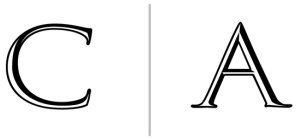

CAMBRIDGE ASSOCIATES LLC

ENHANCED U.S. EQUITY INDEXING

July 2000

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ENHANCED EQUITY INDEXING

Investors index to achieve portfolio diversification at the lowest possible cost, but abandon any chance of outperforming the chosen benchmark. In contrast, active investors pay higher fees and incur the risk of underperforming the benchmark because they believe their managers will add value over time. With lower fees than active management, close benchmark tracking, but also the possibility of some incremental return, enhanced indexing is a compromise between the two. Conceptually based on *indexing*, enhanced strategies focus on risk and returns *relative* to the benchmark and seek to minimize the risk of underperforming the benchmark over all time horizons.

Enhanced indexing strategies can be broadly categorized as either *synthetic* or *stock selecting*, each of which involves fundamentally different risks. Synthetic managers typically seek to earn incremental returns by buying equity index futures and actively managing the cash collateral in fixed income strategies, or occasionally in marketable alternative strategies (e.g., index arbitrage). In contrast, the stock selectors typically hold diversified portfolios of securities that replicate the characteristics of the index, but with small incremental deviations in company or sector exposures. The two approaches are so completely different that one could argue they should not be characterized as variants of a common theme. However, we categorize both as enhanced indexing because they occupy the same place on the spectrum between pure index replication and active management.

Broad Market Exposure: Indexing, Enhanced Indexing and Active Management

In order for a stock portfolio to behave like its benchmark index, it must actually hold many of the same securities as the index, weighted accordingly. In other words, broad market exposure is not necessarily attained simply by mirroring the index's fundamental characteristics. For example, one can readily create a portfolio with the same weighted average price-earnings multiple as the market by overweighting both low P/E value stocks and high P/E growth stocks, with nothing in the middle. This is the kind of strategy we would prefer to call risk-controlled active management rather than enhanced indexing, a distinction that is usually captured by R^2. Since a portfolio's R^2 indicates how closely its performance is explained by the behavior of the benchmark, portfolios that provide broad benchmark exposure typically have a higher R^2 (0.99 or 1.00) than those that simply replicate benchmark characteristics rather than benchmark holdings.

Synthetic enhanced index portfolios exhibit very high R^2 statistics simply because of the index replication qualities of derivatives. However, if the manager achieves returns in the cash collateral portion of the portfolio that are dramatically different and/or uncorrelated with the return stream of the equity index, R^2 will fall. Standing alone, the index derivatives provide broad market exposure, but in

combination with the investment of the cash collateral, the total risk exposures can be quite different. If the collateral is invested in a high risk strategy that might require the liquidation of the index portion in a crisis (and is, in itself, inappropriate for a large position at the core of an investment fund), we prefer to recognize it directly as an equitized marketable alternative or other equitized strategy rather than as an enhanced index.

If the purpose of indexing is to attain broad portfolio diversification at the lowest possible cost, then a strategy called enhanced indexing should not stray so far into the realm of active management that it no longer offers stable broad market exposure. As for costs, most enhanced index managers tend to downplay transaction costs because they believe their excess returns will more than compensate for these, as do active managers. However, the greater the portfolio's turnover, whether from rebalancing or tactical realignments, the higher the transaction costs, and the greater the benchmark tracking risk the manager must necessarily assume to overcome this hurdle-from enhanced indexing to fully active management quickly becomes a slippery slope.

On the other side of the coin, the line between indexing and enhanced indexing is also rather fine. Obviously, a portfolio with 200 or even only 50 basis points (bps) of tracking error is more actively managed than an index fund. On the other hand, there is also nothing passive about index fund management. Synthetic index managers have to choose which type of index derivatives to use and manage the reinvestment of funds whenever short-term contracts don't extend to cover the long-term investment horizon. Stock index managers have to pay careful attention to cash flow requirements and manage the effects of shifts in the constituents of the benchmark. For example, when Standard and Poor's announced the addition of Yahoo! to the S&P 500, the stock's price started to rise. On the day it was added, some weeks later, the price spiked even more dramatically to close at an unprecedented high. The price started to drop again the day after and came back to its trading range within another few days. Since the stock entered the benchmark at the closing price on the day it was added- just at the peak of its spike-an index manager who was most concerned about minimizing tracking error would have had to buy shares at that high peak price. However, a manager willing to incur some tracking error could have bought Yahoo! for a much better price earlier or later than the day it entered the benchmark. Deciding when to trade is very much an active management decision: choosing a middle ground between low tracking error and low transaction costs. While index managers may not be analyzing stocks, they are using trading skills for a purpose other than just replicating the benchmark, and this is another way of enhancing the index.

By the same argument, any index-like strategy that has some purpose other than simply replicating the unmanaged benchmark can be construed as a form of enhanced indexing. For example, tax-managed index funds seek to earn excess returns on an after-tax basis. While this is obviously preferable for a taxable investor, it is not the same as naïve indexing. Also, indexes with social responsibility screens carry an auxiliary purpose, even when they do not seek excess returns.

With the huge growth in popularity of index funds over the last decade, marketers have hit upon 'enhanced indexing' as a way to present non-index strategies in comforting terms. Although it may be an egregious example, we were shocked to discover a couple of retail mutual funds that invest in leveraged index futures represent themselves as enhanced indexing (while charging active management fees for what is essentially a brokerage service). Having some similarity to an index does not mean an investment strategy is 'enhanced indexing.' Caveat emptor.

Synthetic Enhanced Indexing

Index futures contracts are structured in such a way that holding long futures plus cash yields the same total return as holding the underlying index portfolio. Replicating the index[1] in this way is referred to as *equitized cash or synthetic indexing*. Synthetic enhanced indexing relies on the potential of outperforming the cash yield imbedded in a synthetic index investment.

Synthetic Indexing

Index futures contracts are generally set to expire quarterly with terms between three and eighteen months. The near term contract has the greatest volume and the highest liquidity, so most institutional investors seeking to replicate an index return using futures will use this contract rather than one that is longer-dated.[2] Thus, maintaining a long synthetic index position requires buying-called "rolling into"-the next contract and selling the near contract as expiration approaches. While the synthetic index manager pays commissions and fees for each contract, the greater expense lies in the *rollover basis*, which is the net mispricing from fair value of the two contracts involved. Factors affecting the rollover basis are interest rates, the yield curve, expected dividend rates, and especially the futures market's own supply and demand characteristics. Experienced synthetic indexers are attuned to all of these factors and strive to manage their portfolios to minimize costs when the roll is rich and maximize return when the roll is cheap.

