Rebalancing Multi-Asset Portfolios: Implementation Considerations

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A critical component of managing investment portfolios is providing for adequate diversification and determining appropriate allocations to investments and asset classes. Once an initial portfolio has been constructed, however, it is equally critical that the asset allocation be monitored and rebalanced in a systematic and disciplined manner. Implementing a systematic rebalancing process not only helps maintain a consistent and appropriate level of risk, but in many cases may actually enhance the return of a portfolio. This follows from the disciplined process used to buy underweight assets that are low in value and sell overweight assets that are highly appreciated.

Systematic rebalancing not only helps maintain a consistent and appropriate level of risk, but in many cases may actually enhance the return of a portfolio.

In a previous paper (Rebalancing Multi-Asset Portfolios)[3] we summarized some of the behavioral characteristics of investors that can lead to poor rebalancing decisions. Data from DALBAR[4] illustrates the dramatic negative impact on individual investors, who in aggregate appear to have historically followed a hot-dot chasing approach, compared to institutional investors who have historically tended to implement more disciplined rebalancing approaches that preserve target allocations.*

* "Quantitative Analysis of Investor Behavior 2008", DALBAR, Inc. 2008

Neither asset allocation nor systematic rebalancing guarantees a profit or protects against a loss.

Drift vs. calendar

We also surveyed literature that discusses different approaches to rebalancing. While there is no single approach that works best in every time frame with every asset allocation, research suggests several ideas:

1. **Drift-based rebalancing may be better than calendar-based rebalancing.**
   Drift-based rebalancing (rebalancing when asset class weightings drift outside of tolerance ranges) can be more effective than calendar-based rebalancing (rebalancing quarterly or annually). Since there is a cost associated with rebalancing, it is better to do it only when it will have a meaningful impact on the portfolio. Calendar-based rebalancing can lead to transactional activity even when asset class weightings are very close to their targets.

2. **It may not be necessary or optimal to bring allocations all the way back to their target weightings.**
   The costs associated with rebalancing are relevant here as well, and a trade-off exists between how far back toward target allocations a portfolio is rebalanced and the cost associated with the trading required to effect the rebalancing.

3. **When implementing a drift-based monitoring approach, the more frequently the portfolio is monitored the better.**
   Daily monitoring is ideal, as anything less frequent can mean opportunities to add value from rebalancing may be missed if they occur within the period but correct themselves by the time the portfolio is checked.

TABLE 1

Asset Class	Target Weight	Minimum Weight	Maximum Weight
U.S. Equities	40%	35%	45%
International Equities	20%	15%	25%
Fixed-Income	40%	35%	45%

Please see page 8 for indexes used to represent the categories.

Drift-based monitoring raises a couple of key questions when it comes to the implementation of a systematic rebalancing approach: (1) how wide should the drift bands around the target allocation be and (2) how far back toward the target should a portfolio be rebalanced? The primary purpose of this paper is to explore these two issues and present a general approach that may be appropriate in most scenarios.

Setting drift bands

We find that a tiered approach to setting drift bands is optimal and practical where a single approach must be implemented across unknown and varied asset allocations. Our research also suggests that portfolios should be rebalanced halfway back to their target allocations to cost-efficiently manage tracking error.

Drift bands are tolerance ranges set around allocation targets for each asset class. Whenever an asset class's weight drifts outside of its band, a portfolio is rebalanced. Table 1 illustrates a simple hypothetical example of a three-asset-class portfolio with target allocations and minimum and maximum drift bands using a 5% tolerance range. As an example, if the weighting of the U.S. equities in the portfolio increased above 45%, the portfolio would be rebalanced.

We analyzed a number of different rebalancing approaches and evaluated how each method performed across a variety of different allocations.

