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Enhanced Portfolio Performance Using a Momentum Approach to Annual Rebalancing

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Abstract: After diversification, periodic portfolio rebalancing has become one of the most widely practiced methods for reducing portfolio risk and enhancing returns. Most of the rebalancing strategies found in the literature are generally regarded as contrarian approaches to rebalancing. A recent article proposed a rebalancing approach that incorporates a momentum approach to rebalancing. The momentum approach had a better risk adjusted return than either the traditional approach or a Buy-and-Hold approach. This article identifies an improvement to the momentum approach and then examines the impact of transactions costs and taxes on the portfolio performance of four active rebalancing approaches.

Keywords: rebalancing; momentum; portfolio performance; asset allocation

1. Introduction

The traditional 60 stock/40 bond portfolio allocation has evolved into a wide range of different approaches with numerous asset classes for both the equity side and the bond side. Many variations to rebalancing can be found in the literature over the last half century. As early as 1971, Pao Lun Cheng (Cheng 1971) found that "the rebalancing policy can be superior to the Buy-and-Hold policy, providing certain conditions are met". Since then, numerous contributions have been made to further identify and explain the benefits and market conditions that favor one approach over another.

The basic concept behind periodic portfolio rebalancing is that different asset classes revert to their mean, long-term trend on different schedules. As an asset class deviates from its long-term trendline in a positive manner, it provides a higher return compared to the others in a portfolio moving on or below their long-term trendline. The goal of rebalancing is to take some of the excess returns from the positive deviations before they return to their long-term trend and put the gains in the asset classes with negative deviations before they return to their long-term trend in a positive manner. Essentially, rebalancing provides a systematic way of "buying low and selling high".

Much of the literature up to the late 1990s focused on the 60/40 stock/bond split, including one of more often-cited papers by Perold and Sharpe (1988). They used the two asset classes to emphasize the fundamentals and then state that the concepts are readily generalized to other asset classes. They compared three dynamic asset allocation strategies to the Buy-and-Hold strategy (the do-nothing strategy) using a 60/40 stock/bill split. The other three are considered dynamic strategies. The first of the three strategies is the Constant-Mix strategy, which maintains the exposure to stocks as a constant fixed percentage of the portfolio. The other two strategies are Constant-Proportion Portfolio Insurance (CPPI) and Options-Based Portfolio Insurance (OPBI).

To implement the Constant-Proportion strategy, the investor selects a multiplier and a floor below which the investor does not want the portfolio value to fall. The Option-Based Portfolio Insurance (OPBI) does not use puts and calls. The investor begins by specifying an investment horizon and a desired floor value at that horizon. The typical OPBI strategy consists of a set of rules designed to give the same payoff at the horizon as would a portfolio composed of bills and call options.

Perold and Sharpe found that Constant-Mix has less downside protection than, and not as much upside as, Buy-and-Hold. They do best in relatively trendless, but volatile markets. The CPPI and OPBI strategies have better downside protection and better upside potential than the Buy-and-Hold strategies. They do worse in relatively trendless, volatile markets.

Dichtl et al. (2016) examined historical data from the United States, the United Kingdom and Germany over the 1982 to 2011 period. They also focused on a 60/40 stock/bond split. They compared three different classes of rebalancing to the Buy-and-Hold strategy based on the theoretical foundations of the Perold and Sharpe research. They looked at two issues. First, since rebalancing strategies represent the sale of the better performing assets and the proceeds invested in the weaker performing asset, does rebalancing generate a value added for the investor. Second, if rebalancing provides added value to the investor which is the optimal rebalancing strategy.

Dichtl et al. provide simulation evidence that all rebalancing strategies (periodic, threshold and range rebalancing with yearly, quarterly and monthly trading intervals) significantly outperform Buy-and-Hold for all countries and for all investment horizons (5- and 10-year). In addition, they found that while rebalancing on average provides value added to the investor, their results suggest that the choice of a specific rebalancing strategy is of only minor importance.

The original rebalancing strategies have evolved into many variations. Opportunistic Rebalancing (Daryanani 2008) and Dynamic Asset Allocation Using Momentum (Miccolis and Goodman 2012) are recent variations that attempt to squeeze more value out of the rebalancing strategies. Both, however, drift from the original objective rules of rebalancing and add a subjective element that may enhance return, but with increased complexity. Opportunistic Rebalancing does not use a fixed calendar time, but creates tolerance bands that guide the frequency of rebalancing. When an asset class drifts out of the preset ban, trades are executed to return the asset class to its original band. Daryanani states that this approach doubles the benefits of the more traditional annual rebalancing approach.

