THE INVESTMENT PERFORMANCE AND TRACKING ERRORS OF SMALL-CAP ETFs

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ABSTRACT

ETFs and index mutual funds are similar and are considered as substitute products. However, ETFs are listed on an exchange, are traded throughout the day, and are generally assumed to have lower tracking errors than index mutual funds. Furthermore, ETFs have lower expenses and are more tax efficient.

This study investigates the tracking errors and investment performance of small-cap ETFs that tracked the Russell 2000 index, and compares the results with those of index mutual funds that tracked the same index. The results show that ETFs are on average larger in the size of assets, they have lower expense ratios, and they have higher portfolio turnover. Moreover, ETFs generally have lower portfolio holdings and they invest a greater percentage of their portfolio funds in the top-ten companies they hold. This suggests that ETFs are less diversified than index mutual funds.

Also, the two types of funds underperformed the Russell 2000 index as indicated by both the Jensen's alpha and by the Sharpe information ratio. Jensen's alpha indicates that index mutual funds outperformed the ETFs, and Sharpe information ratio indicates that ETFs outperformed the index mutual funds. This latter finding is more realistic because previous studies have documented that mutual fund portfolios contain significant idiosyncratic risks. Surprisingly, the results also indicate that ETFs have larger tracking errors than index mutual funds irrespective of the two methodologies used.

Keywords: Exchange Traded Funds, ETF Tracking Errors, Index Mutual Funds, Investment Performance, Portfolio Selection, Fund Size.
JEL Codes: C12, C13, C18, C33, G11, G12, G23, N20.

I. INTRODUCTION

Exchange traded funds (ETFs) are in many ways similar to index mutual funds. ETFs are essentially index mutual funds that are listed on an exchange, according to Fuhr (2001). And, according to Kostovetsky (2003), the goal of ETFs and index

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mutual funds is essentially the same—to buy large quantities of stock at a low cost, and to provide investors with a way to tie their holdings to a well-diversified indexed portfolio.[2] Furthermore, both types of funds are regulated by the SEC under the Investment Company Act (1940), and they are considered as substitute products. Svetina (2010) finds that the creation of an ETF reduces fund flows to index funds. However, there are major differences between the two types of funds. ETFs are listed on a stock exchange and are bought and sold continuously on the exchange at prices that vary throughout the trading day. Because of arbitrage activities in the ETF market, it is generally assumed that the share price of an ETF remains close to the ETF's NAV. Mutual funds, on the other hand, are forward priced which means that mutual fund investors purchase and redeem mutual fund shares at the fund's closing NAV for the particular trading day. All of the fund's investors receive or pay the same price per share each day.

Other differences between an ETF and an index mutual fund relate to the fund's expenses. The management fees and shareholder-transactions costs of an ETF are lower than those of an index mutual fund, and ETFs are more tax efficient than index mutual funds. (Kostovetsky, 2003). Furthermore, because ETFs are continuously traded during the day, an investor is able to place a limit order and stop orders on ETF shares. Another significant difference between the two types of funds relate to the way shares are purchased and redeemed by investors.

ETF shares are created and redeemed in-kind. "Authorized participants," which are typically institutional investors create ETF shares by depositing the ETF's "creation basket" and/or cash with the ETF's sponsor. The creation basket is a list of names and quantities of securities and other assets, and is either a replicate or sample of the ETF's underlying portfolio. In return for the creation basket, the authorized participant receives a "creation unit," which generally consists of 25,000 to 200,000 ETF shares. The authorized participant may then keep the shares or sell them in the secondary market.[3] Retail investors typically buy or sell the ETF shares in the secondary market.

A creation unit is redeemed when an authorized participant returns the specified number of shares in the creation unit to the sponsor, and in return receives the "redemption basket," which consists of securities and/or other assets contained within the ETF's underlying portfolio. The redemption basket typically mirrors the creation basket. Mutual fund shares, on the other hand, are purchased or redeemed directly with the mutual fund company—at the closing day's NAV.