Technically, investors enter into long and short futures contracts with the exchange (actually, the exchange's clearinghouse), which regulates much of the trading process and guarantees the performance of contracts to all parties. Because U.S. futures exchanges are considered strong AAA credits and because of the tendency for the government to bail out institutions whose failure might threaten the integrity of the financial system, futures are widely considered to have lower counterparty risk than other types of derivatives (e.g., swaps).

[1] While we contain our discussion here to S&P index futures, which are by far the most liquid and most widely used, other futures instruments are available on U.S. exchanges which synthetically replicate indexes such as Dow, the S&P 400 MidCap, the NASDAQ 100, the Russell 2000® and the Nikkei. Index futures are also available on exchanges outside the United States.

[2] At the end of March 2000, the open interest in S&P Index Futures expiring in June numbered approximately 360,000 contracts, while the open interest in contracts expiring in September was about 5,000.

Synthetic index and enhanced index managers most commonly use futures for index exposure; however, some do use swaps, often to avoid the hassle of the daily futures mark-to-market, or perhaps to customize the long equity exposure in a way that is different from standardized futures specifications. Swaps, however, are typically more expensive than futures, less liquid, and have greater counterparty risk. Some managers use a mix of options, futures, swaps or any other type of derivative that might be able to deliver the cheapest exposure to the index. We encourage investors to explore the risk and return characteristics of other such derivatives thoroughly before hiring a manager that uses them. Such derivative instruments usually involve counterparty risks, instrument performance characteristics, costs, and implementation methodologies that differ from those described above.

Enhancing the Returns of a Synthetic Index

Since fair value prices in the futures market are based on the assumption that the cash component earns LIBOR interest rates, investors can attempt to enhance their total return by investing their cash in higher-yielding securities. The risk, of course, is that LIBOR outperforms these alternatives, and the greater the difference between LIBOR and the alternatives, the greater the risk that the strategy underperforms.

The consensus among synthetic enhanced index managers is that the "plain vanilla" strategy is to invest in a well-diversified portfolio of lower-duration fixed income securities. We might also call this strategy *equitized fixed income*, or *equitized enhanced cash*. The manager uses all the usual tools of fixed income management-duration and yield curve management, sector rotation, credit analysis, etc.-to earn some incremental return over LIBOR, and therefore an incremental return over the unenhanced stock index. Depending on their particular area of expertise and the risk tolerance of their funds, managers might further diversify into mortgage securities or asset-backed securities, perhaps with a dash of high-yield or emerging markets debt. Some managers might use a barbell approach, balancing three-year maturities with commercial paper. In addition, they may use bond derivatives to hedge the optionalities imbedded in their bond holdings.

Either implicitly or explicitly, most managers organize the enhancement portfolio into liquidity tranches. The reason for this stems from the mechanism of the daily futures mark-to-market which, in effect, forces the liquidation of the fixed income portfolio in down markets, and leaves the portfolio manager flush with cash to invest in up markets. Although the latter scenario has its own challenges, the composition of the cash portion of a synthetic enhanced index portfolio is most often driven by the risk of a sharp decline in the equity market, which results in a premium on liquidity, since the manager will need to meet variation margin calls.

To guard against a futures-driven "forced liquidation," managers arrange their liquidity tranches to match their estimation of the likelihood of a given percentage decline in the stock market over a relatively short period of time, usually a year or less. Since the probability of a 10% or 15% decline over such a time horizon is relatively high, at least 10% to 15% of the enhanced cash portfolio might be held in very liquid securities of very short duration such as commercial paper. To cover less likely but still quite possible declines of up to 60% to 65%, the middle tranche might be invested in fairly liquid instruments such as short-term corporates, short-term mortgage securities, or the more liquid asset-backed securities. Because a decline of greater than 65% might be seen as highly unlikely, a last tranche of the remaining 35% to 40% of the portfolio might be made up of less liquid asset-backs, mortgages, corporates, longer-dated securities, high-yield, or foreign debt. It is in this least-liquid tranche that the managers hope to generate the bulk of the enhancement to the index. Though managers may explicitly have more tranches or no tranches at all, they all are keeping these liquidity issues in mind in the management of their fixed-income portfolios.

Thus, in assessing the riskiness of a synthetic enhanced strategy, investors should focus not only on the portfolio's quality, duration, and diversification, but should also scrutinize its liquidity to ensure its ability to meet variation margin calls even under the most adverse circumstances (e.g., the October 19, 1987 stock market crash).

Low Correlation between Enhanced Cash and Equities

In a severe down market, a variety of scenarios could evolve within the cash portion of a synthetic enhanced strategy. For example, if spreads widen in less liquid or lower credit securities, positions would have to be sold to meet the mark-to-market, and underperformance could result. Another possibility, however, is a flight-to-quality, in which bonds of any reasonable quality outperform as investors seek the relative safety of high-grade fixed income instruments. This would likely result in outperformance for the enhanced portfolio. Most likely, however, elements of both scenarios would come into play. The net effect on the cash portfolio would depend on the overall quality and liquidity composition of the portfolio and on the relative performance of illiquid/low-grade versus high-grade/liquid securities.

In discussing the disaster scenario, managers often point out that they do in fact expect the bulk of the fixed income securities they hold to rise in value when the equity markets fall. This lack of correlation between fixed income and equity returns has both advantages and disadvantages for an enhanced index investment. The advantage is that the enhanced cash acts as a partial hedge against an absolute loss in the equity index. Thus, under these conditions, we might expect a synthetic enhanced index portfolio to do relatively well in an equity bear market. On the other hand, in a fixed income bear market we would expect the synthetic enhanced index to underperform.

Investors should therefore consider what return characteristics they want from an enhanced index allocation and how it relates to the rest of their investment fund. Some investors will argue that it is sensible to choose a synthetic enhanced index because its fixed income based source of enhancement is relatively uncorrelated with their other equity positions. Other investors will object to the positive correlation of a synthetic enhanced position with their fixed income investments, since it implies an increased exposure to fixed income risks.

Equitized Marketable Alternative Strategies and Portable Alpha

Rather than employing these "plain vanilla" strategies, many firms enhance an index by investing the cash not used for futures margins in marketable alternative strategies. This approach is sometimes called a *portable alpha* strategy because it can be combined with any index that is widely traded on a futures exchange. In truth, any strategy that tries to synthetically enhance an index by beating the interest rates embedded in index futures-including fixed income strategies-might be thought of as a portable alpha strategy.[3] In practice, however, only the more exotic strategies tend to be tagged with this moniker. Examples of equitized marketable alternative strategies include futures overlaid onto index arbitrage, convertible arbitrage, market neutral portfolios, and even on risk arbitrage and distressed securities. One well-known manager overlays index swaps onto a fund-of-funds made up of several different marketable alternative strategies.

