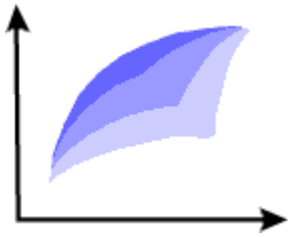
Efficient Frontier



An Online Journal of Practical Asset Allocation

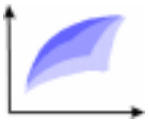
Edited by William J. Bernstein

July 1997

Table of Contents

Cover Home E-Mail

The Intelligent Asset Allocator



William J. Bernstein

How Good is the *Value Line* Appreciation Index?

I suspect that hundreds of thousands of investors all over the country take the same financial sacrament once every month or two, usually in the course of a routine visit to the public library. A quick look at the front cover of the latest ***Value Line*** supplement, and check out the valuation indicators for the Value Line Universe: P/E, dividend yield, and the 3-5 year appreciation index. Any serious investor wants to know just how expensive or cheap the market is, and the ***Value Line*** indicators are probably the most expeditious way of finding out. (***Investor's Business Daily*** and ***Barron's*** are a close second.) For example, the 5/23/97 edition of ***VL*** tells us the following:

	Current (5/23/97)	Market High (9/4/87)	Market Low (12/23/74)
Price Earnings	16.9	16.9	4.8
Dividend Yield	2.0	2.3	7.8
3-5 Yr. Appreciation	50%	40%	234%

The above data should suggest to cautious investors that we're not in Kansas any more. Are the old yardsticks still useful, or are we in a new era? I'll leave that food fight to others, but will remind readers of John Templeton's admonition: "The four most dangerous words in the English language are '*This time it's different.*'"

The 3-5 year appreciation index holds a special fascination for investors -- here is a direct projection of asset expected return, and it gets very good press. Mark Hulbert, for instance, citing Dan Seiver's ***PAD System Report***, states forthrightly that all you have to do is subtract 55% from the 3-5 year estimate to accurately predict the 5 year S&P return. Interestingly, Mr. Seiver himself, although relying on the appreciation index, denies ever having published a study on the issue.

Well, fans, the truth is out there. I sent Mr. Seiver my check for $15, and 3 weeks later received a diskette with the 3-5 year appreciation index from 1968 to the present. I then correlated it with future 5 year returns for the S&P 500. I did the same for the dividend yield, PB, and PE ratios back to 1926, using the Ibbotson data for S&P return, and the ***Value Line***

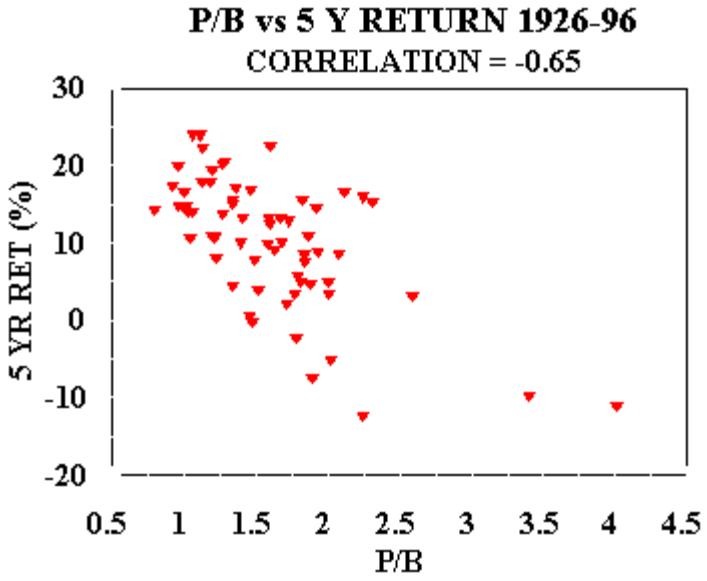
data for valuation.

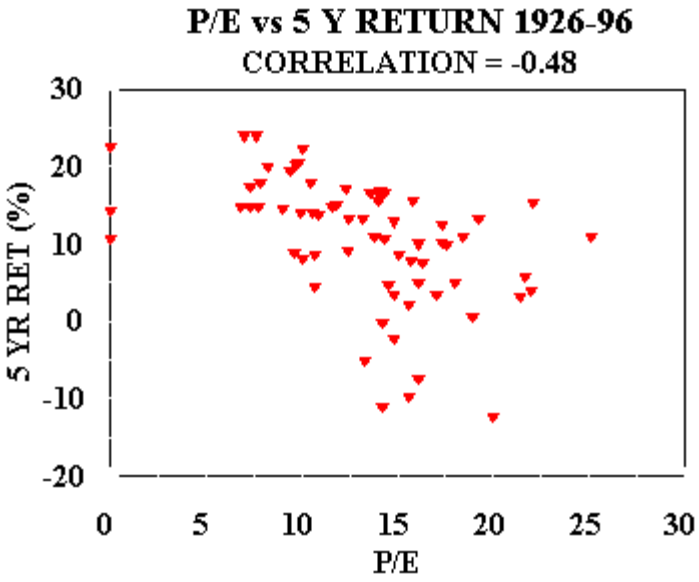
Here's how the correlations stack up:

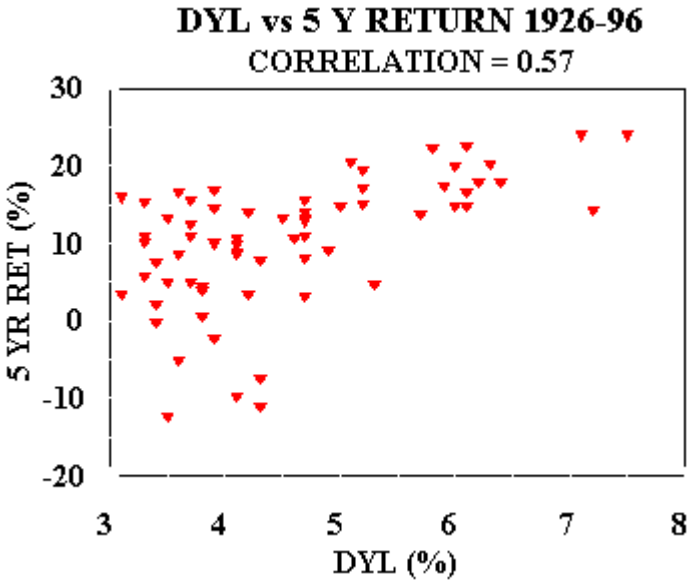
	1926-96 5 Yr. Returns	1968-95 5 Yr. Returns
Price/Book	-0.65	-0.44
Price/Earnings	-0.48	-0.54
Dividend Yield	+0.57	+0.61
VL 3-5 Yr. Appreciation	-------	+0.55

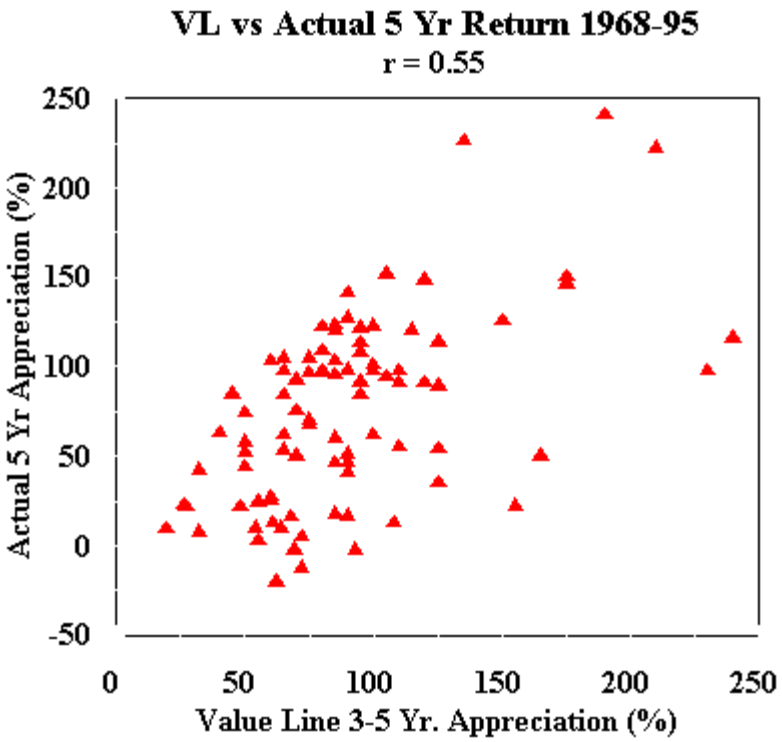
Remenber that the sign of the correlation is irrelevant in judging it's quality. A correlation of -0.55 is as good as +0.55.

Some of the x-y plots for the data are shown below. Remember, the 1926-96 data for PE, PB, and DYL is for annual data points, and the VL 1968-95 data is quarterly. For the first 3 graphs the "5 year return" is an annualized value, for the last graph with the ***VL*** data the "5 year return" is a total return value.




P/E vs 5 Y RETURN 1926-96
CORRELATION = -0.48
5 YR RET (%)
30
20
10
0
-10
-20
0
5
10
15
20
25
30
P/E


DYL vs 5 Y RETURN 1926-96
CORRELATION = 0.57
5 YR RET (%)
30
20
10
0
-10
-20
3
4
5
6
7
8
DYL (%)



So, how good is the 3-5 year appreciation index? Not too bad, but probably no better than the other three indicators. In fact, all four indicators are nothing more or less than a simple proxy for price. All other things being equal, each indicator will change in linear fashion with the price of the S&P500 or the Value Line Index.

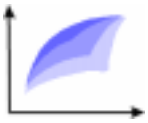
I sure wouldn't bet the farm on any of these 4 parameters, i.e., try to use them to judge when to be 100% in or out of stocks. However, it does seem to be profitable, at least in the long run, to make small and infrequent adjustments in your stock/bond mix based on valuation data. What you find when you play asset allocation spreadsheet games with these parameters for the 1926-94 period (see ***The Intelligent Asset Allocator***, Chapter 5) is that increasing or decreasing your stock exposure according to valuation indicators does improve both return and risk slightly. However, once you use one of the indicators, adding in a second to the mix doesn't add that much further benefit, for the simple reason that all of these indicators are measuring the same thing -- price.