Miccolis and Goodman claim that their approach enables the investor to make more informed choice about when to rebalance by "checking the pulse of the market". They use momentum by calculating the moving average to extract information to guide the rebalancing decision. They report on 50-day and 250-day moving averages for market and asset class indicators. When the particular asset class is above the predetermined moving average, then stay invested; otherwise, they recommend selling it. They found that each of the variations had unique strengths under different market circumstances. This approach seems to add a timing element to rebalancing and the likelihood of selecting the wrong moving average ranges and buy/sell signals for a given market environment.

All the strategies and variations detailed are built on the theory of selling some of the "winners" and using the proceeds to buy some of the "losers". Specifically, the essence of rebalancing is mean reversion, the tendency for asset classes to return to their long-term trend line when they venture to far in either direction from it. Miccolis and Goodman state that "Momentum and mean reversion can be seen as opposites. Momentum continues until it runs out of steam, then mean reversion takes over as the driving force, leading the momentum in the other direction".

The approaches detailed above are generally considered to be contrarian approaches to portfolio asset allocation (Sharpe 2010). Unlike the Miccolis and Goodman use of momentum, Mattei and Mattei (2016) wondered if there was a rebalancing strategy based on a momentum rule that does not buy the weakest performing asset classes as opposed to a contrarian approach where the winning asset classes are sold and the proceeds used to purchase the weaker performing asset classes. They developed a momentum strategy and a more extreme contrarian strategy, then compared them to Buy-and-Hold and the traditional fixed rebalancing strategy.

In that paper, several rebalancing strategies were introduced that ranged from a 100% Momentum strategy to a 100% Contrarian strategy. In the 100% Momentum strategy, the total portfolio is equally divided across on the top four asset classes of the prior year. At the end of the year, the portfolio is rebalanced such that the entire portfolio is equally spread across the top four asset classes of the prior

year. In the 100% Contrarian strategy, the total portfolio is equally spread across the lowest performing four asset class from the prior year.

This study makes two important contributions to the literature, as well as to investment practice. First, the research demonstrates the superiority of a more diversified approach to the original Mattei and Mattei momentum strategy. By carefully selecting six of the eight asset classes, it is shown that the ending portfolio value is higher than for the four-asset class approach with a better Sharpe ratio. The second contribution is that the results can be achieved in actual practice, not just in theory. By examining the transaction costs and tax implications, this paper demonstrates that the more diversified momentum strategy performs better, in actual practice, than any of the contrarian approaches found in the literature and the original momentum approach (Mattei and Mattei 2016).

2. Update to Original Momentum Strategy

Table 1 contains the results of the original Mattei and Mattei research with three additional years of historical data added. It shows that the 100% Momentum approach continues to outperform all the other active strategies; however, none are an improvement over Buy-and-Hold for the shorter five-year period. As in Perold and Sharpe, the Buy-and-Hold strategy is used as an anchor point for the more complex approaches. The Fixed Annual Rebalancing is the same as the Constant-Mix strategy detailed in Perold and Sharpe, but with more asset classes.

Table 1. Portfolio performance of the original models.

Comparison of Portfolio Strategies	1992–2011 (20 Years)				2012–2016 (5 Years)			
No Transaction Costs or Taxes	**Value End of 2011**	**Mean ROI**	**Std Dev**	**Sharpe Ratio**	**Value End of 2016**	**Mean ROI**	**Std Dev**	**Sharpe Ratio**
Buy and Hold	$353,343	8.60%	13.38%	0.00	$208,123	9.88%	6.89%	0.00
Fixed Annual Rebalancing	$388,462	8.92%	12.03%	0.03	$161,641	6.10%	6.78%	−0.56
100% Momentum	$422,018	9.36%	11.90%	0.06	$230,274	7.57%	9.12%	−0.25
100% Contrarian	$346,185	8.48%	13.78%	−0.01	$98,435	4.64%	7.35%	−0.71

The original Momentum and Contrarian models were developed using a time frame extending from January 1992 through year end 2011. This time frame encompassed a number of bull, bear and flat markets and avoids any bias introduced by a single market condition. The models were then tested with five years of data (2012–2016) that was "held back" to validate the models. The percent change for each asset class for each year are listed in Appendix A. The original portfolio had $80,000 spread equally (12.5%) across eight asset classes ($10,000 in each asset class) as reported by MFS (2017) and defined as:

