Measuring Style Efficiency

Jared Kizer, CFA

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Abstract

As we noted in Grover and Kizer [2016], the proliferation of style (or factor) investing has created a more complicated landscape for investors. It can be difficult for investors and their advisors to understand what style exposures a particular fund or strategy provides, whether the net expense ratio is reasonable for the style exposures provided and the efficiency of the style exposures of the strategy, which is the focus of this paper. To help with this last issue, I develop two new measures of style efficiency, one related to the expected style return of the strategy per bps of net expense ratio, which I refer to as the Cost Efficiency Ratio (CER), and one related to the expected style return of the strategy relative to expected tracking error, which I refer to as the Tracking Error Efficiency Ratio (TEER).

I am thankful for comments from Ronen Israel, Antti Ilmanen and research support from Daniel Campbell and Sean Grover. Please send any comments to jkizer@bamadvisor.com. This analysis is for academic purposes only. The research, opinions and data shared within this paper are those of Mr. Kizer and do not directly reflect those of Buckingham Asset Management, LLC.

1 Introduction

The proliferation of style investing over the last two plus decades has brought its own challenges. In a multi-dimensional world, similarly named funds may provide materially different style exposures. This means two funds may have significantly different expected excess returns and tracking error when compared to a market-cap weighted equity benchmark although at first glance an investor might not think so. Or, funds may provide similar style exposures but have markedly different expense ratios. Grover and Kizer [2016] developed a measure to help investors better understand expense ratio pricing across funds given varying exposure to the styles of size, value and momentum. In this paper, I develop two new measures to help investors better understand differences in style efficiency across funds.

Section II reviews existing measures of a strategy's efficiency; Section III develops the two new measures of style efficiency; Section IV analyzes these metrics across a sample of passively managed funds; Section V addresses shortcomings and considerations surrounding these new measures of style efficiency; and Section VI concludes.

2 Existing Measures of Efficiency

The two most prominent measures of a strategy's efficiency are the Information Ratio and the Sharpe Ratio (henceforth IR and SR). Both measures can be calculated using either the realized returns of a strategy or the expected dynamics of a strategy. Setting $\overline{f}$ equal to the fund's realized average return and $\overline{b}$ that of the benchmark the IR is computed as:

$$IR = \frac{\overline{f} - \overline{b}}{\sigma_{(f-b)}}$$

In words the IR is the average return of a fund in excess of the benchmark's average return divided by the volatility of the fund's returns less the benchmark's returns. The term in the numerator is frequently referred to as "alpha" while the term in the denominator is frequently referred to as "tracking error." Alternatively, IR can be computed as:

$$IR = \frac{\alpha_f}{\sigma_\epsilon}$$

Here α_f and σ_ϵ are the output of a regression analysis of the fund's returns less the risk-free rate on a constant and the returns of a benchmark less the risk-free rate (or the returns of various factors). Specifically, α_f is the intercept from the regression while σ_ϵ is the standard error of the regression.

Both methods for calculating the IR measure the returns a strategy has achieved relative to a benchmark and divide that calculation by the volatility of that skill. So, a larger IR is clearly preferred. The IR can be interpreted as the amount of excess return, or alpha, for every unit of volatility of alpha.

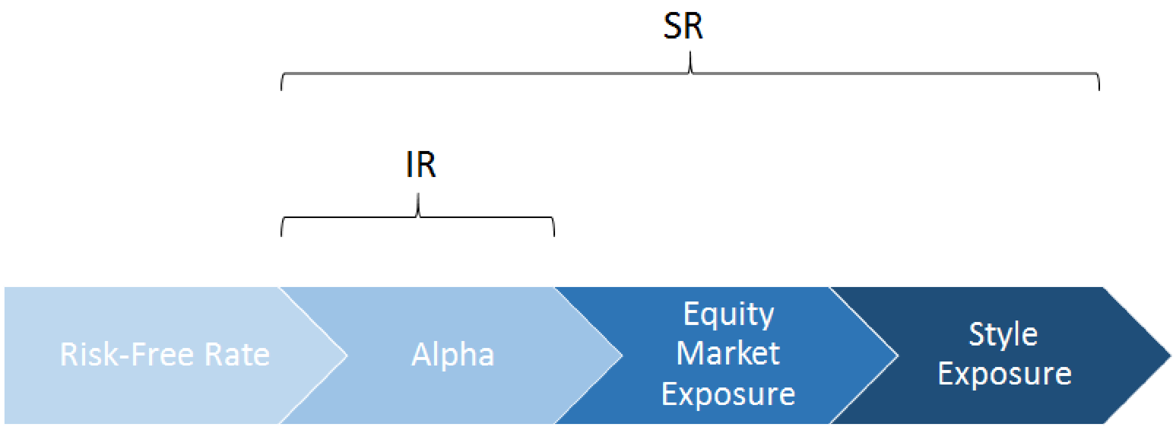
SR is computed as follows where $\overline{rf}$ represents the average return of the risk-free rate:

$$SR = \frac{\overline{f} - \overline{rf}}{\sigma_{(f-rf)}}$$

This measure divides the average return of a fund in excess of the average return of the risk-free rate by the volatility of the returns of the fund in excess of the risk-free rate. The SR can be interpreted as the amount of return of the fund above the risk-free rate for every unit of volatility of the returns of the strategy above the risk-free rate.

If we think of stock returns as being composed of four parts — the return of the risk-free rate, alpha, equity market exposure and style exposure — Figure 1 illustrates the four sources of return and the sources covered by the IR and SR where the IR calculation is done using the output of a regression that attempts to adjust for various style exposures.

Figure 1: Sources of Return, IR and SR



As Figure 1 shows neither the IR nor the SR purely measure the returns associated with style exposures. The IR, in fact, does not measure style exposure at all. SR, on the other hand, does not purely measure style exposure because its measurement is polluted by the simultaneous measurement of alpha and general equity market exposure. Therefore, to exclusively measure the efficiency of systematic sources of return like styles (or synonymously factors) new measures are needed.

3 Measuring Style Efficiency

Like the second version of the IR noted above the style efficiency measures presented below rely on the output of a regression model. The first step associated with each measure is the selection of a factor model. The point of this piece is not to argue what model is best, but nevertheless model selection and the identification of the factors associated with each model will drive the results associated with style efficiency measures. For explanation of the measures that follow I will use a generic four-factor equity model. A representation of a four-factor model is:

$$R_{it} - rf_t = \alpha + \beta_1 R_{1t} + \beta_2 R_{2t} + \beta_3 R_{3t} + \beta_4 R_{4t} + \epsilon_t \tag{1}$$

3.1 Total Style Return (TSR)

Total Style Return (TSR) sums the products of each of the estimated style betas and the corresponding average premia. Note that these average premia could be in expectation, over the entire history of the premia or the average premia over the time period the regression covers.

However, the style betas will almost certainly be the estimates taken from a historical regression analysis. In the context of our generic four-factor model, TSR is calculated as follows:

$$TSR = \sum_{i=2}^{4} \beta_i \overline{R_i} \tag{2}$$

If the average premia used in the calculation of TSR are the expected premia, TSR gives an estimate of the expected style return of the strategy before accounting for expenses or trading costs.[1] In this context, TSR will generally be positive for strategies that have positive exposures to one or more style premia and will generally be negative for strategies that have negative exposures to one or more style premia. As an example, a TSR of +100 bps would indicate the strategy has an expected style return of +100 bps.

3.2 Cost Efficiency Ratio (CER)

The first measure of style efficiency is the **Cost Efficiency Ratio (CER)**. CER divides TSR by the strategy's expense ratio in excess of the cost of general equity market exposure. The purpose of this measure of expense ratio is to isolate how much of the expense ratio can be thought of as attributable to style exposure. In Grover and Kizer [2016] we labeled this portion of the expense ratio as the "Net Expense Ratio" or NER. So, CER would then be computed as:

$$CER = \frac{TSR}{NER} \tag{3}$$

CER effectively tells an investor how much style return is expected to be earned per bps of net expense ratio. So a CER of 5, for example, would indicate the strategy is expected to provide 5 bps of style return for every bps of NER. Obviously, strategies with higher CERs are preferred to strategies with lower CERs. In practice, investors could use this ratio to determine what strategies are most cost efficiently delivering style exposure and to identify funds with extremely low or negative CERs.

