Fundamental Indexation[i,ii]

Robert Arnott
Chairman, Research Affiliates, LLC

Jason Hsu
Research Affiliates, LLC

Philip Moore
Research Affiliates, LLC

Abstract

The insights from the celebrated Capital Asset Pricing Model (CAPM) have led many to champion capitalization-weighted "equity market portfolios" as mean-variance optimal. Armed with these insights, investment managers and consultants have created a trillion dollar industry, based on investing in passive capitalization-weighted indexes, such as the S&P 500 and other indexes constructed by Russell, MSCI, The Financial Times, Wilshire, Forbes and Fortune to name a few. Trillions more are actively managed, and benchmarked against these same capitalization-weighted indexes. But, the CAPM literature already rejects the mean-variance efficiency of capitalization-weighted equity market indexes. It should be possible to construct stock market indexes that are more mean-variance efficient than those based on market capitalization.

In this paper, we examine a series of equity market indexes weighted by fundamental metrics of size, rather than market capitalization. We find that these indexes deliver consistent and significant benefits relative to standard capitalization-weighted market indexes. These indexes exhibit similar beta, liquidity and capacity compared to capitalization-weighted equity market indexes and have very low turnover. They show annual returns that are on average 215 basis points higher than equivalent capitalization-weighted indexes over the 43 years of the study. They contain most of the same stocks found in the traditional equity market indexes, but the weights of the stocks in these new indexes differ materially from their weights in capitalization-weighted indexes. Selection of companies and their weights in the indexes are based on simple measures of firm size such as total book value, cash flow, gross dividends, revenues, sales, and total company employment. [iii]

While price inefficiency could lead to the observed alpha, as capitalization weighting assuredly overweights the overvalued stocks and underweights undervalued stocks, the superior performance may also be attributable to superior mean-variance portfolio construction or to hidden risk factors (in an APT or Fama-French framework), none of which violates the assumption of price efficiency. Regardless of the exact reason, these Fundamental Indexation indexes appear to provide long-term performance superior to that of comparable capitalization-weighted equity indexes. We offer them not as substitutes for capitalization-weighted indexes, but as simple alternatives, that may offer superior return and risk characteristics.

Is the S&P500 mean-variance efficient?

The Capital Asset Pricing Model (CAPM) says that the "*market portfolio*" is mean-variance optimal. While this model is predicated on an array of assumptions, most of which are arguably not accurate, it leads to the conclusion that a passive investor/manager can do no better than holding a market portfolio. The finance industry, with considerable inspiration and perspiration from Harry Markowitz, Bill Sharpe, Jack Bogle, Burton Malkiel, Bill Fouse, Dean LeBaron and many others, has translated that investment advice into trillions of dollars invested in or benchmarked to capitalization-weighted market indexes such as the S&P500 and the Russell 1000.

Many academic papers reject the idea that capitalization-weighted indexes are good *CAPM market* proxies.[iv] This is equivalent to rejecting the mean-variance efficiency of these indexes.[v] This rejection of capitalization-weighted equity market indexes as mean-variance efficient suggests that more efficient indexes exist. However, the exercise to identify a better index may be moot if *ex ante* identification is impossible or if capitalization-weighted equity market indexes are *almost optimal*.[vi]

The ex ante construction of a mean-variance efficient portfolio is a difficult problem; forecasting expected stock returns and their covariance matrix for thousands of stocks, which is necessary for applying Markowitz's mean-variance portfolio construction, is intellectually challenging and resource intensive. This is precisely why CAPM remains so powerful: if one can find the "market" portfolio, one simultaneously identifies a mean-variance optimal portfolio.

Our industry and countless MBA programs have promoted the belief that capitalization-weighted equity market indexes are *sufficiently* representative of the CAPM "market portfolio" to be very nearly mean variance efficient. This assumption reduces the complicated problem of optimal portfolio construction to essentially buying and holding a capitalization-weighted index such as the S&P500 or Russell 1000. We demonstrate in this paper that investors can do much better than capitalization-weighted market indexes; and we provide fundamental equity market indexes that deliver superior mean-variance performance.

In this study we construct indexes using gross revenue, equity book value, gross sales, gross dividend, cash flow and total employment as weights. If capitalization is a "Wall Street" definition of the size of an enterprise, these are clearly "Main Street" measures. When a merger is announced, the Wall Street Journal may cite the combined capitalization, but the New York Post will focus on the combined sales or total employment. We show that these non-capitalization-based indexes consistently provide higher returns and lower risks than the traditional capitalization-weighted equity market indexes. In a sense, our work suggests that indexes constructed using "Main Street" measures of company size are significantly better than the capitalization-weighted "Wall Street" indexes.

Additionally, we show that these "Fundamental Indexes" deliver better risk-adjusted performance than traditional capitalization-weighted equity market indexes in various macroeconomic regimes, such as in rising and falling rate environments, in bull and bear markets and in expansions and recessions. We believe these results are not mere accidents of history but are likely to persist into the future. We offer our interpretations of the results and explain why the results should not be dismissed as active management anomalies or the product of data mining or data snooping. Ultimately, we hope to persuade the reader that our proposed Fundamental Indexes improve upon the capitalization-weighted indexes like S&P500 and Russell 1000.

Merits of capitalization-weighted equity market portfolios

Before introducing the methods we use to construct the fundamentals weighted equity market indexes, it is important to review the merits of capitalization weighting. Certainly, pension funds and endowments are indexed to S&P500 and Russell 1000 for many reasons other than the presumed mean-variance efficiency of these indexes. Whatever its shortcomings, capitalization weighting has many benefits. Any alternative should largely preserve these benefits.

- Capitalization weighting is a passive strategy requiring little trading; it therefore incurs far lower trading costs and fees than active management. Capitalization-weighted portfolios automatically rebalance as security prices fluctuate. Apart from the impact of stock buybacks and secondary equity offerings, there is no rebalancing cost associated with executing this strategy, except for replacing a constituent security in the portfolio. The

capitalization-weighted indexes require material adjustment only when new companies become large enough to merit inclusion in an index or when others disappear through merger, failure or relative changes in capitalization, collectively referred to as reconstitution. Such changes are not insignificant, however. A study of changes in the composition of the S&P 500 by Marshall Blume found that nearly half, 235 companies, had been replaced between 1995 and 2000.[vii]

- A capitalization-weighted index provides a convenient way to participate in the broad equity market. Capitalization-weighting seeks to assign the greatest weights to the largest companies. These companies are also typically among the largest as measured by other metrics of size as well, including sales, book value, cash flow, dividends, or total employment.

- Since market capitalization is highly correlated with trading liquidity, capitalization-weighting tends to emphasize the more heavily traded stocks, thereby reducing portfolio transaction costs.

- Since market capitalization is highly correlated with investment capacity, capitalization-weighting tends to emphasize the stocks with greater investment capacities, thus allowing the use of passive indexing on an immense scale by large pension funds and institutions.

The aim of this paper is to offer indexes that are more mean-variance efficient than the usual capitalization-weighted market indexes, while retaining the many benefits of capitalization-weighting for the passive investor.[viii] Fortunately, the alternative size measures we use allow us to construct passive portfolios that retain the above-listed benefits of capitalization-weighted indexing.

We find most alternative measures of firm size such as book value, cash flow, sales, revenues, gross dividends or total employment are highly correlated with capitalization and liquidity, which means these Fundamental Indexes are also primarily concentrated in the large capitalization stocks, preserving the liquidity and capacity benefits of traditional capitalization-weighted indexes. In addition, as compared with conventional capitalization-weighted indexes, these Fundamental Indexes typically have substantially identical volatilities, and CAPM betas

and correlations averaging 0.95 and 0.96, respectively. The *market* characteristics that investors have traditionally gained exposure to, through holding capitalization-weighted market indexes, are equally accessible through these Fundamental Indexes.

Maintaining low turnover is the most challenging aspect in the construction of Fundamental Indexes. In addition to the usual reconstitution, a certain amount of rebalancing is also needed for the Fundamental Indexes. If a stock price goes up 10%, its capitalization also goes up 10%. The weight of that stock in the Fundamental Index will at some interval need to be rebalanced to its Fundamental weight in that index. If the rebalancing periods are too long, the difference between the policy weights and actual portfolio weights become so large that some of the suspected negative attributes associated with capitalization weighting may be reintroduced.

We base the Fundamental Index strategies described in this paper on annual rebalancing as of January 1st. The resulting turnover only modestly exceeds the turnover for capitalization-weighted indexes. Since the Fundamental Indexes are concentrated in large, liquid companies, the relatively low rebalancing turnovers translate into rebalancing costs that are nearly as low as for a capitalization-weighted strategy.[ix]

The genesis of our non-capitalization-weighted market indexes stems from a concern that market capitalization is a *particularly* volatile way to measure a company's size or its true fair value. If so, capitalization weighting may lead to sub-optimal portfolio return characteristics because prices are too noisy relative to fundamentals. Mathematically, capitalization weighting assuredly gives additional weight to stocks that are currently overpriced relative to their (unknowable) discounted future cash flows (the true fair value), and reduces weights in stocks that are currently trading below that true fair value (see Hsu [2004] and Treynor [2004] for different derivations of this result). This leads to a natural performance drag in capitalization-weighted and other price weighted portfolios.

Equal weighting, which is obviously not price weighted, is a much-studied alternative, but it does not preserve the benefits of capitalization weighting enumerated in the previous section. It lacks the liquidity and capacity found in traditional market indexes and its return characteristics are not representative of the *aggregate equity market*. Furthermore, equal weighting has logical inconsistencies: for instance, an equal-weighted portfolio containing the Russell 1000 stocks

gives as much weight to the 1000th-largest company as to the largest, but gives no weight whatsoever to the 1001st-largest company.

Fundamental Indexes: Construction

Adopting Fundamental Indexation is more than just changing the basis for weighting the stocks in an index. For instance, if we simply re-weight the stocks in the S&P 500 or the Russell 1000 by book value, we miss a large number of companies with substantial book value but trading at a low price-to-book-value ratio. We end up with a portfolio, concentrated most heavily in stocks that are large in *both* capitalization *and* book value.

Instead we rank *all* companies by each metric, then select the 1000 largest. Each of these 1000 largest is included in the index, *at its relative metric weight*, to create the Fundamental Index for that metric. The measures of firm size we use in this study are:

- *book value (designated by the shorthand "book" later in this paper),*
- *trailing five-year average cash flow ("cash flow"),*
- *trailing five-year average revenues ("revenue"),*
- *trailing five-year average sales ("sales"),*
- *trailing five-year average gross dividend ("dividend"),*
- *total employment[x] ("employment"),*

We also examine a composite, equally weighting four of the above fundamental metrics of size ("composite"). This composite excludes the total employment because that is not always available, and revenues because sales and revenues are so very similar. The four metrics used in the composite are widely available in most countries, so that the Composite Fundamental Index could easily be applied globally and even in the emerging markets.

Financial statement data are taken from the Compustat database. Stock price information is collected from the CRSP database and linked to the corresponding Compustat entries using the CRSP/Compustat merged list. The roster of selected stocks and the portfolio weights for January

1 of any year are generated using only data available on the last trading day of the prior year. In most cases this means using data which is lagged by at least one quarter. The index is rebalanced on the last trading day of each year, using the end of day prices. We hold this portfolio until the end of the next year, at which point we use the most recent company financial information to calculate the following year's index weights.