This creation and redemption of ETF shares in-kind provide arbitrage opportunities to the ETF investor that forces the ETF shares closer to the NAV of constituent shares. Elton, et al. (2002), who analyzed the performance of an exchange traded fund known as the Standard and Poor's Depository Receipts, or SPDR

[2] Prior to 2008, all ETFs were index based and tracked specific equity indexes. Since 2008, actively managed ETFs have been launched.

[3] See the 2012 ICI Fact Book.

(Spiders), found that the tracking errors of the SPDRs are small and short-lived.[4] Such arbitrage opportunities which force share price closer to the NAV are not present in the mutual fund marketplace. Thus tracking errors of mutual funds are generally assumed to be higher than those of ETFs.

The purpose of the present study is to analyze the tracking errors of a sample of small-cap ETFs that tracked the Russell 2000 index, and to compare them with the tracking errors of a sample of mutual funds that tracked the same index.

II. DATA

The data consist of twelve ETFs and 56 index mutual funds all of which track the Russell 2000 index.[5] The sample period is from January 2001 to March 2012. Monthly rates of return on the Russell 2000 index, on the ETFs, and on the mutual funds were extracted from the Morningstar Principia database. Quarterly yields on the 91-day Treasury bills were obtained from the federal reserve bank of St. Louis and then converted to monthly rates of return.

As shown in Table 1, the average net assets (NASSETS) of the ETFs is $2162 million compared to $232 million for the mutual funds. However, the mutual funds are substantially more diversified as indicated by their portfolio holdings (Holdings) of 1499 stocks, compared with 576 stocks for the ETFs. Moreover, the average mutual fund invested only 9% of its portfolio in the top-ten companies (TOPTEN) it held, compared with approximately 25% for the ETFs, again indicating greater diversification for the mutual fund portfolios. And, as expected, the average ETF appears to have a lower expense ratio (EXRATIO) of 0.57% compared with 0.90% for the average mutual fund, which supports Kostovetsky (2003). Furthermore, the average mutual fund carried a front-end load (FLOAD) of approximately 0.4% compared with zero percent for the average ETF. Finally, as expected, the ETFs had a higher portfolio turnover (TOVER) of approximately 70% versus 56% for the mutual funds, indicating greater trading activity by the ETFs.

[4] This study by Elton, et al. is the only study, to my knowledge, which systematically examined the tracking errors of an exchange traded fund, in this case the S&P 500 Depository Receipts.

[5] Although ETFs have experienced rapid growth in number and assets since the first U.S. based ETF was launched in 1993, few ETFs have a long enough series of historical data, and relatively few ETFs tracked the Russell 2000 index.

Table 1: Sample Characteristics of EFTs and Index Mutual Funds (January 2001 – March 2012)

Variable	Exchange Traded Funds		Index Mutual Funds	
	Mean	STD	Mean	STD
NASSETS ($m)	2161.980	4550.850	232.188	425.811
D-Stocks (%)	123.743	62.921	93.977	9.077
F-Stocks (%)	1.208	1.722	1.654	1.163
Bonds (%)	0.797	2.753	0.001	0.002
Holdings	576	570	1499	630
TOPTEN	24.871	36.942	9.126	9.143
EXRATIO (%)	0.568	0.287	0.898	0.550
FLOAD (%)	0	0	0.436	1.423
TOVER (%)	69.750	77.714	56.418	116.098

Note:

Note: NASSETS represent the fund's net assets ; D-Stocks is the percentage of the fund's portfolio invested in domestic common stocks; F-Stocks is the percentage of the portfolio invested in non-U.S. stocks; Bonds is the percentage of the fund's portfolio invested in bonds; Holdings represent the number of stocks held by the fund; and TOPTEN is the percentage of the fund's portfolio invested in the top-ten stocks it held; EXRATIO and TOVER refer to the fund's expense ratio and portfolio turnover, respectively. FLOAD is the fund's front-end load. Cash and other securities held by the fund are not included in this table.

