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The Real Efficient Frontier
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If past history was all there was to the game, the richest people would be librarians.
- Warren Buffett

Since the beginning of money management, investors have yearned for a better way to manage their investment dollars. In the early years, success or failure was easily gauged; you either made money or lost money. Portfolios didn't exist, at least not officially. Rather, investors owned a collection of seemingly unrelated assets. The relationship between holdings didn't matter as long as each individual holding increased in value. In the 1950's, Harry Markowitz found that by blending risky assets together, the combined portfolio could actually have less risk than the components. The reason was the imperfect correlation or the relationship between the securities. As long as the group of securities did not move in unison, portfolio risk could be less than the average of the components. This marked the unofficial beginning of portfolio management as we know it, where the collection was more important than any individual piece. Additionally, Markowitz found that one could mathematically model combinations of assets, given a set of assumptions, to determine which group represented the best combination in terms of return per unit of risk. In essence, he found efficiency in asset management; spend as little risk as possible to capture return. This group of "efficient portfolios" came to be known as the efficient frontier. Markowitz's work even 60 years later was seismic in terms of its effect on how we think in investing.

The Problem with Efficient Portfolios

Beginning Period Valuations

Over the course of the past 100 years, the average return on the S&P 500 was 10.5% per year. Should an investor with a long-term time horizon of 10 or 20 years assume they will receive that same historical return? The answer is it depends. If beginning period valuations are identical, it is a very reasonable assumption otherwise it is nothing more than a poor guess. Take a simple example to illustrate how valuations impact future return. Buy a grocery store. The grocery store generates $100,000 per year in earnings. For this store, you pay $1m. Your return on investment is 10% ($100k divided by $1m). What happens to your return on investment if you pay twice the price for the same earnings? Your return is now 5%. In our first example, you paid 10x earnings for the business. In the second example, you paid 20x earnings. The valuation was higher in the second example and the corresponding return was lower as a percentage of your investment.

While the influence of Markowitz's work blazed new trails in the scope of portfolio management, it is not without limitations. Before we get into that, it is worth mentioning exactly what Markowitz created. First, he built a series of mathematical models that accounted for not only the return and risk of assets within a portfolio, but also their correlations to one another. From there he extended his work such that given a set of assumptions for risk, return and correlation, he could solve for the optimal combination of assets. The key here is the phrase "given a set of assumptions." Markowitz's genius was twofold. He recognized that correlations matter as much if not more than risk in diversified portfolios and then created the mathematical framework to solve for it. That's it.

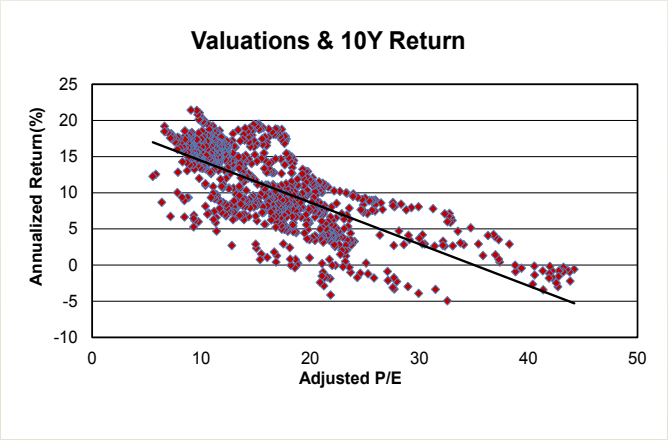
The primary flaw in the use of Markowitz's model or the efficient frontier is with the inputs used by most practitioners. If we as practitioners use bad inputs, is this the fault of the model? This would be akin to dining at a five star restaurant,

ordering a $100 dry-aged steak and requesting that they cook it for 30 minutes as opposed to the normal 10-minute cooking time. Should you blame the owner or chef because you changed the input and your steak is now charred beyond recognition? Most practitioners in creating efficient portfolios use historical data for risk, return, and correlation as the model inputs which leads to several problems. First, in order for historical data to be relevant as an estimate of future returns, beginning period valuations must be identical (see the side bar example on page 1 to understand why). Ignoring valuations is the first mistake. The second, and almost equally damaging mistake is ignoring time horizon. When evaluating historical data, most will use long-term averages of 20, 30, or even 100 years. How relevant is a 100-year average return if your time horizon is ten years? Case in point, how relevant was the long term average return on US stocks using 100 years' worth of data of 10.5% for those investors with a 10-year horizon beginning in 1999? The return on the S&P 500 over the next ten years was -1.38% per year.