Although all claim to be enhanced indexing, these strategies are barely comparable one to another, and we are particularly concerned about the marketing spin that suggests that an equitized marketable alternative strategy necessarily carries a low level of risk-"this is just an enhanced index." While some risk factors are indeed hedged away in marketable alternative strategies, other factors are often magnified. A market neutral manager, for example, may have hedged away the exposure to the automobile industry by going long Ford and short GM, but has also increased the relative exposure to stock selection risk; in other words, the return will be a function of stock selection skill. Some marketable alternative strategies may very well deliver consistent alpha with relatively low volatility; however, they frequently introduce risks of a different order than those discussed above, including various types of equity exposure and/or layers of embedded leverage that are not apparent without extensive due diligence.

In short, we would not muddy the waters of enhanced indexing by including such strategies, preferring to characterize them as alpha transport. In general, investors should view these products less as core equity manager substitutes and more as equity manager satellites or hedge funds with high correlations to a chosen index.

[3] Although one could argue that the fixed-income based excess return in synthetic strategies is technically derived more from fixed income risk premia factors than from true alpha generation.

Stock Selecting Enhanced Indexing

Index fund managers attempt to replicate the risk exposures and return stream of the benchmark while simultaneously minimizing transaction costs (for more detail, see our recent paper, *U.S. Equity Indexing*). *Tracking error*–the standard deviation of the excess return over (or under) the benchmark-is the statistic summarizing a manager's success in achieving these two goals.[4]

In 'enhancing' an index, managers add a third goal: positive excess return. Theoretically, it is possible to run a portfolio that returns consistently more than the benchmark with no tracking error–because the daily fluctuation in the return rates is identical, even though the portfolio's return is actually higher (as shown in Exhibit 3). In practice, however, enhanced index managers seeking to eke out incremental returns by means of stock selection are simply a cross between active managers and indexers. On the one hand, they are very comfortable with the mathematical quotients and computerized models used in index fund portfolio construction; on the other hand, they study the same statistics as fundamental analysts: earnings growth, dividend yield, price-to-book, operating margins, debt-to-equity, insider trading, earnings revisions, etc.–albeit through quantitative processes. The end result is a series of very small decisions which in aggregate the enhanced indexer believes will add value, as opposed to the traditional, active manager's process of making a much smaller number of decisions, each one of which is likely to be more consequential. In their book, *Active Portfolio Management*, Grinold and Kahn describe the mathematical argument that even with a low probability of picking more winners than losers, an investment process applied to a large number of decisions will yield a slightly higher total portfolio return than the same process applied to a small number of decisions. This is the foundation upon which stock selecting enhanced indexers stake their claim: a large number of small bets relative to the index, without any particular style bias.

Portfolio Construction

The ability to fine-tune the level of systematic versus stock-specific risk through portfolio construction came about with the development of tools like BARRA's *Aegis Portfolio Manager* software and databases like their *US Equity Model*. The *Risk Manager* and *Optimizer* modules, and similar tools written by BARRA's competitors, are commonly used by index managers. When it is not feasible for indexers to hold all the stocks in the benchmark–because the stocks are too many or too illiquid, or because the account size is not large enough to afford the transaction costs associated with holding smaller stocks–they use a risk analyzer to test the portfolio's exposures to industries or risk factors,[5] in order to ensure that these are as closely aligned as possible with those of the benchmark. Enhanced

[4] Because the benchmark return is measured gross of management fees, tracking error is also calculated gross of fees. Investors should, of course, be gauging *performance* net of fees.

[5] BARRA's program defines 56 industry factors and 13 other risk factors. The non-industry specific factors quantify exposures like price volatility, capitalization size, valuation, earnings growth, and leverage.

indexers often use these tools as well, not just to analyze their risk exposures, but to optimize the weights of their positions. That is, they determine what excess return they expect from each of the stocks in the universe, enter those expectations along with any portfolio constraints, and ask the program to indicate what weightings will yield the highest expected aggregate return. The constraints may be items such as levels of exposure to industry or risk factors, relative weights to sectors or stocks, or almost any other definable portfolio characteristic. The program also quantifies the expected risk characteristics of the suggested portfolio, leaving the manager to tweak the stock positions and adjust the risk accordingly.

Typically, stock selecting enhanced indexers constrain the optimizer to match the portfolio characteristics of the benchmark. Quantities like aggregate price-to-earnings, price-to-book, earnings growth, average and median market capitalization, and the other risk factors are neutralized to ensure the portfolio makes minimal or no style or economic bets. Often the manager will deliberately constrain the industry weights as well, say to within 10 or 50 bps of the benchmark weight. Several managers simply constrain the relative weights of the individual stocks to within, say, 50 or 100 bps. Constraining the stock weights has the greatest effect in ensuring broad diversification, since the stocks are the smallest components in the analysis.

Satisfying any single constraint in isolation, however, does not ensure broad market exposure or a risk-averse strategy. For example, one could construct a portfolio of as few as 44 stocks in which the weight of each holding was within +/- 100 bps of the weight in the S&P 500 index. At a constraint of +/- 50 bps, the portfolio could be as small as 68 names, still not a large number. Recognizing that tracking error is the statistic that investors and marketers have most strongly latched on to in defining the gradations of risk between index and active strategies, BARRA analyzed the relationship between the number of stocks in a portfolio and the tracking error predicted by their US E3 model. Using the S&P 500 at December 31, 1999, the lowest possible predicted tracking error in a portfolio containing 75 stocks was 183 bps.[6] For 25 stocks, the lowest predicted tracking error was 474 bps; for 150 stocks it was 89 bps. (These results and those of a similar test based on the Russell 2000® are shown in Exhibit 2.)

Tracking Error

Exhibits 4a and 4b show the tracking error for U.S. large-cap enhanced index and active managers with five- and ten-year records who defined their benchmark as the S&P 500. Over ten years, only one active manager out of 255 had an annualized tracking error less than 200 bps. Over five years, only

[6] BARRA constrained the number of stocks as designated and asked the optimization program to pick the portfolio with the lowest predicted tracking error, regardless of any other portfolio risk characteristics. The optimizer would have deliberately chosen the stocks that contributed the most to the performance of the benchmark. Given that the recent market environment has demonstrated unusual narrowness—the benchmark's performance has been driven by a small number of stocks—the predicted tracking error numbers in this test may be lower than in a different time period.

seven out of 338 active managers came in below that floor. The median tracking error for active managers is 619 bps among those with ten-year records and 608 bps among those with five-year records. Using tracking error as a line of demarcation between enhanced index managers and active diversified managers, we would therefore expect the former to have tracking error no greater than 200 bps, and the latter tracking error consistently in excess of that level. We are not picking this number out of a hat. If 200 basis points is the natural floor for active strategies, in order to achieve a lower tracking error, a manager must deliberately control and minimize the portfolio's active risks relative to the benchmark index.

