MarquetteAssociates

Rebalancing Position Paper

December 2018

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Contents

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INTRODUCTION

Regularly rebalancing portfolios is one of the key duties of trustees and other fiduciaries responsible for managing an institutional portfolio. Asset allocations are set to provide a predetermined risk/reward profile that fits a fund's objectives and constraints. Portfolios are rebalanced when they drift away from policy target in order to maintain the risk/reward profiles implicit in the original asset allocations. But how often should clients rebalance their portfolios? What guidelines should clients use to determine when to rebalance? And what are the costs and benefits associated with rebalancing? This paper takes a rigorous look at rebalancing and provides some guidelines for implementing a rebalancing policy.

METHODOLOGY

We examined two different approaches to rebalancing:

- **Calendar rebalancing:** Also called "time dependent" rebalancing, calendar rebalancing sets up a portfolio to rebalance based on a predetermined time frame, regardless of the allocations. The most basic form of calendar rebalancing is often used by many 401(k) participants, when plans are set to automatically rebalance on a monthly, quarterly, or annual basis.

- **Deviation from policy target:** This type of rebalancing is used by most institutional clients where predetermined ranges around policy targets are established and portfolios are rebalanced once the range is breached.

For the purposes of this paper we analyzed monthly returns for the S&P 500 (including dividends) and the BarCap Aggregate Index going back to 1926 assuming a conventional 60/40 stock/bond portfolio. We believe historical data is more instructive than simulated returns for this analysis. The time frame includes periods of outperformance for both asset classes (stocks and bonds) and is a long enough time period to draw general conclusions about rebalancing. We look at both returns and risk for portfolios that are rebalanced regularly based on predetermined parameters. We primarily used ten year rolling-return data to examine performance and risk. The goal of this analysis is to develop some guidelines around the optimal approach to rebalancing.
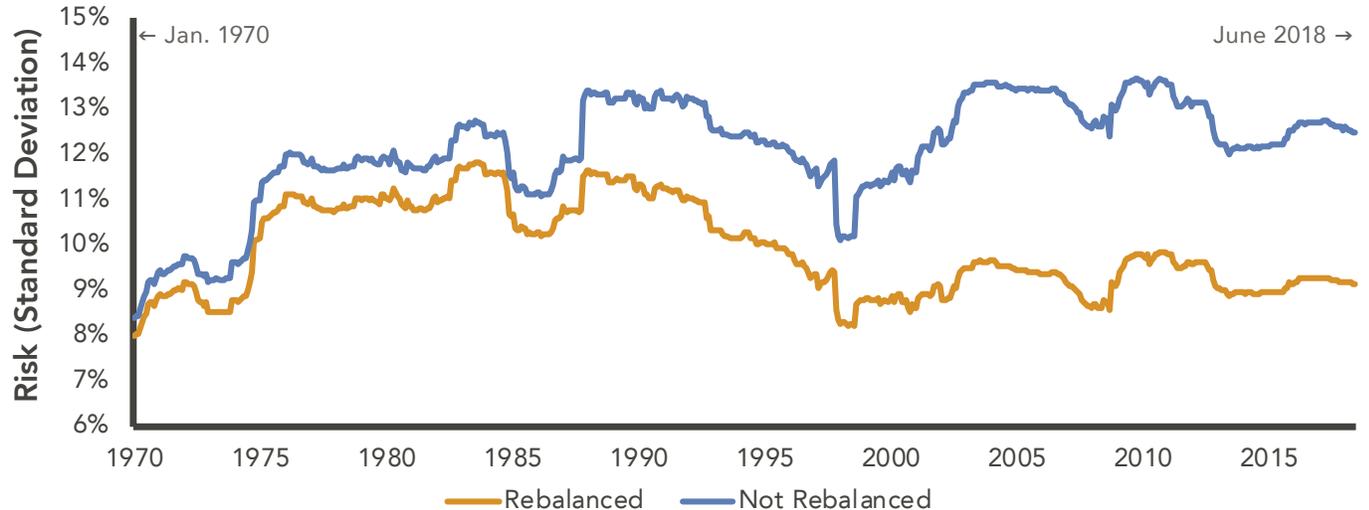
WHY REBALANCE?

Stocks are a higher risk asset class and over long periods of time expected to generate higher returns for investors than bonds. Investors seeking to maximize returns allocate the majority of their assets to the highest risk asset class to achieve the highest possible return. However, institutional investors are not simply concerned about returns but also must take into account the amount of risk in their portfolios. Assuming too much risk in a portfolio increases the chance that the portfolio does not meet its target objective. As a result, it is important for institutional investors to periodically rebalance their portfolios. Without periodic rebalancing, risk assets will eventually come to dominate the portfolio. For example, Exhibit 1 *(following page)* illustrates a 60% stock, 40% bond portfolio on December 31, 1959. Without rebalancing, it would grow to 91.2% stocks and just 8.8% bonds by June 30, 2018, thus creating a very different risk profile in 2018 than the original portfolio that was constructed in 1959. If portfolios are not rebalanced, their risk profiles will change materially over time.

