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Style index rebalancing for better diversification: lessons from broad market and equity style indexes

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Abstract

We explore the effectiveness of rebalancing approaches by examining the performance of both time-based and various asset-level-based triggers using equally weighted portfolios comprised of six equity style indexes. Although either form of style rebalancing attains superior performance (both absolute and risk-adjusted) over a naïve, buy-and-hold approach, we find trigger-based rebalancing results to be marginally superior. We also note that both the inability to rebalance asset allocation within a traditionally indexed equity investment fund as well as intermediate-term variability in size and style performance combine to dispel the widespread belief that investors can achieve adequate diversification solely through broad-market index holdings.

JEL classification: G11; D14

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1. Introduction

Does rebalancing a portfolio truly improve its overall performance? If so, is one approach to rebalancing clearly superior to another? The answers to these questions embody the primary motivation for our research and have gained increased importance as a result of the behavior of traditional broad-market index (BMI) funds from the late 1990s through the early 2000s. During the 2000 to 2002 bear market, many investors whose portfolios tracked a BMI

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Table 1 Panel A: Broad-market index peak-to-trough performance for the two most recent market cycles

	S&P 500	Russell 3000	Wilshire 5000
2000–2002			
Record high close (03/24/00)	1,527.46	844.78	14,751.60
Subsequent low (10/09/02)	776.76	430.16	7,342.86
Percentage decline from peak-to-trough	−49.15%	−49.08%	−50.22%
2007–2008			
Record high close (10/09/07)	1565.15	1667.25	15745.39
Subsequent low (11/20/08)	752.44	785.93	7450.95
Percentage decline from peak-to-trough	−51.93%	−52.86%	−52.68%

Note: These are the three most commonly cited BMIs (broad-market indexes).

Panel B: Historical correlation matrix of BMI monthly returns, January 1986-December 2008

	S&P 500	Wilshire 5000	Russell 3000
S&P 500	1		
Wilshire 5000	0.987	1	
Russell 3000	0.993	0.998	1

Panel C: Correlation matrix of style index daily returns, June 1995-December 2008

	T200G	T200V	MCG	MCV	2000G	2000V
T200G	1					
T200V	0.840	1				
MCG	0.900	0.764	1			
MCV	0.803	0.932	0.809	1		
2000G	0.823	0.733	0.934	0.808	1	
2000V	0.746	0.812	0.804	0.908	0.895	1

through open-end mutual funds or exchange-traded-funds (ETFs) learned a painful lesson when they discovered their holdings were not as well diversified as previously believed. In fact, this lack of diversification played a major role in the peak-to-trough losses of roughly 50% observed for the Standard & Poor's 500, Russell 3000 and Wilshire 5000 indexes over this period.

Great success in the technology sector during the late 1990s led to unprecedented exposure to technology stocks within the three primary BMIs, a consequence of the market capitalization-based weighting schemes they each use. For example, the S&P 500 reached a peak technology sector exposure of 34.46% of assets in August of 2000, more than triple the index's exposure to technology at the beginning of 1995.[1] In other words, market cap weighting had caused more than one-third of the assets in an ostensibly well-diversified broad market index to become allocated to a single industry.

The impact of overexposure in the technology sector was virtually identical across all cap-weighted BMIs, as evidenced by the remarkable consistency of the peak-to-trough declines displayed in Panel A of Table 1. The three BMIs reached simultaneous all-time highs on March 27, 2000 and then experienced simultaneous peak-to-trough lows on October 9, 2002. Each index experienced an overall decline of 50%, with a variance of less than 95 basis points. Subsequently, these three indexes again attained simultaneous all-time highs and new peak-to-trough lows from October 9, 2007 to November 20, 2008, respectively. The performance of all three indices on this occasion was once more remarkably similar, each falling 52%, with less than 90 basis points in variation. The similarity is no coincidence. As demonstrated in Panel B of Table 1, the major BMIs have near-perfect long-term correlation. This confirms that the returns of all three are driven by the same group of very large firms, as cap-weighted indexes, rendering the impact on index performance of the smaller firms virtually inconsequential.

Among BMI choices, the S&P 500 index has long been regarded as the bellwether market proxy. Some might contend that with 3,000 and more than 7,000 stocks, respectively, the Russell 3000 and Wilshire 5000 indexes are substantially broader in scope, including a wide range of large and small cap stocks, and would therefore be better gauges of the entire equity market. That argument, however, fails to consider the effects of market-cap weighting on the stocks of smaller companies. For example, the smallest 600 stocks in the Russell 3000 represent less than one-half of 1% of the entire index capitalization combined. Therefore, even if the prices of all 600 of these firms were to double overnight, the resulting impact on the index would be barely discernable. The correlation among the monthly returns of indexes over the past 20 years shown in Panel B of Table 1 perhaps demonstrates an even more persuasive argument, with correlations of 0.99 across all three possible index pairs. Moreover, in response to the contention that market shocks such as September 2001 or October 1987 might be driving the near-perfect correlation, we remove the 20 largest negative returns and find correlations remain nearly perfect, at roughly 0.98. With performance differences among the three BMIs virtually non-existent, we streamline the analysis in our article by utilizing the S&P 500 as our sole BMI proxy.

The dramatic ascent of the technology sector weight in the S&P 500 throughout the mid- to late-1990s was driven by the extraordinary performance of technology stocks relative to other industry sectors. The level of diversification within BMIs declined dramatically, because of the rapid growth in the market capitalization of the tech sector relative to virtually all other sectors over the period. Meanwhile, given the common perception that index funds and ETFs are simple, inexpensive investment vehicles with broad diversification benefits, most investors were likely unaware that anything was amiss. Even those who did recognize the major indexes had become dangerously concentrated in technology were faced with the difficult decision of what to do about it. Being unable to directly rebalance an index fund, investors wishing to rectify the situation would have been forced to liquidate some or all of their indexed holdings. Precisely how much of the index fund to sell, however, and what to do with the proceeds were complex questions lacking definitive answers. Consequently, even those index investors who were able to recognize the technology-overweighting problem likely did nothing.

Using data from obtained from Barra, Fig. 1 shows the relative changes in S&P 500 sector weights between August 2000 and September 2001. Note that the proportion of technology stocks in the index fell by more than 50% in the thirteen months following the sector's collapse, while the weight of every other sector rose. Overall, the market capitalization of the index retreated by more than 30% during the period.[2] Thus, despite a steady general market decline over this timeframe, technology firms indisputably led the downhill charge.

