

THE RETIRED MARKET CONTEMPLATOR (RMC)

June 2006

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THIS MONTH'S HISTORY LESSON (JUNE 2006).

ASSET ALLOCATION, DIVERSIFICATION, and PORTFOLIO OPTIMIZATION:

1.0 ASSET ALLOCATION: Is determining how a portfolio should be split between equities and fixed income. Equities may be stocks or stock funds, while fixed income can be bonds, bond funds, money market funds, CD's or cash. The split between equities and fixed income depends on a person's age and risk tolerance. Younger persons are usually willing to take on higher risk in the hopes for a much higher return than older folks who are more interested in capital preservation.

In the history lesson for May 2006 (see [Archives Page >>>](#)), we analyzed the return-to-risk characteristics for a single asset, and showed how to pick the best mutual fund. This month we do a similar analysis for a portfolio consisting of many different assets, and analyze its return-to-risk characteristics. By the end of this article, you will be able to analyze whether your portfolio matches your risk profile, if you are adequately diversified, and if the total return matches your income needs.

As always, we start with definitions and terminology, and then proceed to the portfolio analysis. *Those wishing to get the bottom line can skip ahead to section 4.0.*

2.0 DEFINITIONS:

2.1 Portfolio: Is the total collection of all assets belonging to an investor, *not including real estate*. These assets will generally consist of stocks, bonds, mutual funds and cash. All accounts belonging to an investor must be included, brokerage, 401K, 403B, IRA's, annuities, savings, etc.

2.2 Weighted Average: Is used to find the average price paid for an item that was purchased in several lots and at a different price per lot. For instance, if several lots of shares are purchased at various prices, the weighted average is used to determine the average price per share. If N1, N2 and N3 are the number of shares bought at price per share of P1, P2 and P3, then:

$$\text{Weighted Average} = (N1 \times P1 + N2 \times P2 + N3 \times P3) / (N1 + N2 + N3)$$

So the weighted average of 100 shares bought at \$10.00, 120 shares at \$12.00, and 90 shares at \$15.00, is = $(100 \times \$10 + 120 \times \$12 + 90 \times \$15) / (100 + 120 + 90) = \12.23 per share.

2.3 Annual Portfolio Return: Is the Annual Return of the total portfolio computed from the individual annual returns of the assets in it, taking into account the proportion represented by each asset.

It is calculated as the sum of the annual returns of the individual assets, weighted by their percentage in the portfolio. For a portfolio consisting of 70% VFINX and 30% VBMFX as in the table below

:

Name	Symbol	Ann Return	Std Deviation	% of Portfolio	Weighted AnnReturn	Weighted StdDev
SP500 Fund	VFINX	17.07%	8.79%	70%	11.95	6.15
BondIndex	VBMFX	2.83%	4.17%	30%	0.85	1.25

$$\text{Annual Portfolio Return} = (0.7 \times 17.07 + 0.3 \times 2.83) = 12.8\%$$

2.4 Annual Portfolio Standard Deviation (Std Dev, sigma): Is the Std Deviation of the total portfolio computed from the individual Std Deviations of the assets in it, taking into account the percentage of each asset in the portfolio.

For a portfolio of 2 assets with Std Deviations S1, S2, and with percentages B1 and B2, remembering the “^” means “squared”, and “SQRT” means “Square Root”,

Annual Portfolio Sigma = SQRT ((B1xS1)^2 + (B2xS2)^2) . For the portfolio of section 2.3,

$$\text{Annual Portfolio Sigma} = \text{SQRT} ((0.7 \times 8.79)^2 + (0.3 \times 4.17)^2) = 6.28\%$$

2.5 Correlation (called Rsquared or Rsq) is a number that denotes the degree to which the prices of two assets move together, both up and down. Assets whose prices move up and down in sync are called “highly correlated”, while assets whose prices move independent of each other are called “uncorrelated”, or “poorly correlated”. Assets with Rsq values of 80% and higher indicate high correlation, while those with Rsq less than 20% have poor correlation. Values for Rsq for any fund can be found in the “Risk” section of <http://finance.yahoo.com> . As explained later in section 3, a portfolio is diversified when it consists of assets that are poorly correlated.