Commodities:	Dow Jones—UBS Commodity Index
Bonds:	Barclays U.S. Aggregate Bond Index
Global Bonds:	JPMorgan Global Government Bond Index (unhedged)
International Stocks:	MSCI EAFE Index
Large Cap Growth Stocks:	Russell 1000 Growth Index
Large Cap Value Stocks:	Russell 1000 Value Index
Real Estates Securities:	FTSE NAREIT All REITs Total Return Index
Small/Mid Cap Stocks:	Russell 2500 Index

The reference portfolio for all strategies is Buy-and-Hold wherein the original $10,000 is increased or decreased each year based on the performance of the asset class. The Buy-and-Hold strategy is considered a passive approach, since there are no Buy-and-Sell transactions; in other words, the initial investments grow or shrink "organically" over time. Essentially, it was untouched over the modeling period of 1992 to 2011. All the other portfolio approaches are considered active strategies.

In order to minimize the weaknesses of backtesting, all approaches were tested with a validation data set for the five years beginning January 2012 to the end of the year 2016. The first column lists the specific asset allocation approach. The set of columns labeled 1992–2011 lists the performance of each

approach using the modeling data set only. The columns labeled 2012–2016 list the performance of the portfolio using the validation data set only.

The mean ROI is the average of the percent change in the total value of the portfolio from the prior year. The standard deviation is calculated over time for the range of mean ROIs. The Sharpe Ratio for 100% Momentum is calculated as follows: (100% Momentum Mean ROI − Buy-and-Hold Mean ROI)/100% Momentum Standard Deviation.

The Sharpe Ratio for the 100% Momentum approach is: (9.36–8.60)/13.38%. The results of the initial analyses indicated that the 100% Momentum approach provided a slightly higher risk adjusted return than any of the other rebalancing approaches. In addition, the results indicated that the traditional Fixed Annual Rebalancing was not much better that the Buy-and-Hold approach over the longer period and substantially inferior over the shorter validation period.

3. Three Diversified Momentum Approaches

While the above results were interesting, there is a downside. The 100% Momentum approach is not well diversified. There are only four asset classes out of the total of eight asset classes in the portfolio each year. This raised the question: "Would it be possible to increase the diversification of the momentum portfolio by adding a few more asset classes and still obtain a higher risk adjusted return using a momentum strategy?"

To answer this question, additional analyses were run by considering the top, middle and lowest six performing asset classes from the prior year. These three approaches were evaluated by rebalancing the initial portfolio by selecting the Top 6 asset classes (rank order 1–6) from the prior year, the Middle 6 (rank order 2–7) and the Bottom 6 (rank order 3–8).

The Top 6 is essentially the same approach as the 100% Momentum described above, but with the next two asset classes, ranks 5 and 6 from the prior year added to the portfolio. The Bottom 6 is similar to the 100% Contrarian described above, but ranks 3 and 4 from the prior year are included in the rebalancing. The Middle 6 provides a range that does not include the best performing or worst performing asset classes from the prior year, specifically ranks 2–7.

4. Portfolio Performance Comparisons

The results of these three additional approaches, Top 6, Middle 6 and Bottom 6 are listed in Table 2. The results are quite surprising. The Top and Middle strategies produced results that are superior to all other approaches, including the 100% Momentum approach, in the modeling period from 1992 to 2011. In the five-year period, which was not used to develop the original model, the Top 6 and Middle 6 also outperformed all other approaches in ending value although the Sharpe ratio was lower than Buy-and-Hold, but better than the other active strategies.

Table 2. Seven rebalancing strategies with model and validation set performances.