Broad market index funds, held in either ETF or open-end mutual fund form, have long

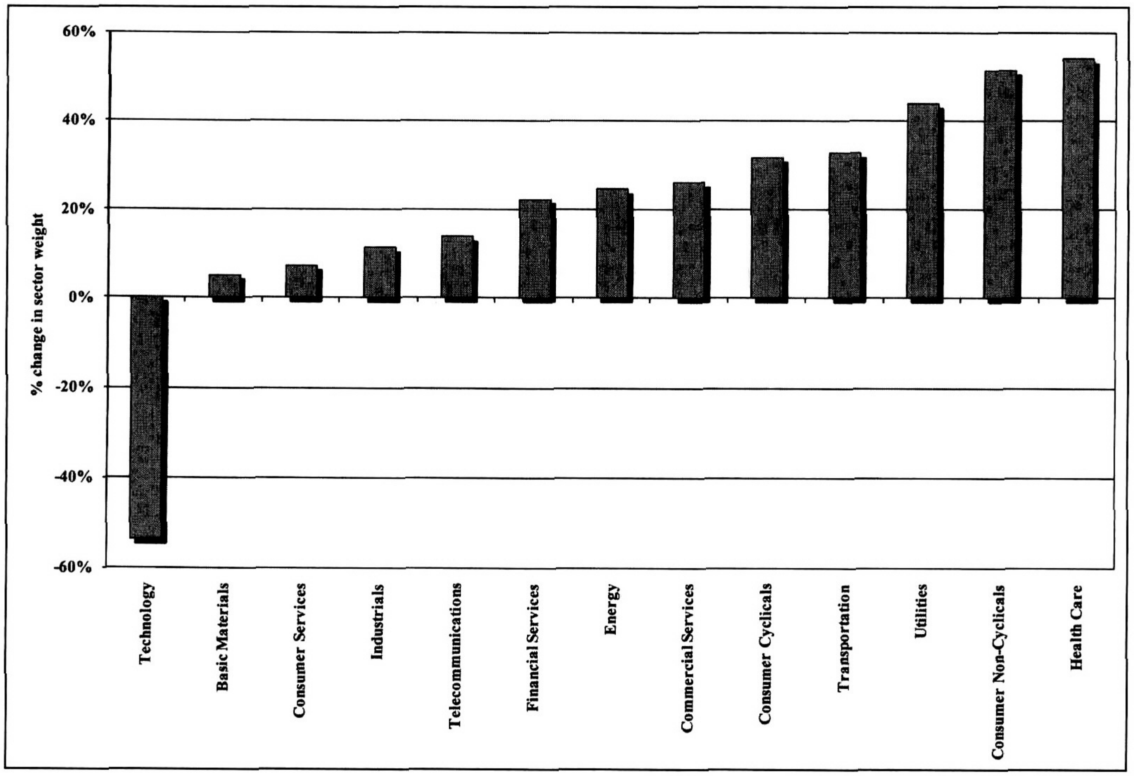

Fig. 1. Percentage change in S&P 500 sector weights between August 2000 and September 2001. Source: Data from the Frank Russell Company.

been touted by the financial press, mutual fund companies, and even some academics, as sound investment vehicles providing outstanding diversification benefits at very low cost. As just demonstrated, however, this view of BMI funds clearly needs scrutiny with respect to diversification benefits. Meanwhile, a lack of suitable, alternate investment vehicles in a single-solution investment or portfolio has left index investors in a quandary. As a potential solution, we advocate a fairly simple approach where investors can retain many of the intrinsic advantages of ETFs and open-end index funds, while achieving better diversification than by holding BMI-based investments alone.

We propose investors utilize a set of style indexes to create and custom-manage a flexible, well diversified and low-cost indexed portfolio. In comparison with the near perfect correlation among BMIs demonstrated earlier, Panel C in Table 1 presents the correlation matrix for the returns of six Russell style indexes (large-, mid-, and small-cap stocks, each split into value and growth categories) from mid-1995 through 2008. These coefficients exhibit far weaker relationships among the six styles than was seen in the correlations between BMIs, in turn suggesting that allocating assets across these styles could afford additional diversification benefits not available when using a standalone BMI.

Consequently, the purpose of this study is twofold: (1) to explore the general benefits of portfolio rebalancing, if any, and determine which approach to rebalancing might be superior; and (2) to examine the feasibility of using style index funds to enhance exposure to stocks of varying sizes and styles, while avoiding the higher risk of "hot" sector concentration to which BMIs remain susceptible. Though an infinite number of weighting schemes exist, we use only a naive, equally weighted approach. We do this to avoid the possibility of introducing bias into the study based on our knowledge of factors such as the value and size premiums. We recognize individual investors may want to consider such factors when forming their own portfolios, but we assume no prior knowledge of index performance differences and thus treat all styles equally for the purposes of this study.

2. Literature review

Renshaw and Feldstein (1960) began advocating the use of index funds in financial services literature as a means of attaining diversification while besting the performance of most active managers nearly 50 years ago. Over time, this idea of buying and holding a broad market index has come to be commonly thought of as the best solution for those who choose to passively manage their funds. Perpetuating this evolved misperception even today, some widely read publications and financial planners continue to encourage passive investors to hold broad market indexes, (Clements, 2006), including investment publications aimed at non-finance industry professionals (Landis, 2008; Newberry, 2000). Even most mutual funds tend to target their performance squarely at some broad market index benchmark such as the S&P 500 index (Chan, Chen, and Lakonishok, 2002), despite the fact that Elebash (1993) brought to light the overwhelming prevalence of index fund holdings among pensions in the United States and questioned the wisdom of this exposure nearly a decade earlier.

Well-known studies by Brinson, Hood, and Beebower (1986) and Brinson, Singer, and Beebower (1991) have long since established that asset allocation is the single largest determinant of portfolio performance over time. Sharpe (1992) acknowledges this central importance of asset allocation in portfolio returns over time while also asserting the idea that factors within asset classes, such as styles, would have further implications to long-term portfolio returns. Most research affiliated with seeking higher (raw or risk-adjusted) returns derived from shifts in style-weights or asset allocation is focused on market timing, tactical or an otherwise active allocation.

