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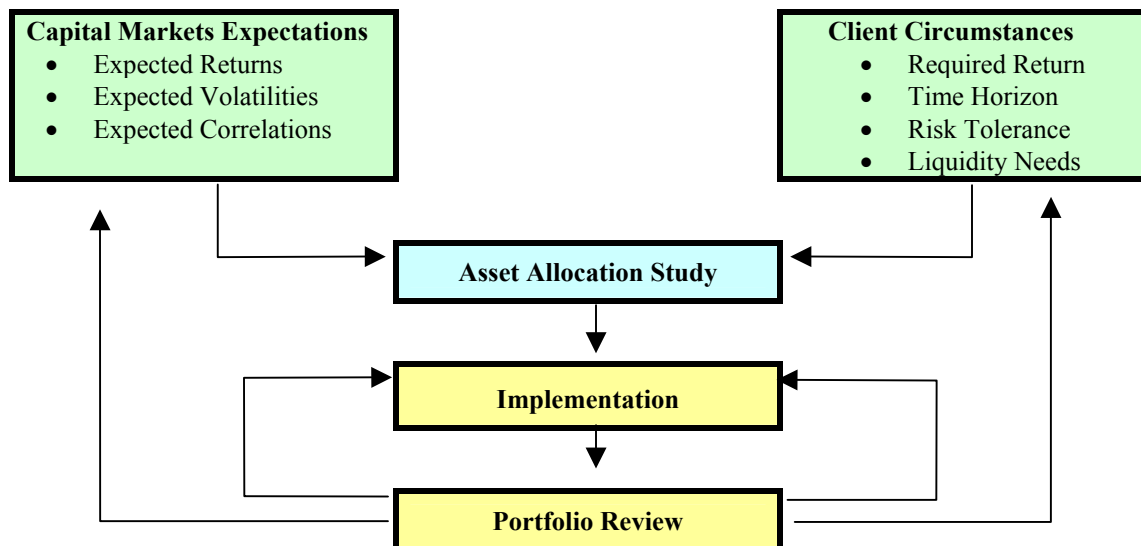Richard J. Tavis, *Investment Analyst*

# Portfolio Rebalancing

## The Asset Allocation Process

The process of asset allocation involves deciding what asset classes (e.g. stocks, bonds, etc.) a portfolio will be invested in, and how much money will be invested in each asset class. Various studies have concluded that asset allocation strategy determines as much as 95% of a portfolio's performance. The primary (perhaps, only) legitimate objective of any effective asset allocation strategy is for an investor to maximize the *probability* of meeting their investment goals over a stated timeframe. This isn't the same as maximizing returns. After all, an investor looking solely to maximize returns would invest 100% of their funds in the asset class with the highest expected return (and hope for the best).

The asset allocation process typically begins with an asset allocation study. This involves developing a set of capital market expectations, and an assessment of the client's unique circumstances, which in turn are used to determine an appropriate asset mix. Most institutional investors set initial allocations based on a five-year strategic timeframe. This doesn't preclude them from making tactical short-term "market timing bets" against the strategic target if market conditions warrant.

As the following chart indicates, a study and initial allocation are simply the *first* steps in the asset allocation process. Market movements will inevitably cause the portfolio's allocation to drift away from the initial asset mix.

**Capital Markets Expectations**
- Expected Returns
- Expected Volatilities
- Expected Correlations

**Client Circumstances**
- Required Return
- Time Horizon
- Risk Tolerance
- Liquidity Needs

**Asset Allocation Study**

**Implementation**

**Portfolio Review**

### Why Re-Balance?

At some point in time, an optimally allocated portfolio will have to be rebalanced back to its initial target allocation, unless changes in capital market conditions or the clients circumstances warrant a wholesale review of the asset allocation strategy.

