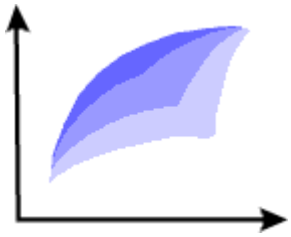
Efficient Frontier



An Online Journal of Practical Asset Allocation

Edited by William J. Bernstein

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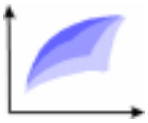


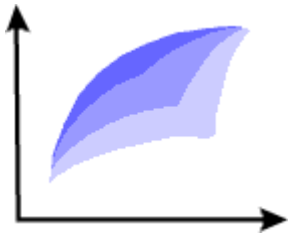
Mean Variance Optimization

The Thinking Man's Ouija Board

Make no mistake about it, portfolio optimizers are big business. Open almost any journal aimed at investment professionals and you'll find full page ads trumpeting the "Nobel Prize winning algorithm" inherent in the $2000 chunk of software being touted. Never mind that the basic code occupies no more than 50-200K on the single floppy that eventually comes in the mail. Advisors and clients alike are dazzled by the upwardly convex curves and precise portfolio compositions flashing on the monitor and lasered into spiffy folders.

I've gotten quite a bit of correspondence about the availability and usefulness of optimization techniques for small investors from readers of ***Efficient Frontier*** and ***The Intelligent Asset Allocator***. I'm skeptical about the technique, and realized that I hadn't conveyed this skepticism well enough.

For those of you new to the asset allocation game, here's the plot: In 1951 Harry Markowitz published a mathematical technique for finding the precise portfolio compositions which yield the best combinations of portfolio risk and return. These portfolios form the upper left border of the risk/return plot of all possible portfolios from a given group of assets, and are said to form the *efficient frontier* of the plot -- hence the name of this site. This site's logo symbolizes this concept:



The vertical axis of the logo represents return, the horizontal axis risk. The multicolored sail like object symbolizes all of the possible portfolio combinations which can be formed from the assets. The upwardly curving part of the sail on its upper left is the "efficient frontier." Portfolios lying on this efficient frontier have the highest return for a given degree of risk. Looked at from another perspective, they have the lowest risk for a given return. Obviously, the efficient frontier is the place to be.

The inputs to the formula are remarkably simple -- the return and standard deviation for each asset, as well as the correlations between each asset. For example, a simple 3 asset portfolio has 9 inputs; 3 returns, 3 SDs, and 3 correlations. A 10 asset portfolio would have 65 inputs (10 returns, 10 SDs, and 45 correlations). The advent of the microcomputer put this technology on the desktop, Professor Markowitz won a well deserved Nobel Prize for his work, and financial analysts become intoxicated with the technique's allure.

However, there is a large and ugly fly in the ointment -- the technique works only in retrospect. It turns out that the outputted portfolio compositions are exquisitely sensitive to even very small changes in the input data. Change a few pieces of the input data slightly and the resultant portfolio compositions change drastically. Since the required input returns, SDs, and correlations are known with precision only in retrospect, mean variance optimization is worthless as a predictor of *future* optimal portfolios. This is because it is impossible to predict with anywhere near the required accuracy the returns, SDs, and correlations.

As a simple example, I fed the following inputs into my MVO for a simple 5 asset model:

Asset	Return	Standard Deviation
A	12.5%	25%
B	11.5%	25%
C	10.5%	15%
D	9.5%	15%
E	5%	1%

Assets A and B represent high return/risk assets, such as emerging markets stocks, C and D lower return/risk assets such as US and European stocks, and E cash. All of the stock assets had typical mutual correlations of 0.5 with each other and 0.0 with cash. The optimizer calculated the following optimal "corner portfolios." (Corner portfolios are the basic output of the MVO algorithm. To find the efficient frontier composition between any two corner portfolios they are combined in appropriate amounts.)

