Monitoring Passively Managed Mutual Funds

PATRICK J. COLLINS

PATRICK J. COLLINS is a vice president at Schultz, Collins, Lawson, Chambers, Inc. in San Francisco.

The growth of index fund investments evidences an increasing level of comfort with passive investment management techniques. We must distinguish, however, between the risk-return expectations of index fund management and the risk-return expectations of structured asset class management. Structured asset class mutual funds, despite passive management techniques, are not index funds; they call for evaluative judgments similar to those required for selection and retention of actively managed funds.

That a fund is passively managed does not mean one can abdicate ongoing monitoring and review. Such a decision would be based on the erroneous supposition that all passively managed funds, by definition, yield a market return, and therefore do not require the level of evaluation commonly given to actively managed investments.

To illustrate the importance of developing and implementing a review and monitoring program, this essay considers the returns of two mutual funds: Vanguard's S&P 500 Index Trust — a replication equity index mutual fund; and Dimensional Fund Advisor's US 9-10 Fund — a structured asset class equity mutual fund. These funds have proven so popular with the investment advisor community that they are often found in the portfolios of retirement plans and non-qualified family trusts.

The funds have substantially different risk-return trade-offs by virtue of the fact that they invest in different segments of the U.S. stock market. Beyond this, however, although both funds are "passive," their investment management policies and objectives also contribute important, non-market-related risk-return characteristics.

FIDUCIARY DUTY TO MONITOR AND REVIEW INVESTMENTS

Many states have enacted legislation based on the American Law Institute's "prudent investor rule." The prudent investor rule draws upon the *Restatement Third of Trusts*. The restatement indicates "what are or ought to be common law rules" (see Halbach [1997, p. 1]). Specifically:

> The trustee is under a duty to the beneficiaries to invest and manage the funds of the trust as a prudent investor would, in light of the purposes, terms, distribution requirements, and other circumstances of the trust. This standard requires the exercise of reasonable care, skill, and caution, and is to be applied to investments not in isolation but in the context of the trust portfolio and as a part of an overall investment strategy (Restatement of the Law Third: Trusts [1992, p. 8]).

The Reporter's commentary on the restatement of trust law extends "fundamen-

tal fiduciary standards" beyond portfolio design and implementation:

> The trustee's duties apply not only in making investments but also in monitoring and reviewing investments, which is to be done in a manner that is reasonable and appropriate to the particular investments, courses of action, and strategies involved (Restatement [1992, pp. 10-11]).

Additionally, the Reporter's commentary provides examples of passive and active strategies:

> Investing in index funds that track major stock exchanges or widely published listings of publicly traded stocks is illustrative of a thoroughly passive but practical investment alternative to be considered by trustees.... [Active strategies] involve searching for advantageous segments of a market, or for individual bargains in the form of underpriced securities [1992, p. 30].

The commentary points out that active strategies increase expenses, transaction costs, and risk, and must be evaluated accordingly:

> A decision to proceed with [active management] involves judgments by the trustee that:
>
> 1) gains from the course of action in question can reasonably be expected to compensate for its additional costs and risks;
> 2) the course of action to be undertaken is reasonable in terms of its economic rationale and its role within the trust portfolio; and,
> 3) there is a credible basis for concluding that the trustee — or the manager of a particular activity — possesses or has access to the competence necessary to carry out the program... (Restatement, [1992, pp. 28-30]).

Although the comments regarding a decision to incorporate active strategies within the portfolio provide some implicit guidelines for an ongoing monitoring and review program, there is no guidance on monitoring and review of passively managed investment programs. We suggest a methodology for fiduciary reporting on passively managed mutual fund investments that has special application to advisors and fiduciaries of qualified retirement savings plans, endowments, and family trusts.

DEFINITIONS

Passively managed mutual funds may be categorized according to whether they attempt to replicate the performance characteristics of an index or an asset class. Additionally, within each of these categories there are several subcategories.

Index Funds

Index funds seek to replicate a stock or bond index. They may buy every security in the index or buy a representative sample of securities whose behavior mimics the index (sampling or sensitivity indexes). The fund manager makes no forecasting decisions. Management attempts to replicate the market rather than to beat it.

Full Replication Index Funds. Full replication index funds hold most or all of the securities in the benchmark index, in the same weightings as in the benchmark.

Sample Index Funds. Sample index funds hold representative samples of the securities in the benchmark. Sample index funds built through a *random sample* process may exhibit a large tracking error between the fund's performance and that of the benchmark index. Sample index funds built through a *stratified cell* approach minimize tracking error.

In a stratified cell approach, the risk-return characteristics of underlying securities are decomposed and quantified. Each cell represents one such characteristic, and securities are selected on the basis of how closely their composition reflects the required characteristic. By filling all the cells (i.e., duplicating all the relevant performance characteristics), the mutual fund becomes a proxy for the more extensive index.

Other Index Investment Approaches. There are several other approaches used by index funds, generally intended to provide performance superior to the index, while retaining the objectivity and risk characteristics of the index approach. These include optimization indexes, such as stratified cell index funds; enhanced index funds, which generally use derivatives in an attempt to benefit from market mispricing; and index funds that apply different market weightings to component securities (see Sauter [1997, pp. 89-94]).

Structured Asset Class Funds

A structured asset class fund may decompose an index in order to capture a specific dimension of risk or return (e.g., the subset of S&P 500 stocks with low market value-to-asset value ratios), or may group securities into a unique index reflecting certain historical risk-return characteristics. Such funds capture returns by purchasing all securities with comparable risk-return characteristics along the identifiable investment dimension (e.g., market size, yield curve placement). They may or may not try to track a benchmark index.

The fund manager makes no forecasting decisions. Management seeks neither to beat the market nor, strictly speaking, to replicate it exactly. The primary objective is instead to capture the long-term returns of the asset class. Purchase and sale of individual securities are based on passive filters designed to preserve the stated risk-return characteristics of the fund.

