
FIDUCIARY DUTY TO MONITOR AND REVIEW PASSIVELY MANAGED MUTUAL FUNDS

Structured asset class mutual funds, despite their passive management techniques, are not index funds; should not be categorized as index funds; and call for evaluative judgements similar to those required for selection and retention of actively managed funds. An ancillary, but nevertheless important, argument of this essay is that the fiduciary is not well served by advisors who abdicate ongoing monitoring and review of passively managed programs. The absence of monitoring may be based on the erroneous supposition that all passively managed funds, by definition, yield a market return and, therefore, do not require the ongoing level of evaluation commonly given to actively managed investments.

In order to illustrate the importance of developing and implementing a review and monitoring program, this essay looks at the returns of two mutual funds:

- 1) Vanguard's S&P 500 Index Trust—a replication equity index mutual fund;¹ and,
- 2) Dimensional Fund Advisor's US 9-10 Fund—a structured asset class equity mutual fund;

These funds have proven popular with the investment advisor community and, therefore, are often found within the portfolios of retirement plans and non-qualified family trusts. Each fund has a substantially different risk/return tradeoff 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," the investment management policies and objectives of each fund also contribute important, non-market-related risk/return characteristics.

Fiduciary Duty To Monitor and Review Investments

Over the past several years, 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...."² 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...."*³

The Reporter's commentary to the restatement of trust law extends "fundamental 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."*⁴

Additionally, the Reporter's commentary provides examples of Passive strategies 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.... and, [Active strategies] involve searching for advantageous segments of a market, or for individual bargains in the form of underpriced securities."

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...."*⁵

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 mention of how to monitor and review passively managed investment programs. This paper outlines a methodology for fiduciary reporting on passively managed mutual fund investments. It has special application to advisors and fiduciaries of qualified retirement savings plans, endowments and family trusts.

Some Preliminary 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 sub-categories:

(Structured asset class) funds capture returns by purchasing all securities with comparable risk/return characteristics along the investment dimension... 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.

Index Funds

Index funds seek to replicate a stock or bond index. They may buy every security in the index, or 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

These index funds hold most or all of the securities contained in the benchmark index, in the same weightings that exist within the benchmark.

Sample Index Funds

These index funds hold representative samples of the securities contained 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 of 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 which apply different market weightings to component securities.⁶

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, etc.). 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. Whereas 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, etc. 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, etc. 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 based 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 advisor has been retained by the fiduciary to provide, on a periodic

The primary monitoring criteria for index mutual funds is the measure of its accuracy in tracking the performance characteristics of its benchmark.

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 to provide 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 allows the fiduciary to determine:

- **Replication Accuracy:** How closely the fund tracks the returns of the index that it seeks to replicate; and,
- **Expenses:** The impact of expenses on net fund returns.

Taxable investors may, in addition, wish to evaluate data concerning turnover/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 this essay.

For structured asset class mutual funds we want statistical data that allows 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; and,
- **Significance of Subtractions from or Additions to Value:** The degree of significance for additions to or subtractions from value caused by passive management rules. Significance must be measured in both the statistical and economic sense of the term. 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. Therefore, the following 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. The advisor who prepares 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 of a table that lists the expense ratios of index mutual funds in major categories (Domestic Large Cap; Domestic Medium/Small Cap; Foreign, etc.) is found in Good & Hermansen's recent book on index investment strategies.⁷ The advisor should, of course, help the fiduciary document that sufficient attention has been given to the non-delegable duty of cost consciousness.

Performance Relative to Benchmark

The primary monitoring criteria for index mutual funds is the measure of its accuracy in tracking the performance characteristics of its benchmark (average return per period, volatility of returns, correlation of returns, etc.). When evaluating funds for a Fiduciary Monitoring and Review Report, the following items merit investigation:

- 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, a determination can be made regarding the future 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 a 'best-fit' benchmark represented either by an index or, in those cases where a comparable index does not exist, by the composite performance results of all funds sharing a similar investment composition can be formed.

Performance Relative to Benchmark

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

- 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 subtraction of value for fund investors, a determination can be made regarding the future suitability of the fund for the investment portfolio.