Comparison of Portfolio Strategies	1992–2011 (20 Years)				2012–2016 (5 Years)			
No Transaction Costs or Taxes	**Value End of 2011**	**Mean ROI**	**Std Dev**	**Sharpe Ratio**	**Value End of 2016**	**Mean ROI**	**Std Dev**	**Sharpe Ratio**
Buy and Hold	$353,343	8.60%	13.38%	0.00	$208,123	9.88%	6.89%	0.00
Fixed Annual Rebalancing	$388,462	8.92%	12.03%	0.03	$161,641	6.10%	6.78%	−0.56
100% Momentum	$422,018	9.36%	11.90%	0.06	$230,274	7.57%	9.12%	−0.25
100% Contrarian	$346,185	8.48%	13.78%	−0.01	$98,435	4.64%	7.35%	−0.71
Top 6: 1, 2, 3, 4, 5, 6	$456,498	9.69%	11.14%	0.10	$276,391	7.98%	8.82%	−0.22
Middle 6: 2, 3, 4, 5, 6, 7	$448,451	9.66%	11.85%	0.09	$279,555	8.20%	8.75%	−0.19
Bottom 6: 3, 4, 5, 6, 7, 8	$396,419	9.08%	12.81%	0.04	$153,882	5.62%	7.26%	−0.59

Comparing the Sharpe Ratios between the 20-year period and 5-year period is inappropriate, since the standard deviation in the denominator will be much higher for a shorter period of time. A better comparison of the portfolio performance is to compare the original 20-year period with the

20-year period from 1997 to 2016, which includes the validation data as shown in Table 3. The Top 6 and Middle 6 approaches consistently outperformed the other five approaches.

Table 3. Twenty-year comparison of model data set with data set including validation set.

Comparison of Portfolio Strategies	1992–2011 (20 Years)				1997–2016 (20 Years)			
No Transaction Costs or Taxes	**Value End of 2011**	**Mean ROI**	**Std Dev**	**Sharpe Ratio**	**Value End of 2011**	**Mean ROI**	**Std Dev**	**Sharpe Ratio**
Buy and Hold	$353,343	8.60%	13.38%	0.00	$417,250	7.87%	12.85%	0.00
Fixed Annual Rebalancing	$388,462	8.92%	12.03%	0.03	$405,733	7.57%	11.59%	−0.03
100% Momentum	$422,018	9.36%	11.90%	0.06	$511,051	8.64%	11.91%	0.06
100% Contrarian	$346,185	8.48%	13.78%	−0.01	$297,213	6.51%	13.35%	−0.10
Top 6: 1, 2, 3, 4, 5, 6	$456,498	9.69%	11.14%	0.10	$593,375	9.22%	10.94%	0.12
Middle 6: 2, 3, 4, 5, 6, 7	$448,451	9.66%	11.85%	0.09	$588,791	9.23%	11.37%	0.12
Bottom 6: 3, 4, 5, 6, 7, 8	$396,419	9.08%	12.81%	0.04	$406,344	7.63%	12.30%	−0.02

5. Portfolio Performance Comparisons Including Transaction Costs

The performance of the Top 6 and Middle 6 strategies are promising, but the next question is: "how will they perform in a real investing environment?" To assess the performance under actual investing conditions this and the next section examine the impact of transaction cost and taxes. For instance, the Top 6 strategy may signal many more transactions that could reduce the additional performance gains. Likewise, the differences in the number and timing of transactions could result in a higher tax burdens further reducing the performance benefits.

This section will examine transaction costs only, and the following section will add taxes to the analysis. For this and the next section a buy or sell transaction cost is assumed to be $7.00; a reasonable amount in the current investing environment. The following table was used to determine the timing, number of transactions and the transactions costs for each year. A rebalancing transaction is assumed to take place (or not take place) given the set of conditions in Table 4.

Table 4. Transaction decision conditions leading to a buy, sell or no transaction.

End of Current Year	Beginning of Next Year, the Asset Class	Transaction
Owned	Needs to be increased by more than $500	Buy
Owned	Needs to be decreased by more than $500	Sell
Owned	Maintained since the increase is less than $500 or decrease is less than $500	None
Owned	Does not need to be in the portfolio	Sell
Not owned	Does not need to be added	None

Over the 20-year time period, the Buy-and-Hold strategy required no transactions. The Fixed Annual Rebalancing required 135 transactions to maintain the original percentages. The Top 6, Middle 6 and Bottom 6 required 130, 132 and 136 transactions, respectively, to implement the approaches. The effects of the transaction costs are shown in Table 5.

There are, at most, 160 transactions that could be required over the 20-year period. Even though the Top 6, Middle 6 and Bottom 6 approaches only invest in six asset classes, they are taken from a universe of eight, so the maximum number of transaction counts is 160 for them, too. Essentially, all the active strategies required an average of 6.5 to 6.9 transactions a year for the eight asset classes or 81% to 85% of the maximum number of transactions, so there is little difference in transaction costs between the active approaches.