Asset	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5
A %	0	15	32	80	100
B %	0	4	11	20	0
C %	1	56	57	0	0
D %	0	25	0	0	0
E %	99	0	0	0	0
Return%	5.06	10.59	11.24	12.3	12.5
Std%	1.00	13.88	16.03	22.91	25.00

Note that the "maximum return" portfolio 5 consists of 100% asset A. In the real world of rebalanced portfolios two assets with SD=25% and correlation= 0.5 will have a rebalanced

return of about 0.8% over their averaged returns, so in actuality the maximum return portfolio will turn out to be a nearly 50/50 mix of A and B, with a return of about 12.8% (the average of 11.5% and 12.5%, plus the "rebalancing factor" of 0.8%) and an SD of 22.1%. In other words, the maximum return portfolio often turns out to be a mixture of 2 or more assets, but MVO will always assign the maximum return portfolio as 100% of the highest performing asset.

Next, you'll recognize that at the lower return/risk region (portfolios 2, 3, and 4) the output favored A over B, and C over D by very wide margins. This is simply the result of A having a 1% higher return than B, with the same true of C and D. If your asset return forecast is off by even 1% then that asset's allocation may be off by several fold. The Lord Almighty Herself cannot make returns forecasts with that sort of accuracy. The same sorts of errors occur with SD and correlation aberrations. Consider a 10 asset model. What do you think the odds are of correctly predicting with any accuracy all 65 required input parameters?

In addition, the tendency for asset returns to mean revert introduces a perverse bias into optimizer results. If you are using returns over the past 5, 10, or even 20 years you are likely to overestimate the returns of the higher performing assets and vice versa. This will result in the optimizer overweighting precisely those assets which are likely to underperform in the future. Some optimizers actually allow the financial analyst to feed raw mutual fund data directly into the algorithm! This is a recipe for disaster.

It is becoming increasingly obvious that naive portfolio allocations, followed with discipline, will beat most active allocation strategies with great regularity. So why do financial analysts use MVO? For starters, the Nobel Prize does get your attention. It's major attraction, however, is its flashiness. Human nature favors the complex over the simple. James P. O'Shaugnnessy, in ***What Works on Wall Street*** cites a psychological study in which two subjects, Smith and Jones, are asked to identify whether cell samples shown on a screen are healthy or sick. Smith and Jones are given a few simple but effective rules for making this decision. Smith is given the correct feedback about whether he is right or wrong, and after a while is right 80% of the time. Jones is given incorrect feedback, and does much more poorly. Smith and Jones are then asked to explain to each other how they made their decisions. Smith's, as expected, is short and simple. Jones' is complex and convoluted, and much more impressive than Smith's. Next, they are asked to look at a new set of cell samples. So impressed is Smith with Jones' complex (but less effective) method that he begins to use it.

The same is true of mean variance optimization versus fixed balanced portfolio allocations. Financial analysts and investors have been conned by MVO's complexity and elegance. It's failure is reminscent of communism's. Marx's system fails because of the flaws inherent in human nature: Markowitz' system fails because of the flaws inherent in economic forecasting.

