

The Role of Returns-Based Style Analysis:
Understanding, Implementing, and Interpreting the Technique

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Introduction

Since its introduction in 1989, returns-based style analysis has fundamentally changed the way many investment analysts assess the behavior of money managers.¹ A number of firms quickly appreciated the benefits of this new technique and began selling software that would perform the necessary calculations. Today, style analysis is no longer housed only within the purview of highly paid consultants and mutual fund rating agencies, instead, anyone with a PC and a little data can assess the style of managers and mutual funds.

Of course, as with any sophisticated new technique, returns-based style analysis has been the source of considerable debate. Generally we have found that the debate relates to two main areas: 1) the role of returns-based style analysis and 2) proper implementation and application of the technique. The purpose of this paper is first to provide a quick summary of what returns-based style analysis is. We then will do some trouble-shooting, addressing potential pitfalls one by one, with an eye to providing insights and methodologies for effective implementation and interpretation of the analysis.

¹ Returns-based style analysis was first introduced by William F. Sharpe in two articles "Determining a Fund's Effective Asset Mix," *Investment Management Review*, December 1988, pp. 59-69 and "Asset allocation: Management style and performance measurement," *The Journal of Portfolio Management*, Winter 1992, pp. 7-19. Sharpe originally used the terms "effective asset mix" and "attribution analysis" describing his work. In recent years the term "returns-based style analysis" has frequently been used to describe the Sharpe method. The purpose of this term is to highlight the technique's reliance on past returns as opposed to other techniques of style or attribution analysis which do not rely on returns. Finally, "correlational analysis" and "return pattern analysis" (first put forth by consultants at Frank Russell) have also been used.

What is Returns-Based Style Analysis?

Returns-based style analysis is a statistical technique that identifies what combination of long positions in passive indexes would have most closely replicated the actual performance of a fund over a specified time period. The passive indexes selected typically represent distinct investment styles within particular asset classes. For example, we might use returns-based style analysis across the large company stock, international stock, and small company stock indexes for an equity manager with a global mandate (“Global Fund”). Given a time period of, say January 1985 to December 1987, we may see results such as 50 percent international stock, 25 percent large company stock, and 25 percent small company stock.

The interpretation of these results is that the Global Fund behaved as if it had a 50 percent allocation (or weighting) to an international stock index fund, 25 percent to large company stocks index fund, and 25 percent to a small company stock index fund. The R^2 statistic identifies how well this constant 50-25-25 allocation tracked the Global Fund’s actual performance over the 1985-87 period.² In this case, the 50-25-25 allocation was associated with 92 percent of the variability of the manager's actual performance. The remaining 8 percent is due to the manager's exposure to other asset classes not included in the analysis, the manager's selection of securities that behaved differently than the passive indexes selected, market timing on the part of the manager between different asset classes, or statistical error.

² R-squared is a statistical measure that quantifies the degree to which the benchmark portfolio can explain the long-term behavior of the mutual fund.

How is Returns-Based Style Analysis Used?

Benchmark Indices

A popular application of returns-based style analysis is to use the weights or exposures to passive indexes to create a benchmark for the purpose of attribution analysis. For example, the benchmark portfolio in the Global Fund example would consist of 50 percent international stock, 25 percent large company stock, and 25 percent small company stock. This portfolio represents a reasonable passive alternative to the manager's active management. We could then compare the performance of the benchmark portfolio over a subsequent time period, say, the next quarter (January 1988 to March 1988) to the actual fund performance. If we assume that the set of passive indexes used fully captures the asset classes and style exposure of the manager and that there was no style shift between the period used to create the benchmark portfolio (in this example, January 1985 to December 1987) and the evaluation period (in this example, January 1988 to March 1988), the difference in returns between this benchmark and the actual fund are the returns due to the manager's active security selection independent of other factors.

A benchmark created with returns-based style analysis meets the major criteria for appropriately measuring manager performance: it is identifiable in advance, it is a viable alternative, it is not easily beaten, and it is easily constructed.

Asset Allocation Policy

The other common application of returns-based style analysis is in implementing a strategic asset allocation policy. Investors have increasingly focused on targeting a given asset mix in hopes of locking in an expected rate of long-term return and risk. While techniques such as mean-variance optimization have been able to pinpoint the expected

risk-return tradeoff for given asset mixes, they do not show how to match up the desired mix with actively-managed mutual funds of the appropriate style. Because of its ability to match mutual fund behavior with asset classes, returns-based style analysis is nicely suited for the task of accurately implementing target asset mixes.

Suppose an investor wants to allocate 25 percent of his portfolio to international equities. The investor wishes to find an international fund that has a large exposure to the international index: he would then make that fund 25 percent of his portfolio. Considering our example earlier, returns-based style analysis shows that the Global Fund might not be an effective way to implement this strategy. The addition of Global Fund will fail to raise the investor's exposure to the desired amount of international stocks: only 12.5 percent exposure may be achieved instead of the desired 25 percent exposure due to the fact that Global Fund has only an estimated 50 percent exposure to the international stock index.

To properly implement the optimal mix, the investor can choose another fund that does have 100 percent estimated exposure to international according to returns-based style analysis. Alternatively he can use returns-based style analysis to locate the funds that would complement Global Fund's exposures and still achieve the desired asset mix.

Paradigm Shift

It is important to understand that estimating the historical behavior of a fund based on performance—as returns-based style analysis does—differs dramatically from calculating portfolio characteristics based on the portfolio holdings of a mutual fund. For example, a domestic equity mutual fund investing in stocks that derive a majority of their revenue from sales abroad will clearly be influenced by factors in foreign economies. If the foreign economies go into

recession, the fund will be affected. In this way, the fund, although domestic, responds to factors in foreign economies with a manner similar to an international equity fund. This is essential information in mapping the fund into an asset mix derived from basic asset classes. In William Sharpe's oft-quoted words, what is important here is that "If it acts like a duck, assume it's a duck."³ Returns-based style analysis is not going to dissect the creature to determine if its DNA belongs to that of a duck, but it will tell you if it has enough duck-like characteristics to qualify.

As an estimate, returns-based style analysis' role is not to replace fundamental analysis, but to replace other estimates such as broad benchmarks or the manager's self-proclaimed style. In other words, *it is meant to provide a better alternative for those who have neither the time, nor the resources to use fundamental analysis.*

Comparing Returns-Based Style Analysis to Fundamental Analysis

As practitioners are well aware, while mutual fund returns are readily available, timely mutual fund holdings can be difficult to obtain. In fact, even mutual fund experts can run into roadblocks. A survey of the December 1995 release of Morningstar's *OnDisc*TM showed that roughly only 1/5 of the portfolios it tracks had been updated within the past three months. A review of the October, 1995 release of Value Line's Fund AnalyzerTM software showed that roughly less than half of the mutual fund portfolios tracked had any reported portfolio holdings at all. If Morningstar and Value Line have

³ William F. Sharpe, "Determining a Fund's Effective Asset Mix," *Investment Management Review*, December 1988, pp. 59-69

such difficulty obtaining up-to-date mutual fund holdings, imagine how difficult it is for the typical financial planner to obtain such information on a regular basis.

