On the Impact of Closet Indexing in Active Fund Management

We propose a simple model to quantify the performance impact of closet-indexing in equity fund management, with a focus on mutual funds. The model requires only two inputs: the Sharpe ratio of the market index and the $R^2$ square from a regression of a fund’s excess returns on systematic factor returns. Due to pervasive closet-indexing, $R^2$squares are uniformly close to one, regardless of the asset pricing benchmark. We show that closet-indexing leads to gross alphas that do not survive realistic trading cost and expense ratios.

Wai Mun Fong, Ph.D.

teaches a course in Personal Finance and Wealth Management at the Department of Finance at the National University of Singapore. He is the author of two textbooks on personal finance (Personal Financial Planning and Personal Investment, both by Pearson) and a research monograph on investment entitled The Lottery Mindset: Investors, Gambling and the Stock Market. Dr. Fong has extensive consulting experience with leading banks and financial institutions including Citibank, UOB, DBS, ANZ, and AIA. He is also on the Asia-Pacific Advisory Board of Brandes Institute in the U.S., the research unit of leading investment firm, Brandes Investment Partner. Dr Fong’s research focuses on portfolio analytics, behavioral finance, market anomalies, and their implication for investors.

1. INTRODUCTION

Mutual fund investors pay active fees, but on average, they receive the performance (before costs) of index funds. This is to be expected given the zero-sum nature of active management, and the simple arithmetic that the market is made up of passive and active managers as noted by Sharpe (1991). Of course, some individual active funds can beat the market - albeit at the expense of other active funds. The fact that mutual funds continue to be the primary investment vehicle of individual investors testifies to the hope among many investors that they can somehow pick the right funds. These investors are likely to be disappointed, however, because for most funds, over 90% of their return variance can be replicated by index funds and exchange traded funds (ETFs). This is a universal finding, appearing most recently in papers such as Fama and French (2010), Amihud and Goyenko (2013) and Doshi, Elkhami, and Simutin (2015). A fund with an $R^2$ of over 0.9 can be regarded as a quasi-closet indexer since selectivity (also known as idiosyncratic or factor tracking variance) drives at most 10% of the portfolio’s return variability. Using data from 1984 to 2006, Fama and French (2010) report an $R^2$ of 0.96 for an equal-weighted portfolio of U.S. equity mutual funds. Unsurprisingly, they find that $R^2$s of larger funds are even closer to one. Amihud and Goyenko (2013) estimate $R^2$ values in the range of 0.53 and 0.99 for their sample of 2,565 equity funds over the period 1988 to 2010 and conclude that the returns of most funds can be replicated by less costly index funds. Another piece of evidence on closet indexing draws upon the fact that the benchmarks used to measure mutual fund performance are generally value weighted. Hence, managers who fear underperforming their peers more than outperforming them are likely to “hug the index” by value-weighting their portfolios. Consistent with this hypothesis, Bhattacharya and Galpin (2011) find that value-weighting has become more dominant in mutual funds investing in developed markets. In a broader context, Lewellen (2011) finds that closet indexing is also common among large institutional investors, including hedge funds and foreign-based funds. Indeed, he finds that institutional equity portfolios show little tendency to deviate meaningfully from the market weights of common characteristics widely studied in the asset pricing literature. These characteristics include market cap, beta, book-to-market ratios, momentum, accruals, and return on assets.

Pervasive high $R^2$ in the supposedly active fund management industry leaves investors short changed because there is strong evidence that funds with high selectivity (low $R^2$ values) do outperform quasi-closet
indexers by at least 2% net of costs (Amihud and Goyenko, 2013). Although by definition, these superior funds are in the minority, it is useful if individual investors have a simple and accurate means to identify them as well as quantify the performance impact of quasi-closet indexers. The goal of this paper is to provide a tractable measure for this purpose. Unlike traditional performance measures, investors using our proposed measure do not need to choose multi-factor benchmarks and run regressions to compute alphas. This may be problematic because the vast majority of mutual fund managers do not publicly disclose time series returns data on the funds they manage. In contrast, data on $R^2$ (a key variable in our model) are available free-of-charge on a number of online platforms such as the New York Times’s mutual fund screener and Zacks.com, an investment research firm.