The impact on portfolio performance is quite small, and the Sharpe Ratios are the same to the second decimal place. The transaction costs for the Fixed Annual Rebalancing over the 20-year, 1992–2011 period, were $959. For the Top, Middle and Bottom 6 approaches, the costs were slightly, but not significantly, lower; $910, $924 and $952, respectively. Essentially transaction costs had a

minor impact on overall portfolio performance reducing it by approximately $2000 for the four active approaches by the end of the 20-year period, and the performance impact is minimal when compared to the Buy-and-Hold strategy.

Table 5. Impact of transaction costs on twenty years from 1992–2011.

Comparison of Portfolio Strategies		**1992–2011 (20 Years)**		
No Transaction Costs or Taxes	**Value end of 2011**	**Mean ROI**	**Std Dev**	**Sharpe Ratio**
Buy and Hold	$353,343	8.60%	13.38%	0.00
Fixed Annual Rebalancing	$388,462	8.92%	12.03%	0.03
Top 6: 1, 2, 3, 4, 5, 6	$456,498	9.69%	11.14%	0.10
Middle 6: 2, 3, 4, 5, 6, 7	$448,451	9.66%	11.85%	0.09
Bottom 6: 3, 4, 5, 6, 7, 8	$396,419	9.08%	12.81%	0.04
After Transaction Costs Only		1992–2011 (20 years)		
Buy and Hold	$353,343	8.60%	13.38%	0.00
Fixed Annual Rebalancing	$386,660	8.90%	12.02%	0.03
Top 6: 1, 2, 3, 4, 5, 6	$454,453	9.66%	11.13%	0.10
Middle 6: 2, 3, 4, 5, 6, 7	$446,361	9.63%	11.84%	0.09
Bottom 6: 3, 4, 5, 6, 7, 8	$394,408	9.06%	12.80%	0.04

6. Portfolio Performance Comparisons Including Transaction Costs and Taxes

The final question examined in this research answers the question, "What is the impact of taxes and transactions costs on overall portfolio performance?" Answering this question requires a number of rather complex calculations based on a considerable list of reasonable assumptions. The tax and performance calculations are based on the following assumptions:

1. All gains and losses are treated as long-term, and taxed at 15%.
2. Transaction costs are a taxable expense and decrease the tax liability.
3. If the amount invested for the following year is within ±$500 of the current year, no sale is executed so no tax liability is incurred.
4. If the tax liability after transaction costs is less than $0, the loss is carried forward to the following tax year.
5. Tax loss carryforwards are only applied to the test portfolio; in other words, they do not shelter other income.
6. Taxes paid at the end of the current year reduce funds invested at the beginning of the following year.
7. If there is no tax liability for the current year (after the carryforward), the amount available for reinvestment is not altered.
8. The tax cost basis for gains and losses are assumed to be the beginning of year value of the asset class.

To calculate the tax liability of a sale, the percent of the ending value of each asset class that needs to be sold is determined. This percentage is then multiplied times the net gain or loss for the year which is then multiplied by the assumed tax rate of 15%. The last assumption significantly reduces the complexity of the calculations, but will tend to understate gains for all four active approaches shown in Tables 6–8.

Table 6 shows the ending portfolio values and Sharpe ratios for both 20-year periods before and after transaction costs and taxes. In all four scenarios, the Top 6 approach has the highest ending portfolio value and highest Sharpe ratio. The Sharpe ratios show the greatest impact of transaction costs and taxes were for the Middle 6 and Bottom 6 strategies for both 20-year time frames.

Table 6. Twenty-year portfolio performance including transaction costs and taxes.

