Sankala Group

Credit: *Thomas Denkenberger*

Rebalancing Alpha

Thomas Denkenberger

It is often said that there is no such thing as a free lunch. With investing, this seems particularly true because an increase in expected return is almost always paid for with an unpleasant increase in risk. Yet there is one famous example of an investing free lunch: Modern Portfolio Theory (MPT). MPT was developed by Harry Markowitz in his 1954 Ph.D. dissertation. Simply put, Markowitz mathematically showed that the sum of a portfolio could be greater than its individual parts. By setting target weights for each holding within a portfolio, and then rebalancing back to those targets on a regular time scale, he found that the portfolio had a slightly higher rate of return and a slightly lower risk than if he did not rebalance back to the target weights. This slightly higher rate of return is what we call “rebalancing alpha” - it is the return above a constant weight portfolio benchmark that is earned by rebalancing back to target weights. The slightly lower risk is accomplished by the rebalancing which systematically sells holdings that have grown above their target weights (and are thus at higher risk of falling) and buys more of holdings that have dropped below their target weights (and thus have less room to fall). Higher return with lower risk is the ultimate investment free lunch. This result was so powerful that Markowitz was awarded the Nobel Prize in Economics in 1990.

To celebrate the 30th anniversary of this momentous Nobel Prize, in this letter we take the general concept of Modern Portfolio Theory a few steps further. We quantify rebalancing alpha at the portfolio and individual holding levels. Next, we explore which characteristics lead to higher rates of rebalancing alpha. Ultimately, using the insights gained, we design an optimized portfolio which harvests significantly more rebalancing alpha than an average portfolio.

We begin our analysis with the canonical 60/40 stock/bond portfolio during the 26 year period from September 1994 through August 2020 (Table 1). For stocks, we use the S&P 500 index represented by the low cost exchange traded fund (SPY), and for bonds we use the Barclays Aggregate Bond index represented by the low cost index mutual fund (VBMFX). By multiplying the simple rate of return of each holding by its portfolio weight, we find that the constant weight portfolio would have an annualized rate of return of 8.14%. But, when we rebalance the portfolio on a semi-annual basis, we find the actual rate of return is 8.43%. The difference between the two results is the portfolio level rebalancing alpha of 0.29%. In a low interest rate world, even this small extra return is significant.

Table 1: Simple 60/40 Rebalancing Alpha Portfolio

Holding	Weight (%)	Simple Return (%)	Rebalancing Alpha (%)	Std. Dev. (%)	US Mkt Correlation	Maximum Drop (%)
SPY	60	9.98	0.46	14.89	0.99	-50.80
VBMFX	40	5.38	0.16	3.52	-0.02	-3.99
Constant Weight Portfolio	100	8.14	0.00	9.04	0.97	-32.42
Semi-Annual Rebalanced Portfolio	100	8.43	**0.29**	8.92	0.97	-31.45

Progressing to the individual holding level, we replace one holding at a time with a money market fund, and recalculate the new portfolio's rate of return. After correcting for the difference in the simple rate of return of the holding versus the money market fund, we are able to isolate the rebalancing alpha directly attributable to the individual holding. Because rebalancing back to target weights results in systematically selling high (when a holding grows larger than its target) and buying low (when a holding declines below its target), we would expect that a more volatile asset would have a larger rebalancing alpha because there would be greater profits harvested when it rises higher, and better value purchased when it drops lower. Stocks are more volatile than bonds, and we find that, indeed, stocks have a rebalancing alpha of 0.46% while bonds have a rebalancing alpha of 0.16%.

Next, we increase the sophistication of the portfolio by adding additional asset classes while maintaining the same overall 60/40 stock/bond allocation. We replace the Barclays Aggregate Bond index with a mutual fund of long Treasury bonds (WHOSX), and we diversify 20% of our S&P 500 holding 10% into an international developed stock index mutual fund (DFALX), 5% into an emerging market stock index fund (VEIEX), and 5% into a gold miner stock mutual fund (OPGSX) (Table 2).

