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CLASSIC AND ENHANCED INDEX FUNDS: PERFORMANCE AND ISSUES

EDWARD TOWER

This chapter discusses the construction of “classic index funds.” It compares this approach with two applications of enhanced indexing. fundamental indexation weights stocks in a portfolio by something other than market capitalization, such as dividends or earnings. Vanguard’s index funds generally use classic indexing, which weights equity shares in a portfolio according to market capitalization. Dimensional Fund Advisors (DFA) uses a combination of classic and “fundamental indexation” and WisdomTree (WT) uses fundamental indexation. Following the discussion, the chapter compares the performance of equity portfolios from the three companies, using a modified system of “style analysis” developed by Sharpe (1992).

With “classic” capitalization-weighted indexing, fluctuations in stock prices do not require the index fund to buy or sell stocks. This reduces transaction cost. But transaction costs are incurred as a stock migrates between styles indexed by different funds. For example, a stock may grow from mid cap to large cap or as its price falls or its fundamentals improve, it may migrate from growth to value.

However, Vanguard manages index funds that colonize different styles, so as a stock migrates between styles, Vanguard ought to be able to move it between its index funds at low cost. The transaction costs should occur mainly as investors rebalance.

WT and some DFA funds use fundamental indexation. Arnott, Hsu and, West (2008) describe the fundamental index as a scheme in which the share of equities in a portfolio depends on fundamentals. WT uses fundamentals rather than capitalization weighting to devise its indexes. An investor can construct a portfolio out of these indexes.

DFA has two mechanisms to devise indexes. One is to determine what goes into each index using stock screens, such as the price earnings ratio, or price to book value, or the dividend yield. After screening, stocks are typically capitalization weighted. The second mechanism applies to the construction of DFA's core portfolios. Here, the portfolio weights depend on fundamentals and capitalization rather than capitalization alone. Investors who wish to use simple strategies can construct portfolios out of these core index funds.

Asness (2006, p.95) asks whether the concept of fundamental indexing “. . . is really new or just a cleverly repackaged version of the discipline known as value investing.” He continues (p.99):

“... at current price I remain a fan of value indexing. . . . In addition, at the right investment management fee and given more information about the details, I am a fan of fundamentally constructed portfolios. But this is no more than I would say about any other form of value investing with the devil being in the details.”

This chapter tries to answer Asness's question by providing details. The chapter asks how the enhanced indexers, DFA and WisdomTree, perform relative to the portfolio of Vanguard classic index funds that has the same mix of styles.

Vanguard

In 1976, Vanguard established the 500 Index Fund, which tracks the S&P 500 Index. Since then, it and other companies have established index funds such as Vanguard's Total Stock Market Index Fund, which tracks a broader range of US stocks, and also a range of index funds that colonize different parts of the market. The approach of these index funds is to track indexes that comprise stocks with certain characteristics: domestic, foreign, a particular sector, or stocks in a particular category, like large cap, mid cap, or small cap, or stocks with a value, blend or growth orientation. In each of these indexes the stocks are then weighted in proportion to their capitalization.

Recently, Vanguard has introduced the High Dividend Yield Index Fund and the Dividend Appreciation Index Fund. The former is based on the FTSE High Dividend Yield Index. According to FTSE (2009), it attaches "...lower weightings to companies that have high yields because of low or falling share prices."

As discussed in Mergent (2006), the "Dividend Appreciation Index Fund will track the performance of the Dividend Achievers Select Index,TM an index created exclusively for Vanguard by Mergent." It uses "a modified capitalization weighting methodology" and "additional proprietary methodology" Almost all Vanguard's index funds are capitalization weighted with a transparent

methodology. In these two cases, however, the distinction is blurred. Thus even Vanguard weights some of its indexes partially on fundamentals.

Dimensional Fund Advisors (DFA)

DFA's Home Page, DFA (2009), is an information-rich and easy-to-use guide to DFA strategy and funds. That page provides the material for much of this chapter's description of DFA. The firm initially constructed stock indexes designed to take advantage of research that showed the better performance of small cap stocks. DFA constructs indexes strongly based on academic research. A number of academic leaders, including E. F. Fama, K. R. French, R. G. Ibbotson, R. C. Merton, and M. S. Scholes continue to work with the firm. DFA believes that the higher returns for small cap and value stocks compensate for risk, rather than market imperfections, and it weights its indexes toward these characteristics. DFA measures value by the ratio of book value to market price (BtM).

DFA's Feeder and Master Funds

DFA has two different structures for its funds: the feeder and master structure and the core structure. For example, the Global Equity Portfolio, like DFA's other feeder portfolios is a fund of funds. The portfolio is made up of master funds that hold individual securities. Master funds use a screen to pick the eligible patch of the market from which they select stocks. In some cases funds of funds, purchase other funds of funds. The master fund uses a market capitalization weighting system or some other method of diversification.

DFA's Core Portfolios

The Core Equity Portfolios invest directly in stocks. These are described in DFA (2009). The quotations in this and the following two DFA sections are drawn from those descriptions.

“The applied core strategies alter the weighting of stocks by considering both a company’s market cap and its book-to-market (BtM) ratio. As a result, exposure to the riskier small and value shares that research shows offer higher expected return is increased. To balance out the greater small and value exposure and still include every stock in the market, the weight of large cap and growth stocks is reduced.”

. . .

“In assessing growth and value, the fund may consider additional factors such as price-to-cash-flow or price-to-earnings ratios as well as economic conditions and developments in the issuer’s industry.”

. . .

“Often when using traditional index funds in a portfolio, overlapping areas and gaps can occur, since attempts to achieve diversification and risk factor exposure result in redundant or inefficient allocations.”

. . .

“Core Equity maintains factor exposure without redundancy via an integrated structure and broad diversification. Each security is held once, efficiently weighted.”

Thus, DFA’s Core Portfolios use a multidimensional fundamental weighting scheme in the sense that the weight attached to each stock in a Core Portfolio depends on its market cap as well as the extent to which it is a value stock. The weight is proportional to market cap with that proportion an increasing function of smallness and valueness.

DFA: Other Aspects

A ‘buffer’ range allows small cap strategies to hold securities that grow out of the buy range, in order to minimize transaction costs and keep portfolio turnover low.

DFA uses larger buffer ranges than classic index funds generally do. This allows funds to hold more securities that have grown out of their buy range in order to minimize turnover and transaction costs.

“Additional screening criteria are employed to eliminate securities that do not display the common qualities of the asset class or that lack sufficient liquidity for cost-effective trading, such as OTC stocks with fewer than four market makers and those not included on the Nasdaq Global Market System.”

. . .

“Each portfolio is authorized to lend securities to qualified brokers, dealers, banks and other financial institutions for the purpose of earning added income.”

Thus any outperformance of DFA may not be due just to its indexing techniques.

“In emerging markets, Dimensional also applies subject requirements, including fair treatment of foreign investors, well developed property rights and a commitment to free markets.”

Excluded are Argentina (from new purchases), Peru, the former Soviet Union, and all of Africa except for South Africa. Consequently, DFA’s emerging market universe differs from Vanguard’s, which holds both Russian and Egyptian equities. DFA’s Global Portfolios target risk factors that have historically delivered increased return, including financial strength.

In summary, DFA practices enhanced indexation by using some indexation based on multidimensional fundamentals and also using a more extensive screening system than classical indexing does.

WisdomTree’s Approach To Fundamental Indexation

Arnott, Hsu and West (2008) present the logic behind fundamental indexation, and the WisdomTree web site, WisdomTree (2009) explains how fundamental indexation has been implemented by WT. This section briefly

summarizes some of the material drawn from the web site. WT believes that weighting the share of equities in a portfolio by indicators such as dividends and earnings, not stock price alone generates portfolios with higher returns and less risk.