STATISTICAL ANALYSIS PART I: DESCRIPTIVE STATISTICS

Initially, we look at Excel's 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 inception of the Vanguard mutual fund (September of 1976) through June of 1997.

	S&P 500 Index	Vanguard Index 500
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%)	0.0052	0.0052

A brief discussion of the statistics reported in the table follows:

Mean: Although we expect the average monthly performance of a mutual fund to be below that of its comparable benchmark [because of expenses incurred to operate the fund], it is a cause for concern if the magnitude of 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 evidences a mean monthly return of approximately 1.29% while the Vanguard Index fund evidences a mean return of 1.26%.

Standard Error: [or, Standard Error of the Mean]: helps determine if 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 Index (4.19%) is very close to that of the mutual fund (4.18%).

Kurtosis: The measurement of the degree of peakedness of a distribution. If an unusually large amount of values are "heaped" in the middle of the distribution, the shape appears to be abnormally elongated in the vertical direction. 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

The primary monitoring criteria for structured asset class mutual funds are the degree to which the fund's performance successfully captures the dimensions of risk and return of an appropriate benchmark asset class; and the extent to which (filter rules) and operating expenses add or subtract value.

The classic example in statistics texts is the class of students in which each receives a grade of C versus the class in which half receives an A grade and half receives an F grade. The mean (average grade) for each class is identical but the risk is not.

flatter shape than a normal distribution. In the Excel output convention, a normal distribution has a value of close to zero for the Kurtosis statistic (most statistical reports assign a value of 3 to the Kurtosis statistic of a normal distribution).⁸ When compiling data for the fiduciary report, it is important to gather information on the “shape” of the distribution of returns as well as the average and the range (minimum/maximum) of the returns. Although two distributions may have similar means, their risks may be quite different. The classic example in statistics texts is the class of students in which each receives a grade of C versus the class in which half receives an A grade and half receives an F grade. The mean (average grade) for each class is identical but the risk is not.

Skewness: A value of zero for Skewness indicates that monthly performance results are symmetric around their mean value. Negative Skewness indicates that the distribution has a longer left “tail.” This means that most values in the distribution will be positive (right side) values. Slight negative skew may be considered a good thing for the investor. Positive results are more likely than negative results and extreme negative returns are not likely to overwhelm long-term wealth accumulation.⁹ Sample distributions taken from the same underlying population should not differ significantly with respect to Kurtosis and Skewness. In the above table, each return series evidences a slight negative Skew.

Range, Maximum and Minimum: 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. Once again, these values are similar for both the Index 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 bench-

mark] within the 95% confidence interval bounds. The value of the Vanguard S&P 500 Index trust (.0126) clearly lies between .0077 and 0.0129; and, therefore, we cannot say with confidence that the means of the two return series are, in fact, different.

STATISTICAL ANALYSIS PART II: REGRESSION

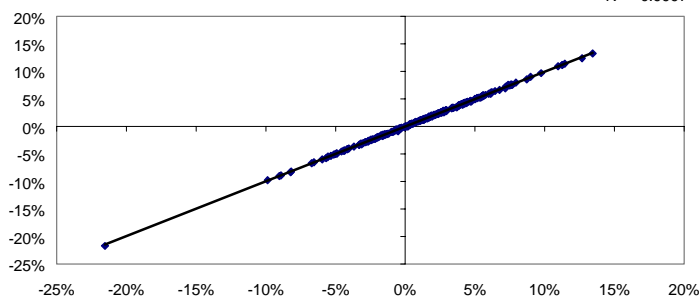
Analysis of Vanguard Index 500

Excel provides for statistical comparison of the monthly return series of the Vanguard S&P 500 Index Trust with the monthly return series of the S&P 500 index in the form of a regression analysis. Again, we analyze the return series from the inception of the Vanguard mutual fund (September of 1976) through June of 1997:

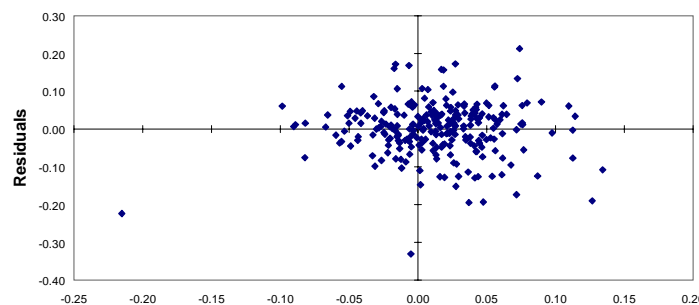
Regression: Vanguard S&P 500 / S&P 500 Index

September '76 - June '97

$y = 0.998x - 0.0269$
 $R^2 = 0.9997$



Vanguard 500 Index Residual Plot



Regression Statistics	
Multiple R	0.99986
R Square	0.99972
Standard Error	0.07005
Observations	253

It is important for the investor to realize the nature of tracking error risk. Even full replication index funds such as the Vanguard S&P 500 Index Trust mutual fund have the potential to exhibit substantial yearly return deviation.

ANOVA					
	Degrees of Freedom	SS	MS	F	Significance of 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

The Excel output shows a scatter plot graph of a regression of the Vanguard Index 500 mutual fund's returns on the returns of the S&P 500 index. The top right-hand corner of the plot contains the regression equation as well as the R² "goodness of fit" statistic. Additionally, we graph the residuals (error terms) of the regression in order to determine if fund management policy results in any systematic tracking error bias. A brief discussion of the Excel output follows:¹⁰

Regression Equation

The regression equation line on the scatter plot 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

Error terms thus illustrate and measure the amount of tracking error that exists 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 subtracting value (most investors will not complain if the management is systematically adding value at a comparable level of risk) is to calculate the sum of the positive and negative error terms. 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.¹¹

Residual Plot

On the Residual Plot of the Vanguard S&P 500 Index Trust mutual fund the horizontal axis indicates the range of monthly returns of the S&P index specified in table 1 (-21.52% to +13.43%). The vertical axis indicates the monthly tracking error of the Vanguard mutual fund corresponding to each of the monthly Index returns. The monthly tracking error ranges from slightly more than +20 basis points to slightly more than -30 basis points. Although tracking errors tend to cancel each other out over time, it 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 for the investor to realize the nature of tracking error risk. Even full replication index funds such as the Vanguard S&P 500 Index Trust mutual fund have the potential to exhibit substantial yearly return deviation.

R Square

The R² statistic provides evidence that the fund management is successfully capturing the returns of the asset class or index that it seeks to replicate. The Excel output confirms this conclusion by virtue of a calculated R² value of 0.99972.

Thus the (Vanguard Index 500) fund appears to be successful in providing the investor with a low cost exposure to the large company U.S. equity market.

Multiple R

In this analysis, Multiple R is equivalent to the correlation coefficient [where the correlation coefficient equals the square root of R²]. The correlation coefficient must have a value of .70 or higher to indicate at least 50% explained variability. In this case, the correlation coefficient or Multiple R is equal to 0.99986.

Conclusions From Review

A brief review of the above data indicates that 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) lagged 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 were 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. For many investors, however, significance, in this case, is more a function of sample size than economic importance. For the fiduciary, a key decision point rests on how well the Vanguard fund's expense ratios compare with alternative S&P 500 index funds. Current average expense ratio of the fund equals 0.20% compared to 1.26% for the composite average of all mutual funds, both actively and passively managed, with similar investment composition within the Morningstar Principia database.¹² 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 our 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 ap-

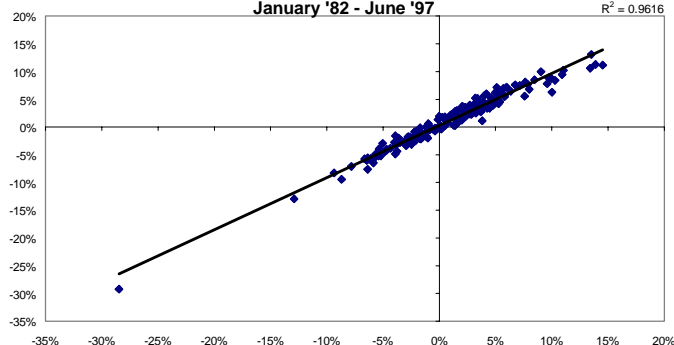
pears to be successful in providing the investor with a low cost exposure to the large company U.S. equity market.