To analyze a mutual fund using returns-based style analysis, the only data that is required are the total returns for the mutual fund and that of a set of passive indexes. This data is readily available on a timely basis (to the point that daily total returns can be looked up in newspapers or downloaded from a variety of on-line services), objective, and uniform. In contrast, fundamental analysis requires a mutual fund's current and historical portfolio holdings, manager interviews (to get a sense of the manager's decision-making process), turnover ratios, current prospectuses, etc. These data tend to be difficult to obtain on a timely basis, complicated to interpret, and often lacking in uniformity (what may be listed as a derivative in one list of portfolio holdings can often be defined as a simple GNMA in another). Moreover, while institutions may have the resources to pay consultants to do elaborate fundamental analysis, individuals and financial planners generally do not. In the best of all possible worlds, fundamental analysis and returns-based style analysis might be equally simple to perform. In reality, however, returns-based style analysis is in a league of its own when it comes to pure feasibility for most investors.

Because of the onerous data requirements of fundamental analysis, investors with limited time and resources are likely choosing between one "simplified estimate" and another: that is, returns-based style analysis or categorizing mutual funds according to very broad definitions (equity funds are simply grouped together and compared to a single index such as the S&P 500) or according to managers' stated objectives. Given the higher R^2 s associated with customized benchmarks versus a single index, returns-based style

analysis adds considerable value. Again, referring to a survey of the December 1995 release of Morningstar's *OnDisc* we find that the average U.S. diversified equity fund shows an R^2 of 65 percent when compared to broad benchmarks such as the S&P 500. When using returns-based style analysis, however, the average R^2 rises to 86 percent.⁴

No Panacea

Returns-based style analysis does not pretend to have all of the answers regarding mutual-fund style: no analytical tool does. Analytical tools give some information, but not all information, and they must be interpreted carefully. Take the example of ratings systems such as the Morningstar star rating. Like returns-based style analysis, this system is quantitative in nature and uses as inputs historical data. The star rating system examines the risk-adjusted historical performance of mutual funds and then ranks funds on a bell curve according to that performance. Because the ratings are backwards looking, they require careful interpretation, however. When a group of funds, such as high-yield bonds funds, international funds, or derivatives funds have limited back histories upon which to judge performance, the ratings results can be misleading. The example of Piper Institutional Government Income Fund is a perfect case in point. On May 13, 1994, Morningstar's ratings—examining the very limited history of the fund, which was started in 1988—awarded Piper Institutional Government Income Fund five stars. Only two weeks later, as more information became available, the fund dropped to a one-star rating. Was the star-rating a failure because it did not anticipate Piper Institutional Government Income Fund's fall from grace? If one expects the star rating system to be a panacea that

⁴ Data from the December 1995 release of Ibbotson Associates Fund Strategist is used in this analysis. Fund Strategist analyzes the returns-based style analysis results of all diversified equity and taxable fixed income mutual funds with greater than three years of performance history.

accurately forecasts all of the fund's future behavior—it was ineffective. Realistically, however, the star rating system was only guilty of giving limited information. Because it was not able to analyze Piper Institutional Government Income Fund over a full market cycle, the information it could convey was limited in its scope, but not inaccurate. Until that point, the fund had low risk and high returns.

In practical terms, the best analytical tools are not expected to be panaceas, but should be expected to quantify and clearly define their own limitations. As we'll see in subsequent sections, on this basis, returns-based style analysis scores well. At its most basic level, the regression analysis used in returns-based style analysis results in statistics such as R^2 which reveal at a glance the scope of the validity of the analysis.

Mathers Fund: An Example

For example, the Mathers Fund has one of the lowest R^2 s (27 percent) of any mutual fund with three years of performance history when analyzed using returns-based style analysis.⁵ (Recall that because R^2 quantifies the degree to which the benchmark portfolio can explain the long-term behavior of the mutual fund, analyses accompanied by low R^2 s should be viewed with greater caution than those with high R^2 s.) The style analysis results show that the fund is mostly exposed to defensive benchmarks such as cash; however, the low R^2 indicates that in all probability, there is much that this analysis is not capturing—further investigation into the fund's characteristics is recommended. Does a low R^2 mean the analysis is a “failure?” In fact, the analysis has provided very valuable information about Mathers Fund. It has shown that this is a unique fund that is

⁵ Analysis taken from Ibbotson Associates Fund Strategist, December 1995. See End Notes for methodology.

not easily pigeonholed according to traditional benchmarks. That the analysis does not give the details of this uniqueness is not a failure—but a limitation. Returns-based style analysis has done its job as an analytical tool with Mathers Fund: you would not wish to use this fund as a traditional component of an asset mix.

Proper Implementation and Application of Returns-Based Style

Analysis

Having developed an understanding of the role of returns-based style analysis, the next step is to understand how to implement and interpret it. Like all forms of analysis, returns-based style analysis is only as “intelligent” as the data-input choices and analytical skills of those that use it. In terms of inputs, the time frame of the style and exposure distribution regressions and the selection of benchmarks are crucial. When it comes to interpretation, what will make the difference between meaningful assessments and misleading ones is whether the analyst has made use of the checks and balances system inherent in the technique. Beyond the simple overall (or average) style analysis, there is a wealth of information associated with returns-based style analysis including the exposure distribution area graph (or rolling style chart), the R^2 , and performance attribution figures such as selection return, market timing return, total alpha, and t-statistic.

Appropriate Benchmarks

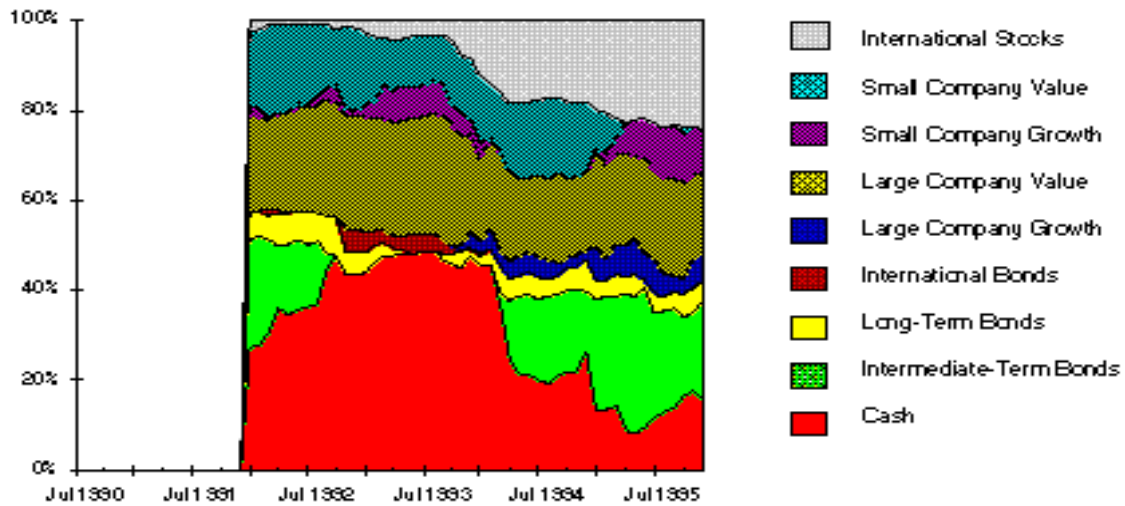
In a recent paper on returns-based style analysis, a regression applied to Fidelity Asset Manager showed that only 5% of the fund’s performance was allocated to foreign benchmarks during 1993 and 1994. Fundamental analysis, in contrast, showed that in 1993 the fund began building a stake in international securities, including a 20 percent in Latin American debt. The author of the paper wondered why the results of the returns-based