Equity Fund Management. A structured asset class equity mutual fund may be illustrated by a small-company stock fund. While a small-company stock index fund might own every security used to calculate its benchmark index, a small company structured asset class fund might impose passive inclusion or exclusion filters on the universe of securities. These filters act as screening devices that determine the composition of the fund.

Inclusion filters might include, e.g., purchase of all securities with accounting ratios within a specified range, or of all securities available at prices below the bid-ask spread. Exclusion filters might proscribe ownership of, e.g., bankrupt firms, or initial public offerings, or of firms whose market capitalization changes to exceed a given threshold. Finally, trading rules may enforce operational economies at the cost of increased tracking error.

Fixed-Income Fund Management. Fixed-income index funds might own a bond through all yield curve environments simply because the weighting of the index demands it. A structured asset class fund investing in fixed-income instruments, on the other hand, may shift maturities within its portfolio depending on available yields (as reflected in the slope of the current yield curve) and on a horizon analysis of total expected return over a given holding period. Such an approach eschews forecasting (whether of interest rates, inter-sector spread, or credit quality) because all analytical inputs are derived from the current yield curve environment.

NATURE AND SCOPE OF A FIDUCIARY REPORT

We assume that the fiduciary retains an advisor to provide, on a periodic basis, a monitoring and surveillance report in order to document the ongoing suitability of the portfolio's investment selections. One important aspect of such a report is provision of data sufficient to allow the fiduciary to determine that the investment selections are performing as advertised.

Thus, for index mutual funds, we want statistical data that allow the fiduciary to determine:

- Replication accuracy: How closely the fund tracks the returns of the index that it seeks to replicate.
- Expenses: The impact of expenses on net fund returns.

Taxable investors may, in addition, wish to evaluate data concerning turnover and holding-period performance characteristics in order to evaluate the after-tax suitability of the investment. Although net after-tax return is important to many investors, an analysis of the tax effects of investment decisions is beyond the scope of our discussion.

For structured asset class mutual funds, we want statistical data that allow the fiduciary to determine:

- Performance tracking: The degree to which the fund's performance successfully captures the dimensions of risk and return of an appropriate benchmark asset class.
- Effect of passive management policies: The extent to which trading, passive inclusion/exclusion filter rules, and operating expenses add or subtract value.
- Significance of reductions or increases in value: The degree of significance for reduction or increase in value caused by passive management rules. Significance must be measured in both statistical and economic senses. If the magnitude of gain or loss is both systematic and substantial, the information becomes an important determinate of ongoing suitability.

MONITORING CRITERIA FOR PASSIVELY MANAGED INVESTMENTS

Monitoring Criteria for Index Funds

Index funds provide broad diversification as well as market return. Two particular monitoring and review criteria apply.

Expense Ratios. It is important for indexed investment vehicles to control expenses in order to assure that they closely track the performance of their benchmark index. Assuming that the index fund successfully replicates its index, the fund's expense ratio may be the primary determinant as to whether the fund does better or worse than comparable index funds. An advisor preparing a fiduciary report may therefore wish to include a table of comparative expense ratios for index mutual funds. The comparison acts as a general guideline for determining the reasonableness of a particular fund's expenses.

An example that lists the expense ratios of index mutual funds in major categories (e.g., domestic large-cap; domestic medium-/small-cap; foreign) appears in Good and Hermansen [1997, pp. 184-185]. The advisor should, of course, help the fiduciary document that it has paid sufficient attention to its duty of cost-consciousness.

Performance Relative to Benchmark. The primary monitoring criterion for index mutual funds is the measure of its accuracy in tracking the performance characteristics of its benchmark (such as average return per period, volatility of returns, correlation of returns). Particularly meriting investigation are:

1. Differences in mean returns between the index and the benchmark.
2. Differences in the distribution shape of investment returns.
3. Differences in the variability of investment returns.
4. Closeness of correlation of investment returns.

To the extent that statistical tests demonstrate significant differences between the fund and its benchmark, the fiduciary must reconsider the suitability of the fund for the investment portfolio.

Monitoring Criteria for Structured Asset Class Funds

Absent filter and trading rules, structured asset class funds share many characteristics common to index mutual funds. As a consequence, one must establish a "best-fit" benchmark represented either by an index or, where a comparable index does not exist, by the composite performance results of all funds sharing a similar investment composition.

The primary monitoring criteria for structured asset class mutual funds are 1) the degree to which the fund's performance successfully captures the dimensions of risk and return of an appropriate benchmark asset class; and 2) the extent to which trading, passive inclusion/exclusion policy (filter rules), and operating expenses add or reduce value. Accordingly, the fiduciary monitoring and review report should be based on research into:

1. Differences in mean returns between the asset class fund and the benchmark.
2. Differences in the distribution shape of investment returns.
3. Differences in the variability of investment returns.
4. Closeness of correlation of investment returns.
5. Degree of historical tracking error.
6. Measurement of the value-added of passive management strategies.

To the extent that the statistical testing demonstrates significant differences between the fund and its benchmark, or a significant reduction in value for fund investors, one must reconsider the suitability of the fund for the investment portfolio.

ANALYSIS OF VANGUARD S&P 500 INDEX TRUST

Descriptive Statistics

Initially, we look at a statistical comparison of monthly return series for the Vanguard S&P 500 Index Trust and the S&P 500 index as reported by Ibbotson and Associates. We analyze the return series from the incep-

EXHIBIT 1
Descriptive Statistics for S&P 500 Index and Vanguard Mutual Fund

	S&P 500 Index	Vanguard Index Trust
Mean	0.0129	0.0126
Standard Error	0.0026	0.0026
Standard Deviation	0.0419	0.0418
Kurtosis	3.3130	3.4247
Skewness	-0.5567	-0.5792
Range	0.3495	0.3499
Minimum	-0.2152	-0.2173
Maximum	0.1343	0.1327
Confidence Level (95.0%)	0.0052	0.0052

tion of the Vanguard mutual fund (September 1976) through June 1997.