We rebalance the index only once a year, on the last trading day of the year, for two reasons. First, the financial data available through Compustat are available only on an annual basis in the earliest years of our study. Second, when we try monthly, quarterly, and semi-annual rebalancing, we increase index turnover but find no appreciable return advantage over annual rebalancing.

Note that we do not adjust for trading costs in the index construction, which is consistent with the practice used by the commercial capitalization-weighted indexes and in most academic research. It would be difficult to know the actual trading cost with any precision, but we do examine the impact of a 1% trading cost (each way). Reciprocally, we measure how large the trading cost must be, in order to completely eliminate the alpha generated by the Fundamental Indexes relative to capitalization-weighted indexes.

We offer the results from six Fundamental Indexes, as well as a composite index combining four of the six. The construction of the 'composite' index requires some explanation. We combine in equal proportions the weights each company would have in the four Fundamental Indexes (book, cash flow, sales and gross dividends) to get the composite weight. We then select the top 1000 companies by composite weight, then we weight each by this composite weight to get the composite index. However, we recognize that many non-dividend paying companies choose not to payout dividends for tax reasons; non-payment is not a sign of weak/small cash flows. Therefore, we treat non-dividend paying companies differently from low dividend paying companies. When a company is indicated as non-dividend paying, we use the average of the remaining three size metrics instead of the full four size metrics.

For our Fundamental Indexes, we use trailing five-year averages wherever substantial volatility in the index weights would result from using year-to-year data; only book value and employment are single year metrics. This five-year averaging reduces index rebalancing turnover. Whenever

fewer than five years of data are available, we average the years of data that are available. When we examine the mean return, volatility, and equity market beta for similar indexes constructed with single year cash flow or revenue, we find the results are not materially different from those of their trailing five-year counterparts, but the portfolio turnover is substantially higher.[xi]

Because none of these measures of size relies on price, none will capture the current market valuation of perceived growth opportunity of the firms. So, young firms and fast-growing firms will be under-represented in the Fundamental Indexes, relative to their weights in capitalization-weighted market indexes. The gross dividend metric excludes all companies electing not to distribute dividends. Empirical studies have shown that zero-yield stocks outpace low-yield stocks with some regularity.[xii] Yet, even though zero-yield stocks are excluded from the gross dividend index while low-yield stocks are not, the index still handily outpaces the traditional capitalization-weighted indexes in the long run, with markedly lower risk.

Ex ante, it might seem that these indexes, which de-emphasize growth characteristics, would produce lower absolute returns and lower risk. This is because growth firms are usually firms with higher market beta risk and correspondingly (in theory) higher expected returns. We show later that this does not occur; in fact, with the exception of the Dividend Index, the Fundamental Indexes have betas ranging from 0.95 to 1.00, but have significantly higher realized returns with surprising consistency, over the 43 years.

For benchmarking purposes, we also construct a 1000-stock capitalization-weighted equity market index using the same construction method. While it bears close resemblance to the highly regarded Russell 1000, it is not identical.[xiii] The construction of this Reference Capitalization index allows us to make direct comparisons with the Fundamental Indexes uncomplicated by questions of float, market impact, subjective selections, and so forth.

The Relative Performance of Fundamental Indexation

Table 1 shows the return attributes of the Fundamental Indexes against the Reference Capitalization-weighted equity market portfolio and the S&P500 for the 43 years from 1962 through 2004. The sample period is selected to cover as long a history as possible with data from the Compustat Database. While Compustat has data extending back to the 1950's, the

number of firms prior to 1962, with sufficient five-year data for our purposes, is far less than 1000. The sample period was not selected to maximize the outperformance of the Fundamental Indexes; indeed, we show results decade-by-decade and for different economic and market environments within the 43 years. The historical portfolio results are not adjusted for any transaction costs associated with maintaining the strategy. We examine the issue of turnover and trading costs separately.

All of the Fundamental Indexes exhibit similar volatility and beta as the capitalization-weighted index except for the Gross Dividend index, which, as might be expected, has significantly lower return volatility and CAPM beta. This index is dominated by mature companies with less risk and lower perceived growth prospects. Even so, perhaps surprisingly, it outpaces the higher-risk conventional capitalization-weighted indexes.

The returns produced by the Fundamental Indexes are, on average, 1.97% higher than the S&P500 and 2.15% higher than the Reference Capitalization index. The best of the Fundamental Indexes outpaces the Reference Capitalization index by 2.56% per annum. The composite rivals the performance of the average, even though it excludes two of the best single-metric Fundamental Indexes! While we don't include this comparison in the tables, most of these indexes outpace both the equal-weighted S&P 500 and the equal-weighted CRSP universe, with lower risk, lower beta. The excess returns are significant and have an average t-statistic around 3.09, with the composite coming in even higher, with a t-statistic of 3.26.

As we can see in Table 2, once we adjust for the slightly lower beta and risk of the Fundamental Indexes, the average CAPM alpha rises to 2.37% with a t-statistic of 3.41; the composite (again, despite excluding two of the best single-metric indexes) delivers an even more impressive alpha of 2.44% with a t-statistic of 3.87. The information ratio[xiv] is above 0.50 for the best of these indexes, with the composite information ratio rising to 0.60 on a beta-adjusted basis. Given that Warren Buffett's lifetime information ratio is about 0.7, we find this to be a very satisfactory result, particularly for a process that isn't even seeking alpha!

Over the investment period of 43 years, the return advantages compound to ending values which are typically well above twice that of the ending value for the Reference Capitalization index.

Only the Book Index and Gross Dividend Index fail to double the cumulative return of the capitalization-weighted indexes.

Portfolio Liquidity

In Table 3, we examine index characteristics that can help us assess the liquidity and capacity of the Fundamental Indexes. In conjunction with the information on annual portfolio turnover, this allows us to assess the impact of transaction costs on the excess returns of the Fundamental Indexes. There are several useful ways to gauge liquidity.

We measure the relative capacity of each Fundamental Index by dividing the fundamentally-weighted average capitalization of that index by the capitalization-weighted average capitalization of the Reference Capitalization index. This "CAP Ratio" measure helps us assess the investment capacity of each index. A CAP Ratio of 0.66 suggests that the weighted average capitalization of the companies in the Composite Fundamental Index is two-thirds as large as that of the "Reference Capitalization" index. One possible inference is that the aggregate amount of money that can be benchmarked to or invested in this index is approximately two-thirds as much as what could be benchmarked to or invested in the Reference Capitalization index**.**

In addition, we examine the average dollar trading volume of the Fundamental Index portfolios, as well as the average number of trading days required to trade a billion-dollar portfolio. For these two measures we use only the data from 1993 through 2003 to report numbers that are relevant to the current environment. These two metrics suggest that, apart from the Employment index, the Fundamental Index portfolios have liquidity that is over half that of the Reference Capitalization portfolio. Given that over $1 trillion is passively managed in some variant of capitalization-weighted index portfolios, this does not seem a serious constraint. It's also interesting to observe that the Fundamental Index portfolios generally have roughly twice the liquidity and half the turnover of an equally weighted portfolio of the Reference Capitalization holdings.

We also measure the concentration of the portfolio in the large capitalization stocks by examining the fraction of the total index capitalization that belongs to the top 100 stocks by metric weight in each Fundamental Index. These concentration ratios are similar for all the

indexes, including the Reference Capitalization index, and range from 43% to 62%. Most are between 51% and 57%, near-identical to the 55% concentration ratio for the capitalization-weighted index.

This table also shows the average annual index turnovers. Recall that the indexes are reconstituted and rebalanced once a year at the end of the year. Observe that the "Reference Capitalization" index has somewhat lower turnover than the others. This is expected since virtually the entire turnover, apart from the modest impact of stock buybacks and secondary equity offerings, arises only from reconstitution (the addition of new stocks to, and removal of existing stocks from, the 1000 stocks in the index). The Fundamental Indexes, on the other hand, must further adjust the index holdings to (a) reflect the deviation in the index weights from the beginning of the year policy weights and (b) reflect changes in prices.

This increases the turnover from 6.3% for the Reference Capitalization index to an average of 13.1% for the Fundamental Indexes, and a surprisingly modest average of 10.6% for the Composite index. The pertinent issue is the erosion of the excess return relative to the capitalization-weighted index due to transactions costs. Assuming a 2% round-trip transaction cost (or 1% each way, including both transaction fees and price impact), the average excess return falls from an average of 2.15% to 2.01%. To completely erode the excess return would require a *one-way* transaction cost of over 16% each trade, and it would take an implausible 24.9% transaction cost *each way* to eliminate the alpha of the lower-turnover Composite Fundamental Index!

Stress-Testing the Results: Outliers and Market Environment

From a mean-variance perspective, the Fundamental Indexes appear to be superior to capitalization-weighted market indexes. Table 4 suggests that, on average, skewness is similar to the capitalization-weighted indexes, and kurtosis is slightly higher, suggesting modestly more outliers in the historical returns. This is evident with the Fundamental Indexes very slightly more exposed to extreme one-month and three-month events than a capitalization-weighted market index.

The pattern is interesting. For the Gross Dividends index compared with the capitalization-weighted index, the worst month is sharply improved but the best month is not degraded. However, for the Employment, Revenue and Sales indexes, the range is wider than for other indexes. The observed extreme events across all of the indexes do not appear to be large enough to account for the high excess return for the Fundamental Index portfolios. Indeed, the extremes are dampened in the Composite Index, so that the Composite outperforms the Reference Capitalization *and* the S&P 500 for both their best and worst month and quarter.

Furthermore, the broader dispersion does not carry through to spans longer than a quarter. The annual results favor *all* of the Fundamental Indexes over the Reference Capitalization index, with a better best outcome *and* a better worst outcome, with the sole exception of the low-beta Gross Dividends index, which lags the best 12-month span for the capitalization-weighted indexes. With this single exception, all of the Fundamental Indexes outperforms the best *and* worst years for the capitalization-weighted indexes, with no exceptions.

If the goal of earning higher returns with lower risk is the raison d'etre for the finance community, we find convincing evidence for indexing to these Fundamental Indexes, as Figures 1A and 1B rather vividly suggest. Figure 1A shows the cumulative growth of a $1 investment in each index; the bold lines correspond to the Reference Capitalization 1000 and the Composite 1000. Figure 1B shows the relative wealth of each Fundamental Index, as compared with the Reference Capitalization 1000 index; the bold lines again correspond to Reference Capitalization 1000 and the Composite 1000, as well as the S&P 500, which tracks very close to the Reference Capitalization 1000 except during the bubble.

It is worth noting, in Figure 1B, that the Fundamental Indexes do not keep pace in large-capitalization high-multiple bull markets (the "nifty fifty" of 1972, the "TMT bubble" of 1998-1999, and, to a lesser extent, the tech-dominated rallies of 1980 and 1989-1991). These markets are characterized by narrow high-multiple leadership, which leave the "average stock" far behind. However, as we shall see, the Fundamental Indexes keep pace with the capitalization-weighted indexes in the *average* bull market. Since they lag in these "bubbles", we can infer that they perform very well in the more conventional bull markets with broad leadership. We return

to this point later after we examine the consistency of the relative performance across time and across market environments.

