

Portfolio Rebalancing: A Page of Resources and Analysis

A Beginning: The Full Swensen Quote

Here in full is the quote that I mentioned in class. The full version add some nuances that contribute usefully to the conversation:

"As a matter of course, every trading day, Yale estimates the value of each of the components of the endowment. When marketable securities asset classes (domestic equity, foreign developed equity, emerging market equity, and fixed income) deviate from target allocations, the university's investment office takes steps to restore allocations to target levels. In fiscal year 2003, Yale executed approximately \$3.8 billion in rebalancing trades, roughly evenly split between purchases and sales. Net profit from rebalancing amounted to approximately \$26 million, representing 1.6% return on the 1.6 billion equity portfolio."

David Swensen, *Unconventional Success*, p. 198.

Contribution to the Discussion about Trading Costs

The full quote helps us to understand the issue of cost in daily rebalancing. Using the most liquid instrument in these major asset classes, we don't need to worry about market impact costs, and plain vanilla trading cost might be only 5pb of the **amount traded**. Since the deviation from target on a daily basis would probably average out to be on the order of one percent per day, we have a ball park figure of 0.05bp/day or about 0.125 percent per year. Please do check my reasoning and arithmetic, but unless I have blundered, the aggregate trading cost is small.

Where Do We Get the Extra 1.6%?

I think I have sorted this out. There were useful hints in [William Bernstein's piece with the formula for the rebalancing bonus](#), but the way I would explain things is to go via our favorite old formula, the one relating average returns and compound returns. I'll explain this in class, and perhaps I will write a little note for publication some place.

Models? We Don't Need No Stinkin' Models

One of the amusing properties of the so-called "sample variance" is that it has arithmetical properties that help us understand a collection of numbers and the ways these numbers bounce around their average. We so often think of this quantity as an estimate of a variance of a population, that we can forget that the **arithmetical object has uses that do not require a population** --- and which certainly does not require independent sampling from a fixed population. Over the last 30 years I have used this "trick" observation several times to prove various amusing little facts.

In class I'll show how we can lean on this trick to get results that relate "past observed empirical correlation" to "past realized (or unrealized) bonuses to rebalancing." **No Stinkin' model is required.** The asset returns could be bizarrely dependent Cauchy, or made up every day by the Devil; the formulas will still be true.

Is It News You Can Use?

I think it is. From the formulas we will see that what drives the bonus is the "empirical correlation." In a world of IID returns, these would not depend (much) on the "sampling period" but in a world of asset returns that have dependences that we only know about by their shadows, we know that the "empirical correlation" or "empirical variance" will indeed depend on the "sampling period." This helps us take a big and useful step toward the very practical question of "how often should I rebalance." We'll have to do some work to see if Swensen has the optimal plan. There is a chance that he doesn't, but it will take empirical work to decide.

What Else?

William Bernstein did a second piece on rebalancing that seems to water down his 1996. It [uses data to 2000](#) that of monthly, quarterly, yearly, and longer periods --- there was more return bonus to the LONGER periods. Here Bernstein argues that this is in part from the small amount of momentum that exists over the short (less than four year) run and the presence of mean reversion at time intervals of length 4 or so years. This piece **may be distorted by its ending period**, which was exceptional by any measure.

In an [a rich, interesting, and widely cited 1996 piece](#) Bernstein **does find** that there is **about 1.5% juice to monthly rebalancing**. He also gives an interesting formula that relates rebalancing value to the correlation.

Theory Project: Work through [Bernstein's formula for the "Rebalancing Bonus"](#) and carefully argue each step. If indeed it does hold water, then bring out your multivariate skills and **find the formula for n-assets**. Finally, explore the implications of your formula by plugging in market estimates for a variety of portfolios.

I'll keep adding links and further discussion. Check back in a week or so.

- [A sell-side puff piece on rebalancing by Smith Barney](#). Nice big type. Easy to read. Raise some issues. No original thoughts or analysis, but perhaps worth a blitz review. Their cost estimates seem to assume that you are dealing with Smith Barney. Still, it is worth thinking about the Japan story.
- Rebalance at the country level? at the industry sector level? This is a bad idea if even one slice of the pie is in a secular bear market. Now we never know we were there until we look back, so, well, life is complicated. [One piece](#) deals with this. Requires registration.
- [Bernstein and Wilkinson and the geometric frontier](#). This is a serious piece. It is model based, but ultimately similar to my story.
- [A Review of Bernstein's 2000 book](#). Make good points about the weirdness of 2000.

- [Pleasant, brief sell-side analysis by David Horan](#) (paragraph below: note focus on Sharpe ratio. **Project:Relate to "my formula"**)
 "Analysis of a 60/40 stock and bond mix ----
 In comparing the effects of rebalancing a 60 percent stock/40 percent bond allocation from 1979 through 2003 (Figure 1), it was quite apparent that rebalancing alone reduced volatility by over 18 percent, dropping the long-term standard deviation down from 12.2 percent down to 10.3 percent. The difference in volatility (as measured by standard deviation) among the three rebalancing frequencies (annual, quarterly and a 5 percent trigger) was minimal, signaling that it is not the method of rebalancing that matters, but just the decision to rebalance that makes a difference. When comparing the returns of these methods, not rebalancing the portfolio provided a marginally better return than the various rebalancing methods."

Figure 1: Analysis Period January 1979-December 2003

	Return	Standard Deviation	Sharpe Ratio
Annual Rebalance	12.39%	10.30%	1.20
Quarterly Rebalance	12.33%	10.22%	1.21
5 Percent Trigger	12.46%	10.28%	1.21
No Rebalance	12.55%	12.22%	1.03

My take on this? It's a pretty limited rebalancing effort, but a 20% improvement in Sharpe ratio is not something to ignore.

- **Bootstrap and Efficient Frontier?** Yep, it has been [tried and patented](#). But if you want to work on it, I wouldn't worry about the patent.

Careful: Same Words Different Meanings?

We have been engaged here with a manager's rebalancing of a portfolio, quite likely a portfolio composed at least in part of index funds. Ironically there is another financial problem where the same words show up. In the Russell 2000 index there are periodic changes to the constituents of the index. One puzzle is whether these "rebalancing" changes yield a product that behaves better or worse than the unchanged collection. Cai and Hougue [find that there are big-time bad consequences](#) of Russell 2000 reconstitutions. This is very interesting, but it has nothing to do with our main topic.

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