Mean. Although we expect the average monthly performance of a mutual fund to be below that of a comparable benchmark (because of expenses incurred to operate the fund), it is a cause for concern if the underperformance is significant. If statistical analysis indicates that underperformance is both systematic and economically significant, the investor has little hope that the situation will be corrected. In this case, the S&P 500 index produces a mean monthly return of 1.29% while the Vanguard Index fund shows a mean return of 1.26%.

Standard Error. The standard error helps determine whether the difference in mean values between the mutual fund and its benchmark is significant.

Standard Deviation. A measure of dispersion of the data from the mean. In this case, the standard deviation of the mutual fund (4.18%) is virtually the same as that of the index (4.19%).

Kurtosis and Skewness. Kurtosis is the measurement of the degree of peakedness of a distribution. If an unusually large number of values are "heaped" in the middle of the distribution, the shape is abnormally peaked vertically. In this case, the kurtosis statistic has a positive value. A distribution with values that are peaked close to the mean indicates a greater probability for achieving average values. A kurtosis statistic with a negative value indicates that the distribution has a flatter shape than a normal distribution.

Although two distributions may have similar means, their risks may be quite different. The classic example in statistics texts is the class in which each student receives a grade of C versus the class in which one-half receive As and one-half receive Fs. The mean (average grade) for each class is identical, but the "risk" is not.

A value of zero for skewness indicates that monthly performance results are symmetric around the mean value. Negative skewness indicates that the distribution has a longer left "tail." For most distributions, this means that most values will be negative (left-side). For strongly skewed distributions, it is important to determine if extreme negative returns are likely to overwhelm long-term wealth accumulation (see Levine, Berenson, and Stephan [1998, pp. 149-150]).

Sample distributions taken from the same underlying population should not differ significantly with respect to kurtosis and skewness. In Exhibit 1, each return series evidences a slight negative skew.

Range (Maximum and Minimum). These are additional measures of dispersion. Maximum and minimum represent the extreme values within the data set — in this case, the highest and lowest monthly investment returns. Range is calculated by subtracting the lowest monthly investment return from the highest monthly return in order to gauge the absolute value of the dispersion. The values are similar for both the S&P 500 and the Vanguard fund.

Confidence Level. We are interested in determining whether there is an overlap in the value of the two sample means (the mean of the mutual fund and the mean of the benchmark) within the 95% confidence interval bounds. The value of the Vanguard S&P 500 Index Trust (0.0126) clearly lies between 0.0077 and 0.0129; therefore, we cannot say with confidence that the means of the two return series are, in fact, different.

Regression

Results of a regression analysis of the monthly return series of the Vanguard S&P 500 Index Trust on the monthly return series of the S&P 500 index are in Exhibits 2, 3, and 4. Exhibit 2 shows a graph of a regression of the Vanguard S&P 500 Index Trust mutual fund's returns on the returns of the S&P 500 index. Shown are the regression equation as well as the R^2 goodness of fit statistic. Exhibit 3 is a scatterplot of the residuals (error terms) of the regression to allow determination of whether fund management policy results in any systematic tracking error bias. Exhibit 4 provides the values of the regression statistics.[1]

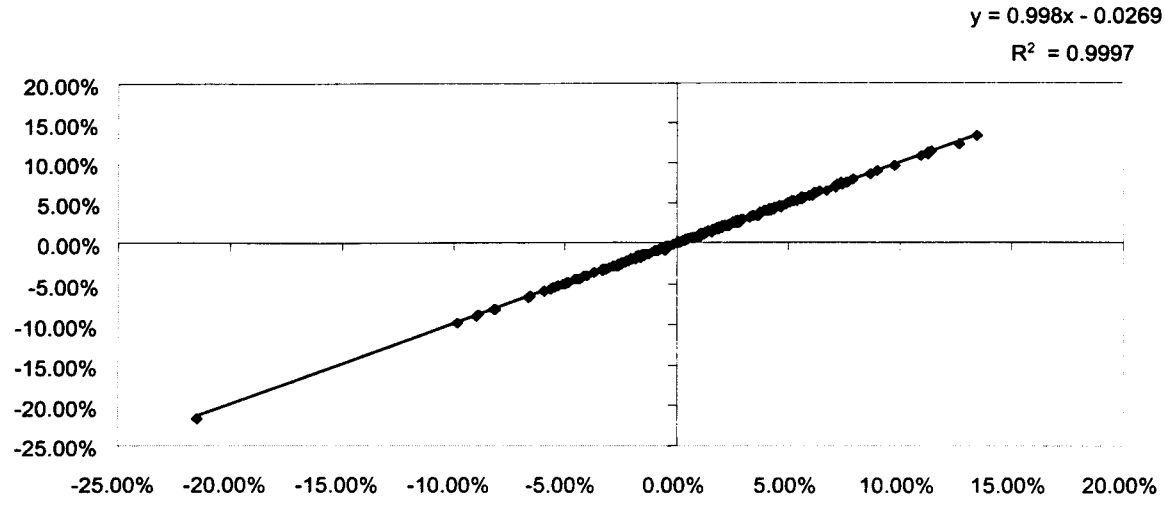
The regression equation line in Exhibit 2 enables us to measure precisely the difference between the calculated linear equation line (i.e., the estimated value of the dependent variable) and the actual performance value of the dependent variable. The difference between estimated mutual fund performance values and actual performance values is known as the estimation error or the residual. The term "error" refers to the measurement process that determines how far the mutual fund's actual performance varies from the ideal of perfect one-to-one correspondence with the benchmark.

