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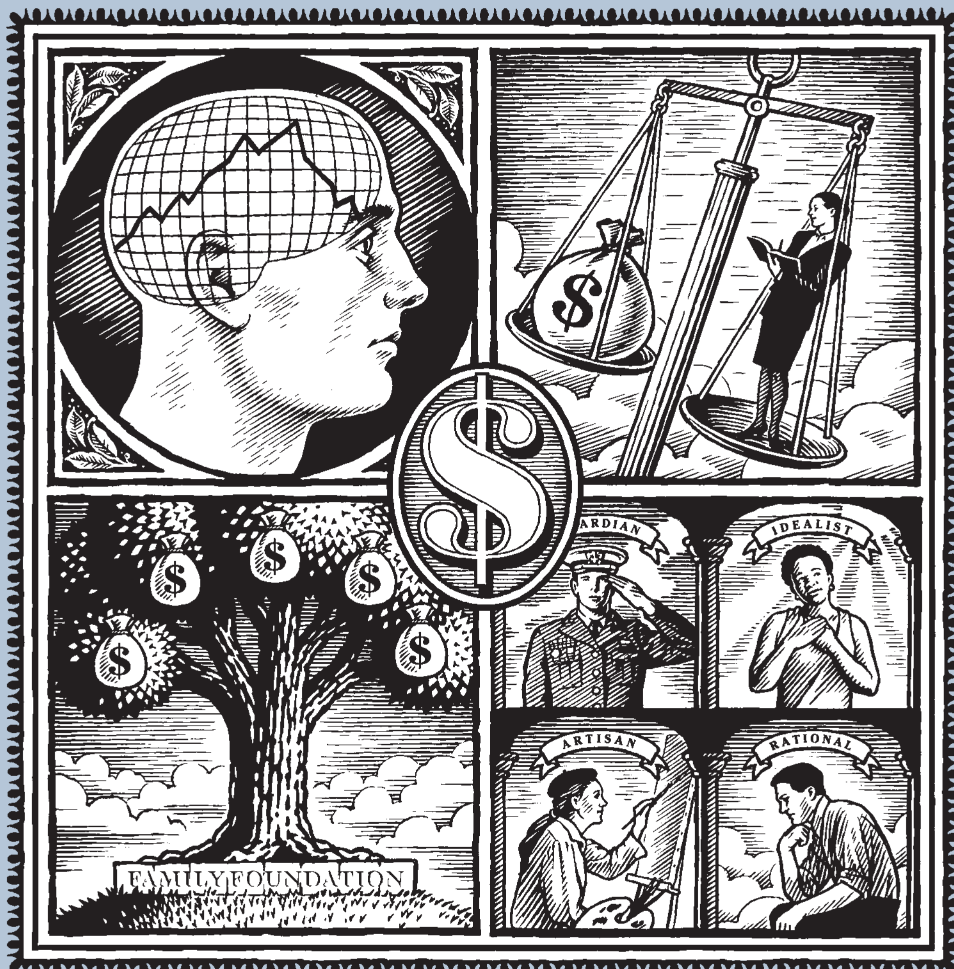


Ken Jacobsen

# Risk-Adjusted Performance of Portfolios—A Measure of the Consultant's Value Added

*By Richard C. Marston, Ph.D.*

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# RISK-ADJUSTED PERFORMANCE OF PORTFOLIOS—A MEASURE OF THE CONSULTANT'S VALUE ADDED

*Richard C. Marston, Ph.D.*

Investment consultants regularly evaluate the performances of fund managers who oversee the components of a portfolio. They evaluate each manager in terms of total return adjusted for the marginal risk that the manager's component adds to the portfolio. The most common performance measure first adjusts the market return for the risk of the fund by using beta from the capital asset pricing model (CAPM), then measures excess return or alpha as the manager's return relative to the risk-adjusted market return.

Evaluating an investment portfolio as a whole is different from evaluating an individual manager within a portfolio. Evaluating the portfolio by returns alone (that is, by asking, "Did the portfolio beat the market?") usually is misleading, because few portfolios have as much risk as the stock market. So it is important to adjust the returns to take into account the risk of the portfolio. Measures of marginal risk such as the CAPM's beta are inappropriate because the whole portfolio is being evaluated. Beta must be replaced with a measure of total risk: the standard deviation of the portfolio.