Exhibit 1: Allocation Since 1960 for a Portfolio That Is Not Rebalanced
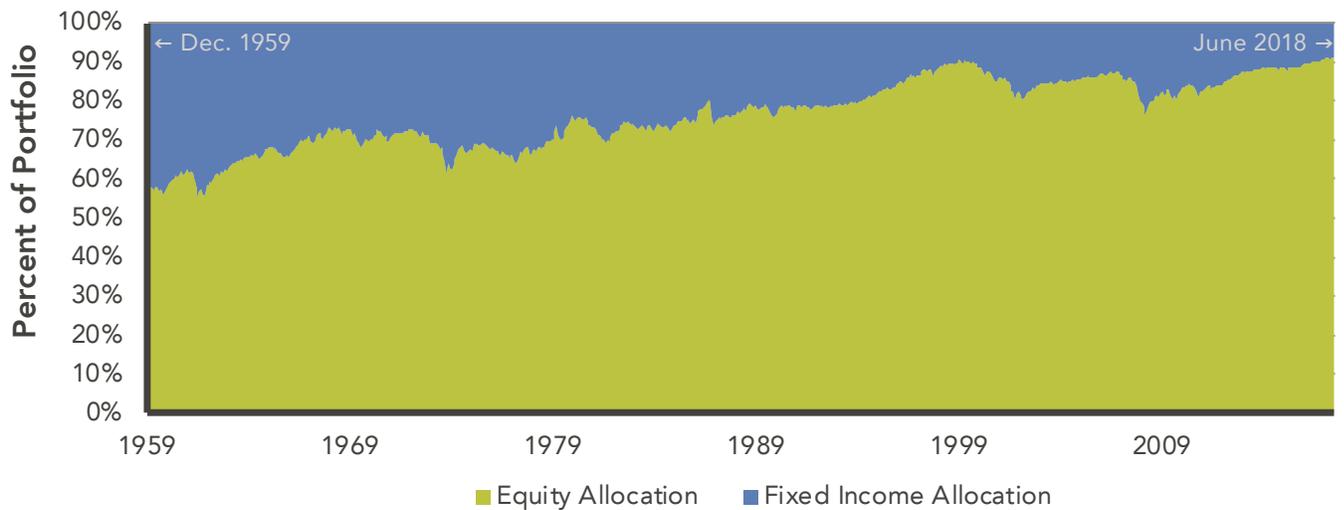
In almost all cases, a portfolio that is not rebalanced will eventually hold a much larger allocation to equities and by extension, grow increasingly risky over the holding period. This is precisely why it is so important for clients to rebalance. As shown in Exhibit 2, a portfolio that is not rebalanced eventually becomes much riskier than a portfolio that is regularly rebalanced. Failure to rebalance exposes portfolios to greater equity risk and leads to more volatile performance.

Exhibit 2: 10-Year Rolling Standard Deviation

The importance of rebalancing a portfolio to maintain a target risk profile should be clear. This paper looks at what type of rebalancing program clients should implement, and the tradeoffs between different programs. For the purpose of this analysis we will discuss two types of rebalancing programs: calendar (rebalanced monthly, quarterly, and annually) and deviation from policy targets (2.5%, 5%, 7.5%, and 10% deviations).

CALENDAR REBALANCING

Looking at rolling ten year returns since 1926, the differences in returns between monthly, quarterly, and annual rebalancing is surprisingly small. As shown in Exhibit 3, the differences are almost indiscernible when shown graphically.

⬊ **Exhibit 3:** 10-Year Rolling Returns for Different Frequencies of Calendar Rebalancing

As another way of showing the minute differences between monthly, quarterly, and annual rebalancing, we chart the differential in returns between quarterly vs. monthly rebalancing (Exhibit 4) and annual vs. monthly rebalancing (Exhibit 5). Exhibits 4 and 5 show that while the relative performance of different rebalancing strategies varies over time, they are very small, averaging between eleven (annual vs. monthly) and twelve (quarterly vs. monthly) basis points annually.

⬊ **Exhibit 4:** Relative Performance of a Quarterly Rebalanced Portfolio (Compared to Monthly)
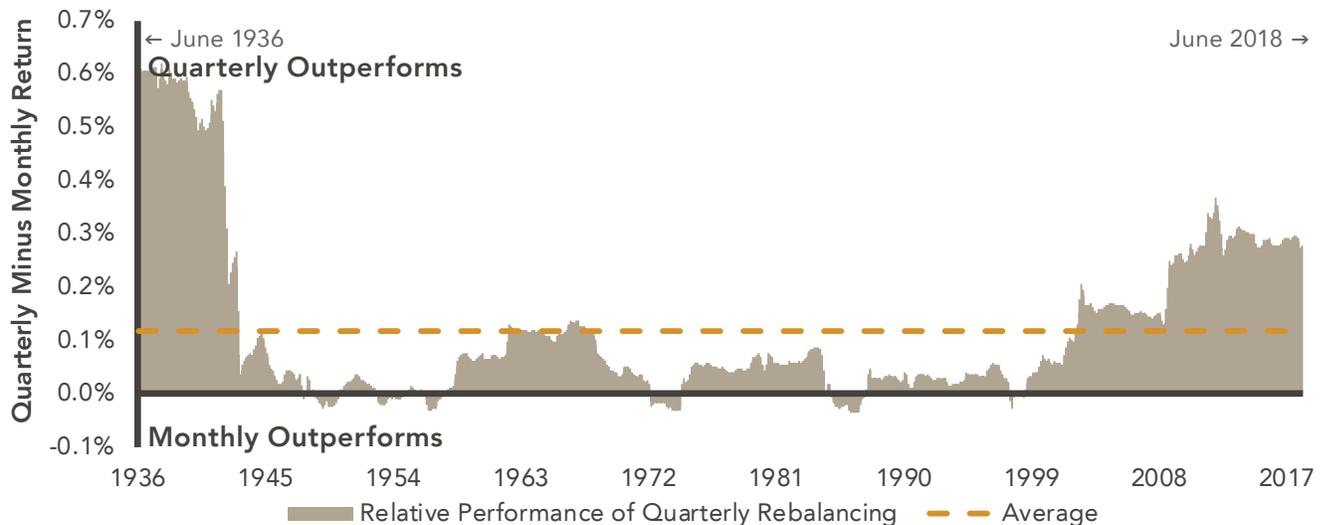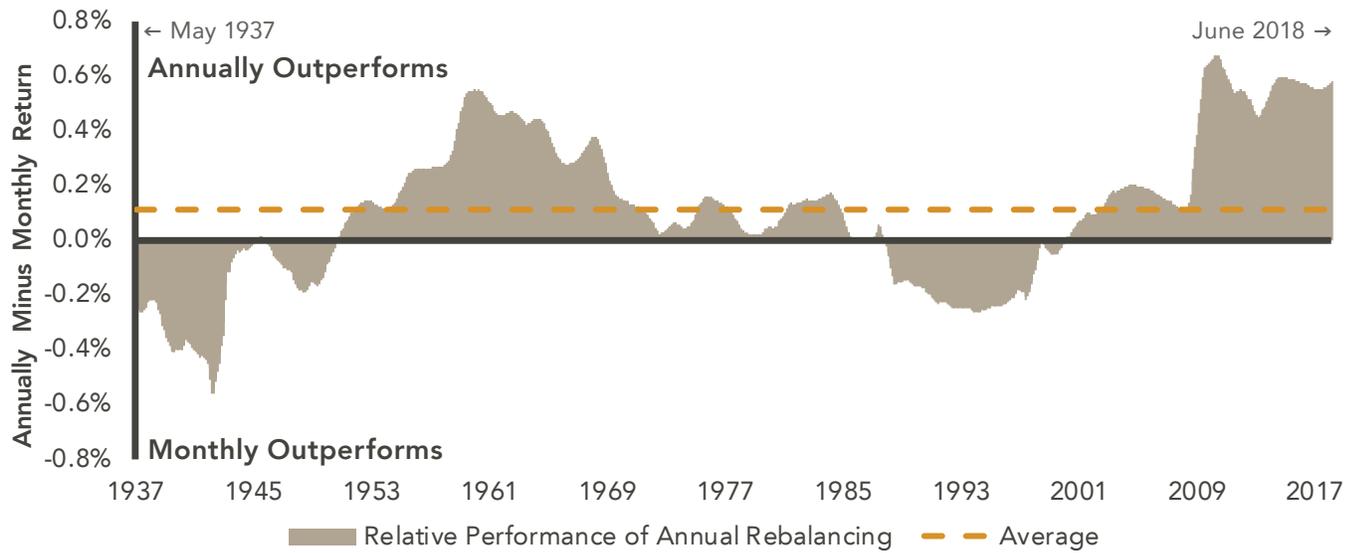
Relative Performance of Annual Rebalancing — — Average