- In Table 5, we show the performance of the indexes in the various decades. In four of the five spans, the Fundamental Indexes beat the capitalization-weighted indexes, often by a wide margin. The only shortfall was in the 1990s, and even during the 1990s the Composite Fundamental Index was ahead of the Reference Capitalization until the end of May, 1999, just ten months before the bubble burst. This decade was characterized by a "mega-cap" dominated decade, fueled in part by a massive flow of investment assets into capitalization-weighted index funds, in which anything outside of the largest companies lagged. Comparing any of the 1000-stock indexes with the S&P 500 in that decade is an apples-to-oranges comparison. In an apples-to-apples comparison, relative to the Reference Capitalization index, the Composite Fundamental Index held a lead until the last eight months of the decade! Then, as the tech bubble of the late-1990s burst, the Fundamental indexes pull ahead by an average of 9.44% per annum, from January 2000 through December 2004.

- In Table 6, we show the performance of the indexes in the recessionary and the expansionary phases of the business cycle as defined by the National Bureau of Economic Research (NBER). The excess returns are particularly strong in the recessionary phase of the business cycle, averaging 4.13% per annum versus 1.80% per annum during expansions. *Still, value was added during expansions as well as recessions*.

- In Table 7, we show the performance in bear and bull markets, where a bull market is defined simplistically (and ex post) by a 20% rally from the previous low and a bear market by 20% decline from the previous high. In Table 7, we find the Fundamental Indexes outperforming by 6.40% per annum in bear markets versus a still-respectable 0.55% per annum in bull markets. Given the value bias of these indexes, the superior performance in bear markets is not surprising. *But, the Fundamental Indexes fully match the capitalization-weighted indexes in the typical bull market, despite the growth bias of the capitalization-weighted indexes*.

- In Table 8, we show the performance in rising interest rate and falling interest rate regimes, where a rising rate regime is defined (simplistically, and ex post) by the 90-day Treasury Bill

yield rising more than 20% from the previous low and a falling rate regime is defined by the Treasury Bill yield falling more than 20% since the previous high. The Fundamental Indexes outperform by an average of 2.54% per annum in falling interest rate environments versus 1.87% per annum in rising interest rate environments.

Tables 4 through 8 are important in addressing the possibility that the excess returns of the Fundamental Indexes are driven by exposures to macroeconomic risks that are not captured fully by the CAPM model. These exhibits suggest that weighting by the "Main Street" definitions of the size of a company is surprisingly robust, improving on the mean-variance efficiency of the ubiquitous capitalization-weighted indexes.

Table 9 compares the correlations of the Fundamental Indexes and the capitalization-weighted indexes with an array of asset class returns. The results are, for the most part, surprisingly bland: the Fundamental Indexes have largely the same correlations as we find for the capitalization-weighted indexes, with a wide assortment of asset classes. The notable exception is that the Fundamental Indexes are more strongly correlated with the Wilshire REIT index than the capitalization-weighted indexes. All correlations larger than 0.11 are statistically significant at the 90% (two-tail) level; 99% significance requires a correlation of 0.18.[xv] Accordingly, most of these correlations are highly significant.

The second panel of Table 9 goes one step further. It examines the correlation of the *value added* for the various indexes, net of the return for the Reference Capitalization index, with an array of asset classes. Here, we find differences that are perhaps more interesting, though often lacking in statistical significance. The S&P 500 would seem to outpace the Reference Capitalization index when the stock market is rising, the broad US bond market is rising (i.e., interest rates are falling), and high-yield bonds, emerging markets bonds and REITS are performing badly. The Fundamental Indexes have mostly the opposite characteristics, performing best when US and non-US stocks are falling and REITS are rising. Curiously, they mostly perform well when High Yield bonds are rising but Emerging Markets bonds are falling. Also, they tend to perform well when TIPS are rising (i.e., *real* interest rates are falling). Most of these results are unsurprising; but, apart from the S&P, REIT and TIPS correlations, most are also not statistically significant.

The Intuition for Fundamental Indexes

Each of the indexes we construct contains 1000 companies. The rosters are generally similar, though not identical, to the stocks in conventional indexes like the Russell 1000. Our innovation in portfolio construction comes from the selection and weighting scheme applied. Instead of selecting and weighting the stocks in the index by capitalization, we use other metrics of firm size, such as book value of assets, cash flow, sales, gross dividend distributions, or even total employment as the basis for both selection and weighting of the 1000 largest companies.

The two forms of indexing might be characterized as "Wall Street indexing" and "Main Street indexing." The general public of "Main Street" does not typically think of market capitalization when considering the size of a company. For most of the population, other measures such as sales, cash flow, employment, book value, and so forth, are the intuitive measures of the true size of a company. It is refreshing, even to us, to find Main Street indexing outperforming Wall Street indexing! Indeed, when the popular press describes mergers and other corporate actions, the size of the companies is generally described in revenues, profits, employees or other "Main Street" measures. The true significance of the difference between these two forms of viewing the stock market may have been best stated by Ben Graham, *"in the short run, the market is a voting machine but in the long run, it is a weighing machine."*

We believe the performance of these Fundamental Indexes is largely free of data mining. Our selection of size metrics were intuitive; they were not selected ex post, based upon results. Nor was the composite constructed by "cherry-picking" the best metrics; we chose the obvious ones, focusing on measures which are readily available in the US and worldwide. For example, we also examined reported and operating earnings, both raw and smoothed, but do not show those results because cash flow is slightly less subject to manipulation than earnings, and is not as vulnerable to global accounting differences; still, those results were near-identical to the results for the cash flow index. We use no subjective stock selection or weighting decisions in their construction, and the portfolios are not fine-tuned in any way. We equal-weighted four measures for the Composite Fundamental Index, excluding two measures which actually would have boosted our results; we did not optimize the weighting of the constituent measures in any way.

Even so, we acknowledge that our research may be subject to at least two – largely unavoidable – criticisms:

- We lived through the period covered by this research (1962-2004); we experienced bubble periods where cap-weighting caused severe destruction of investor wealth, contributing to our concern about the efficacy of capitalization-weighted indexation (the "nifty fifty" of 1971-72, the bubble of 1999-2000).

- Our Fundamental metrics of size, such as book value, revenues, smoothed cash flow, total employment, and so forth, all implicitly introduce a value bias, amply documented as possible market inefficiencies or as priced risk factors. (Reciprocally, it can be argued that capitalization-weighted indexes have a growth bias, whereas the *Fundamental Index*es do not.)

Table 10 compares the 20 largest companies in the capitalization-weighted index with the 20 largest in the Composite Fundamental Index as of December 31, 2004. With few exceptions, it would be reasonable to suggest that the stocks on these lists are intuitive and unsurprising. It is also evident that the capitalization-weighted list has a marked bias in favor of high-multiple stocks with strong *perceived* growth opportunities, relative to the Composite Fundamental Index. Whether this growth bias proves more profitable in the future we cannot say; it has not proven profitable in the past.

While the top three stocks on both indexes are the same, albeit in a different order, few aspects of the Fundamental Indexes more starkly highlights the difference with capitalization-weighted indexes than the fourth largest company in the two indexes. Microsoft, at a 3.2% weight in the Reference Capitalization index, is unequivocally an important part of today's economy – and tomorrow's. The capitalization-weighted indexes are weighted in accordance with the market's view of future profits, while the Fundamental Indexes are weighted in accordance with the current scale of an enterprise in today's economy. From the perspective of "Main Street," the Composite Fundamental Index suggests that Microsoft occupies eleventh place, with a more modest 1.3% of today's economy. But, for the average citizen, the fourth-largest company in the Composite Fundamental Index, Wal-Mart, occupies a larger share of our consumption basket (revenues), pays larger dividends, earns larger profits, employs more people and consumes more

of our nation's capital stock (book value) than Microsoft. Accordingly, the Fundamental Indexes weight Wal-Mart in fourth place, at 1.6% of today's economy, even though it ranks thirteenth in capitalization.

Of course these index weights do not suggest that Microsoft is overvalued or that Wal-Mart is undervalued. These weights merely indicate that Microsoft's scale in the current economy is smaller than Wal-Mart's current scale. Empirically, the volatility associated with the *shifting* perceptions of future scale for individual companies creates a performance drag on the capitalization-weighted indexes. "Wall Street" is making the judgment that Wal-Mart will be 45% smaller in the *future* economy than Microsoft, but Fundamental Indexing pegs Microsoft as 20% smaller in the *current* economy than Wal-Mart. That's a big gap; the market's perception that Microsoft will be larger in the future than it is today may or may not prove true.

Figures 2A and 2B illustrate another interesting attribute of the Fundamental Indexes, the stability of the sector allocations over time. The capitalization-weighted index reacts strongly to shifting investor preferences, with a huge spike and collapse in the allocation to energy in the early 1980s and to the technology bubble and collapse from 1998-2001. By contrast, the Fundamental Indexes more closely reflect the steady evolution of the economy at large, with a gradual change in sector allocations in response to the shifting composition of the economy.

Performance Attribution

As mentioned before, the observed excess return of the Fundamental Indexes is consistent with the hypothesis that stock prices are inefficient. But, the incremental performance is also consistent with other explanations, not based on price inefficiency. We explore the possible reasons behind the performance of the Fundamental Indexes and show evidence supporting both views. Ultimately we remain agnostic as to the true driver of the excess return over the capitalization-weighted indexes; we simply recognize that they have outperformed significantly and with some consistency, across diverse market and economic environments. Our research suggests little reason to believe that this pattern will not continue.[xvi]

In Table 2, we saw that most of the CAPM betas and correlations averaged 0.95 and 0.96 for the Fundamental Indexes; the notable outlier is Gross Dividends, which has an average beta of 0.84.

Adjusted for beta risk, the average excess performance increases from 2.15% to 2.37% per annum. The t-statistics are significant for all the Fundamental Indexes, approaching four for the Composite index. How do we explain these alphas? Much of this work builds on existing knowledge: alphas have been used repeatedly in the academic literature to reject (1) the S&P 500 as a good market proxy, (2) the linkage between "noise" in asset pricing and the factor returns observed for value and size, (3) CAPM's single risk factor framework, and (4) price efficiency.

There are many theoretical reasons why the S&P500 index and other capitalization-weighted indexes do not proxy well for the "true" equity market portfolio,[xvii] so our identification of a better equity market index is unsurprising. This is a defensible interpretation of our empirical results , though it is not particularly confidence-inspiring. That said, there is no ex ante reason to believe these Fundamental Indexes are a better proxy for the "true" CAPM "market portfolio," that must include all assets that are in positive net supply (such as commodities, real estate and human capital).

Hsu (2004) demonstrates that capitalization-weighted portfolio suffers from a return drag if prices are noisy relative to movements in firm fundamentals. Treynor (2004), in a forthcoming FAJ paper **[Ed – Verify before typesetting!]**, shows that random pricing errors lead to a *negative alpha* for any price-weighted or capitalization-weighted portfolio relative to a price-indifferent portfolio, such as the Fundamental Indexes (or equal-weighting).

As portfolio managers, we like to believe that the observed performance is alpha and is driven by price inefficiency. But, we recognize that any assumption of price inefficiency is significantly more difficult to defend. We understand this point and do not wish to overstate our case. Many practitioners and academics do believe, however, that the extraordinary run-up in share valuations and the subsequent crash from 1998-2002 was a bubble; this adds support to the contention that price fluctuations sometimes do not reflect changes in firm fundamentals.