style analysis were so far off from those of fundamental analysis. The answer is simple: improperly applied analysis.

We performed our own analysis of Fidelity Asset Manager, using carefully selected comprehensive and mutually-exclusive benchmarks: cash, intermediate-term bonds, long-term bonds, large company growth, large company value, small company growth, small company value, international bonds, and international stocks. (Note we did not include a mid-cap index because that would correlate too highly with the small- and large-cap style indexes.) We selected a rolling return period of 36 months, which is short enough to capture considerable style movement, while remaining long enough to avoid excessive “noise” in the data. We examined the fund from its inception in December of 1988 through December of 1995.⁶

Fidelity Asset Manager Exposure Distribution Area Graph

⁶ Analysis taken from Ibbotson Associates Fund Strategist, December 1995. See End Notes for methodology.



The results of our analysis show that exposure to foreign benchmarks appeared in early 1993, and by the end of 1993, roughly 20% of returns were allocated to the international stock benchmark. This is quite different than the 5% foreign exposure reported in the author’s paper. The likeliest reason for the discrepancy in results is the choice of style benchmarks. If the benchmarks overlapped, noise would result as the model struggled to differentiate between the benchmark returns. If they were not comprehensive, a poor fit would result (again, creating noisy results) as the model—which is typically constrained to attribute 100% of the fund’s performance to the selected benchmarks—strived to make a match between the fund returns and the returns of the indexes. Alternatively, if the analyst used infrequent data, or exposure periods that were too long, the results may also have been affected. Whatever the reason, it is clear that a properly performed analysis would have resulted in a picture of Fidelity Asset Manager that matches what is known about the fund from fundamental analysis.

Understanding Unstable Results

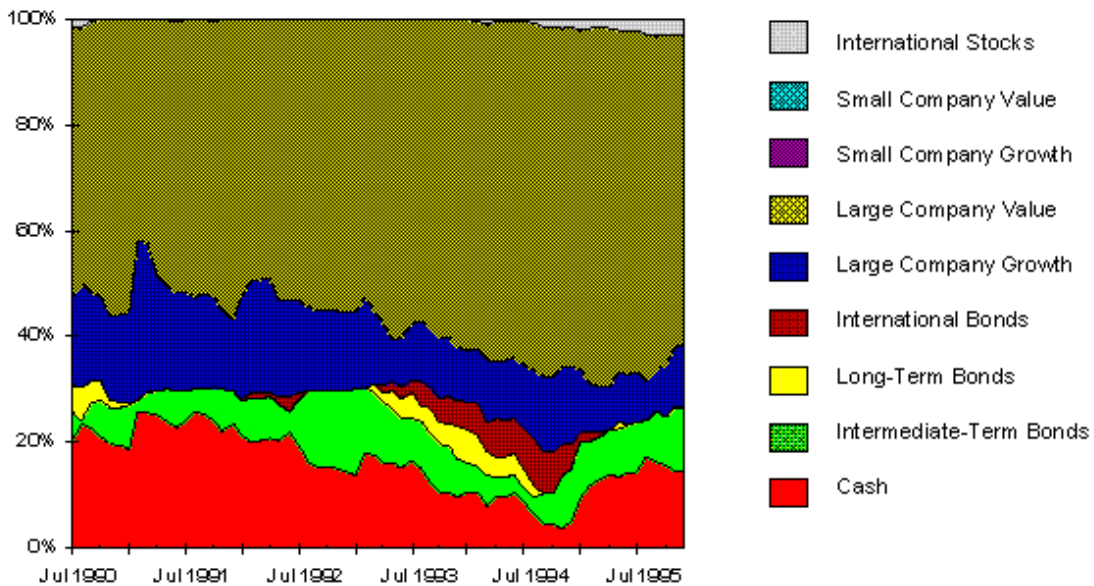
Of course, the instability of results that accompanies poor implementation and interpretation is a problem that plagues all of investment analysis whether it is quantitative in nature or not. In a September, 1995 written summary based on fundamental analysis, Fidelity Magellan manager Jeffrey N. Vinik was quoted as being unlikely to “radically change the fund’s weightings any time in the near future.” This assessment specifically included his fund’s 43% position in technology. However, by February of 1996, the same publication reported that the technology weighting had declined to 36% and that “Vinik’s three-year love of technology and semiconductor stocks came to an abrupt end.” Clearly this end was an unexpected one, too, from the perspective of the fundamental analyst. Because mutual fund behavior is unstable, all analytics related to mutual funds have an element of instability, especially if poorly implemented or interpreted.

Exposure Distribution Area Graph

Fortunately, the checks and balances system inherent in returns-based style analysis allows practitioners to easily assess the accuracy and stability of results. One of the easiest ways to determine how stable a fund—or its results—have been is in the exposure distribution area graph, also known as rolling style or style over time. This graph shows the changes in a mutual fund’s style by graphing the output from a series of rolling period regressions. For example, the monthly returns of a fund might be compared to those of a set of benchmarks over rolling 36 months periods for the past ten years (January 1986 through December 1995). The first regression would find the mix of asset classes that best matches the mutual fund’s returns from January 1986 through December 1988. After this allocation is determined, a second regression is run for the next period, which in this case

would be from February 1986 through January 1989. This is continued until there are only 36 months of data left, and then the last regression is run. The output from all of the regressions is shown in the exposure distribution area graph, with the result being that a dynamic view “over time” of the fund’s style—and changes in style—is portrayed.