3.3 Tracking Error Efficiency Ratio (TEER)

Many investors and their advisors care deeply about the tracking error associated with a particular style tilt. As a general rule the deeper the style tilt the greater the expected TSR but also the greater the tracking error relative to a market-cap weighted portfolio or a widely followed benchmark like the S&P 500. Therefore, it would be helpful to consolidate both expected style return and tracking error into a single measure. I call this measure the **Tracking Error Efficiency Ratio (TEER)**. It is calculated as:

$$TEER = \frac{TSR}{TE} \tag{4}$$

where TE is calculated as follows:

$$TE = \sqrt{\beta^T V \beta + \sigma_\epsilon^2} \tag{5}$$

In this equation β is a column vector of the style betas from the regression equation; V is the covariance matrix of the factor returns associated with each style; and σ_ϵ^2 is the variance of the

[1] Note, however, that the calculation could easily be extended to subtract estimates of expenses and trading costs.

error term in the regression.[2] Note that the covariance matrix could either be a historical covariance matrix or an expected covariance matrix. Funds with relatively low TEER values may not efficiently deliver style exposure while funds with relatively high TEER values can be expected to efficiently deliver style exposure in the context of tracking error.

4 Analyzing and Interpreting TSR, CER and TEER

4.1 Data

The starting universe includes mutual funds and ETFs from Blackrock iShares, Dimensional Fund Advisors (DFA), SPDR State Street Global Advisors and Vanguard that were in the Morningstar Office data set as of June 2017 (this is a similar starting universe as that used in Grover and Kizer [2016]). From that starting list of funds I filter out:

1. Funds with less than 90% of assets allocated to U.S. equities as of the most recently reported portfolio-holdings date.
2. Funds with less than 180 months of returns history ending December 2016.
3. Sector-oriented funds
4. Actively managed funds (which only applies to some Vanguard funds)
5. Multiple share classes, which has the most significant impact on Vanguard funds. For Vanguard funds with multiple share classes I use the Admiral share class when available and otherwise use the Investor share class.

These filters reduce the starting universe to 55 funds with good representation across each of the fund companies and across the dimensions of size of companies held and valuation of companies held.

I obtain research factor returns data for the U.S. versions of MKT, SMB, HML, UMD and the risk-free rate from Ken French's data library. The particular versions of SMB and HML I use are formed from two-by-three sorts on market capitalization and book/price, respectively.

4.2 Analyzing Total Style Return (TSR)

As noted above, TSR is a function of the style betas from a regression analysis of fund returns on a factor model and some assumption about the size of each factor premium. Regressing each fund's monthly returns history on the Carhart four-factor equity model gives the style betas needed to calculate TSR. In addition to these style betas I use the long run (1927–2016) arithmetic annual averages of each premium to complete the TSR calculation.[3] Figure 2 is a histogram of TSR (in bps) across the sample of 55 funds.

[2] As before, one could net expenses and trading costs out of TSR to come up with a modified version of the TEER calculation.

[3] Note that in a perfect world one would use style betas from a regression of annual fund returns on annual return premia since average annual premia are used to complete the TSR calculation. This is generally not possible since the use of annual fund returns would greatly reduce the sample size of the returns history in most applications.