To illustrate the rationale for rebalancing, we present the example of a portfolio with an initial 60% Stock / 40% Bond asset mix "typical" of an institutional investor. The equity sub-portfolio was invested 60% Large Cap Equities, 15% Small Cap Equities, and 25% International Equities. If one had bought this portfolio in July of 1980 and held it to June 2003, the 23-year compound results (compared to a target index rebalanced monthly without transactions costs) would have been as follows:

| *July 1980 – June 2003* | Portfolio | Target Index* |
|---|---|---|
| **Return** | 11.4% | 11.7% |
| **Standard Deviation** | 11.1% | 9.6% |
| **Tracking Error** | 2.08% | - |
| **Sharpe Ratio** | 0.40 | 0.49 |

*Rebalanced monthly assuming no transaction costs*

Over this entire extended timeframe the portfolio would have done slightly worse than the target index. But, from July 1980 to March of 2000, the portfolio gained an annualized 14.7%, or 50 bps *better* than the target index. By March 2000, generally strong equity market performance had caused the portfolio's exposure to stocks to drift upward, from a target weighting of 60% to nearly 83% of assets. After the equity market bubble collapsed in mid-2000, performance of the now equity heavy portfolio was considerably weaker than the benchmark. From March 2000 through July 2003, the portfolio lost 6.4%, or **4%** per annum more than the index. This more than erased the portfolio's previous lead.

Looking at statistical risk measures like standard deviation and tracking error shows (not surprisingly) that the portfolio's risk profile increased markedly as its equity exposure drifted upward. Consequently the portfolio's performance on a risk adjusted basis, as measured by the Sharpe Ratio, was considerably worse than that of the target index.

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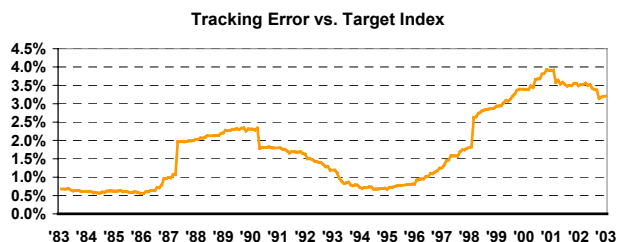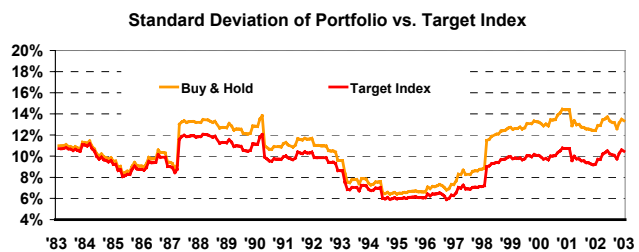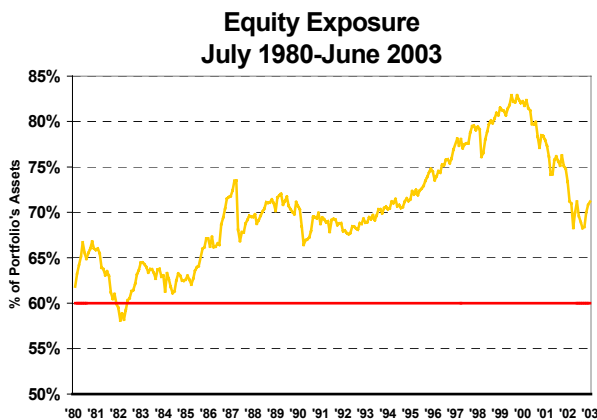
The above graphs demonstrate that letting an asset mix wander unchecked can undermine an investor's initial asset allocation decision. That's not to say that an expert application of tactical asset allocation can't be rewarding, or that an investor should slavishly adhere to a static mix if fundamental circumstances change. But, long-term investment market returns suggest that asset allocation needs to be approached thoughtfully on an ongoing basis, rather then simply "setting it and forgetting it".

### The Rebalancing Process

We have carefully studied the two primary approaches to portfolio rebalancing commonly used by institutional investors. The first is to rebalance the portfolio periodically (many institutions rebalance annually); the second is to rebalance the portfolio back to targets whenever actual asset allocation drifts beyond a pre-specified threshold. The specific algorithms we used to simulate the rebalancing strategies are as follows:

1. **Rebalance the Portfolio periodically**

- We started with the same initial 60% Stock / 40% Bond asset mix, with the equity sub-portfolio allocated 60% Large Cap Equities, 15% Small Cap Equities, and 25% International Equities.

- The portfolio was rebalanced annually, in June. We inserted the real world assumption that an investment committee receives June account balance information sometime in July. They use this 6/30 market value data to calculate the necessary rebalancing trades, and execute those trades at the end of July. This delay causes real world implementation "slippage."