If we assume that monthly rebalancing is the baseline against which to evaluate all other rebalancing programs, the tracking error for a portfolio that is rebalanced quarterly or annually is also quite small. Not surprisingly, as shown in Exhibit 6, tracking error increases the less frequently portfolios are rebalanced. However, since the end of the Great Depression, the tracking errors of portfolios rebalanced quarterly or annually are minimal.

↘ **Exhibit 6:** Tracking Error of Portfolios Rebalanced Quarterly and Annually

Quarterly (moving average) —— Annually (moving average)
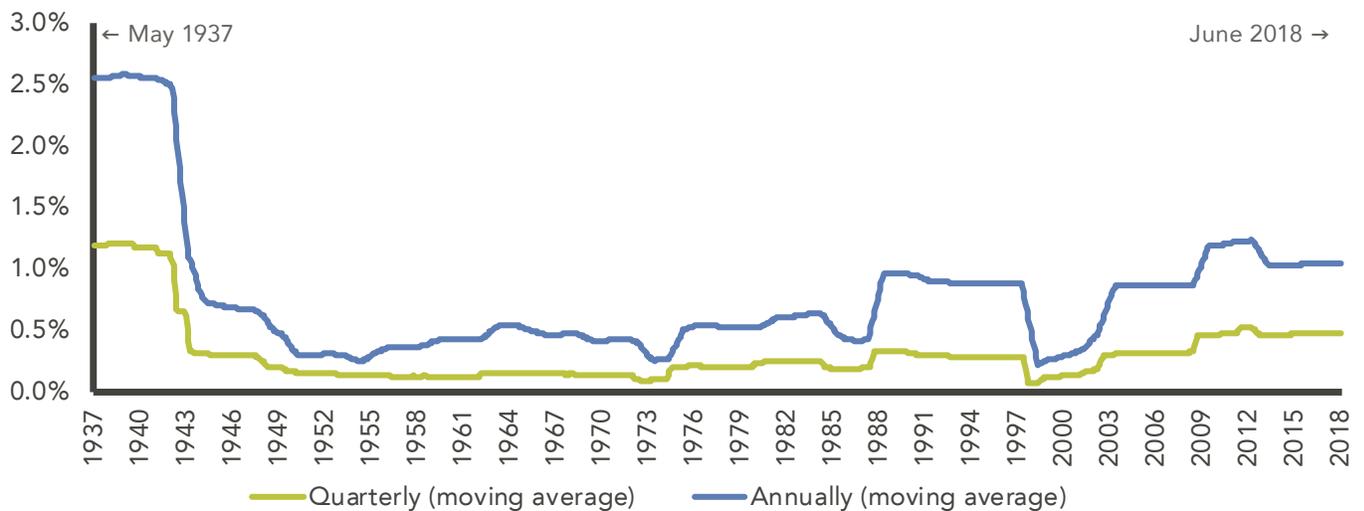
The differences between various calendar rebalancing strategies are small, so to better demonstrate the tradeoffs we looked at how often each rebalancing strategy generated the best outcome. To do this we looked at rolling ten year periods ending each month since 1926 (there are 985 periods in this sample). We then looked to see how often each strategy produced the highest return, lowest risk, or highest Sharpe ratio, for each of the 985 data points. For example, over the 985 observations in our analysis, monthly rebalancing produced portfolios with the highest Sharpe ratio 8% of the time, or 78 times out of 985. Exhibit 7 *(following page)* shows the results of different calendar rebalancing programs on a rolling ten year basis, since 1926. These results do not describe the magnitude of the performance, but help to illustrate the tradeoffs inherent in different rebalancing strategies.

Rolling 10 Years

	Percentage of observations with the best Sharpe	Percentage of observations with the best return	Percentage of observations with the lowest standard deviation	Number of rebalancing events	Average equity allocation
Monthly	7.9%	4.1%	17.1%	120	60.08%
Quarterly	34.3%	36.5%	22.1%	40	60.21%
Annually	57.8%	59.4%	60.8%	10	60.59%

Annual rebalancing appears to offer the best rolling ten year return most often. Intuitively, this makes sense since less frequent rebalancing should, on average, lead to a slightly larger equity allocation, which in turn should lead to slightly higher return. Surprisingly, annual rebalancing also tends to generate slightly lower risk portfolios over time. However, the magnitude of these differences is not large enough to be predictive about the future. The average difference in return between monthly and annual rebalancing is just ten basis points annually. And the average difference in risk is only 7 basis points.

Under shorter timeframes the same pattern emerges: annual rebalancing equates to slightly higher returns, mostly because of a higher average allocation to equities. As shown in Exhibit 8 the difference in returns over a rolling three year period also show a negligible margin between the assorted frequencies of rebalancing.

↘ **Exhibit 8:** 3-Year Rolling Returns for Different Frequencies of Calendar Rebalancing

In total, this analysis demonstrates that infrequent rebalancing is very effective, which is all the more notable because we do not attempt to include any estimation of the costs[1] associated with rebalancing. The costs of rebalancing will vary based on the investor, the asset classes in the portfolio, and the market environment. However, regardless of these variables, it is certain that there are costs to rebalancing. As demonstrated by the data, investors do not need to rebalance their portfolios all that often to maintain policy targets and risk profiles. Between the costs associated with rebalancing and the extremely thin margins in return and risk metrics for the different frequencies, annual rebalancing appears to be the most optimal frequency if a calendar rebalancing program is chosen.