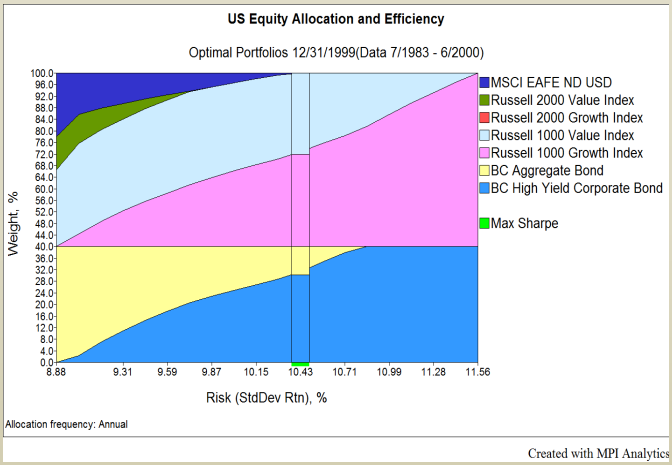
The reality is that constructing efficient portfolios using historical inputs can be highly inefficient. In this case, it is the combination of the brilliance in the mathematical techniques developed by Markowitz and the flawed use of historical inputs that lead us astray. You see, a Markowitz Mean Variance Optimization (what is used to determine efficient portfolios) is nothing more than a return per unit of risk maximizer. Depending on whether your inputs are forward - looking or historical will lead you to either drive looking out of the windshield or rear view mirror. As such, using mean variance optimization with historical inputs often leads you to portfolios that are concentrated in assets that have done best recently, are likely to have become overvalued and are highly unlikely to repeat their performance over the next five or ten-year period.

A Science Experiment: Efficient Portfolios at Market Peaks

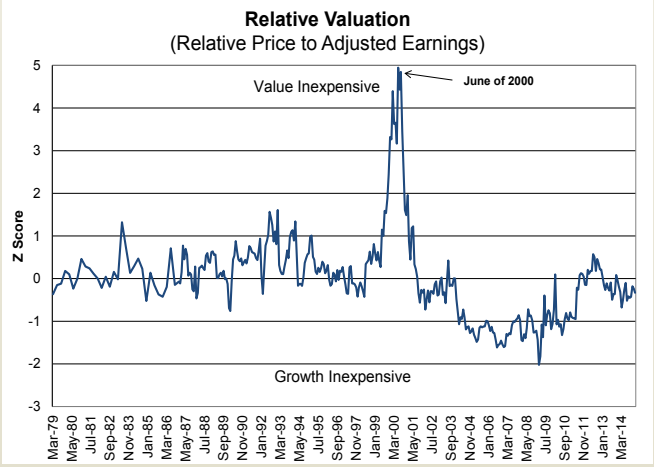
When conducting a search for efficient combinations of assets, this is referred to as an optimization. In practice, optimizations are usually done in a constrained manner. By doing this, an investor states the minimum and maximum they are willing to own of a

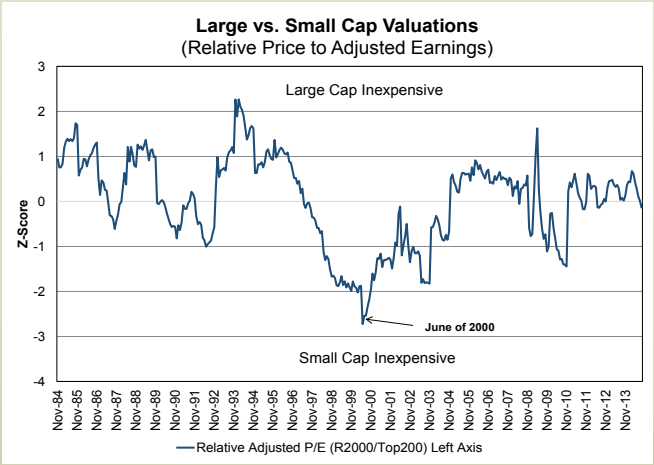


In 1999, the adjusted P/E of the S&P 500 was 44. From this valuation level, equities have never produced a positive rate of return over the subsequent 10-year period. Yet, if we searched for efficient portfolios using the historical returns as an input, our expected return for the next 10 years would be for an annualized return of 14.4% (the average from 1983-1999) over that period. In reality, investors experienced a loss of .82% per year from 2000-2010.