Table 2: Moderate 60/40 Rebalancing Alpha Portfolio

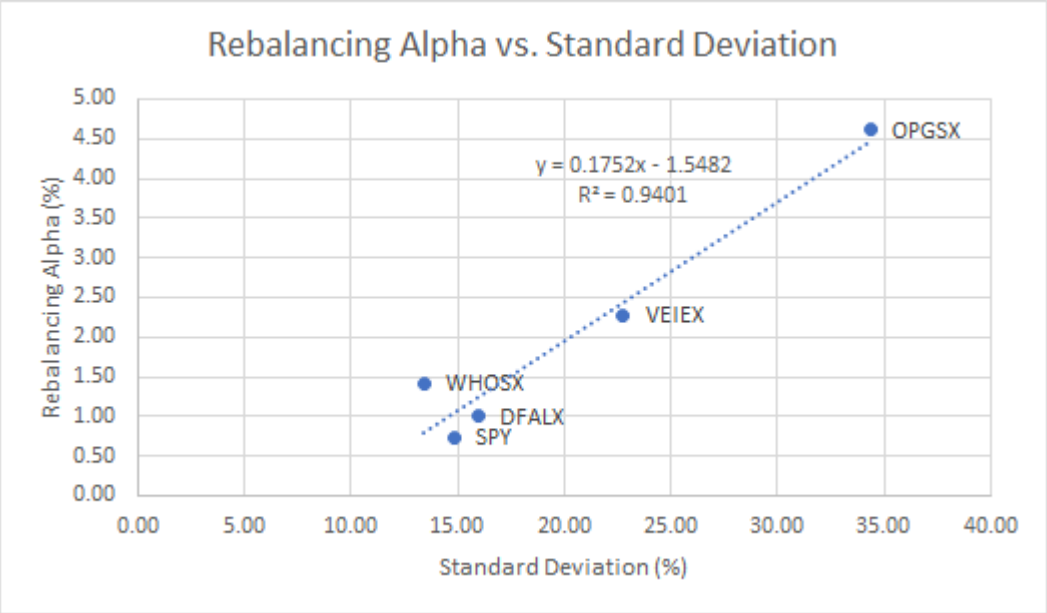
Holding	Weight (%)	Simple Return (%)	Rebalancing Alpha (%)	Std. Dev. (%)	US Mkt Correlation	Maximum Drop (%)
WHOSX	40	8.25	1.44	13.47	-0.28	-22.56
SPY	40	9.98	0.76	14.89	0.99	-50.80
DFALX	10	4.90	1.04	16.09	0.85	-55.97
VEIEX	5	5.35	2.39	22.70	0.77	-62.70
OPGSX	5	6.50	4.84	34.54	0.34	-77.97
Constant Weight Portfolio	100	8.37	0.00	9.41	0.77	-28.13
Semi-Annual Rebalanced Portfolio	100	9.54	**1.17**	9.29	0.74	-25.16

By including more volatile and less correlated assets, we increase the portfolio level rebalancing alpha from 0.29% up to 1.17%. This analysis was run over the same time period as Table 1, so it is interesting to note that the rebalancing alpha for SPY is actually higher in the second portfolio due to the beneficial effects of being paired with other more volatile and less correlated holdings. It is also important to see that the gold miner stock mutual fund (OPGSX) has a very large rebalancing alpha of 4.84%; so large that when combined with its simple rate of return, OPGSX's total return contribution is 11.34%! The standard intuition of only investing in assets that individually have a high return and low risk leads to a suboptimal outcome because you would never include OPGSX, which is extremely volatile and has had a lower return than SPY. Yet, when this individually inferior investment is included as part of a diversified portfolio, we find that its overall return contribution (simple return + rebalancing alpha) is greater than all of the other holdings, even the two that have a higher simple return.

A highly volatile investment is one that has large swings up and down. To quantify the magnitude of the normal distribution of these swings, we calculate what is called the standard deviation. For a portfolio, standard deviation can be understood as the plus or minus brackets around the average rate of

return. Observations around the average that occur 68% of the time are said to be within 1 standard deviation. The semi-annual rebalanced Moderate 60/40 portfolio in Table 2 has a rate of return of 9.54% with a standard deviation of 9.29%, which means that 68% of the time, the annual rate of return is 9.54% +/-9.29%. To explore the relationship between rebalancing alpha and standard deviation, we graphed them in Figure 1.