Some studies seek to demonstrate the benefits of market timing via active asset allocation (Arshanapalli, Switzer, and Hung, 2004). Among these, style-based studies are becoming increasingly common in the literature (Holmes and Faff, 2007; Puttonen and Seppa, 2007). Some research supports value over growth (Bauman and Miller, 1997), whereas some supports growth over value (Chan et al., 2002). Further, advocating the use of styles to help guide individual investors seems to be growing in popularity (Detzel, 2006). Ahmed, Lockwood, and Nanda (2002) demonstrate considerable benefits to investors applying style considerations to simulated portfolios using a tactical asset allocation strategy. They suggest that even moderate multi-style rotation strategies result in a strong likelihood of outperforming a BMI. Arshanapalli, Switzer, and Panju (2007) also show that active multi-style rotation strategies can be used to best returns from buy-and-hold portfolios, even in the face of transaction costs. Eakins and Stansell (2007) examine alternative portfolio rebalancing strategies, as applied to sector funds, but are unable to determine whether calendar-rebalancing or trigger-rebalancing is superior. Although we test rebalancing strategies similar to that of Eakins and Stansell, our approach may be the first to suggest a technique for better diversification while using a passive approach along with style rebalancing.

Active shifting among styles and asset classes (market timing) raises a whole new set of application issues, however. While Kao and Shumaker (1999) address style timing, they also illustrate the difficulties of attaining such benefits from including styles as part of an active strategy. Levis and Liodakis (1999) find the profitability of style rotation will vary through time because of styles falling in and out of favor with the markets, implying the intrinsic difficulties of market timing. In fact, efforts to actively manage portfolios based on asset class correlation appear fruitless, based on the seemingly unpredictable and significant changes in correlation among asset classes found to occur over time by Coaker (2006).

A passive form of rebalancing among styles, as we propose, makes intuitive sense as a way to improve performance if only because it resets asset allocation that otherwise becomes skewed from periodic sector out-performance or underperformance. This follows from the findings of Barberis and Shleifer (2003), who show price-levels among different styles exhibit long run tendencies toward their fundamentals. Barberis and Shleifer also demonstrate significant autocorrelation patterns in style returns and argue that "there are substantial profits to be made from a combination of contrarian and momentum trading." Nevertheless, they further illustrate the noise in prices and the inefficiencies that arise as styles fall in-and-out of favor, again indicating some of the difficulties in market-timing attempts. Although we provide no evidence for or against active management to capture potential excess gains, we do provide support for rebalancing techniques that can *automatically* capture some of these profits when undertaken by those having the foresight to use them.

The debate concerning whether active or passive investment management techniques reign superior continues unresolved today. Regardless of the answer, a large proportion of investors subscribe to passive strategy arguments, and many of these select BMI-based investments to implement this strategy selection. Benefits most often touted from passive investing in BMI-based vehicles include diversification, lower turnover (incurring less taxation) and lower costs. Although turnover is certainly lower relative to active fund management, this is only relevant for retirement accounts. Clearly, lower costs are also an inherent advantage, but the full potential of diversification benefits may not be entirely realized in aiming to mimic broad market index funds, as we show in this article. Here, we propose a promising alternative for passive investors.

3. Data

Equity style indexes tracking the U.S. markets are currently available from the Frank Russell Company, S&P 500, and Dow Jones. For investors, these indexes are generally available in investable form either via traditional open-end mutual funds or as ETFs. We use data from June 1995 through December 2008, obtained from the Frank Russell Company. Russell index data provide the longest daily time-series for style indexes available. The specific indexes selected for this study include the Russell Top 200 Growth, Top 200 Value, Mid-Cap Growth, Mid-Cap Value, Russell 2000 Growth, and Russell 2000 Value. These six

Table 2 Russell style index descriptive statistics, June 1995-December 2008

Russell index	Arithmetic mean annual return	Geometric mean annual return	Annualized standard deviation	Minimum daily return	Maximum daily return
Large cap growth	6.30%	3.95%	22.02%	−8.58%	11.92%
Large cap value	8.25%	6.45%	20.02%	−9.61%	11.75%
Mid cap growth	8.18%	5.01%	25.66%	−10.69%	12.42%
Mid cap value	9.66%	8.31%	18.26%	−10.34%	10.05%
Small cap growth	5.80%	2.60%	25.42%	−10.67%	10.14%
Small cap value	10.31%	8.58%	20.38%	−12.91%	8.95%

indices correspond to the growth and value splits on large-, mid-, and small-cap stocks, respectively, which in combination represent the entire Russell 3000 index without duplication or overlap.

A set of descriptive statistics for the daily style index return histories appears in Table 2. Note the spread of roughly 400 basis points between the small and midcap growth index performances over the sample period, demonstrating the dynamic nature of return disparities between firms of differing size over various periods. In addition, note that the annual geometric mean returns are significantly lower for each of the growth indexes than for their value counterparts, illustrating the sharp divergence in performance across equity styles even for stocks within the same size category. For example, the difference in annual geometric mean returns between small-cap growth and small-cap value over the study period is roughly 600 basis points, a marked variation.

4. Methodology

We investigate the performance of both time- and trigger-based approaches to rebalancing to a naïve target asset allocation using portfolios comprised of equity style indexes. The style indexes are categorized by both size (small, mid, and large cap) and type (value and growth), providing six independent styles. We create a core equity portfolio by equally weighting each of the six style indexes (16.67% initial weights), and we use these weights as our predetermined target percentages throughout this study.[3] Divergence in performance across the various styles alters the asset allocation of the core portfolio going forward, but the core portfolio is returned to the original equally weighted status at each rebalancing event.

We should note that in equally weighting the portfolio, we are not advocating a particular asset allocation. A naïve, equally weighted approach was selected simply because it assumes no a priori knowledge of index performance differentials and helps assure readers that the initial target weights are not driven by researcher bias or data mining. We recognize that individual investors will use differing asset allocation weights depending on their own risk-return profiles and investing preferences, just as they should. Regardless of the initial target weights selected, however, each of the six indexes possesses its own unique risk and return characteristics based on size and value-growth elements. Thus, market fluctuations and the inevitable variability between index types will gradually cause higher performing indexes to gain influence within the overall portfolio, whereas lower performing indexes see their influence reduced. Eventually, the actual portfolio will deviate significantly from the target weights that were originally selected, intuitively suggesting the need to rebalance periodically to maintain the portfolio's original risk and return characteristics.