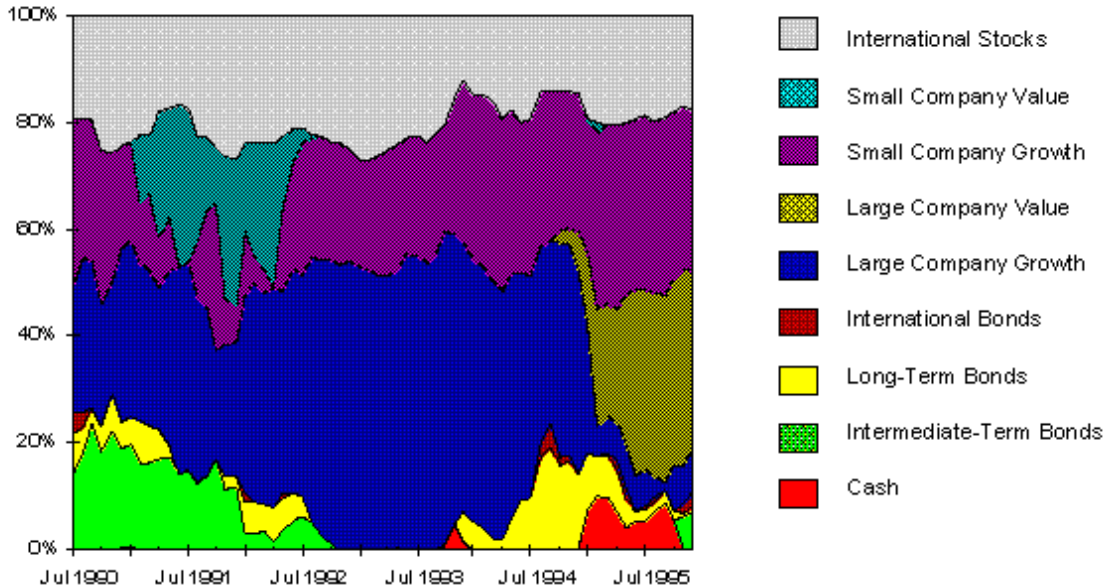
American Mutual Fund Exposure Distribution Area Graph



The exposure distribution area graph above charts the estimated style over time of American Mutual Fund between July 1987 and December of 1995⁷. From the chart we can see that the fund’s exposure to various styles has been fairly consistent. Consistently, a large portion of American Mutual’s return has been attributable to the large company value benchmark. Lesser exposures to Cash, Intermediate-Term Bonds, and Large Company Growth have also been relatively consistent over time.

⁷ Analysis taken from Ibbotson Associates Fund Strategist, December 1995. See End Notes for methodology.

Berger 101 Fund Exposure Distribution Area Graph



In contrast, the exposure distribution area graph of Berger 101 Fund (above) is relatively inconsistent.⁸ Exposure to large company growth and large company value have vacillated; the fund has periodically shown exposure to the long-term bond benchmark and the cash benchmark; small company growth exposure has occasionally given way to small-company value exposure.

The instability in the exposure distribution area graph of funds such as Berger 101 has four potential sources: (1) the way in which the fund is managed, (2) changes in the nature of the securities themselves, (3) noisy data, and (4) poorly selected passive indexes.

Fund Management

An active exposure distribution area graph could indicate market timing or sector rotation. The fund manager may be switching in and out of asset classes or sectors, with the result that the customized benchmark that best explains the fund's returns constantly

⁸ Analysis taken from Ibbotson Associates Fund Strategist, December 1995. See End Notes for methodology.

changes. Because a high fund turnover ratio will accompany market timing, it is generally easy to detect when that might be the case.

Changes in the Nature of the Securities

If the turnover on the fund is low, it could be that the securities themselves are changing. Funds with high concentrations in individual securities are candidates for this type of activity within the exposure distribution area graph. Sequoia Fund, for example, has an extremely active exposure distribution area graph, but a turnover that rarely exceeds 30% annually. The fund only owns a handful of holdings, however, with its top stock position most recently reported to account for 27% of its assets. Clearly, this fund will be highly sensitive to how quickly this holding goes in and out of favor, how much it behave like a value or growth stock, etc.

Noisy Data

If there are any errors in the data that underlies the regression —e.g., an incorrect total return—vacillations in the exposure distribution area graph may also result. For example, in entering the returns for a bond fund, the analyst might type 0.20 instead of 0.02 for the monthly total return. Given the magnitude of the difference (18%), that particular return might correlate with an equity benchmark instead of its appropriate fixed-income benchmark.

Poorly Selected Passive Indexes

One of the most essential elements in performing returns-based style analysis is to use the appropriate benchmarks: ones that are comprehensive and yet mutually exclusive. If benchmarks are too highly correlated (not mutually exclusive), when the regression

attempts to match the fund's return over a shorter time period, the factor weightings may oscillate between the two highly correlated assets from period to period. Likewise, if the set of benchmarks is incomplete, when the regression attempts to match the fund's returns, it will have trouble pinning down a benchmark that consistently explains the fund's behavior from period to period. As mentioned earlier, the typical returns-based style analysis will use a constrained regression—meaning the sum of the benchmark exposures must equal 100%. Therefore, the model must find a fit with one of the benchmarks being used. If those benchmarks are inadequate, the regression is likely to flip-flop between those that temporarily provide a best fit (a fact which will also likely be reflected in a low R^2).

There are no iron-clad guarantees that a vacillating exposure distribution area graph signals actual changes in portfolio style. However it does not require much digging to get to the heart of which of the above factors have caused an unstable looking exposure distribution area graph. A high turnover is a likely sign that market timing or sector rotation is behind the vacillating exposures. A highly concentrated portfolio likely indicates that changes in the stocks themselves explain the results. If neither explanations fit, it may be necessary to try alternative benchmarks or reexamine the underlying total return data. As we noted earlier, no mutual fund analysis is foolproof.

Viewing Data in a Vacuum

Interestingly, many who use returns-based style analysis never even view the exposure distribution area graph, preferring to focus on the results of the Style Analysis Chart instead. The style analysis chart provides a long-term perspective of the “average” fund style, usually either in the form of a bar chart or even a single number (e.g., average

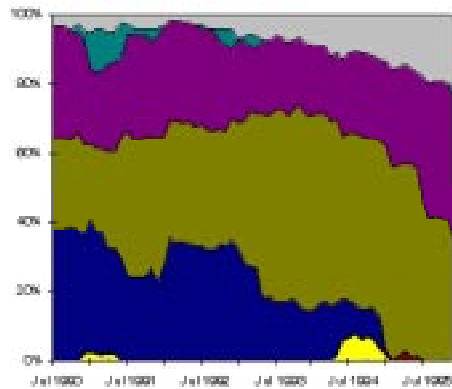
fund exposure to large company growth is 20%). The overview perspective of the style analysis chart makes it one of the easier outputs of returns-based style analysis to interpret—but also one of the more potentially deceptive if viewed in a vacuum. The typically long time frame of the style analysis bar chart (the regression period is often as long as ten years) tends to mask recent changes in style.