In fact, even among enhanced index managers, there is disagreement about optimal tracking error levels. As students of money managers, it appears to us that managers would choose to maximize their information ratios—the excess return per unit of tracking error, or active risk-within the context of their skills and opportunities (i.e., preferred investment process). On the contrary, most managers are choosing tracking errors in response to specific client requests or based on what they imagine their prospective clients would prefer. Asked why they weren't minimizing active risk, several stock selecting managers expressed a disbelief that clients would take an interest in products with less than 250 or 300 bps of tracking error—"if we don't take some risk, we won't have an opportunity to deliver excess returns." The managers may be correct (at least regarding their own particular investment styles), but the attitude gives credence to the criticism that stock selecting enhanced indexers are really just active managers with added risk-control.

Stock selecting enhanced index managers suggest they can dial tracking error up or down at will, achieving proportionately changing excess returns, and the same information ratio at different risk levels. This is a nice idea. "You pick how much risk you want to take, and we'll give you alpha equal to 1.20 times your risk no matter what." In practice, however, matters are not that simple. First, the managers may not be able to achieve the tracking error they select. Although historical tracking error may be a calculable fact, predicted tracking error is as subject to misspecification as all other predictions. Several managers have told us that they have to target a predicted tracking error 50 or 100 bps lower than their objective, because their achieved tracking error always comes out higher. Second, the managers have not demonstrated that their investment processes are *consistently* able to generate excess returns from the risks they take. We can't say that they are unable to do this because we lack sufficient data to test the question—very few managers have products using the same process at different risk levels—but we have our reservations.

More about Information Ratios

We can observe the information ratios of enhanced indexers relative to active managers. We have discussed above how the information ratio is a measure of the return per unit of active risk. It is also a measure of the consistency of delivering that excess return. Because tracking error is measured as the standard deviation of excess return, the tracking error will be higher, and the information ratio lower, if

the excess return varies a lot over time. The premise of enhanced indexing is that by targeting specific risk opportunities, and taking less total relative risk, the manager can achieve more consistent excess returns than active strategies. If this is true, we would expect the information ratios for enhanced indexers to be higher than those of active managers. Exhibits 5a and 5b shows the information ratios of the managers in our five- and ten-year universes, distributed by tracking error tranches.

Indeed, the information ratios for enhanced indexers are higher than for active managers, whose ratios are consistently negative and declining until the tracking error reaches the very high level of 1,200 bps.

Stock Selectors versus Synthetics – Other Statistics

Too few enhanced index managers have track records long enough to enable us to analyze whether there is persistence of manager performance over time. Nevertheless, we have been able to draw some observations from the data:

1. Synthetic enhanced index managers seem able to generate incremental returns with much lower tracking error than stock selectors. Many synthetic managers delivered tracking errors of 40 bps or less, while most stock selectors delivered tracking errors between 40 and 240 bps.
2. Synthetic managers also delivered excess returns with greater consistency. Among this group, 50% delivered excess returns within a range of 0 to 100 bps, while the stock selector's excess returns were more broadly distributed with half the observations between -100 and + 100 bps. The stock selectors also displayed an unfortunate tilt toward negative excess returns– although the small number of observations calls into question the statistical validity of this observation (which may well be explained by the value tilt that is common among these managers). In a different market environment, where benchmark returns are not so narrowly driven by a few stocks and there are more winners for stock-pickers to pick, we would expect different results.
3. In addition, most synthetic managers offered positive information ratios (between 0 and 1.0) while stock selectors' ratios were more evenly distributed between -2.0 and +2.0.
4. The beta of the stock selectors was normally distributed between 0.86 and 1.02, with a median at 0.93 and a slight skew to the higher betas. Synthetic managers demonstrated a higher concentration at the median 0.91 and a skew to lower betas. We expect these lower betas for synthetic managers given that their excess returns are generated by strategies, such as fixed income, which have low correlations with long equities.

Conclusion

Synthetic and stock selecting enhanced indexing have very little in common, other than the general goal of generating excess return with low tracking error. Nevertheless, they do both offer broad market diversification of the sort that belongs at the core of multi-manager investment structures.

Stock selecting strategies are less diversified than indexes, but are typically more diversified than a 100-stock active portfolio. Investors should be careful to examine the economic sector exposure and the excess return-seeking processes of the stock selecting strategy, keeping in mind that the portfolio must take some risk in order to earn excess returns. Typically preferring quantitative techniques, enhanced index managers are interested in the same kinds of stock characteristics as active managers. To the extent that the portfolio commits less to systematic market risk and more to stock-specific risk, it becomes less appropriate for a core equity mandate and more appropriate in a style-tilted core or a satellite position.

Synthetic enhanced index portfolios offer market exposure through the use of derivatives, most commonly index futures. Excess return is typically derived from fixed income strategies that are relatively uncorrelated with the return stream of the equity index. Investors should pay attention to the ability of the cash enhancement portion to serve the liquidity needs of the futures overlay in the event of a crisis. Equitized marketable-alternative strategies–even those with relatively little volatility and consistent excess return–are generally taking greater equity risks and so should be viewed more as hedge funds or satellite managers than as true enhanced index or core substitutes.

APPENDIX

A Quick Primer on Index Futures

An index futures contract represents an agreement to buy or sell the particular index on the date when the contract expires. However, the buyer does not pay the full notional value of the index, but is required only to post cash collateral amounting to about 5% of that value. A synthetic index investor (as opposed to someone investing in index futures for a different purpose) would invest the remaining 95% of the index's value in high-grade, short-term instruments, such as LIBOR. The exchange 'marks-to-market' the futures contracts on a daily basis, and the contract holder either receives or pays the daily difference (called the *variation*) in the notional value of the futures contracts. This places a cash flow burden on the investor: if the index drops in value, more money must be posted to maintain the 5% margin; if the index rises in value, cash is transferred into the account. At expiration, the total net gain or loss on the futures coupled with the return on the invested cash will approximately equal the stock index return over the same period. The return is *approximately* the same as that of the index because other factors, such as the investor's skill in managing the cash flows and the richness or cheapness in the index futures market, alter the return to a small degree.