Suppose the assumption of price inefficiency is true. After all, even Fischer Black famously remarked that, "the markets are far more efficient when viewed from the banks of the Charles than from the banks of the Hudson." It need not immediately suggest easy money. Suppose we merely know that some firms are overvalued while others are undervalued; there are no simple

ways to trade away this idiosyncratic noise in prices, because one cannot know which stock is currently overvalued and which stock is undervalued.

However, any price deviation from "true fair valuation" implies that capitalization weighting will overweight *all* currently overpriced stocks and underweight *all* undervalued ones. This overreliance on low-IRR stocks and underreliance on high-IRR stocks leads to lower risk adjusted performance relative to hypothetical fair-value-weighted strategies – *and likely also relative to strategies that randomize these errors.*[xviii] The size metrics that we explore are valuation-indifferent, and therefore will not be subject to this bias, or the corresponding performance drag in capitalization-weighted indexes. Admittedly they could introduce other potentially more costly biases; however, we find no evidence of that in the data.

The literature on stock return predictability, where price-related ratios such as dividend yield and earnings yield appear to forecast next period stock returns is also consistent with our price inefficiency hypothesis.[xix,xx] This is a stronger form of price inefficiency since the pattern of price deviation is systematic (e.g. high P/E stocks have a greater tendency to underperform), and there are obvious strategies to profit from the inefficiency.[xxi] This return predictability suggests a systematic inefficiency that can be exploited by using firms' financial ratios as trading signals. The Fundamental Indexes implicitly condition on firm financial ratios in its annual reconstitution and reweighting, that allows these indexes to benefit from the documented predictive relationships between dividend yields and other value measures on future stock returns.

While the construction of the Fundamental Indexes systematically underweights growth stocks relative to a capitalization-weighted portfolio, we would argue that a better way to state this is that the capitalization-weighted "Wall Street" indexes systematically overweight growth stocks relative to a "Main Street" Fundamental Index. A Fama-French 3-factor regression shows that the Fundamental Indexes have factor exposure to the value factor (and, to a lesser extent, the size factor) and thereby earn an excess return which can be attributed to a value (and size) premium relative to a capitalization-weighted equity market index. We can adopt the interpretation that value premium is an anomaly and is a pure alpha due to a systematic price inefficiency.

This is not as controversial a stance as might be expected. The finance academic literature has still not reached a consensus on the source of the value premium and journals continue to publish

general equilibrium models demonstrating how the Fama-French value factor could be a proxy for an underlying risk factor. There has been, however, little convincing evidence on the value factor proxying for a macroeconomic risk factor. The most popular interpretations of the value factor as a systematic distress risk factor fail to identify economy-wide distress scenarios that coincided with price collapses in value stocks. The finance literature on return anomalies, and on systematic market inefficiencies driven by behavioral biases, certainly lend support to the interpretation of our capturing of the value premium as pure alpha.

Note that the capitalization-weighted index underperformance is positively related to the size of the price deviation, whether that deviation is idiosyncratic or systematic.[xxii] This is illustrated powerfully in Table 5, where the capitalization-weighted market portfolio underperforms by an average of 9.44% relative to the Fundamental Indexes in the current decade, after high tech share prices begin to revert to a level of normalcy relative to their fundamentals.

Certainly, we readily concede that the observed excess returns could also be attributed to hidden risk exposures rather than return anomalies from price inefficiency. As we mentioned before, the Fundamental Indexes underweight growth stocks relative to a capitalization-weighted index. This index characteristic may exposure the Fundamental Indexes to additional risks, such as economy-wide liquidity or distress risk when compared to a capitalization-weighted index. While the history of stock returns to which we have access does not provide support for this view (except, weakly, in the worst single month for a few of the Fundamental Indexes), it is impossible to eliminate the hidden risk factor proposition.

The three explanations we put forth above are not mutually exclusive. That is, the added performance can be attributed in part to market mispricing and in part to the index taking on additional hidden risk exposure. *A common denominator in all three explanations is that, in any but the simplest CAPM definition of alpha, this value-added is attributable more to a structural negative return bias from Capitalization-weighted or Price-weighted indexes than to any positive alpha from Fundamental Indexation.*

Whether the better mean-variance performance is driven by better market index construction, by pure CAPM alpha (driven by a structural negative return bias in capitalization-weighted portfolio) or by beta exposure to additional risk, historically these Fundamental Indexes are materially

more mean-variance efficient than standard capitalization-weighted indexes. To the extent that an investor wants a more mean-variance efficient market portfolio, the data suggests that the Fundamental Indexes are superior alternatives to traditional capitalization-weighted equity market indexes.

Continuing Research

We are pursuing additional research, beyond the scope of this paper, in areas that include the following:

- This method compares more handsomely, and with greater consistency, on the "next 2000 stocks," (roughly equivalent to the Russell 2000). It does so with higher average capitalization, broader diversification, less concentration, greater liquidity, and essentially the same turnover, when measured relative to the next 2000 capitalization-weighted stocks.

- This method should perform well outside of the US. Preliminary results in Japan are even better than in the US, with an average of 2.4% of incremental return over the past 25 years.[xxiii]

- For international and global portfolios, it's noteworthy that Fundamental Indexing introduces a more stable country allocation than capitalization weighting. Just as the Fundamental Indexes smooth the movement of sector and industry allocations to mirror the evolution of each sector or industry's scale in the overall economy, a global Fundamental Indexes index will smooth the movement of country allocations, mirroring the relative size of each country's scale in the global economy. In other words, global Fundamental Indexes should offer the same advantages as GDP-weighted global indexing, with the same rebalancing "alpha" enjoyed by GDP-weighting. We would argue that the "alpha" from GDP-weighting in international portfolios is perhaps attributable to the elimination of the same capitalization-weighted return drag (from overweighting the overvalued countries and underweighting the undervalued countries) as we observe in the US indexes. This is the subject of some current research that we hope to publish in the coming year.

- This method outpaces most active managers, by a greater margin and with more consistency than conventional capitalization-weighted indexes. This need not argue against active management; it only suggests that active managers have perhaps been using the wrong "market portfolio" as a starting point, making active management "bets" relative to the wrong index. If an active management process can add value, then it should perform far better if it makes active bets against one of these Fundamental Indexes than against capitalization-weighted indexes.

- This work may reveal interesting insights into the nature of market inefficiencies. One peculiarity in our results herein may suggest an interesting path for additional research. The Fundamental Indexes sharply outpace the capitalization-weighted indexes in bear markets, but not bull markets. On the other hand, they add more value when interest rates are falling, which correspond more to bull markets than bear markets, than when interest rates are rising. The clear implication is that when stocks are rising in the face of rising interest rates, shrugging off the rising cost of capital, Fundamental Indexes must disappoint! We might infer that these are market environments characterized by a less disciplined focus on objective fundamentals (bubbles?). But, such speculations would not be consistent with an efficient market – so we'll leave that investigation for another time!

- There may be important risk premium implications. If these simple indexes outpace the capitalization-weighted indexes by some 2.15% per annum, then an optimally-constructed market portfolio must offer a risk premium relative to bonds or cash at least 2.15% higher than the risk premium of a capitalization-weighted index. Stocks are more attractive, at any level of risk premium, to investors in these indexes than to investors in capitalization-weighted indexes.

- We think that it is a worthy question whether the Fundamental Indexes have a "value bias" relative to the capitalization-weighted indexes or the capitalization-weighted indexes have a "growth bias" relative to the Fundamental Indexes. This is more than a mere matter of semantics. It may well be that the returns for the APT or Fama-French risk factors are driven by the *negative* return drag in the overweighting of intrinsically overvalued companies (those trading above their – unknowable – true fair value) and underweighting of intrinsically

undervalued companies in capitalization-weighted indexes. It would be interesting to see the impact of respecifying APT or Fama-French based on the Fundamental Indexes; it may make a material difference.

- Many value-oriented indexes have been created in response to concerns about the higher risk and, perhaps, lower returns of growth stocks. Most of these involve eliminating half of the stocks in the market (more or less), *and then applying capitalization weighting to the value stocks that are left.* If capitalization weighting is a source of the very problem that we're trying to address, then the existing value indexes *reintroduce that same error* after stripping out half of the market. Also, because stocks drift up or down in size and between the growth and value segments of the stock market, the turnover in these value indexes is surprisingly high. The Fundamental Indexes historically produce comparable average returns with less tracking error, greater statistical significance, lower turnover, and better liquidity than the conventional value-oriented indexes. It would be interesting to better understand why the conventional value indexes are so very inferior, on a risk-adjusted basis, to these simple Fundamental Indexes.

- Most of the arguments favoring value "anomalies" center on a common theme: mean reversion. If price/earnings ratios mean-revert, if return on equity mean-reverts, if profit margins mean revert, if the return on capital mean reverts relative to the return on labor, if productivity growth rates mean revert, if earnings growth rates mean revert (Little, 1962), each of these can produce one or another of the much-studied market "anomalies." These same mean reversion tendencies will accrue to the benefit of the fundamentally-based indexes and/or to the detriment of a capitalization-weighted index. It would be useful to better understand whether mean reversion creates market inefficiencies, or asset values correctly reflect the likely impact of mean reversion in these many measures.

- We continue to seek improvements on the Fundamental Indexes described here, but these efforts often lead us into the domain of data mining. Accordingly, we do not include any of these attempts in this article.

Conclusion

In this paper we offer a selection of fundamentally-based market portfolios whose construction method is based on selection and weighting with metrics of firm size other than capitalization weighting. These size measures include book value, revenue, dividends, and others. The resulting portfolios outperform the S&P500 by an average of 1.97% per annum over the 43-year span tested. The performance is robust across time, across phases of the business cycle, across bear and bull stock markets, and across rising and falling interest rate regimes. We note that the excess return of the Fundamental Index portfolios over the S&P500 can arise from (1) superior market portfolio construction, (2) price inefficiency, (3) additional exposure to distress risk, or (4) a mixture of the three. We leave it to readers to choose a favorite explanation.

The mean-variance superiority of the Fundamental Indexes is robust and significant. If higher mean return and lower total return volatility are the goals of investment management and if there is reason to expect these robust historical results will continue into the future, then investment in these Fundamental Indexation metric market indexes will be preferred to traditional capitalization-weighted market indexes.