Figure 2: Histogram of Total Style Return (TSR) Across Funds

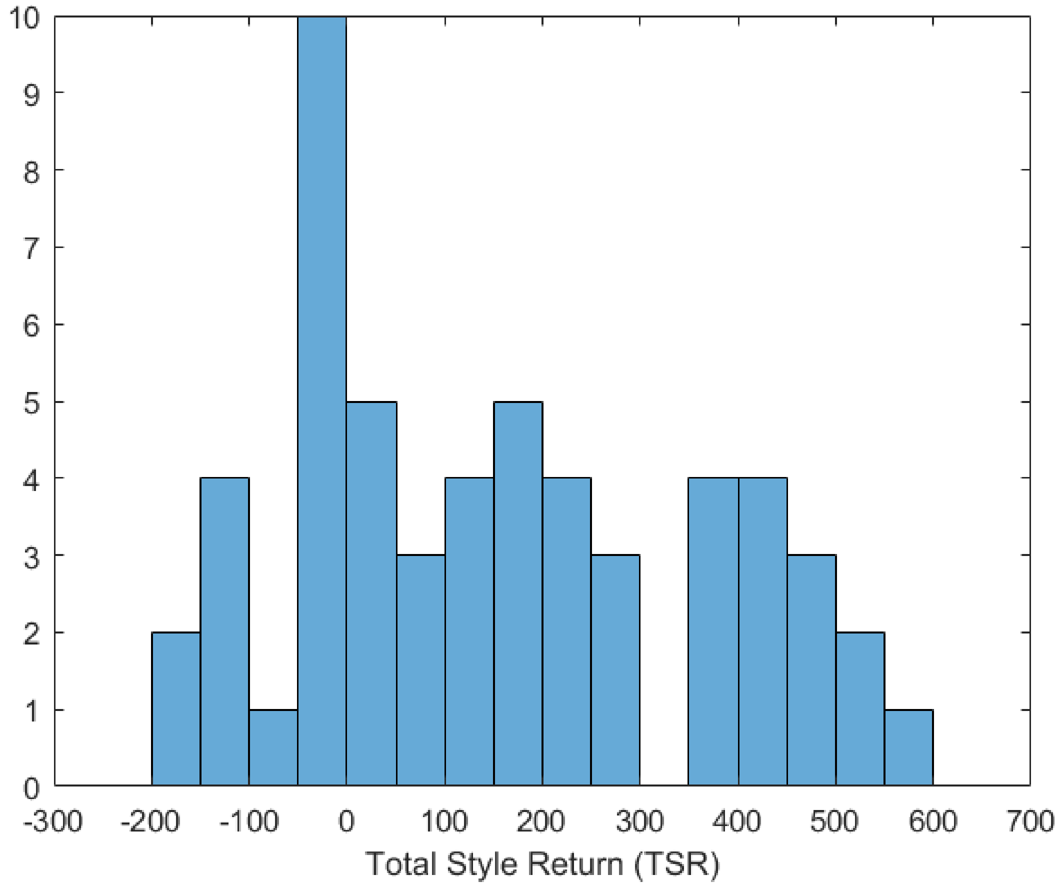


Figure 2 shows that TSR varies from about −200 bps to 600 bps. The funds with negative TSRs will tend to be funds that are tilted toward larger company stocks and/or growth-oriented companies while the funds with positive TSRs will tend to be funds that are tilted toward smaller company stocks and/or value-oriented companies. As I will discuss further in section V, applying different assumptions for the premia will result in radically different TSRs. For example if we instead use return premia that are half of the long-run averages we get the following histogram.

Figure 3: Histogram of TSR Across Funds (Reduced Premia)