Getting back to the example of Fidelity Magellan, from the pair of charts below we can see quite clearly how deceptive it would be to view only the style analysis chart (long term or “average”) results of this fund without considering changes in style over time. While a long-term style analysis might span a period that would include former manager Peter Lynch’s tenure, exposure distribution area graphs—which would commonly show shorter-term regressions of three years—can illustrate trends in fund style that result from manager changes. Below we have the style analysis bar chart (on the right) and the exposure distribution area graph (on the left) for Fidelity Magellan. The style analysis bar chart shows the overall eight-year style of the fund; the exposure distribution area graph is comprised of three-year rolling periods spanning mid-1990 to year-end 1995 to show the style over time.⁹ It is clear from this latter graph that the fund’s style has changed since manager Jeffrey Vinik began in 1992: exposure to the large company growth index has declined, replaced with increasing exposure to the international index and the large company value index. This is not portrayed so clearly in the style analysis bar chart.

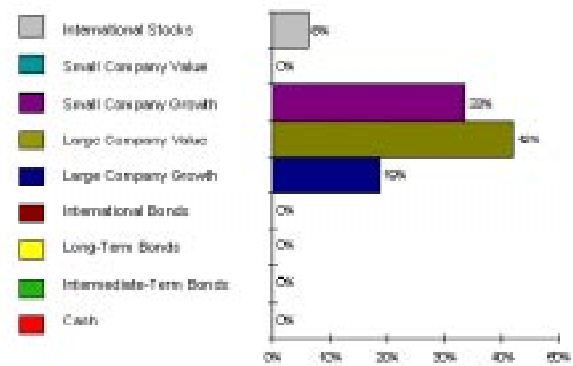
Fidelity Magellan Style Analysis Results

⁹ Analysis taken from Ibbotson Associates Fund Strategist, December 1995. See End Notes for methodology.

Exposure Distribution



Style Analysis



Changes in Manager or Objective: Selected American Shares

Returns-based style analysis has been accused of providing results that are dated (because of the rear-view nature of the analysis). When practitioners refer only to the style analysis bar chart, this is certainly a danger. However, the exposure distribution area graph shows a more recent style picture (based on its shorter regression) and provides vivid evidence of a mutual fund’s “tracks in the sand”—the trends in style over time.

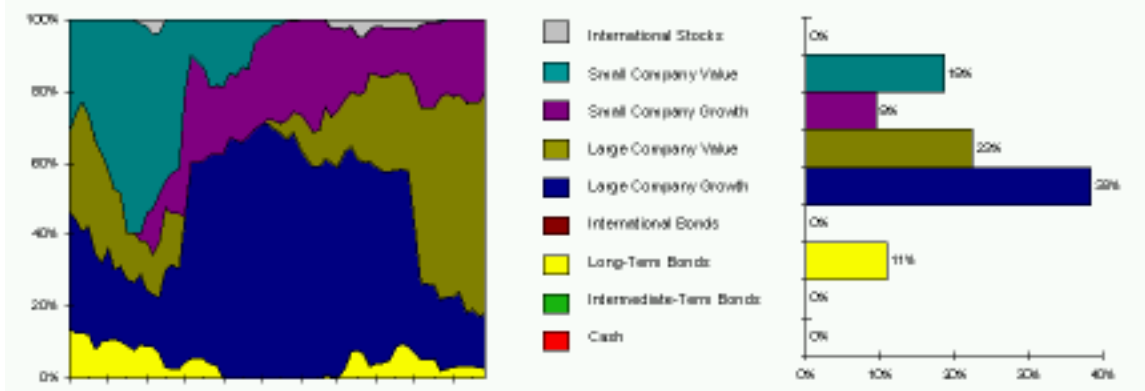
How important are the full scope of tracks in the sand? Take the case of Selected American Shares, which underwent a series of manager changes in the early 1990s—beginning with the departure of Donald Yachtman. Those engaged in fundamental analysis suggested that everything that had been written previously about the fund (including any ratings) was up for grabs: Yachtman’s idiosyncratic style could not be expected to be maintained under new management. Practitioners were advised to view the fund’s long-term total returns and overall risk and ratings within the context of short-term performance (as short-term performance was more relevant). Note, they were not advised to disregard long-term performance—indeed, to this day (after two additional managers changes) the fund’s reported returns and risk ratings consistently continue to include

performance that pre-dates current management in most fundamental analysis reports. Even adherents to fundamental analysis do not advocate erasing tracks in the sand.

The exposure distribution area graph of Selected American Shares shows that the fund's tracks in the sand are very informative indeed.¹⁰ From the exposure distribution area graph we can see that the fund underwent a material change in its style—it is not even necessary to specifically know that a manager change occurred. It is equally clear that if *only* the overall long-term style figures were reviewed the change would be difficult to detect. Just as any analysis can be misleading if only part of data is considered, an understanding of a fund's tracks in the sand can be difficult if both the overall style and the exposure distribution area graph are not reviewed in tandem in a returns-based style analysis.

Selected American Shares Style Analysis Results

¹⁰ Analysis taken from Ibbotson Associates Fund Strategist, December 1995. See End Notes for methodology.



R-Squared

Another area that is sometimes problematic for those who implement and interpret returns-based style analysis is R^2 . Because R^2 quantifies the degree to which the benchmark portfolio can explain the long-term behavior of the mutual fund, it is the self-auditing feature of style analysis (although some have mistaken it for a pure measure of the component of value added). The higher the percentage value of the R^2 , the better, and often more consistently, the style analysis portfolio is able to explain the long-term return behavior of the fund. A low or moderate R^2 may be the result of many factors, only one of which is security selection.

To determine the source of a low R^2 , it is essential that the R^2 be viewed in context. Below is the R^2 of Janus Venture Fund viewed within the context of most of the relevant statistics associated with returns-based style analysis.¹¹ The R^2 of Janus Venture is modest—but is it modest due to selection return or due to other factors such as inconsistent behavior by the fund or poor benchmark selection?

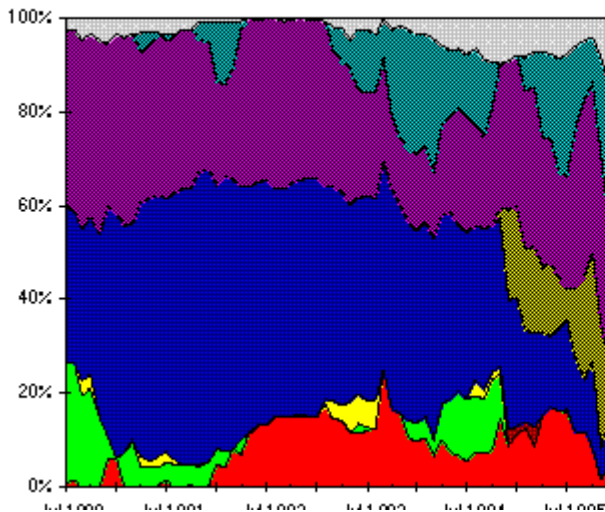
¹¹ Analysis taken from Ibbotson Associates Fund Strategist, December 1995. See End Notes for methodology.