Figure 1: Rebalancing Alpha vs. Standard Deviation



We find a very strong positive correlation between standard deviation and rebalancing alpha. The one point on the graph which appears to have an anomalously large rebalancing alpha given its low standard deviation is the long Treasury bond mutual fund (WHOSX). This makes sense because the long Treasury fund is the only holding which is negatively correlated with all of the other portfolio holdings (See Table 2). This means that it pairs well to increase the rebalancing alpha of the other holdings because it zigs when they zag. Thus, its removal has a multiplier effect that reduces the rebalancing alpha of the other holdings, which has the effect of magnifying its individual rebalancing alpha. The equation from this chart allows us to estimate the likely rebalancing alpha of an individual holding based on its standard deviation. For example, bitcoin has not been around long enough to back test a reliable rebalancing alpha, but we know that its standard deviation for the past few years has been about 85% so we can calculate that its rebalancing alpha should be approximately 13%. This suggests that even if bitcoin has no simple return but maintains its volatility, it will add to the total rate of return of the portfolio as if it had grown at 13%.

While knowing a holding's correlation can be helpful in explaining deviations from the strong relationship between standard deviation and rebalancing alpha, we found that plotting rebalancing alpha vs. correlation produced no useful information (data not shown). Ultimately, a high standard deviation accurately predicts a high rebalancing alpha, while a low or negative correlation appears to slightly increase the rebalancing alpha.

Using the knowledge from the preceding analysis, we set out to design a diversified, risk-managed portfolio that is optimized to harvest a high rebalancing alpha. Because the key investment attribute which leads to a higher rebalancing alpha is a high standard deviation, we intentionally selected volatile holdings. The least volatile holding has a standard deviation of 13.17%, the average is 26.60%, and the most volatile is 58.57%. Despite the extreme volatility of each individual holding, when combined into a semi-annually rebalanced portfolio, the portfolio level standard deviation fell to only 11.58%: lower than any individual holding! The portfolio level rebalancing alpha is 3.12% (Table 3). While we are always skeptical of great looking back tests, we expect this rebalancing alpha result to be particularly robust because the primary driver is volatility, which we don't expect to be significantly different in the future. In terms of reducing risk, this portfolio has had a maximum drawdown of 24.88%, which is slightly better than the 25.16% drop of the Moderate 60/40, and significantly better than the 31.45% drop of the Simple 60/40.

Table 3: Optimized 60/40 Rebalancing Alpha Portfolio (*holdings not shown*)

Portfolio	Weight (%)	Simple Return (%)	Rebalancing Alpha (%)	Std. Dev. (%)	US Mkt. Correlation	Maximum Drop (%)
Constant Weight Portfolio	100	9.80	0.00	11.90	0.83	-28.72
Semi-Annual Rebalanced Portfolio	100	12.92	**3.12**	11.58	0.81	-24.88

By separating the simple rate of return of each portfolio holding from its rebalancing alpha, we are able to construct more efficient portfolios with the knowledge that a holding can add significant return above its simple rate of return. These results run counter to the standard intuition that each holding should ideally have high return and low risk. We find that building portfolios composed of only high return and low risk holdings leaves money on the table by failing to harvest higher rebalancing alpha. Thus, we aim to select holdings with both high return and high volatility in order to maximize the overall portfolio return. The careful inclusion of high risk holdings can produce a portfolio level rebalancing alpha approximately 3% above the Simple 60/40 portfolio.

In addition to increasing the return, this portfolio design also decreases the maximum drawdown risk. True to the promise of Modern Portfolio Theory, we are able to increase return and decrease

risk. While this result is a mathematical economic free lunch, psychologically it is not a completely free lunch because it requires us to endure large volatility at the level of the individual holdings. In fact, it was the fear of individual holding volatility which prompted us to write this letter to lay out our case for this non-intuitive, yet mathematically superior way to optimize portfolio design.

At the end of the day, portfolio design will always be a blend of art and science. We hope that our careful analysis will allow you to enjoy the free lunch of higher returns and lower risk, provided by our artfully built portfolios that leverage science to achieve significantly higher rebalancing alpha.

Best,

Thomas M. Denkenberger
Sankala Group LLC
T: (720) 549-3355