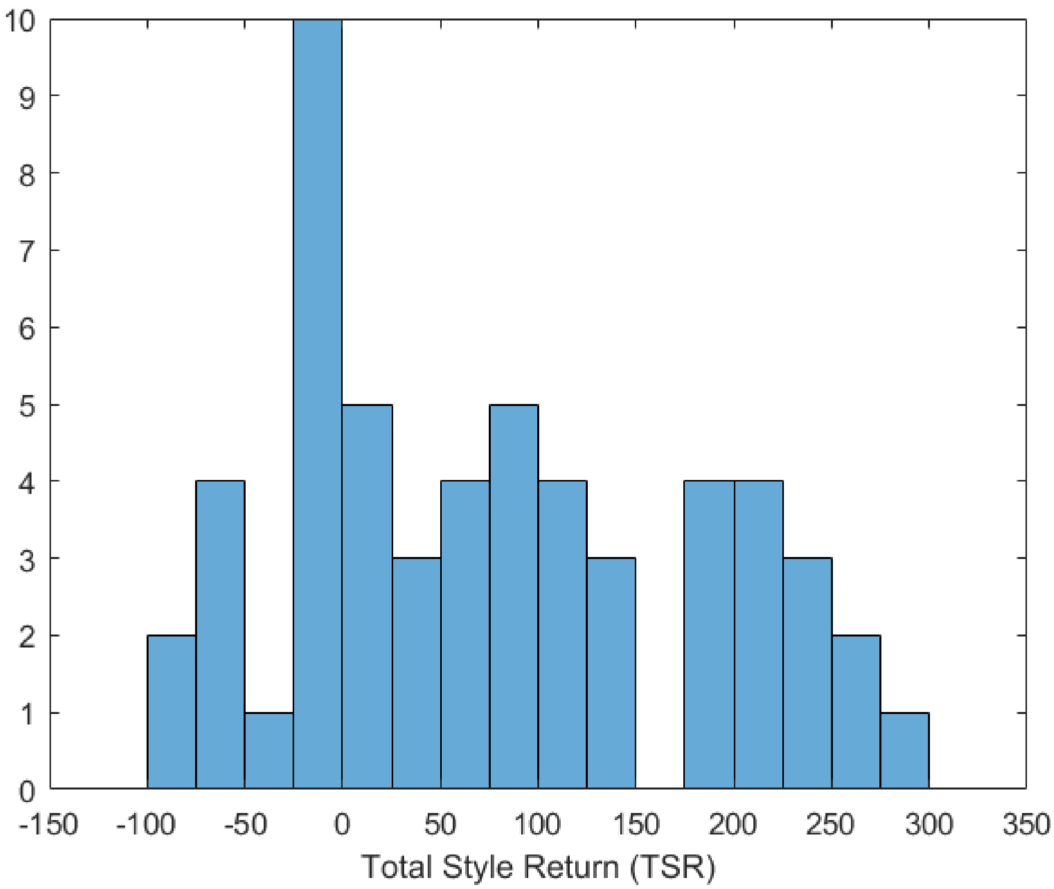
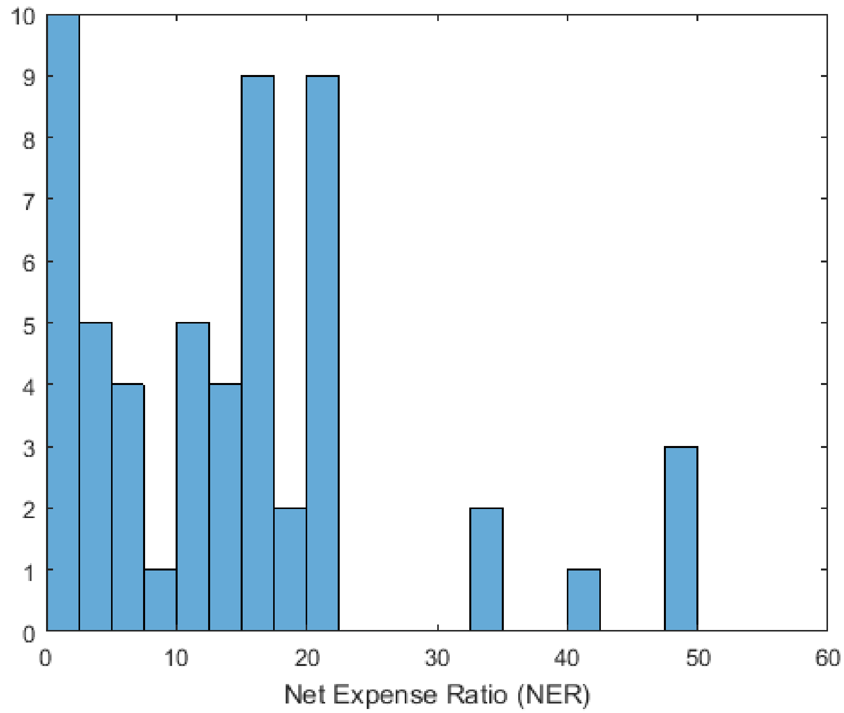


Figure 3 shows a more compressed TSR distribution and one could potentially argue a more reasonable expectation for the TSR distribution across passively managed funds since the forward-looking premia associated with size, value and momentum may be smaller than they have been over the long-run past since all three premia are well known to the marketplace.