Janus Venture Fund: An Example

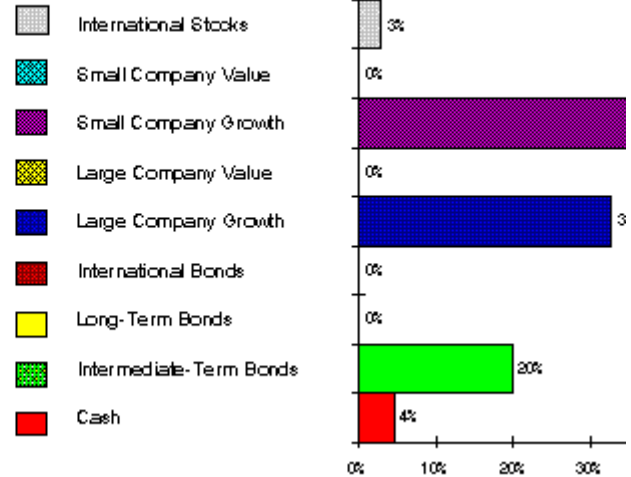
Again, evidence of a fund's style inconsistency idikely be demonstrated in the exposure distribution area graph, and that is the first place one should look when confronted with a low R^2 . The exposure distribution area graph below shows the rolling three-year exposures of Janus Venture Fund since 1987. It indicates considerable fluctuations and variability in benchmark exposures. Note how the small-company growth, large-company growth, and intermediate-term bonds benchmarks—which account for a large percentage of performance in the overall style analysis (the style over the past eight years)—in recent exposures have diminished in terms of explanatory power. The inconsistency of the exposure distribution area graph and the lack of correspondence between the style analysis chart and the exposure distribution area graph are strong evidence that in the case of Janus Venture Fund's low R^2 , inconsistency of style, not purely selection return, may account for the low R^2 . The inconsistent exposure distribution area graph is also accompanied by an annual turnover that generally exceeds 100%. This lends further credence to the idea that the low R^2 is more a function of changes in investment style over time as opposed to pure manager value added in terms of stock selection.

Janus Venture Fund

Exposure Distribution



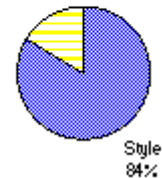
Style Analysis



R-squared

Background Data

	1991	1992	1993	1994	1995
Turnover	167%	124%	139%	114%	NA
Expense Ratio	1.04%	1.07%	0.97%	0.96%	NA
Net Assets (\$Millions)	\$1,464	\$1,706	\$1,779	\$1,496	\$1,790



Other Sources of Low R^2

It may be that the statistics that accompany the R^2 in a returns-based style analysis paint a different picture: turnover may be low and/or the exposure distribution area graph may be consistent. In this case, it may be necessary to examine the fund's prospectus to learn if the fund is permitted to invest in unusual or exotic securities (such as derivatives). If the fund can, the low R^2 may be signaling that the fund is holding such assets, and that these assets are not well explained by the benchmarks used in the analysis. Again, the important point here is that R^2 is most informative within the context of other relevant data. Moreover, only when inconsistency of the fund's style, or inadequacy of the

benchmarks have been ruled out should one assume that R^2 is purely signaling the extent of selection return contributed by the manager.

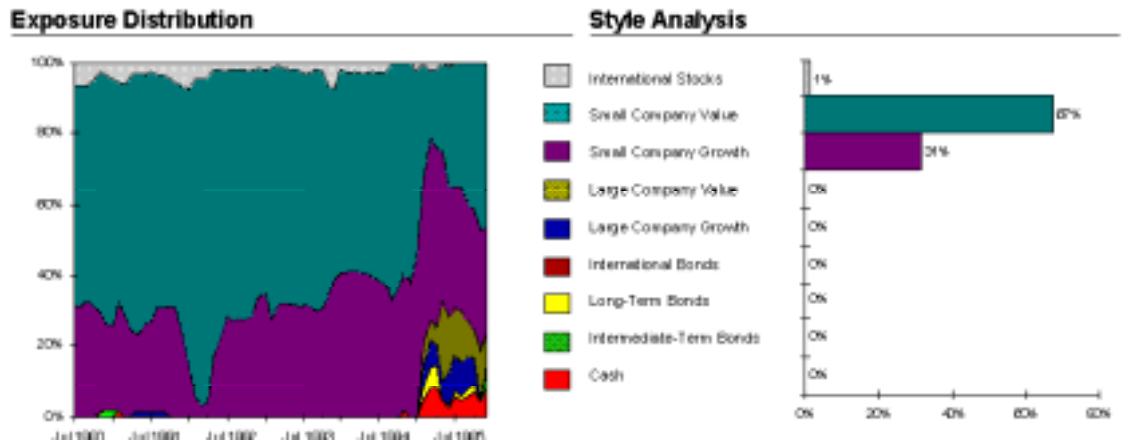
When Results Aren't Noisy

DFA U.S. 9-10 Small Company Portfolio: An Example

When statistics such as R^2 , rolling style over time, and long-term style are viewed in tandem, what may otherwise be construed as “noise,” may in fact emerge as important insight into the fund. DFA U.S. 9-10 Small Company Portfolio has been erroneously cited as a fund whose returns-based style analysis results contain an unwarranted amount of “noise.” The fund, of course, is considered to be a value-oriented index-like small-company fund in that its charter specifically calls for it to only invest in companies traded on the NYSE, the AMEX, or the over-the-counter market that have market capitalizations comparable with those in the smallest quintile of the NYSE. Given the fund's stringent charter, how can the returns-based style analysis of DFA U.S. 9-10 Small Company spanning eight years through December of 1995 show that the fund has experienced certain shifts in style over time from small company value to small company growth¹³

DFA U.S. 9-10 Small Company Portfolio Style Analysis Results

¹² Analysis taken from Ibbotson Associates Fund Strategist, December 1995. See End Notes for methodology.



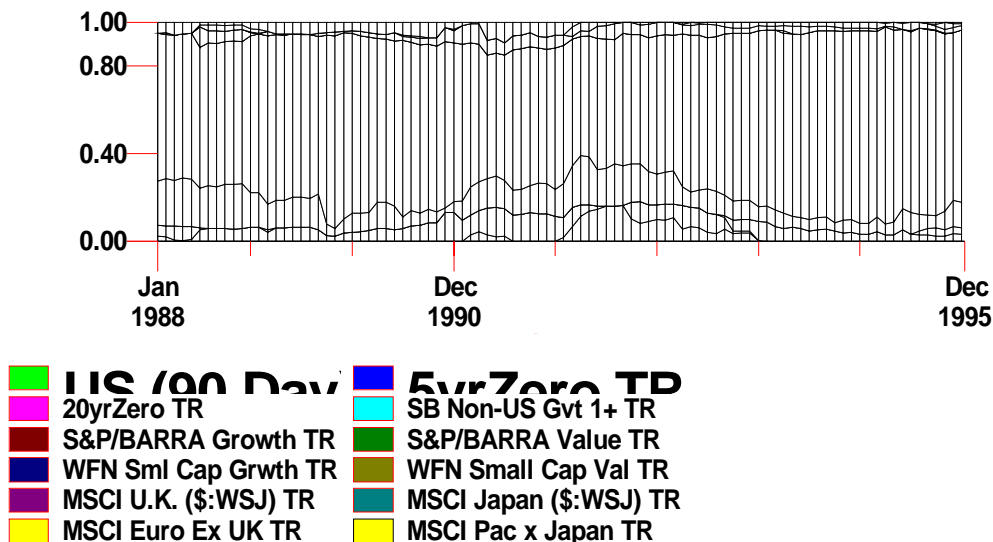
Investigating the fund further we learn that it is actually not managed in accordance with the strictest rules of indexing. Notably, the fund excludes those stocks within its indexes whose marketcapitalizations are less than \$10 million, or securities that don't actually qualify as operating companies, such as ADRs, REITs, and investment companies. Also, it won't automatically buy or sell stocks that drift into lower deciles, nor will it purchase bankrupt firms. This fund "activity" is clearly being picked up in the style analysis (for example, the style analysis may be giving a glimpse of how stocks in the fund's portfolio have drifted into lower sizedeciles).

