Being Strategic About Tactical Allocations

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Abstract

In this paper we address the issue of balancing the value of tactical decisions with the costs required to implement them. We propose a process where factor bets are extracted from portfolio weights and used in an optimization to balance the cost of trade implementation with tracking error. In a naïve test, overall turnover is reduced by 66-75% while incurring an annualized tracking error of 1.68-2.22%.

Introduction: The Cost of Being Tactical

One of the greatest costs of being tactical is trading and market impact cost. Frequently one of the largest critiques of tactical portfolios is their high turnover rates, frequently exhibiting well over 100% turnover per year.

For portfolios incurring trading costs, this can be incredibly damaging. For example, a $50,000 portfolio of 10 ETFs that rebalances twice a month at $7/trade incurs a drag of 360 basis points (bp) *per year* just in trading costs.

While implementation costs have come down over time, implementation shortfall costs on large-capitalization U.S. equities is near 36.5bp; all in costs including commissions is near 43.7bp.[1] A portfolio with 300% turnover[2] would incur 262.2bp of performance drag per year.

Determining when these costs are worth bearing is the key element in retaining the value of active portfolio management without incurring exorbitant fees.

The Idea

Securities frequently share common performance drivers. For example, U.S. equities tend to be highly sensitive to U.S. economic concerns; as evidence, consider that during crises, the correlation of most securities to the S&P 500 crash towards 1.

If asset weights are instead interpreted as generalized performance driver exposures, a turnover decision could be made based on how much a change in asset weights is really a change in performance driver exposure. For example, if the S&P 500 is classified as U.S. Equity and the Russell 3000 as U.S. Equity, why incur a large turnover cost to trade one for the other if the overall portfolio exposure profile remains the same?

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[1] ITG Global Cost Review Q2/2012 (http://www.itg.com/marketing/ITG_GlobalCostReview_Q22012_20130205.pdf)

[2] Turnover is measured as the sum of absolute weight differences divided by 2

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Introducing Eigenportfolios

In linear algebra, there is a process called *eigedecomposition* -- or sometimes spectral decomposition -- which factorizes a matrix (A) into a set of eigenvectors (Q) and eigenvalues (Λ).

Equation 1

$$A = Q\Lambda Q^{-1}$$

When the matrix A is a correlation or covariance matrix, the eigenvectors in the resulting decomposition represent asset weights for eigenportfolios.

One of the interesting properties of an eigendecomposition is that the eigenvectors are linearly independent. This means that the *historical* returns of the eigenportfolios are statistically guaranteed to be non-correlated. This may not necessarily hold going forward, but if correlation relationships between assets remain fairly stable, it is a concept we can take advantage of.

One of the ways to interpret eigenportfolios is as the factors driving the performance of our securities or as the independent bets that our asset weights translate into. If we have asset weights (w) we can actually determine our weights to the underlying factors ($\widetilde{w}$) as:

Equation 2

$$\widetilde{w} = Q^{-1}w$$

The interpretation of eigenportfolios as independent bets is critical in the optimization process employed in the smart rebalance process.

While it can be difficult to interpret statistical factors, in many portfolios the eigenportfolios have an intuitive meaning. There is often an eigenportfolio representing market risk and an eigenportfolio representing interest rate sensitivity. By translating our asset weights into bet weights, we can take advantage of the fact that many of our assets will have similar bet characteristics.

The Smart Rebalance Process

The smart rebalance process is an optimization that utilizes the current portfolio weights (w), the target portfolio weights (w^t), and the interpretation of eigenportfolios as independent bets.

At each rebalance period, a set of eigenportfolios is constructed based on a trailing, realized correlation matrix, C. In this paper, we assume a 63 trading-day look back window.

Equation 3

$$C = E\Lambda E^{-1}$$

Effective target bet weights (t) are extracted from the target weights (w^t):

Equation 4

$$t = E^{-1}w^t$$

An optimization procedure is then run. The optimization seeks to find a new set of weights ($\widetilde{w}$) and corresponding target bets ($\tilde{t}$) that minimizes both turnover, $||\widetilde{w} - w||$, and tracking error, $k||\tilde{t} - t||$ (where k is the scaling factor determining how important turnover is relative to maintaining consistency in bets taken; in this paper, we set k=1).

This process does not incorporate any future information.