Error terms thus illustrate and measure the amount of tracking error between the fund and its benchmark. We anticipate a random scattering of error terms around the value of zero. This indicates that the management of the mutual fund is not systematically biasing results through the imposition of particular strategies.

One way to check that the fund is not systematically reducing value is to calculate the sum of the pos-

EXHIBIT 2

Regression of Vanguard S&P 500 on S&P 500 Index — September 1976 to June 1997



itive and negative error term (most investors will not complain if the management is systematically adding value at a comparable level of risk). If the sum of the residuals approaches zero, we have evidence suggesting a lack of bias in fund management. That is to say, management does not distort returns by adhering to unproductive practices.

In this analysis, however, when we compare a particular mutual fund to an index, we expect that a significant number of tracking errors will have negative values, because the expenses of operating the fund act as a drag on performance.[2]

In Exhibit 3, the horizontal axis indicates the range of monthly returns of the S&P index specified in Exhibit 1 (-21.52% to +13.43%). The vertical axis indicates the monthly tracking error of the Vanguard fund corresponding to each of the monthly index returns. The monthly tracking error ranges from slightly more than +20

EXHIBIT 3

Vanguard S&P 500 Index Trust Residual Plot

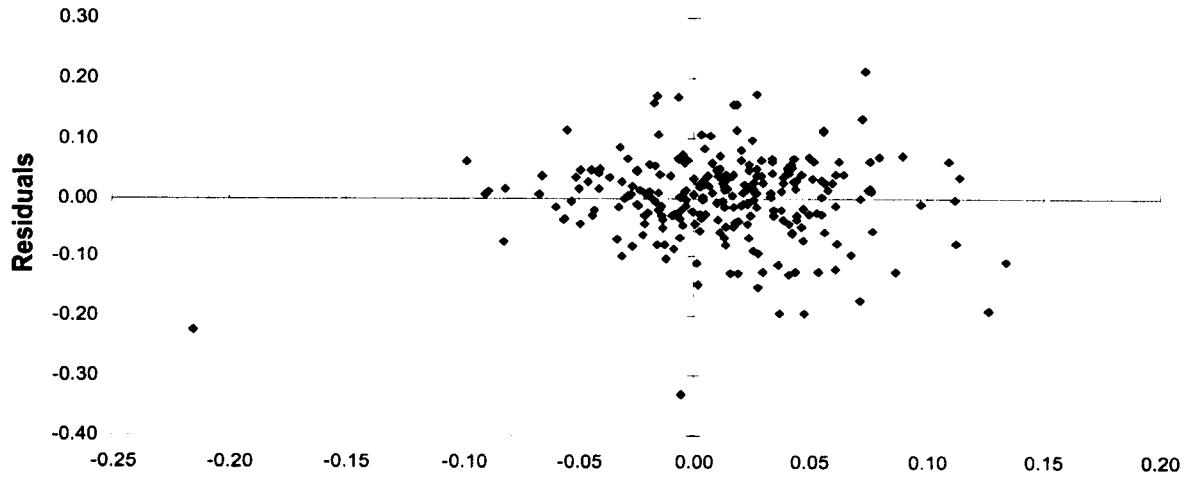


EXHIBIT 4

Regression Analysis of Vanguard S&P 500 Index Trust and S&P 500 Index

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.99986
R Square	0.99970
Standard Error	0.07005
Observations	253

ANOVA

	Degrees of Freedom	SS	MS	F	Significance F
Regression	1	4401.111	4401.111	896989.69	0
Residual	251	1.232	0.00491		
Total	252	4402.342			

	Coefficients	Standard Error	t-Stat	P-value	Lower 95%	Upper 95%
Intercept	-0.00027	4.609E-05	-5.8419	1.594E-08	-0.00036	-0.000179
S&P 500	0.9980	0.0011	947.0954	0	0.9959	1.00003

basis points to slightly more than −30 basis points.

Although tracking errors tend to cancel out over time, this nevertheless suggests the possibility of a run of positive or negative monthly tracking errors (by random chance) that could cause substantial yearly deviation between index and fund returns. It is important that the investor realize the nature of tracking error risk. Even full replication index funds such as the Vanguard S&P 500 Index Trust mutual fund can exhibit substantial yearly deviation from the return of the underlying benchmark.

The R^2 of 0.9997 in Exhibit 4 provides additional evidence that the fund management is successfully capturing the returns of the asset class or index that it seeks to replicate. Multiple R of 0.99986 is equivalent to the correlation coefficient (where the correlation coefficient equals the square root of R^2). The correlation coefficient must have a value of 0.70 or higher to indicate at least 50% explained variability.

A review of the data indicates that the return patterns of the Vanguard S&P 500 Index Trust mutual fund are 99.9% positively correlated with the benchmark S&P 500 index. Average monthly return of the fund during the period under evaluation (September 1976–June 1997) lags the average monthly return of the index by approximately 3 basis points. Examination of the residual plot shows normal distribution of tracking errors (i.e., performance deviations from the benchmark are not biased in either a positive or negative direction).

Regression analysis indicates that, at a 0% return level for the index, calculated value-added of the fund is fractionally negative per year. This value is statistically significant at the 95% confidence level. Significance, in this case, is more a function of sample size than economic importance.

For the fiduciary, a key decision point would be how well the Vanguard fund's expense ratios compare with alternative S&P 500 index funds. Its current average expense ratio equals 0.20%, compared to 1.26% for the composite average of all mutual funds, both actively and passively managed, with a similar investment composition according to the Morningstar Principia data base.

Analysis of variance (ANOVA) indicates a strong relationship between the intercept and slope values of returns generated by the fund and by its benchmark. The

"significance of F" indicates the probability of attaining the values of the regression analysis if, in fact, the null hypothesis is true; i.e., there is no relationship between the slope parameter of the fund and the benchmark. In this case, the probability of obtaining the calculated slope value under the null hypothesis assumption is zero (significance F = 0). Thus the fund appears to be successful in providing the investor with a low-cost exposure to the large company U.S. equity market.