But how should the risk-adjusted return be measured? Since the pioneering work of Sharpe,[1] the accepted measure of risk-adjusted returns has been the Sharpe ratio. But the Sharpe ratio is difficult to interpret. Investors are interested in comparing returns, not a dimensionless number such as the Sharpe ratio. For this reason, Modigliani and Modigliani[2] introduced risk-adjusted performance, now commonly referred to as $M^2$. The portfolio is first adjusted so it has the same risk as the benchmark, then its performance is judged relative to the benchmark.

This paper proposes an alternative performance measure called $\alpha^*$ that may prove more useful to consultants because it measures the investor's excess return at the risk level of the investor's portfolio, not the benchmark.

## Proposed Measure of Portfolio Performance

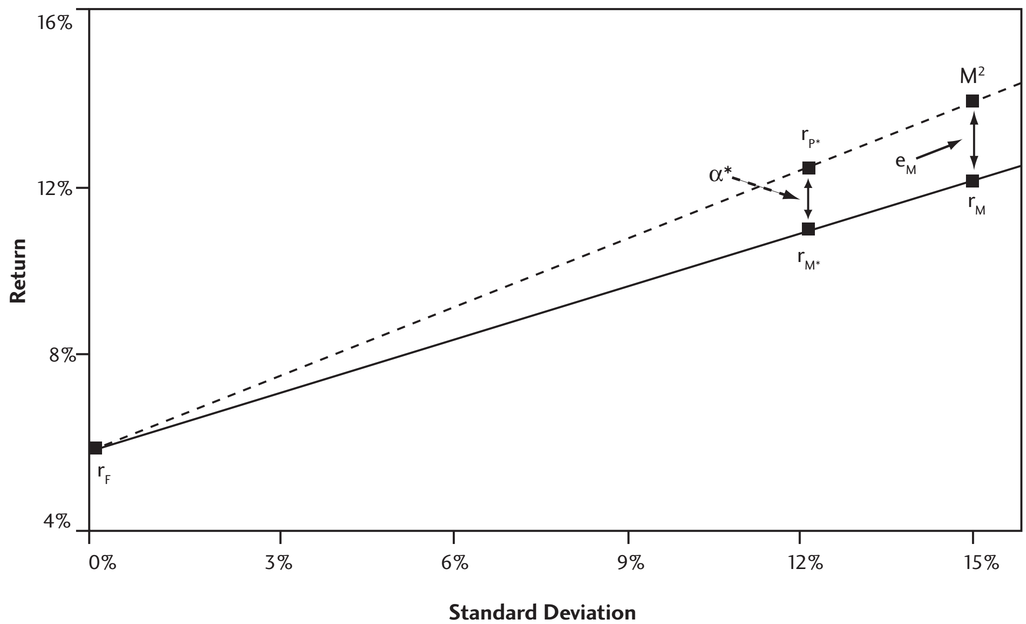
Let $r_{P*}$ be the return on the portfolio, $r_M$ be the return on the market benchmark, and $r_F$ be the return on the risk-free rate. To obtain $M^2$, first adjust the standard deviation of $r_{P*}$ to match that of the benchmark $r_M$. If the benchmark is an index such as the S&P 500, then the portfolio likely will have less risk than the benchmark, so adjusting the portfolio's return for risk involves increasing its risk by leveraging the portfolio. That risk-adjusted return is labeled $M^2$ in figure 1. Note that $M^2$ has the same standard deviation, 15 percent, as the benchmark return $r_M$. The gap in returns at that risk level is a measure of the portfolio's excess return and is labeled $e_M$ in figure 1.

This study proposes a modification of $M^2$ called $\alpha^*$ that may be more useful to investment consultants. Instead of adjusting the portfolio risk to match the benchmark risk, the proposed measure adjusts the benchmark risk to match the portfolio risk. This is preferable because it gives the investor a measure of the excess return at the risk level relevant to the investor. $M^2$, in contrast, gives the excess return for a hypothetical investor who chooses the asset allocation of the portfolio in question, but then increases its leverage by borrowing at the risk-free rate to obtain the same risk as that of the benchmark.[3]

Figure 1 illustrates $\alpha^*$. The standard deviation of the investor's portfolio is less than that of the benchmark, so

FIGURE 1

**RISK-ADJUSTED RETURNS**




the proposed method measures excess return at a lower level of risk than $M^2$. The excess return is labeled $\alpha^*$. To measure $\alpha^*$ precisely, first consider the return of a hypothetical portfolio obtained by combining the benchmark return and the risk-free return. This portfolio, with its risk-adjusted market return $r_{M^*}$, is designed to have the same risk as that of the investor's portfolio. It is also designed to have the same Sharpe ratio as the benchmark:

$$r_{M^*} = r_F + (\sigma_{P^*} / \sigma_M)(r_M - r_F) \tag{1}$$

where $\sigma_{P^*}$ and $\sigma_M$ are the standard deviations of the portfolio and the benchmark, respectively.[4] In figure 1, the portfolio has a 12-percent standard deviation compared with the benchmark's 15-percent standard deviation, so the standard deviation of the benchmark return $r_M$ is adjusted down to that of the portfolio to give the risk-adjusted return $r_{M^*}$. The excess return $\alpha^*$ is then given by:

$$\alpha^* = r_{P^*} - r_{M^*} \tag{2}$$

This excess return is measured at the level of risk chosen by the investor.