Mind you, correlations in the 0.45-0.65 range are nothing to sneeze at. In fact, I don't know of any other indicators of future equity return which work nearly as well as the above 4 parameters. What I find truly astonishing are the prevalence of unfounded assertions of the validity of various other markers of future return. A few years ago there were pieces in both ***The Wall Street Journal*** and the ***AAII Journal*** describing how dividend yield was worthless as a market indicator. *Inflation adjusted* dividend yield, it was asserted, was far better. Well, the inflation adjusted dividend yield is trivial to calculate and correlate with future return, and the correlation turns out to be very close to zero. The analyst interviewed for the ***AAIIJ*** piece had never actually looked at the data. To its credit the ***AAIIJ*** printed some irate letters pointing this out, but for some reason I never saw an errata in the ***WSJ***.

The next time somebody tells you about a dandy new market barometer, casually ask them

"So, Bob, what's it's correlation coefficient with future returns?" Then, watch the smile disappear from their face.

The Intelligent Asset Allocator



William J. Bernstein

Roll Your Own

Portfolio Tools for the Masses

In the September 1996 and January 1997 editions of EF we discussed the limited asset allocation tools available to small investors. To recap,these tools fall into two categories:

1) Mean variance optimizers (MVO), using the Markowitz critical line technique, and

2) Portfolio backtesters, which calculate returns and Standard Deviations of hypothetical portfolios based on historical index data.

As of the January edition, the pickings were extremely limited. There was a slightly awkward Markowitz MVO from Portfolio Software, with its $150 DOS based package. We've since looked at several Windows based shareware MVOs, and they are all amazingly difficult to use, with exceedingly cumbersome data entry procedures.

Mutual Fund Expert, from Steele Systems, is a mutual fund database with rather limited backtesting capabilities, (10-15 year returns, but only 3 year SDs). At about $100, it's not a bad mutual fund database, and the backtesting ability is nice bonus, but we wouldn't buy it as a primary portfolio tool. Morningstar has just added some portfolio testing capability to Principia, but amazingly did not allow for the use of indexes, or allow for periodic rebalancing, which is a mathematically trivial procedure.

Help is on the way. For the first time, there are relatively inexpensive and simple to use spreadsheet based portfolio tools available for small investors.

Wagner Associates MVO

Wagner Associates, a financial consulting firm and neighbor to the Vanguard Group, traditionally caters to folks with five figure software budgets, but has recently produced an Excel based spreadsheet file which will rapidly compute and plot the Markowitz mean variance efficient frontier. Data entry is stone

simple and intuitive -- you simply directly enter individual asset returns and SDs, as well as the correlation grid into the spreadsheet cells, hit the "optimize" button, and off you go. It's astonishing that nobody has thought of offering such a package to small investors before. The only disadvantage of the program is that you need Excel 7 to run it. I couldn't get it to load into my Quattro 6, and although it loaded into Quattro 7, it wouldn't optimize. I had to go to my accountant's office to see it do its stuff. Hopefully they will dumb the program down a bit for those of us who are spreadsheet cheapskates. The price will be $99. Of course, you'll have to supply your own input data. Sample correlations can be found in The Intelligent Asset Allocator Appendix, and returns/SDs in Chapter 1. Remember, GIGO.
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Portfolio Backtesting:

Asset Returns from TAM Asset Management, Spreadsheet File from Yours Truly

You would think that somebody by now would have produced a simple index based portfolio backtester for investors to get their fingers dirty with real assets over long time periods. While I have dozens of spreadsheet files which do so, the index data in them is copyrighted, and since I have a yellow streak a mile wide I've been afraid to put this data online. Bill Sharpe can get permission from Ibbotson and Morgan Stanley to do this, but I can't.

TAM Asset Management, Inc., a money management firm in mellow Marin County, comes to the rescue. They're recently put online annual returns for a range of global assets going back to 1973, as part of an FA type client presentation. They've agreed to make this available to EF's readers, and I've written a spreadsheet template that the data can be entered into.

TAM's site is located at http://www.tamasset.com, and is well worth a visit. Jeff Troutner of Tamasset puts out a dandy monthly bulletin of asset allocation called ***Asset Class*** on the site. I don't miss an issue.

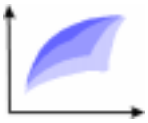
The numbers are located at http://www.tamasset.com/tampres.pdf , and will of course need Acrobat for viewing. The data itself is located on page 12 of the 19

page document. The spreadsheet template into which the data is entered is downloadable by ***clicking here***. It is an Excel based spreadsheet, and will need to be unzipped. I suggest printing out the data from the .pdf document, engaging the num lock key if you have a number pad, and use the pad. It should take you about 5-10 minutes to manually load the data into cells B3 .. H26.

When you're done with the data entry simply enter the portfolio compositions in cells D29 .. J29 as decimals (i.e., 50% = 0.5), and the 24 year annualized return/SD will pop out in cells C32 and C33. Make sure that the total portfolio composition is 1.0 in cell C31. You can plot the annual portfolio return data in cells R3 .. R26. Perhaps one of you can sweet talk Jeff into making the data available in .txt form for direct importation into the spreadsheet.

So what are you waiting for? The truth is out there. Go find it!