DEVIATION FROM POLICY TARGET

Although calendar rebalancing is appealing from an intuitive perspective, most institutional clients do not use calendar rebalancing, but instead focus on rebalancing when asset classes deviate substantially from policy targets. The primary benefit of range based rebalancing is that portfolios are only rebalanced when they deviate from policy targets. Consequently, clients do not incur transaction and operational costs when it is unnecessary (as can be the case with calendar rebalancing). Instead of selecting a frequency by which to rebalance, clients must decide on appropriate target ranges to optimize risk and return. For the purposes of our analysis, we examine four ranges: 2.5%, 5%, 7.5%, and 10%, which are defined as the percentage of the allocation. For example, a 10% range around a target allocation to bonds of 40% is +/-4% (i.e. 10% of the allocation). In a two asset class portfolio, this results in a full rebalance once the asset class with the smallest weight falls out of range. As the chart in Exhibit 9 shows, the differences in returns between the different rebalancing ranges are small.

Exhibit 9: 10-Year Rolling Returns for Different Ranges of Rebalancing
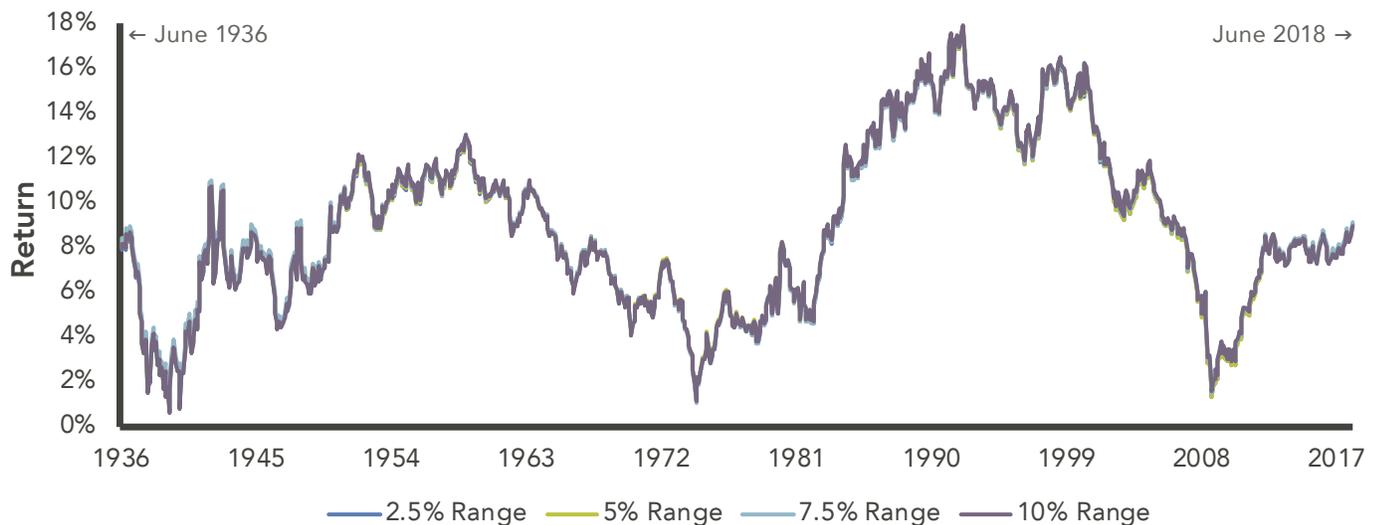
Similar to how we compared the different frequencies for calendar rebalancing, we now compare the relative performance of each range to our baseline case of monthly rebalanced portfolios. Again, the results are favorable, with the average return of each range-based rebalancing program greater than zero (as shown by the dotted orange line in each chart).

Exhibit 10: Relative Performance of a Rebalanced Portfolio: 2.5% Range (Compared to Monthly)
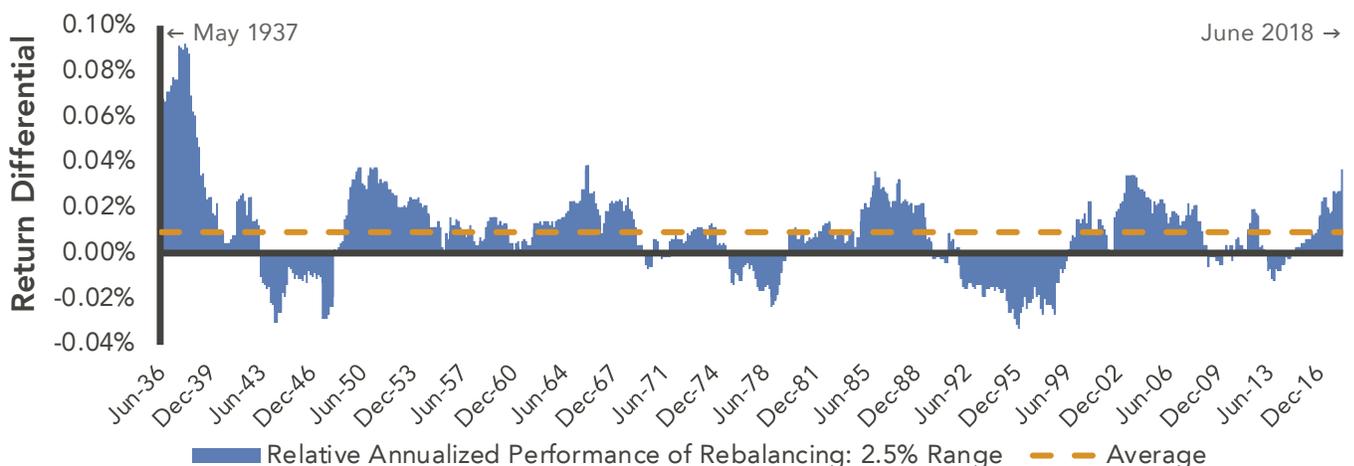
← May 1937

June 2018 →

Relative Annualized Performance of Rebalancing: 5.0%   — — Average

↘ **Exhibit 12:**   Relative Performance of a Rebalanced Portfolio: 7.5% Range (Compared to Monthly)