ANALYSIS OF DIMENSIONAL FUND ADVISORS 9-10 FUND

Exhibits 5–8 show the results of analysis of one of the DFA structured asset class mutual funds. The 9-10 fund is based on the CRSP (Center for Research in Security Prices) 9-10 Index. DFA and CRSP data come from Dimensional Fund Advisors.

The DFA 9-10 Fund is an example of a passively managed structured asset class fund. In 1991, Rex Sinquefield, a Dimensional Fund Advisor director, contrasted "pure indexers" with structured asset class fund managers:

> [Pure indexers] tend to hold securities in their portfolios in the exact proportions of the target universe....The pure indexers do not materially overweight a security held in the target index. Maintaining target-like portfolio balance seems to be their primary concern.... The pure indexers tend to seek "immediacy of execution." In general, when orders are placed, brokers are instructed to complete all or most of the buy program in a few days, at most (Sinquefield [1991, p. 49]).

By contrast, a passively managed structured asset class fund:

> may overweight positions by purchasing large blocks below current bid prices and underweight positions by trying to avoid purchases at or above current ask prices.... A large fraction of [the] portfolio holdings depart from perfect balance.... Brokers are instructed to try to purchase securities without pushing prices. As a result, a large portion of [the] buy program will be unexecuted, even after several weeks, and many positions will be underweighted. Uninitiated blocks are considered if the execution terms are favorable, so many positions will be overweighted (Sinquefield [1991, p. 49]).

Sinquefield argues that the illiquid nature of the small-company equity market generates formidable bid-ask spreads. To overcome the high costs of trading, it may be profitable to use strategies that are often considered to be in the exclusive domain of active management. The fund, of course, is passively managed in the sense that no forecasting techniques are employed, either for security selection or market timing. Without such "active" portfolio management strategies, the returns of small-company mutual funds may never be able to approach the returns of the indexes on which they are based: "in the long run, a pure indexing approach to small-company management, even passive management, is not feasible" (Sinquefield [1991, p. 50]).

Thus, the challenge of the structured asset class fund is twofold:

1. Achieve the dimensions of risk and return that characterize the asset class upon which it is based.
2. Overcome the costs of running the mutual fund.

More recently, Keim [1999] quotes another DFA director as noting that the DFA 9-10 Fund employs "innovative trading techniques and management decision rules. As such, it can be considered a 'non-conventional' active management approach" (Keim [1997, p. 5]).

Although Keim is primarily interested in a critical examination of portfolio management strategies that ultimately will provide insight into optimal future mutual fund design — i.e., the best of passive and active strate-

EXHIBIT 5
CRSP 9-10 Index and DFA 9-10 Fund (January 1982–June 1997)

	CRSP 9-10 Index	DFA 9-10 Fund
Mean	0.0109	0.0126
Standard Error	0.0037	0.0036
Standard Deviation	0.0509	0.0487
Kurtosis	5.7186	7.5292
Skewness	-0.8613	-1.3554
Range	0.4300	0.4224
Minimum	-0.2847	-0.2919
Maximum	0.1453	0.1305
Confidence Level (95.0%)	0.0074	0.0070

EXHIBIT 6

Regression of DFA 9-10 Fund Monthly Returns on CRSP 9-10 Index — January 1982-June 1997

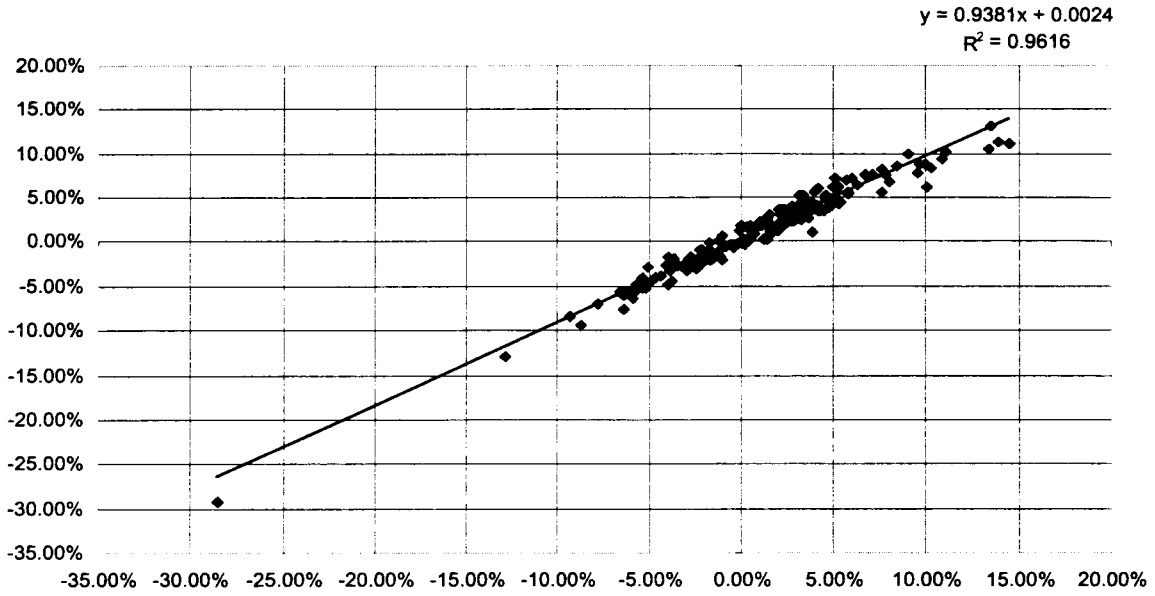
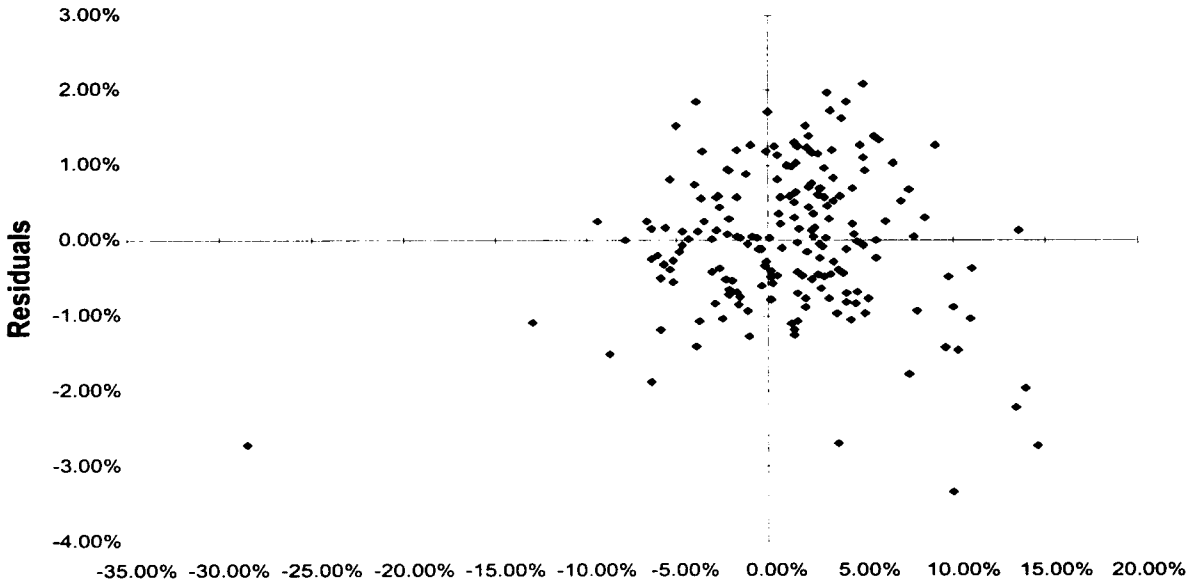