2.6 Portfolio Sharpe Ratio: The History Lesson for May 2006 showed that the best mutual fund is the one with the highest Sharpe Ratio. Similarly, the best portfolio is the one with the highest Portfolio Sharpe ratio.

It is calculated as the Portfolio Annual Return minus the 3 month T-bill rate divided by the Portfolio Std Deviation. Construct several candidate portfolios and the one with the highest Sharpe Ratio has the best return for a given amount of risk.

3.0 DIVERSIFICATION:

Diversification comes about when you combine assets that have low correlation, resulting in a portfolio that provides a desired return, and at the lowest possible risk. It uses the principle that when assets with low correlation are combined, the risk of the portfolio is reduced.

When some asset prices drop, other asset prices will often go up, provided they are poorly correlated. This smoothes out price fluctuations for the entire portfolio, and thereby reduces its risk.

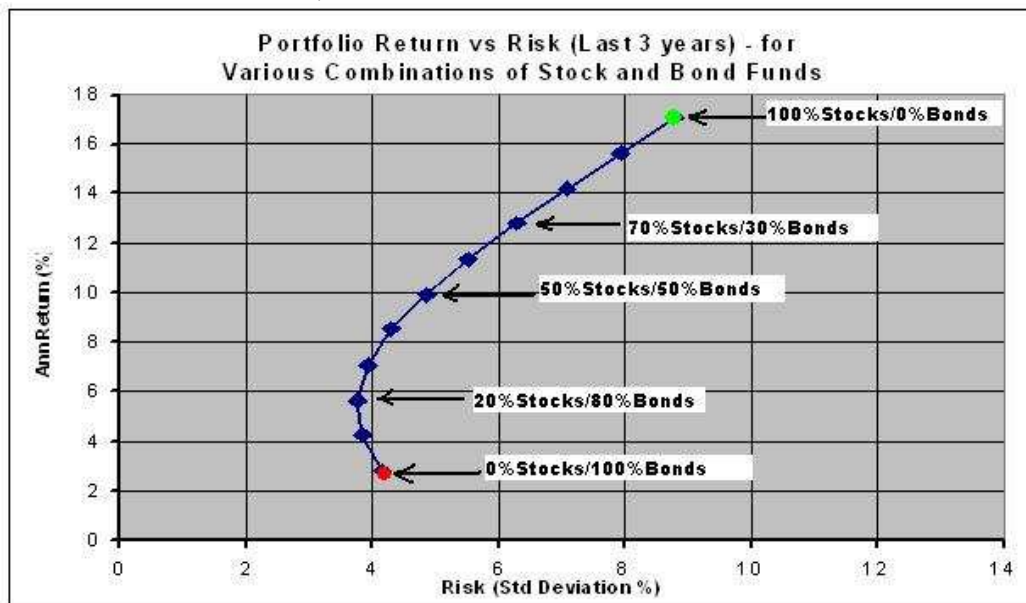
Mathematically, the sigma of the combined portfolio is lower than the weighted average of the individual sigmas of the assets in the portfolio.

For example from section 2.4, the previously calculated portfolio sigma is 6.28%

From the table in section 2.4, the weighted average sigma = $(0.7 \times 8.79 + 0.3 \times 4.17) = 7.4\%$.

Therefore, the actual portfolio sigma is 6.28% against a weighted average sigma of 7.4%, which is 15.1% reduction in risk. *The lowering of the portfolio sigma by combining different assets with low correlations is the fundamental principle behind diversification.*