Analysis of the Dimensional Fund Advisors 9-10 Fund

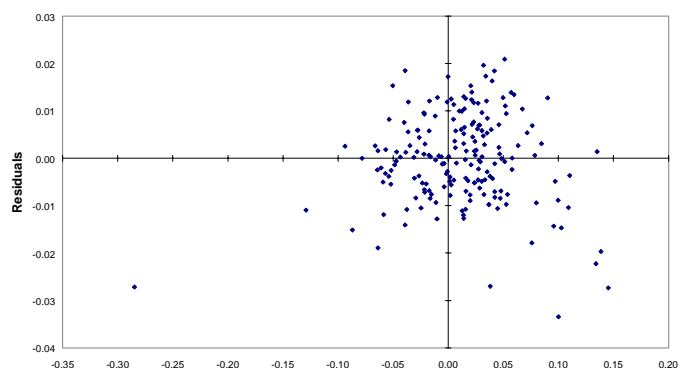
The following is the tabular and graphical output for one of the DFA structured asset class mutual funds, covering the period January 1982 through June 1997. The 9-10 fund is based on the CRSP (Center for Research in Security Prices) 9-10 Index.¹³

	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%)	0.0074	0.0070

DFA 9-10 Fund Monthly Returns / CRSP 9-10 Index
January '82 - June '97



DFA 9-10 Residual Plot



Sinquefield argues that the illiquid nature of the small company equity market generates formidable bid-ask spreads. To overcome the high costs of trading, strategies that are often considered to be in the exclusive domain of active management may be profitably employed.

ANOVA					
	Degrees of Freedom	SS	MS	F	Significance of F
Regression	1	0.4219	0.4219	4611.37368	3.1983E-132
Residual	184	0.0168	9.1485E-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
CRSP 9-10	0.9380	0.0138	67.9071	3.198E-132	0.9108	0.9653

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

The DFA 9-10 fund is an example of a passively managed structured asset class fund. In a 1991 article, Rex Sinquefield, a member of the Dimensional Fund Advisor’s board of directors, 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.”¹⁴

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.”¹⁵

Sinquefield argues that the illiquid nature of the small company equity market generates formidable bid-ask spreads. To overcome the high costs of trading, strategies that are often considered to be in the exclusive domain of active management may be profitably employed. 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.”¹⁶ 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 they are based; and
- 2) Overcome the costs of running the mutual fund.

More recently, Donald Keim cites another member of the DFA board of directors who noted 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.”¹⁷ 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 strategies; nevertheless, his decomposition of the 9-10 fund’s investment and trading strategies are particularly illuminating for this essay. Keim enumerates the differences between the fund and the index upon which it is based. The DFA 9-10 fund:

- 1) Excludes limited partnerships, bank-

Statistical analysis helps the fiduciary determine the extent to which the mutual fund has captured the investment performance of the market segment upon which it is based, as well as the success or failure of the fund in overcoming 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.

rupt firms, NASDAQ NMS stocks with less than four market makers, non-NMS stocks, stocks with a price less than \$2.00 or market capitalization less than \$10,000,000.

- 2) Delays purchasing Initial Public Offerings for six months to one year.
- 3) Holds stocks until they grow into the upper half of the 8th decile.

In addition to the above-listed investment rules, the DFA 9-10 fund employs the trading strategies outlined in Sinquefeld's article. 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 in 910 fund. 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." ¹⁸

Keim's analysis suggests the importance of avoiding uncritical acceptance of passively managed structured asset class funds. Statistical analysis helps the fiduciary determine the extent to which the mutual fund has captured the investment performance of the market segment upon which it is based, as well as the success or failure of the fund in overcoming 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.