Over the ensuing ten years, the historical efficient portfolio's largest equity holding, Large Growth stocks, lost 41%, while Small Cap Value stocks, which were not represented, gained 105%. In total, the historical efficient portfolio produced an anemic 10-year annualized rate of return of 2.29%. Under this scenario, the "efficient portfolio" would have been highly inefficient.





Using valuations as a guide, we can see that at the market peak in 2000, both Value and Small Cap stocks were inexpensive relative to Growth and Large Cap stocks. Over the next ten years Value stocks outperformed Growth stocks +2.38% vs -5.14%, while Small Cap outperformed Large Cap +4.71 vs -.41%.

given asset class, regardless of the answer. For our purposes today, we aren't going to do that. Rather, we are going to perform an unconstrained optimization for a 60% Equity 40% Fixed Income portfolio, so that constraints do not get in the way of our experiment. My thesis is that mean variance optimization using historical inputs will lead you to highly inefficient portfolios over an investor's time horizon. For our purposes, we will define a long-term investor as someone with a 10-year time horizon. I will illustrate this using two well-known inflection points, the bursting of the internet bubble in 1999 and the market bottom of the credit crisis in early 2009. The flaws are the same regardless of the date but are just more obvious at the inflection points.

Taking the longest common history of assets is a common practice for those using historical averages as inputs, so we will do the same. This gives us a window that begins in 1983 and extends just prior to the market top in June of 2000, or later in the article the market bottom in February of 2009. In the chart on the prior page we can see a range of efficient portfolios at various risk levels. The portfolio that offers the maximum return per unit of risk, or Sharpe Ratio, is indicated by the boxed area and is underscored in green. At this juncture in 2000, the "efficient portfolio" could have been accomplished by blending .71% high yield bonds, 39.29% investment grade bonds, 23.25% Large Cap Growth Stocks, 19.95% Large Cap Value Stocks, 16.81% International and 0% in Small Cap.

Over the ensuing ten years, the portfolio's largest equity holding, Large Growth stocks, lost 41%, while Small Value stocks, which were not represented, gained 105%. Sadly, the decision to focus primarily on domestic equities also did not pay off, as the S&P 500 lost nearly 15% over the period, while International Developed stocks gained 1.5%. In total, the historical efficient portfolio produced an anemic annualized rate of return over the next 10 years of 2.29%.

It is fairly apparent from the preceding section that investing based on the "historical efficient portfolio" would have been an unmitigated disaster. So what would we propose to do differently? Simple, instead of blindly expecting the past to repeat itself, we would use forward looking estimates of return based on a valuation-driven philosophy. Instead of taking historical

averages of the past, we estimate returns over the next 10 years by observing market driven variables that create return. For those that are interested, our methodology[1] is footnoted at the bottom of this page. For those that are not, I will spare you the geekery!

As seen in the table below, our value based estimates (column B) lie in stark contrast to the historical inputs that were used to project the 10 years forward from 2000-2010 in the prior section. By using the historical methodology, one would expect Large Cap Growth stocks to generate 17.46% per year for the ten years from 2000-2010. By contrast, our forward-looking approach, based on valuations, estimates returns for Large Cap Growth stocks to be just .58% per year. In actuality, the return over the period from 2000-2010 was -5.14% (see Column C). In total the historical approach missed its mark by an average 10.66% per year while the value based approach strayed by only 2.77%.