The Intelligent Asset Allocator



William J. Bernstein

"What Rate of Return Can You Reasonably Expect . . . or What Can the Long Run Tell Us about the Short Run?"

This is the title of a masterful piece in the March/April ***Financial Analyst's Journal*** by Peter L. Bernstein (unfortunately, no relation). If you enjoy finance, Mr. Bernstein's analysis of the expected return for stocks and bonds is pure mind candy. Five stars. (Find a library that has it, copy it, and read it 3 or 4 times.)

Yes, PLB agrees, the real (inflation adjusted) long term return of common stocks over the past 71 years has been about 7%. However, much of that return has been the result of increasing valuations -- look down the PE column of the stock table and note the dearth of single digit numbers. Mr. Bernstein observes that future stock returns may not benefit from this bonanza. He dissects out the effect of multiple expansion by analyzing 63 episodes averaging 35 years with the same starting and ending PE for the period 1871-1976.

The average real return turns out to be 5.7% for these 63 periods. Further, the standard deviation of real returns for these 63 periods was only 1.1%. In plain English, over the long term real stock returns are highly predictable, and not quite as high as we would expect from looking at the raw 1926-96 data.

Nowadays, every stock broker, tax attorney, CPA, and their dogs too, will tell you that the nominal long term return of common stock is 10%. However, if Mr. Bernstein is correct, and if I can perform simple arithmetic, his 5.7% real return added to the current inflation rate of 2.5% gives only a nominal 8.2%.

These numbers fall out exactly the same way from the dividend discount model. In 1926 the Dow yielded 4.5%, and the US economy has been growing at a real rate of 1% since. Add the two together, and you get . . . 5.5% real return, or 8.5% nominal return. (To complete the picture, over the past 71 years earnings multiples have doubled, adding another 1% to the long term real stock return.)

The next piece of the puzzle is bond returns. Here the waters muddy. Mr. Bernstein applies the same sort of analysis to bonds, this time comparing 63 periods from 1803 to 1978 with the same starting and ending yields. He comes up with a real return of 2.7% and an SD of 2.1%. In other words, in the long run, *bond returns are actually a lot more unpredictable than stock returns.*

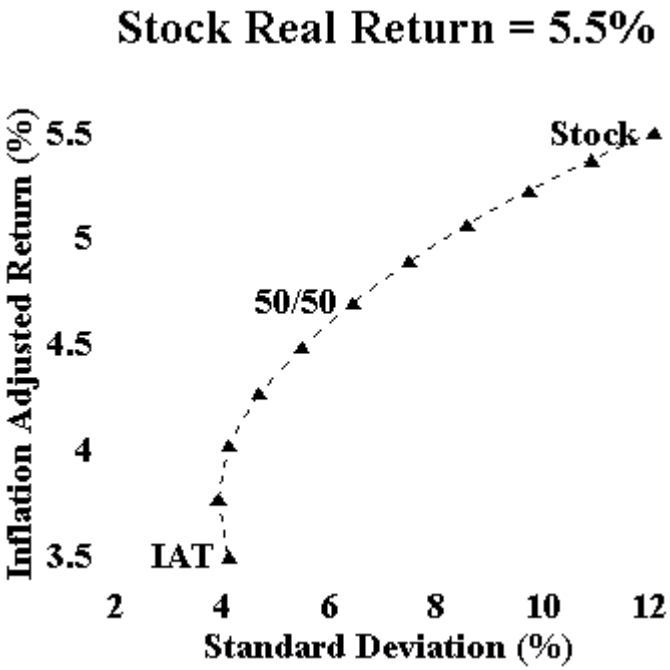
Perhaps. However, I can tell you one thing with absolute certainty about real bond returns over the next 10 years; if you buy an inflation adjusted US Treasury

obligation your real return is guaranteed to be within 20-30 basis points of 3.6%. You don't have to take my word for this. It's backed up by the full faith and credit of the US government.

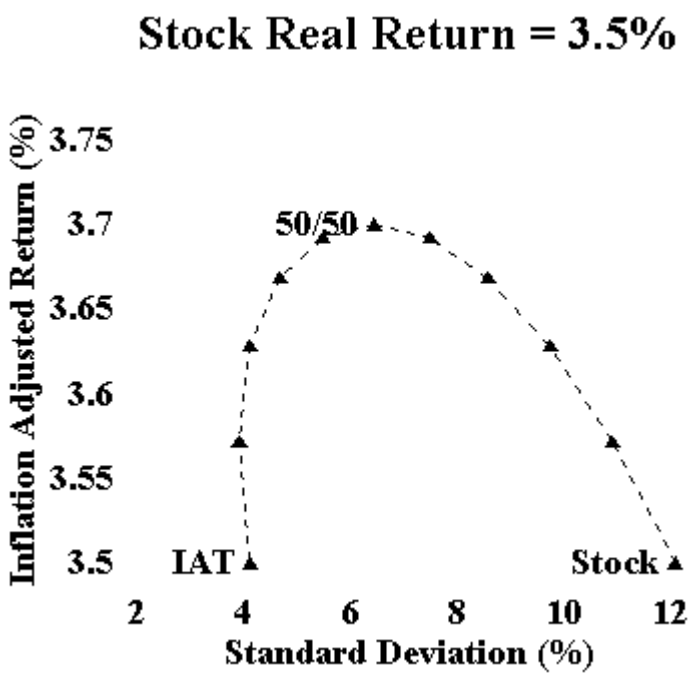
So let's take a trip with Professor Peabody in the WayBack machine to, say, 1954. Stocks yield 4.7% and have a PE of 11.8. Government bonds yield 2.7%. At that time one could have reasonably predicted a long term real stock return of 5.7% (either with PLB's estimate, or adding the 4.7% yield to the 1% real growth rate), and a long term real bond return of zero (the coupon being the same as inflation). Clearly, stocks were a much better deal than bonds in 1954.