It is also important to note that the strategy of investing in separate style-indexes, as opposed to a single broad market index, makes resetting the risk-return characteristics of the overall portfolio possible. In contrast, investors holding a single BMI are unable to rebalance and run the risk of the index becoming overweighted in whatever sector is "hot" at a particular time. Further, given that markets tend to revert to the mean eventually, the inability to rebalance can be costly. In contrast, the ability to rebalance provides an opportunity to capture excess returns from sectors that are hot by returning the overall portfolio to its original state. When the S&P 500 reached a weight of roughly 40% in technology in late 1999, the ability to rebalance would clearly have been beneficial. Investors holding the S&P 500 as their only equity investment, however, had no such opportunity and suffered severe losses when the tech bubble finally burst.

A common investing practice is to rebalance a portfolio according to a predetermined schedule or time-period. Thus, to gauge the performance of time-based periodic rebalancing methodologies, we examine both quarterly and annually rebalancing, whereby the portfolio is automatically returned to an equally weighted status across the six style indices at the end of each period. An alternative approach to periodic rebalancing involves the use of portfolio-weight triggers. This is akin to the constant-ratio asset allocation method of investing, where portfolio composition is maintained by rebalancing whenever the weight of any single asset or asset class rises above a specific predetermined trigger point.

To investigate the performance of rebalancing to triggers, we begin with an equally weighted six-asset portfolio. We establish both upside and downside rebalancing triggers which initiate a portfolio-rebalancing event whenever the weight of one or more of the six portfolio components exceeds one of the preset levels. For simplicity, we establish triggers at whole percentage intervals above and below the initial equal (16.67%) weights of the individual style indexes, beginning at 17% for the upside triggers and 16% for the downside triggers. These initial triggers are then raised or lowered in single percentage increments to the point where no rebalancing events are triggered (25% on the upper boundary and 12% on the lower boundary). We examine the performance of the upside and downside triggers both independently and in combination with one another. In each case, whenever the weight of an individual index within the portfolio reaches the preset trigger percentage, rebalancing is initiated and all six style indexes are returned to equal 16.67% weights at the end of that trading day.

Unlike calendar or time-based rebalancing, with no specific rationale for determining when a portfolio is rebalanced, trigger rebalancing relies on the extent of the divergence between the individual asset classes to initiate an event. This means rebalancing events will occur more (less) frequently during periods of higher (lower) market volatility and periods of lower (higher) correlation among the style index returns. As a result, trigger rebalancing events are market driven, rather than the ad hoc nature of the time-based approach.

Table 3 Relative performance of periodic rebalancing vs. a non-rebalanced buy-and hold control portfolio of Russell style indexes, June 1995-December 2008

	Non-rebalanced control	Quarterly rebalanced	Annual rebalanced
Arithmetic mean annual return	8.03%	8.17%	8.18%
Geometric mean annual return	6.10%	6.29%	6.31%
Annualized standard deviation	20.51%	20.33%	20.30%
Sharpe ratio	0.297	0.309	0.311
Minimum	−10.40%	−10.13%	−10.12%
Maximum	10.55%	10.79%	10.77%
Number of positive daily returns	1864	1864	1865
Number of negative daily returns	1562	1562	1561
Number of times rebalanced	0	54	13
Gain from rebalancing	—	0.19%	0.21%
p-value compared to Control	—	0.29	0.26

5. Results

5.1. Periodic rebalancing results

Table 3 presents results for the portfolios using time-based rebalancing compared with a buy-and-hold, non-rebalanced control portfolio. We find both quarterly and annual rebalancing produced higher average returns and lower standard deviations over the sample period than the non-rebalanced control portfolio. The p-values for these return differences, however, indicate the returns have no statistically significant difference from the control portfolio. Even so, a $100,000 investment in the annually rebalanced and control portfolios over the 163-month study period would have resulted in a difference of more than $6,000 in the ending portfolio values, a non-trivial amount.[4] Of the two periodic rebalancing methods, annual rebalancing marginally outperforms quarterly rebalancing both in terms of risk (standard deviation) and return, perhaps suggesting that less frequent rebalancing provides marginally better performance.

5.2. Trigger rebalancing results

Table 4 presents the results for upside triggers compared to the buy-and-hold control portfolio and the annually rebalanced portfolio.[5] We find that rebalancing to upside triggers outperforms both time-based rebalancing and the control portfolio for all triggers above 19%. In addition, triggers above 19% display higher Sharpe reward-to-variability measures than the time-based or control portfolios.

Although triggers under 20% generated higher returns and lower standard deviations than the non-rebalanced control portfolio, they underperformed the annually rebalanced portfolio. This suggests that triggers in close proximity to the original target weights (16.67% for each index in our case) may be less desirable because they rebalance so frequently that hot sectors have little room to run their course. For example, a 17% trigger would have initiated 341 separate rebalancing events over the 163-month study period, which would clearly be

Table 4 Relative performance of rebalancing to upside triggers vs. annual rebalancing and the non-rebalanced control portfolio of Russell style indexes, June 1995-December 2008 (using daily data)

Portfolio type	Arithmetic mean annual return	Annualized standard deviation	Geometric mean annual return	Sharpe ratio	Times rebalanced[a]	Annual rebalancing gain	p-Value
Un-rebalanced	8.03%	20.51%	6.10%	0.1112	0	—	—
Annual rebalancing	8.18%	20.30%	6.31%	0.1229	13	0.21%	0.26
17% Trigger	8.13%	20.37%	6.23%	0.1184	341	0.13%	0.34
18% Trigger	8.14%	20.36%	6.25%	0.1196	31	0.15%	0.31
19% Trigger	8.17%	20.32%	6.28%	0.1214	12	0.19%	0.29
20% Trigger	8.28%	20.25%	6.42%	0.1285	8	0.32%	0.17
21% Trigger	8.31%	20.30%	6.44%	0.1295	5	0.35%	0.11
22% Trigger	8.42%	20.33%	6.55%	0.1345	4	0.45%	0.06
23% Trigger	8.66%	20.22%	6.83%	0.1490	4	0.73%	0.02
24% Trigger	8.87%	20.25%	7.04%	0.1594	4	0.95%	0.01
25% Trigger	8.38%	20.53%	6.47%	0.1290	2	0.37%	0.06