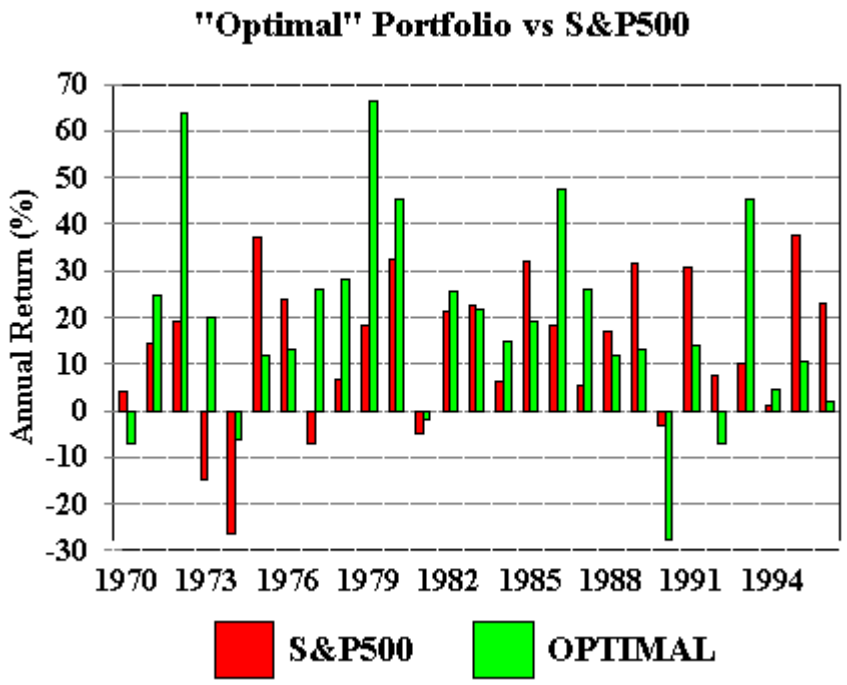
The Loneliness of the Long Distance Asset Allocator

It's late in the evening. The children have gone to bed, and you are all alone with your IRA accounts and spreadsheet, wrestling with your asset allocation strategy. You nod off and reawake in an alternative universe. Strange tropical plants are growing out of your keyboard, and snow wafts down from the ceiling.

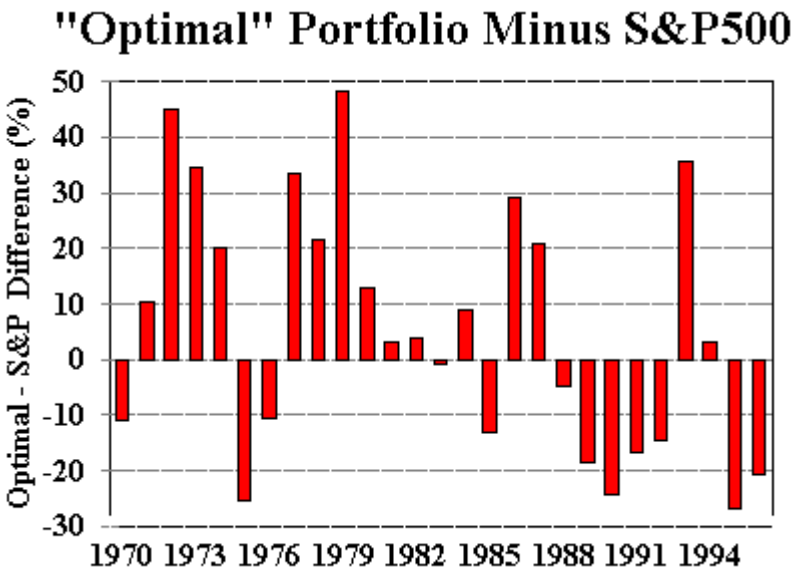
A genie appears, looking like some vague demented amalgam of Mario Vargas Llosa and Harry Markowitz. "The spirits inform me that you are a seeker of efficient portfolios," he intones. "Oy vey," you respond, "Excedrin headache number 11." The genie offers a sly smile. He tells you that in his pocket are the annual returns for for the next 27 years for the MSCI regional indexes (Europe, Japan, Pacific X Japan), US large and small stocks, and an index of gold mutual funds.

Can you see them? Of course not. The genie will, however, tell you what mix of these assets will produce the highest return over the next 27 years. Still interested? You bet.