The Test

The Securities

The securities in the test were selected to represent the asset classes found in a regular investor's portfolio. The proxy ETFs or funds selected were chosen for their extensive track records, allowing the length of the test to be extended back to June 20, 1996.

Asset Class	Proxy	Name
U.S. Equities	SPY	SPDR S&P 500
International Equities	FDVIX	Fidelity Advisor Diversified International

Emerging Market Equities	FEMKX	Fidelity Emerging Markets
U.S. Growth Equities	FBGRX	Fidelity Blue Chip Growth
U.S. Mid-Cap Stock	FMCSX	Fidelity Mid-Cap Stock
Investment Grade Bonds	FBNDX	Fidelity Investment Grade Bond
U.S. Treasuries	FGOVX	Fidelity Government Income
Municipal Bonds	FHIGX	Fidelity Municipal Income
Short-Term Treasuries	FFXSX	Fidelity Limited Term Government
High Yield	FAGIX	Fidelity Capital & Income
Emerging Market Bonds	FNMIX	Fidelity New Markets Income

The Process

Allocations over time for 100 hypothetical portfolios are constructed randomly. Each portfolio is given the same start date (6/20/1996; based on common data availability) and randomly selects its next rebalance date as the current date plus an offset pulled from a random normal distribution with a mean of 63 trading days and a standard deviation of 10 trading days.

On each rebalance date, securities are assigned a random value between [0,1] (drawn from a uniform distribution). The values are then normalized such that they sum to 1; the normalized values are the security weights.

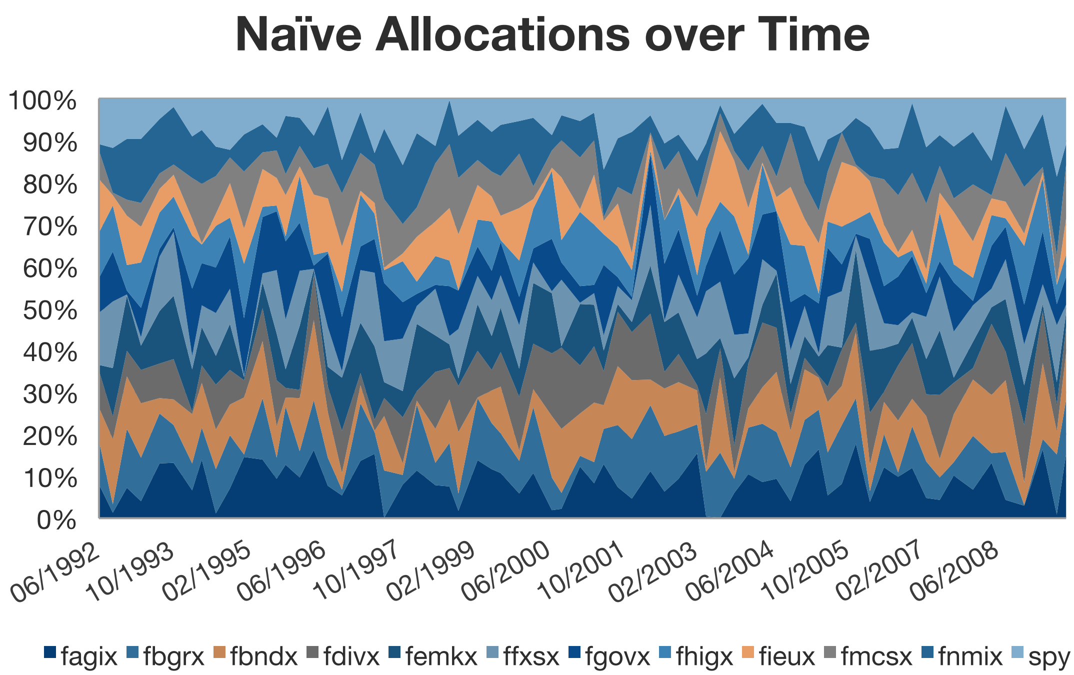

Figure 1: Example Random Allocations over Time for Portfolio #0

An index is then constructed from each set of naïve allocations (assuming zero trading and impact costs). Allocation changes are implemented at the next available open.

The optimization procedure is then run over each set of naïve weights, creating a set of "smart" allocations. A "smart" index is then constructed for each "smart" allocation.

Results

Example Individual Result

Below is a graph demonstrating the results of the optimization procedure when it is applied.