impractical even without considering the mediocre performance. Moving to an 18% trigger significantly reduces the rebalancing frequency, by more than a factor of 10, but would still have resulted in 31 triggered event times over the sample period. This equates to slightly more than two rebalancing events per year. On the other hand, a 20% trigger would have required only eight rebalancing events, equating to one event every 1.7 years, and outperforming the annually rebalanced and control portfolios across the board. Moreover, triggers of 22%, 23% and 24%, would have initiated just four rebalancing events each (one every 3.4 years) with each subsequent trigger outperforming the previous one. Finally, a 25% trigger would have been activated only twice over the study period and would have generated geometric mean returns superior to all except those portfolios using 22%, 23%, and 24% triggers. The risk (standard deviation) of the 25% trigger portfolio, however, is higher than that of any other portfolio, including the control. Consistent with our findings concerning rebalancing too frequently, this suggests that rebalancing too infrequently can also compromise performance.[6]

In addition to upside triggers, we also examined the performance of downside triggers, both individually and in combination with upside triggers. Fig. 2 shows the relative performance of using upside triggers and downside triggers when compared to a combined trigger approach, with relative performance measured on the Y-axis. The lightly shaded bars represent the relative performance of using upside triggers only, compared to the combined trigger approach. The darkly shaded bars represent the relative performance of using downside triggers only, compared to the combined approach.[7]

Left to right, each upside trigger from 20% to 25% is combined with four separate downside triggers ranging from 15% down to 12%. Note that for each trigger combination, the results for the individual upside and downside triggers could be either better, worse, or no different from the combined trigger approach. Bars extending above the zero line represent outperformance, whereas bars extending below the line represent underperformance, and bars not visible represent a zero or imperceptible change in performance relative to the combined triggers.[8]

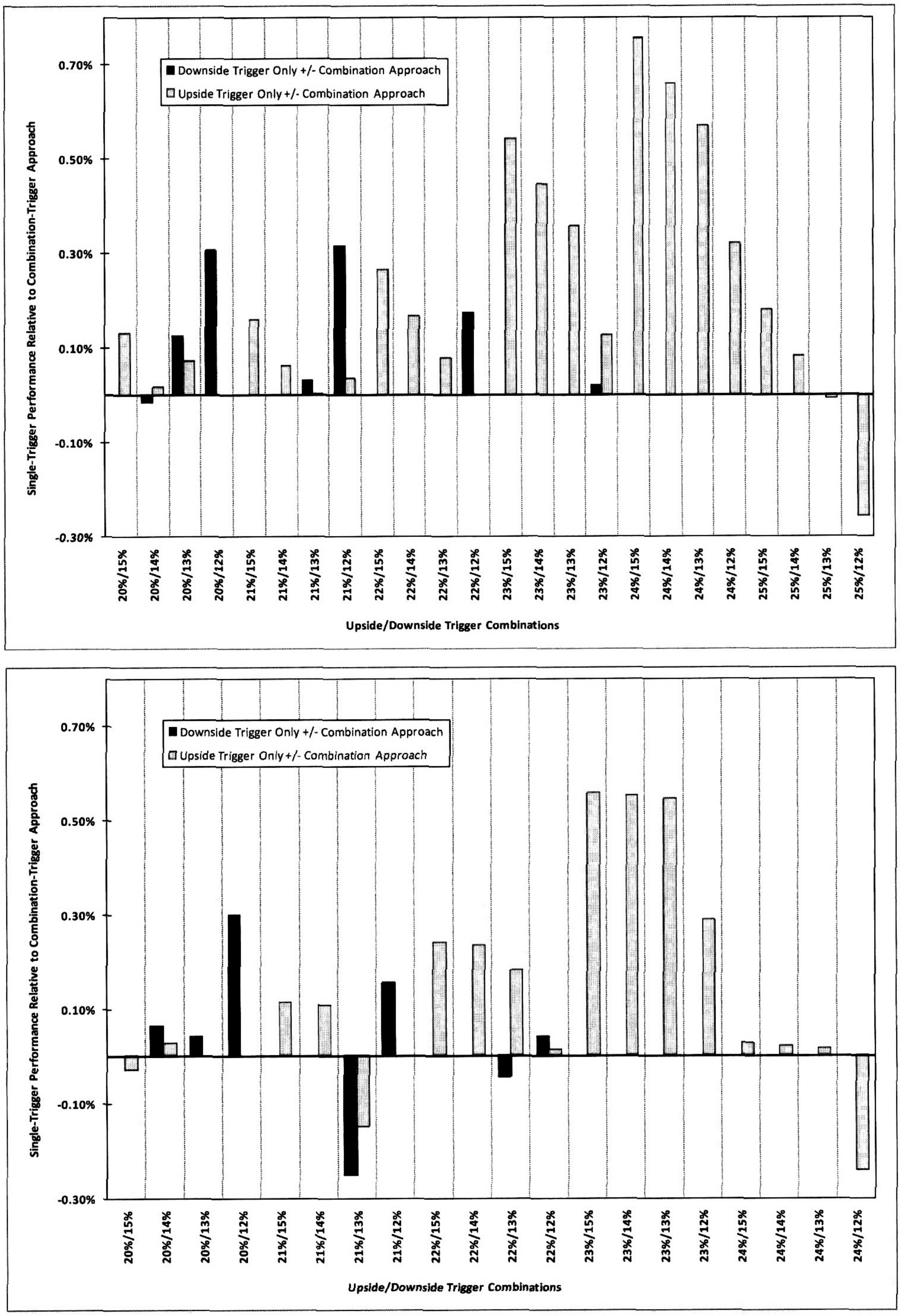

Fig. 2. Relative annual performance of upside, downside, and combined up-down trigger rebalancing, June 1995 thru December 2008. (a) Relative performance of upside, downside, and combined up-down trigger rebalancing, June 1995 thru December 2008. Using monthly returns data.