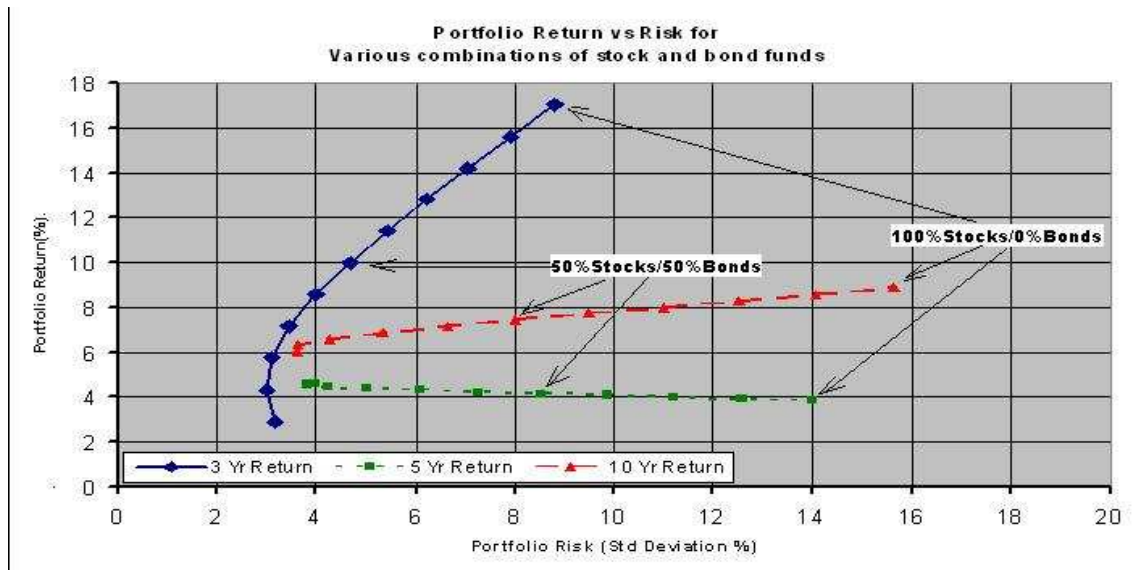
This result, in Figure 1 below, shows the Annual Portfolio Return versus Portfolio Risk (Std Deviation) over the last 3 years for a series of portfolios consisting of different proportions of VFINX and VBMFX. Each point represents a different portfolio with a different percentage of stock to bond funds. The uppermost data point is a portfolio with 100% Stocks and 0% Bonds. The next lower data point is 90% stocks and 10% bonds, and so on in 10% increments, till the lowest at 0% Stocks and 100% Bonds



The lowest data point (in red) represents a very conservative portfolio consisting of all bonds, i.e., 0% Stocks/100% Bonds, with an annual return of 2.8% and a Std deviation of 4.2%. By changing over to 20% Stocks/80% Bonds, the portfolio annual return increases to 5.7% and the portfolio sigma goes down to 3.8%. This means that we have increased

the return by a whopping 200% while simultaneously reducing the risk by 10%. *Adding a small amount of stocks to an all bond portfolio increases the return and also reduces the risk!*

Figure 2 below has similar return-to-risk curves, but for various time periods; the last 3 years, 5 years and 10 years. For each curve, the uppermost point is a portfolio with 100%stocks and 0%Bonds, the next 90%Stocks/10%Bonds, and so on, till the lowest point at 0%Stocks/100%Bonds.



The shapes of the portfolio return-to-risk curves vary significantly over these time periods, rising sharply during the bull market of the last 3 years, falling slowly over the bear and then bull market of the last 5 years, and gently rising over the last 10 years. If we could look into the future, and see the shape of our portfolio return-to-risk curve, which of course we can't, we would have chosen a portfolio heavily weighted in stocks for the last 3 years, one heavily weighted in bonds for the last 5 years, and a stock and bond mix over the last 10 years.

Just as for individual mutual funds, the portfolio return-to-risk fluctuates significantly over the short term. Therefore it is prudent to use only the long term data, say 10 years or longer, for decisions regarding diversification and asset allocation.

The highest data point on the 10 year return-to-risk curve (dashed red lines), represents a very aggressive portfolio consisting of all stocks, i.e., 100%Stocks/0%Bonds, with an annual return of 8.9% and a sigma of 15.6%. By changing over to 70%Stocks/30%Bonds, the portfolio annual return falls to 8.0%, but the risk (Std Dev) falls a larger amount to 11.0%. So we get a 30% reduction in risk by sacrificing 10% of return. *Adding a small*

amount of bonds to an all stock portfolio can significantly increase the return to risk ratio.