Here are some examples. The WisdomTree LargeCap Growth Fund weights growth stocks by earnings. Companies in the index on which it is based must have cumulative positive earnings in the prior four fiscal quarters and pass WisdomTree's market capitalization and liquidity requirements. The WisdomTree LargeCap Dividend Index is made up of the 300 largest companies by market capitalization, weighted by the share of dividends each component company is projected to pay in the coming year. The WisdomTree Equity Income Index consists of the 30% of companies that have the highest dividend yield, and it weights by actual dividends paid. WisdomTree structures its funds in the form of exchange traded funds (ETFs), unlike DFA that issues ordinary mutual funds. Full descriptions are provided on the web site.

Most of the WT funds have been established recently, so to assess what their performance would have been historically, one needs to evaluate the monthly performance data for the indexes on which they are based, on the WT web site, and then subtract the gap by which WT funds are expected to underperform the indexes.

Some Evaluations of Fundamental Indexation

The case for DFA is elegantly presented in Hebner (2007), and the case for WT is thoroughly presented in Arnott, Hsu and West (2008). Several authors

have criticized the fundamental approach and others have evaluated the performance. In response to Siegel (2006)'s apology for fundamental indexation, Bogle and Malkiel (2006) argue that fundamental indexing is unlikely to be as productive as classic indexing, because of reversion to the mean. They show that from 1937 to 1997 and from 1997 to 2006 value and growth returns have been virtually identical. They also note the less favorable tax consequences, higher transaction costs and higher expenses of owning fundamental stock index funds.

Blitz and Swinkels (2008, p.1) argue that

“... because fundamental indices are primarily designed for simplicity and appeal, they are unlikely to be the most efficient way of benefiting from the value premium. Compared to more sophisticated, multi-factor quantitative strategies, fundamental indexation is likely to be an even more inferior proposition.”

This argument suggests that DFA is superior to WT.

Tower and Yang (2008) used data for the eight-year period from the beginning of 1999 through the end of 2006. They found that the DFA portfolio of domestic funds, with asset weights adjusted each month beat the style-adjusted portfolio of Vanguard domestic funds by 2.61% per year continuously compounded. The corresponding differential for the international funds was 3.59% per year. This chapter updates those estimates by using data through the first half of 2008 and uses daily data rather than monthly data.

Bernstein (2006) uses data from 1962 through 2004 to assess the performance, corrected for style, of the composite Research Affiliates Fundamental Index, RAFI, used in Arnott, Hsu and West (2008). He finds the combination of the Fama–French Large Value Index and Large Growth indexes

(French, 2009) that has the same value load as the RAFI would have underperformed the RAFI by 0.14% per year. Thus, the style-adjusted outperformance of the RAFI index is 0.14% per year. He concludes:

“Fundamental indexing is a promising technique, but its advantage over more conventional cap-weighted value-oriented schemes, to the extent that it exists at all, is relatively small. . . . Differences in the expenses, fees, and transactional costs incurred in the design and execution of real-world portfolios can easily overwhelm the relatively small marginal benefits of any one value-oriented approach.”

This chapter examines the performance of a range of fundamentally-weighted indexes and funds that WT has created based on them.

Arnott, Hsu and West (2008, p.208), using data from 1962 through June 2007, find the stock selection component of the outperformance of the RAFI U.S. Large index over the S&P 500 index is 0.26 % per year. This is after adjusting for size, value and sector exposure, so it is the contribution of fundamental indexation *per se*, and is close to the Bernstein figure.

Estrada (2008), using data from 1974 to 2005 inclusive, finds that a dividend-weighted fundamental index using benchmarks from 16 countries outperforms a cap-weighted index by 1.90% per year and that is outperformed by 1.70% per year by a strategy of weighting the same country benchmarks by dividend yield, a strategy with an even more pronounced value tilt. This totals to an advantage of fundamental weighting using dividend yield over cap weighting of 3.6% per year.

Branch and Cai (2008) find that a cash flow weighted index beat a sales-weighted index and a gross profit-margin weighted index beat value weighting.

They find a dividend-weighted index had a still higher return, but it was accompanied by higher risk.

Style Analysis to Compare Vanguard and DFA

In order to assess the choice between passive and enhanced indexation this chapter asks two questions. First, which is better: Vanguard or DFA? Second, which is better: Vanguard or WisdomTree?

We use two ways to answer each question: a comparison with a tracking index that holds Vanguard index funds in long positions only and one that is permitted to hold some of the funds in short positions, abbreviated as “LONG” and “SHORT.” This section explains the LONG simulations. This chapter uses a technique called “style analysis” developed by Sharpe (1992), to explore whether a mutual fund out-returns a basket of indexes with the same style. Chapter 12, which explores the choice between Vanguard index and managed funds also uses Sharpe’s style analysis, except the chapter 12 and 13 comparisons are with Vanguard index funds rather than indexes. Using this technique, the return of the DFA fund or portfolio of funds is described as the return of a basket of Vanguard index funds plus a constant term plus a random term. Confusingly, DFA (2009) refers to its funds as “portfolios.” The size and sign of the constant term reflects the prowess of DFA’s indexing technique relative to Vanguard’s. The basket chosen is that which gives the lowest mean square sum of the random terms. Intuitively, it is the basket that tracks the return of the DFA portfolio the best. Specifically, in combination with the constant term that helps the fit the most, it is the basket that predicts most accurately.

This basket is labeled the tracking index for the portfolio. If the DFA portfolio is largely composed of stocks in Vanguard's value and small index funds, then the composition of the tracking index will be largely Vanguard's value and small index funds, because the returns of a combination of these funds will best explain the returns of the DFA portfolio. Thus, the composition of the DFA portfolio can be inferred by examining the composition of the tracking index. The size of the constant term will depend positively on Vanguard's expenses and turnover relative to DFA's, and positively on DFA's prowess of stock selection relative to Vanguard's. One appeal of Sharpe's (1992) methodology is that if different degrees of smallness or valueness have different patterns of return, the Sharpe methodology captures those, whereas, simply characterizing the value or smallness dimension of a portfolio by one number, as Fama-French (1993) loads do, does not capture these different patterns of return. For example, return may be a nonlinear function of size and value, so characterizing fund performance as a function of Fama-French loads may hide information that emerges from a Sharpe style-analysis approach.

The calculation is performed using Microsoft Excel's solver utility, just as is done in Chapter 12. Solver is instructed to find the weighted sum of the returns of the Vanguard indexes and the constant term that minimizes the mean square error of prediction, subject to the constraints that all the coefficients are positive and add to one. Requiring all coefficients to be positive means conceptually that no index funds are sold short. Requiring the coefficients to add to one means conceptually that the portfolio shares sum to one.

The figures used in the calculations for DFA are daily returns of both the DFA funds and the Vanguard index funds. These returns are provided in the Center for Research in Securities Prices (CRSP) database. Since daily returns are used, the DFA return is being compared with the return of a Vanguard tracking basket that is rebalanced daily. Such rebalancing would be impossible without incurring transaction cost. Still, the analysis uses daily rather than monthly data to find the tracking index that most closely tracks the DFA portfolio over short periods as well as longer ones. Assuming daily rebalancing is unlikely to introduce a bias, because both the DFA fund and the tracking fund are similarly affected by it. For example, if positive momentum exists in equity returns, frequent rebalancing should shrink the performance of both Vanguard and DFA funds by the same amount, leaving no bias in the calculation of the differential return between the two.

The criterion used for outperformance of the DFA portfolio is the geometric alpha, just as in chapter 12. This criterion is the continuously compounded geometric return of the DFA portfolio minus that of the Vanguard tracking index over the time span. Geometric average returns measure the average return over a span of time, but arithmetic average returns do not. If two funds have the same average return over the time span, the more volatile fund will have a higher average arithmetic return, but by definition the two funds will have the same geometric return. Also, if one believes that anomalous returns in one direction are likely to be followed by anomalous returns in the other direction, so average geometric returns are more likely to be replicated than average arithmetic

returns, the geometric average return is superior to the arithmetic average return for predicting multi-period returns. This argument is more fully developed with a numerical example in Chapter 12.

Continuous compounding in measuring average returns is also likely to generate a more stable alpha. If the only reason an alpha is negative is that the expense ratio is higher for DFA than for Vanguard, then if we use differential annual rates of return to measure alpha, alpha will be less negative in falling markets than in rising markets, because of the confusion of compounding. When markets are rising, a small difference in alpha will result in a large difference in return over the year. But, with continuous compounding, constant expense ratios will lead to constant alphas.