← May 1937

June 2018 →

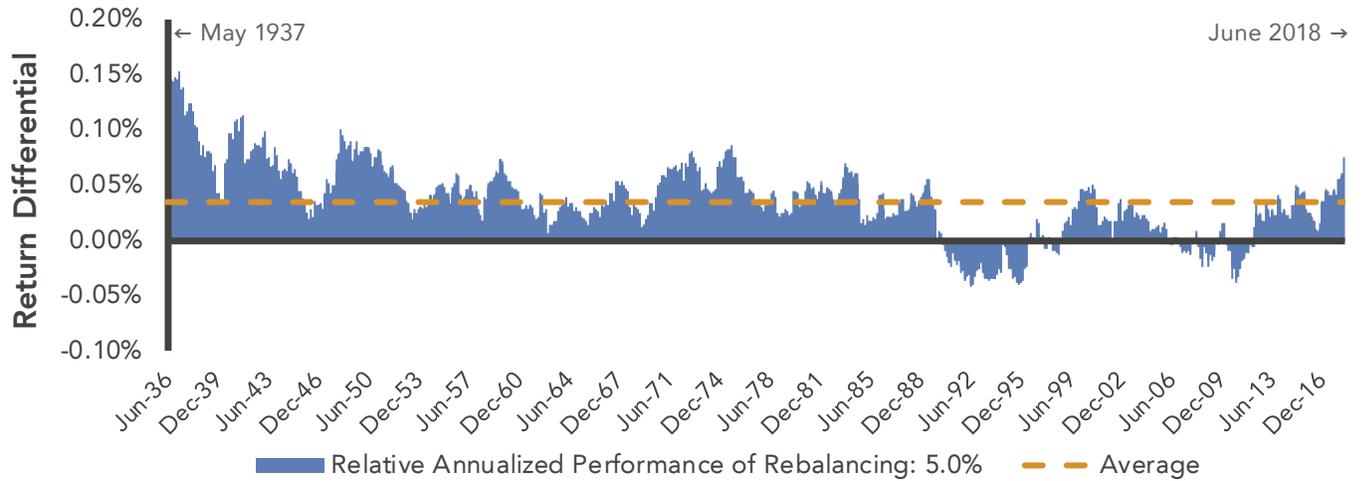Relative Annualized Performance of Rebalancing: 7.5%   — — Average
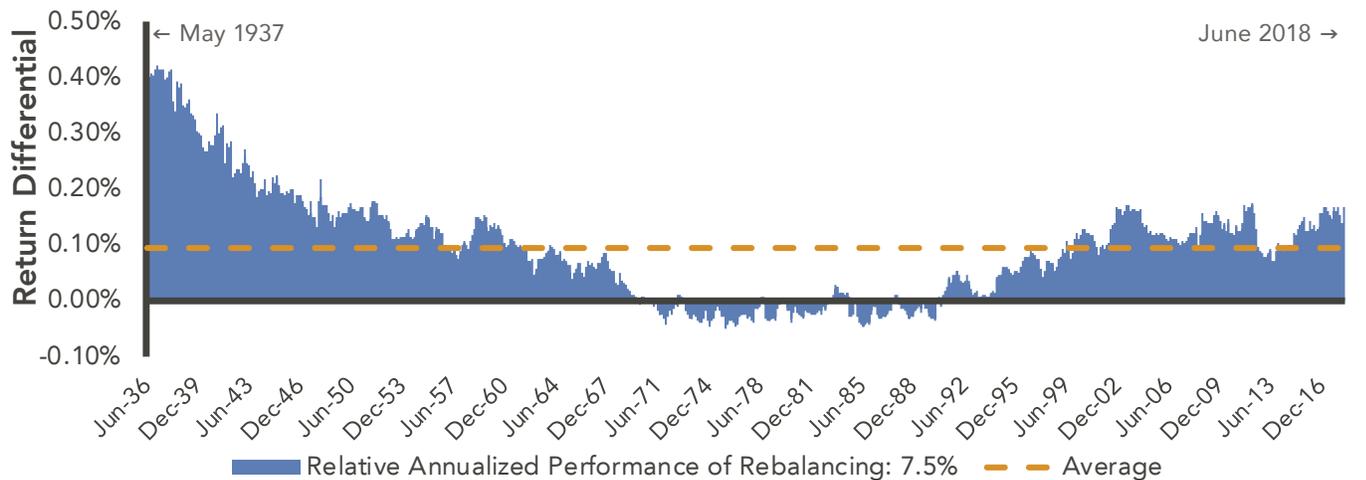
↘ **Exhibit 13:**   Relative Performance of a Rebalanced Portfolio: 10.0% Range (Compared to Monthly)

← May 1937

June 2018 →

Relative Annualized Performance of Rebalancing: 10.0% Range   — — Average

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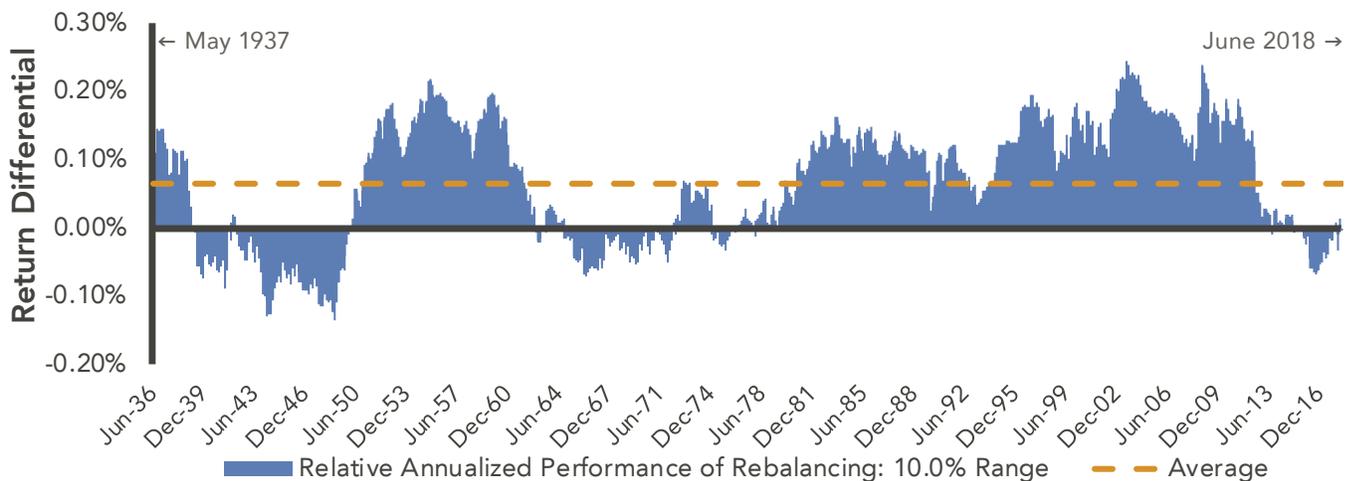
If we again assume that monthly rebalancing is the baseline for comparison, the tracking errors of portfolios rebalanced for various target ranges are also quite small. Not surprisingly, as shown in Exhibit 14, tracking error increases the wider the range around the target allocation. However, similar to calendar rebalancing, the differences between the tracking errors are minimal.