Comparison of Portfolio Strategies	1992–2011 (20 Years)				1997–2016 (20 Years)			
No Transaction Costs or Taxes	**Value End of 2011**	**Mean ROI**	**Std Dev**	**Sharpe Ratio**	**Value End of 2011**	**Mean ROI**	**Std Dev**	**Sharpe Ratio**
Buy and Hold	$353,343	8.60%	13.38%	0.00	$417,250	7.87%	12.85%	0.00
Fixed Annual Rebalancing	$388,462	8.92%	12.03%	0.03	$405,733	7.57%	11.59%	−0.03
Top 6: 1, 2, 3, 4, 5, 6	$456,498	9.69%	11.14%	0.10	$593,375	9.22%	10.94%	0.12
Middle 6: 2, 3, 4, 5, 6, 7	$448,451	9.66%	11.85%	0.09	$588,791	9.23%	11.37%	0.12
Bottom 6: 3, 4, 5, 6, 7, 8	$396,419	9.08%	12.81%	0.04	$406,344	7.63%	12.30%	−0.02
After Transaction Costs & Taxes	1992–2011 (20 years)				1997–2016 (20 years)			
Buy and Hold	$353,343	8.60%	13.38%	0.00	$417,250	7.87%	12.85%	0.00
Fixed Annual Rebalancing	$377,487	8.76%	12.00%	0.01	$378,504	7.31%	11.55%	−0.05
Top 6: 1, 2, 3, 4, 5, 6	$449,541	9.60%	11.10%	0.09	$581,828	9.16%	10.93%	0.12
Middle 6: 2, 3, 4, 5, 6, 7	$412,136	9.19%	11.83%	0.05	$516,991	8.73%	11.38%	0.08
Bottom 6: 3, 4, 5, 6, 7, 8	$334,221	8.15%	12.69%	−0.03	$308,558	6.72%	12.19%	−0.09

Table 7 shows the difference in ending portfolio balances, comparing before and after transaction costs and taxes for the two 20-year periods. The Middle 6 and Bottom 6 were impacted the most by these costs while the Fixed Annual Balancing and Top 6 approaches were substantially lower and quite similar in magnitude.

Table 7. Tax impact on ending portfolio value.

Portfolio Strategy	Difference	
	1992–2011	1997–2016
Buy and Hold	$0	$0
Fixed Annual Rebalancing	−$10,974	−$27,229
Top 6: 1, 2, 3, 4, 5, 6	−$6,957	−$11,547
Middle 6: 2, 3, 4, 5, 6, 7	−$36,315	−$71,800
Bottom 6: 3, 4, 5, 6, 7, 8	−$62,198	−$97,786

The actual tax liabilities for the 25-year time period by strategy are shown in Table 8. The Top 6 approach not only resulted in no tax liability, it generated a tax loss carryforward of $9422, which creates a tax reduction for those investors with other income that can be sheltered from taxes. Assuming the marginal rate of 30%, this carryforward would reduce one's tax liability by approximately $2800 in addition to the superior portfolio performance.

Table 8. Tax liabilities for each approach over the 25-year time horizons.

Portfolio Strategy	1992–2016 Capital Gains Taxes Paid, Net of Tax Loss Carryforwards	1992–2016 Tax Loss Carryforwards
Buy-and-Hold	Assumed $0	$0
Fixed Annual Rebalancing	$7325	$0
Top 6 Approach	$0	$9422
Middle 6 Approach	$28,390	$0
Bottom 6 Approach	$49,497	$0

Despite the tax simplifications, the trends are quite telling. If rebalancing is performed in taxable accounts, there is substantial impact on the ending portfolio balance for both 20-year time periods. The Sharpe Ratios are somewhat lower between the results without transaction costs and taxes and the results that include them, but consistent between the earlier 20-year period and the later 20-year period.

7. Conclusions

In a portfolio made up of a wide range of asset classes, this research suggests avoiding investments in the prior year's poorest-performing asset class. The three active strategies that invest in poorest performing asset class from the prior year, namely Fixed Annual, 100% Contrarian and Bottom 6 underperformed all other active strategies for every time frame in all scenarios with and without transaction costs and tax considerations.

The data analyzed for this research has spanned major bull and bear markets including the Dot-Com bubble and the Great Recession. Given the wide range of market returns over this 25-year time period, it seems unlikely that the results are an aberration unique to this particular time frame or set of asset classes. Using five years of validation data that was held back from the original research should counter any concerns that the model was fit to the data instead of being created from the data.

The results of this research bring into question the advisability of Fixed Annual Rebalancing, which has become the de facto portfolio management strategy. While Fixed Annual Rebalancing makes intuitive sense, the results of this research question investing in the poorest performing asset class. Is selling the best performing asset classes of the prior year cutting short the full potential of momentum, or is buying the poorest performing asset classes penalizing the investor for entering into these asset classes too soon? This question warrants more investigation.