- Transaction costs cannot be ignored and are notoriously difficult to estimate with any degree of accuracy. The reason is that explicit commissions are estimated to account for only 20% of the true cost of trading. The remaining 80% are hidden costs associated with market impact. Various studies have estimated the cost of trading US equities to be anywhere from a few basis points to four and a half percent. We have assumed transaction costs of 50 bps for Large Cap U.S. Equities, 200 bps for Small Cap US Equities, 150 bps for International Equity, and 35 bps for Domestic Fixed Income. From our research, we feel these are reasonably conservative figures.
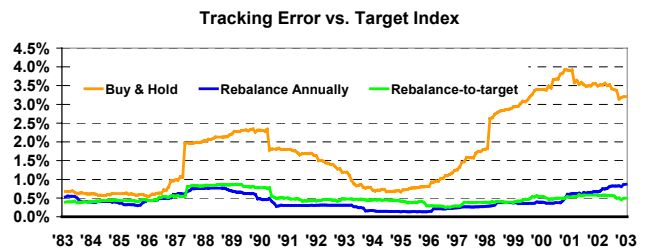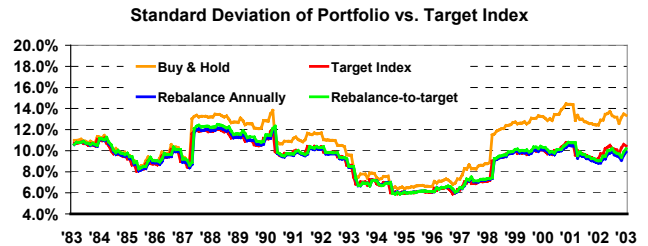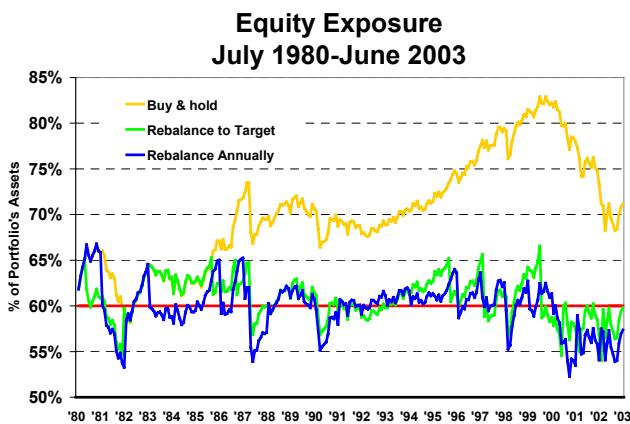
2. **Rebalance the Portfolio to keep within allocation "bands"**

- Starting with the same 60% Stock / 40% Bond asset mix, the decision to rebalance is triggered whenever the portfolio's Fixed Income allocation at any months' end passes beyond a ± 5% threshold versus its target allocation. For example, if the portfolio's fixed income exposure drifts to less than 35% or greater than 45% of total assets, then the *entire* portfolio will be rebalanced back to its initial target allocation.

- We continued to assume a real world lag in the implementation of portfolio rebalancing. For example, if the portfolio's fixed income allocation reached 47% as of December 31st, then rebalancing occurred on January 31st, but based on December 31st market values.

- We used the same transaction cost assumptions of 50 bps for Large Cap U.S. Equities, 200 bps for Small Cap US Equities, 150 bps for International Equity, and 35 bps for Domestic Fixed Income.

- For lack of a better name, we refer to this strategy as "rebalance-to-target".

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| *July 1980 - June 2003* | Target Index* | Buy & Hold | Rebalance Annually | Rebalance to Target |
|---|---|---|---|---|
| **Annualized Return** | 11.7% | 11.4% | 11.7% | 11.6% |
| **Annualized Standard Deviation** | 9.6% | 11.1% | 9.5% | 9.6% |
| **Tracking Error** | - | 2.1% | 0.5% | 0.5% |
| **Sharpe Ratio** | 0.49 | 0.40 | 0.50 | 0.48 |
| **Number of Rebalancings** | Monthly | 0 | 23 | 10 |
| **Annualized Impact of Transaction Costs** | 0.0 | 0.0 | -0.06% | -0.036% |
| **Average Equity Exposure** | 60.0% | 70.3% | 59.9% | 60.8% |
| **Maximum Equity Exposure** | - | 82.9% | 66.8% | 66.5% |
| **Minimum Equity Exposure** | - | 58.1% | 52.3% | 54.1% |