Fast forward to the present. The real return on the 10 year inflation adjusted treasury *will* be 3.6%. The real return on stocks will be about 3% (2% dividend yield plus 1% real long term growth) if you believe the dividend discount model, or 5.7% if you take Mr. Bernstein's research at face value. Either way, a dispassionate analysis suggests that stocks will not beat bonds with the same (or perhaps any) margin over the next decade or two.

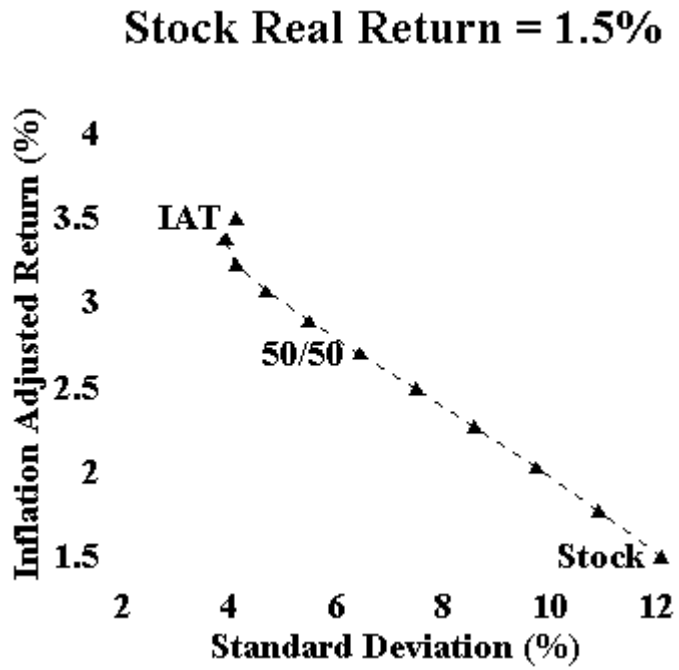
Let's assume that Mr. Bernstein is correct, and that the real long term return of stocks is 5.5%. Assuming that the correlation of inflation adjusted treasuries with whatever domestic or global you are using is zero, we use the methodology described in the September 1996 issue to estimate return, and the Markowitz algorithm to estimate risk (SD). Below is the risk/return plot for various mixes of IATs and stocks. In each of the bolow one tick indicates a 10% change in composition:



Now, let's assume that the dividend discount model is approximately correct, and that the long term future returns of equity is the same as IATs -- 3.5%:

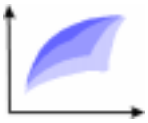


Finally, assume regression to the mean , a la the 1970s, with real returns of only 1.5%:



Ben Graham advised investors to hold an equal mixture of stocks and bonds. Much as Mr. Graham deserves our admiation and gratitude for putting the art of investing on a firm quantitative footing, this was lousy advice in 1934 (***Security Analysis***) and in 1971 (***The Intelligent Investor***). It may just be that "the dean" was simply ahead of his time.

The Intelligent Asset Allocator



William J. Bernstein

The July 1997 Coward's Portfolio

The Ducks are Quacking. Feed them.

--IPO underwriter battle cry

Perhaps investors are more sophisticated then they were a generation or two ago. Sadly, though, they still chase performance as avidly as my dog chases birds on the beach.

July 14's Wall Street Journal brought word that investors have once again got Saturday Night Fever with a Latin beat. Record amounts flowed into south-of the-border funds, inspired by near 50% returns in the first half of this year. One analyst from GT Global offered "The election results were a big plus for Mexico." Where was this genius two years ago when prices on the Bolsa were half of today's? In fairness, most of the analysts consulted for the piece suggested that the new investors rushing into these funds were fat, dumb, happy, and very liable to get egg on their faces in the not too distant future. Morningstar's maven flatly opined "They chase performance."

Well, yes. But that is not where the ottoman really meets the fan. Where our friend from GT Global, as well as the new money, errs is in attempting to extrapolate the news into investment returns. There may be a correlation between economic or political data and returns, but it is weak and most likely negative. Even the most cursory examination of market history shows that economic optimism is often a precursor of poor returns (1929, 1966) and that economic disaster (1932, 1974, 1982) is usually a recipe for high returns. In the global marketplace, Cambell Harvey has recently shown that nations with high *perceived* political and economic instability have higher returns than more stable nations. This should not surprise -- the fundamental investment equation is the positive correlation of risk and return.