Note the parallels between the risk-adjusted excess return on a portfolio and the excess return or alpha for an individual manager within a portfolio. Of course, the measure of risk is different. In the case of an individual manager, the beta of the investment (measured relative to the manager's benchmark) replaces the ratio of the standard deviations in equation 1. But in each case, excess return is measured at the level of risk of the investment, not at the level of risk of the benchmark.

Let $r_j$ be the return of fund j within a portfolio. Then the risk-adjusted return (the expected return of the CAPM) is obtained by adjusting the risk of the market by the beta of the fund:

$$r_{EXP} = r_F + \beta_j (r_M - r_F) \tag{3}$$

The excess return, or alpha, is then given by:

$$\alpha = r_j - r_{EXP} \tag{4}$$

Equations 1 and 3 each adjust the risk of the benchmark return to that of the investment being evaluated, so equations 2 and 4 each reflect the risk levels of the actual investments. But the measures of risk are quite different. In the evaluation of a manager, beta is the measure of risk, and alpha is measured relative to the security market line (SML). In the evaluation of an overall portfolio, the standard deviation is the measure of risk, and $\alpha^*$ is measured relative to the capital market line (CML).[5]

The proposed measure thus parallels the measure commonly used to evaluate individual managers.[6]

**TABLE 1**

Model Portfolio Descriptions

| | MODEL A | MODEL B | AVERAGE RETURN (1979–2002) |
|---|---|---|---|
| U.S. Bonds | 45% | 25% | 9.5% |
| Foreign Government Bonds | 5% | 5% | 9.8% |
| Russell 1000 Value | 18% | 23% | 14.2% |
| Russell 1000 Growth | 17% | 22% | 13.0% |
| Russell 2000 | 5% | 10% | 13.5% |
| Foreign Stocks | 10% | 10% | 10.9% |
| Emerging Market Stocks | | 5% | 10.8% |

How is $\alpha^*$ related to the Sharpe ratio? In figure 1, the portfolio's Sharpe ratio is the slope of the dotted line through the portfolio return $r_{P*}$. That dotted line also passes through $M^2$, the portfolio's risk-adjusted return. So both measures are related to the Sharpe ratio. What consultants need, however, is a way to compare the Sharpe ratio of the portfolio with that of the benchmark. The proposed $\alpha^*$ measure does just that.

Let $S_{P*}$ and $S_M$ be the Sharpe ratios of the portfolio and benchmark, respectively.

$$S_{P*} = (r_{P*} - r_F) / \sigma_{P*} \qquad (5a)$$
$$S_M = (r_M - r_F) / \sigma_M \qquad (5b)$$

Then the excess return $\alpha^*$ is given by

$$\alpha^* = (S_{P*} - S_M)\, \sigma_{P*} \qquad (6)$$

Alpha* measures the difference between the two Sharpe ratios, but the difference is expressed in terms of the excess return earned at the portfolio's level of risk $\sigma_{P*}$. In this way, the Sharpe ratios can be translated into an excess return that measures the relative performance of the investor's portfolio.[7]

## An Example: Assessing the Asset Allocation Decision

To illustrate how $\alpha^*$ might be used, consider two asset allocations chosen by a major brokerage firm for investors with two different risk profiles. Most brokerage firms develop model portfolios based on mean-variance analysis. These portfolios are called strategic asset allocations because they guide investors' long-run portfolio decisions. Model A has a 50/50 weighting of stocks and bonds, and model B has a more aggressive 70/30 stock/bond weighting.

Normally, a consultant's performance will involve more than just strategic asset allocation. For example, the consultant may decide to tactically reallocate the portfolio as market conditions change. And, in most cases, the consultant will choose active managers in place of passive indexes. But for purposes of this illustration, the consultant is assumed to provide only strategic asset allocation, so we can use historical data for stock and bond indexes to represent each of these investments.