*Rebalanced monthly assuming no transaction costs*

In the graphs below, the impact of rebalancing is immediately clear. The portfolio's asset mix stays range bound, producing returns and volatility generally in line with the original intentions of the asset allocation strategy. While the non-rebalanced portfolio's average equity exposure was 70.3%, each rebalanced portfolios' average equity exposures was closely consistent with the 60.0% target. At its highest, the non-rebalanced portfolio's equity exposure reached 82.9% of assets. Equity exposure for the annually rebalanced portfolio reached 66.8%, and hit 66.5% for the rebalanced-to-target portfolio (the latter figure demonstrating the real world impact of implementation slippage).



**Equity Exposure
July 1980-June 2003**



**Standard Deviation of Portfolio vs. Target Index**



**Tracking Error vs. Target Index**

Contrary to most institutional investors' opinions, a rebalance-to-target policy based on our ± 5% Fixed Income threshold would have required you to rebalance far fewer times over the past 23 years than would an annual policy (just 10 times compared to 23). Consequently, transactions costs only detracted 3.6bps from annualized performance versus 6.0bps if you rebalance annually. In either case, we find it interesting that rather high execution cost assumptions translated into such a low impact on total return. If we doubled our execution cost assumptions, the impact would still be modest.

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## Rebalancing over 5-year Periods

Looking at investment results over a long timeframe helps provide some perspective, but assuming an Investment Committee would set a single asset allocation policy, then take a 23 year hiatus before reviewing its handiwork, is unrealistic. Also, our analysis thus far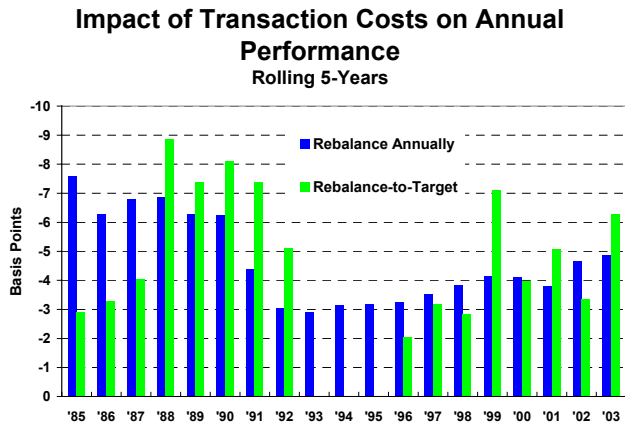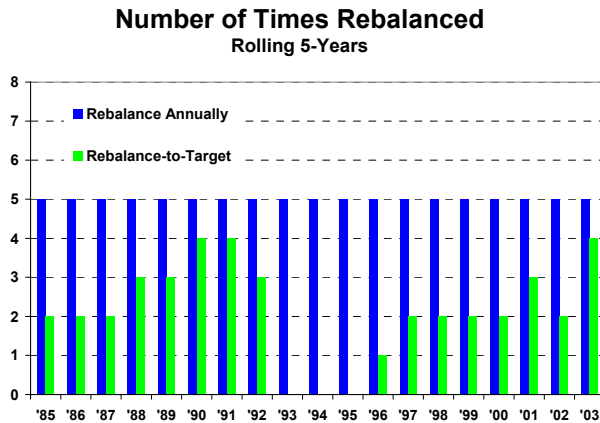 has only considered <u>one</u> time period, albeit a long one. **Any** single time period analysis of historical returns is sensitive to the beginning date and the ending date. In other words, you get different results depending on the time period you use.

To help mitigate this problem, we broke the 23 years of data into five-year periods, with each period spaced one-year apart. This isn't a statistically perfect solution. Rather than independent observations, there is considerable overlap in the data. It does, however, substantially mitigate the problems associated with endpoint sensitivity.