Futures Pricing

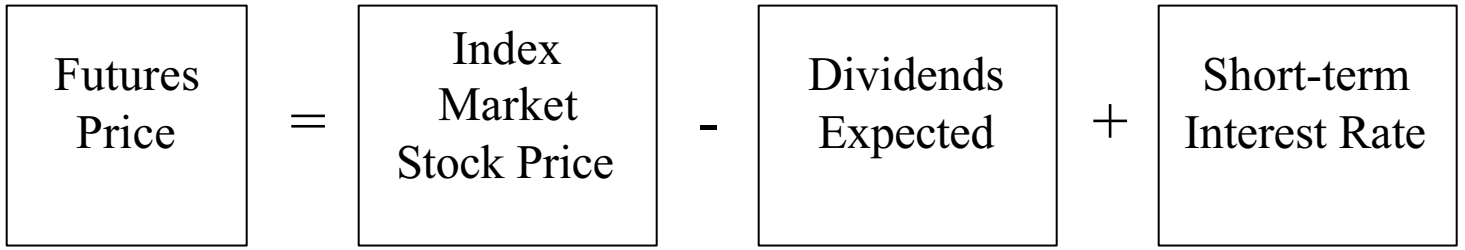
Futures contract holders do not receive dividends on the underlying stocks in the index. However, they do receive interest on the 5% margin in their brokerage account, and–if they are seeking to replicate the index–on the remaining 95% invested in short term securities. The market prices futures to take into account these two differences between the way futures and stocks function. That is, the *fair value* futures price is equal to the prevailing index price minus expected dividends for the index plus a short-term interest rate which reflects the cost of money over the remaining term of the contract. (This interest rate tends to approximate LIBOR rates.) Exhibit 1 describes this relationship in simpler mathematical terms. The net term, interest minus dividends, is called the *cost of carry* and represents the adjustment between the spot index price and the futures price; i.e., the embedded cost of holding futures until expiration.

Note that because of the way index futures contracts are designed, if the investor holds the futures position until expiration, the price of the futures will converge to the price of the underlying index and the futures contracts will be cash-settled. That is, rather than arrange for delivery of actual index stocks, the contract simply calls for net gains or losses on the futures contracts to be paid out in cash. Until expiration, however, futures will occasionally trade *rich* and *cheap* relative to the futures theoretical fair value–that is, for a price higher or lower than the fair value. The risk that the actual price to transact futures may be different from the fair value is called *basis risk*.

In practice, index futures trade very close to their theoretical fair value because any gap between the actual price and fair value tends to be arbitraged away very quickly–since the late 1980s the futures markets have been so efficient that only arbitrageurs with the lowest financing and execution costs find any room for profits. This is not to say that the futures market is so efficient that investors don't have to keep tabs on the fair value relationship. They do. Futures prices do occasionally get out of line and the uninformed buyer or seller could give up some return by not paying attention to the fair value relationship.

Exhibit 1

SYNTHETIC INDEXING



Buy an Index Futures Contract	Receive Daily Index Stock Market Price Changes	Forego Dividends on the Stocks	Receive Interest Income on Invested Cash

Exhibit 2

PREDICTED TRACKING ERROR VS. S&P 500
As of December 31, 1999

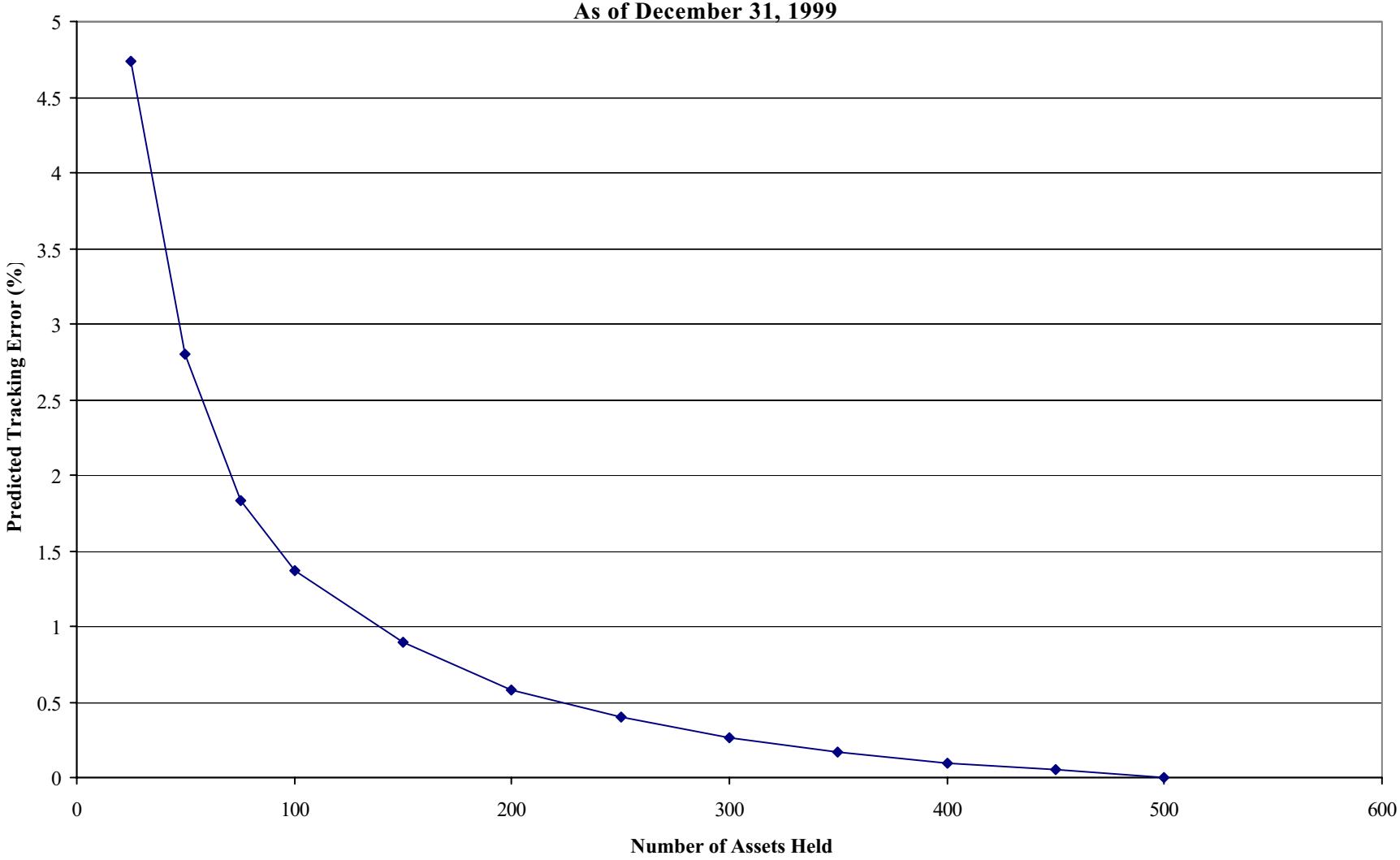


Exhibit 2 (continued)