EXHIBIT 7

DFA 9-10 Residual Plot



gies — his decomposition of the 9-10 Fund's investment and trading strategies is particularly illuminating. The DFA 9-10 Fund:

1. Excludes limited partnerships, bankrupt firms, Nasdaq NMS stocks with fewer than four market makers, non-NMS stocks, stocks with a price lower than $2.00, or market capitalization under $10 million.
2. Delays purchase of initial public offerings for a period of six months to one year.
3. Holds stocks in the portfolio until they grow into the upper half of the eighth decile.

EXHIBIT 8

Regression Analysis: DFA 9-10 Fund and CRSP 9-10 Index

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.9806
R Square	0.9616
Standard Error	0.0096
Observations	186

ANOVA

	Degrees of Freedom	SS	MS	F	Significance F
Regression	1	0.4219	0.4219	4611.373675	3.1983E-132
Residual	184	0.0168	9.14852E-05		
Total	185	0.4387			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.0024	0.0007	3.2899	0.0012	0.0009	0.0038
X Variable 1	0.9380	0.0138	67.9071	3.1983E-132	0.9108	0.9653

The DFA 9-10 Fund also follows the trading strategies outlined in Sinquefield [1991]. Keim observes that:

> An important outcome of DFA's trading strategy is that the security weights in the 910 (sic) Fund are substantially different from those in the Index. In particular, the heavy reliance on block trades tends to distort the weightings.... For example, the 910 Fund had a 24.9% weighting in technology stocks in 1994, compared to 15.1% for the Index. Such weighting differences can result in substantial return differences that can vary through time.... "Active" management of the portfolio is an important contributor to the observed performance differential (Keim [1997, p. 6]).

Keim's analysis suggests the importance of critical examination of passively managed structured asset class funds. Statistical analysis helps the fiduciary determine the extent to which the mutual fund has captured the performance of the market segment upon which it is based, as well as the success or failure of the fund in compensating for operational and investment expenses. Hypothesis testing is particularly helpful in determining levels of significance so that assessments regarding the likelihood of future performance values can be made.

The data in Exhibit 5 indicate that the average monthly return of the "live" DFA 9-10 Fund exceeds the average monthly return of the comparable "paper" benchmark index. Although the DFA Fund advantage has been substantial (over 15.5% extra return per year at only 96% of the risk as measured by standard deviation, or 93.8% as measured by the beta parameter of the regression analysis), the difference in means at the 95% confidence level is not statistically significant.

Although the outperformance is welcome, we cannot say with a high degree of certainty that it is reasonable to expect it to continue into the future. The confidence level intervals suggest that returns are being generated from the same underlying population.

The attractive risk-return advantage of the DFA 9-10 Fund underscores the importance of the regression analysis as a check on the likelihood that the advantage derives because the fund drifts from the pattern of returns evidenced by the CRSP index. In this case, however, we find that an R^2 statistic of 0.9616 evidences little overall

unique risk for the 9-10 Fund. Indeed, the return patterns have a positive correlation of 0.9806. These observations are further confirmed by the very high value of the F-statistic (Exhibit 8).

Additionally, the regression output provides a window on several interesting and important phenomena. First, unlike the fractional basis point value subtracted by the Vanguard S&P 500 Index Trust's alpha statistic, the DFA 9-10 evidences a positive value for the intercept. The fact that the positive value is statistically significant suggests that:

- There is expectation of continued value-added performance in the future.
- There is additional evidence that management investment and trading policies can offset expenses over a wide range of investment returns.