Briefly, the data indicates 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 2% 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), nevertheless, the difference in means, at the 95% confidence level is not statistically significant. Although the out-performance 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 the R² statistic of .9616 evidences little overall unique risk for the 9-10 Fund. Indeed, the return patterns have a positive correlation of .9806. These observations are further confirmed by the very high value of the F statistic in the ANOVA section of the regression output.

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 for continued value-added performance in the future; and,
- there is evidence that management investment and trading policies can overcome expenses over a wide range of investment returns.

Secondly, despite the high R² and cross correlation statistic values, examination of the residual scatter plot evidences a much greater degree tracking error for the DFA 9-10 Fund compared to 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 subtraction of value as a result of management policies), nevertheless, the degree of monthly tracking error has been as high as approximately $\pm 3\%$. 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 by a system of benchmark comparisons.

Investors expect 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... Structured asset class mutual funds do not guarantee the market returns of their benchmarks.

Investors expect 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 that purchased the 9-10 fund at the beginning of 1991. During the next twelve months, the fund *underperformed* the CRSP Index by 6.98%. 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 3.78%. Structured asset class mutual funds do not guarantee the market returns of their benchmarks.

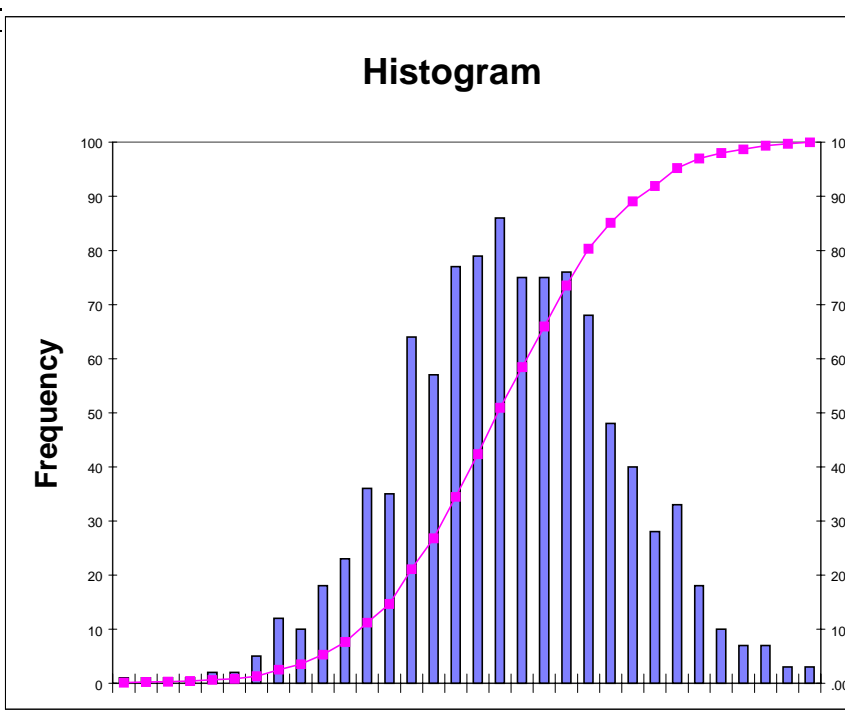
As we noted earlier, tracking risk can be approximated by the error terms of a regression analysis (difference between the fitted trend line and the actual values of the dependent variable). The history of an investment’s returns represents only a single path among many theoretical paths or “random walks.”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

The statistical methodology employed to acquire a more comprehensive picture is known as “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 back into the population of historical 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. The bootstrap data analysis technique enables us to break from the historical path in order to consider a wider range of mathematical possibilities.¹⁹ The histogram exhibits a 1,000-sample bootstrapped distribution of error terms for the 9-10 Fund.

The bootstrapped distribution indicates that the DFA 9-10 Fund has an approximately one percent chance of underperforming the CRSP benchmark by more than 8% per year. Although the minimum calculated value was 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 equals approximately 1.8% (-1.01 to +0.7).