4.3 Analyzing the Cost Efficiency Ratio (CER)

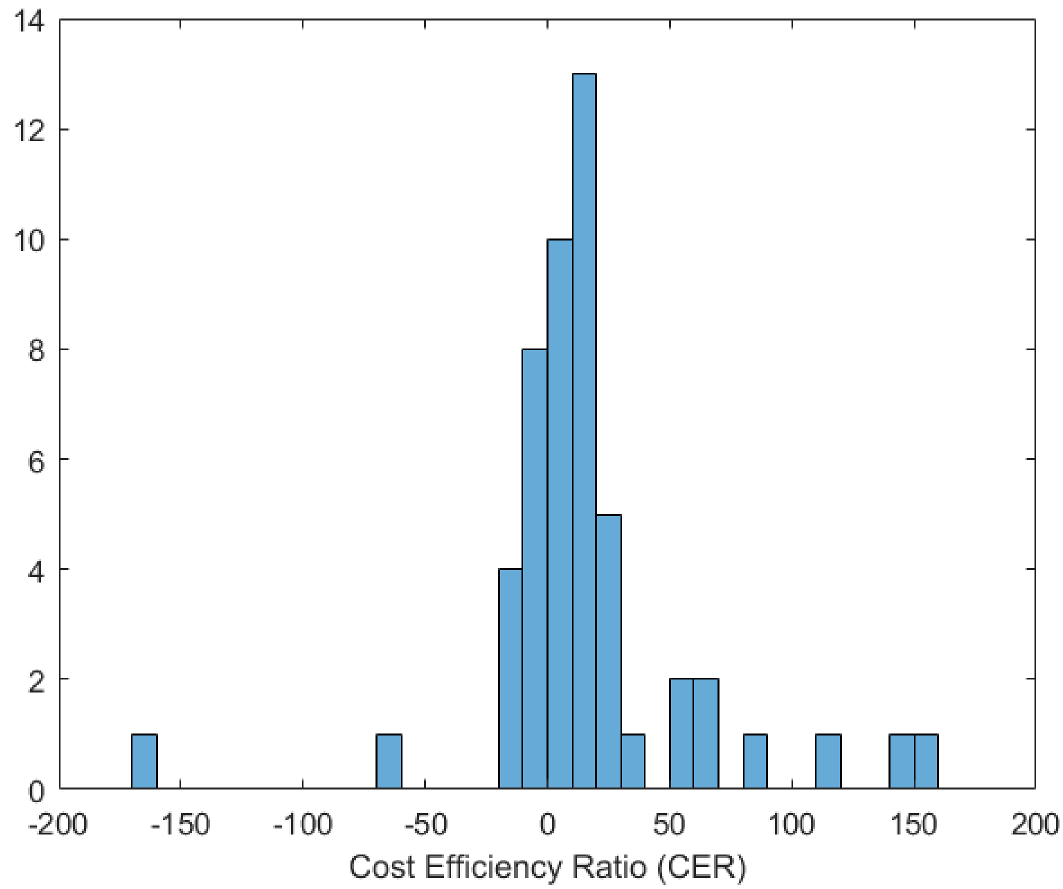
Before analyzing CER itself, it's worth examining the NERs of the underlying funds since for NERs close to zero CER will approach $+\infty$ or $-\infty$, dramatically altering the shape of the CER distribution. Figure 4 is a histogram of the underlying NERs.

Figure 4: Net Expense Ratio (NER) Across Funds



NER is bounded by zero so we see that NERs range from zero bps to almost 50 bps but are clustered in the range of zero to 20 bps. Funds with NERs close to zero typically have minimal exposure to all three styles but that is not always the case. For CER, I exclude the four funds that had NERs of zero, leaving a sample of 51 funds for the CER computation. Figure 5 is a histogram of the CER of these 51 funds.

Figure 5: Cost Efficiency Ratio (CER) Across Funds



Keeping in mind that the CER expresses the TSR per bps of NER, a strict application of the calculation would call for avoiding funds with negative CERs. The histogram shows that there are indeed a number of these funds. A negative CER means the investor is paying an expense ratio above that required for general equity market exposure *but* is invested in a fund that has a negative expected style return in the context of the Carhart four-factor equity model and an assumption that the expected size, value and momentum premia will continue to be positive.

Looking at the funds with positive CERs, we see there are a number of funds that are very cost efficient relative to the style exposures they provide. For example, there are eight funds with a CER of 50 or higher indicating these funds can be expected to provide 50 bps of style return per bps of NER[4].