Second, despite the high R^2 and cross-correlation statistic values, examination of the residual scatterplot in Exhibit 7 evidences a much greater degree of tracking error for the DFA 9-10 Fund than for the Vanguard S&P 500 Index Trust. Although the 9-10 residual plot shows the cloud-like shape that characterizes a normal distribution of error terms (i.e., no systematic bias in the addition or diminution of value as a result of management policies), the degree of monthly tracking error has been as high as approximately 3%. The risk of the fund, therefore, appears not in its long-term performance results, but rather in its short-term tracking error.

This is a key piece of information for the investor who measures investment performance through benchmark comparisons. Investors expect that a "passively managed" investment that is, over a substantial period of time, 98% positively correlated with its index will not deviate substantially from its underlying index.

Consider, however, the plight of the fiduciary who purchased the 9-10 Fund at the beginning of 1991. During the next twelve months, the fund *underperformed* the CRSP Index by 698 basis points. Indeed, over the period 1982–1995, Keim calculates that the average of the absolute annual difference between the 9-10 Fund and its benchmark index is 378 basis points. Structured asset class mutual funds do not guarantee the market returns of their benchmarks.

As we noted earlier, tracking risk can be approximated by the error terms of a regression analysis (difference between the fitted trend line and the actual values of the dependent variable). The history of an investment's returns represents only one single path among many theoretical paths or "random walks." Although there is great interest regarding the path that is, in fact, realized, the likelihood that such a path will be duplicated in the future is remote. We need to look at a more comprehensive picture of risk so that the fiduciary has a better understanding of possible future risk-return trade-offs.

To do this, we use "bootstrapping." From the historical distribution of monthly investment returns, we take a random sample of twelve. Each random sample is annualized (time-weighted annual return), and, following the calculation of the annual return, each monthly sample is placed in the population of returns. Assuming that returns are independent and identically distributed, the "true" nature of the theoretically possible distribution can be, over many samplings, bootstrapped from the historical data (see Sortino and Forsey [1996]). The bootstrap data analysis technique enables us to break from the historical path in order to consider a wider range of mathematical possibilities.[3]

Exhibit 9 shows a histogram of 1,000-sample bootstrapped distribution of error terms for the DFA 9-10 Fund. The bootstrapped distribution indicates that the DFA 9-10 Fund has about a 1% chance of underperforming the CRSP benchmark by more than 8% per year. Although the minimum calculated value is negative 11.39%, such an extreme outcome is unlikely.

Nevertheless, the bootstrapped 9-10 Fund distribution of error terms contrasts sharply with a comparable 1,000-sample bootstrap of the Vanguard S&P 500 Index Trust's error terms. Where the DFA Fund's range of yearly error terms equals approximately 21% (-11.39 to +9.27), the range of yearly error terms for Vanguard is much narrower, at approximately 1.8% (-1.01 to +0.70).

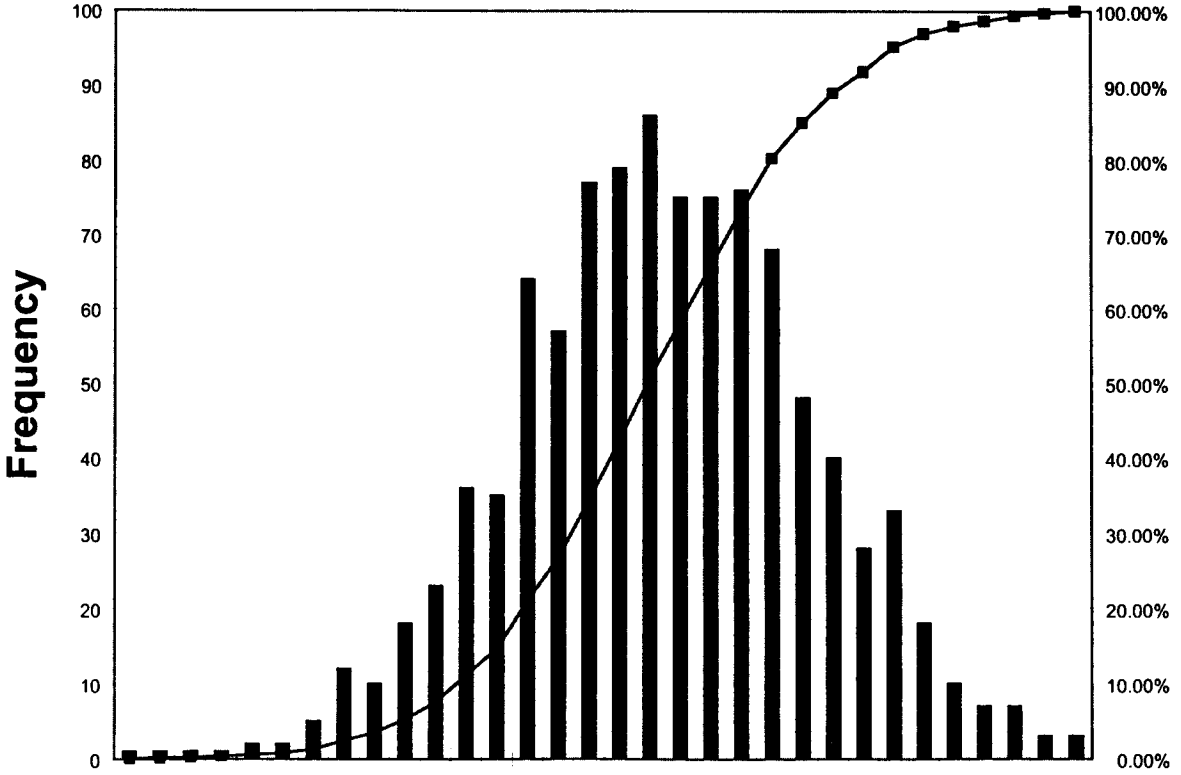
FINAL OBSERVATIONS

Passively managed structured asset class funds are not indexes. They should not be promoted by advisors as indexes, and they require ongoing monitoring and review. Where there is a clear relationship between a benchmark index and the structured asset class fund, the advisor can easily provide the fiduciary with the insight to make informed decisions regarding the risk and reward of the mutual fund investment. For many structured asset class funds, however, there is no clear benchmark index for comparison purposes. In this case, the advisor may wish to provide a comparative analysis between the fund and several other, more distantly related, return series.[4]