Absolute (fixed band) approach

The simplest method for setting a drift band is to select a band that seems reasonable for a standard asset allocation and then use that fixed band for all assets and allocations. A commonly used band is ± 5%, which allows for a reasonable level of drift in many scenarios. The bands in Table 1 appear reasonable, and are in fact quite similar to those produced by the percentage approach.

Percentage approach

The percentage approach sets drift bands as a relative percentage of each asset's target weight (for example, a 25% band around a 40% target allocation would result in a ±10% tolerance range). We examined a number of different asset allocations to see if one relative percentage consistently led to positive results over the 30 years ended 12/31/12.

Depending on the allocation, the percentage that would have produced the highest risk-adjusted return varied, but tended to fall between 20% and 40%. Figure 1 plots the standard deviation and return for one of our sample allocations relative to drift tolerances that are varied by 1% increments. The number of rebalances that would have been triggered by drift is plotted on the secondary y-axis. Using a 25% relative rebalance, on average one rebalance would have been triggered per year.

There are several points worth highlighting in Figure 1. First, returns tend to increase initially as bands are widened, but eventually reach a peak and begin to decline. This suggests that rebalancing too soon (i.e., establishing very narrow drift bands) and allowing excessively large drift tolerances are both less than optimal from a return perspective. With respect to risk, the general trend is for overall portfolio risk to increase as the size of the bands increases.

Using a relative drift tolerance range of 25% with the allocation in Table 1 would produce the drift bands shown in Table 2.

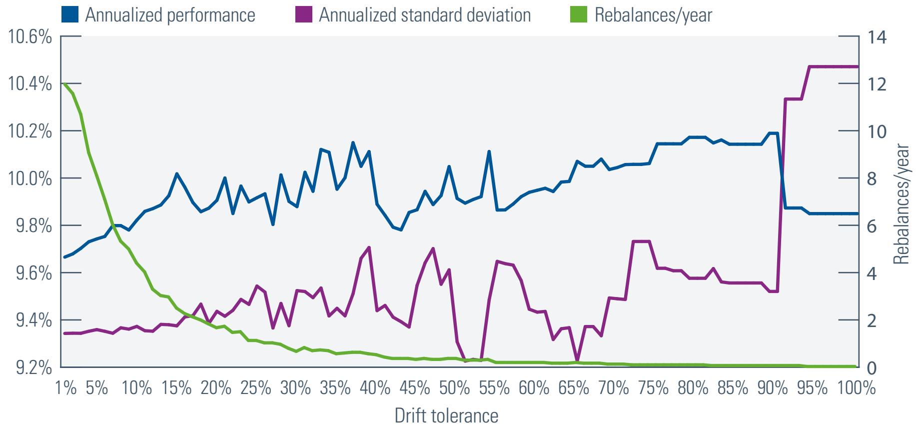
The drift bands in Tables 1 and 2 are similar or identical in the case of a 20% allocation. The choice of methodology consequently has relatively little impact on the drift bands of the medium-sized allocations used in this basic allocation model. Methodology choice, however, has a significant impact on resulting bands when small or large allocations are included in the overall portfolio.

Problems with absolute and percentage drift bands

A comparison of drift bands in Table 3, using absolute and percentage drift methodology for a range of allocation sizes, illustrates the extent to which these methods can produce varying and non-intuitive drift bands.

With small allocations, the percentage approach produces relatively tight bands and the absolute approach produces relatively loose bands. The reverse is true with large allocations. An allocation target of 2% results in a relative percentage drift band of 1.5% to 2.5%, which could trigger frequent rebalancing. Conversely, the 0% to 7% drift band prescribed by the absolute band would imply that a 250% increase from a target 2% allocation is acceptable.

FIGURE 1: DRIFT TOLERANCE FOR GROWTH AND INCOME TRAILING 30 YEARS THOUGH 12/31/12



Source: Managed Portfolio Advisors®

Tight bands that result from using the percentage method with small allocations or the absolute method with large allocations can trigger excessive rebalancing and in turn higher trading expenses. Less frequent rebalancing caused by relatively loose bands may increase portfolio volatility and decrease returns (as evidenced by the data in Figure 1). Drift band methodology should produce reasonable results across a full range of potential target allocation weights.