Detailed results of the simulations can be found in Appendix A. Looking at the rolling 5-year observations, we continue to find that rebalancing the portfolio leads to lower tracking error and performance closer to the initial "optimal" target policy, which was the intent in the first place. Rebalancing doesn't necessarily lead to *better* returns during all 5-year periods. During the late 1990s, for example, equity markets handily outperformed the bond market for an extended period. In that environment, letting your bet on these winning asset classes "ride," was well rewarded. However, entering March 2000 overweight equities would have hurt performance significantly enough that recent 5-year periods have suffered. This simply re-iterates our point that the purpose of portfolio rebalancing isn't to achieve higher returns; it's to keep actual portfolio risks consistent with your original objectives.
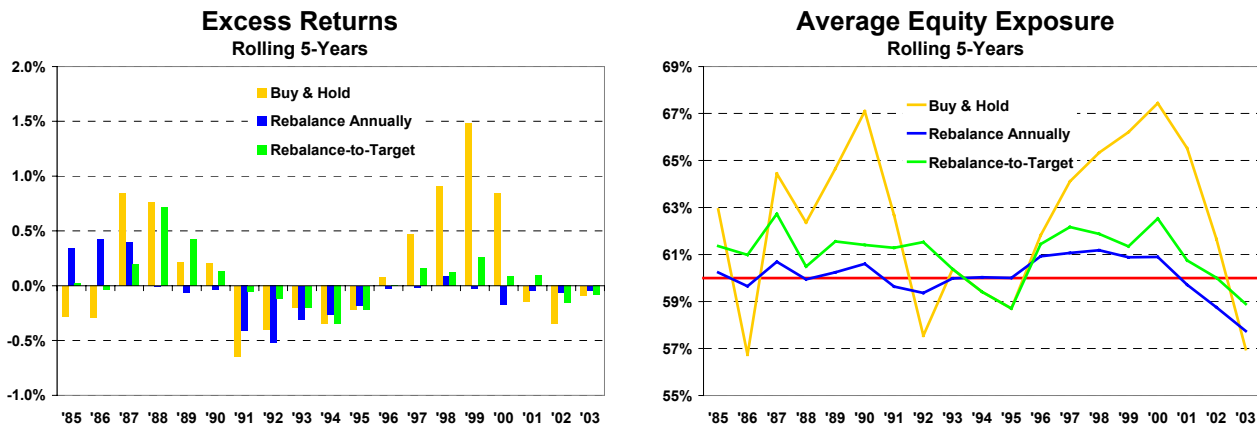


We found transactions costs associated with rebalancing to be modest over <u>all</u> 5-year periods. The impact on annualized returns ranged from 2.9-7.6bps when rebalancing annually, and 0-8.9 bps when rebalancing-to-target. Although rebalancing-to-target turned out to be the cheaper to implement strategy over the whole 23 years, that was not the case in every five year period. For example, market volatility surrounding the October 1987 crash (included in all rolling five year periods ending in 1988-1992) caused transaction cost's impact on performance for the rebalance-to-target strategy to be higher than if you had rebalanced annually. *However*, the rebalance-to-target portfolios outperformed the annually rebalanced portfolios in each of those periods, so you certainly were better off even after transaction costs. Further, the frequency of rebalancing was less in every five-year period when rebalancing-to-target versus rebalancing annually.

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**Number of Times Rebalanced**
Rolling 5-Years

**Impact of Transaction Costs on Annual Performance**
Rolling 5-Years

## Conclusions

Rebalancing is most appropriately viewed as part of the asset allocation process. Letting your asset mix drift unchecked can lead to unintended consequences and undermine the original objective of your asset allocation strategy. This is similar in impact to changing your asset allocation strategy without giving thought to changes in your capital markets expectations or fundamental circumstances. Ultimately, rebalancing is a tool to ensure that asset allocation decisions are based on reason rather than emotion or inaction.

While rebalancing helps control risk (the primary objective of asset allocation), it doesn't necessarily lead to better returns. There are times when letting your asset mix drift has aided performance – these have been when the markets rather consistently trended upward. In these environments, letting your winners ride would have been rewarding in the short term. It also would have left you considerably overweight equities when the market eventually corrected, as was the case in 1987 and 2003.  Adopting a systematic rebalancing program is one of the most powerful tools institutional investors have at their disposal to protect themselves from getting caught up in the "animal spirits" associated with periods of irrational exuberance or pessimism.

We examined two commonly used methods for rebalancing portfolios; doing it annually, or rebalancing to stay within pre-determined allocation bands. Both methods accomplish the primary goal of keeping a portfolio's asset allocation reasonably in line with initial allocation targets, resulting in risk/return characteristics similar to the benchmark. Rebalancing only when a target allocation band is violated has resulted in much **less** frequent rebalancing than an annual program, with generally *lower* rebalancing costs. The times when rebalancing-to-target costs exceeded those of rebalancing annually were during volatile markets, when it was also the most rewarding.