The two model portfolios are described in table 1. Both portfolios include six assets: U.S. bonds (represented by the Lehman Aggregate Index), foreign government bonds (represented by the Lehman Global Ex-U.S. Treasury Index), large-capitalization growth and value stocks (Russell 1000 Growth and Value indexes), small-capitalization stocks (Russell 2000 index), and foreign stocks (Morgan Stanley EAFE Index). Model B also includes emerging market stocks (S&P EMDB Global Composite Index).

The last column of table 1 shows the average historical return for each asset class. The average returns are measured as arithmetic averages from 1979 to 2002.[8] Two of the series begin after 1979: the series for emerging market stocks, which begins in 1985; and the series for foreign bonds, which begins in 1987. Rather than truncate all of the series to measure average returns for the shortest data set available, we used a premium method to extend these two series back to 1979. For emerging market stocks, we measured the premium of this series relative to the S&P 500 index from 1985 to 2002, then used it to extend the series from 1979 to 1984. Similarly for foreign bonds, we measured the premium of this series relative to the Ibbotson medium-term government bond series from 1987 to 2002, then used it to extend the series from 1979 to 1986. For measurement of the standard deviations and correlations, we chose the period 1987–2002, which corresponds to the shortest data series.[9]

What benchmark might be used to assess these diversified portfolios? Two common choices are the S&P 500 and the Russell 3000. The two have similar returns over this period, but it seemed preferable to use the broader Russell 3000 index to calculate relative performance.[10]

**TABLE 2**

Evaluation of Diversified Portfolios, 1979–2002

| | MODEL A | MODEL B |
|---|---|---|
| standard deviation | 8.4% | 11.1% |
| return $r_{P^*j}$ | 11.3% | 12.0% |
| Sharpe ratio | 0.58 | 0.50 |
| risk-adjusted return $r_{M^*j}$ | 10.2% | 11.4% |
| $\alpha^*$ | 1.1% | 0.6% |

Table 2 reports the results of this evaluation. In model A, the 50/50 allocation leads to a standard deviation of 8.4 percent and an average return of 11.3 percent.[11] To match this level of risk, the Russell 3000 index return of 13.6 percent was adjusted downward along the market line to a standard deviation of 8.4 percent, resulting in a return of 10.2 percent.[12] So the $\alpha^*$ of this portfolio is 1.1 percent; this is how much the asset allocation in model A has raised the risk-adjusted return. In model B, the standard deviation is 11.1 percent, and the return is 12.0 percent. When the Russell 3000 index return is adjusted to this risk level, its return is only 11.4 percent, so the $\alpha^*$ of model B is 0.6 percent. Diversification leads to an improvement in returns of from 60 to 110 basis points depending on which portfolio is chosen.

Why is $\alpha^*$ preferable to $M^2$ for measuring excess return? Because an investor is interested in the excess return at a chosen level of risk, not the hypothetical level of risk associated with a market index. If an investor needed to compare models A and B, it would be necessary to standardize the measures of risk at the market level or some other common level. But normally an investor does not want to compare portfolios with widely different risk levels. Instead, an investor wants to determine how much excess return has been earned with a particular portfolio strategy at a particular chosen level of risk.

## Active Management and Tactical Asset Allocation

The preceding example assumed that the investor invested in the indexes of each asset class and maintained the same asset allocation throughout the period studied. In actual practice, a consultant typically will choose managers who use indexes merely as benchmarks to measure their own returns. In addition, a consultant may choose asset allocations that vary over time. As a result, a consultant's portfolio decisions usually involve the following three conceptually distinct elements:

1. The consultant determines the normal (that is, strategic) asset allocation of the portfolio. This decision involves selecting a level of estimated risk appropriate for the investor. It also requires decisions about which assets to include in the portfolio to achieve that level of risk.
2. The consultant may modify the normal asset allocation to take advantage of tactical opportunities. For example, as the economy emerges from recession, small-cap stocks are believed to outperform large-cap stocks, so the consultant may recommend an overweighting to small-cap stocks. Some consultants refrain from any tactical repositioning on the grounds that it is difficult to increase returns through such short-term shifts. For such consultants, their only short-term actions involve the rebalancing of assets to ensure that the normal allocation is continuously maintained.
3. The consultant selects managers using standard CAPM (beta–alpha) methodology, trying to find managers who will outperform the benchmark indexes for each component of the portfolio. When we ask whether manager selection has contributed to portfolio performance, we are talking about the portfolio's entire set of managers.

To see how all three elements contribute to the total return earned by the consultant, consider the following decomposition of the actual return.