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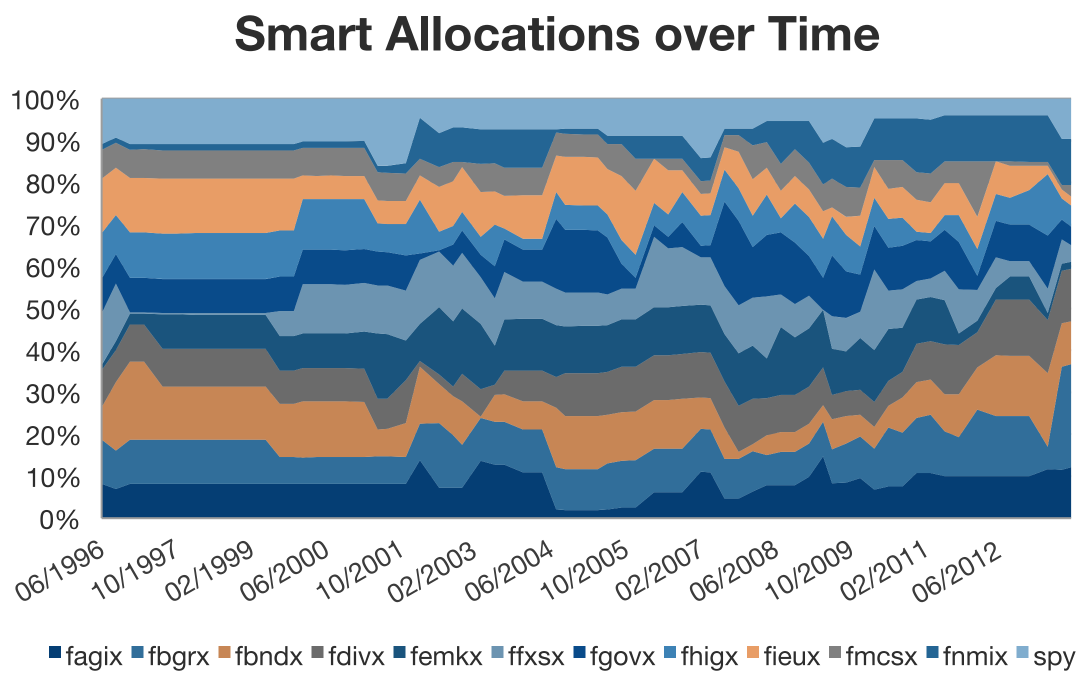
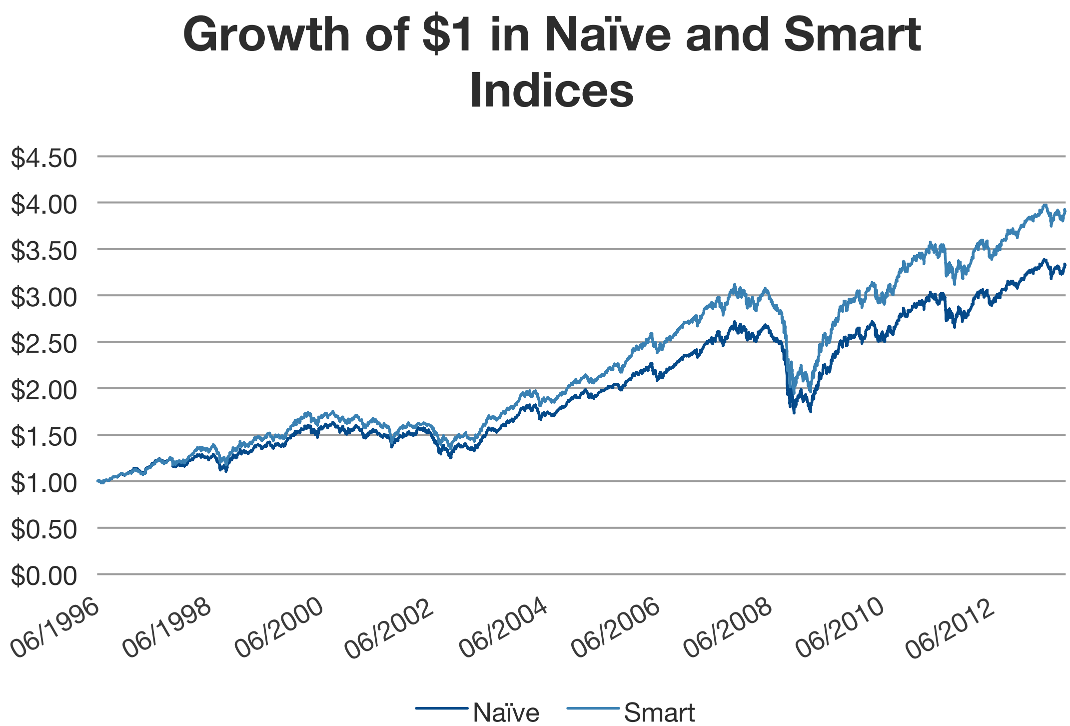