PREDICTED TRACKING ERROR VS. RUSSELL 2000
As of December 31, 1999

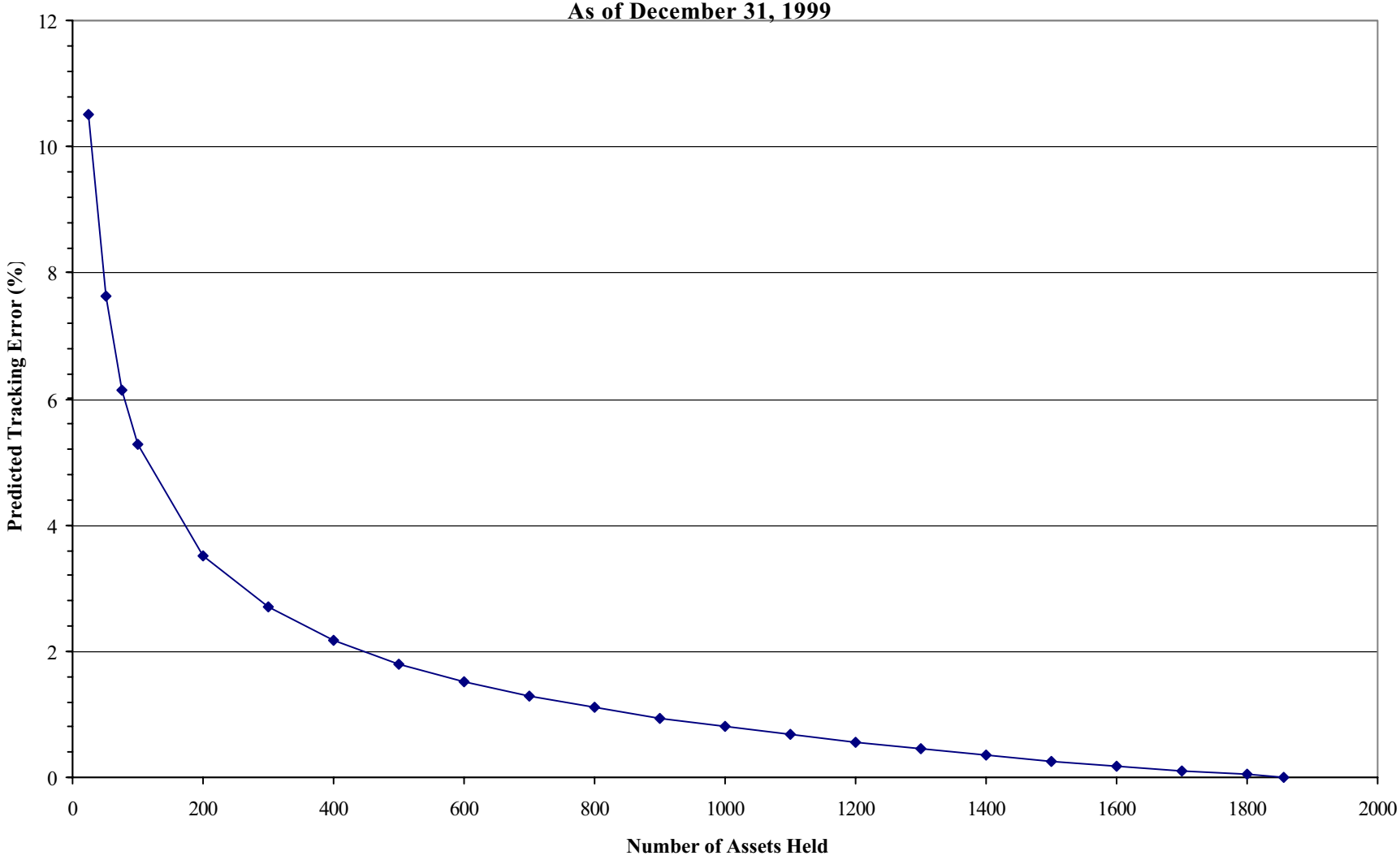
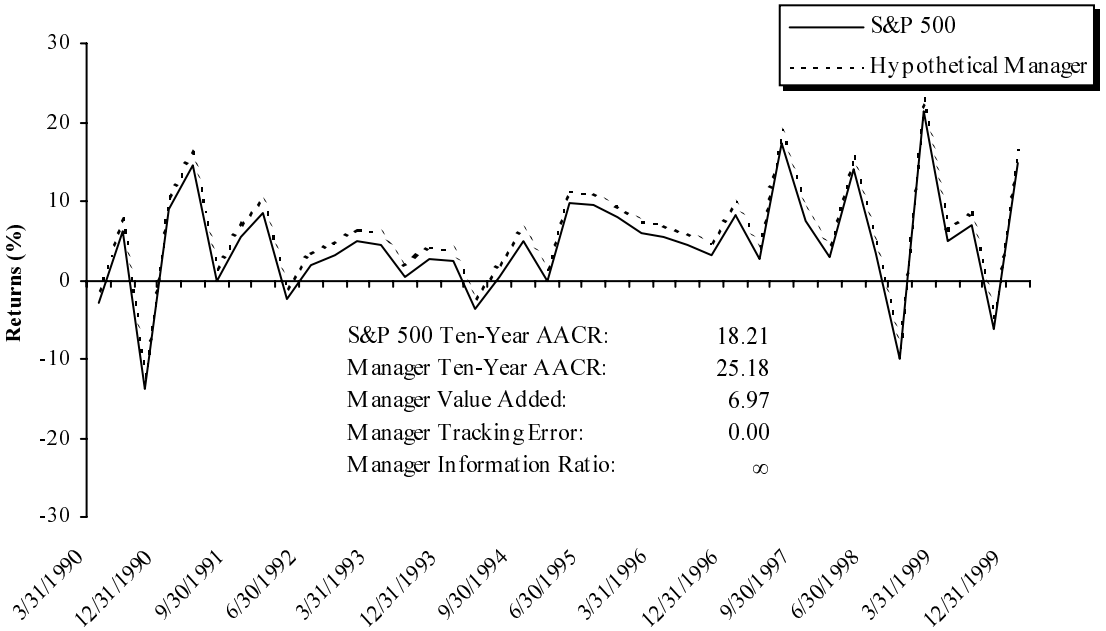