Let $r_{Pt}$ = actual return on the portfolio in period t
$r_{N*t}$ = return on the normal or strategic portfolio
$r_{Bjt}$ = return on the benchmark index for asset j
$r_{Pjt}$ = actual return of manager j (for asset j)
$w_{jt}$, $w_{jt}'$ = weights of asset j in the normal and tactical portfolios, respectively[13]
$\sigma_{N*}$ = standard deviation of the normal or strategic portfolio
$\sigma_P$ = standard deviation of the actual portfolio

Then the actual return on the portfolio for period t can be written as the sum of the normal return plus the contribution of tactical allocation and manager performance:

$$r_{Pt} = r_{N*t} + \Sigma_j (w_{jt}' - w_{jt})\, r_{Bjt} + \Sigma_j\, w_{jt}'\, (r_{Pjt} - r_{Bjt}) \quad (7)$$

The second term on the right side of equation 7 shows the effects of changing the weights of the portfolio while still relying on index returns, whereas the third term shows the effects of replacing index returns with the returns of the managers.[14]

If tactical asset allocation and manager selection lead to a higher or lower standard deviation than that of the normal portfolio, it is important to adjust the actual returns for the greater or lower risk involved. Without this adjustment, the portfolio's excess return will reflect not only better risk-adjusted performance, but also the higher or lower risk actually achieved. For example, a portfolio may achieve a higher return only because the consultant has chosen more aggressive managers or adopted aggressive tactical positions. We need to ask, "How much of the enhanced return is due to higher risk and how much is due to the combined effects of active management and tactical asset allocation?"

To answer that question, it is important to assess returns at the risk level chosen for the investor. That is, the risk level used as a benchmark for performance should be that of the normal or strategic portfolio, because it represents the investor's long-run position, chosen as a matter of investment policy.

Consider the example illustrated in figure 2, in which the actual portfolio with return $r_P$ has a greater return than the normal or strategic portfolio with return $r_{N*}$. The actual portfolio has a greater return in part because it has a higher risk level than originally intended for this investor. To properly assess the consultant's

FIGURE 2

**EFFECTS OF MANAGER SELECTION AND TACTICAL ASSET ALLOCATION**

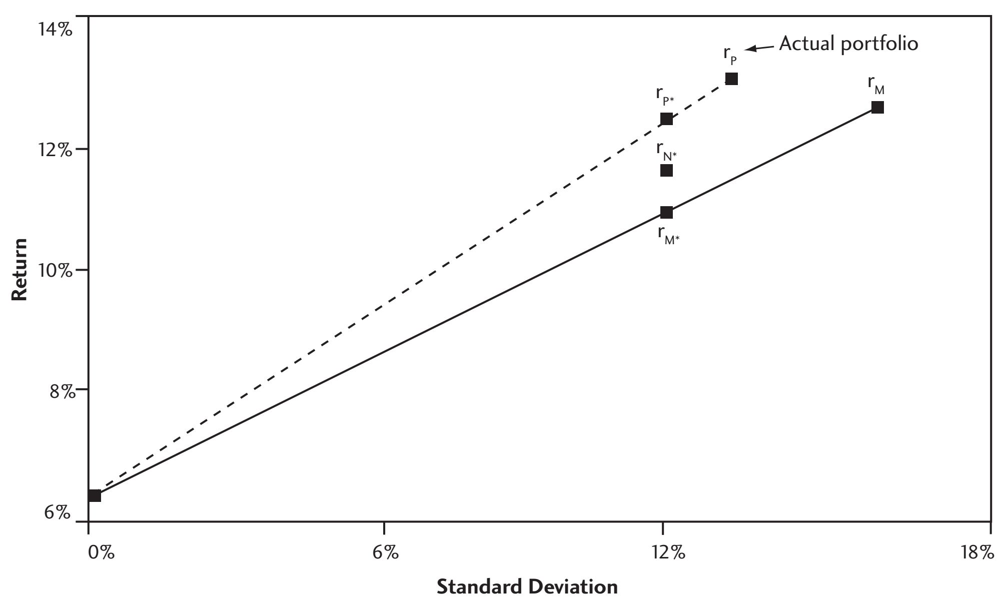


TABLE 3

Performance of Mutual Funds Relative to Their Benchmarks, October 1988 to June 2003

| MUTUAL FUND | BENCHMARK | VS. BENCHMARK | | VS. RUSSELL 3000 | |
|---|---|---|---|---|---|
| | | BETA | ALPHA | BETA | ALPHA |
| Bond Fund A | Lehman Aggregate | 1.05 | 0.7% | | |
| Growth Fund B | Russell 1000 Growth | 1.06 | 3.2% | 1.21 | 2.0% |
| Value Fund C | Russell 1000 Value | 0.97 | 0.1% | 0.80 | 1.6% |
| Small-Cap Fund D | Russell 2000 | 0.68 | 4.8% | 0.75 | 3.6% |
| Foreign Stock Fund E | EAFE | 0.64 | 4.7% | | |