Which brings us to the July 1997 Coward's survey. The 3 cowards do not attempt one iota of active allocation. As in previous issues, we compare the risk/return characteristics of our automatons with the performance of the "multiasset global" and "asset allocation" funds in the Morningstar universe. To review, the 3 portfolios we have studied in the past are fixed mixes of the following indexes/funds, rebalanced quarterly:

The Coward's Portfolio (CEI)

- 20% S&P 500
- 20% US small stocks (DFA US 9-10 Portfolio)
- 15% EAFE-Europe
- 5%EAFE Pac. Ex Japan
- 5% Japan Large (MSCI Japan)
- 10% Continental Small (DFA Cont. Sm. Co. Portfolio)
- 5%UK small (DFA UK Sm. Co. Portfolio
- 5% Japan Small (DFA Jap. Sm. Co. Portfolio)
- 5% Pac. EX Japan small (DFA Pac. Rim Sm. Co. Port., before 1/93 EAFE Pac. X J)
- 10% Latin American (MSCI Lat. Am.)

(This portfolio is mixed with the DFA 1 year corporate bond fund to produce a risk/return curve for the past 3 and 5 years.)

The Small Investor's Coward's Portfolio (SICEI)

- 20% Vanguard Index Trust 500
- 20% Vanguard Small Cap Index Fund
- 15% Vanguard European Index Portfolio
- 7% Vanguard Pacific Index Portfolio
- 8% Vanguard Emerging Markets Index Portfolio
- 5% Scudder Latin America Fund
- 12.5% Tweedy Browne Global Value Fund
- 12.5% Acorn International Fund

(This portfolio is mixed with the Vanguard Short Term Corporate Bond Fund to produce a risk/return curve for the past 3 years.)

The Academic Coward's Portfolio (ACEI)

- 25% DFA US Large Cap Value
- 25% DFA US Small Cap Value
- 25% DFA Int'l Value
- 25% DFA Int'l Small Cap Value

(This portfolio is mixed with the DFA 1 year corporate bond fund to produce a risk/return curve for the past 3 years.)

The Problem with Indexing? -- A 4th Coward

A Simple, but Active, Approach

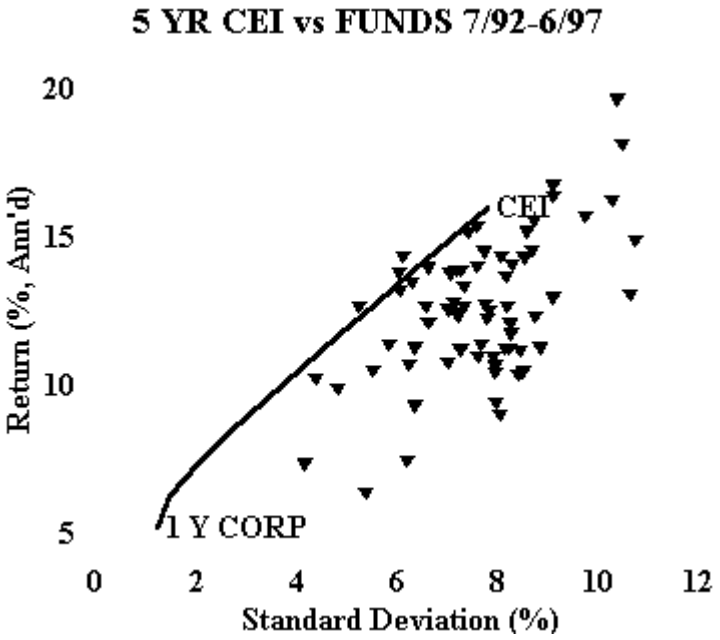
Readers of ***Efficient Frontier*** know that I am no fan of active management. And yet, I am troubled by one aspect of indexing -- the fact that indexes usually hold stocks in cap weighted proportions. This tends to overweight overpriced stocks, and should at least in theory lower returns accordingly. This goes double for global portfolios. Not only will overpriced stocks be overweighted, but so too will overvalued national markets. The extraordinary returns of large growth

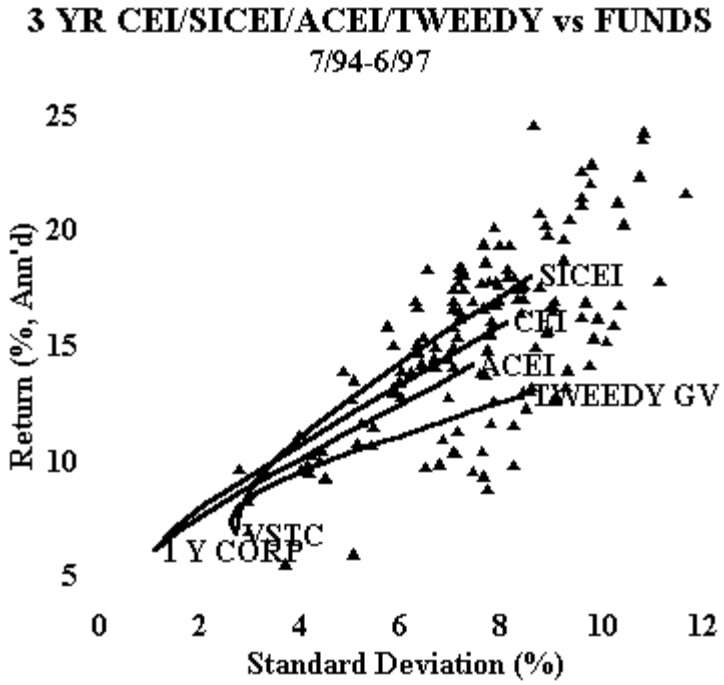
stocks in the past 10 years means one of two things: either all of the academic data demonstrating the superiority of value ("cheap") stocks is wrong, or else the past 10 years have been an extraordinary anomaly. The latter seems more reasonable.