Table 1. Return Characteristics of Fundamental Indexes, 1962-2004

	Ending Value of $1	Geometric Return	Volatility	Sharpe Ratio	Excess Return vs REF CAP	Tracking Error vs REF CAP	Information Ratio	t-Stat for Excess Return
S&P 500	$ 73.98	10.53%	15.1%	0.315	0.18%	1.52%	0.12	0.76
Reference Cap	$ 68.95	10.35%	15.2%	0.301	-	-	-	-
Book Value	$ 136.22	12.11%	14.9%	0.426	1.76%	3.54%	0.50	3.22
Cash Flow	$ 165.21	12.61%	14.9%	0.459	2.26%	3.94%	0.57	3.72
Revenue	$ 182.05	12.87%	15.9%	0.448	2.52%	5.03%	0.50	3.25
Sales	$ 184.95	12.91%	15.8%	0.452	2.56%	4.93%	0.52	3.36
Gross Dividends	$ 131.37	12.01%	13.6%	0.458	1.66%	5.33%	0.31	2.02
Employment	$ 156.83	12.48%	15.9%	0.423	2.13%	4.64%	0.46	2.98
Composite	**$ 156.54**	**12.47%**	**14.7%**	**0.455**	**2.12%**	**4.21%**	**0.50**	**3.26**
Average, Excl Comp	**$ 159.44**	**12.50%**	**15.2%**	**0.444**	**2.15%**	**4.57%**	**0.47**	**3.09**

Table 2. CAPM Characteristics of Fundamental Indexes, 1962-2004

	Ending Value of $1	Geometric Return	Correlation vs REF CAP	CAPM Beta vs REF CAP	Excess Return vs REF CAP	CAPM Alpha vs REF CAP	Information Ratio of Alpha	t-stat for CAPM Alpha
S&P 500	$ 73.98	10.53%	100%	0.99	0.18%	0.23%	0.16	1.00
Reference Cap	$ 68.95	10.35%	-	-	-	-	-	-
Book Value	$ 136.22	12.11%	97%	0.95	1.76%	1.98%	0.57	3.71
Cash Flow	$ 165.21	12.61%	97%	0.95	2.26%	2.51%	0.65	4.21
Revenue	$ 182.05	12.87%	95%	0.99	2.52%	2.57%	0.51	3.32
Sales	$ 184.95	12.91%	95%	0.99	2.56%	2.63%	0.53	3.46
Gross Dividends	$ 131.37	12.01%	94%	0.84	1.66%	2.39%	0.49	3.17
Employment	$ 156.83	12.48%	96%	1.00	2.13%	2.15%	0.46	3.00
Composite	**$ 156.54**	**12.47%**	**96%**	**0.93**	**2.12%**	**2.44%**	**0.60**	**3.87**
Average, Excl Comp	**$ 159.44**	**12.50%**	**96%**	**0.95**	**2.15%**	**2.37%**	**0.53**	**3.41**

Table 3. Liquidity Characteristics of Fundamental Indexes, 1962-2004

	Ending Value of $1	CAP Ratio	Concentration Ratio	Weighted $ Trading Volume*	Weighted Trading Days*	Turnover	Excess Return @ 1% Trade Cost	Trade Cost for no Excess Return
Reference Cap	$ 68.95	1.00	55.06%	191 MM	0.9	6.30%	-	-
Book Value	$ 136.22	0.64	51.46%	134 MM	1.5	13.20%	1.62%	12.73%
Cash Flow	$ 165.21	0.65	57.06%	126 MM	1.3	12.14%	2.14%	19.34%
Revenue	$ 182.05	0.55	54.66%	105 MM	2.0	14.15%	2.36%	16.05%
Sales	$ 184.95	0.54	52.48%	99 MM	1.7	13.41%	2.42%	17.99%
Gross Dividends	$ 131.37	0.71	61.99%	110 MM	1.6	11.10%	1.56%	17.27%
Employment	$ 156.83	0.38	42.76%	70 MM	9.3	14.56%	1.96%	12.89%
Composite	**$ 156.54**	**0.66**	**51.76%**	**102 MM**	**1.5**	**10.55%**	**2.03%**	**24.93%**
Average, Excl Comp	**$ 159.44**	**0.58**	**53.40%**	**107 MM**	**2.9**	**13.09%**	**2.01%**	**16.04%**

**Liquidity information is from 1962~2003*

Table 4. Outlier Risks of Fundamental Indexes, 1962-2004

	skewness	excess kurtosis	maximum monthly return	minimum monthly return	maximum 3-month return	minimum 3-month return	maximum trail 12mo return	minimum trail 12mo return
S&P500	(0.32)	1.79	17.0%	-21.7%	27.1%	-29.7%	61.6%	-39.0%
Reference Cap	(0.36)	1.69	17.5%	-21.3%	27.0%	-28.8%	62.4%	-41.0%
Book Value	(0.30)	1.94	17.9%	-21.3%	27.2%	-28.3%	62.8%	-32.9%
Cash Flow	(0.30)	2.01	18.4%	-21.0%	28.0%	-28.7%	64.6%	-34.3%
Revenue	(0.33)	2.36	21.3%	-23.3%	33.1%	-30.7%	72.9%	-33.9%
Sales	(0.33)	2.38	21.2%	-23.3%	33.1%	-30.7%	72.8%	-33.9%
Gross Dividends	(0.23)	2.00	17.8%	-19.1%	25.8%	-26.3%	58.8%	-32.7%
Employment	(0.36)	2.45	21.3%	-23.5%	32.2%	-29.4%	69.7%	-36.8%
Composite	**(0.29)**	**2.11**	**18.9%**	**-21.2%**	**27.8%**	**-28.5%**	**64.4%**	**-33.4%**
Average, Excl Comp	**(0.31)**	**2.19**	**19.7%**	**-21.9%**	**29.9%**	**-29.0%**	**66.9%**	**-34.1%**

Figure 1A. Growth of $1, Various Indexation Metrics, 1962-2004

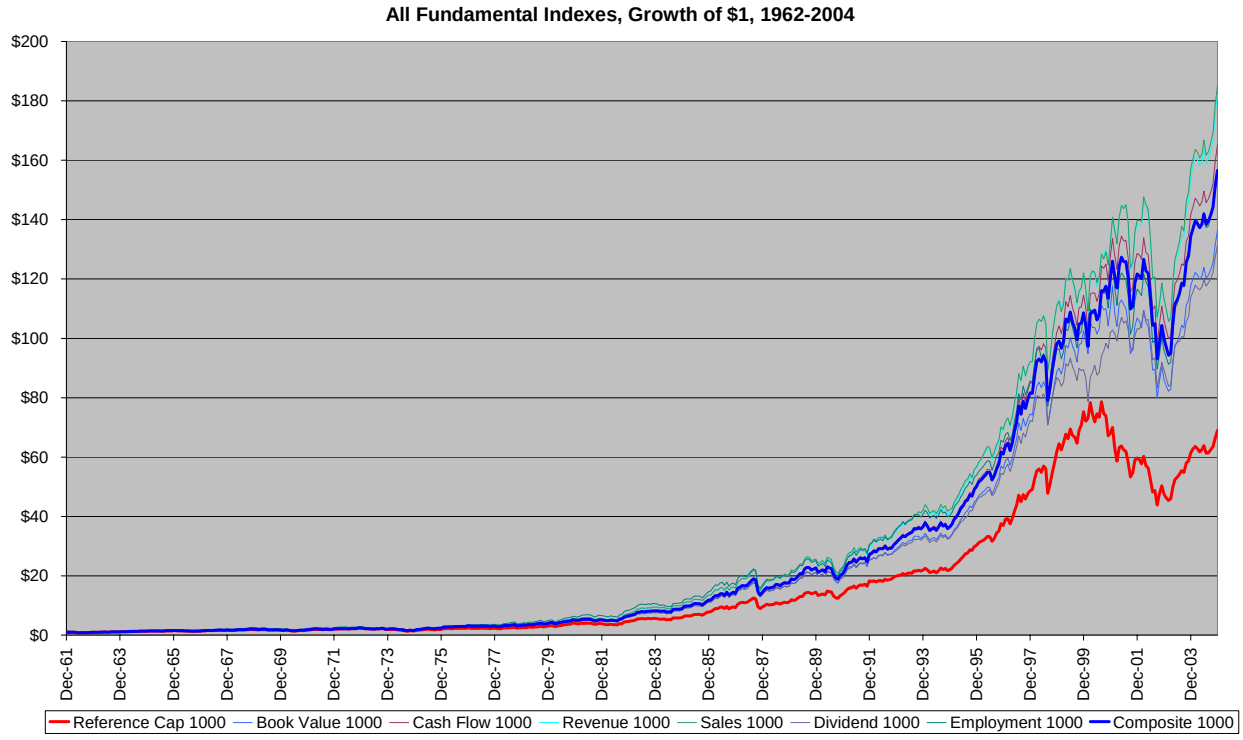


Figure 1B. Value-Added versus Reference Capitalization Portfolio, 1962-2004

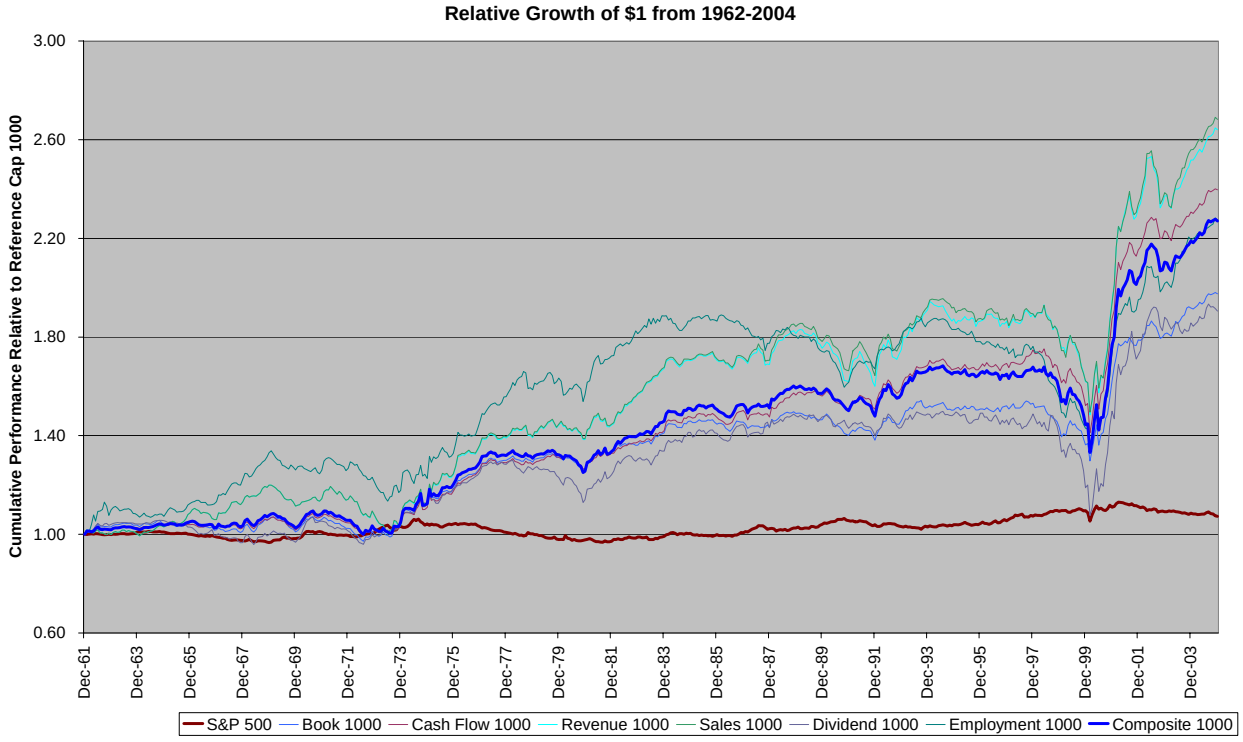


Table 5. Return Characteristics of Fundamental Indexes, by Decade, 1962-2004

Panel A. Geometric Return

Geometric Return	1/62 - 12/69	1/70-12/79	1/80-12/89	1/90-12/99	1/00-12/04
S&P500	6.58%	5.86%	17.71%	18.57%	-2.15%
Reference Cap	6.80%	5.90%	17.00%	17.94%	-1.73%
Book Value	6.94%	8.72%	18.29%	17.09%	5.84%
Cash Flow	7.04%	8.64%	19.04%	17.65%	7.60%
Revenue	8.26%	8.67%	19.32%	16.99%	8.38%
Sales	8.26%	8.70%	19.47%	16.84%	8.66%
Gross Dividends	6.37%	8.48%	19.15%	15.42%	7.98%
Employment	9.94%	8.69%	17.74%	15.65%	7.82%
Composite	7.13%	8.63%	19.04%	16.95%	7.59%
Average, Excl Comp	**7.80%**	**8.65%**	**18.83%**	**16.61%**	**7.71%**