III. METHODOLOGY

I use the following model to measure the risk-adjusted performance of fund companies:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}\,, \qquad [1]$$

where, R_{it} is the excess return on fund i, in month t, i.e. the fund's return in excess of corresponding monthly yield on 91-day-Treasury bills; R_{mt} is the excess return on the Russell 2000 index in month t; and ε_{it} is the residual return on fund i, in month t. Fund i's risk-adjusted performance is measured by Jensen's alpha, α_i. I measure the risk-adjusted performance again using the Sharpe Information Ratio as suggested by Reilly and Norton (2006) and Goodwin (1998). According to Reilly and Norton (2006),

the Sharpe Information Ratio, S_p, is a more general measure of portfolio performance than the traditional Sharpe measure.

If "D_t" is the differential return between the portfolio and the benchmark (R_{pt}–R_{mt}) in month t, then:

$$S_p = \frac{\bar{D}}{\sigma_D}\ , \qquad [2]$$

where, $\bar{D}$ is the arithmetic average of the monthly differential returns, i.e. $\bar{D} = \frac{1}{n}\sum_{t=1}^{n} D_t$; σ_D is the standard deviation of the differential returns; and n is the number of monthly returns. For the test of null hypothesis--that the differential returns are zero, on average--the t-statistic is:

$$t = \frac{\bar{D}}{\sigma_D \sqrt{n}}. \qquad [3]$$

The t-statistic has a t distribution with n-1 degrees of freedom.

As with Jensen's alpha, the Sharpe Information Ratio indicates portfolio performance relative to the benchmark index and lends itself to statistical tests of significance. However, unlike the Jensen's alpha, the Sharpe Information Ratio adjusts for total risk, rather than just systematic risk. This is crucial for performance measurement because previous studies have shown that mutual fund portfolios, on average, contain significant idiosyncratic risks. Reilly and Norton (2006) and Goodwin (1998) argue that the Sharpe Information Ratio is a more general measure of portfolio performance than the traditional Sharpe measure.

Tracking error (TE) of the fund's portfolio is calculated as follows:

$$TE = \sigma_D \sqrt{12}, \qquad [4]$$

where "12" signifies that the number of return periods in a year is 12 (for monthly returns).[6]

IV. EMPIRICAL RESULTS

The measures of investment performance for the two types of funds are shown in Table 2. Although the monthly risk-adjusted-excess return measured using the Jensen's, α_p, is negative for both types of funds, the index funds as a group have

[6] See Reilly and Brown (2009) for the measurement of tracking error.

outperformed the ETFs, as indicated by the alpha of -0.039 for the index funds and -0.199 for the ETFs. This is in line with Elton, et al. (2002) who find that SPDRs were outperformed by index funds. Prather, et al. (2009) similarly find that index mutual funds that track the S&P 500 index "dominate" SPDRs. Furthermore, Svetina (2010) finds that ETFs underperform their benchmarks and "are not immune to tracking error." Small, et al. (2012) however find that ETFs earn returns "that are similar to their benchmark portfolio." The index funds also had smaller tracking errors than the ETFs as indicated, in Table 2, by the portfolio betas of 0.973 for the index mutual funds and 1.195 for the ETFs. The root mean square errors of 0.395 and 1.644 for the index mutual funds and the ETFs, respectively, indicate the accuracy with which the betas and the alphas have been estimated.

Table 2: Measures of Investment Performance for EFTs and Index Mutual Funds (January 2001 to March 2012)

Variable	Exchange Traded Funds				Index Mutual Funds			
	N	Mean	Minimum	Maximum	N	Mean	Minimum	Maximum
Panel A:								
$\bar{D}$	12	0.084	-0.607	2.240	56	-0.042	-0.394	0.110
σ_D	12	3.110	0.449	14.024	56	0.435	0.048	2.797
S_p	12	-0.065	-0.410	0.160	56	-0.452	-1.987	0.113
TE	12	10.773	1.554	48.581	56	1.507	0.166	9.689
Panel B:								
α_p	12	-0.199	-1.120	0.114	56	-0.039	-0.374	0.114
β_p	12	1.195	0.542	2.932	56	0.973	0.694	1.003
σ_{error}	12	1.644	0.450	3.628	56	0.395	0.046	2.077