Exhibit 3

TEN-YEAR RETURNS AND TRACKING ERROR



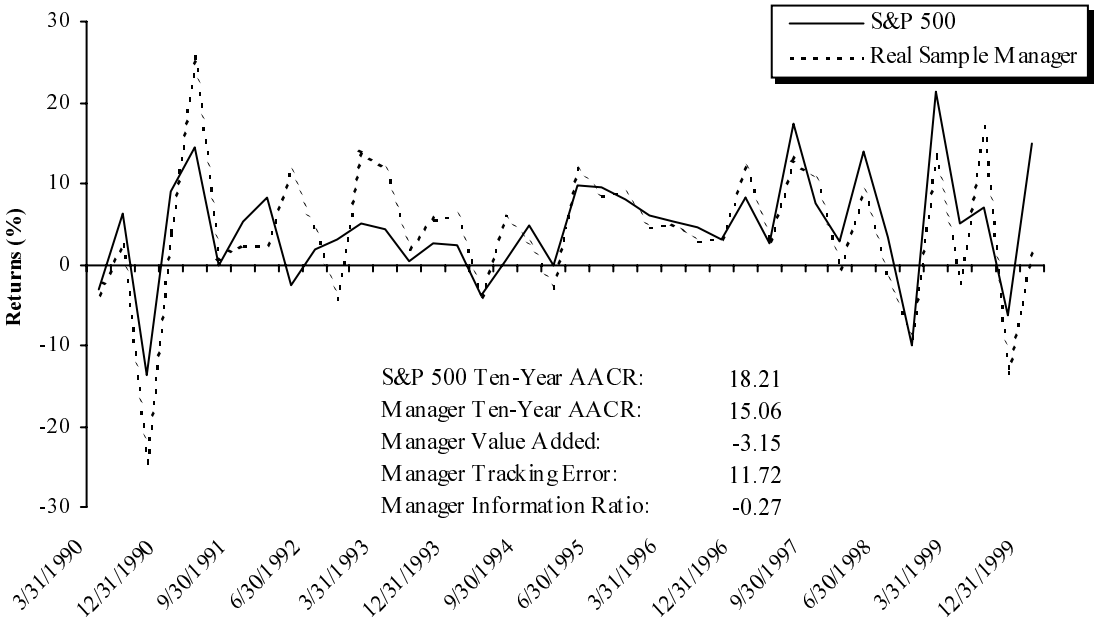


Exhibit 4a

INDEX VS. ACTIVE/ENHANCED PRODUCTS
5-Year Tracking Error : Value-Added Relationship
January 1, 1995 - December 31, 1999

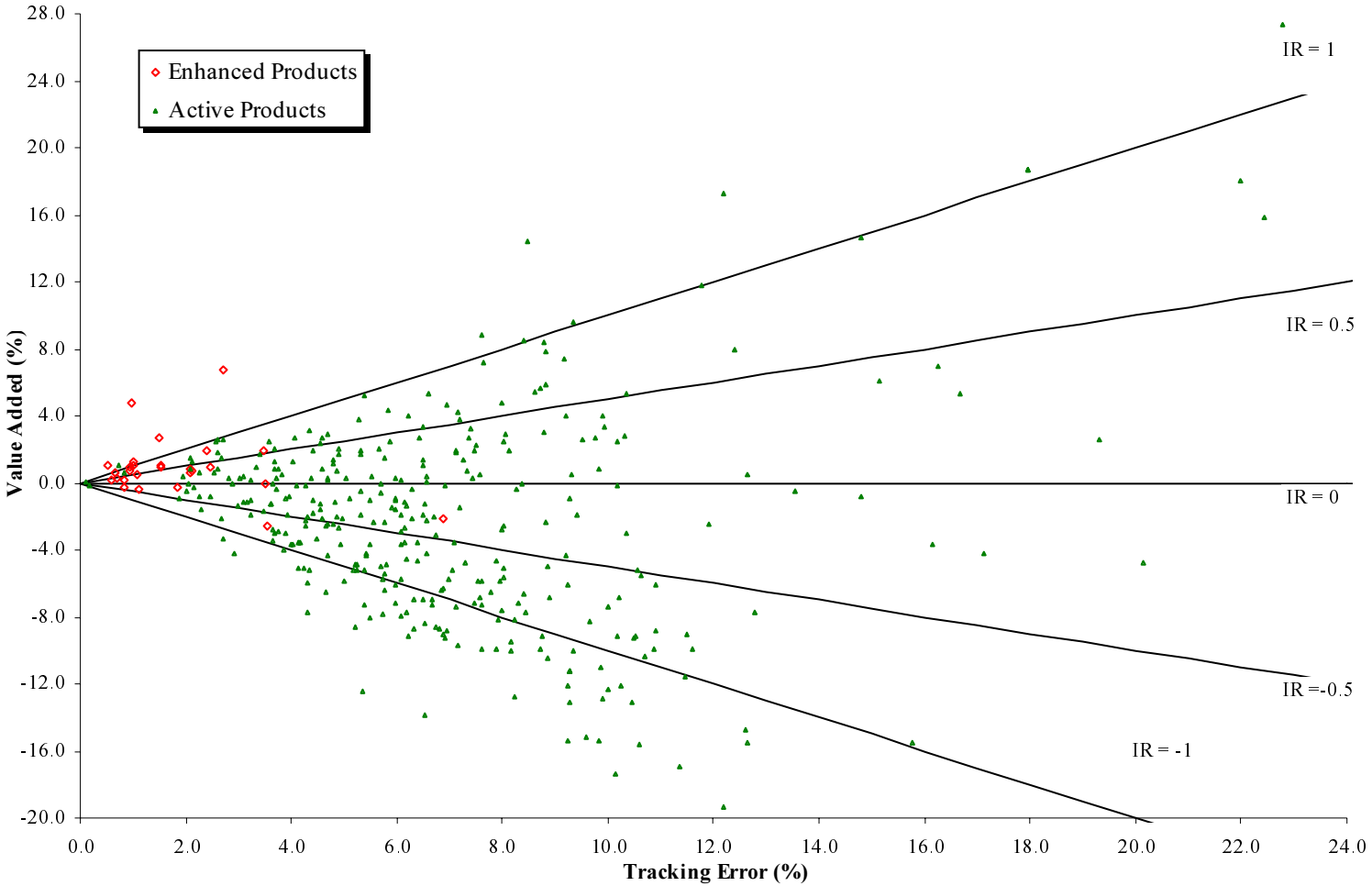


Exhibit 4b

INDEX VS. ACTIVE/ENHANCED PRODUCTS
10-Year Tracking Error : Value-Added Relationship
January 1, 1990 - December 31, 1999