Finally consider the case of a 50% stock and 50% bond portfolio for the 10 year return curve. This “balanced portfolio” has a return of 7.5% with a risk of 8%. *It therefore captures 84% of the gains of an all-stock portfolio, with only 51% of the risk. We therefore recommend a balanced portfolio for investors who are retired or nearing retirement.*

4.0 DIVERSIFICATION – EXTENDED CASE:

We are comfortable holding a simple 2 asset portfolio, such as the combination of VFINX and VBMFX examined in section 3.0. This is because these stock and bond funds are poorly correlated, and the combination provides a well diversified portfolio. Many investment advisers recommend adding more assets to get higher performance. They also charge hefty fees to divulge the funds and percentages in their portfolio, and change them around quite often. Since one cannot know the optimum portfolio ahead of time, this is a totally ridiculous exercise. Nevertheless, one may want to set up and hold a portfolio with more than two asset classes, and is this covered next.

International stocks gave superior returns in the 1970’s, and emerging market stocks have performed very well over the last 3 years. However, US large cap stocks had much higher returns in the 1990’s, than International or Emerging Market stocks. The best performing asset rotates among the various types available, and changes with the time period under consideration.

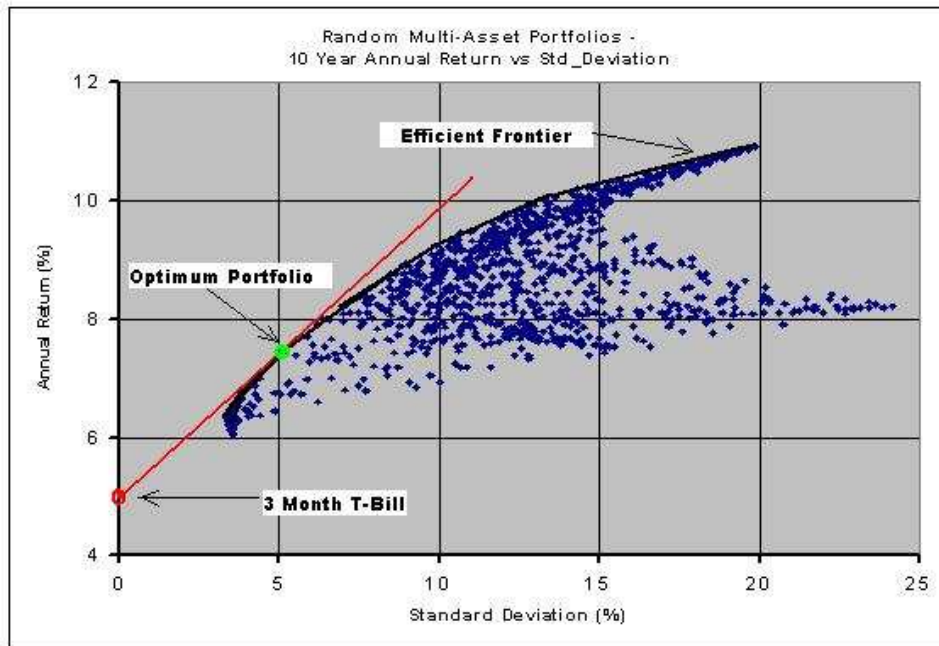
The question of how many assets to have in a portfolio depends on how they will perform in the future, which of course we have no way of knowing. We first discuss the return-to-risk ratio for a multi-asset portfolio, and then return to this question.

A list of Vanguard funds and their 10 year return and risk is listed in the table below. All the five funds have low correlation between each other.

Symbol	Name of Fund	Ann. Return	Std. Deviation
VFINX	US S&P500 Large Cap Index	8.88	15.63
NAESX	US Small Cap Index	10.93	20.08
VWIGX	International Growth	7.51	15.65
VEIEX	Emerging Market Index	8.2	24.39
VBMFX	Total Bond Market Index	6.02	3.62

We now construct 1,000 hypothetical portfolios using *random amounts* of these five asset categories, and plot the Portfolio Annual return and risk in the figure below. The upper

boundary of the cloud of data delineates a curve of the highest return to risk ratio, and is called “the efficient frontier”.



