risk note that the risk adjusted statistics in table VI are the best. Note that if we consider the Sharpe, Sortino, Omega and Calmar ratios in the worst case, they are larger than the corresponding statistics in the case of S&P 500, Eurostoxx 50, CRB and the Bond Fund.

Table VI: The performance of the 21 TAA portfolios

PERFORMANCE STATISTICS*				
	Average	Standard Dev.	Minimum (1)	Maximum (1)
Total Cumulative Return	529.55%	56.70%	435.85%	663.06%
Annualized Rate of Return	12.83%	0.860%	11.28%	14.72%
Average Daily Return	0.05%	0.003%	0.04%	0.05%
Median Daily Return	0.02%	0.004%	0.02%	0.03%
Best Day	3.28%	0.43%	2.45%	3.88%
Worst Day	-2.24%	0.19%	-2.59%	-1.81%
% of Positive Days	60.89%	1.14%	59.25%	63.44%
Average Daily Gain	0.27%	0.013%	0.25%	0.29%
% of Negative Days	39.11%	1.14%	36.56%	40.75%
Average Daily Loss	-0.29%	0.013%	-0.32%	-0.26%
Excess Kurtosis	5.00	1.12	3.14	7.30
Skewness	0.16	0.14	-0.08	0.53

RISK STATISTICS				
	Average	Standard Dev.	Minimum (1)	Maximum (1)
Maximum Drawdown	-11.67%	2.97%	-16.76%	-7.35%
Annualized Standard Deviation	6.45%	0.32%	5.65%	6.92%
Annualized Downside Deviation	6.44%	0.32%	5.70%	7.02%
Daily Modified VaR $\alpha=5\%$	-0.56%	0.03%	-0.63%	-0.51%

RISK ADJUSTED PERFORMANCE				
	Average	Standard Dev.	Minimum (1)	Maximum (1)
Sharpe Ratio	1.52	0.13	1.32	1.74
Sortino Ratio	1.53	0.15	1.32	1.78
Omega Ratio	1.40	0.03	1.35	1.45
Calmar Ratio	1.17	0.32	0.75	1.93

* The whole period goes from 1994 to 2008

MAR=3% annual

(1) Maximum and minimum respect to the 21 portfolios

Conclusions

Faber (2006) considers a portfolio composed by different kind of asset and a strategy which takes care of the trend. We apply this strategy to a portfolio composed by US and European Stocks, bond fund and commodities using daily data. We show that even in the worst scenario the strategy produces a better portfolio than the stocks, bond funds and commodities, separately.

Reference

Faber, M. (2006), "A Quantitative Approach to Tactical Asset Allocation", Working Paper available at: <http://ssrn.com/abstract=962461>.