performance, adjust the actual portfolio so that it has the same risk as the strategic portfolio. To do this, $r_P$ should be adjusted downward as follows:

$$r_{P*} = r_F + (\sigma_{N*} / \sigma_P)(r_P - r_F) \quad (8)$$

The risk-adjusted return $r_{P*}$ now reflects the risk level chosen for the investor in the normal portfolio (that is, $\sigma_{P*} = \sigma_{N*}$), so it now can be compared with the benchmark return. The excess return $\alpha^*$ then can be measured using equation 2 at the risk level of the strategic portfolio and is seen as the vertical distance between $r_{P*}$ and $r_{M*}$ in figure 2.

## An Example: Active Management with Mutual Funds

To illustrate how an actual portfolio might be evaluated, consider the following example, which evaluates the performance of a portfolio of mutual funds using one of the strategic models outlined above. The example illustrates the effects of manager selection without tactical asset allocation.

The portfolio is the 50/50 stock/bond portfolio, model A in table 1. For each asset class, we chose a mutual fund with a track record of at least ten years in the Morningstar database.[15] Because most mutual funds for foreign bonds were begun only in the mid-1990s or later, we assumed that the 50 percent allocated to bonds was invested only in U.S. bonds. We chose the mutual funds arbitrarily because the objective is to illustrate performance measurement methodology rather than mutual fund selection. To ensure a difference between the strategic performance of portfolios using indexes and the actual performance using managers, we chose mutual funds with a positive alpha for the period. Because we chose these managers for illustration only, there is no claim that the search was random or that these managers would have been chosen ex ante as opposed to ex post.

Table 3 gives performance statistics for the mutual funds chosen using the traditional beta–alpha analysis appropriate for evaluating a single fund at a time. The performance of these funds is measured from October 1988 to June 2003 because data for the Small-Cap Fund D are not available any earlier. Two sets of performance statistics are provided in the table. Each fund is first compared with its own benchmark (that is, the index in the strategic portfolio used in tables 1 and 2). Then the U.S. stock funds are compared with the benchmark for the U.S. stock market (that is, the Russell 3000 index).[16] As shown in table 3, all the funds chosen outperformed their benchmarks on a risk-adjusted basis. But to what extent did manager selection contribute to portfolio performance?

To further assess this portfolio's performance, we compare it with a portfolio of the benchmark indexes listed in table 3. This way the actual portfolio will be compared with a benchmark portfolio that reflects the strategic asset allocation of model A in table 1, which uses the underlying indexes for each asset class.[17] These two portfolios are compared in table 4 from October 1988 to June 2003. The first column of data in table 4 gives the performance of model A using the benchmark indexes for each asset in the model, while the second column gives the performance of model A using the actual mutual funds in place of the indexes. For comparison, the table also includes the benchmark returns of the Russell 3000.

Table 4 also reports the Sharpe ratios for the benchmark portfolio, the mutual fund portfolio, and the Russell 3000 index.[18] Because the mutual fund portfolio has a much higher Sharpe ratio than either the bench-