Any portfolio lying on the efficient frontier, provides the highest return for a given amount of risk. The process of setting up portfolios, and understanding their return-to-risk characteristics is a fairly recent field of study, called “Modern Portfolio Theory (MPT)”.

The “riskless” rate of return is provided by the 3 month T-bill, currently with an Annual Return of 4.82%, and a Std deviation of 0%, shown as a red dot in the figure. MPT states that the optimum portfolio lies on a line tangent to the efficient frontier and passing through the 3 month T-bill data point, shown as the solid red line. The optimum portfolio is shown as the green dot, at the point of tangency of the efficient frontier and the red line. Over the last 10 years, the optimum portfolio has an annual return of 7.5% and a Std deviation of 5.0%.

The Portfolio Sharpe ratio is the slope of the red line, which is the Annual return less the T-bill rate, divided by the Std deviation. The optimum portfolio (green dot) has the highest possible slope of a line that meets the two conditions of passing through the riskless rate of return and still touching the efficient frontier. *Therefore, the optimum portfolio is the one with the highest Sharpe ratio.*

7.0 CAUTION – ANNUAL PORTFOLIO SIGMA: The formula for Portfolio Sigma in section 2.4, assumed that the assets in the portfolio are uncorrelated. For correlated assets, the Sigma will be larger than for uncorrelated assets; the higher the correlation, the higher the portfolio sigma (risk). But in real life it is difficult to find uncorrelated assets, and so we apply the previous formula as an *approximation for assets that have low correlation*.

[For those interested in the gory mathematical details, we note that for correlated assets the formula for portfolio sigma must be modified to add an extra term. This extra term is the “Covariance” between the two assets, which is a measure of the degree of correlation between them. The higher the correlation, the larger the covariance, and the larger will be the portfolio sigma. “Covariance” can be found in any statistics textbook, such as in reference 8, “An introduction to Probability Theory and Applications”, Feller, 1977. An excellent treatment of this subject can also be found in reference 9, “The Intelligent Asset Allocator”, by William Bernstein, McGraw Hill, September 2000.]

8.0 CONCLUSIONS:

- *Adding a small amount of stocks to an all bond portfolio increases the return while also reducing the risk.*
- *Adding a small amount of bonds to an all stock portfolio can significantly increase the return to risk ratio.*
- *A balanced portfolio captures 84% of the gains of an all-stock portfolio, with only 51% of the risk*
- *We recommend a balanced portfolio (50% equities, 50% fixed income) for investors who are retired or nearing retirement.*
- *It is prudent to only use long term data, say 10 years or longer, for decisions regarding asset allocation and diversification.*
- *Evaluate several portfolios and pick the one with the highest Sharpe ratio. This will give the optimum portfolio.*

7.0 CLOSING THOUGHTS: We cannot predict which portfolio composition will give the highest return to risk ratio in the future. Our best bet is to choose a portfolio that is likely to perform well in all types of markets, both up and down. This portfolio will not necessarily be the one with the highest performance, but is likely to serve us well in an uncertain future.

Hopefully the Predictable Investing model will take us out of the market during multi-year bear markets, while enabling us to benefit during bull markets. Therefore, we recommend that during the period that we are invested in the market, the portfolio should consist of 50% stocks and 50% bonds for the conservative retired (or near retirement) investor, and up to 70% stocks and 30% bonds for the more aggressive investor.

The stock portion of the portfolio should consist of widely diversified low-expense ratio mutual funds, mostly in a US large cap index fund. Smaller amounts can be in mutual funds of US small cap, international and emerging markets. The bond portion should be in US intermediate bond funds of around 4 to 5 year duration, which may be in Treasuries, Municipals, or Corporate bond funds.

During periods when the PI model takes us out of the market, the stock fund portion of the portfolio is placed in Money Market funds, while the bond portion remains intact. Please also remember to re-balance the portfolio once every year, i.e., bring the stock to bond ratio back to your desired asset allocation. This is necessary as it forces selling of highly appreciated assets and buying poorer performing assets, thus forcing you to sell high and buy low. The annual rebalancing is best done early in the year, so any taxes are deferred to the subsequent year.