Recent Performance of DFA Funds

Insert Table 1 about here.

The methodology of style analysis just described is applied in Table 1. It is used in this section to assess the recent performance of DFA domestic funds relative to Vanguard funds. The data series of returns on Vanguard index funds and DFA enhanced index funds start on November 17, 2006, the inception date for Vanguard's High Dividend Yield Index Fund. Including that fund is important, because dividend yield is a measure of value and it is desirable to have a comparison of enhanced indexing with full range of Vanguard's current index funds. The data series finish on June 30, 2008, the most recent date available for daily returns on the CRSP database, so the period is extremely short. A more recent close date could have been chosen if we were to use the daily return data

on Yahoo. But Yahoo's reportage of dividends for some funds is irregular, Yahoo does not always alert the user to missing dividend data, and Yahoo sometimes reports dividends as being paid on the wrong date. DFA does post monthly returns of its funds with almost no lag, but daily data provides more information and leads to more trustworthy tracking indexes. The study focuses on diversified equity funds, ignoring tax managed funds, real estate funds, social funds, and sustainability funds.

For now, let's focus on the top line for each fund. It presents the results of the calculations just described, which constrain the tracking index to contain no Vanguard funds short. "Max short" is the maximum percent of the tracking index which can be held short, so it equals zero for these simulations. Alpha is the outperformance of the DFA fund in percentage points per year (henceforth, simply % per year): DFVEX, DFA's U.S. Vector Equity I Portfolio underperforms its tracking index by 1.87% per year. Alpha's t value is -1.52. The P tells us that alpha is significant on a one tailed test at the 5.7% level. The mean square error of the daily predictions is 0.09%. The ratio of the standard deviation of the DFA fund to that of the tracking index is V, which stands for relative volatility. It is 0.998, which means that the DFA fund was slightly less volatile. The correlation squared between the DFA daily return and the tracking index return is 99.4%. The interpretation of P is that if the sample of daily returns is selected randomly from an infinitely large population of returns, P is the probability that the signs of the means of the population and the sample differ, or simply that the calculated

alpha has the wrong sign. P and the t that supports it are calculated by the t test (paired sample for means) using Excel.

Two funds were added to the DFA collection after the start of the series on November 17, 2006 (a social and a sustainability fund). These two funds are ignored throughout the chapter. The alpha for the equally-weighted portfolio is -1.80% per year, with a P of 4.5%. So, in this instance DFA has underperformed Vanguard.

The Tracking Portfolio with Long and Short Positions in Tracking Index

Now let's focus on the second line for each fund. DFA focuses on both small funds and value funds. Suppose that all of Vanguard's index funds are less oriented toward value and smallness than a particular DFA fund or DFA portfolio. Then, the way to replicate DFA's style in a comparison portfolio is to construct a Vanguard portfolio that holds some of Vanguard's growth and large company indexes short. To implement this, Excel is instructed that the sum of the index components must be 1, as before, except Excel is no longer instructed to make all coefficients in the tracking portfolio non-negative. To limit the magnitude of short selling for any one fund, the short value of any Vanguard index fund in the tracking index is restricted not to exceed 100% of the portfolio's value. This is implemented by constraining the coefficient for each fund to be no less than -1. Furthermore, the aggregate short position, "max short," is restricted not to exceed 200% of the portfolio. This is implemented by constraining the sum of the negative coefficients to be no less than -2. The advent of electronically traded funds has made short sales possible, so this approach has a relevance that did

not exist prior to the introduction of ETFs. In the tables and figures we label the tracking portfolio with all positive quantities: the LONG portfolio and the one described in this paragraph: the SHORT portfolio.

There is another way to think about this approach. Suppose I hold a wide variety of Vanguard index funds. I can replicate its style by buying a DFA fund and selling the SHORT tracking index. So for example if my SHORT tracking index is 150% Vanguard Small Cap Index Fund and -50% Vanguard 500 Index Fund, and I buy \$100 of the DFA portfolio, I would replicate my initial position by simultaneously selling \$150 of the Vanguard SmallCap and buying \$50 of the Vanguard 500 Index Fund.

In Table 1, let's revisit fund #1, DFVEX, the fund considered previously, When we allow a short position of 200%, the actual aggregate short position is 116%. The alpha is -1.52% per year. P is 7.4%. The mean square error falls (as it must with additional degrees of freedom) to 0.09% per day (although table rounding hides the fall). Only two funds have any positive alphas and the equally-weighted portfolio has alphas of -1.80% per year and -1.40% per year. The method of calculation means that these alphas do not reflect the differential performance of different styles, unless the DFA style is not replicated in the tracking index. Rather, the alphas reflect the differential performance of DFA relative to Vanguard after correcting for style. For the equally-weighted portfolio the SHORT alpha is closer to zero than the LONG alpha. The lower absolute value for the SHORT alpha is expected, since the SHORT alpha has more freedom to approximate the style of the DFA portfolio. Throughout the chapter

the SHORT alpha is generally closer to zero. The difference between the two alphas is smaller for the equally weighted DFA portfolio (0.40%) than for the individual funds on average (0.41%). The individual funds exhibit more extreme styles than the equally-weighted portfolio does, so the sign of the difference is expected, but the smallness of the difference is a surprise.

Insert Table 2 about here.

Table 2 tells the rest of the story of the simulations. The right-hand columns show the tracking indexes for the LONG and SHORT portfolios. For example, the LONG portfolio includes 34% of the Vanguard 500 Index Fund and 28% of the Vanguard Small-Cap Index Fund. The SHORT portfolios involve selling short both the Vanguard Growth Index Fund and the Vanguard Large-Cap Index Fund. Given DFA's focus on small and value styles, this is expected.

Insert Figure 1 about here.

Figure 1 graphs the LONG alphas versus the SHORT alphas for the funds and time periods of Table 1. All but two of the points are in the NorthEast or SouthWest quadrants on a line through the origin that is at least as steep as the principal diagonal. This indicates, again, that the alphas for the SHORT portfolios are closer to zero than those of the LONG portfolios.

The predominately negative alphas show that for this recent nineteen and a half month period DFA domestic funds were inferior to the corresponding Vanguard ones. Thus DFA has not always beaten Vanguard.

The middle columns of Table 2 show the tracking indexes for the entire period covered by CRSP: September 1, 1998-June 30, 2008. The next section discusses these simulations.

Domestic DFA Over the Entire CRSP Horizon

Insert Table 3 about here.

Table 3 shows the performance of the DFA equal-weight domestic portfolio over the nine and five sixths year period covered by CRSP. It presents the alphas calculated for individual years and parts of years, allowing the tracking index to vary from year to year, and recognizing that simulations for recent years have more Vanguard index funds to choose from in selecting the tracking index. Using daily data instead of monthly data allows us to have more faith in the alphas calculated for short periods. The data include for 1998 only the last third of the year and for 2008 only the first half. The alphas average +1.15% per year for the LONG tracking index and +1.12% per year for the SHORT (with smaller weights for the two partial years). These alphas are remarkably similar. Using the same tracking index throughout the entire period, the alphas are 1.05% and 0.96% for LONG and SHORT. According to these simulations, and if returns continue to be drawn from the same population, Vanguard will beat DFA with a probability of 14.05% and 16.09% for LONG and SHORT, respectively.

Insert Figure 2 about here.

Figure 2 graphs the annual alphas for the DFA equally-weighted domestic portfolio both LONG and SHORT. Again the short alphas tend to be closer to zero, and DFA has not done well relative to Vanguard over 2007 and the first half

of 2008, with extraordinarily good performance of DFA occurring in 2001 and extraordinarily bad performance occurring in the last quarter of 1998. In these periods, DFA did not closely track its tracking index.

Insert Figure 3 about here.

Figure 3 graphs the average performance of the DFA equally-weighted portfolio from the year indicated through the middle of 2008. DFA has roughly the same performance as Vanguard from January 2005 to the middle of 2008, and outperforms only if one goes back to a start date before 2005.