Fig. 2 contains 24 total upside/downside combinations. In 19 of these combinations, we find that using upside triggers only would have outperformed the combined upside/downside approach. In addition, the upside-only approach underperforms the combined approach just twice, with both instances occurring at the most extreme (i.e., 25%) upside trigger level (with one of those two occurrences nearly imperceptible). In contrast, downside triggers outperform the combined approach in just six of the 24 instances, and they underperform the combined approach only once. Compared head-to-head, the upside-only trigger outperforms the downside only trigger in 17 of the 24 instances.

In general, the relative performance of the downside triggers appears to be best when compared to (or combined with) the lower levels of upside triggers. Lower upside triggers elicit more frequent rebalancing, which again suggests that rebalancing too frequently can reduce performance. Using upside triggers only is clearly the best option most of the time, frequently generating annual returns that are 10 to as much as 70 basis points above the performance to the combined and/or downside only trigger approaches.

One explanation for this result is tied to the momentum of specific style indexes. As the academic literature indicates, momentum and momentum reversals are very real phenomena in the investments industry, and upside triggers appear to benefit from allowing hot investments (i.e., styles indexes, in this case) to run up to a certain level before triggering a rebalancing. Using upside triggers to rebalance a portfolio, then, can be viewed nothing more than a form of forced profit taking, with the assets in question determining when the profit taking will occur.

In contrast, downside triggers may not perform as well precisely because they are capitalizing on downside momentum rather than upside momentum. Rebalancing to downside triggers requires the sale of hot assets and the purchase of out of favor assets, similar to that required by using upside triggers, but focusing on upside momentum seems to provide better overall results.[9] Finally, it should also be noted that although our results show upside triggers work better than downside triggers, downside triggers still work better than none, and they almost always work as well as, or better than, combined triggers.

Fig. 3 presents a plot of the geometric mean annual returns combined with the Sharpe reward-to-variability measures for upside triggers (medium-shaded bars), downside trigger (light-shaded bars), and calendar–based rebalancing (dark-shaded bars) compared with the un-rebalanced control portfolio (non-shaded bar). The results indicate that any form of rebalancing outperforms the un-rebalanced control portfolio, both in terms of total return and reward-to-variability ratio. In addition, rebalancing to either upside or downside triggers generally outperforms calendar rebalancing. Further, both average annual return and reward-to-variability ratio tend to increase as the triggers move away from the target percentage weight (16.67% for this study). This is consistent with the momentum literature and suggests the importance of allowing specific assets (or asset classes) to rise sufficiently in value before taking profits via rebalancing.

Fig. 4 displays the relative portfolio weights of the six assets, with Panel A containing a plot of the un-rebalanced control portfolio over the study period. All six assets are equally weighted at the beginning of the study period but quickly diverge as differences in performance alter their relative weight in the overall portfolio. Large growth is clearly the most volatile asset class, with its portfolio proportion ranging from more than 25% to near 11%

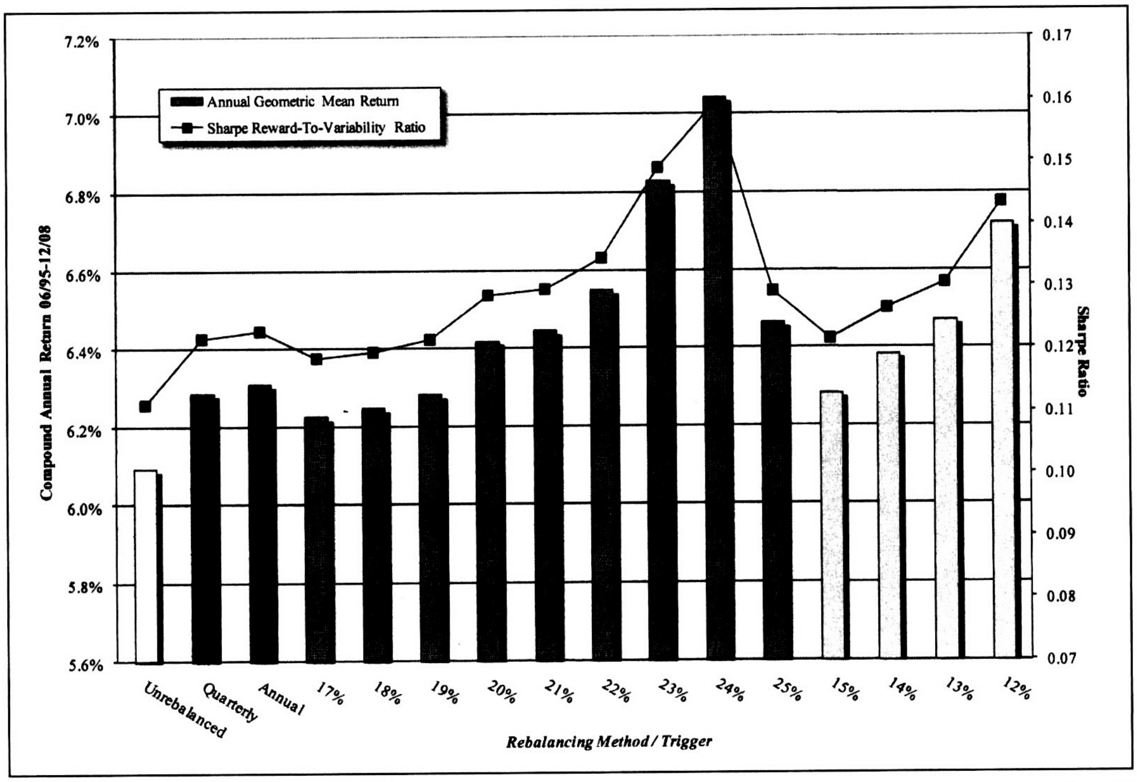

Fig. 3. Sharpe ratio and return characteristics across each rebalancing method, June 1995 thru December 2008.

over the period. Sizeable portfolio imbalances can clearly arise as asset styles rotate in and out of favor with investors. As Panel A shows, these imbalances can materialize and dissipate rapidly.

In contrast to the un-rebalanced portfolio, Panel B of Fig. 4 illustrates the fluctuations in a portfolio rebalanced using a 20% upside trigger. This trigger was chosen because it was activated eight times over the study period and provides a good illustration of the mechanics of rebalancing. Rebalancing events are depicted with vertical dotted lines. Note that five of the six individual style indexes were responsible for activating at least one rebalancing event over the period, demonstrating the unpredictable style rotation that active managers so fervently strive to foretell. The large value index alone failed to activate a 20% trigger over the study period.