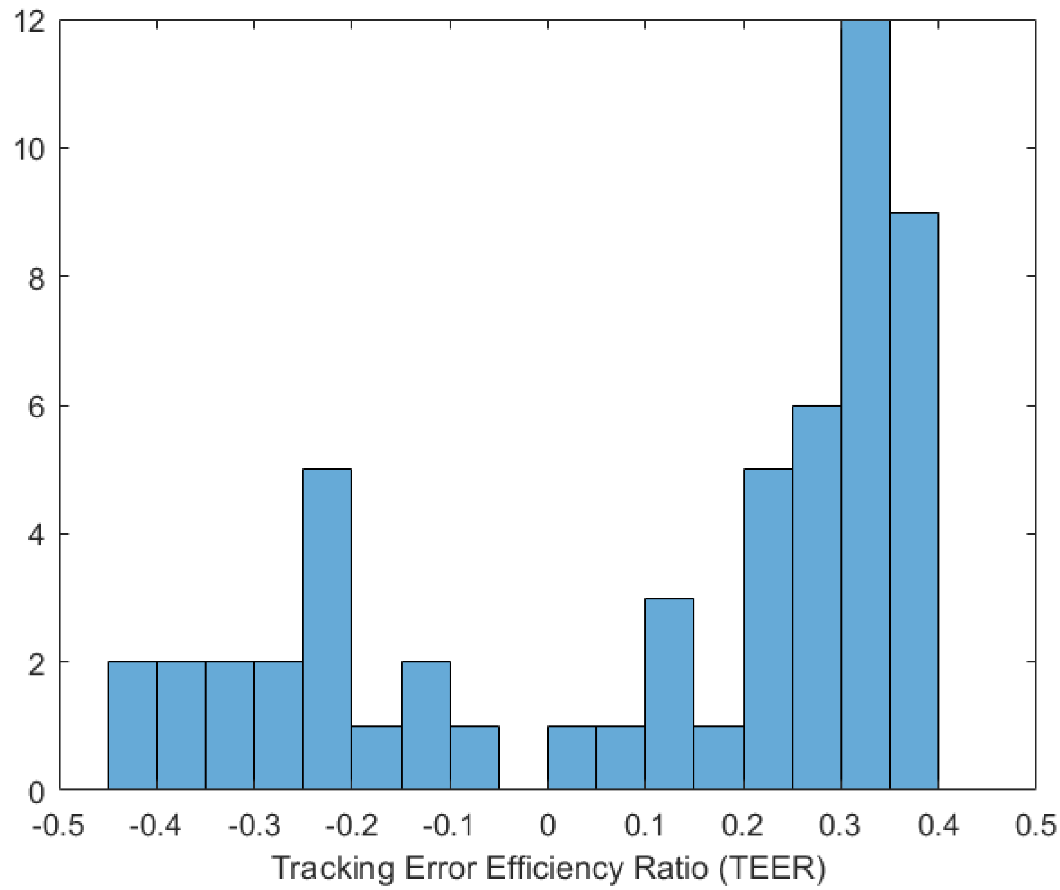
4.4 Analyzing the Tracking Error Efficiency Ratio (TEER)

Due to the way TEER is formulated, it can be interpreted as a Sharpe Ratio like measure but one that is zeroed in on the style component of a fund's return as opposed to the excess return over the risk-free rate, which as noted above is effectively an amalgamation of three different sources of return

[4]Keep in mind this embeds an assumption that we have the correct measures of the style betas for each fund and that the long-run average annual premia are reasonable indicators of size of the the forward-looking premia

(alpha, market return and style return). In my calculations of TEER I use the TSR data calculated earlier in the numerator and the denominator is calculated using the long run (1927–2016) annual covariances across the SMB, HML and UMD factors. Figure 6 displays a histogram of TEER across the full sample of 55 funds.

Figure 6: Tracking Error Efficiency Ratio (TEER) Across Funds



The TEER ranges from about -0.40 to $+0.40$. In bps, this means that there are funds that can be expected to provide about -40 bps of annual style return per 100 bps of annual tracking error and, on the other end of the spectrum, funds that can be expected to provide about $+40$ bps of annual style return per 100 bps of annual tracking error. It's also notable that there is a fairly wide spread of TEER with significant clustering on the right-hand side of the distribution.