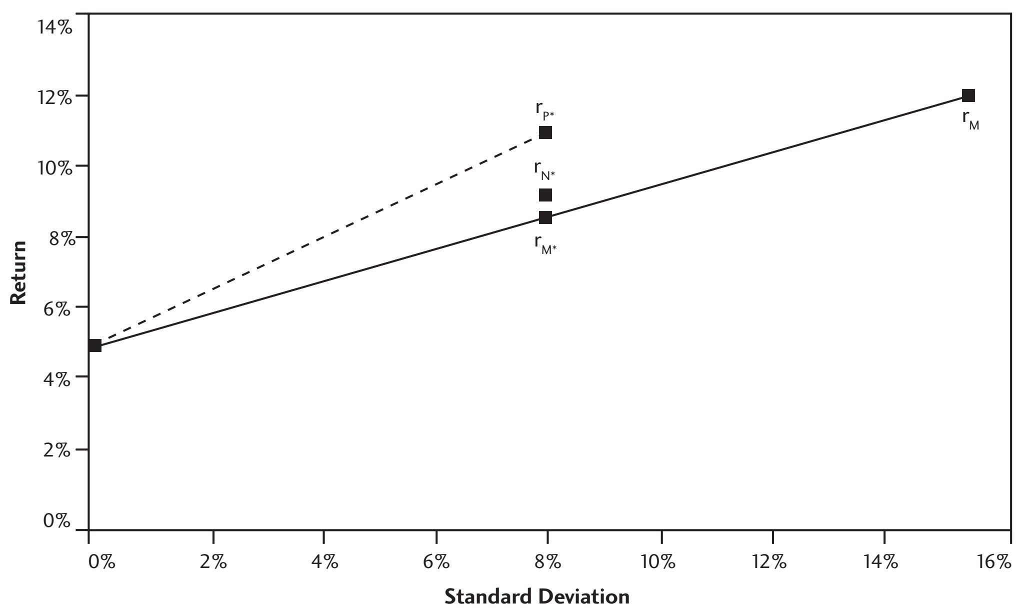
TABLE 4

Performance of Normal and Mutual Fund Portfolios, October 1988 to June 2003

| | NORMAL PORTFOLIO ($r_{N*}$) | MUTUAL FUND PORTFOLIO ($r_P$) | RUSSELL 3000 ($r_M$) |
|---|---|---|---|
| return | 9.4% | 11.0% | 11.9% |
| standard deviation | 7.7% | 7.7% | 15.0% |
| Sharpe ratio | 0.584 | 0.792 | 0.467 |
| adjusted return | | $r_{P*}$ = 11.0% | $r_{M*}$ = 8.5% |

FIGURE 3

EFFECTS OF MANAGER SELECTION ON PORTFOLIO PERFORMANCE




mark portfolio or the Russell 3000, the consultant evidently has achieved superior performance through the choice of these mutual funds. But how much of this performance is due to the higher (or lower) risk of the mutual funds chosen? To address this question, we compare the mutual fund portfolio and the Russell 3000 at the same level of risk.

The mutual fund portfolio has an average return of 11.0 percent with a standard deviation of 7.7 percent. Because the standard deviation of the benchmark portfolio (using index returns in place of mutual fund returns) is also 7.7 percent, $r_P = r_{P*}$, and there is no need for a risk adjustment of the mutual fund portfolio using equation 8. The Russell 3000 index has a higher risk than either the mutual fund portfolio or the benchmark portfolio, so the Russell 3000 index must be adjusted for risk. After adjusting for risk using equation 1, the Russell 3000 return is reduced from 11.9 percent to 8.5 percent. The excess return achieved by the portfolio of mutual funds is therefore 2.5 percent:

$$\alpha^* = r_{P*} - r_{M*} = 11.0\% - 8.5\% = 2.5\%.$$

This excess return reflects both the diversification benefits of the benchmark portfolio and the superior performance of the mutual funds chosen by the consultant.

Figure 3 illustrates the different portfolio returns calculated in this example. The return on the Russell 3000 index $r_M$ is adjusted down to $r_{M*}$ so that it has the same risk level as that of the benchmark portfolio chosen by the consultant. The return on the portfolio of mutual funds $r_{P*}$ is then compared with $r_{M*}$ to obtain $\alpha^*$. The source of the excess return $\alpha^*$ can be broken into two components:

$$r_{N*} - r_{M*} = \text{excess return due to strategic asset allocation} = 9.4\% - 8.5\% = 0.9\% \quad (9a)$$

$$r_{P*} - r_{N*} = \text{excess return due to manager selection} = 11.0\% - 9.4\% = 1.6\% \quad (9b)$$

The second excess return, $r_{P*} - r_{N*}$, is the purest measure of the value added by the consultant beyond strategic asset allocation. In this example, that value added consists of manager selection only. In actual practice, the consultant may offer additional value added through tactical asset allocation or other means.

The components of $\alpha^*$ can be calculated using Sharpe ratios rather than risk-adjusted returns.

$$r_N^* - r_M^* = (S_{N*} - S_M)\sigma_{N*} = (0.584 - 0.467) * 0.077 = 0.9\% \quad (10a)$$

$$r_{P*} - r_{N*} = (S_{P*} - S_{N*})\sigma_{N*} = (0.792 - 0.584) * 0.077 = 1.6\% \quad (10b)$$

In each equation, the difference in the Sharpe ratio is multiplied by the standard deviation of the normal portfolio chosen for the investor. This is a simple calculation that neatly summarizes the sources of the consultant's value added.

The $\alpha^*$ measure of performance provides the consultant with a concise summary of the risk-adjusted excess return. By design, this excess return is measured at the level of risk chosen as a matter of investment policy, and it can be broken down easily into components due to strategic allocation and manager performance. A similar methodology can further decompose $\alpha^*$ into tactical vs. strategic asset allocation.