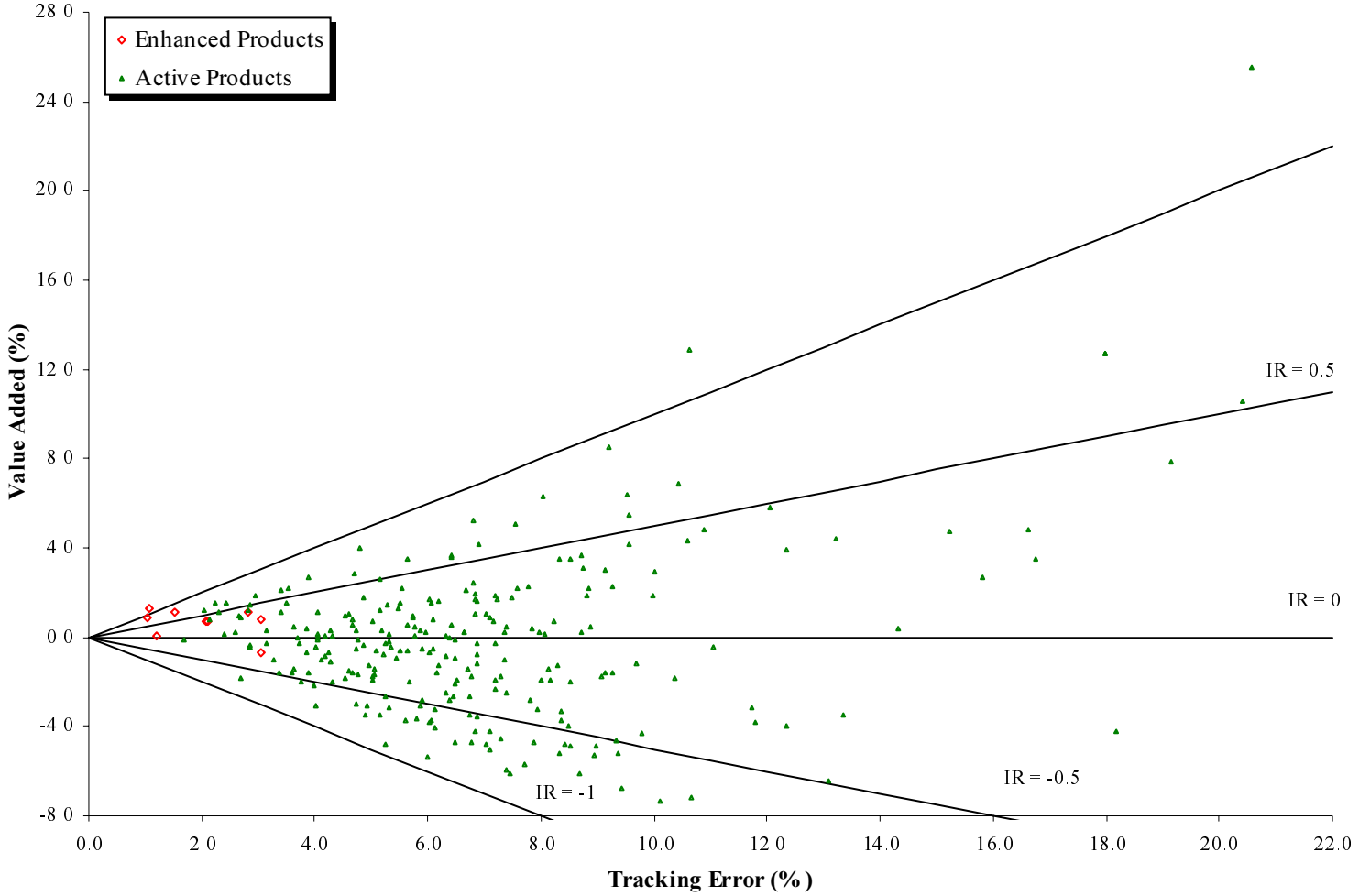


Exhibit 5a

INFORMATION RATIO VS. TRACKING ERROR
ACTIVE AND ENHANCED INDEX PRODUCTS

January 1, 1995 - December 31, 1999

Tracking Error

Information Ratio			< 200	200 to 400	400 to 600	600 to 800	800 to 1000	1000 to 1200	1200 to 1400	1400 to 1600	1600 to 1800	1800 to 2000	> 2000	All Ranges	Active Total	Enhanced Index Total	TOTAL
	>	1.2	5	1			1		1						3	5	8
1.2	to	1.0	1			1	2				1		1		5	1	6
1.0	to	0.8	3	3	1	1	3	1		1			1		11	3	14
0.8	to	0.6	2	4	5	3	3		1				1		17	2	19
0.6	to	0.4	3	7	5	6	1	1		1	1				20	5	25
0.4	to	0.2	3	10	8	5	8	2			1				32	5	37
0.2	to	0.0	1	6	8	8	2		1			1			27	0	27
0.0	to	-0.2	1	6	9	5	3	1	1	1					25	2	27
-0.2	to	-0.4	3	10	7	9	3	2			2		1		34	3	37
-0.4	to	-0.6	1	3	12	6	2	3							27	0	27
-0.6	to	-0.8		7	5	10	5	3	1						30	1	31
	<	-0.8	1	6	29	29	21	14	3	1					103	1	104
Number of Managers																	
Active			7	54	89	82	54	26	8	4	5	1	4				
Enhanced Index			17	9	0	1	0	1	0	0	0	0	0				
TOTAL			24	63	89	83	54	27	8	4	5	1	4				
Median Information Ratio																	
Active			0.22	-0.08	-0.41	-0.54	-0.47	-0.81	-0.32	0.17	0.37	0.13	0.76	-0.34			
Enhanced Index			0.71	0.38	--	-0.31	--	-1.42	--	--	--	--	--	0.44			
TOTAL			0.58	-0.02	-0.41	-0.51	-0.47	-0.83	-0.32	0.17	0.37	0.13	0.76	-0.29			

Exhibit 5b

INFORMATION RATIO VS. TRACKING ERROR
ACTIVE AND ENHANCED INDEX PRODUCTS

January 1, 1990 through December 31, 1999

Information Ratio			Tracking Error: < 200	200 to 400	400 to 600	600 to 800	800 to 1000	1000 to 1200	1200 to 1400	1400 to 1600	1600 to 1800	1800 to 2000	> 2000	All Ranges	Active Total	Enhanced Index Total	TOTAL
>	1.2							1					1		2	0	2
1.2	to	1.0	1												0	1	1
1.0	to	0.8	1		1		1								2	1	3
0.8	to	0.6	1	7	2	3	2	1			1				16	1	17
0.6	to	0.4		4	2	2	5	2	1			1	1		17	0	18
0.4	to	0.2		5	9	13	5	1	2	1	2				37	4	38
0.2	to	0.0		7	18	14	5			2					45	1	46
0.0	to	-0.2	1	7	15	10	6	2							40	0	41
-0.2	to	-0.4	1	3	13	14	3	2	1			1			37	1	38
-0.4	to	-0.6		5	5	8	9		1						27	0	28
-0.6	to	-0.8		1	8	10	4	2							25	0	25
	<	-0.8			2	2									4	0	4
Number of Managers																	
Active Total			1	34	75	76	40	11	5	3	3	2	2				
Enhanced Index Total			4	5	0	0	0	0	0	0	0	0	0				
TOTAL			5	39	75	76	40	11	5	3	3	2	2				
Median Information Ratio																	
Active			-0.07	0.11	-0.09	-0.12	-0.16	-0.04	0.32	0.17	0.50	0.09	0.88	-0.04			
Enhanced Index			0.79	0.32	--	--	--	--	--	--	--	--	--	0.36			
TOTAL			0.74	0.20	-0.09	-0.12	-0.16	-0.04	0.32	0.17	0.50	0.09	0.88	-0.03			