Bin	Frequency	Cumulative %
-0.1139	1	.10%
-0.1073	1	.20%
-0.1006	1	.30%
-0.0939	1	.40%
-0.0873	2	.60%
-0.0806	2	.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%



FINAL OBSERVATIONS

Passively managed structured asset class funds are not indexes, should not be promoted by advisors as indexes, and should not be exempt from 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 requisite insight to make conscious 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.²⁰ 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 becomes meaningless. Rather, statistical analysis can be best 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" utilizes futures and other derivative instruments within the mutual fund's portfolio. Rather than a clear line of demarcation between active and passive management, there exists a spectrum of management styles. On this spectrum can be included the replication, and stratified cell index funds; the funds that select securities via "black box" screening or neural networks; the structured asset class funds; the "quantitative driven" mutual funds such as those offered by Rosenberg Institutional Equity Management; synthetic indexes (with or without accompanying cash management strategies) that utilize arbitrage or volatility-based strategies, and many others.²¹

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 becomes closer to market reality, the entire debate over the theology of active vs. passive management may be rendered moot.

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¹ Returns from Ibbotson Investment Planning Software, June 1977, Ibbotson Associates, Chicago, IL, (1997).

² Halbach, Edward C., Jr., "What Estate Planners Should Know About California's New Uniform Prudent Investor Act," Symposium presentation at The Thirteenth Annual San Francisco Trust Forum Sponsored by Northern Trust Bank (September 11, 1997)

³ Restatement of The Law Third: Trusts The American Law Institute (1992), §227. P. 8.

⁴ *Ibid.*, pp. 10-11.

⁵ *Ibid.*, pp. 28-30.

⁶ Sauter, George U., "Medium and Small Capitalization Indexing," Professional Perspectives on Indexing Frank J. Fabozzi (ed.) New Hope, Penn. (1997), pp. 89-94.

⁷ Good, W. R., & Hermansen, R. W., Index Your Way To Investment Success. The New York Institute of Finance (1997).

⁸ Vose, David Quantitative Risk Analysis: A Guide to Monte Carlo Simulation Modelling. John Wiley & Sons (1996), p. 295.

⁹ Levine, D.M., Berenson, M.L. & Stephan, D., Statistics for Managers Using Microsoft Excel, Prentice-Hall, Inc. (1998), pp. 149 – 150.

¹⁰ The discussion of regression analysis draws heavily from Ragsdale, Cliff T. Spreadsheet Modeling and Decision Analysis, International Thomson Publishing (1995) pp. 329-367. A Polynomial equation of the second order produces only a marginally better trend line.

¹¹ For a discussion regarding tracking error in indexed portfolios see Dynkin, L. & Hymn, J.M., "Quantitative Methods of Enhanced Fixed-Income Indexing," Fabozzi, Op. cit., pp. 231-233.

¹² Morningstar Principia for Mutual Funds, June 1997, Morningstar, Inc., Chicago, IL, (1997).

¹³ DFA Fund and CRSP Index returns from DFA Return Series, June 1997, Dimensional Fund Advisors, Inc., Santa Monica, CA

¹⁴ Siquefield, Rex A., "Are Small-Stock Returns Achievable?" *Financial Analysts Journal* (January/February, 1991) p. 49.

¹⁵ *Ibid.*, p. 49.

¹⁶ *Ibid.*, p. 50.

¹⁷ Keim, Donald B., "An Analysis of Mutual Fund Design: The Case of Investing in Small-Cap Stocks," Draft of unpublished paper dated April 13, 1997. P. 5. Final version to appear in forthcoming issue of *Journal of Financial Economics*.

¹⁸ *Ibid.*, p. 6.

¹⁹ For a discussion of the bootstrap, see Sortino, Frank A., & Forsey, Hal J., "On the Use and Misuse of Downside Risk," *The Journal of Portfolio Management* (Winter, 1996), pp. 35-42. The Excel 'Sampling' Analysis tool is described in Middleton, Michael R., *Data Analysis Using Microsoft Excel* (Duxbury Press, 1997).

²⁰ For a discussion regarding the issues surrounding selection of a benchmark see Neubert, Albert S., "Knowing Your Indexes: Background, Definitions, and Rules," Fabozzi, Op. cit., pp. 61-66.

²¹ Loftus, John, "Enhanced Equity Indexing," Op. cit., pp. 41-49.