The genie suddenly disappears, and along with him the snow and tropical plants. Rats! Just another asset allocation hallucination. But perhaps you have learned something. Your computer contains the returns for the past 27 years for these indexes. You quickly calculate the optimal mix of these six assets for the 1970-96 period. It consists of just 3 of the assets: 35% Japanese, 28% small US, and 37% gold. Very unconventional, but it yielded 16.85% over the 27 year period, versus 12.27% for the S&P500. (Annual rebalancing is assumed.) The annual returns for this optimal mix and the S&P are plotted below:



What is striking is just how different the annual returns of these two portfolios are. In order to better appreciate this, I've plotted the "tracking error" (optimal portfolio minus S&P return) of the portfolio:



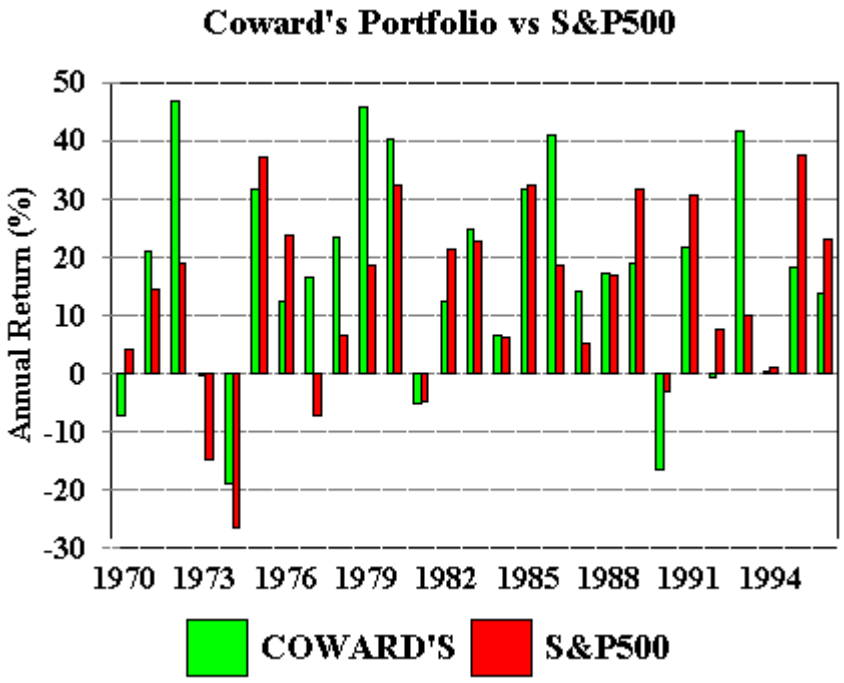
Above the line, the "optimal" portfolio's annual return was higher, below it the S&P was better. Despite the fact that the optimal portfolio yielded 4.58% compounded more than the S&P, it lagged it in 12 out of 27 years, or 44% of the time. The underperformance was not trivial either, on one occasion 27%. In other words, international diversification is not a free lunch. You must be willing to feel like a fool for extended periods of time in order to reap its benefits. If you're a small investor, that is not such a high price to pay. For the professional money manager the cost is much higher; lagging the benchmark by such margins turns you

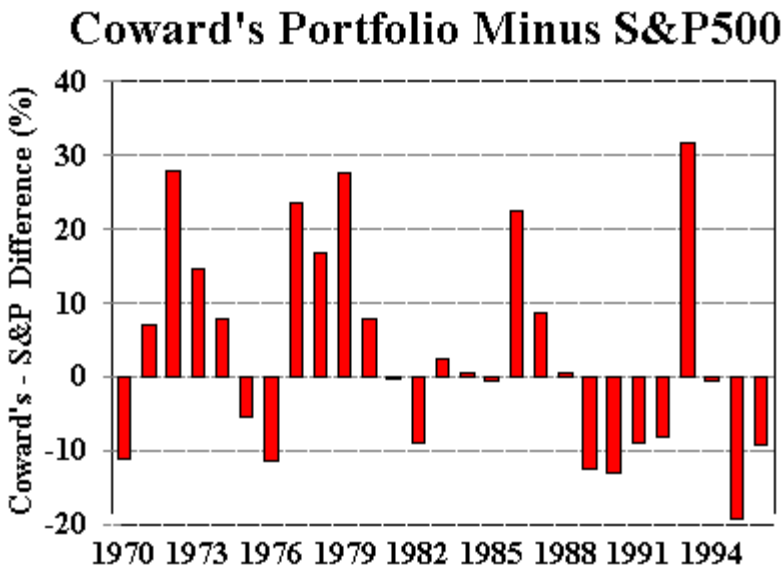
into instant roadkill. The small investor definitely has an unfair advantage over the professional in the asset allocation arena.