It is quite possible that the widespread use of the Fixed Annual Rebalancing approach has created an inefficiency in the market that results in a higher risk adjusted return for the approaches that avoid investing in the lower performing asset classes. Only time will tell if it is, indeed, an inefficiency, assuming a momentum approach that avoids the poorest performing asset class becomes more widespread. In the meantime, it seems to be a superior asset allocation strategy.

In addition to the question noted above, future research will focus on two areas. First, can the Top 6 strategy be generalized to other mixes of asset classes? Did the eight classes used for this research provide results that would not be obtained with a different mix of asset classes? A variation on this investigation would be to analyze the performance using six, 10 or even 12 asset classes. While it would be difficult to compare the momentum strategies detailed here to the earlier research using the 60/40 split, it might be possible to select asset classes such that 60% (about five) are equity-based and the other 40% (about three) are fixed income.

A second area for further study is to analyze the performance of the momentum strategies over shorter time periods. Five- and ten-year rolling periods are quite common in the literature. This area of investigation would help determine if there are specific market conditions that favor one strategy over another. Most of the articles cited indicate that the various traditional rebalancing strategies performed better in some market conditions than other approaches. It would be interesting to see how the momentum strategies compare to each other under differing market conditions and also how they compare to the traditional rebalancing strategies under the different market conditions.

Conflicts of Interest: The author declared no conflict of interest.

Appendix

Percent change from prior calendar year data for 1992 to 2016.

Year	Inter-National	Large-Cap Growth	Large-Cap Value	Small/Mid-Cap	Bonds	Global Bonds	REITs	Commodities
1992	−0.1185	0.0499	0.1358	0.1609	0.0740	0.0455	0.1217	0.0370
1993	0.3294	0.0287	0.1807	0.1655	0.0975	0.1227	0.1855	−0.0107
1994	0.0806	0.0262	−0.0198	−0.0105	−0.0292	0.0128	0.0081	0.1661
1995	0.1155	0.3718	0.3836	0.3170	0.1847	0.1932	0.1831	0.1521
1996	0.0636	0.2312	0.2164	0.1903	0.0363	0.0440	0.3575	0.2316
1997	0.0206	0.3049	0.3518	0.2436	0.0965	0.0140	0.1886	−0.0339
1998	0.2033	0.3871	0.1563	0.0038	0.0869	0.1531	−0.1882	−0.2703
1999	0.2730	0.3316	0.0735	0.2414	−0.0082	−0.0508	−0.0648	0.2435

Year	Inter-National	Large-Cap Growth	Large-Cap Value	Small/Mid-Cap	Bonds	Global Bonds	REITs	Commodities
2000	−0.1396	−0.2242	0.0701	0.0427	0.1163	0.0234	0.2589	0.3184
2001	−0.2121	−0.2042	−0.0559	0.0122	0.0844	−0.0079	0.1550	−0.1951
2002	−0.1566	−0.2788	−0.1552	−0.1780	0.1025	0.1937	0.0522	0.2591
2003	0.3917	0.2975	0.3003	0.4551	0.0410	0.1451	0.3847	0.2393
2004	0.2070	0.0630	0.1649	0.1829	0.0434	0.1010	0.3041	0.0915
2005	0.1402	0.0526	0.0705	0.0811	0.0243	−0.0653	0.0829	0.2136
2006	0.2686	0.0907	0.2225	0.1617	0.0433	0.0594	0.3435	0.0207
2007	0.1163	0.1181	−0.0017	0.0138	0.0697	0.1081	−0.1783	0.1623
2008	−0.4306	−0.3844	−0.3685	−0.3679	0.0524	0.1200	−0.3734	−0.3565
2009	0.3246	0.3721	0.1969	0.3439	0.0593	0.0190	0.2745	0.1891
2010	0.0821	0.1671	0.1551	0.2671	0.0654	0.0642	0.2758	0.1683
2011	−0.1173	0.0264	0.0039	−0.0251	0.0784	0.0722	0.0728	−0.1332
2012	0.1790	0.1526	0.1751	0.1788	0.0421	0.0130	0.2014	−0.0106
2013	0.2329	0.3348	0.3253	0.3680	−0.0202	−0.0450	0.0321	−0.0952
2014	−0.0448	0.1305	0.1345	0.0707	0.0597	0.0067	0.2715	−0.1701
2015	−0.0039	0.0567	−0.0383	−0.0290	0.0055	−0.0261	0.0229	−0.2466
2016	0.0151	0.0708	0.1734	0.1759	0.0265	0.0157	0.0928	0.1177

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