International DFA over the entire CRSP horizon

Insert Table 4 about here.

Table 4 shows the tracking index for the equally-weighted DFA international funds. The tracking index is made up solely of Vanguard's international funds. Vanguard has no international small or value or growth index funds. So the international tracking index includes Vanguard funds that are not truly index funds: International Explorer (a small and mid cap fund), International Growth, and International Value. However, as John Bogle (2006) has argued Vanguard's managed funds mimic Vanguard's index funds in the sense of having low expenses and turnover. Moreover, the issue is whether investors should forsake Vanguard's international funds for DFA's international funds. Both the LONG and SHORT tracking indexes have large positive weights for International Explorer and International Value, which is expected.

Insert Table 5 about here.

Table 5 presents the performance differentials for the equally-weighted portfolio of 18 international funds. Only those funds with an inception date of 2008 are left out on purpose and the LWAS/DFA International High Book-to-Market Fund was left out inadvertently. The funds are listed on the DFA web site. The alphas using a constant tracking index are 0.84% and 0.29% per year for LONG and SHORT, respectively. The average alphas, allowing the tracking indexes to vary annually (with smaller weights for the two partial years) are the larger 2.08% and 1.59% per year for LONG and SHORT, respectively. It is a puzzle why the latter two exceed the former two, just as was the case for the domestic funds although the P's are relatively big, which means that the tracking indexes hover less closely around the DFA international portfolio than around the DFA domestic one.

Insert Figures 4 and 5 about here.

Figures 4 and 5 do the same thing that Figures 2 and 3 do, but they apply it to the DFA equally-weighted international portfolio. Again the SHORT alphas are closer to zero than the LONG alphas. Over the entire period the international DFA portfolio with the tracking index changed each year outperforms by more than the domestic DFA fund does. But, using the constant tracking indexes the ranking is reversed.

DFA's Core Portfolios

DFA has constructed Core portfolios that combine stocks based on fundamentals, into portfolios for investors who want a simple solution to asset allocation. Investors can combine the Core portfolios to create their entire

portfolios. Table 6 evaluates the DFA core portfolios and the DFA global equity fund, which is constructed on the same principle. These are all the core funds established before August 2006. Recently, Social Core Equity portfolios and Sustainability Core portfolios have been established, which include only those companies that pass social or environmental screens.

Insert Table 6 about here.

Table 6 presents alphas and accompanying data for the extent to which these funds outperform their Vanguard tracking indexes. For the U.S. core funds tracking indexes of Vanguard U.S. equity index funds are used. For the international core the five Vanguard international funds are used, excluding Vanguard's Emerging Markets Stock Index Fund. For the Emerging Markets Core, just the Vanguard Emerging Markets Stock Index Fund is used. For the DFA Global Equity Portfolio, all Vanguard index funds, including the three international funds that are not index funds are used. In devising the tracking index, the share of the U.S. funds is constrained to lie within the historical range of the portfolio reported by Morningstar (2008), which is between 46.6% and 70.5%. It is notable for understanding DFA's strategy that DFA has chosen to vary the share of domestic assets in its Global Equity Portfolio so substantially.

The results are that only the DFA Global Equity Portfolio has a positive alpha. The alphas in Table 6 for DFA's six diversified funds, five of which are Core funds range from +0.22% per year to -1.96% per year. This makes DFA look inferior to Vanguard, especially since an investor must incur additional transaction costs and advisor fees to invest with DFA. However, the significance

levels are huge. The probabilities that the sign of the population alpha differs from the sign of the sample alpha in all of the simulations of Table 6 lie between 47% and 14%.

Additional DFA Costs

DFA funds may be purchased only through an advisor. Tower and Yang (2008) explored advisor fees and transaction costs for DFA funds, which are not levied on investors in Vanguard funds. However, some Vanguard international funds have charges on purchases and sales that are paid into the funds and we have not dealt with here. Tower and Yang estimate that an investor with DFA and a \$10 million portfolio would pay an additional 0.0156% to 0.504% per year to invest with DFA, and that an investor with a \$100K portfolio could pay as little as 1.665% per year, additional. Part of these figures should be subtracted from the performance of DFA, to obtain comparability. Smaller proportions should be subtracted to the extent that the advisor provides valuable services, in addition to access to DFA funds; and larger proportions should be subtracted if the comparison is with the less expensive Vanguard Admiral funds, which require larger investments than Vanguard Investor funds do. For example, the expense ratio of the Admiral shares of the Vanguard 500 Index Fund is 0.09% per year lower than that of the investor shares, used in this chapter.

DFA Summary

The SHORT alphas are closer to zero than the LONG ones, which implies that the capture of style is better with the SHORT simulations than with the LONG ones. The constant-weight tracking index simulations have alphas closer

to zero than the varying-weight ones. Focusing on the SHORT constant tracking indexes since the fourth quarter of 1998 for the equal-weight domestic portfolio DFA beats Vanguard by 0.96% per year, with a P of 16% (top line of Table 3). For the international portfolio the corresponding figure is 0.29% per year with a P of 44% (top line of Table 5). The large P's indicate limited confidence that the sign of the differential will be replicated in the future. Focusing on the SHORT variable tracking indexes, the figures are 1.12% for the domestic portfolio (bottom line of Table 3) and 1.59% for the international (bottom line of Table 5). However, the DFA domestic portfolio has underperformed since the beginning of 2006. Strikingly, none of the core portfolios or the global portfolio has outperformed Vanguard by more than 0.22% per year (Table 6). The median alpha for these portfolios is -0.51% per year (Table 6). For net returns one must subtract from these figures the transaction costs and advisor fees associated with DFA. However, these funds have been established recently, so the observation period is short. Perhaps the appropriate lesson is that we are unable to rank with confidence the two fund companies, and hence the approaches to indexation they provide. Perhaps this is what we should have expected. Some advisors use both Vanguard and DFA funds. This should happen only if the two are comparable.

How Do These Alphas Differ from Tower and Yang Alphas?

The alphas estimated here are considerably less than those of Tower and Yang (2008). Comparing the constant tracking indexes, The Tower-Yang alpha for domestic funds is 2.61% per year as compared with the LONG and SHORT

tracking indexes of 1.05% and 0.96% per year, respectively. For the international funds the alpha falls from Tower and Yang's 3.59% per year to the LONG and SHORT alphas of 0.84% and 0.29% per year, respectively. The differences in approach from the previous study are the current study (1) includes the last third of 1998 in addition to 2007 through the first half of 2008, (2) equally weights the DFA funds rather than weighting them by assets under management, and (3) uses daily rather than monthly observations.

WisdomTree Versus Vanguard: Which is Better?

The WisdomTree Web Site, WisdomTree (2009), presents monthly return data for each WT fund and the index on which it is based. The starting dates for these data are January 1964 for the domestic dividend indexes, April 1990 for the Large Cap Growth Index, January 1996 for India, emerging markets, Global, and international indexes, March 2002 for domestic earnings, and June 2005 for the Middle East Dividend Index. The funds themselves were created between June 2006 and July 2008. CRSP data for WT funds are currently unavailable after December 2007, and as mentioned previously Yahoo's data on dividends are unreliable. Consequently data from WT is used to assess the performance of each WT fund and index. Only monthly data are available, so the analysis compares WisdomTree with Vanguard funds, with both rebalanced monthly.

Vanguard's High Dividend Yield Index Fund was established in November 2006. In order to include it in the performance comparison, we perform the Sharpe style-comparison analysis already described, using data from December 2006-November 2008 inclusive. This analysis is described in Table 7. The tracking

indexes for WT's domestic funds are calculated from Vanguard's domestic index funds, and the tracking indexes for WT's international funds are calculated from Vanguard's international funds.

Insert Table 7 about here.

There are six domestic funds and indexes based on weighting earnings and six domestic funds and indexes based on weighting dividends. The construction of these alphas has already been described. The averages and medians for these indexes have negative alphas using the LONG portfolios and positive alphas using the SHORT portfolios. For the WT indexes, the SHORT average and median alphas are over 3% per year greater than the LONG ones. As argued earlier the SHORT alphas do a better job of eliminating style differences.