The measure we propose is derived from an analytical model of fund management originally developed by Treynor and Black (1973) in which a mutual fund manager is assumed to allocate funds between a passive fund (P) and an active fund (A) to maximize the fund’s Sharpe ratio. For simplicity, we assume that the passive fund is a market index which also serves as the passive benchmark. However, the method is generalizable to a multi-factor benchmark. Based on this simple setting, a fund’s information ratio (IR) can be shown to be a simple function of a fund’s $R^2$ and the market’s Sharpe ratio. This relationship has interesting implications for performance evaluation. To preview the discussion, in the limiting case of a pure closet indexer ($R^2 = 1$), gross alpha will be zero while net alpha will obviously be negative. In reality, few funds are pure closet indexers. For the more relevant case of quasi-closet indexers (funds with $R^2$ close to one), performance evaluation involves empirical measures of the fund’s $R^2$ and the market’s Sharpe ratio over the evaluation period. Both of these inputs are easily obtainable, making it easy for individual investors to infer a fund’s alpha and IR. To illustrate this point, we bring our model to the data by calibrating it to the findings of a widely cited study of U.S. equity mutual funds by Fama and French (2010). This study is especially relevant to the topic of closet indexing since Fama and French report an $R^2$ of more than 0.96 for the average equity fund in their sample (the range is 0.96 to 0.99 depending on the asset pricing model). Using the market’s Sharpe ratio of 0.51 for their sample period (1984 to 2006) and a regression $R^2$ of 0.98 for the average fund using the four-factor model, we deduce an “active” Sharpe ratio that results from fund managers taking on tracking error risks and find that this active Sharpe ratio is very small compared to the market’s Sharpe ratio. In other words, due to quasi closet-indexing, the typical equity mutual fund makes only a miniscule contribution to boosting the fund’s Sharpe ratio beyond what investors could obtain more cheaply by investing in an index fund or ETF.

Besides IR, our method also makes it easy to back out the alpha of a quasi-closet indexer. The idea is that since the return standard deviation of a quasi-closet indexer is approximately similar to the market’s standard deviation, multiplying the active Sharpe ratio by the market standard deviation provides an estimate of the fund’s gross alpha. Subtracting published estimates of trading cost and expense ratios from the gross alpha results in an average net alpha of -1.05%, which is close to that reported by Fama-French for their average fund. On a more optimistic note, we also provide sensitivity analysis to show that investors could break-even if they had chosen funds which were slightly less tethered to the overall market (specifically those with an $R^2$ of 0.93). This finding (that skilled funds are those that take on higher tracking error variance) parallels the results of a more comprehensive empirical study of equity mutual funds by Amihud and Goyenko (2013).

Our calibration exercise suggests that investors can use our measure to infer the ex-post IR and alpha of a quasi-closet indexer using just two inputs, namely the market’s Sharpe ratio and the fund’s $R^2$. They can also use the model to select funds based on forward-looking IRs provided they have forecasts of the market’s Sharpe ratio and fund $R^2$s over the intended investment horizons. In relation to the literature, our study is not the first to highlight the important role of $R^2$ in fund performance measurement. Titman and Tiu (2011) and Sun, Wang, and Zheng (2012) use $R^2$ as a measure of factor exposure to evaluate hedge fund performance. These studies find that hedge funds with low $R^2$s have superior performance relative to those that hug the index. Amihud and Goyenko (2013) use $R^2$ relative to the Fama-French four-factor model as the main independent variable in return predictive regressions in a study of over 2,000 equity mutual funds. Controlling for other performance determinants such as fund size, managerial tenure, expense ratios, past performance, and risk factors, they find that
low $R^2$’s predict high alphas for up to six months following estimation periods. They also highlight that $R^2$ is a powerful performance predictor because selectivity and not market timing is the main driver of mutual fund performance.

Our measure, which emphasizes $R^2$ as a key fund performance parameter, is similar in spirit to the findings of the above studies. With the exception of Titman and Tiu (2011) and Sun et al. (2012) in the hedge fund context, most of this literature is empirically motivated. Titman and Tiu (2012) show that under the plausible assumptions, that an active fund manager chooses a portfolio to maximize the fund’s Sharpe ratio, there is a simple (closed-form) relationship between a fund’s $R^2$ and classic performance measures such as IR and alpha. This insight is equally applicable to the context of equity mutual funds and thus potentially useful to mutual fund investors in general, and investors of quasi-closet indexers in particular.

The rest of this paper is organized as follows. Section 2 describes the model for quantifying the effects of closet-indexing. Section 3 examines how well the model is able to match the empirical performance of equity mutual funds as documented by Fama and French (2010). This calibration exercise also draws on recent research on mutual fund trading costs by Edelen, Evans, and Kadlec (2013). Section 4 summarizes our main results.