Note:

All of the variables were estimated separately for each fund and then averaged across the particular group of funds, as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}, \quad \text{Equation [1]}$$

$$S_p = \frac{\bar{D}}{\sigma_D}, \quad \text{Equation [2]}$$

$$TE = \sigma_D \sqrt{12}, \quad \text{Equation [4]}$$

All variable definitions are as discussed in the Methodology section. σ_{error} is the root mean square error from the regression of the fund's excess returns on the excess returns of the Russell 2000 index.

Similar to Jensen's alpha, the Sharpe information ratio, S_p, also indicates that investment performance was negative for both of the two types of funds. However, the Sharpe information ratios of -0.452 and -0.065 for the mutual funds and the ETFs, respectively, indicate that the ETFs outperformed the mutual funds during the study period—contrary to the results obtained using the Jensen's alpha.[7] The average differential return between the fund portfolio and the underlying benchmark, $\bar{D}$, as well as the average standard deviation of the return differentials, σ_D, are both closer to zero for the index funds, which indicates that the index mutual funds tracked the benchmark portfolio much better during the study period. This finding is supported by the calculated tracking errors (TE), which were 10.773 for the ETFs and 1.507 for the index mutual funds. The finding does not support the assumption generally made by market participants that ETFs have smaller tracking errors because of the arbitrage opportunities in the ETF market; opportunities that are not present in the mutual fund market.

In summary, the results indicate that ETF portfolios on average outperformed index mutual funds when the Sharpe information ratio is used as a measure of investment performance. Moreover, ETFs had larger portfolio betas and larger tracking errors than index mutual funds.

V. SUMMARY AND CONCLUSIONS

ETFs and index mutual funds are similar in several ways. They have the same goal and are regulated by the SEC under the Investment Company Act (1940). The two types of funds are considered as substitute products and are used by market participants to invest in a well-diversified portfolio which tracks a specific index. However, unlike mutual funds, ETFs are listed on an exchange and are traded throughout the day. And because of continuous trading and arbitrage activities in the ETF market, an ETF is generally assumed to have lower tracking errors than an index mutual fund. Index mutual funds are purchased and redeemed directly with the mutual fund company at the fund's closing NAV. Furthermore, ETFs have lower expenses and are more tax efficient.

The purpose of the present study is to investigate the tracking errors of a sample of small-cap ETFs that tracked the Russell 2000 index, and to compare them with the tracking errors of a sample of mutual funds that tracked the same index. The results show that ETFs are on average larger in terms of the size of net assets, they have lower

[7] The Jensen's alpha methodology assumes that the fund portfolio being analyzed is perfectively diversified. This assumption is not realistic since past research has shown that the average mutual fund portfolio is substantially undiversified. Because the Sharpe information ratio method does not assume a perfectly diversified portfolio, it is the more appropriate method for our purposes.

expense ratios and, generally, they have no front-end load, unlike many index mutual funds. Furthermore, ETFs generally have lower portfolio holdings and a greater percentage of their portfolio funds is invested in the top-ten companies they hold. This suggests that ETFs are less diversified than index mutual funds. Moreover, as expected, ETFs have higher portfolio turnover.

The results also indicate that the two types of funds underperformed the Russell 2000 index as indicated by their Jensen's alphas and by their Sharpe information ratios. However, when the Jensen's alpha is used as a measure of performance, index funds outperformed the ETFs. When the Sharpe information ratio is used instead, the ETFs outperformed the index mutual funds. This latter finding is more realistic because the Sharpe information ratio is not based on the assumption that the portfolio being analyzed is fully diversified. Previous studies have documented that mutual fund portfolios contain significant amount of idiosyncratic risks. Surprisingly, the results indicate that ETFs have larger tracking errors than index mutual funds irrespective of the two methodologies used.

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