Panel B. Value Added Relative to Reference Capitalization

Excess Return	1/62 - 12/69	1/70-12/79	1/80-12/89	1/90-12/99	1/00-12/04
S&P500	-0.22%	-0.05%	0.71%	0.63%	-0.43%
Reference Cap	-	-	-	-	-
Book Value	0.13%	2.81%	1.29%	-0.85%	7.57%
Cash Flow	0.23%	2.73%	2.04%	-0.29%	9.33%
Revenue	1.46%	2.77%	2.32%	-0.95%	10.10%
Sales	1.46%	2.79%	2.47%	-1.10%	10.39%
Gross Dividends	-0.44%	2.57%	2.15%	-2.52%	9.71%
Employment	3.14%	2.78%	0.74%	-2.29%	9.55%
Composite	**0.33%**	**2.73%**	**2.04%**	**-1.00%**	**9.32%**
Average, Excl Comp	**1.00%**	**2.74%**	**1.84%**	**-1.33%**	**9.44%**

Panel C. Annualized Standard Deviation of Returns

Standard Deviation	1/62 - 12/69	1/70-12/79	1/80-12/89	1/90-12/99	1/00-12/04
S&P500	12.38%	16.11%	16.56%	13.55%	17.98%
Reference Cap	12.61%	16.62%	16.40%	13.46%	18.07%
Book Value	12.40%	16.58%	15.61%	13.22%	18.18%
Cash Flow	12.27%	16.55%	15.81%	13.52%	17.63%
Revenue	13.38%	18.23%	16.59%	13.96%	18.22%
Sales	13.38%	18.21%	16.60%	13.64%	18.15%
Gross Dividends	11.80%	15.47%	14.45%	11.95%	15.27%
Employment	12.88%	18.63%	16.50%	13.75%	18.56%
Composite	**12.43%**	**16.63%**	**15.56%**	**12.99%**	**17.22%**
Average, Excl Comp	**12.69%**	**17.28%**	**15.93%**	**13.34%**	**17.67%**

Panel D. Sharpe Ratios

Sharpe Ratio	1/62 - 12/69	1/70-12/79	1/80-12/89	1/90-12/99	1/00-12/04
S&P500	0.19	(0.03)	0.53	1.01	(0.27)
Reference Cap	0.20	(0.03)	0.49	0.97	(0.24)
Book Value	0.22	0.14	0.60	0.93	0.17
Cash Flow	0.23	0.14	0.64	0.95	0.28
Revenue	0.30	0.13	0.63	0.87	0.31
Sales	0.30	0.13	0.64	0.88	0.33
Gross Dividends	0.18	0.14	0.71	0.89	0.35
Employment	0.44	0.12	0.53	0.79	0.28
Composite	**0.23**	**0.14**	**0.65**	**0.93**	**0.28**
Average, Excl Comp	**0.28**	**0.13**	**0.62**	**0.88**	**0.28**

Table 6. Return Characteristics of Fundamental Indexes, in NBER Business Cycles, 1962-2004

	EXPANSIONS			RECESSIONS		
	Geometric Return	Volatility	Sharpe Ratio	Geometric Return	Volatility	Sharpe Ratio
S&P500	11.75%	14.13%	0.45	3.15%	20.34%	(0.25)
Reference Cap	11.66%	14.13%	0.44	2.46%	20.90%	(0.28)
Book Value	13.19%	13.89%	0.56	5.51%	20.13%	(0.13)
Cash Flow	13.60%	13.94%	0.59	6.55%	20.03%	(0.08)
Revenue	13.82%	14.74%	0.57	7.03%	21.75%	(0.05)
Sales	13.84%	14.67%	0.58	7.24%	21.62%	(0.05)
Gross Dividends	12.70%	12.75%	0.57	7.74%	18.36%	(0.03)
Employment	13.63%	14.61%	0.56	5.49%	22.24%	(0.12)
Composite	13.40%	13.75%	0.58	6.77%	19.93%	(0.07)
Average, Excl Comp	**13.46%**	**14.10%**	**0.57**	**6.59%**	**20.69%**	**(0.08)**

Table 7. Return Characteristics of Fundamental Indexes, in Bull and Bear Markets over 20%, 1962-2004

	BULL MARKETS			BEAR MARKETS		
	Geometric Return	Volatility	Sharpe Ratio	Geometric Return	Volatility	Sharpe Ratio
S&P500	20.81%	13.62%	1.21	-24.02%	16.49%	(1.89)
Reference Cap	20.89%	13.56%	1.22	-24.89%	17.01%	(1.89)
Book Value	21.20%	13.51%	1.25	-19.30%	16.77%	(1.58)
Cash Flow	21.63%	13.64%	1.27	-18.62%	16.49%	(1.56)
Revenue	22.24%	14.46%	1.24	-19.36%	17.90%	(1.48)
Sales	22.27%	14.38%	1.25	-19.30%	17.85%	(1.48)
Gross Dividends	19.68%	12.63%	1.21	-15.27%	14.84%	(1.51)
Employment	21.62%	14.34%	1.20	-19.08%	18.43%	(1.42)
Composite	**21.26%**	**13.48%**	**1.25**	**-18.09%**	**16.37%**	**(1.54)**
Average, Excl Comp	**21.44%**	**13.83%**	**1.23**	**-18.49%**	**17.05%**	**(1.51)**

Table 8. Return Characteristics of Fundamental Indexes, in Rising and Falling 90-Day T-Bill Yield, Moves larger than 20%, 1962-2004

	FALLING RATES			RISING RATES		
	Geometric Return	Volatility	Sharpe Ratio	Geometric Return	Volatility	Sharpe Ratio
S&P500	18.05%	16.31%	0.75	5.08%	13.99%	(0.05)
Reference Cap	18.13%	16.31%	0.76	4.73%	14.19%	(0.07)
Book Value	19.81%	16.04%	0.87	6.53%	13.78%	0.06
Cash Flow	20.94%	16.04%	0.94	6.61%	13.80%	0.06
Revenue	20.99%	16.84%	0.90	7.00%	14.91%	0.08
Sales	21.02%	16.74%	0.91	7.06%	14.86%	0.09
Gross Dividends	20.38%	14.47%	1.01	5.99%	12.75%	0.02
Employment	20.87%	17.13%	0.88	6.44%	14.62%	0.05
Composite	**20.56%**	**15.74%**	**0.94**	**6.63%**	**13.75%**	**0.06**
Average, Excl Comp	**20.67%**	**16.21%**	**0.92**	**6.60%**	**14.12%**	**0.06**

Table 9. Correlations with Major Asset Classes, 1988-2004

Correlation of Index Returns	S&P 500 Index	Hedged EAFE Index	Wilshire REIT Index	Lehman Aggregate US Bond Index	Lehman US TIPS*	Merrill US High Yield B-BB Index	JP Morgan Unhedged Non-US Bonds	JP Morgan Emerging Markets Bonds	Dow Jones AIG Commodity Index
S&P500	1.00	0.54	0.30	0.20	(0.22)	0.49	0.01	0.54	(0.05)
Reference Cap	0.99	0.54	0.31	0.19	(0.22)	0.51	0.01	0.55	(0.04)
Book Value	0.96	0.52	0.41	0.19	(0.18)	0.52	(0.01)	0.54	(0.01)
Cash Flow	0.95	0.51	0.42	0.21	(0.16)	0.53	(0.02)	0.55	(0.03)
Revenue	0.92	0.50	0.46	0.17	(0.15)	0.56	(0.04)	0.52	(0.03)
Sales	0.92	0.51	0.46	0.16	(0.15)	0.56	(0.03)	0.52	(0.02)
Gross Dividends	0.90	0.45	0.42	0.25	(0.13)	0.48	0.03	0.50	(0.03)
Employment	0.93	0.51	0.46	0.18	(0.15)	0.55	(0.02)	0.55	0.01
Composite	**0.94**	**0.50**	**0.43**	**0.20**	**(0.16)**	**0.53**	**(0.01)**	**0.53**	**(0.02)**
Average, Excl Comp	**0.93**	**0.50**	**0.44**	**0.19**	**(0.16)**	**0.53**	**(0.02)**	**0.53**	**(0.02)**

Correlation of Index VA over Reference Cap	S&P 500 Index	Hedged EAFE Index	Wilshire REIT Index	Lehman Aggregate US Bond Index	Lehman US TIPS*	Merrill US High Yield B-BB Index	JP Morgan Unhedged Non-US Bonds	JP Morgan Emerging Markets Bonds	Dow Jones AIG Commodity Index
S&P500	0.12	0.01	(0.08)	0.09	0.03	(0.11)	0.05	(0.06)	(0.07)
Reference Cap	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Book Value	(0.17)	(0.12)	0.32	(0.03)	0.12	0.00	(0.06)	(0.05)	0.09
Cash Flow	(0.17)	(0.13)	0.28	0.02	0.16	0.02	(0.06)	(0.03)	0.04
Revenue	(0.14)	(0.08)	0.36	(0.05)	0.15	0.12	(0.11)	(0.07)	0.03
Sales	(0.17)	(0.08)	0.37	(0.08)	0.15	0.10	(0.09)	(0.09)	0.05
Gross Dividends	(0.44)	(0.31)	0.10	0.05	0.19	(0.20)	0.03	(0.23)	0.03
Employment	(0.14)	(0.09)	0.44	(0.04)	0.17	0.13	(0.06)	(0.02)	0.15
Composite	**(0.26)**	**(0.18)**	**0.26**	**(0.01)**	**0.16**	**(0.03)**	**(0.05)**	**(0.12)**	**0.05**
Average, Excl Comp	**(0.21)**	**(0.13)**	**0.31**	**(0.02)**	**0.16**	**0.03**	**(0.06)**	**(0.08)**	**0.06**

*** - From February, 1997. US TIPS did not previously exist.**

Table 10. Largest by Capitalization and by Fundamental Composite, 12/31/2004

20 Largest by Capitalization		20 Largest by Fundamental Composite	
GENERAL ELECTRIC CO	3.19%	EXXON MOBIL CORP	2.763%
EXXON MOBIL CORP	2.75%	CITIGROUP INC	2.482%
CITIGROUP INC	2.05%	GENERAL ELECTRIC CO	2.455%
MICROSOFT CORP	2.03%	WAL-MART STORES	1.610%
PFIZER INC	1.70%	FANNIE MAE	1.492%
BANK OF AMERICA CORP	1.58%	BANK OF AMERICA CORP	1.485%
JOHNSON & JOHNSON	1.56%	SBC COMMUNICATIONS INC	1.468%
INTL BUSINESS MACHINES	1.37%	CHEVRONTEXACO CORP	1.377%
AMERICAN INTL GROUP	1.24%	GENERAL MOTORS CORP	1.335%
INTEL CORP	1.24%	AMERICAN INTERNATIONAL GROUP	1.311%
PROCTER & GAMBLE CO	1.18%	MICROSOFT CORP	1.310%
JPMORGAN CHASE & CO	1.15%	FORD MOTOR CO	1.232%
WAL MART STORES INC	1.12%	VERIZON COMMUNICATIONS	1.220%
CISCO SYSTEMS INC	1.08%	J P MORGAN CHASE & CO	1.189%
ALTRIA GROUP INC	1.03%	ALTRIA GROUP INC	1.140%
VERIZON COMMUNICATIONS	0.93%	PFIZER INC	1.003%
CHEVRONTEXACO CORP	0.93%	MERCK & CO	0.947%
DELL INC	0.88%	MORGAN STANLEY	0.935%
WELLS FARGO & CO	0.87%	INTL BUSINESS MACHINES CORP	0.913%
HOME DEPOT INC	0.79%	WELLS FARGO & CO	0.845%