There are 17 international funds (including emerging markets) that have been in existence for at least a year. Their average and median alphas for both LONG and SHORT range between 2% and 3%.

What explains a negative alpha for the comparison of WT with the LONG tracking index and a positive one for the comparison with the SHORT tracking index? One possibility is that the WT fund is more value oriented than the Vanguard value fund, so to make the Vanguard tracking index equally value oriented, you would need to sell Vanguard growth short and buy more of the value fund with the proceeds. Now, if the Vanguard growth fund has a higher return than the Vanguard value fund, then selling it short would have been a bad

idea that resulted in a higher alpha for the comparison of WT to the SHORT tracking index.

The return of each WT fund differs from the return of the index on which it is based by management fees and transaction costs. To find out how large they are, the return of each WT fund is subtracted from the return of the corresponding WT index over the year ending September 31, 2008, provided by WT. This difference is labeled Gap (% per year). Returns are continuously compounded in this calculation as throughout the chapter.

The WT funds are ETFs. The returns of the ETFs (market returns) differ from the returns on the assets that they hold (net asset value returns), because the arbitrage that keeps the two prices in line is not perfect. The calculations of gap use NAV returns.

For the domestic funds the expense ratios are 0.28% and 0.38%. For the international ones they range from 0.48% to 0.88%. Gap was expected to be bigger than these figures by the transaction cost. Some of the gaps are negative, reflecting differences between the composition of the indexes and the composition of the funds, perhaps reflecting large buffer ranges designed to keep transaction costs low. For each group the median gap is larger than the average gap. The alpha for each fund is derived as the alpha for the corresponding index minus the gap. The average and median fund alphas have the same signs as the corresponding index alphas.

The relevant comparison group for Vanguard with WT is the set of WT funds, not the indexes, but since alphas are initially calculated for the indexes we

need to subtract gap. To mitigate the influence of outliers we focus on median rather than average gaps. The median gaps vary between 0.40% and 0.63%. In our comparisons of Vanguard and WT funds, we use a gap of 0.60, at the high end of the range, so if anything this comparison is biased against WT, although using Vanguard's Investor shares rather than its Admiral shares biases the calculations against Vanguard for investors with large portfolios.

Insert Table 8 about here.

Table 8 calculates alphas for WT's world portfolios over the period March 2002—November 2008 inclusive. The start date is constrained by the start date of the series for the domestic earnings index. Calculations are presented both for the asset-weighted WT portfolio and the equally-weighted WT portfolio, where the asset weights are drawn from the WT web site and dated September 31, 2008.

Since assets in funds that have done relatively well, grow relatively fast due to both valuation and the attraction of additional investor funds, it is expected that asset-weighted performance using recent weights will exceed that using earlier weights and consequently overestimate the returns that a typical investor would have received. This effect should operate on both the WT portfolio and its tracking index, mitigating its effect in determining alpha. To assess this possible bias and to test the robustness of the calculations Table 8 presents calculations both for the asset-weighted and the equally-weighted WT world portfolios, using all the indexes from Table 7, except GULF with an inception date of July 2008.

In constructing the tracking indexes we constrain the share of Vanguard domestic index funds to be the same as the share of the WT domestic index funds in the portfolio (43% for equally-weighted and 33% for asset-weighted).

As expected, the asset-weighted alphas exceed the equally-weighted alphas. The alphas range from 2.78% to 3.55% per year. The probability that the sign is incorrect is less than 0.2% in each case. As before the SHORT alphas are closer to zero than the LONG alphas, indicating that the short simulations have captured style better than the long ones.

The alphas for each year are calculated using the tracking-index weights calculated for the entire period, because there are not enough degrees of freedom to do otherwise. The volatility ratio is the standard deviation of monthly return of the WT portfolio divided by that of the Vanguard tracking index. The LONG comparison shows WT to be slightly less risky, but the SHORT comparison shows it to be slightly more risky. Using a gap of 0.6% to determine alphas for the WT fund portfolios, the alphas range from 2.44% to 2.92%, with P's always less than 0.9%.

[Insert Table 9 here.](#)

What happens when the performance of WT is broken down into categories? Table 9 does this. Again the SHORT alphas are closer to zero than the LONG alphas, except for domestic growth. The composition of the tracking index shows a bias toward value except for domestic growth, which, predictably, has a growth bias. Using our gap of 0.6% and focusing on fund SHORT performance, WT earnings under returns Vanguard by a tiny .07% per year, with

a P value of 47%. Domestic growth underperforms Vanguard by 0.23% per year, with a P of 46%. Domestic dividends outperform Vanguard by 0.78% per year. International outperforms Vanguard by a remarkable 3.61%, with a tiny P of 0.29%.

[Insert Table 10 about here.](#)

Table 10 performs the same analysis for the recent period December 2006—November 2008, which permits use of all Vanguard funds. Naturally, the results are similar to those in Table 7, which calculated alphas for WT's individual indexes and funds. The SHORT portfolios have alphas averaging 0.2% per year closer to zero. Recent inception dates force use of the WT indexes rather than the funds. The alphas of all the fund SHORT portfolios (0.6% less than the index portfolio alphas) are positive and exceed 1.2% per year. Paradoxically, R^2 , the correlation squared between the returns of the WT portfolios and the tracking indexes does not rise as we move from LONG to SHORT for domestic growth and international dividend. This is possible because the algorithm minimizes mean square error and does not maximize R^2 .

Phil Steinmeyer has suggested to me that there is an issue of data snooping bias in using the WT indexes prior to inception of the WT funds. "Presumably, when the folks behind WT were setting things up prior to the inception of their funds, they performed similar backtests" for many different rules, and "the success of those backtests probably helped lead to WT's formation. They may have fine tuned their methodology using backtests, but even if they did not, I doubt that they would have started WT had their brainstorm

(fundamental indexation) turned out, upon backtesting, to produce little or no benefit.” Thus the post-inception tests are better tests for they are free of data snooping bias.

Insert Figures 6 and 7 about here.

Figures 6 and 7 assess WT performance for various asset categories through time, based on Table 9. Figure 6 presents the average alphas for the long simulations and Figure 7 presents them for the short simulations. The averages are graphed versus the year in which the span is started through November 2008, starting in each year. Both figures present the average alphas from the beginning of data in each year through November 2008. They adjust the average alphas to recognize that our 2008 data are only 11 months and that for WT domestic earnings the data start only in March 2002. We include a marker for the level of the gap (0.6%). Index average alphas are the levels indicated on the chart. Fund average alphas are the difference between the height of the chart and the level of gap. Over the entire period the WT domestic growth fund underperformed Vanguard in both simulations and domestic earnings underperformed in the SHORT simulation. All the others outperformed. Figures 6 and 7 show the LONG and SHORT simulations respectively. They both show that from the beginning of 2003 through November 2008 two WT fund portfolios underperformed and two outperformed. The two figures also show, from the beginning of 1999 through November 2008, that one WT portfolio underperformed and two outperformed.

WisdomTree Summary

It may be frustrating for the reader that the analysis shows that we cannot confidently rank Vanguard relative to WisdomTree. On the other hand, as argued in the context of Vanguard versus DFA, in a competitive market we would expect that both firms exist precisely because there is no clear-cut preference for one or the other. One cannot conclude that WT beats Vanguard or the opposite. All one can say is over a particular period one firm beat the other for a particular simulation and for a particular asset class.

Some conclusions that do emerge are:

1. Figures 6 and 7 tell that except for domestic growth, WT's advantage through mid 2008 has been declining since the beginning of 1999. Barras, Scaillet and Wermers (2008, abstract) “. . . find a significant proportion of skilled (positive alpha) funds prior to 1996, but almost none by 2006.” The negatively sloped curves in Figures 6 and 7 could indicate that this downward trend applies to the screens and weighting used by WT, as well.
2. For periods up to November 2008 and reaching back to 2003 and before, the out performance of the WT international portfolio is striking and greater than the out performance of the other portfolios. This is one reason why the launch of Vanguard's international small-cap fund, expected in the first quarter of 2009, is welcome.