Accordingly, one might look for a fund which picks stocks according to strict Graham and Dodd criteria without regard to nationality or market cap, and has low turnover and expenses. The Tweedy Browne Global Value Fund meets most of these criteria. It is not perfect -- its expenses are a trifle high at 1.6%, and it does not invest in emerging markets. (Its annual reports usually contain the admonition "We don't invest anywhere we can't drink the water.") This fund has only about 15% domestic exposure, reflecting high stock valuations in the US. It is also completely currency hedged, and I will leave the pros and cons of that particular can of worms for another day. I've chosen to combine this fund with the Vanguard Short Term Corporate Bond Fund, to produce a return/risk spectrum accessible to the small investor.

Remember, the CEI and ACEI are meant as a benchmarks for institutional investors. The SICEI and Tweedy portfolios are provided as portfolios easily accessible to the small investor.

With all that out of the way, here are the results for 5 years (CEI only) and 3 years (all 4 indexes):





Over 5 years, no fund beats the CEI by a significant amount on a risk adjusted basis. Period. Only 3 funds protrude slightly above the line: the Sogen International, Merrill Lynch Global Asset A, and Berwyn Income Funds. Several funds produce returns higher returns than the all equity CEI, but all do so with higher risk than the CEI. All fall on or below the imaginary line projected up and to the right of the all equity CEI.

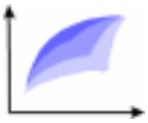
Over a 3 year period, things are not so pretty. Only the SICEI beats most of the actively managed portfolios, but a substantial number of funds perform better on a risk adjusted basis. The other 3 cowards do not beat the majority of funds on a risk adjusted basis. The reason for this is obvious -- over the past 3 years large cap US stocks, still the mainstay of most allocation funds, have outperformed all other assets. In the 157 fund 3 year sample, the average foreign exposure is only 23.5%, and the median market cap a whopping $13.2 billion.

The Tweedy Browne approach does particularly poorly for this reason, with its 85% foreign exposure. There is another, more subtle reason, for Tweedy's poor performance -- the national allocation generated by strict adherence to value cirteria is tends to be rather lopsided, being at present 50% European, with about 15% each US and Japanese, and little exposure to the Pacific Rim or Emerging Markets. This results in a modest increase in risk. Confounding the analysis is the fact that the fund holds about 15% cash. Still, I think that the Tweedy Browne approach holds promise as an alternative model for asset allocation, and should do well as reversion to the mean closes the gap between US and foreign equity returns.

The past 3 years have been a particularly awkward time for the cowards, although the stellar performance of the CEI over the longer time period is encouraging. By this time next year, when I plan to update them again, the CEI will have a 10 year

track record, and the SICEI, ACEI, and Tweedy approach a 5 year record. Stay tuned.

The Intelligent Asset Allocator



William J. Bernstein

Rebalancing: Practical Issues

The pieces on portfolio rebalancing in the September 1996 and January 1997 EF generated a fair amount of comment, much of it along the lines of "Well, that's all very nice, but all the math made my head hurt and I still don't have a good feel for how often I should be doing it, and when it does and does not work."

So, I've decided to approach the problem from a descriptive angle. Instead of throwing a lot of math at you, I'll provide some real world examples, and describe what falls out.

When It Doesn't Work -- the 1926-94 Stock/Bond Model

Believe it or not, sometimes rebalancing bites you. Consider a portfolio consisting of equal parts of stocks (S&P 500 index) and corporate bonds (Ibbotson Long Corporate index), rebalanced each year. Now, the annualized return of this portfolio turns out to be 8.34%, which is 0.49% higher than the average of the long term return of stocks (10.19%) and bonds (5.51%). This 0.49% margin above the 7.85% average annualized return of the two assets is really not an excess return; it is mathematically incorrect to average long term annualized returns when estimating portfolio returns.

Had one *not* rebalanced, the return would have been 9.17%, since by the end of the period the portfolio would have consisted of 95% stock. (Each dollar invested in bonds grew to $40.51, each dollar in stock, $809.10.) Clearly, the extra return earned by not rebalancing came at the cost of higher risk in the latter part of the study period. From the sole perspective of return, rebalancing was a losing strategy during this period. Why? Firstly, the returns of the assets were so different, and over such a long time period. Secondly, and more importantly, the rebalancing benefit is directly proportional to asset *variance*, which is the square of the standard deviation. US stocks and bonds are just not volatile enough to generate excess rebalancing return.

When It Pays off Very Well -- Emerging Markets

Let's look at the opposite end of the rebalancing spectrum. Consider a portfolio consisting of 12 emerging markets:

Argentina
Brazil
Chile
India
Korea
Malaysia
Mexico
Philippines
Portugal
Taiwan
Thailand
Turkey

These are wild and crazy assets. The SD of annual returns for 1988-96 is 165.9% for Turkey, and 126.5% for Argentina. The least volatile market was Chile, with an SD of only 33.0%. Compare this with the SD of the S&P for the same period of 13.5%.