The use of a calendar as the rebalancing trigger also seems arbitrary. While investment committees' schedules are calendar driven, investment markets are not. Sharp market moves may still allow an asset allocation to drift substantially. Sometimes the timing of a periodic rebalancing can prove fortuitous, and sometimes it can hurt you.  Using the calendar can also prompt you to go through the cost and effort of rebalancing, when it isn't really needed. But, it is a much better policy than none at all.

If the approval of your plan's entire committee or board is currently required to trigger each rebalancing, change to an "autopilot" rebalance-to-target or rebalance annually policy; the long-term benefits compared to not rebalancing, or ad hoc rebalancing, will be considerable.

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# References

Arnott, Robert D., and Robert M. Lovell Jr. "Monitoring and Rebalancing the Portfolio." *Managing Investment Portfolios: A Dynamic Process*, 2nd. Edition.

Masters, Seth J. "Is There a Better Way to Rebalance." AllianceBernstien Research Paper. 2002.

Perold, Andre F. and William F. Sharpe. "Dynamic Strategies for Asset Allocation.*" Financial Analysts Journal.* January-February 1988.

Sharpe, William F. "Asset Allocation" *Managing Investment Portfolios: A Dynamic Process*, 2nd. Edition.

Sharpe, William F. "Asset Allocation: Management Style and Performance Measurement." *The Journal of Portfolio Management.* Winter 1992.

Wagner, Wayne H., Mark Edwards. "Implementing Investment Strategies: The Art and Science of Investing." *Handbook of Portfolio Management, Frank J. Fabozzi, ed.* John Wiley & Sons, Inc. 1998.

Wagner, Wayne H. "Measuring, Controlling, and Allocating Transactions Costs" *AIMR Conference – Ethical Issues for Today's Firm.* Association For Investment Management and Research. 2000.