Rebalancing: A tracking error problem

Masters (2003)[5] lays out an approach for both setting the drift bands and determining how far back toward the target allocations to rebalance using analysis based on the trade-off between the cost and benefit of rebalancing. He points out that the benefit of rebalancing is the reduced tracking error of the portfolio relative to a portfolio with the desired target allocations. Since tracking

TABLE 2

Asset Class	Target Weight	Minimum Weight	Maximum Weight
U.S. Equities	40%	30%	50%
International Equities	20%	15%	25%
Fixed-Income	40%	30%	50%

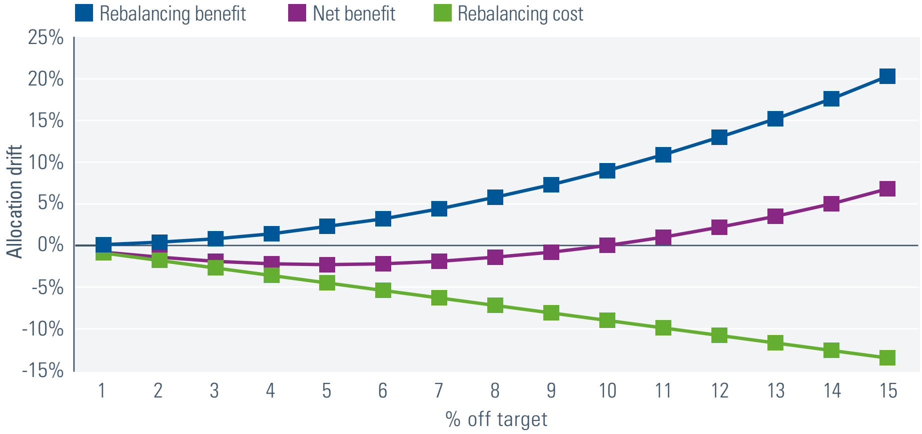
Source: Managed Portfolio Advisors®

TABLE 3

Allocation	Absolute Drift (5%)	Percentage Drift (25%)	Difference
2%	0–7%	1.5–2.5%	4.5%
5%	0–10%	3.75–6.25%	3.75%
10%	5–15%	7.5–12.5%	2.5%
20%	15–25%	15–25%	0%
40%	35–45%	30–50%	-5%
60%	55–65%	45–75%	-10%
80%	75–85%	60–100%	-15%

Source: Managed Portfolio Advisors®

FIGURE 2: BENEFIT, COST AND NET BENEFIT OF REBALANCING



This example above is hypothetical and is being shown for illustrative purposes only.
Source: Managed Portfolio Advisors®

error is quadratic, this benefit increases geometrically as the actual weights drift away from the targets, as illustrated in Figure 2. Mathematically Masters expresses this benefit as:

$$\text{Rebalancing benefit} = \frac{(\text{tracking error})^2 \times \Delta^2}{2K}$$

Where Δ is the difference between the target weight and the actual weight of the asset class and *K* is the investor's risk tolerance.

The costs of rebalancing consist primarily of transaction costs, including taxes paid on net-realized gains for non-exempt accounts. The cost of rebalancing is therefore a linear function, as illustrated in Figure 2.