With technology stocks playing a pivotal role in the market downturn of 2000 to 2001, we also felt compelled to examine technology sector exposure for competing rebalancing strategies. Fig. 5 presents the relative weights of technology stocks within the un-rebalanced, annually rebalanced, and 20% upside trigger portfolios from the beginning of the study period through September 2001, thereby encompassing the entire boom-to-bust cycle of the technology sector. Note that the technology weights are virtually indistinguishable among the portfolios through the end of 1998, but as the sector gained momentum, rebalanced portfolios quickly begin to exhibit lower technology exposures than the un-rebalanced control portfolio. The maximum weight of technology in the un-rebalanced portfolio peaks at 30.5% in the first quarter of 2000; with corresponding weights of 27.3% and 25.7% for the

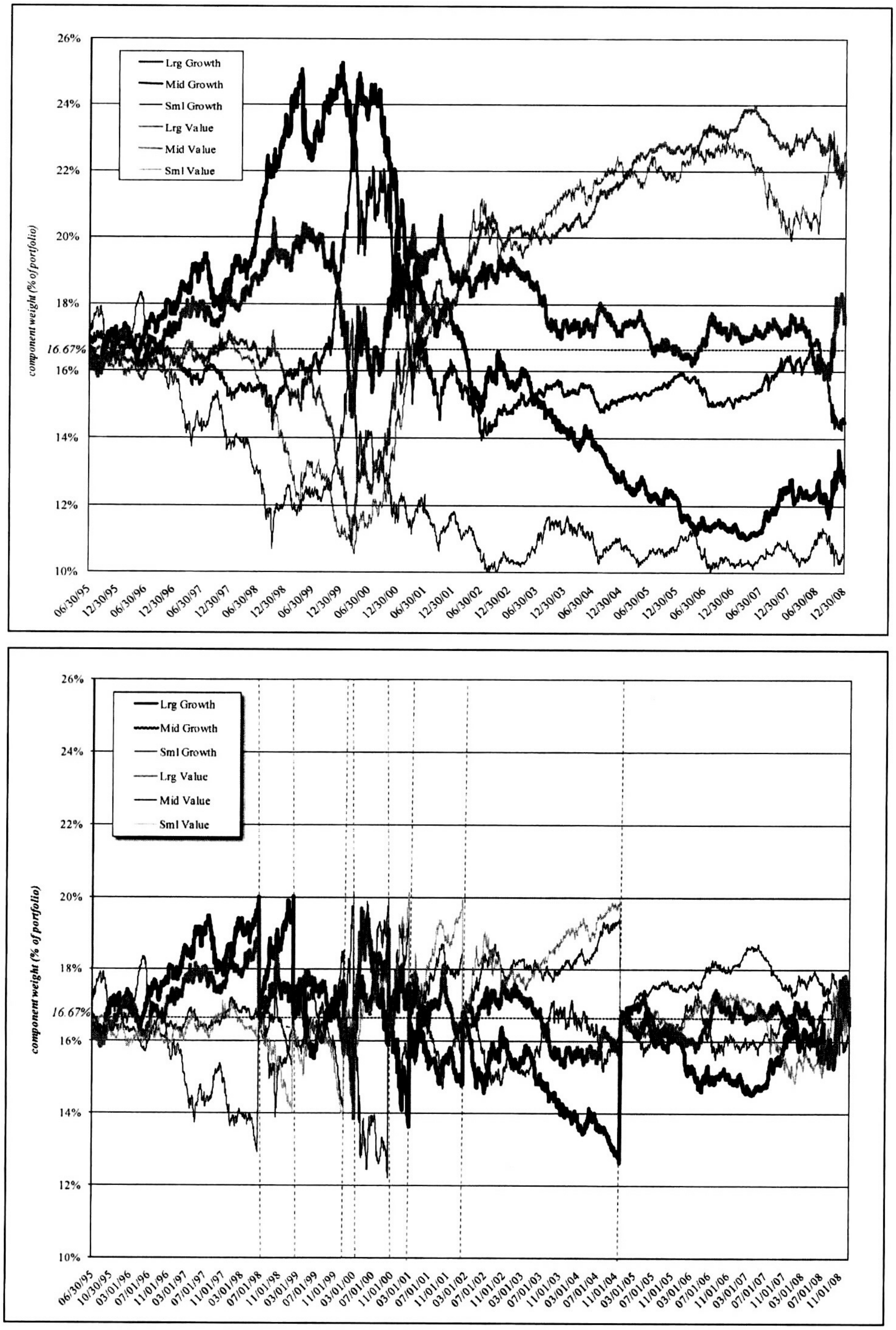

Fig. 4. Panel A: Relative portfolio weights for Russell style indexes without rebalancing, June 1995 thru December 2008. Panel B: Relative portfolio weights for Russell style indexes rebalanced to a 20% trigger, June 1995 thru December 2008.