2. THE MODEL

We consider a mean-variance fund management model developed by Titman and Tiu (2012), which is a special case of the seminal work of Treynor and Black (1973). To model closet indexing, we assume that most of the funds received by the active manager are invested in an index fund (P) with expected excess return $\mu_P$ and standard deviation $\sigma_P$. The balance of funds is deployed in an “alpha-seeking (active) strategy,” with expected excess return $\mu_A$ and standard deviation $\sigma_A$. All excess returns are net of a (constant) risk-free rate ($r$). For simplicity, we assume there is no correlation between the returns of the index fund and the returns of the alpha-seeking strategy. Allowing for positive correlation between these components will only bias us in the direction of finding more evidence for closet indexing.

Following Titman and Tiu (2012), the fund manager chooses to maximize the portfolio Sharpe ratio by allocating part of the portfolio to P and the rest to A. Denote these asset weights by $w_p$ and $w_A$. Let

$$\Omega = \frac{w_p}{w_A}$$

Then the expected excess return of the fund can be written as:

$$\mu_F = w_A \mu_A + \Omega w_A \mu_P = w_A (\mu_A + \Omega \mu_P). \quad (1)$$

The standard deviation of the fund is:

$$\sigma_F = w_A \sqrt{\sigma_A^2 + \Omega^2 \sigma_P^2} \quad (2)$$

and the fund’s Sharpe ratio is:

$$SR_F = \frac{\mu_A + \Omega \mu_P}{\sqrt{\sigma_A^2 + \Omega^2 \sigma_P^2}} \quad (3)$$

The optimization problem can be framed in terms of minimizing the portfolio variance holding the portfolio expected return fixed. Let $i = A$ or P. The optimization problem is then:

$$\text{Min} \sum_{i=1}^{2} w_i^2 \sigma_i^2 - 2\lambda \left( \sum_{i=1}^{2} w_i \mu_i - \mu_P \right) \quad (4)$$

where $\lambda$ is the Lagrangian multiplier.

Differentiating (4) with respect to the asset weight and equating the result to zero gives the optimal weight for each asset as:

$$w_i^* = \lambda \frac{\mu_i}{\sigma_i^2} \quad (5)$$

Using (5), we have the following optimal quantities (with asterisks):

$$\mu_F^* = \lambda \frac{\sum_i \mu_i^2}{\sigma_i^2} \quad (6)$$

$$\sigma_F^2 = \lambda \frac{\sum_i \mu_i^2}{\sigma_i^2} \quad (7)$$

$$SR_F^2 = \lambda \frac{\mu_A^2}{\sigma_A^2} + \frac{\mu_P^2}{\sigma_P^2} \quad \text{and} \quad (8)$$

$$\Omega^* = \frac{\mu_P / \sigma_P^2}{\mu_A / \sigma_A^2} \quad (9)$$
To quantify the degree of closet indexing, we use the $R^2$-square from a regression of the portfolio excess returns $R_P - r$ against the $R_F - r$ systematic factor returns. The $R^2$-square is:

$$R^2_F = \frac{\Omega^2 \sigma^2}{\sigma^2_A + \Omega^2 \sigma^2_P}$$

$$= \frac{1}{1 + \left(\frac{\mu_A}{\sigma_A}\right)^2 \left(\frac{\mu_P}{\sigma_P}\right)^2}.$$  (10)

From (10), the expression for the information ratio of the active strategy is:

$$IR_A = \frac{\mu_A}{\sigma_A} = \frac{\mu_P}{\sigma_P} \sqrt{1 - R^2}.$$  (11)

### 3. PERFORMANCE IMPACT

Assume the Sharpe ratio of the index fund is positive. Equation (11) says that the higher is the $R^2$, the smaller is the information ratio of the active strategy. As $R^2$ approaches 1, the “value add” implied by the active strategy approaches zero. How likely is this in actual practice? To answer this question and also to check the ability of our model to match empirical findings, we refer to the mutual funds study of Fama and French (2010), whose sample includes 1,308 U.S.-focused equity funds from 1984 to 2006.

Fama and French (2010) find that regressions of monthly excess returns for an equal-weighted portfolio of mutual funds yield an $R^2$ of 0.96 using the CAPM and marginally higher (0.98) using the three and four-factor models. Moreover, the market factor loading is close to one while factor loadings for the other risk factors are both small and often insignificant. The dominant influence of the market on mutual funds’ returns is consistent with quasi-closet indexing. Fama and French (2010) obtain very similar results with value-weighting, a strong indication that quasi closet-indexing not only exists on average, but also in aggregate (i.e.,