The Coward's Portfolio

The "optimal" portfolio has a most peculiar allocation. Further, it is dubious that the same allocation will be anywhere near optimal during the *next* 27 years. Financial history doesn't repeat (or even rhyme, as Mark Twain suggested). Is it possible to predict the "optimal" portfolio allocation for the next 5, 10, or 30 years with any accuracy? Your chances of doing so are about the same as starting at point guard for the Bulls next season. Can an "investment professional" using state of the art software and a Cray 23 do any better? Hardly likely.

If you've perused these pages before, you know the answer. Pick an allocation, almost any allocation, and stick to it. How about equal amounts of all 6 of the above assets (Europe, Japan, Pacific X Japan, US large and small stocks, and gold equity)? The 27 year return of this "coward's strategy" was 15.33% -- just 1.5% less than the best possible strategy. Again, even though this strategy beat the S&P by 3% annualized, it lagged the S&P in 13 out of 27 years -- almost half of the time. Below are the annual returns for the equally weighted coward's portfolio and S&P, followed by the graph of its S&P tracking error.





Which brings us to the past decade. For those of you who've been living in a trappist monastery since 1987, the S&P 500 has been the only place to be. For the past 10 years the S&P has returned 15.26% versus 6.59% for the "optimal" portfolio and 10.44% for the "cowards" (equally weighted) portfolio. For internationally diversified investors it's been a very long decade indeed.

So which period do we rely on for guidance -- the past decade of US large cap outperformance or the longer period of global portfolio dominance? There is no sure answer to this dilemma. However, it is likely that longer periods provide more reliable data. Asset return divergences generally revert; the underperformance of foreign assets during the past decade is probably simply "payback" for their overperformance before 1987. If this is true then the next 10 years should again provide handsome rewards for foreign diversification.

Hence, the loneliness of the long distance asset allocator. Holding foreign assets during the past decade has been a lonely, frustrating experience. Few things offend human nature more than watching helplessly as your neighbors become effortlessly rich investing in the big blue chips. Keep the faith -- your day will come.

Cover Home E-Mail

Rebalancing Emerging Markets Closed End Funds

Portfolio Theory's Brass Ring

In earlier pieces we've discussed the nature of portfolio rebalancing, and discovered that there is often an excess return to be earned from it. In general, when a small amount of a volatile asset is added to a portfolio, and rebalanced regularly, its actual return is usually considerably higher than the stand alone return. This is because the interaction of asset volatility and policy rebalancing produces a natural "buy low/sell high" bias into the rebalancing transactions. In addition, rebalancing benefits most with risky assets with similar returns.

In previous work we have shown that this "rebalancing bonus" is approximated by

$$(1-r) \times Var/2$$

where r is the correlation of the asset with the rest of the portfolio, and Var is its variance. Precious metals equity is a good case in point. The variance of a diversified portfolio metals equity is in the 0.1 range, and its correlation with most diversified portfolios is zero. Thus, an approximately 5% (1 x 0.1 x 1/2) excess return on the asset is earned simply by rebalancing it regularly.

Are there other assets which behave the same way? Indeed there are; the equity assets of emerging market nations. For monthly returns for the period 1/88-3/96 the following nations had a correlation of less than 0.2 with large US stocks (the S&P500): Brazil, Chile, India, Korea, Taiwan, and Turkey. Brazil and Turkey both had variances in the 0.5 range as well, suggesting the possibility of up to a 25% "rebalancing bonus" for the disciplined investor in these volatile markets. To be sure, there are significant transaction costs for both the large and small investor in the securities of these nations, but they are dwarfed by the potential excess returns. To say nothing of the emotional rigor required to buy equity in a country in the wake of a coup, civil war, or natural disaster.