Figure 2: Optimized Allocations over Time for Portfolio #0

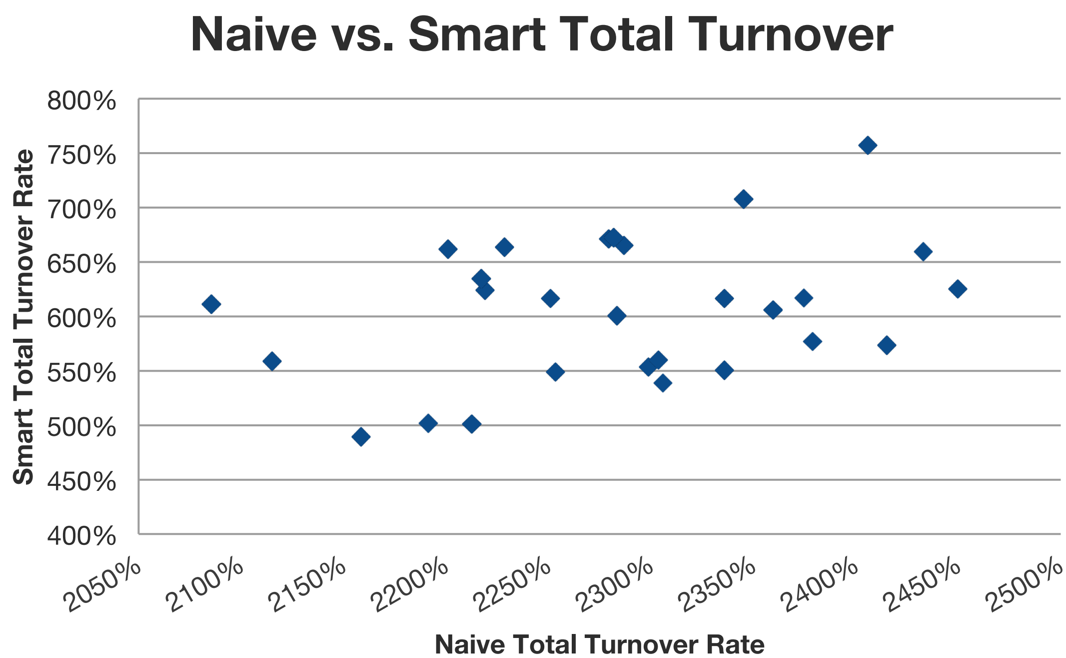
In this example, turnover is reduced by 77.33% in this example. Of course, by changing the allocations, the performance results change: the new index has an annualized tracking error of 1.67% to the old.