Figure 2 also illustrates that when allocations drift modestly from targets, the net benefit of rebalancing is negative as the costs associated with rebalancing exceed the benefits. As deviations increase, however, the benefit to be gained from rebalancing accelerates while the costs continue to increase linearly. Eventually the net benefit crosses into positive territory. This is the trigger point at which it makes sense to rebalance. Masters derives a mathematical formula for calculating the trigger point for each asset T_i :

$$T_i = \frac{2KC_i}{(\sigma_i^2 + \sigma_j^2 - 2\rho_{ij}\sigma_i\sigma_j)}$$

Where:

K is the investor's risk tolerance

C_i is the cost of trading asset i

σ_i is the volatility of asset i

σ_j is the volatility of the rest of the portfolio

ρ_{ij} is the correlation between asset i and the rest of the portfolio

Input uncertainty

For the purposes of this paper we don't need to focus very much on the formula or its derivation. It is important, however, to take note of the factors that determine the trigger point. This is where problems arise when trying to put this theory into practice. Measuring a client's risk tolerance is an inexact science, but the inclusion of the volatility levels and the correlation between each asset class and the rest of the portfolio present more significant problems. These are inherently unstable, making it very difficult to decide what values to use. They will vary depending on what historical time frame is considered and are unlikely to remain constant going forward.

Therefore, while the formula provides a good theoretical framework for analyzing the problem, the uncertainty surrounding the inputs means the process is more difficult than just plugging numbers into a formula. The previous methods discussed are challenged with respect to selecting an appropriate allowable absolute or relative percent drift that is optimal across various allocations, while the approach described by Masters is challenged with respect to selecting inputs that will work across multiple forward-looking time periods and clients.

Tiered approach

We next considered a tiered approach as a solution to some of the drawbacks highlighted in the absolute method, percentage approach, and Masters formula. Tiers were structured to produce intuitive drift bands across a full range of allocation sizes and can be applied with a single set of inputs across multiple clients and time periods. Our analysis led to the tiered absolute drift bands shown in Table 4.

For example, for a small allocation of 5%, the sleeve would be allowed to drift between 2% and 8% before being rebalanced. This compares to a 3.75%–6.25% band using the percentage approach (25%) and 0–10% using an absolute approach of 5%. In Table 5 we compare the bands over a number of different allocations to highlight the differences between the rebalancing strategies.

As we have highlighted previously and illustrated in Figure 3, drift bands may be materially different for large and small allocations. Mid-sized allocations are fairly close to one another, and at a target allocation of 20% have the exact same band for all three of the approaches we have considered. The Masters formula cannot be calculated for this comparison, as it can only specify bands in the context of a total allocation.

Comparing approaches

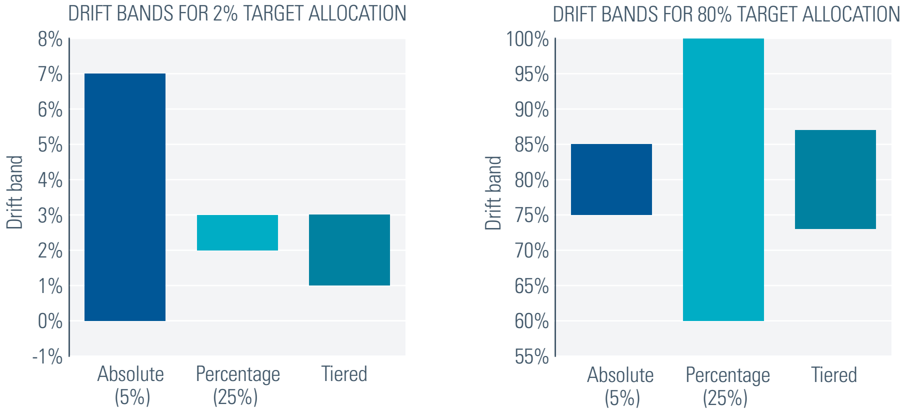
We calculated drift bands for several multi-asset-class portfolios (target allocations are provided in Table 6) using each of the five drift calculations we have discussed, and evaluated the historic performance and risk that each would have produced over the 30 years ended December 31, 2012. For the volatility levels and correlation inputs to the Masters formula, we used the standard deviations and correlations observed over the 29 years for each asset and allocation. We calculated drift bands using a 5% absolute drift, a 25% relative percentage drift, and tiers as specified above.