## Conclusion

This paper has outlined a method for evaluating a consultant's portfolio performance that translates the Sharpe ratio into an excess return similar to the alpha used in manager evaluation. Manager evaluation relies on a concept of marginal risk measured by the beta of the manager relative to a market benchmark. The proposed measure of a portfolio's overall performance relies on a total risk measure, that is, the standard deviation of the portfolio, which is the same measure used to calculate the Sharpe ratio. But, like the alpha measure of a manager's excess return, it adjusts the standard deviation of the benchmark before measuring the excess return of the portfolio. This excess return, which we have called $\alpha^*$, reflects the combined effects of strategic and tactical asset allocation as well as manager selection.

This method can be modified to measure separately the effects of each element of the consultant's recommendations: strategic asset allocation, tactical overlay, and manager selection. Strategic asset allocation sets the risk level used to assess each of the other elements, so actual portfolio return is assessed at the level of risk chosen for that investor.

This approach has three advantages. First, like $M^2$, it gives the Sharpe ratio an excess-return dimension. Second, it measures this excess return at the level of risk appropriate to the investor, not the stock market benchmark. Third, it allows the consultant to distinguish the value added from strategic and tactical asset allocation and manager selection.

## Acknowledgment

The author would like to thank Craig MacKinlay and Meir Statman for their helpful comments.

### ENDNOTES

1. William F. Sharpe, "Mutual Fund Performance," *Journal of Business Supplement on Security Prices* (January 1966).

2. Franco Modigliani and Leah Modigliani, "Risk-Adjusted Performance: How to Measure It and Why," *Journal of Portfolio Management* (winter 1997): 45–54.

3. $M^2$ is preferable if the objective is to compare many portfolios at the same time. In the $M^2$ study, for example, the

measure is used to evaluate a set of mutual funds relative to the market benchmark.

4. Note that Statman uses a similar measure to address the issue of how many stocks are necessary for a diversified portfolio. See Meir Statman, "How Many Stocks Make a Diversified Portfolio?" *Journal of Financial and Quantitative Analysis* (September 1987): 353–363.

5. We recognized that standard deviation may not represent the risk of some asset classes well enough, but a discussion of alternative risk measures is beyond the scope of this paper.

6. If the $\alpha^*$ performance measure is used to judge a particular asset class rather than the portfolio as a whole, the benchmark must be tailored to that asset class. In most circumstances, however, a consultant evaluating a particular asset class is doing so within the context of a larger portfolio, so it would be more appropriate to evaluate that asset class using beta and alpha rather than $\alpha^*$.

7. Equation 6 shows that the proposed $\alpha^*$ will not lead to a ranking of the investor's portfolio relative to the benchmark different than that provided by the Sharpe ratio or $M^2$. But this performance measure does translate the difference in Sharpe ratios into an excess return, $\alpha^*$, that investors can interpret more easily.

8. Returns during this period on both stocks and bonds were unusually high by historical standards. For a discussion of long-run stock returns, see Richard C. Marston, "Reevaluating Long-Run Equity Returns," Wharton School Weiss Center Working Paper (2003).

9. Risk measures are generally more stable over time than average returns, so we chose the shorter data period for convenience.

10. The consultant could instead choose a more diversified benchmark that includes, for example, the stocks of other countries (using the Morgan Stanley World Index in place of the Russell 3000). The same methodology would be involved, but in this case, the investor is assumed to pursue a more diversified portfolio strategy even in the absence of the consultant's advice about strategic asset allocation.

11. We calculated an arithmetic rather than geometric average. For a discussion of why the arithmetic average is preferred for such comparisons, see Modigliani and Modigliani, p. 52.

12. The Russell 3000 has an average return of 13.6 percent and standard deviation of 15.9 percent during the period 1979–2002. The Treasury bill return (representing the risk-free return) is 6.4 percent.

13. Assume that the tactical weight $w_{jt}'$ is chosen at the beginning of period t.

14. Alternatively, decompose the actual return by using the normal weights to assess the effects of manager selection. Then an additional cross-product term reflects the combined effect of manager selection and tactical asset allocation.

15. Mutual fund performance statistics were obtained using the Zephyr Style Advisor's Morningstar database.

16. Replacing the Russell 3000 with the S&P 500 as the market benchmark results in similar betas and alphas.

17. As noted above, model A is modified to exclude foreign bonds.

18. The risk-free return used in these calculations is 4.9 percent.

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