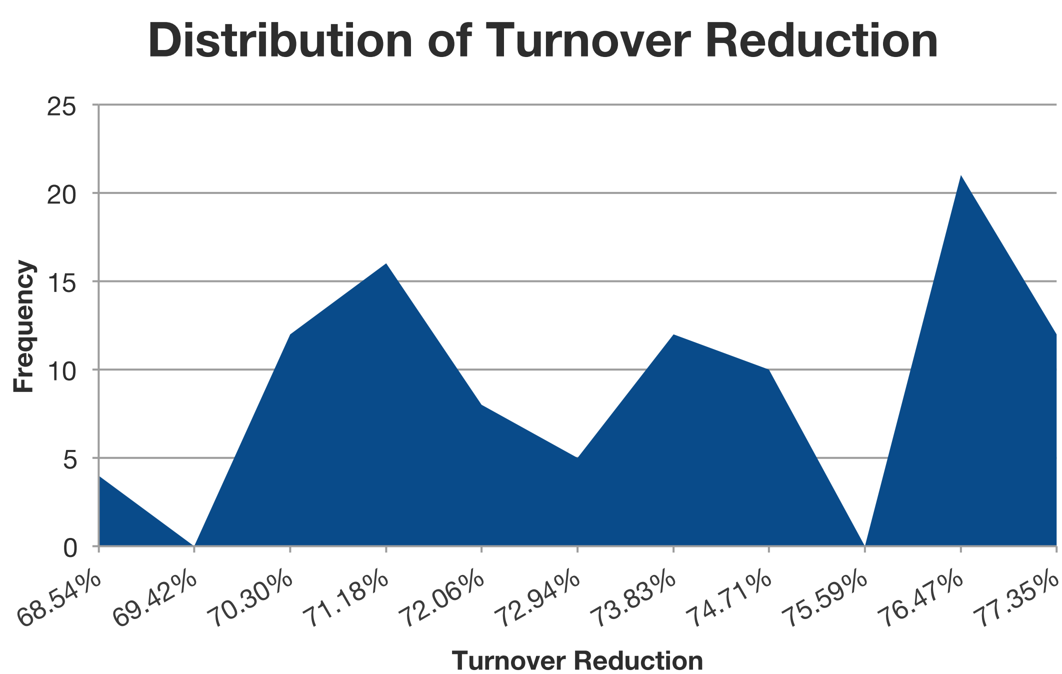
Statistic	Naïve	Smart
Total Turnover	2158%	489%
Annualized Turnover	124.93%	28.31%
Reduction		77.33%
Annualized Return	7.00%	8.04%
Annualized Volatility	10.76%	11.03%
Max Drawdown	36.31%	37.49%
Annualized TE		1.67%



Summary of Turnover Reduction

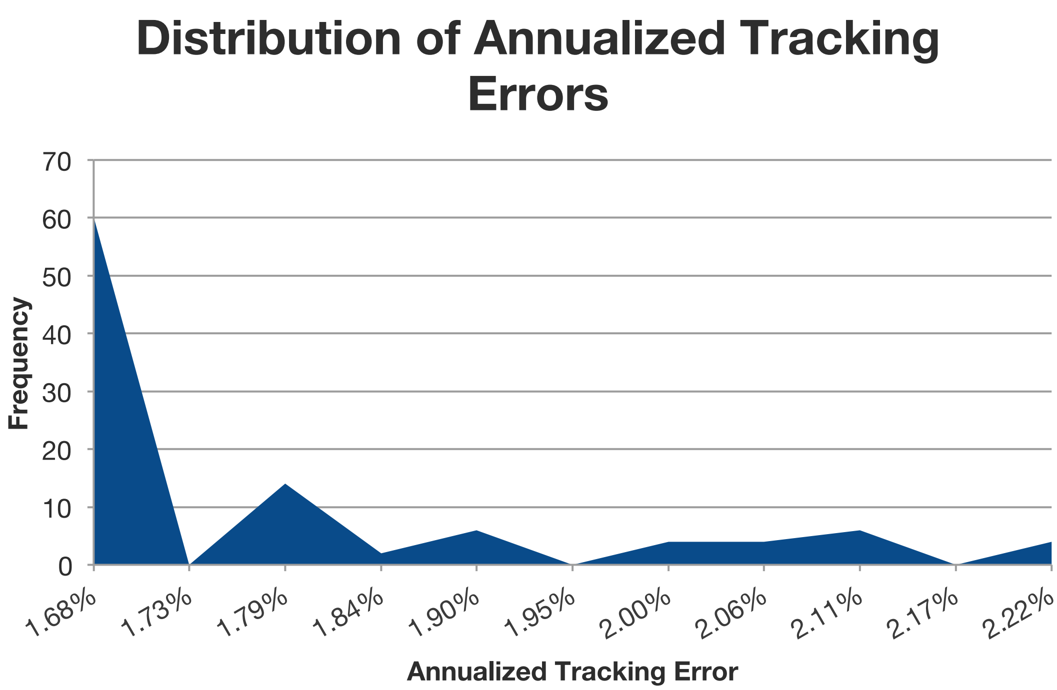
The primary goal of the process is to reduce overall portfolio turnover. In the 100 samples, the minimum reduction achieved was 68.54% bringing turnover from 2405% to 756%. The maximum reduction was 77.35%. In other words, total turnover of the new portfolios was equal to between 25-33% of prior turnover levels!