The important point to keep in mind is that nothing in the fundamentals of the fund is materially at odds with a returns-based style analysis of the fund. These results are not really noisy at all. In fact, the returns-based style analysis of the fund reveals important aspects of DFA U.S. 9-10 Small Company that may not be apparent in its low turnover and stated objectives. If an investor had done quick and dirty fundamental analysis on the fund, they could easily have overlooked these anomalies in behavior. Returns-based style analysis, however, would have alerted the investor to the need for further analysis regarding this unusual "index" fund.

Lexington Corporate Leaders: An Example

The case of Lexington Corporate Leaders is another prime example of a purported noisy analysis that isn't so noisy after all when the results of returns-based style analysis are properly evaluated. The fund is unusual as, according to its prospectus, it was established as a Grantor Trust in 1935. Originally, it purchased 30 of the leading companies in America: there was no expectation of turnover. Although one might expect a very consistent exposure distribution area graph for Lexington Corporate Leaders associated with returns-based style analysis, that isn't the case. We performed an analysis using the following benchmarks, which were again chosen to be comprehensive and mutually-exclusive: cash, intermediate-term bonds, long-term bonds, large company growth, large company value, small company growth, small company value, international bonds, and international stocks. Our rolling return period was 36 months, and we examined the fund from January of 1985 through December of 1995.

Lexington Corporate Leaders



The results of our analysis show that the fund's large company growth exposure has ranged from roughly 5% to 25%, and that there has also been occasional exposure to other benchmarks. Why has the fund's style drifted if it has had no turnover? Digging further into some very basic fundamental analysis, we see that Lexington Corporate Leaders' portfolio, while not adding any new stock names (as per its charter) has certainly adjusted its stock positions (for example, a list of portfolio holdings from September of 1995 showed that the fund had recently reduced its stake in Santa Fe Pacific). In addition, between its origination and the present, the fund has removed eight of its original 30 stock holdings altogether, with spinoffs such as Praxair (from Union Carbide) also changing the portfolio composition. Finally, the style of the stocks themselves has "drifted." Allied Signal, for example, sported a price to book value that was less than half that of the S&P 500 in the early 1990s; however as of 1995 the stock's price to book ratio had climbed to 101% that of the S&P 500, indicating a material change in style. Given that Allied Signal

was nearly 4% of total portfolio assets in 1995, this change in stock style would likely translate into a measurable change in fund style. From this perspective, the marginal style drift revealed in the analysis of Lexington Corporate Leaders does not appear to be faulty at all, but a useful insight into the fact that even a low turnover fund such as this one is not necessarily static. Used properly, returns-based style analysis pinpoints important style information that anyone just performing a “quick and dirty” fundamental analysis of a fund (e.g., examining turnover and the fund’s stated objective) is likely to overlook.

Attribution Analysis

When it comes to performance attribution, there are many checks and balances available for those looking to interpret results—revealing that returns-based style analysis is actually quite a robust analytical tool. Practitioners can view selection, market timing, and total alpha return in assessing a fund’s value added relative to its customized benchmark, its value added relative to its average style, and its total value added, respectively.

Selection Return

Selection return is the measure of the value added by the fund relative to its customized benchmark. It is calculated by taking the arithmetic difference between a mutual fund’s return and the return of a fund’s customized benchmark, using the following equation:

$$r_s = r_{mf} - r_b$$

where,

r_s = the monthly selection return of the fund in period t;

r_{mf} = the monthly return of the mutual fund in period t; and

r_b = the monthly return on the customized benchmark in period t.

A positive selection returns means that additional fund returns in excess of the customized benchmark are present. These returns may indicate that the fund is adding value through security selection or other factors.

Market Timing Return

Market timing return measures the value added (or removed) via active market timing or sector rotation. The market timing return is the arithmetic difference between a mutual fund's customized benchmark return and the return of its style analysis portfolio, and it is calculated using the following equation:

$$r_{mt} = r_b - r_{sa}$$

where,

r_{mt} = the monthly market timing return of the fund in period t;

r_b = the monthly customized benchmark return in period t; and

r_{sa} = the monthly style analysis portfolio return in period t.

Deviations from the long-term style analysis portfolio (the regression performed over the full period) that are illustrated by the rolling exposure results are considered evidence of market timing. When these deviations result in a positive market-timing return, they are considered evidence of value added by the fund in terms of changes in asset mix over time.

Total Alpha Return

Total alpha return is the total portion of the fund's returns that are not explained by the style analysis portfolio. The total alpha is calculated as the arithmetic difference between a mutual fund's return and the return of its style analysis portfolio, using the following equation:

$$r_{ta} = r_{mf} - r_{sa}$$

where,

r_{ta} = the monthly total alpha return of the fund in period t,

r_{mf} = the monthly return of the mutual fund in period t; and

r_{sa} = the monthly style analysis portfolio return in period t.

The total alpha can also be considered the sum of the selection return and the market timing return. A positive total alpha indicates that historically, the fund appears to have added value over its average passive mix of benchmarks.

T-statistic

Investors do not have to take selection, market-timing, and total alpha returns at face value. A fourth statistic, the t-statistic, can be calculated to measure the statistical significance of each. In general, a t-statistic is used in regression analysis to test the validity of a hypothesis. The hypothesis in this case might be that the total alpha return for a particular fund is different than zero. The alternative, the null hypothesis, is that the total alpha return is equal to zero.

From a t-table (which can be found in a statistics book) it is possible to determine the t-statistic necessary to reject the null hypothesis with a specified level of confidence. For example, at the 90% confidence interval, a t-statistic with an absolute value greater than 1.81, 1.70, and 1.67 would be necessary to reject the null hypothesis for one, three,

and five years respectively. A higher t-statistic allows more confidence to be asserted regarding the total alpha return. The t-statistic is calculated as follows:

$$t = (r_{ma} - \mu) / (s / \sqrt{n})$$

where,

t = the t-statistic;

r_{ma} = the monthly mean total alpha return;

$\mu = 0$, the null hypothesis;

s = the monthly total alpha return standard deviation; and

n = the number of observations or months.