⬊ **Exhibit 14:** Tracking Error of Portfolios Rebalanced Based on Deviation from Target
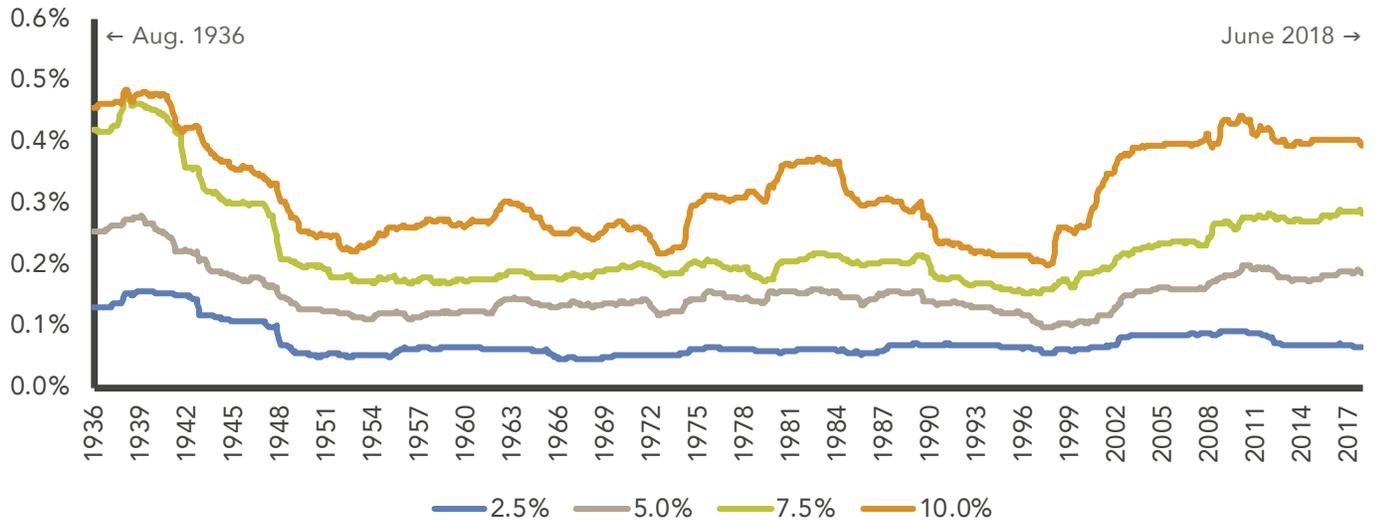
Clearly, there is a notable correlation between the width of the rebalancing range and tracking error. This is largely due to the average equity allocation, shown in Exhibit 15. Portfolios that are rebalanced less frequently tend to exhibit slightly more volatility driven by the higher allocation to equities. Wider ranges also lead to fewer rebalancing events and higher average returns. Conversely, portfolios with a narrow range consistently exhibit the lowest volatility, but at the expense of lower returns.

⬊ **Exhibit 15:** Range Based Rebalancing Outcomes

	Rolling 10 Years				
	Percentage of observations with the best Sharpe	Percentage of observations with the best return	Percentage of observations with the lowest standard deviation	Number of rebalancing events	Average equity allocation
Range 2.5%	0.7%	0.0%	31.9%	50	60.14%
Range 5%	13.9%	11.3%	17.2%	24	60.24%
Range 7.5%	41.5%	39.6%	14.6%	16	60.50%
Range 10%	43.9%	49.1%	36.3%	10	60.61%

Exhibit 15 shows that while frequent rebalancing often led to lower standard deviation, it generally came at the expense of a lower return and Sharpe ratio. However, it should be noted that — as we demonstrated earlier — the differences in returns and risk, while quantifiable, are very small and may be irrelevant to many investors. Over a ten year period the annualized average difference in returns is between zero and ten basis points, depending on which range is utilized. Ultimately, the type of rebalancing program an investor implements is likely to have a far smaller effect on the final performance of the portfolio than transactions costs, management fees, and the timing of cash flows into and out of the fund.

These same themes are apparent when looking at shorter time periods as well. As shown in Exhibit 16, the differences in returns between the various rebalancing strategies over a rolling three year period are also small.

⬎ **Exhibit 16:** 3-Year Rolling Returns for Different Ranges of Rebalancing
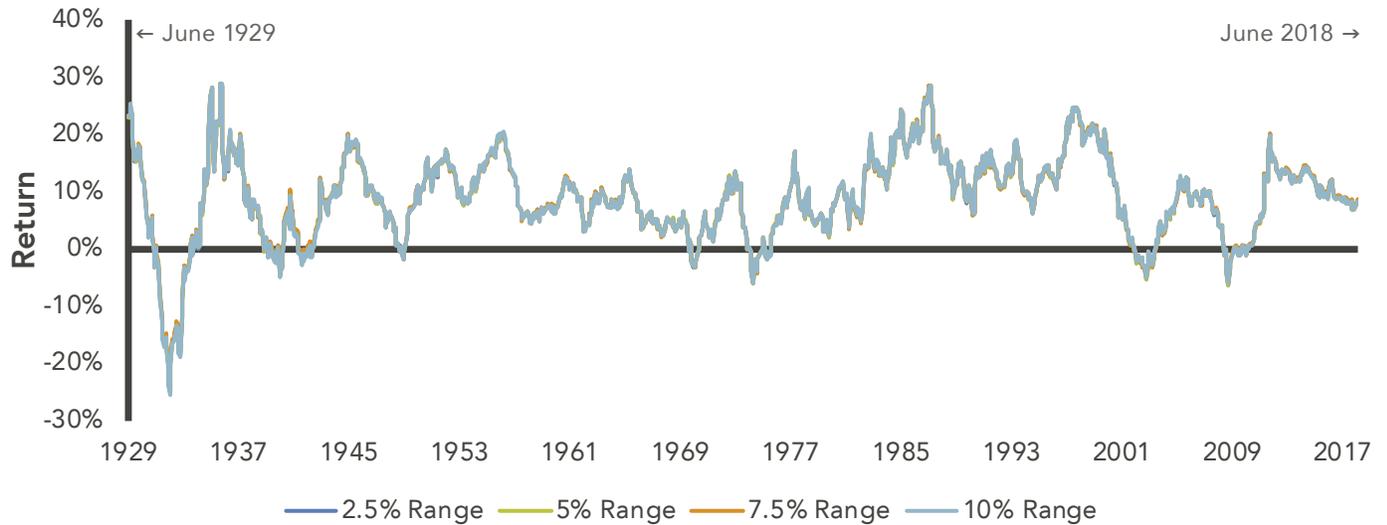