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**Appendix A**

| FIVE YEARS ENDING: | J-85 | J-86 | J-87 | J-88 | J-89 | J-90 | J-91 | J-92 | J-93 | J-94 | J-95 | J-96 | J-97 | J-98 | J-99 | J-00 | J-01 | J-02 | J-03 | Avg. | Median |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BUY & HOLD** | | | | | | | | | | | | | | | | | | | | | |
| Return | 14.6% | 19.5% | 26.0% | 17.1% | 20.1% | 16.4% | 9.9% | 8.5% | 11.4% | 8.8% | 10.1% | 12.3% | 14.1% | 15.0% | 17.3% | 15.1% | 9.8% | 4.7% | 2.4% | 13.3% | 14.1% |
| Excess Return | -0.28% | -0.3% | 0.8% | 0.8% | 0.2% | 0.2% | -0.6% | -0.4% | -0.2% | -0.4% | -0.2% | 0.1% | 0.5% | 0.9% | 1.5% | 0.8% | -0.1% | -0.3% | -0.1% | 0.1% | -0.1% |
| St. Dev | 10.1% | 9.9% | 9.6% | 10.9% | 10.8% | 11.6% | 11.6% | 10.5% | 8.6% | 8.7% | 7.8% | 6.2% | 6.5% | 7.7% | 9.4% | 9.9% | 10.9% | 10.3% | 10.0% | 9.5% | 9.9% |
| Tracking Error | 0.64% | 0.51% | 0.99% | 1.67% | 1.69% | 2.13% | 1.06% | 0.59% | 0.59% | 0.54% | 0.47% | 0.31% | 0.57% | 0.84% | 1.35% | 1.40% | 1.19% | 0.66% | 1.34% | 0.97% | 0.84% |
| Sharpe Ratio | 0.29 | 0.73 | 1.37 | 0.47 | 0.73 | 0.39 | -0.12 | -0.25 | 0.00 | -0.27 | -0.15 | 0.13 | 0.37 | 0.42 | 0.57 | 0.34 | -0.13 | -0.59 | -0.82 | 0.18 | 0.29 |
| Equity Allocation | | | | | | | | | | | | | | | | | | | | | |
|   Average | 62.9% | 56.7% | 64.4% | 62.4% | 64.7% | 67.1% | 62.7% | 57.5% | 60.4% | 59.4% | 58.7% | 61.8% | 64.1% | 65.3% | 66.2% | 67.4% | 65.5% | 61.7% | 57.0% | 0.62 | 0.63 |
|   Min | 58.1% | 51.9% | 58.6% | 57.0% | 58.0% | 59.6% | 58.9% | 53.9% | 57.1% | 56.0% | 55.2% | 58.8% | 59.6% | 60.1% | 60.1% | 60.5% | 58.8% | 54.3% | 45.4% | 0.57 | 0.58 |
|   Max | 66.8% | 61.6% | 72.6% | 71.2% | 71.5% | 72.0% | 67.0% | 62.0% | 63.0% | 62.1% | 61.3% | 67.1% | 70.8% | 72.4% | 73.8% | 74.2% | 71.0% | 67.4% | 65.2% | 0.68 | 0.67 |
| **REBALANCE ANNUALLY** | | | | | | | | | | | | | | | | | | | | | |
| Return | 15.2% | 20.2% | 25.5% | 16.3% | 19.8% | 16.2% | 10.1% | 8.4% | 11.3% | 8.9% | 10.2% | 12.2% | 13.6% | 14.2% | 15.8% | 14.1% | 9.9% | 5.0% | 2.4% | 13.1% | 13.6% |
| Excess Return | 0.34% | 0.42% | 0.40% | -0.01% | -0.06% | -0.04% | -0.41% | -0.52% | -0.31% | -0.27% | -0.18% | -0.02% | -0.02% | 0.08% | -0.02% | -0.17% | -0.05% | -0.07% | -0.04% | -0.05% | -0.04% |
| Standard Deviation | 9.8% | 10.2% | 9.3% | 10.7% | 10.3% | 10.8% | 11.1% | 10.7% | 8.6% | 8.7% | 7.8% | 6.2% | 6.3% | 7.2% | 8.3% | 8.8% | 9.8% | 9.7% | 10.2% | 9.2% | 9.7% |
| Tracking Error | 0.46% | 0.42% | 0.52% | 0.61% | 0.60% | 0.60% | 0.54% | 0.42% | 0.26% | 0.26% | 0.26% | 0.15% | 0.21% | 0.23% | 0.31% | 0.35% | 0.51% | 0.58% | 0.72% | 0.42% | 0.42% |
| # of Rebalancing | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5.0 | 5.0 |
| Sharpe Ratio | 0.35 | 0.78 | 1.37 | 0.42 | 0.74 | 0.40 | -0.11 | -0.26 | -0.01 | -0.26 | -0.15 | 0.12 | 0.32 | 0.34 | 0.48 | 0.28 | -0.14 | -0.60 | -0.80 | 0.17 | 0.28 |
| Impact of Trans. Costs* | -7.60 | -6.29 | -6.81 | -6.86 | -6.30 | -6.26 | -4.39 | -3.05 | -2.91 | -3.13 | -3.18 | -3.26 | -3.53 | -3.83 | -4.15 | -4.11 | -3.82 | -4.65 | -4.87 | -4.68 | -4.15 |
| Equity Allocation | | | | | | | | | | | | | | | | | | | | | |