If you are a small investor, and you decide to go this route, and wish a reasonably diversified approach to a given national market, you have only one choice -- single country closed end funds. They trade on the major US exchanges, usually the NYSE. These securities do have drawbacks. Firstly, their expenses are quite high, usually about 2% per year. Next, trading costs will be on the order of 2%-4% round trip even with a deep discount brokerage, because

of the wide bid-ask spread of most of these securities. Since they trade in the US, and can sell at a premium or a discount to their NAV, will they not be subject to the sentiment of the US market, thus increasing their correlation with it? If so, then the increased correlation with the US market would greatly lessen their value to the US investor. How well are these funds managed? Is the US investor likely to see their returns lessened by incompetent active management?

In order to answer these questions I decided to examine the performance and correlation of the available emerging market single country funds. The data are summarized below. For each country the senior fund was chosen. Monthly returns for each fund were studied beginning either at the inception of the fund or January 1988, whichever was later. (January 1988 being the beginning of the available emerging markets data from MSCI.) Returns for the study period for the market return, NAV, and appropriate MSCI country index are tabulated, as are the correlations of each of the three returns with the S&P500.

Fund	Dates	Market Ret. (%)	N. A. V. Ret. (%)	MSCI Index Ret. (%)	S&P Cor. (Market)	S&P Cor. (N. A. V.)	S&P Cor. (MSCI)
Argentina	11/91-3/96	-1.32	6.50	-8.45	0.34	0.27	0.47
Brazil	5/88-3/96	15.58	16.07	18.6	0.35	0.31	0.18
Chile	10/89-3/96	20.41	25.73	25.90	0.32	0.20	0.05
India Growth	9/88-3/96	7.88	5.10	21.86	0.26	-0.04	-0.06
Indonesia	4/90-3/96	-6.48	-2.73	-4.83	0.36	0.30	0.23
Korea	1/88-3/96	4.69	9.12	0.77	0.29	0.16	0.17
Mexico	1/88-3/96	23.55	25.40	27.08	0.33	0.22	0.28
1st Phillipine	12/89-3/96	8.08	15.15	12.74	0.28	0.20	0.27
Portugal	12/89-3/96	-1.30	4.12	-1.20	0.49	0.40	0.33
Taiwan	1/88-3/96	10.17	18.18	13.65	0.40	0.15	0.09
Thai	3/88-3/96	6.97	13.33	10.51	0.40	0.36	0.35
Turkish Inv.	1/90-3/96	-9.23	-10.89	-6.22	0.23	-0.10	-0.03
Average	---------	4.83	10.42	9.20	0.34	0.20	0.19

The returns data are pleasantly surprising. Although the average market return is significantly lower than the average MSCI index return, this is largely attributable to the well known proclivity of these funds to develop fairly wide discounts after issuance. Many of the countries studied have two or more funds available, causing further widening of their discount. However, there has been few recent single country IPOs, and it seems that further significant widening of the fund discounts is unlikely. The NAV return is a better index of management skill, and it is somewhat surprising that this is actually a full percent higher than the average MSCI benchmark, an impressive accomplishment in the face of the typical 2% fund expense. It would seem, then, that the purchase of these shares at a historically high discount would more likely than not result in benchmark beating performance.

It is reassuring that the correlations of the NAV returns with the S&P are nearly identical with the benchmark returns -- a quite low 0.20. Unfortunately, as expected, the fact that these funds trade in the US markets adversely affects the fund market return/S&P correlation. The correlation of the market returns with the US market is considerably higher at 0.34. A correlation of 0.34 means that you will lose about one third of the "rebalancing bonus" estimated from the "half variance" approximation. Further, you are going to be losing about 3% per year in return to fund expense and trading expense. Still, for an asset with SD = 0.5 and Var = 0.25, that still amounts to an about 5% per year return increment.

Emerging Markets closed end funds are no walk in the park. However, for the small investor with nerves of steel and the discipline to buy into disaster and sell into euphoria, the potential returns are considerable.