Exhibit 17 shows the relative benefits of target versus calendar rebalancing. The results point to some of the same conclusions already discussed: less frequent rebalancing leads to larger equity allocations and slightly higher returns. Though the annual rebalancing method did have lower volatility on average, it was by such a small margin that we do not view this as meaningful towards predicting future performance. Much more notable is the difference in tracking error between the two styles. By comparing Exhibits 6 (calendar rebalancing) and 14 (deviation from target rebalancing) we see that the tracking errors of portfolios that are rebalanced based on deviations from target tend to be lower. This allows clients to more closely track the returns of their target asset allocations, with fewer rebalancing events. Therefore, a range based approach appears to be the most effective way to limit the number of rebalancing events and generate the targeted risk and return profile.

⬎ **Exhibit 17:** Rebalancing Outcomes

	Rolling 10 Years				
	Percentage of observations with the best Sharpe	Percentage of observations with the best return	Percentage of observations with the lowest standard deviation	Number of rebalancing events	Average equity allocation
Annual	47.5%	46.1%	58.0%	10	60.59%
Range 2.5%	0.2%	0.0%	22.3%	50	60.14%
Range 5%	4.5%	3.7%	2.8%	24	60.24%
Range 7.5%	20.4%	20.4%	9.8%	16	60.50%
Range 10%	27.4%	29.8%	7.0%	10	60.61%

REBALANCING DURING "HIGHER MOMENTS" IN THE CAPITAL MARKETS

Intuitively, investors already know that rebalancing is the key to maintaining target asset allocations. Earlier analysis has demonstrated that portfolios which are not rebalanced typically become riskier since historical equity market outperformance (relative to bonds) translates to a higher overall equity exposure and hence, risk. Despite this pattern, the topic of rebalancing comes up in board rooms most often when equity markets have underperformed and investors are more sensitive to further losses. It is at these moments when investors are tempted to abandon rebalancing programs due to concerns that rebalancing will increase the risks and lower the returns of their portfolios.

Exhibit 18: Rebalancing After Poor Equity or Bond Performance

	Equal or better performance rate	Average outperformance	Higher standard deviation rate
Equity Rebalance	80.4%	0.6%	76.8%
Bond Rebalance	83.6%	0.2%	50.9%

To examine the effect of rebalancing during periods of equity market stress we looked at the subsequent three year annualized returns after poor equity market performance. We define poor equity market performance as monthly returns that fall in the bottom 5% of monthly returns (monthly return less than or equal to -7.34%) since 1926. The subsequent three year annualized returns were equal or better for portfolios that were rebalanced 80% of the time. Looking at all periods that fall into the bottom 5% of returns, the average outperformance (including when rebalanced portfolios underperformed) was 0.57% annually. Interestingly, rebalancing also led to a higher portfolio standard deviation (risk) 77% of the time. This actually makes sense, since rebalancing into equities after poor equity market performance increases the allocation to equities, which leads to greater portfolio volatility over the subsequent timeframe (compared to not rebalancing). Increased risk in this instance is appropriate; there is a tradeoff between risk and return and if portfolios are too "low risk" (i.e. the allocation to equities is significantly below the original target allocation) the portfolio is less likely to meet the investor's return expectations.

The benefit of rebalancing is also evident after the bond market has performed poorly. Looking at the bottom 5% of monthly bond market returns (monthly return less than or equal to -3.17%) since 1926, rebalanced portfolios outperformed portfolios that were not rebalanced over the subsequent three year period 84% of the time. The average outperformance of the rebalanced portfolios was 0.2% annually. However, rebalancing after poor bond market returns had little impact on the portfolio's standard deviation, with the rebalanced portfolio having higher risk 51% of the time. So while the benefit of higher returns was smaller, rebalancing back into bonds had a negligible effect on volatility.

These results demonstrate that during periods of capital market stress it is important to continue to rebalance. Rebalancing achieves the appropriate risk and return objective implicit in the original asset allocation and usually adds to total portfolio return.

MULTI ASSET CLASS PORTFOLIO

To this point, our analysis has centered on a two asset class portfolio because there is significantly less historical data for other asset classes. However, modern institutional portfolios typically have more than two asset classes. It is reasonable to wonder whether the results we have found for a two asset class portfolio hold as more asset classes are added to the portfolio. To do this, we split the equity allocation into U.S. (S&P 500) and non-U.S. (MSCI EAFE) stocks, while leaving the bond allocation at 40%, beginning in 1970.

Exhibit 19: Rebalancing Outcomes for a Multi-Asset Portfolio

Rolling 5 Years	Best Sharpe	Best return	Lowest standard deviation		Rolling 3 Years	Best Sharpe	Best return	Lowest standard deviation
Range 2.5%	34.4%	33.5%	41.5%		Range 2.5%	34.0%	32.1%	38.2%
Range 5.0%	11.7%	12.4%	16.1%		Range 5.0%	13.0%	9.9%	15.3%
Range 7.5%	7.1%	8.2%	9.0%		Range 7.5%	10.7%	16.4%	8.4%
Range 10.0%	46.8%	45.9%	33.5%		Range 10.0%	42.3%	41.5%	38.0%

Not surprisingly, many of the same themes we observed in the two asset portfolio appear here as well. Over a longer time frame (five years) there does appear to be some tradeoff between risk and return as portfolios that have wider ranges tend to have higher returns, while those with the narrowest ranges had the lowest risk. It should also be noted that as we mentioned previously, the differences in returns (i.e. the magnitude of these results) are not significant.