In Figure 4, we compared the various rebalancing procedures across five hypothetical portfolios moving from conservative to aggressive. Throughout our analysis of the various scenarios, we factored in transaction costs of 0.5% to more accurately represent the end experience for the client.

The results clearly illustrate the benefits of having a systematic rebalancing process. Across virtually all of the models all of the systematic rebalancing methods (other than constant rebalancing) reduced risk materially, often with little or no impact on return. Systematic rebalancing shifts the efficient frontier up and to the left across this range of allocation models. A second take-away from the chart is that constant rebalancing may reduce performance meaningfully due to high transaction costs. A properly implemented rebalancing strategy can add material risk-adjusted value over time, preventing the portfolio from taking on too much risk while still allowing for some movement to take advantage of positive market trends.

Each of the various rebalancing methods that we analyzed improved upon constant or no rebalancing, but no single approach outperformed in every

FIGURE 3: DRIFT BAND COMPARISON



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allocation. Implementation and perception weaknesses proved to be the deciding factors in choosing the tiered approach. The efficacy of the method proposed by Masters is highly sensitive to the accuracy of the input estimates. Faulty inputs could lead to overly wide (or narrow) bands. The demands of regularly re-estimating these inputs and the client perception challenge of explaining why drift tolerance has changed from one period to another can be significant drawbacks to this rebalancing method.

The percent and absolute drift approaches are appealing in the simplicity of their implementation; however, both of these methods suffered from practical drawbacks with small and large allocations. With large or small allocations, they either triggered high levels of rebalancing (multiple times per year) or low levels (one rebalance every 3 to 5 years). The tiered approach stands out as most practical in that it produces similar results across a full range of potential allocations and is relatively easy to implement and explain.

TABLE 4

Allocation Size	Allowable Drift (+/-%)
0–1%	0.5%
2–3%	1.0%
4–5%	1.5%
6–8%	2.0%
9–11%	2.5%
12–15%	3.5%
16–30%	5.0%
31–40%	6.0%
Greater than 40%	7.0%

Source: Managed Portfolio Advisors®

TABLE 5

Allocation	Absolute Drift (5%)	Percentage Drift (25%)	Tiered
2.0%	0–7%	1.5–2.5%	1–3%
5.0%	0–10%	3.75–6.25%	3.5–6.5%
10.0%	5–15%	7.5–12.5%	7.5–12.5%
20.0%	15–25%	15–25%	15–25%
40.0%	35–45%	30–50%	34–46%
60.0%	55–65%	45–75%	53–67%
80.0%	75–85%	60–100%	73–87%

Source: Managed Portfolio Advisors®

FIGURE 4: RISK VS. RETURN OF VARIOUS DRIFT METHODS, 29 YEARS ENDED 12/31/12 – SYSTEMATIC REBALANCING REDUCED RISK

Source: Managed Portfolio Advisors®

Please see page 8 for indexes used to represent the categories.

How far to rebalance back

Once the decision has been made to rebalance a portfolio, opinion also differs on how far back toward the target allocations portfolios should be rebalanced. Arnott and Lovell (1993) suggest rebalancing all the way back to the target allocation. Leland (2000) recommends rebalancing to just back within the drift band, and Masters (2003) advocates going back halfway to the target. Figure 5 provides an illustration of these different approaches using an example where an asset class with a 10% target allocation and a +4% drift band has drifted beyond that threshold to an actual allocation of 15%.

Masters used the same theoretical framework discussed earlier to conclude that rebalancing halfway back to the target allocation provides the optimal trade-off between the costs and benefits of rebalancing. Our empirical analysis suggests that the impact of this decision is somewhat small, and that the results vary depending on the time frame, allocations and asset classes being considered.