For example, take a fund that has a five-year average monthly total alpha return of 0.2%, and a monthly total alpha return standard deviation of 0.9%. The t-statistic would be:

$t = (0.2\% - 0) / (0.9\% / \sqrt{60}) = 1.72$. This result is considered satisfactory at the 90% confidence interval; therefore, rejecting the null hypothesis (selection return = 0). For a higher confidence interval, a higher t-statistic would be necessary to reject the null hypothesis.

Going back to the Janus Venture Fund example, we had found that the fund sported a low R^2 with evidence of vacillating style weightings in the exposure distribution area graph. Apparently, market timing had played a role in this fund (its average style and rolling style over time differed). But has management added value through market timing? The performance attribution results below show that the average market timing return over the one-, three-, and five-year periods are either low or negative. Selection return, however, is positive resulting in a positive total alpha over the three- and five-year periods. Yet these results are not supported by a high t-statistic. In other words, at the

90% confidence level, it is not evident that the total alpha is statistically significant. Although market timing appears to have occurred in Janus Venture Fund, there is no conclusive evidence that the activity has resulted in value added (or subtracted) over a passive benchmark.

How many performance analyses come equipped with statistics that give precise indication of the confidence with which they should be viewed? One of returns-based style analysis' greatest strengths is the transparency of its assumptions. This is no black box system, but one that is crystal clear in what it does and does not accomplish.

Janus Venture Fund

Performance Attribution

	Annualized Return		Total Alpha	T-Statistic
	Selection	Market Timing		
1 Year	-0.39%	-0.08%	-0.47%	-0.06
3 Years	2.16%	-0.48%	1.68%	0.47
5 Years	2.43%	0.37%	2.80%	1.10

The “Art” of Returns-Based Style Analysis

It is important to remember that for all its strengths, returns-based style analysis is an estimate. It is not directly tied to the actual holdings of a mutual fund. Returns-based style analysis is only concerned about the behavior of a mutual fund. As mentioned, this is something of a paradigm shift for those who are accustomed to dealing with fundamental analysis—but it is a crucial element in accurately gauging and using the results of this technique.

The case of Twentieth Century Ultra Investors is instructive. According to recently-performed fundamental analysis, Twentieth Century Ultra Investors' rapid asset

growth has pushed its median market capitalization past \$6 billion, and led management to boost its foreign stock holdings from nothing in 1990 to 30 percent in 1994, before cutting them back again recently. According to one published assessment, returns-based style analysis was unable to capture these movements described by fundamental analysis, portraying Twentieth Century Ultra Investors' instead as a pure small-cap growth fund with no foreign exposure at all.

We performed a regression of Twentieth Century Ultra Investors based on 36 month rolling periods, using standard benchmarks (cash, intermediate-term bonds, long-term bonds, large company growth, large company value, small company growth, small company value, international bonds, and international stocks) and a style analysis window going back to mid-1987 (which gives approximately five years of rolling periods).

Examining *just* the overall style analysis chart, we find that indeed, there is no evidence of international exposure: Twentieth Century Ultra Investors' long-term greatest exposure is to the small-company growth benchmark (90%), with 10% attributable to the large company benchmark. However, again, the exposure distribution area graph tells a different story. Starting in early 1994, the shorter-term (36 month) regressions show international index exposure growing to as much as 10% between 1994 and 1995. Still, even with the added information from the exposure distribution area graph, the returns-based style analysis of Twentieth Century Ultra Investors does not duplicate the results of fundamental analysis. The important thing is, however, that final conclusions drawn from both sets of results are more similar than different.

Let's first look at the fact that the returns-based style analysis did not show the fund's full, reported 30% international exposure. This is clear evidence that returns-based

style analysis does not give to the basis point a fund's exposure to any given benchmark—nor is it geared to. It is an estimate (just as it is possible to say that snapshots of a fund's portfolio holdings provide an estimate of what the fund looked like throughout the quarter or year between the two snapshots). The analysis does accurately portray Twentieth Century Ultra Investors' international exposure as “noise” rather than an entrenched exposure, and this is very much in sync with what fundamental analysis concludes about the fund: the international exposure was short-lived and temporary—not a major change in strategic direction. To have purchased Twentieth Century Ultra Investors hoping to obtain foreign exposure would have been unwise, as the most recently portfolio holdings show that by the end of 1995, the fund had reportedly already reduced its foreign stake to under 10 percent.

As to whether the fund is large-cap or small-cap in its emphasis as claimed by fundamental analysis or returns-based style analysis—at issue here is really what constitutes a large-company or small-company mutual fund. It is interesting to note that the same fundamental analyst compares the fund—in other materials—*to both* the S&P 500 and the Wilshire 4500 (a broad market stock index). The analyst also shows that the R^2 for Twentieth Century Ultra Investors when compared to the S&P 500 is only 40 percent, but when compared to the Wilshire 4500, the fund's R^2 increases to 77 percent. For this reason, the fundamental analyst calls the Wilshire 4500 Twentieth Century Ultra Investors' “best fit” index.

That the fund has a reported 70% in technology makes it questionable whether a large company comparison is really valid regardless of the fund's median market capitalization: technology stocks are notably more aggressive than the average large

company stock. Recall recent initial public offering Netscape Communications Inc. was technically a large stock at the beginning of the year, with a market capitalization exceeding \$5 billion. Few, however, would confuse the expected behavior of this high-beta stock with that of the typical lower-beta large-company stock. In fact, a small- or mid-cap benchmark may best capture the aggressiveness of this fund's returns quite accurately. In either case, the point remains that returns-based style analysis attempts to capture a representation of the behavior of a fund, not whether the fund is investing in stocks that reside in one index or another.

Conclusion

We do not suggest that the discussion and examples cited above are a complete and comprehensive guide to the proper implementation, understanding, and interpretation of returns-based style analysis. In the months to come, we hope to add to our insights as we continue our research. However, we believe that this initial paper addresses many of the major questions regarding this technique. We believe we've show that the technique remains an informative and cost effective analytical tool for investors interested in creating more relevant benchmarks and assessing the asset allocation implications of their mutual fund choices.

End Notes

Benchmarks used in Ibbotson Associates Fund Strategist are 90 Day Treasury Bills, 5-Year zero coupon bond, 20-year zero coupon bond, S&P 500/Barra Growth, S&P 500/Barra Value, Wells Fargo Nikko Small-Cap Growth, Wells Fargo Nikko Small-Cap Value, MSCI EAFE, and Salomon Brothers Non-U.S. Govt. 1+. The rolling return period (used in the exposure distribution area graph) is 36 months; the

overall style analysis period (used the style analysis chart) is from 6/30/87 (or fund inception) to 12/31/95.

All dated is updated through December, 1995. Mutual fund data is by Morningstar, Inc.