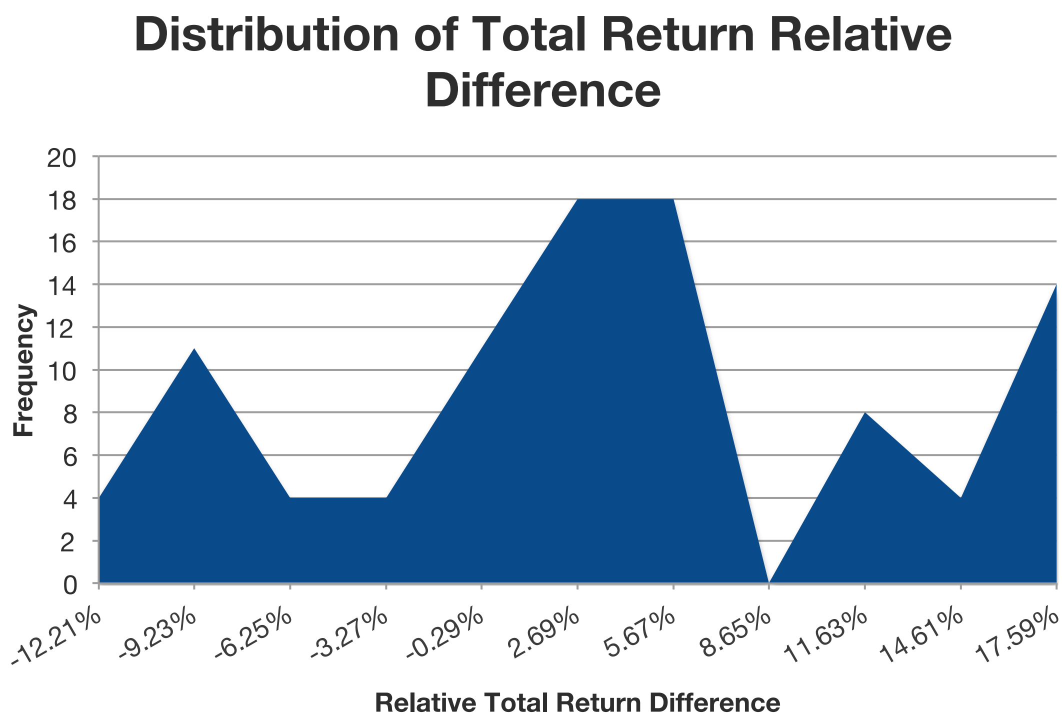

Naive vs. Smart Total Turnover
800%
750%
700%
650%
600%
550%
500%
450%
400%
Smart Total Turnover Rate
2050%
2100%
2150%
2200%
2250%
2300%
2350%
2400%
2450%
2500%
Naive Total Turnover Rate


Distribution of Turnover Reduction
25
20
15
10
5
0
Frequency
68.54%
69.42%
70.30%
71.18%
72.06%
72.94%
73.83%
74.71%
75.59%
76.47%
77.35%
Turnover Reduction

Summary Results of Tracking Error

Turnover reduction, in and of itself, is not impressive. After all, the system could be set to simply not trade and turnover would be completely removed! It is important, therefore, that the resulting indices from the allocation changes also incur a minimal amount of tracking error and that the relative total return difference is distributed equally around 0%. We find both of these criteria to be met:

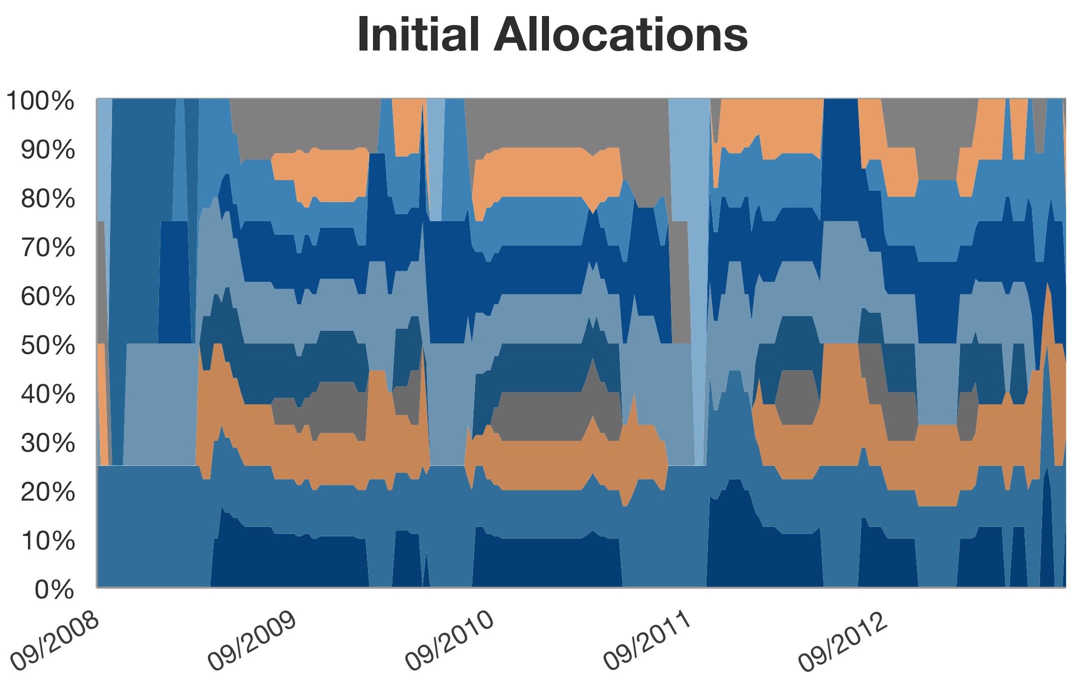




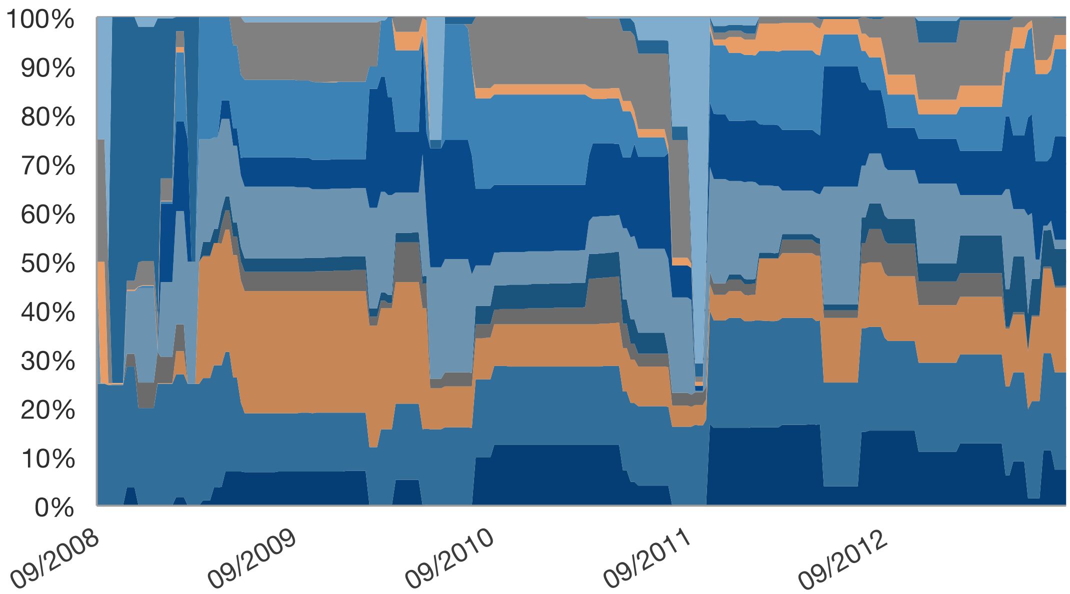
The tracking errors may seem high, but we have to consider that our process is attempting to minimize turnover for a set of allocations that are generated completely randomly approximately every quarter. The efficacy of the process is constrained, therefore, by the fact that the relationship between securities – which the process assumes remains fairly stable between rebalance periods – can dramatically change. For example, consider the case where Coca-Cola is a sell and Pepsi is a buy, but instead of replacing Coca-Cola with Pepsi, Coca-Cola is retained in the portfolio. If, between rebalance dates, something were to occur that materially affected Coca-Cola's business such that it no longer had a high degree of similarity to Pepsi, the portfolio would not longer reflect the intended bets of the original target weights.