Going one step further we looked at a truly diversified portfolio that more closely resembles a modern institutional portfolio, with allocations to thirteen distinct asset classes. However, performance data only goes back to 1990 so historical data is limited.

Exhibit 20: Average Allocations for a Multi-Asset Portfolio

Asset Class	Agg Bond	High Yield	Large Value	Large Core	Mid Growth	Small Value	Intl SC
Target	20.0%	10.0%	5.0%	9.5%	6.5%	5.5%	5.0%
Range 2.5%	19.9%	10.0%	5.0%	9.5%	6.5%	5.5%	5.0%
Range 5.0%	19.8%	10.0%	5.1%	9.6%	6.6%	5.5%	5.0%
Range 7.5%	19.5%	10.0%	5.1%	9.6%	6.6%	5.6%	5.0%
Range 10%	19.4%	10.0%	5.1%	9.7%	6.6%	5.6%	5.0%

Asset Class	Intl Core	EM	REITS	GSCI	Eq Hedge	Multi-Strat	Avg. # of Rebalance Events per Year
Target	10.5%	4.0%	10.0%	4.0%	3.0%	7.0%	
Range 2.5%	10.5%	4.0%	10.0%	4.0%	3.0%	7.0%	11.8
Range 5.0%	10.5%	4.0%	10.1%	4.0%	3.0%	7.0%	10.4
Range 7.5%	10.5%	4.0%	10.1%	4.0%	3.0%	6.9%	8.0
Range 10%	10.5%	4.0%	10.1%	4.0%	3.1%	6.9%	6.9

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What stands out is the high number of rebalancing events compared to the simpler two asset class portfolio. Even with the widest range (10.0%) around the asset classes, it's easy for one or more asset classes to move out of the target range. For portfolios with tighter ranges, portfolios are rebalanced on a nearly monthly basis. Looking at portfolio outcomes, Exhibit 21 shows a stronger relationship between the return of the portfolio and the range around the target. Tighter ranges generally led to better performance, while maintaining similar standard deviation as the wider bands. However, transaction costs are not included in this example, but would undoubtedly add sufficient costs to the narrower ranges to make them less efficient than larger ranges for rebalancing. The limited historical data also makes this analysis less robust than the analysis based on data going back to 1926.

Exhibit 21: Rebalancing Outcomes for a Modern Institutional Portfolio

Rolling 5 Years

	Best Sharpe	Best return	Lowest standard deviation
Range 2.5%	49.5%	47.0%	24.0%
Range 5.0%	40.6%	41.0%	20.8%
Range 7.5%	0.0%	0.0%	30.4%
Range 10.0%	9.9%	12.0%	24.7%

IMPLEMENTATION

The material presented in this paper demonstrates that the portfolio outcomes from different rebalancing strategies are relatively small. As such, there is a considerable amount of room for investors to implement a rebalancing program that best suits their constraints. However, all rebalancing programs should incorporate the following conclusions from the paper:

- Investors should implement a rebalancing program that leads to relatively infrequent rebalancing in order to minimize transaction costs.
- The differences in risk and return between various types of rebalancing are minimal.
- Target ranges are the optimal way to rebalance because they minimize rebalancing events and tracking error compared to the target asset allocation.
- For clients that focus on target ranges to guide rebalancing, wider is better. However, less frequently rebalanced portfolios do exhibit slightly higher risk.
- Marquette recommends the following ranges based on the size of the allocation:

Size of the Allocation	Percentage Range (+/-)	Absolute Range (+/-)
Up to 5%	+/- 20%	+/- 1.0%
6% to 19%	+/- 15%	+/- 1.5%
Greater than 20%	+/- 10%	+/- 2.0%

- Clients that have significant concerns about overall portfolio volatility should use narrower ranges, keeping in mind that less frequent rebalancing is preferable.
- Target ranges should also account for the liquidity of the asset class; rebalancing should be driven primarily by the large, liquid allocations. Less liquid allocations should have wider target ranges since they are difficult and costly to rebalance.

- For clients that find it difficult to regularly monitor their portfolio allocations, annual rebalancing is simple, minimizes transaction costs, and achieves an appropriate amount of risk reduction.

- When rebalancing, clients should rebalance back to target.

- Cash flows are a very effective tool for rebalancing, and help to limit transaction costs incurred when portfolios are rebalanced.

- The most important part about a rebalancing program is to stick to it consistently over time to ensure that the portfolio is rebalanced, regardless of the prevailing market environment.

Rebalancing is really about reducing risk in a portfolio by maintaining an asset allocation that meets a client's objectives. Portfolios do not need to be rebalanced very often to benefit from significant risk reduction (compared to a portfolio that is not rebalanced). The data is not conclusive about the best type of rebalancing to implement, so clients should pick a rebalancing program that fits their needs. Clients that are unable to monitor portfolios regularly may prefer annual rebalancing. Clients that want less volatility in their portfolios may set tighter ranges around their asset class target allocations. Most importantly, clients should adopt a rebalancing program and stick to it during various market cycles. The only obvious mistake that investors make is when they abandon their rebalancing policies. ◗

NOTES

[1] This paper does not attempt to incorporate rebalancing costs because they can differ considerably, depending on the portfolio. However, all clients typically incur two types of costs when they rebalance: direct transaction costs (commissions) and indirect transactions costs (bid-ask spread of the security being traded).

[2] A considerable amount of ink has been spilled over exactly how a client should "rebalance." Arnott and Lovell (1993) argued that clients rebalance back to target, which is what Marquette recommends. Leland (2000) then recommended that portfolios should only be rebalanced back to within the target range. Masters (2003) attempted to better account for transaction costs and argued portfolios should be rebalanced back to the "mid-point," halfway between the target allocation and the current allocation. Both Leland and Masters make a number of assumptions about transaction costs, client risk tolerance, and asset classes that are not constant across different clients. The primary objective of rebalancing is to maintain a predetermined asset allocation, thus Marquette recommends rebalancing portfolios all the way back to target.

About Marquette Associates

Marquette Associates is an independent investment consulting firm that guides institutional investment programs with a focused client service approach and careful research. Marquette has served a single mission since 1986 – enable institutions to become more effective investment stewards. Marquette is a completely independent and 100% employee-owned consultancy founded with the sole purpose of advising institutions.

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