We backtested the tiered rebalancing approach on the asset allocations (conservative, income and growth, balanced, growth and income, and aggressive models) described above. We examined risk-adjusted returns across a continuum of rebalancing distances. These ranged from rebalancing all the way back to the target (rebalance distance of 0.0 on the chart in Figure 6), as suggested by Arnott and Lovell, to the approach recommended by Leland of bringing allocations back to just within the drift band (rebalance distance of 1.0 in Figure 6).

In Figure 6 we've plotted the raw data points for each of these five allocations at each rebalancing distance. Since the data is fairly noisy, we've also fitted polynomial curves to each data series to illustrate the overall trend. The results are not unambiguously conclusive, but do provide some support to the approach recommended by Masters that rebalancing halfway back (rebalance distance of 0.5) is the best approach. For the balanced and income and growth portfolios, the fitted curves peak between rebalancing 40% and 60% of the way back to the target. The conservative, growth and income, and aggressive models' curves contradict this, however, and rise/decline steadily as the rebalance distance increases.

TABLE 6 – HYPOTHETICAL PORTFOLIO ALLOCATIONS

	Conservative	Income & Growth	Balanced	Growth & Income	Aggressive
Cash	20.0%	12.0%	8.0%	5.0%	0.0%
Fixed-Income	60.0%	48.0%	32.0%	15.0%	0.0%
REITs	7.0%	6.0%	4.0%	0.0%	0.0%
Large-Cap Growth	9.0%	9.0%	16.0%	22.0%	29.0%
Large-Cap Value	4.0%	11.0%	21.0%	27.0%	27.0%
Small-Cap Growth	0.0%	4.0%	4.0%	7.0%	11.0%
Small-Cap Value	0.0%	6.0%	8.0%	12.0%	19.0%
International Equity	0.0%	4.0%	7.0%	12.0%	14.0%

Source: Managed Portfolio Advisors®

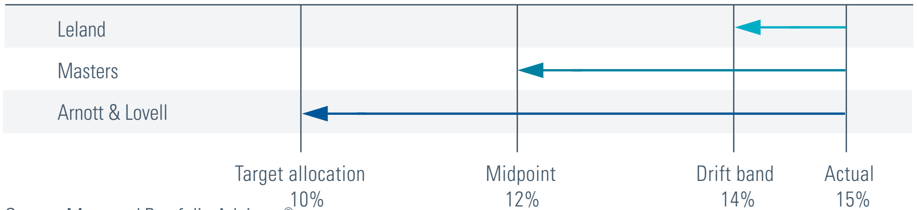
This example above is hypothetical and is being shown for illustrative purposes only. For definitions, please refer to the last page.

Please see page 8 for indexes used to represent the categories.

Practical considerations

When designing a rebalancing methodology, practical considerations must also be taken into account. These considerations may be even more important with respect to issues where the empirical data does not suggest material differences between various approaches and where the data does not point unambiguously to a single optimal approach. While the approach espoused by Leland (rebalancing back to the outer limit of the drift band) makes sense conceptually based on the fact that it minimizes transaction costs, it has some practical drawbacks. If the relative performance trend that triggered the rebalance continues, the drift band may be violated anew each day. The daily rebalancing that this would necessitate may be acceptable for large institutional portfolios where exposures can be modified cheaply through the use of futures or forward contracts. It is less practical for separately managed accounts and unified managed accounts, where rebalancing may require trading of many individual security positions within each segment of a portfolio and clients may be sensitive to trade volume as well as expense.