Case Study

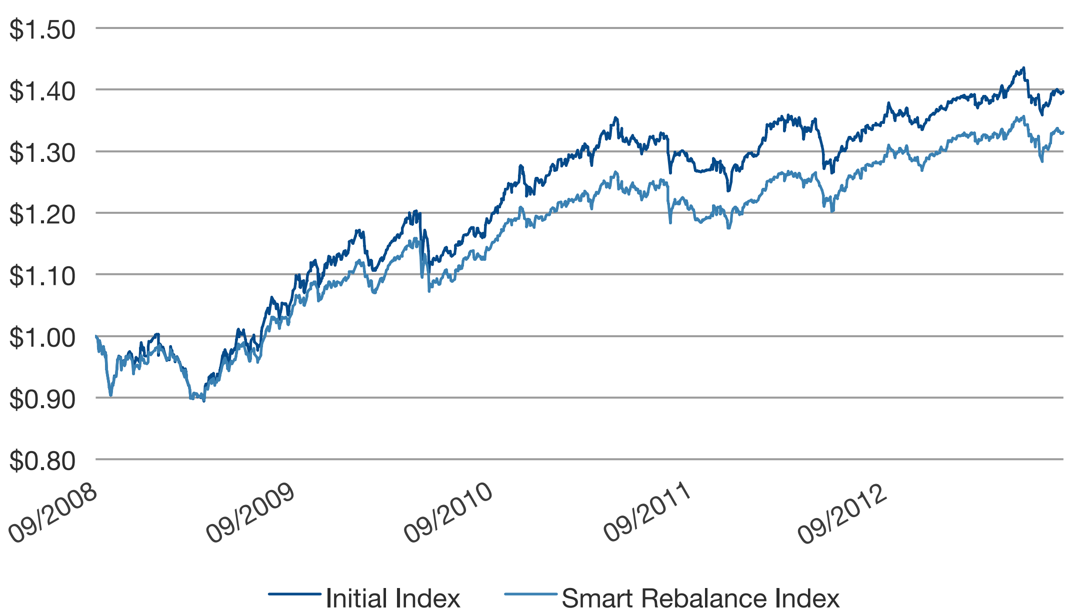
To address the issue of unrealistic allocation changes over time -- as well as potentially problematically long periods between rebalances -- we wanted to test our methodology over a proposed client strategy that rebalances weekly. Due to the reduced rebalance period, the look back period for the correlation matrix was shortened from 63 trading days to 21 trading days.



Smart Allocations



Growth of $1



The annualized tracking error for the Smart Rebalance index is 0.95%. Annualized turnover is reduced from 327% to 195% -- a reduction of approximately 40%. With a market impact of 43.7bp, the 132 point reduction translates to a savings of 115.36bp per year.

Conclusion

We believe that tactical strategies enable rapid adaptation to changing market environments, allowing for more efficient capture of relative outperformance opportunities and capital protection. Active trading, however, is a double-edged sword, and excessive trading can lead to capital bleed through market impact and trading costs.

In this paper we have outlined a framework that translates asset allocation decisions into independent bets and uses an optimization procedure to balance the trade-off between turnover and tracking error.

In a naïve set of trials, total turnover was reduced by 66-75%, incurring a tracking error of 1.68-2.22% per year.

Future Work

Reducing Tracking Error through Bet-Based Turnover Constraints

The process outlined in this paper is applied as an *overlay* to an existing asset allocation process. The implication of the overlay process is that it can only trade when the underlying process decides to rebalance. This means that if the behavior of a security changes, in relation to the other securities in the portfolio, between rebalance periods, tracking error will increase.

To reduce this risk, this process could be inlayed into the rebalance decisions such that if the current bet weights drift from the target bet weights, the portfolio is rebalanced. This would minimize overall tracking error.

Turnover versus Trading Cost

In this paper, we do not distinguish between the cost of turnover and the cost of trading. There is a difference, however, in trading costs between a 20%

turnover due to a single trade and a 20% turnover due to 10 trades. The latter will incur far more fixed trading costs.

The methodology outlined above can be extended to incorporate trading costs, however care must be taken to ensure that the penalty cost is of the same scale of turnover cost and bet different costs.

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