Figure 2A. Sector Weightings, Reference Capitalization Index
(12-month centered moving average, 1962-2004)

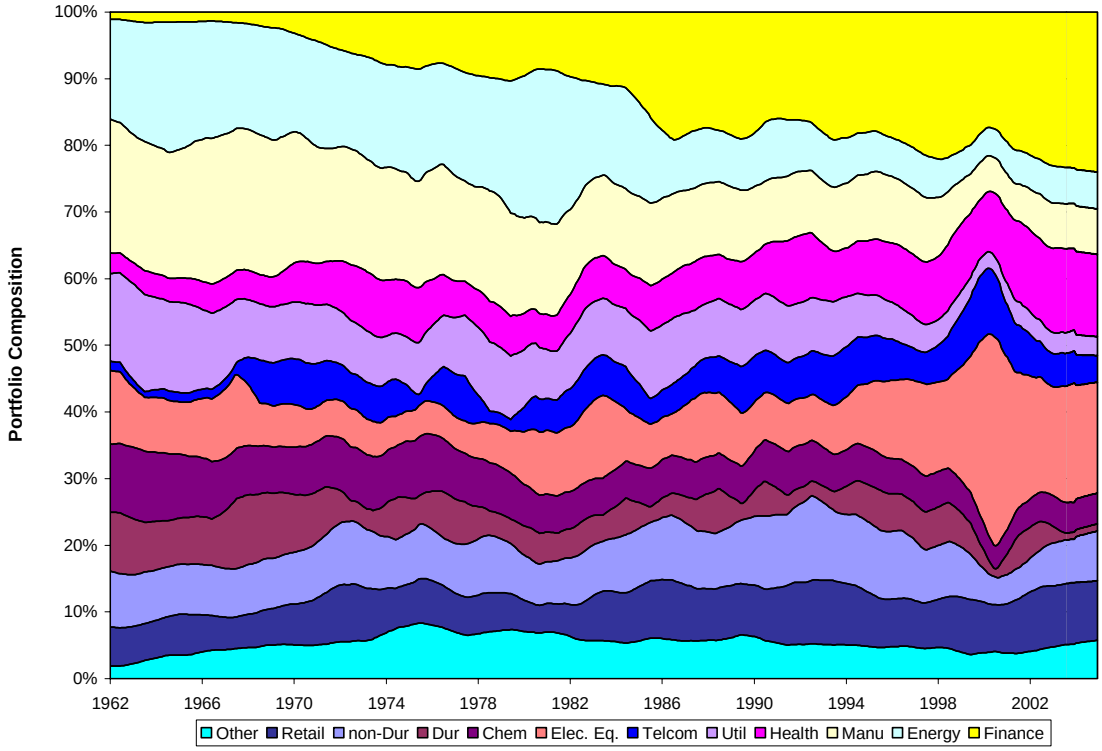
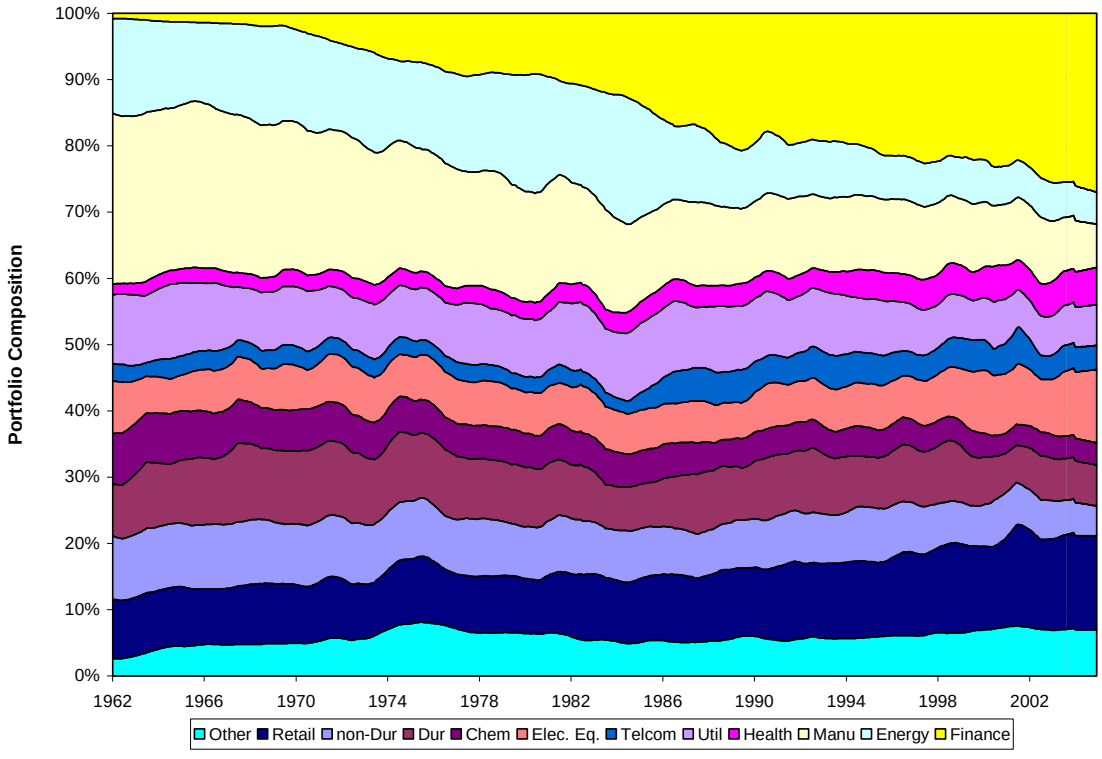


Figure 2B. Sector Weightings, Composite Fundamental Index
(12-month centered moving average, 1962-2004)



Bibliography

Arnott, Robert D. and Clifford S. Asness, " Surprise! Higher Dividends = Higher Earnings Growth," *Financial Analysts Journal*, Jan/Feb 2003, pp. 70-87.

Arnott, Robert D. "What Hath MPT Wrought: What Risks Reap Rewards," *Selected Topics in Investment Management*, Institutional Investor, 1988.

Bansal, Ravi, Magnus Dahlquist and Campbell R. Harvey, "Dynamic Trading Strategies and Portfolio Choice," *NBER working paper*, 2004.

Barberis, Nicholas, "Investing for the Long Run When Returns Are Predictable," *The Journal of Finance*, Vol. 55, No. 1. (Feb., 2000), pp. 225-264.

Blanchard, Olivier J., Robert Shiller and Jeremy J. Siegel, "Movements in the Equity Premium", *Brookings Papers on Economic Activity*, Vol. 1993, No. 2. (1993), pp. 75-138.

Blume, Marshall E., "Stock Returns and Dividend Yields: Some More Evidence," *The Review of Economics and Statistics*, Vol. 62, No. 4. (Nov., 1980), pp. 567-577.

Blume, Marshall E. and Roger M. Edelen, "S&P500 Indexers, Delegation Costs, and Liquidity Mechanisms," Rodney L. White Center for Financial Research *working paper #04-03*, 2003.

Bond, Stephen R., Jason G. Cummins; Janice Eberly and Robert J. Shiller, "The Stock Market and Investment in the New Economy: Some Tangible Facts and Intangible Fictions," *Brookings Papers on Economic Activity*, Vol. 2000, No. 1. (2000), pp. 61-124.

Brown, Stephen J. and William N. Goetzmann, "Performance Persistence," *The Journal of Finance*, Vol. 50, No. 2. (Jun., 1995), pp. 679-698.

Campbell, John Y., "Stock Returns and the term structure," *Journal of financial economics*, 18. (Apr., 1987), pp. 373-399.

_____, "Understanding Risk and Return," *The Journal of Political Economy*, Vol. 104, No. 2. (Apr., 1996), pp. 298-345.

_____, "Asset Pricing at the Millennium," *The Journal of Finance*, Vol. 55, No. 4, Papers and Proceedings of the Sixtieth Annual Meeting of the American Finance Association, Boston, Massachusetts, January 7-9, 2000. (Aug., 2000), pp. 1515-1567.

_____, and Robert J. Shiller, "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors", *The Review of Financial Studies*, Vol. 1, No. 3. (Autumn, 1988), pp. 195-228.

Chan, Louis K. C., Narasimhan Jegadeesh and Josef Lakonishok, "Momentum Strategies," *The Journal of Finance*, Vol. 51, No. 5. (Dec., 1996), pp. 1681-1713.

Chan, Louis K. C., Jason Karceski and Josef Lakonishok, "The Risk and Return from Factors," *The Journal of Financial and Quantitative Analysis*, Vol. 33, No. 2. (Jun., 1998), pp. 159-188.

Chen, Nai-Fu, Bruce Grundy and Robert F. Stambaugh, "Changing Risk, Changing Risk Premiums, and Dividend Yield Effects," *The Journal of Business*, Vol. 63, No. 1, Part 2: A Conference in Honor of Merton H. Miller's Contributions to Finance and Economics. (Jan., 1990), pp. S51-S70.

Cochrane, John, "New Facts in Finance," *Economic Perspectives*, XXIII (3) Third quarter 1999 (Federal Reserve Bank of Chicago).

Fama, Eugene F. and Kenneth R. French, "Dividend yields and expected stock returns," *Journal of Financial Economics*, 25 (1988), pp. 3-24.

_____, "Business conditions and expected returns on stocks and bonds," *Journal of Financial Economics*, 25 (1989), pp. 23-49.

_____, "The Cross-Section of Expected Stock Returns," *The Journal of Finance*, Vol. 47, No. 2. (Jun., 1992), pp. 427-465.

_____, "Size and Book-to-Market Factors in Earnings and Returns," *The Journal of Finance*, Vol. 50, No. 1. (Mar., 1995), pp. 131-155.

_____, "The CAPM is Wanted, Dead or Alive (in Shorter Papers)," *The Journal of Finance*, Vol. 51, No. 5. (Dec., 1996), pp. 1947-1958.

_____, "Multifactor Explanations of Asset Pricing Anomalies," *The Journal of Finance*, Vol. 51, No. 1. (Mar., 1996), pp. 55-84.

_____, "Value versus Growth: The International Evidence," *The Journal of Finance*, Vol. 53, No. 6. (Dec., 1998), pp. 1975-1999.

Gibbons, Michael R., "Multivariate tests of financial models: A new approach," *Journal of Financial Economics*, 10, (1928), pp.3-27.

_____, R., Stephen A. Ross and Jay Shanken, "A test of the efficiency of a given portfolio," Econometrica 57, (1989), pp. 1121-1152.

Goetzmann, William N. and Philippe Jorion, "Testing the Predictive Power of Dividend Yields (in Shorter Papers)," *The Journal of Finance*, Vol. 48, No. 2. (Jun., 1993), pp. 663-679.