FIGURE 5: VARIOUS APPROACHES TO HOW FAR BACK TO REBALANCE



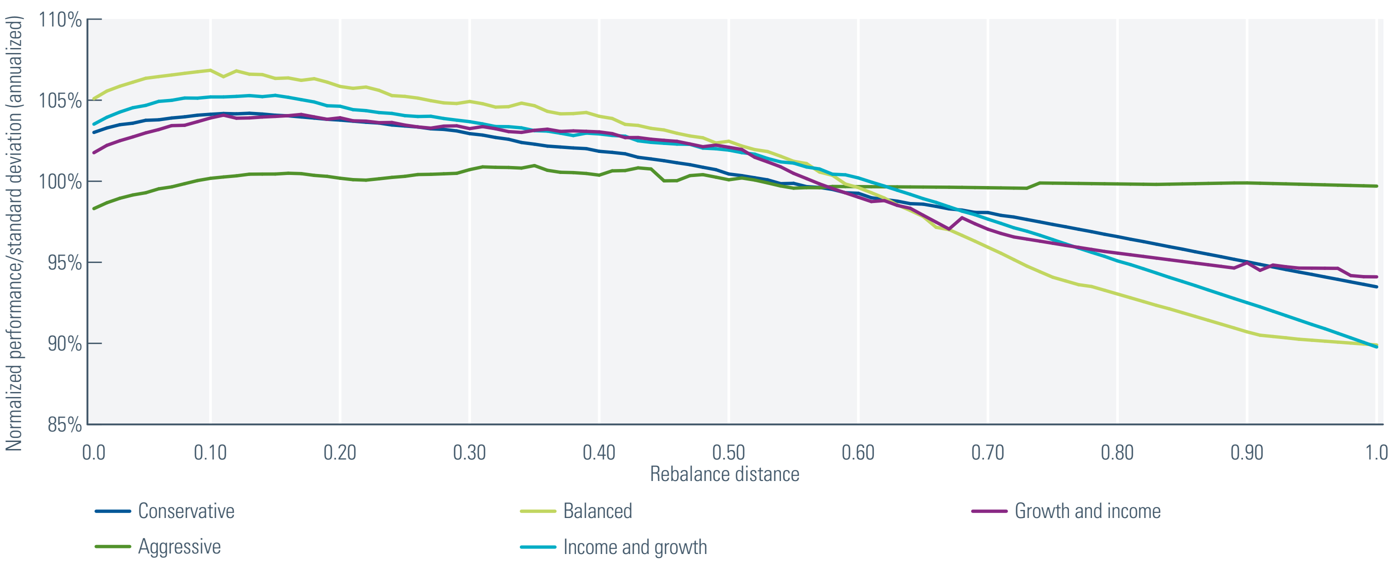
Source: Managed Portfolio Advisors®

Conclusion

With respect to drift bands, a hybrid approach appears to produce more attractive results than alternatives. Specifically, a tiered band methodology was found to produce drift bands that balanced out the more extreme results produced by absolute- and percentage-drift approaches. Tiered bands are also more straightforward to calculate and maintain than the Masters drift band methodology, which is sensitive to the accuracy of forecasts for client risk tolerance, asset class correlation, and asset volatility.

Similarly, when deciding how far back to rebalance portfolios, we believe a middle-of-the-road approach is prudent. Rebalancing halfway back to target combines the benefit of reducing the amount of trading and transaction costs with the avoidance of situations that might require a repeated series of small trades in multiple positions. This avoidance of a high volume of trades is especially appealing to taxable clients who file itemized gain/loss reports and all clients who are sensitive to receiving a high volume of trade confirms.

FIGURE 6: RISK-ADJUSTED RETURN RESULTS, 30 YEARS ENDED 12/31/12



Source: Managed Portfolio Advisors®

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1 Net asset value as of September 30, 2015. Assets under management (AUM) may include assets for which non-regulatory AUM services are provided. Non-regulatory AUM includes assets which do not fall within the SE C's definition of 'regulatory AUM' in Form ADV, Part 1.

2 Cerulli Quantitative Update: Global Markets 2015 ranked Natixis Global Asset Management, S.A. as the 17th largest asset manager in the world based on assets under management as of December 31, 2014.

DEFINITIONS

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4 DALBAR, Inc. "Quantitative Analysis of Investor Behavior 2008."

5 Masters, Seth J. "Rebalancing." *Journal of Portfolio Management*, Spring 2003.

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