EXHIBIT 9

Histogram of Error Terms for DFA 9-10 Fund

Bin	Frequency	Cumulative %
-0.1139	1	0.10%
-0.1073	1	0.20%
-0.1006	1	0.30%
-0.0939	1	0.40%
-0.0873	2	0.60%
-0.0806	2	0.80%
-0.0739	5	1.30%
-0.0673	12	2.50%
-0.0606	10	3.50%
-0.0539	18	5.29%
-0.0473	23	7.59%
-0.0406	36	11.19%
-0.0339	35	14.69%
-0.0273	64	21.08%
-0.0206	57	26.77%
-0.0139	77	34.47%
-0.0073	79	42.36%
-0.0006	86	50.95%
0.0061	75	58.44%
0.0127	75	65.93%
0.0194	76	73.53%
0.0261	68	80.32%
0.0327	48	85.11%
0.0394	40	89.11%
0.0461	28	91.91%
0.0527	33	95.20%
0.0594	18	97.00%
0.0661	10	98.00%
0.0727	7	98.70%
0.0794	7	99.40%
0.0861	3	99.70%
More	3	100.00%



For example, a regression of the DFA global income bond fund's returns on the composite average of world bond fund returns reveals the value added or subtracted by portfolio management strategies, and reveals the interrelationship between the decision to pay for currency hedges and the degree of tracking error over the range of performance results. Such analysis should not be performed in order to create a "scorecard" or "star rating" system for the funds under evaluation. In the portfolio evaluation context demanded by the Third Restatement of Trusts, this type of ratings objective is meaningless. Rather, statistical analysis can best be used to inform the fiduciary more fully about the range of important performance characteristics of an index or structured asset class fund.

Additionally, as new investment products come to the mutual fund marketplace, advisors should recognize that facile distinctions between active and passive investment management belie the complexity and richness of the investment choice available to the fiduciary. Even the most "pure indexer" uses futures and other derivative instruments in a portfolio.

Rather than a clear line of demarcation between active and passive management, there are a spectrum of management styles, including: replication and stratified cell index funds; funds that select securities via "black box" screening or neural networks; structured asset class funds; "quantitative-driven" mutual funds such as those offered by Rosenberg Institutional Equity Management; synthetic indexes (with or without accompanying cash management strategies) that use arbitrage or volatility-based strategies, and many others (see Loftus [1997]).

Indeed, in the competitive environment of the mutual fund industry, it is becoming impossible to find a fund that is managed completely by either passive or active management strategies. Perhaps, as Keim's optimally designed mutual fund comes closer to market reality, the entire debate over the theology of active versus passive management may be rendered moot.

ENDNOTES

[1]The discussion of regression analysis draws heavily on Ragsdale [1995, pp. 329-367].

[2]For a discussion of tracking error in indexed portfolios, see Dynkin and Hyman [1997, pp. 231-233].

[3]The Excel sampling analysis tool is described in Middleton [1997].

[4]For a discussion of the issues surrounding selection of a benchmark see Neubert [1997].

REFERENCES

Dynkin, L., and J.M. Hyman. "Quantitative Methods of Enhanced Fixed-Income Indexing." In Frank J. Fabozzi, ed., *Professional Perspective on Indexing*. New Hope, PA: FJF Associates, 1997, pp. 231-233.

Good, W. R., and R.W. Hermansen. *Index Your Way To Investment Success*. The New York Institute of Finance, 1997, pp. 184-185.

Halbach, Edward C., Jr. "What Estate Planners Should Know About California's New Uniform Prudent Investor Act." Symposium at the Thirteenth Annual San Francisco Trust Forum, sponsored by Northern Trust Bank, September 11, 1997.

Keim, Donald B. "An Analysis of Mutual Fund Design: The Case of Investing in Small-Cap Stocks." Working paper, Wharton School of Business, University of Pennsylvania, forthcoming, *Journal of Financial Economics*, 1999.

Levine, D.M., M.L. Berenson, and D. Stephan. *Statistics for Managers Using Microsoft Excel*. Englewood Cliffs, NJ: Prentice-Hall, Inc. (1998), pp. 149-150.

Loftus, John S. "Enhanced Equity Indexing." In Frank J. Fabozzi, ed., *Professional Perspective on Indexing*. New Hope, PA: FJF Associates, 1997, pp. 41-49.

Middleton, Michael R. *Data Analysis Using Microsoft Excel*. Belmont, CA: Duxbury Press, 1997, pp. 85-95.

Neubert, Albert S. "Knowing Your Indexes: Background, Definitions, and Rules." In Frank J. Fabozzi, ed., *Professional Perspective on Indexing*. New Hope, PA: FJF Associates, 1997, pp. 61-66.

Ragsdale, Cliff T. *Spreadsheet Modeling and Decision Analysis*. Cambridge, MA: International Thomson Publishing, 1995.

Restatement of The Law Third: Trusts. The American Law Institute, 1992.

Sauter, George U. "Medium and Small Capitalization Indexing." In Frank J. Fabozzi, ed., *Professional Perspective on Indexing*. New Hope, PA: FJF Associates, 1997, pp. 89-94.

Sinquefield, Rex A. "Are Small-Stock Returns Achievable?" *Financial Analysts Journal*, January/February, 1991, p. 49.

Sortino, Frank A., and Hal J. Forsey. "On the Use and Misuse of Downside Risk." *Journal of Portfolio Management*, Winter 1996, pp. 35-42.