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>This table reports the effects of closet indexing (high $R^2$) on performance of equity mutual funds. In Panel A, the $R^2$ of 0.98 is taken from Fama and French (2010, Table 2) and is estimated by regressing monthly excess returns of an equal-weighted portfolio of U.S. equity mutual funds against factor returns in the four-factor model. $SR_F$ is the Sharpe ratio of a passive index fund tracking the CRSP value-weighted stock index). $IR_A = \frac{\mu_A}{\sigma_A}$ is the information ratio of the active strategy employed by the average fund. $SR_P$ is the Sharpe ratio of the average fund which incorporates the influence of closet indexing (through $SR_F$), and the active strategy (through $IR_A$). See equation 8 in the text. The right-hand side of Panel A reports gross and net alphas of the average fund. Gross alpha is estimated by $IR_A \times \sigma_P$. Net alpha is gross return minus trading cost ($TC$) and expense ratio ($Exp Ratio$). $TC$ is set as 1.13% per annum and expense ratio is set at 1.02% from Edelen, et al. (2013). Both are asset-weighted averages of costs for mid-cap and large-cap funds both. The sample period for calculating Sharpe ratios and alphas is 1984 to 2006, similar to the sample period used by Fama and French (2010). Panel B reports similar results as Panel A, but based on a hypothetical $R^2$ of 0.93 that yields a net alpha of approximately zero.</td>
</tr>
<tr>
<td>Panel A.</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>$SR_F$</td>
</tr>
<tr>
<td>$R^2$</td>
</tr>
<tr>
<td>$IR_A$</td>
</tr>
<tr>
<td>$SR_F$</td>
</tr>
<tr>
<td>Panel B.</td>
</tr>
<tr>
<td>$SR_F$</td>
</tr>
<tr>
<td>$R^2$</td>
</tr>
<tr>
<td>$IR_A$</td>
</tr>
<tr>
<td>$SR_F$</td>
</tr>
</tbody>
</table>
total wealth invested in all equity funds).

For the period studied by Fama and French (2010), the Sharpe ratio of the overall U.S. stock market was 0.508 and as mentioned, the $R^2$ for the average fund is close to one. Table 1 (Panel A) backs out an IR of 0.073 based on the market Sharpe ratio of 0.508 and the four-factor $R^2$ of 0.98. This result implies that the active component of the average equity mutual fund adds very little to the overall Sharpe ratio, which is 0.514 using equation (8). The qualitative aspect of this result is not surprising given the zero-sum game nature of active management (Sharpe, 1991). Still, the ability to quantify the size of the value-add of the average active fund may be of interest to investors, in view of the pervasive nature of quasi-closet indexing.

Another way to assess the impact of closet indexing is to back out the alpha implied by $IR_A$. We take advantage of the fact that because the average behaves like a closet indexer, its returns will be highly correlated with that of the market, and thus its standard deviation is approximately equal to the market’s standard deviation (15.1% per annum over the sample period). Using this estimate gives a gross alpha of 1.1% per annum before costs. Mutual fund investors not only bear the expense ratio cost (mainly management, custodian and administration fees), but also various trading costs that are incurred when fund managers buy and sell securities. Using detailed portfolio holdings and transaction data of equity mutual funds between 1995 and 2006, Edelen, Evans, and Kadlec (2013) find that trading costs vary significantly depending on fund size and investment style. To compute net alpha, we use their estimate of 1.13% annual trading cost for mid- and large-cap funds (averaged across value, growth and blended investment styles) and average expense ratio of 1.02% per annum for these funds. Subtracting these cost estimates from the gross alpha leads to a net alpha of -1.05% per annum, confirming the well-known finding that on average, mutual funds earn negative risk-adjusted returns.

Panel B of Table 1 repeats the previous analysis except that $R^2$ is reduced to a hypothetical 0.93. We see that the net alpha is now approximately zero, which means that investors can avoid the fate of negative risk-adjusted returns by choosing funds that are less extreme closet indexers.

4. CONCLUSION

We have proposed a simple mean-variance model for quantifying the impact of closet-indexing in active fund management. The model requires few inputs, all of which are easily obtainable. Calibrating this model to the Fama-French (2010) study leads to two key results. First, closet-indexing leads to a miniscule boost in the Sharpe ratio of the average equity mutual fund, suggesting that investors of active funds overpay for the prospect of positive alphas and the hope of minimizing negative alphas. Second, consistent with the first point, the gross alpha of the average fund (1.1%) fails to survive realistic trading cost and the typical expense ratios. These costs eroded the alpha to a negative 1.05 percent. Funds which were slightly less tethered to the overall stock market had decidedly better investment outcomes. This is also the message from recent research by Amihud and Goyenko (2013) using R-squares and Doshi, Elkamhi and Simutin (2015) using “active weights,” a concept related to active shares.

REFERENCES


ENDNOTES

1 If the index fund is expected to have negative returns, the optimal portfolio should just comprise the active strategy, $R^2$ becomes zero and the information ratio is simply $\frac{\mu_A}{\sigma_A}$. 