_____, "A Longer Look at Dividend Yields," *The Journal of Business*, Vol. 68, No. 4. (Oct., 1995), pp. 483-508.

Hodrick, Robert J. "Dividend Yields and Expected Stock Returns: Alternative Procedures for Inference and Measurement," *The Review of Financial Studies*, Vol. 5, No. 3. (1992), pp. 357-386.

Hong, Harrison and Jeremy C. Stein, "A Unified Theory of Underreaction, Momentum Trading, and Overreaction in Asset Markets," *The Journal of Finance*, Vol. 54, No. 6. (Dec., 1999), pp. 2143-2184.

Hsu, Jason, "Cap-Weighted Portfolios are Sub-optimal Portfolios," *Research Affiliate Working Paper* (2004).

Jobson, J. D. and Bob Korkie, "Potential performance and tests of portfolio efficiency," *Journal of Financial Economics*, 10 (1982), pp. 344-466.

Kandel, Shmuel and Robert F. Stambaugh, "On correlations and inferences about mean-variance efficiency," *Journal of Financial Economics*, 18 (1987), pp. 61-90.

Kothari, S.P. and Jay Shanken, "Book-to-market, dividen yield and expected market returns: A time-series analysis," *Journal of Financial Economics*, 44 (1997), pp. 169-203.

Lamont, Owen, "Earnings and Expected Returns," *The Journal of Finance*, Vol. 53, No. 5. (Oct., 1998), pp. 1563-1587.

Lee, Charles M. C. and Bhaskaran Swaminathan, "Price Momentum and Trading Volume," *The Journal of Finance*, Vol. 55, No. 5. (Oct., 2000), pp. 2017-2069.

Little, I., "Higgledy piggledy growth," *Bulletin of the Oxford University Institute of Economics and Statistics*, 24 (November 1962).

Lo, Andrew W. and A. Craig MacKinlay, "When are Contrarian Profits Due to Stock Market Overreaction?" *The Review of Financial Studies*, Vol. 3, No. 2. (1990), pp. 175-205.

MacKinlay, A. Craig and Matthew P. Richardson, "Using generalized method of moments to test mean-variance efficiency," *The Journal of Finance*, 46 (1991), pp. 511-527.

Mayers, David, "Nonmarketable Assets, Market Segmentation, and the Level of Asset Prices," *The Journal of Financial and Quantitative Analysis*, Vol. 11, No. 1. (Mar., 1976), pp. 1-12.

Roll, Richard, "A critique of the asset pricing theory's tests," *Journal of Financial Economics*, 4 (1977), pp. 129-176.

_____, "A Possible Explanation of the Small Firm Effect", *The Journal of Finance*, Vol. 36, No. 4. (Sep., 1981), pp. 879-888.

_____ and Stephen A. Ross, "On the Cross-Scetional Relation between Expected Returns and Betas," *The Journal of Finance*, Vol. 49, No. 1 (Mar., 1994), pp. 101-121.

Ross, Stephen A., "The capital asset pricing model (CAPM), short-sale restrictions and related issues," *The Journal of Finance*, 32 (1997), pp. 177-183.

Moskowitz, Tobias J. and Mark Grinblatt, "Do Industries Explain Momentum?" *The Journal of Finance*, Vol. 54, No. 4, Papers and Proceedings, Fifty-Ninth Annual Meeting, American Finance Association, New York, New York, January 4-6, 1999. (Aug., 1999), pp. 1249-1290.

Shanken, Jay, "Multivariate tests of the zero-beta CAPM," *Journal of Financial Economics*, 14 (1985), pp. 327-348.

_____, "Multivariate proxies and asset pricing relationss," *Journal of Financial Economics*, 18 (1987), pp. 91-110.

Stambaugh, Robert F, "Testing the CAPM with Broader Market Indexes: A Problem of Mean-Deficiency" Journal of Banking and Finance(7), 1982, pp. 5-16.

Timmermann, Allan, "Excess Volatility and Predictability of Stock Prices in Autoregressive Dividend Models with Learning," *The Review of Economic Studies*, Vol. 63, No. 4. (Oct., 1996), pp. 523-557.

Treynor, Jack, "Why Fundamental Indexing Beats Cap-weighted Portfolios," Working Paper, 2004.

Wood, Paul and Richard Evans, "Fundamental Profit Based Equity Indexation", *Journal of Indexes*, (2nd Quarter) 2003.

Zhou, Guofu, "Small sample tests of portfolio efficiency", *Journal of Financial Economics*, 30 (1991), pp. 165-191.

[i] A patent is currently pending for the construction and management of indexes based on objective non-capitalization measures of company size. Please contact Research Affiliates, LLC, before using these ideas for index construction or for portfolio management.

[ii] We are indebted to George Keane who, as a member of the Investment Advisory Committee of the New York State Common Retirement Fund, became concerned early in 2000 with the valuation of the S&P 500 index used by the Fund for the majority of its domestic equity exposure. He later prepared a paper detailing several serious problems with the structure and management of the S&P 500 index, and proposed the development of better approaches to indexing. Subsequent discussions with George and with Marty Leibowitz, also a member of the NYCRF Investment Advisory Committee, focusing on finding better ways to manage passive portfolios, sowed the seeds for the research presented in this paper. We also appreciate the valued feedback and suggestions of Peter Bernstein, Burton Malkiel, Harry Markowitz and Jack Treynor, with additional help from Cliff Asness, Michael Brennan, Bob Greer, Philip Halpern, Bing Han, Max Moroz, Richard Roll, Glenn Swartz and Ashley Wang. Special thanks go to Yuzhao Zhang for assistance with CRSP/Compustat data issues. The anonymous referees also had some very useful suggestions on content and structure.

[iii] Our work is not the first to explore weighting by fundamental factors, though none of these came to our attention before our research was completed. Goldman Sachs managed an Earnings-weighted S&P 500 index during the early 1990s, as has David Morris, of Global Wealth Allocation, from 1999 to 2003; Barclays Global Investors recently introduced a dividend-weighted strategy. Paul Wood, of England, manages an Earnings-weighted 100 (out of the S&P 500) strategy (see Wood and Evans, 2003). None of these strategies select the index *universe* by any metrics other than inclusion in some existing capitalization-weighted index. Therefore, each of these strategies requires companies to be large in *both* capitalization and their selected metric of size. Also, none has published a theoretical basis for the success of their strategies.

[iv] Mayers (1976) is the first paper to point out that the CAPM market portfolio should include all assets in positive net supply and therefore the equity market portfolio cannot be a reasonable proxy for it. Traditional CAPM tests using the a capitalization weighted equity market portfolio have found the CAPM relationship to not hold, which represents either a rejection of the equity market portfolio as the CAPM portfolio or a rejection of the mean-variance optimality of individual's portfolio. Stambough (1986) extends on Mayers's idea and tests the CAPM model using a market portfolio that includes non-equity asset classes with improved success over traditional CAPM tests.

[v] Roll and Ross (1994) state "…*it is well known that a positive and exact cross-sectional relation between ex ante expected returns and betas must hold if the market index against which betas are computed lies on the positively sloped segment of the mean-variance efficient frontier. Not finding a positive cross-sectional relation suggests that the index proxies used in empirical testing are not ex ante mean-variance efficient*." See Roll (1974), Ross (1974) and Roll and Ross (1994) for excellent reviews on this topic. Papers that reject the efficiency for various capitalization-weighted market indexes include Ross(1980), Gibbons (1982), Jobson and Korkie (1982), Shanken (1985), Kandel and Stambaugh (1987), Gibbons, Ross and Shanken (1989), Zhou (1991) and MacKinlay and Richardson (1991).

[vi] Roll and Ross (1994) suggest that the standard capitalization-weighted market indexes may be located within 22 basis points below the true market index in the mean-variance space.

[vii] See Blume and Edelen (2003), pg 5.

[viii] The capitalization weighted index has the added intellectual satisfaction of macro consistency. All investors can hold a capitalization weighted portfolio without violating market clearing. The alternative indexes proposed in this paper would not be market clearing portfolios. But, CAPM is predicated on an array of simplifying assumptions which are not factually correct; these have been repeatedly shown to invalidate the mean-variance efficiency of that market clearing portfolio. Accordingly, we find little reason for investors seeking better indexes to care greatly about this market clearing property.

[ix] It's well worth noting that turnover is surprisingly high on the most widely used "passive" indexes. For example, the widely respected Frank Russell Company makes available annual 'index portfolio turnover', defined as "the percentage of an index fund that must be 'traded out' at reconstitution to maintain an exact replication of the index in the Russell 1000, which represents 92% of all domestic equity market value, has averaged 9.2% per year during the period 1983-2000. The Russell 3000, which represents 98% of all domestic market value, has averaged 9.0%.

[x] We are indebted to Burton Malkiel for suggesting that we test this measure of company size. In addition to the number of employees, we also looked at dollar payroll, with near identical results. We did not include this in our study, due to the more limited availability of these data.

[xi] The differences in annual returns between the indexes, which use 5-year trailing average statistics and 1-year trailing statistics are within +/- 10bps, while turnover increases uniformly by more than 2%.

[xii] These companies tend either to be fast-growing enough for shareholders to accept a policy of 100% earnings retention, or to be struggling enough to have cancelled the dividend and to be marked down in price as a consequence. See Robert D. Arnott, "What Hath MPT Wrought: What Risks Reap Rewards," Selected Topics in Investment Management, Institutional Investor, 1988.

[xiii] The Russell indexes are weighted by float, not aggregate capitalization, and are rebalanced annually at mid-year.

[xiv] The information ratio is a ratio of the value-added, divided by the standard deviation in value-added (or the "tracking error").

[xv] Because of a more limited history, the required correlations for the TIPS correlations are 0.18 for 90% significance and 0.29 for 99% significance.

[xvi] For example, the capitalization ratios of the AIM indexes are currently well within normal ranges, suggesting that the excess return is not merely a function of a 42-year revaluation of the Fundamental Indexing metrics.

[xvii] The CAPM market portfolio theoretically should be a portfolio that includes all assets in positive net supply including all financial instruments backed by physical assets as well as non-traded capital assets such as human capital. That means the true market portfolio should include (at least) U.S. and international stocks plus corporate bonds, commodities, real estates as well as human capital. This means that a globally diversified all-asset portfolio would be closer to being mean-variance efficient than a diversified stock portfolio. The word 'market' in 'CAPM market portfolio' is much more than the US stock market.

[xviii] Marty Leibowitz has referred to this as "underperformance relative to a 'true-value-weighted index'," which, of course, we cannot identify!

[xix] See Blume (1980), Campbell and Shiller (1988), Fama (1990), Chen, Grundy and Stambaugh (1990), Fama (1992), Hodrick (1992), Campbell (1992), Goetzmann and Jorion (1993), Goetzmann and Jorion (1995), Fama and French (1995), Lamont (1998), Barberis (2000), Arnott and Assness (2003).

[xx] See Cochrane (1999) for an excellent review on return predictability. We note that the particular return predictabilities explored in most academic general equilibrium models are not related to price inefficiencies but are related to time-varying risk premia.

[xxi] See Bansal, Dahlquist and Harvey (2004) for a trading strategy based on the literature of return predictability to enhance buy-and-hold portfolio returns.

[xxii] See Hsu (2004, Research Affiliates Internal Research Memo).

[xxiii] We have been working with Nomura Research Institute on this research, which may be published shortly.