Reflections

Roughly ten years of historical performance have been examined. Conflicting evidence makes it impossible to rank the three companies with confidence. Different DFA and WisdomTree portfolios perform differently with respect to their Vanguard counterparts, and the differential performance depends on the period over which they are evaluated. The chapter provides two tools, the LONG and SHORT simulations using tracking indexes, to help investors develop informed predictions and decisions. This analysis, by correcting for style, illuminates the role of the way different firms construct portfolios more brightly than just comparing the performance of individual funds.

Analyses like this, which appropriately correct for style, may be useful to encourage fund families to keep costs low and to use efficient screens to colonize productive parts of the equity universe. Perhaps the uncertainty was to be expected. In a competitive market with sophisticated investors or sophisticated advisors, the coexistence of several players is explained by the inability to rank their performance conclusively.

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Note

The Excel program developed here is available upon request, so readers can use it to ask other questions and analyze more recent performance as new statistics become available.

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Table 1. Performance of DFA's Domestic Funds 11/17/2006-6/30/2008

Ticker Name	Max short	α %	t	P %	mse %	V	R ² %	short %
1 DFVEX US Vector Equity I	0 200	-1.87 -1.52	-1.52 -1.31	5.7 7.4	0.09 0.09	0.998 0.997	99.4 99.4	0 116
2 DFQTX US Core Equity 2 I	0 200	-1.21 -1.06	-1.36 -1.21	8.7 11.4	0.07 0.07	0.997 0.996	99.6 99.6	0 42
3 DFEQX US Core Equity 1 I	0 200	-0.81 -0.80	-1.20 -1.19	11.6 11.7	0.05 0.05	0.995 0.996	99.8 99.8	0 31
4 DFSCX US Micro Cap I	0 200	-6.50 -6.50	-2.22 -2.95	1.3 0.2	0.23 0.18	0.998 0.999	96.6 98.1	0 200
5 DFFVX US Targeted Value I	0 200	-3.28 -2.88	-1.87 -1.68	3.1 4.7	0.14 0.14	0.994 0.996	98.8 98.8	0 163
6 DFELX Enhanced US Large Co	0 200	-0.97 -0.86	-0.39 -0.35	34.9 36.3	0.2 0.19	0.996 1.006	96.7 96.7	0 43
7 DFLCX US Large Co	0 200	-0.03 0.02	-0.21 0.17	41.9 43.2	0.01 0.01	0.999 1.000	100.0 100.0	0 6
8 DFSVX US Small Cap Value	0 200	-4.23 -3.53	-1.66 -1.61	4.9 5.4	0.2 0.17	1.049 1.007	97.9 98.3	0 200
9 DFLVX US Large Cap Value I	0 200	-1.35 -0.53	-0.49 -0.20	31.4 42.1	0.22 0.21	1.045 1.015	96.6 96.9	0 154
10 DFSTX US Small Cap	0 200	-3.73 -3.33	-1.77 -2.17	3.9 1.5	0.17 0.12	1.019 1.005	98.3 99.1	0 200
11 DFCVX US Large Cap Value II	0 200	-1.26 -0.34	-0.46 -0.13	32.4 44.9	0.22 0.21	1.046 1.014	96.7 97.0	0 153
12 DFUVX US Large Cap Value III	0 200	-1.16 -0.24	-0.42 -0.09	33.9 46.4	0.22 0.21	1.046 1.015	96.6 96.9	0 136
13 DFUSX US Large Co. Inst. Index	0 200	0.14 0.17	0.30 0.38	38.1 35.2	0.04 0.04	1.000 1.000	99.9 99.9	0 152
14 DFBMX DFA US High Book-to-Market	0 200	-1.47 -0.64	-0.53 -0.24	29.7 40.4	0.22 0.21	1.045 1.014	96.7 96.9	0 139
15 Equally weighted portfolio of all 14 funds	0 200	-1.80 -1.40	-1.70 -1.34	4.5 9.0	0.08 0.08	1.002 0.998	99.5 99.5	0 81
16 Average of 14 funds	0 200	-1.98 -1.57	-0.98 -0.90	20.1 23.6	0.15 0.14	1.016 1.004	98.1 98.4	0 124

The 14 funds are those DFA funds that have existed for the whole period since Vanguard's High Yield Dividend Index Fund has been extant (11/17/2006). Throughout the chapter, alpha is expressed as percentage points/year, P is the significance level on a one tailed test (%). It is the probability that the true alpha has a different sign from that calculated, mse is the mean standard error between the return of the fund and the tracking index augmented by the constant term (%). V is relative volatility of the DFA fund. It is the standard deviation of the DFA fund divided by that of the tracking index. R is the correlation between monthly return of the mutual fund and the tracking index (%). Max short is the maximum % of the tracking index that is permitted to be short, and Short is the percent of the tracking index that is short.

Table 2. Tracking Indexes for DFA Equal Weight Domestic Portfolios					
Vanguard Index Funds	inception date	WHOLE PERIOD		11/17/2006 to	
		9/98-6/08		6/30/2008	
		LONG	SHORT	LONG	SHORT
VFINX 500		0	13	34	86
VEXMX Extended Market		0	-4	3	17
VTXMX Total Stock Market		0	-19	2	39
VIVAX Value		46	46	14	-8
VIGRX Growth		8	10	0	-31
NAESX Small-Cap		12	19	28	17
VISVX Small-Cap Value		27	24	16	15
VISGX Small-Cap Growth		2	2	0	-2
VIMSX Mid-Cap		5	8	0	4
VLACX Large-Cap 2/2/2004		non		0	-23
VDAIX Dividend Appreciation 4/28/2006		existent		0	1
VMVIX Mid-Cap Value 8/25/2007		for		3	0
VMGIX Mid-Cap Growth 8/25/2006		part of		0	-5
VHDYX High Dividend Yield 11/17/2006		period		0	-12
% short		0	-23	0	81
α % pts/year		1.05	0.96	-1.80	1.40
Dates are inception of funds. Nondated funds existed for the entire period.					

Table 3. Performance of the DFA Equal Weight Domestic Portfolio 9/1/1998-6/30/2008											
	LONG					SHORT					short %
	α	t	P	mse	R ²	α	t	P	mse	R ²	
9/1998-6/2008	1.05	1.08	14.05	0.19	97	0.96	0.99	16.09	0.19	97	23
2008	-0.72	-2.25	1.26	0.09	100	-0.40	-2.25	1.26	0.09	100	158
2007	-2.92	-2.25	1.26	0.08	99	-2.50	-2.00	2.33	0.08	99	100
2006	2.21	0.69	24.66	0.20	94	1.74	1.60	5.51	0.07	99	48
2005	0.77	0.59	27.79	0.08	99	1.33	1.05	14.70	0.08	99	200
2004	1.33	0.88	18.89	0.09	99	1.15	0.81	21.01	0.09	99	200
2003	2.83	1.73	4.28	0.10	99	2.69	1.66	4.92	0.10	99	74
2002	3.18	1.10	13.59	0.18	99	2.92	1.03	15.26	0.18	99	125
2001	8.24	1.99	2.37	0.26	96	6.07	1.57	5.89	0.24	96	187
2000	-3.38	-0.75	22.83	0.28	95	-2.26	-0.51	30.53	0.28	95	93
1999	2.37	0.66	25.53	0.22	93	2.86	0.82	20.74	0.22	93	196
1998	-8.94	-1.55	6.19	0.21	98	-8.22	-1.55	6.19	0.21	98	26
Annual Average	1.15	0.08	13.51	0.16	97	1.12	0.20	11.67	0.15	98	128
1998 data are for last 1/3 of year. 2008 data are for first 1/2 of year, so avg alphas are weighted.											