Now, let's create a portfolio consisting of equal parts of each of the above markets on 1/1/88, and hold it, untouched, until 12/31/96. The theoretical return for this portfolio would have been 20.72%. (*Very* theoretical, since it is not possible for foreign investors to own all of the stocks in some of these indexes, and the transactional cost involved is considerable.)

However, had one rebalanced back to equal amounts of each market annually, the theoretical return would have been 25.86%. Admittedly, some of this return would have been lost via the high costs of trading these markets. We can estimate the trading costs mandated by rebalancing by noting that the portfolio typically turned over an average of 21.5% per year. Assuming a 5% trading cost, the 5% rebalancing benefit still greatly outweighs the estimated 1% extra expense generated by rebalancing.

The reason for the large rebalancing benefit is the very high variance/SD of these assets combined with their very low correlations. Even though there were enormous return differences (The highest return market, Argentina, yielded 34.6% annually, while the worst, Portugal, returned -1.11% annually.) the very high asset volatility generated more than enough excess return to overcome this.

The Real World: Regional Indexes in the 1970-96 Period

Neither of the above examples is terribly relevant to the average investor. Very few of us are going to be investing for 69 years, or will be rebalancing annually individual emerging markets portfolios. On the other hand, most of us do have available to us broad portfolios and indexes of regional markets, and will be actively investing for 3 or 4 decades. Accordingly, I've constructed a model which incorporates the following markets for the years 1970-96:

Asset	1970-96 Return(%)	1970-96 SD(%)
US large stocks	12.27	15.85

US small stocks	14.15	22.93
European stocks	13.05	20.95
Pacific Rim stocks	12.26	30.84
Japanese stocks	14.54	33.68
Prec. Met. stocks	13.70	42.99
20 Year Treasuries	9.27	11.89
5 Year Treasuries	9.28	6.80
30 Day Treasuries	6.88	2.67

(Sources: For US Large Stocks (S&P500), US small stocks, and 30 day, 5 year, and 20 year treasury securities, ***Stocks, Bonds, Bills, and Inflation, 1997 Yearbook***. For Japanese, European, and Pacific Rim (MSCI-PACXJ) MSCI Indexes, from Morningstar ***Principia***. The gold equities index consists of the precious metals mutual fund objective return series from Morningstar after 1976. For 1970-75 the return

of the Van Eck Gold Fund is used, courtesy of the Van Eck Group.)

I then constructed the 36 possible 50/50 portfolios for each 2 asset combination, and calculated the difference in return between the rebalanced and nonrebalanced portfolios:

	S&P500	USSM	EAFE-E	PXJ	JAPAN	GOLD	20 Y T	5 Y T	T-bill
S&P500	---								
US SM	+0.19	---							
EAFE-E	+0.24	+0.52	---						
PXJ	+0.58	+0.61	+0.56	---					
JAPAN	+0.86	+1.24	+0.76	+0.92	---				
GOLD	+1.82	+2.38	+1.79	+1.92	+2.34	---			
20 Y T	+0.01	-0.02	+0.02	+0.92	+0.36	+1.15	---		
5 Y T	0.00	-0.03	+0.03	+0.87	+0.37	+1.00	+0.04	---	
T BILL	-0.49	-0.77	-0.57	+0.27	-0.45	+0.17	-0.01	-0.12	---

(Note that a positive value signifies that the rebalanced portfolio has the higher return, a negative value that the unrebalanced portfolio has a higher return.)

For each stock asset pair, a significant rebalancing benefit is seen, even with the highly correlated S&P/US SM pair. The only asset which produced persistently negative rebalancing effects was the treasury bill, with its very low return and variance/SD.

Let's look at some more realistic portfolios. A portfolio consisting of equal parts of each of the six stock assets had an excess return of 1.92% over the unrebalanced portfolio, and an average annual turnover of 8.5%. A portfolio consisting of equal parts of all of the assets (2/3 stocks and 1/3 bonds) had an excess return of 1.08% over the unrebalanced portfolio and an average annual turnover of 7.8%. Finally, a highly conventional all stock portfolio of 25% each S&P and US SM and 12.5% each PXJ, EAFE-E, Japan and Gold had a return of 1.65% higher than the unrebalanced portfolio and an average annual turnover of 7.6%.

Clearly, then, there is a considerable excess return to be earned rebalancing global portfolios, in the range of 1%-2%. The transactional costs in the tax

sheltered environment are minimal -- at a trading cost of 1.5% and average turnover of about 8% only 0.12% is lost to the trading mandated by rebalancing. In the taxable arena the situation is different. Assuming that you are in the 28% capital gains bracket, it can be seen that 8% annual turnover will likely produce a capital gains jolt which can easily exceed the rebalancing benefit.

What rebalancing interval is optimal? In the previous articles it was shown that that depends on the differences between the annualized variances and correlations for each interval for the period considered; the "optimal" rebalancing interval cannot be accurately predicted. It is clear, however, that since rebalancing benefit is roughly linear with variance and turnover is roughly linear with SD, that more frequent rebalancing will likely be less efficient in terms of transactional cost.