For purposes of completing our experiment, let's repeat the efficient portfolio exercise using our value-based estimates. Remember, we are doing this in an unconstrained way so as to be able to evaluate historical returns as expected future returns vs. forward looking value-based inputs. Not surprisingly, the optimal portfolio changes significantly. Using our forward-looking value-based inputs, the efficient portfolio recommendation (Max Sharpe Ratio portfolio) becomes 40% High Yield bonds and 60% Small Cap Value stocks. This portfolio produces an annualized rate of return over the next 10 years of 7.63%, compared to 2.29% for the portfolio constructed using historical inputs.

	A	B	C	D	E
Asset Class	**Trailing Historical Return(Max Common Period 1983-2000)**	**Value Based Expected Return Estimate**	**Actual Return(Ex Post)**	**Actual Return vs. Value Estimate**	**Actual Return vs. Historical Estimate**
Large Growth	17.46%	0.58%	-5.14%	5.72%	22.60%
Large Value	15.44%	5.31%	2.38%	2.93%	13.06%
Small Growth	11.42%	1.59%	-1.72%	3.31%	13.14%
Small Value	12.50%	7.09%	7.48%	-0.39%	5.02%
International Developed Equity	15.35%	3.87%	0.14%	3.73%	15.21%
High Yield Bonds	10.21%	10.63%	7.32%	3.31%	2.89%
Investment Grade Bonds	9.17%	7.24%	6.47%	0.77%	2.70%
Average				2.77%	10.66%

A Science Experiment: Efficient Portfolios at Market Bottoms

OK, so we have just shown that historical inputs do a pretty lousy job at market tops. What about at market bottoms? For this, we shift our focus to February 27, 2009 and repeat the exercise. At this point in time, the historical efficient portfolio would have been comprised of 40% Investment Grade Fixed Income, 43.7% Large Cap Value Stocks, 5.27% Small Cap Value Stocks, and 11.02% International Equity. While, in an absolute sense, returns were significantly better over subsequent period, using historical inputs was once again a monumental failure in terms of asset class selection. While Investment Grade bonds produced an annualized 5.36% return over the next 6 years, High Yield bonds annualized 15.86%, of which the historical efficient portfolio owned none. Large Value stocks produced an annualized 20.88% gain while

[1] Our research has shown that P/E ratios adjusted for profit margins are highly predictive of future results over large blocks of time like a decade. Our methodology for estimating returns was to take the adjusted earnings yield as a base estimate of return. We then fully mean revert the adjusted P/E to its historical value to obtain an estimate of what multiple expansion or contraction would add/subtract from the implied earnings yield. The combination of the two is our estimate.

Large Growth gained 21.71% over that same period. Again, the portfolio owned none. Small Growth outperformed Small Value by 250 bps per year over the past 6 years. Once again, the historical portfolio owned none. Lastly, International Equities trailed all other equity assets, gaining 13.56% over the period.

While the value-based approach produces an equally strange portfolio, I must remind our readers that we have not put any constraints on our experiment for the sake of purity of the exercise and easy comparison. The value-based portfolio favored 40% High Yield bonds, 44.13% Large Value stocks and 15.87% International Equities. From March of 2009 – Present, the historical portfolio produced an impressive annualized return of 14.01%. The value based portfolio produced an annualized result of 17.86% per year. While this is impressive, I must remind you that value-based techniques work very well over 10-year periods, but not as well as you shorten the horizon. To this day, International Developed Markets stocks remain undervalued. It will be interesting to observe this result given the balance of the remaining 4 years of this10-year period.

The Efficient Frontier Today

Much like the turn of the century, investors are faced with a daunting task. It is natural to want to trust your senses. The historical input methodology appeals to this in our nature. However, it is our very senses that will betray us. Complicating matters, Wall Street often presents legitimate techniques, but simplifies them to render them completely ineffective. Long-term historical returns are only relevant to tomorrow if the beginning period valuations and estimation time horizons are identical. How relevant is a 100 year average to you if your time horizon is 10 or 20 years? The answer is it isn't. This is the case with efficient portfolios based on historical inputs. In most cases, dominant assets of the past become expensive and vulnerable to future underperformance, much like Large Growth stocks in 2000, while inexpensive assets, like International Developed and Emerging Markets equities, struggle to find a place in the historical efficient portfolio. They will certainly find a place in a value-based portfolio. Thank you for your trust and confidence.

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