Table 4. Tracking Indexes for DFA Equal Weight International Portfolio for the Entire Period 9/1998 to 6/2008

Vanguard index fund	LONG	SHORT
VTRIX International Value	35	53
VINEX International Explorer	43	46
VEIEX Emerging Mkt Stock	14	14
VPACX Pacific	8	4
VWIGX International Growth	0	-8
VEURX European Stock	0	-9
Sum	100	100

Table 5. Performance of the DFA Equal Weight International Portfolio											
	LONG					SHORT					
	α	t	P	mse	R ²	α	t	P	mse	R ²	short %
9/1998-											
6/2008	0.84	0.46	32.4	0.37	84	0.29	0.16	43.5	0.36	92	17
2008	0.08	0.01	49.4	0.23	97	0.22	0.04	48.3	0.23	99	11
2007	5.14	1.03	15.2	0.31	92	5.09	1.03	15.3	0.31	96	22
2006	0.24	0.06	47.4	0.24	94	0.00	0.00	50.0	0.24	97	26
2005	-1.79	-0.44	33.1	0.26	81	-1.83	-0.45	32.8	0.26	90	7
2004	1.21	0.25	40.3	0.31	84	-0.71	-0.15	44.0	0.30	92	6
2003	0.43	0.11	45.5	0.25	87	0.48	0.12	45.1	0.24	93	12
2002	10.37	1.34	9.1	0.49	66	10.03	1.32	9.4	0.47	82	8
2001	13.24	2.26	1.2	0.37	89	11.90	2.07	2.0	0.36	94	16
2000	0.38	0.07	47.2	0.35	82	-0.32	-0.06	47.5	0.33	91	21
1999	-9.55	-1.92	2.8	0.32	80	-9.62	-1.94	2.7	0.32	89	2
1998	1.85	0.22	41.4	0.31	91	1.95	0.23	40.9	0.31	95	4
Annual Average	2.08	0.29	30.41	0.32	86	1.59	0.20	31.78	0.31	93	13
1998 data are for last 1/3 of year. 2008 data are for first 1/2 of year, so avg alpha is wgt'd.											

Table 6. Performance of DFA's Diversified Portfolios Since Inception										
Ticker	Name	inception	Max short	α	t	P	mse	V	R^2	short
1	DFVEX US Vector Equity	1/3/2006	0	-0.63	-0.63	27	0.100	1.00	99.2	0
			200	-0.07	-0.08	47	0.098	1.00	99.2	64
2	DFQTX US Core Equity 2I	9/16/2005	0	-0.60	-0.93	18	0.068	1.00	99.5	0
			200	-0.49	0.81	21	0.067	1.00	99.6	36
3	DFQTX US Core Equity 1I	9/16/2005	0	-0.56	-1.10	14	0.054	0.99	99.7	0
			200	-0.56	-1.10	14	0.054	0.99	99.7	13
4	DFIEX International Core Equity	9/16/2005	0	-0.51	-0.19	42	0.003	0.97	92.3	0
			200	-0.45	-0.17	43	0.003	0.97	92.2	9
5	DGEIX Global Equity I	2/26/2003	0	0.22	0.31	38	0.095	1.00	98.8	0
			200	0.17	0.24	40	0.094	1.00	98.8	16
6	DFCEX Emerging Mkts Core Equity	4/8/2005	0	-1.96	-0.76	22	0.003	0.94	95.0	0
For this fund Vanguard Emg Mkts Stock Idx Fund is the tracking index, so no short simulation exists.										
For US funds tracking index is Vanguard US index funds. For International Core Equity it is Vanguard international except emerging markets. For Global it is all Vanguard funds with domestic share constrained to lie between the historical limits of the fund reported by Morningstar: 46.6% and 70.5%.										

Table 7. Performance of individual WisdomTree indexes 12/2006-11/2008 inclusive

Ticker for fund and fund name	α index LONG	α index SHORT	Gap	derived α fund LONG	derived α fund SHORT
1 EXT Total Earnings	0.97	2.30	0.37	0.60	1.93
2 EPS Earnings 500	1.34	2.60	0.55	0.79	2.05
3 EZM MidCap Earnings	1.63	2.98	-0.36	1.99	3.34
4 EES SmallCap Earnings	-4.44	-6.55	-0.67	-3.77	-5.89
5 EEZ Earnings Top 100	-3.08	4.96	0.51	-3.59	4.45
6 EZY Low P/E	-2.77	5.70	0.44	-3.21	5.26
Domestic earnings average	-1.06	2.00	0.14	-1.20	1.86
Domestic earnings median	-0.90	2.79	0.40	-1.30	2.70
7 DTD Total Dividend	-0.72	1.67	1.01	-1.73	0.66
8 DLN LargeCap Dividend	-0.48	2.10	0.56	-1.05	1.54
9 DON MidCap Dividend	-1.46	1.17	-0.32	-1.13	1.49
10 DES SmallCap Dividend	-3.24	-2.05	0.02	-3.26	-2.07
11 DHS Equity Income	-6.73	0.28	0.69	-7.42	-0.41
12 DTN Dividend Top 100	-1.76	4.12	0.72	-2.49	3.39
Domestic dividend average	-2.40	1.21	0.45	-2.85	0.77
Domestic dividend median	-1.61	1.42	0.63	-2.11	1.07
13 DOL International LargeCap Dividend	2.86	2.06	0.29	2.57	1.76
14 DIM International MidCap Dividend	2.47	2.38	-0.59	3.06	2.97
15 DLS Intl SmallCap Dividend	-0.09	1.91	0.00	-0.09	1.91
16 DOO Intl Dividend Top 100	-0.80	-0.68	-0.28	-0.52	-0.40
17 DEB Europe Total Dividend	1.51	1.44	1.34	0.16	0.10
18 DFE Europe SmallCap Dividend	-9.91	-6.99	0.70	-10.61	-7.70
19 DEW Europe Equity Income	-1.47	-2.26	1.30	-2.78	-3.57
20 DND Pacific ex-Japan Total Dividend	6.03	5.83	0.66	5.37	5.17
21 DNH Pacific ex-Japan Equity Income	2.64	4.07	0.96	1.68	3.11
22 DXJ Japan Total Dividend	2.64	4.07	-0.47	3.11	4.54
23 DNL Japan Equity Income	8.35	10.69	-0.14	8.49	10.83
24 DFJ Japan SmallCap Dividend	5.61	9.56	-0.15	5.77	9.72
25 EPI India Earnings Fund	1.64	-2.00	0.62	1.02	-2.62
26 DWM DEFA Index	2.29	2.04	2.33	-0.04	-0.28
27 DTH DEFA Equity Income	1.53	0.71	1.08	0.44	-0.37
28 DEM Emerging Markets Equity Income	6.29	6.55	0.51	5.78	6.04
29 DGS Emerging Markets SmallCap Div	6.29	6.55	0.30	5.99	6.26
International average	2.23	2.70	0.50	1.73	2.20
International median	2.47	2.06	0.51	1.68	1.91
30 IGHIX Global HighYielding Equity	-0.27	-0.08			
31 ROI Large Cap Growth	2.96	2.84			
32 GULF Middle East	19.01	10.97			

Index refers to the index on which each WT fund is based. Gap is the underperformance of the ETF below the index on which it is based over the year ending 9/31/2008. It is calculated as the return of the index minus the return of the ETF which is based on it. All figures are % per year. Returns are continuously compounded. Start date is chosen so Vanguard's High Dividend Yield Index Fund can be included in the comparison set. LONG refers to the tracking index which holds no short Vanguard positions. SHORT is the tracking index which can hold up to 200% off the Vanguard portfolio short.

Conclude: Average and median alphas, both LONG and SHORT for the international funds are positive, indicating that they out performed the corresponding Vanguard tracking indexes. Average and median alphas LONG are negative for the domestic earnings and dividend funds, but the corresponding SHORT ones are positive. Thus international funds out performed their Vanguard counterparts. The domestic funds under performed their LONG Vanguard tracking indexes, but out performed their SHORT Vanguard tracking indexes.