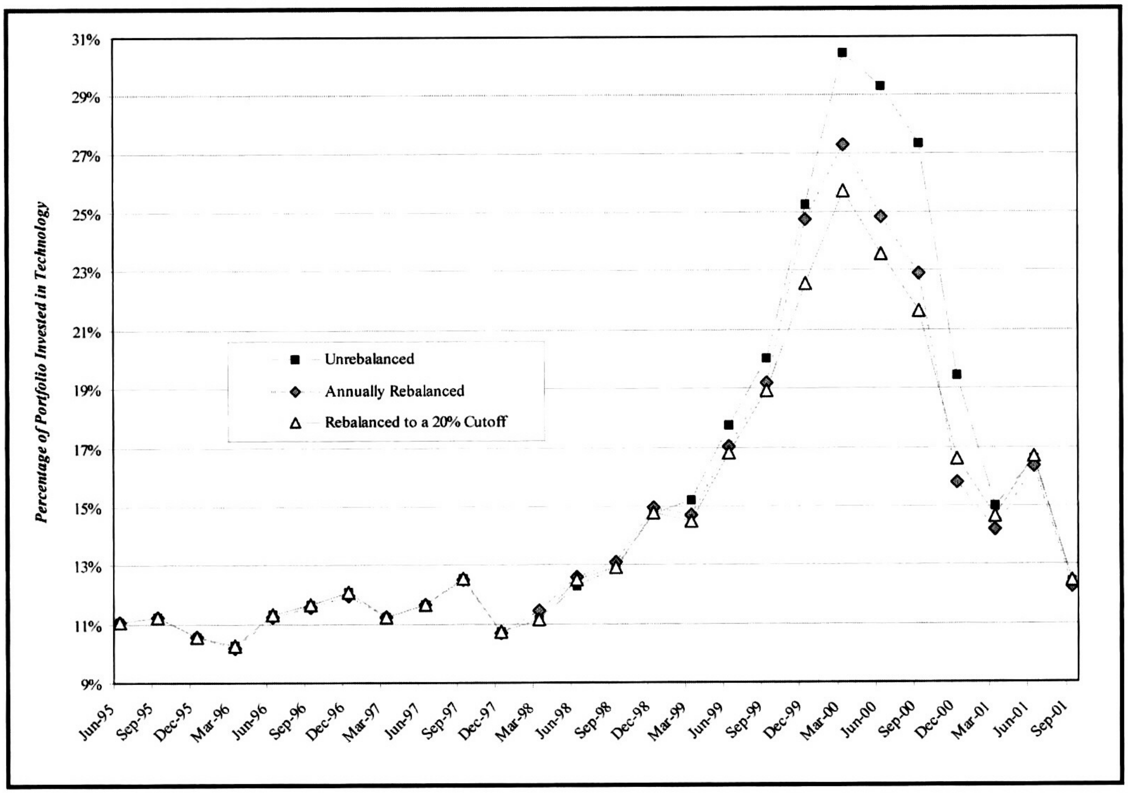

Fig. 5. Technology sector weights for rebalanced and un-rebalanced portfolios by quarter, June 1995 thru September 2001.

annually rebalanced and 20% trigger portfolios, respectively. After the collapse of the technology sector in early 2000, the weights for all three portfolios converge within 18 months, further underscoring the virtues of portfolio rebalancing.

6. Conclusions

Our findings confirm that actively rebalancing a portfolio can hold a significant advantage over a passive buy-and-hold (un-rebalanced) approach. We find rebalancing either periodically or to portfolio-weight triggers results in higher returns concurrent with lower risk than those of a purely passive approach. This is consistent with prior research. Further, we find rebalancing to portfolio weight triggers generally outperforms periodic, time-based rebalancing (i.e., quarterly or annually). This outperformance proves greatest at upside trigger levels derived from practical rebalancing frequencies, (in our example, triggers generally happening slightly less often than annually), leading us to conclude that rebalancing to appropriate triggers is also superior to a periodic rebalancing approach.

Despite the fact that investors cannot know, ex ante, which trigger will perform best in the face of an unknown future, our results do indicate ex post that using a trigger large enough to avoid continual activation, yet not so large as to be nearly impossible to activate, will provide the best chance for success. Data-limitations prohibit extensive robustness checks on our findings, but it is reassuring that the findings are both intuitive and easy to explain rationally within the context of the momentum literature. Nonetheless, the relatively short time-series we are able to study and the limitations this presents in terms of studying various sub-periods suggest our results should be interpreted with caution until further investigation of the topic can be performed over longer periods of time.

Finally, although this study focuses on an equally weighted, six-index approach, the methodology can easily be adapted to any combination of assets or asset classes and any portfolio weights desired. Investors should not feel limited to just six indexes. Asset classes such as real estate, bonds, international stocks, and emerging markets could easily be incorporated into this approach. In addition, new portfolio-weight tracking software available from a variety of websites and discount and full-service brokerage firms can automate the process of tracking specific asset allocation characteristics of a portfolio and can send alerts to investors when a specified range is exceeded. All that is left to the investor is to determine the characteristics to be tracked and where to set the triggers for the alerts. Results will naturally vary depending on the characteristics and triggers selected, but our style index results are encouraging in their implication that any form of rebalancing is superior to a naïve, buy-and-hold approach.

Notes

1. Source: Barra, Inc.
2. Source: Ibbotson, Inc.
3. We recognize that individual investors will use differing asset allocation weights depending on their own risk-return profiles and preferences. We choose a naïve, equally weighted approach because it assumes no a priori knowledge of index performance differentials and to help assure readers that the initial target weights were selected without the influence of data mining bias. Portfolio weights generated using Markowitz Efficient Frontier optimizations were considered, but a high frequency of single index solutions made this unfeasible. In addition, optimization-based allocations are uniquely dependent upon the timeframe considered, making generalization of results to future time periods problematic.
4. Transactions costs and taxes are not considered. Transactions costs are not considered because style indexes are available in the form of no-load, open-ended mutual funds. Investors could also elect to use ETFs, although these would be subject to trading commissions. Even so, ETFs bought and sold through discount brokerage firms can be traded at nominal commission levels. In tax-advantaged portfolios, such as retirement accounts and pension funds, taxes would not be a consideration. For tax-conscious investors, however, quarterly and annual rebalancing may not be appealing because any gains would be realized with high frequency. Finally, we do not consider management fees in this study as investors would be subject to similar fee structures regardless of how (or whether) they choose to rebalance.

5. We omit quarterly rebalancing results because annual rebalancing proved superior in terms of both risk and return, as per Table 3 results and discussion.
6. To test robustness and allay concerns about the ability of investors to closely monitor the timing of these triggers, we also ran this analysis using monthly returns data. The results do not materially differ from those obtained using daily returns. (Shown in an alternate Table 4 and Fig. 2, Table 4a and Fig. 2a are available upon request.) This suggests that precisely timing the individual re-balancing is not essential and that an investor could even miss a trigger by up to a few weeks with little or no impact on the benefits achieved.
7. The combined trigger performance is represented by the horizontal line with origin at zero, and the upside/downside trigger combinations are labeled on the X-axis.
8. We omit the downside trigger of 16% and upside triggers from 17% to 19% because they elicit an impractically large quantity of rebalancing events. Upside triggers above 25% and downside triggers below 12% are omitted because they fail to trigger any rebalancing events over the study period.
9. Whether this is a function of the study period or a permanent phenomenon is not known. We will continue to periodically revisit our findings to see if they persist as more data become available.

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