|   Average | 60.2% | 59.7% | 60.7% | 59.9% | 60.2% | 60.6% | 59.6% | 59.4% | 60.0% | 60.0% | 60.0% | 60.9% | 61.1% | 61.2% | 60.9% | 60.9% | 59.7% | 58.8% | 57.7% | 60.1% | 60.0% |
|   Min | 53.3% | 53.4% | 58.0% | 53.9% | 53.9% | 53.9% | 53.9% | 53.9% | 55.2% | 55.2% | 55.2% | 59.0% | 58.7% | 58.7% | 55.3% | 55.3% | 52.3% | 52.3% | 52.3% | 54.9% | 53.9% |
|   Max | 66.8% | 65.0% | 65.2% | 65.2% | 65.2% | 65.2% | 65.1% | 62.2% | 62.1% | 62.1% | 62.0% | 64.0% | 64.0% | 64.0% | 64.0% | 64.0% | 63.7% | 62.7% | 62.8% | 64.0% | 64.0% |
| **REBALANCE TO TARGET** | | | | | | | | | | | | | | | | | | | | | |
| Return | 14.9% | 19.7% | 25.3% | 17.1% | 20.3% | 16.3% | 10.5% | 8.8% | 11.4% | 8.8% | 10.1% | 12.3% | 13.8% | 14.2% | 16.1% | 14.4% | 10.1% | 4.9% | 2.4% | 13.2% | 13.8% |
| Excess Return | 0.02% | -0.04% | 0.19% | 0.72% | 0.43% | 0.13% | -0.05% | -0.12% | -0.20% | -0.35% | -0.22% | 0.00% | 0.16% | 0.12% | 0.26% | 0.09% | 0.10% | -0.16% | -0.08% | 0.05% | 0.02% |
| Standard Deviation | 9.9% | 10.2% | 9.5% | 10.6% | 10.3% | 10.8% | 11.2% | 10.8% | 8.6% | 8.7% | 7.8% | 6.2% | 6.4% | 7.2% | 8.3% | 9.1% | 10.0% | 10.0% | 10.4% | 9.3% | 9.9% |
| Tracking Error | 0.42% | 0.37% | 0.52% | 0.92% | 0.62% | 0.63% | 0.61% | 0.55% | 0.59% | 0.54% | 0.47% | 0.26% | 0.35% | 0.30% | 0.40% | 0.50% | 0.49% | 0.51% | 0.50% | 0.50% | 0.50% |
| Sharpe Ratio | 0.32 | 0.73 | 1.32 | 0.48 | 0.79 | 0.41 | -0.08 | -0.22 | 0.00 | -0.27 | -0.15 | 0.12 | 0.34 | 0.35 | 0.51 | 0.29 | -0.12 | -0.59 | -0.79 | 0.18 | 0.29 |
| # of Rebalancing | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 3 | 0 | 0 | 0 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 4 | 2.2 | 2.0 |
| Impact of Trans. Costs* | -2.9 | -3.3 | -4.1 | -8.9 | -7.4 | -8.1 | -7.4 | -5.1 | 0.0 | 0.0 | 0.0 | -2.0 | -3.2 | -2.8 | -7.1 | -4.0 | -5.1 | -3.3 | -6.3 | -4.3 | -4.0 |
| Equity Allocation | | | | | | | | | | | | | | | | | | | | | |
|   Average | 61.4% | 61.0% | 62.7% | 60.5% | 61.6% | 61.4% | 61.3% | 61.5% | 60.4% | 59.4% | 58.7% | 61.4% | 62.2% | 61.9% | 61.3% | 62.5% | 60.7% | 60.0% | 58.9% | 61.0% | 61.3% |
|   Min | 54.7% | 54.4% | 58.6% | 53.3% | 53.3% | 54.1% | 53.9% | 53.9% | 57.1% | 56.0% | 55.2% | 58.8% | 59.5% | 58.4% | 55.2% | 59.4% | 54.6% | 53.6% | 54.1% | 55.7% | 54.7% |
|   Max | 65.1% | 65.5% | 65.6% | 66.0% | 66.4% | 65.1% | 65.3% | 65.3% | 63.0% | 62.1% | 61.3% | 65.5% | 65.6% | 65.7% | 65.9% | 65.3% | 66.0% | 65.2% | 65.1% | 65.0% | 65.3% |
| **TARGET INDEX** | | | | | | | | | | | | | | | | | | | | | |
| Return | 14.9% | 19.8% | 25.1% | 16.3% | 19.9% | 16.2% | 10.5% | 8.9% | 11.6% | 9.2% | 10.3% | 12.3% | 13.6% | 14.1% | 15.8% | 14.3% | 10.0% | 5.1% | 2.5% | 13.2% | 13.6% |
| Standard Deviation | 9.8% | 10.1% | 9.3% | 10.6% | 10.3% | 10.7% | 11.2% | 10.7% | 8.7% | 8.8% | 7.9% | 6.2% | 6.2% | 7.1% | 8.3% | 8.8% | 9.9% | 10.0% | 10.7% | 9.2% | 9.8% |
| Sharpe Ratio | 0.32 | 0.75 | 1.33 | 0.42 | 0.75 | 0.40 | -0.07 | -0.21 | 0.02 | -0.23 | -0.12 | 0.12 | 0.32 | 0.34 | 0.48 | 0.30 | -0.13 | -0.57 | -0.76 | 0.18 | 0.30 |

*\* In Basis Points*

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