Table 8. Performance of WisdomTree world portfolio indexes (3/2002-11/2008 inclusive)				
	asset weighted		equal weighted	
	LONG	SHORT	LONG	SHORT
Performance % per year				
α % per year	3.55	3.38	3.16	2.78
t for index	3.05	3.86	3.01	3.73
P for index	0.15	0.01	0.17	0.02
mean square error % per mo	0.85	0.64	0.77	0.54
R(fund, track indx, %)	98	99	99	99
α 2008	0.17	-1.74	-0.35	-1.81
α 2007	4.46	5.35	3.36	3.85
α 2006	4.26	3.46	3.61	2.96
α 2005	-1.14	0.53	-0.70	0.38
α 2004	3.38	2.96	3.29	2.69
α 2003	4.11	5.63	2.74	4.47
α 2002	10.49	7.76	11.25	7.26
volatility ratio	0.97	1.01	0.96	1.01
t for fund: gap of 0.6%	2.54	3.17	2.44	2.92
P for fund: gap of 0.6%	0.66	0.11	0.84	0.22
Tracking Index %				
VFINX	6.48	111.31	13.97	110.82
NAESX	0.00	-59.82	0.00	-64.31
VEXMX	0.00	32.83	0.00	41.14
VIGRX	0.00	-58.29	0.00	-63.59
VIVAX	19.31	-43.52	13.90	-44.13
VTSMX	0.00	16.12	0.00	15.64
VIMSX	0.00	-14.72	0.00	-4.57
VISGX	0.00	7.58	0.00	8.51
VISVX	7.43	41.76	15.13	43.50
VEIEX	9.08	19.70	5.66	15.97
VEURX	22.46	29.79	15.42	25.95
VINEX	15.43	20.75	15.61	16.76
VPACX	19.81	15.70	20.32	15.73
VTRIX	0.00	-19.17	0.00	-17.41
VWIGX	0.00	-4.48	0.00	-5.98
short part of portfolio %	0.00	-200	0.00	-200
The alphas for the funds are the alphas for the WT indexes minus the gap from Table 7. The volatility ratio is the standard deviation of daily returns of the WisdomTree fund/that of the Tracking index basket.				
The asset weights are those for 9/31/2008 from the WT web site.				
Conclude: All whole period alphas are positive and exceed Table 7's gap. Average alphas are positive for the last two years. As expected, the alphas for the asset weight portfolio, using recent weights, exceed those for the equal weight portfolio.				

Table 9. Performance of WisdomTree equal weight portfolios 1/1999-11/2008 inclusive									
	domestic earnings		domestic dividends		domestic growth		international dividend		Average
	LONG	SHORT	LONG	SHORT	LONG	SHORT	LONG	SHORT	
Performance %/year	3/2002-11/2008		1/1999-11/2008						
α % per year	1.08	0.53	2.16	1.38	0.35	0.37	4.80	4.21	1.86
t for α	1.00	0.63	1.02	0.83	0.15	0.17	1.86	1.75	0.93
Prob t>T (one tailed test %)	16.12	26.57	15.60	20.29	43.97	43.23	3.28	4.15	21.65
mean square error %/mo	0.80	0.61	1.89	1.46	2.05	1.94	1.25	1.15	1.39
R(fund, track indx, %)	98.6	99.0	95.4	95.9	91.6	91.7	96.5	96.7	95.7
α 2008	-2.80	-2.90	0.74	-2.95	-1.72	-1.74	0.95	-5.80	-2.03
α 2007	1.59	2.45	-1.58	1.68	5.62	7.14	1.80	1.15	2.48
α 2006	0.35	-0.70	-0.31	-1.67	2.79	2.51	4.18	6.06	1.65
α 2005	0.95	1.22	-2.28	-0.69	2.35	1.98	-1.52	-0.69	0.16
α 2004	0.11	-0.42	0.50	-0.62	3.61	3.06	7.11	8.63	2.75
α 2003	-0.03	0.94	-1.93	1.81	-3.41	-2.91	5.26	7.69	0.93
α 2002	8.29	3.27	13.80	10.34	8.23	5.61	13.55	10.70	9.22
α 2001			15.41	8.04	-5.68	-3.51	12.82	8.33	5.90
α 2000			11.26	1.81	-12.28	-12.18	8.47	8.72	0.83
α 1999			-14.12	-4.32	3.78	3.54	-4.92	-3.51	-3.26
volatility ratio	0.95	0.99	0.89	0.88	1.07	1.04	0.95	1.04	0.83
α for fund	0.48	-0.07	1.56	0.78	-0.25	-0.23	4.20	3.61	1.26
t for fund: gap of 0.6%	0.44	-0.09	0.78	0.53	-0.11	-0.11	3.04	2.81	0.91
P for fund: gap of 0.6%	33	-47	22	30	-46	-46	0.15	0.29	-6.60
Tracking Index %									
VFINX	0	0	0	-41	0	54	0	0	2
NAESX	0	-88	0	-16	0	-66	0	0	-21
VEXMX	0	22	0	-74	16	82	0	0	6
VIGRX	0	-85	0	-65	58	67	0	0	-3
VIVAX	34	-27	71	5	6	17	0	0	13
VTSMX	9	180	0	217	0	-100	0	0	38
VIMSX	24	14	0	19	9	-7	0	0	7
VISGX	0	27	0	-4	0	11	0	0	4
VISVX	32	56	29	59	11	41	0	0	29
VEIEX	0	0	0	0	0	0	1	10	1
VEURX	0	0	0	0	0	0	9	11	3
VINEX	0	0	0	0	0	0	10	9	2
VPACX	0	0	0	0	0	0	19	15	4
VTRIX	0	0	0	0	0	0	61	55	15
VWIGX	0	0	0	0	0	0	0	-12	-2
Short part of portfolio %	0	200	0	200	0	173	0	-200	
Conclude: All whole period alphas are positive. For last three years average alphas average are negative for domestic earnings and dividends; the average is positive for other funds.									

Table 10. Performance of Equal Weight Wisdom Tree Index Portfolios With New Vanguard Indexes 12/2006-11/2008 inclusive

	domestic earnings		domestic dividends		domestic growth		international dividend	
	LONG	SHORT	LONG	SHORT	LONG	SHORT	LONG	SHORT
Performance								
α per year	-0.85	1.96	-2.69	1.81	2.95	2.90	3.42	2.43
t for α	-0.62	2.10	-0.96	1.41	1.33	1.69	1.78	1.34
P	27.15	2.35	17.39	8.53	9.75	5.25	4.40	9.65
mean square error %/mo	0.53	0.37	1.07	0.49	0.85	0.67	0.75	0.71
R(WT fund, track indx, %)	99.5	99.8	97.9	99.6	98.9	91.2	99.3	97.0
volatility ratio	1.02	1.00	1.05	1.01	0.99	0.98	0.99	1.01
Tracking Index								
VFINX	0	4	0	-17	13	-66	0	0
NAESX	54	86	0	-27	0	0	0	0
VEXMX	0	-98	0	68	0	-48	0	0
VIGRX	0	0	0	45	8	44	0	0
VIVAX	0	-62	0	4	0	49	0	0
VTSMX	31	11	0	-1	0	73	0	0
VIMSX	0	0	0	-7	0	42	0	0
VISGX	0	-25	0	-65	0	16	0	0
VISVX	15	31	41	54	0	-17	0	0
VLACX	0	-16	0	0	29	72	0	0
VDAIX	0	7	0	-79	6	0	0	0
VMGIX	0	0	0	-6	45	-12	0	0
VMVIX	0	0	0	10	0	3	0	0
VHDYX	0	0	59	120	0	-58	0	0
VEIEX	0	0	0	0	0	0	0	1
VEURX	0	0	0	0	0	0	5	-3
VINEX	0	0	0	0	0	0	27	29
VPACX	0	0	0	0	0	0	0	-13
VTRIX	0	0	0	0	0	0	68	87
VWIGX	0	0	0	0	0	0	0	-4
short part of portfolio	0	150	0	200	0	200	0	21

Conclude: for domestic dividend and earnings long portfolios alphas are negative.
For all others alphas are positive.

Figure 1. Alphas for DFA Domestic Mutual Funds
11/17/2006-6/30/2008

Figure 2. Alpha for equal weight DFA domestic portfolio

Figure 3. Average alpha for equal weight DFA domestic portfolio

Figure 4. Alpha for equal-weight DFA international portfolio

Figure 5. Average alpha for equal-weight DFA international portfolio

Figure 6. WT Average alphas long

Figure 7. WT average alphas short