As with the CER, a practical application of TEER would be a deeper examination of the funds with negative TEER since the interpretation would be that these funds are generally expected to underperform the market even though they have tracking error with respect to the market. Another practical application would be potentially using funds with highly positive TEER as part of an overall approach of implementing style exposure as efficiently as possible.

5 Limitations and Other Considerations

There are a number of considerations to understand with CER and TEER as with any ratio that is trying to simplify interpretation of financial market returns. In this section, I cover some of these considerations.

5.1 Caution When Using Short-Term Factor Returns to Form TSR

If TSR is formed using factor returns covering relatively short periods of time (e.g., 10 years or less) these realized factor returns may be of the opposite sign of the long-run realized factor returns. For example, if TSR was formed using five years of data when value performed poorly relative to growth, the value premium embedded in the TSR calculation would be negative while the long-run value premium has been positive. This could cause the sign of the CER and TEER calculations to be the opposite of what is expected. Therefore, there is a good general argument for using long-run historical data or forward-looking expectations for the factor premia input into the TSR calculation.

5.2 Instability of Style Betas

Since TSR is part of the CER and TEER calculations, this means that the style betas from the historical regressions are effectively an important input into CER and TEER. As with any regression these style betas will be measured imprecisely. Therefore, TSR is estimated imprecisely. This concern, however, is somewhat mitigated by the analysis presented here which focuses on passively managed funds. In general the style betas of passively managed funds will be measured more precisely and be more stable over time compared to the style betas associated with actively managed funds.

5.3 Incorporating Expenses into TEER

An argument can be made for trying to incorporate a measure of costs in the TSR calculation used in the numerator of TEER. For example, one could calculate TSR as above but subtract the fund's NER and some estimate of annual transactions costs to come up with a "net TSR." This version of TSR would likely be more indicative of long-run realized fund returns relative to broad market benchmarks than measures of TSR that do not incorporate expenses.

Yet another approach would be to add the alpha from the factor model regression to TSR. The challenge with this approach is that alpha is typically statistically insignificant and may well be positive over the horizon of the regression. In this case this would increase TSR even though there may not be a good basis for assuming the fund will continue to generate positive alpha.

5.4 Should Premia be Reduced?

Figure 3 displayed a histogram of TSR with the long run average annual returns for SMB, HML and UMD all cut in half. Is this a reasonable assumption or should a different percentage discount be used? Or perhaps no discount should be applied? These questions are impossible to answer with any precision but there does seem to be a good argument for using premia that are less than their long run values if for no reason other than biasing the statistics toward conservatism/reality in light of research that suggests data mining is a problem with some portions of the factor literature and that premia appear to be smaller post academic discovery compared to prior to discovery (McLean [2016]).

5.5 Which Factor Model?

The choice of factor model will impact both the CER and TEER values so significant thought should be put into this decision. Also, while this paper has focused on CER and TEER with respect to U.S. equity funds, both calculations could be applied to international equities, emerging market equities and fixed income as long as a reasonable factor model can be selected.

The importance of the selected factor model can be related through an example from the U.S. equity fund market. If the Carhart four-factor model is selected, most traditionally the value factor (i.e., HML) is then the research series from Ken's French data library. For this series, stocks are sorted into value versus growth using the price/book ratio. If a particular fund implements a value strategy but instead uses price/cash flow to select stocks its HML style beta may be muted due to the imperfect correlation between price/cash flow and price/book even though the fund is truly implementing a value strategy. The same analogy could be applied to other factors within the model like momentum (UMD).

6 Conclusion

This paper introduces two new measures of style efficiency: the Cost Efficiency Ratio (CER) and the Tracking Error Efficiency Ratio (TEER). CER measures expected style return per bps of Net Expense Ratio (NER). TEER measures expected style return per bps of tracking error risk. Both measures should help investors and their advisors better understand the landscape of factor-based investment strategies and possibly reveal interesting findings within the universe of actively managed funds as well.

Within the sample of funds analyzed I find that CER ranges from -169 to $+158$ indicating there are funds that are providing negative expected style return even though they are more costly than funds that provide no style exposure (e.g., Vanguard's Total Stock Market fund). It also shows, however, that there are many funds that can be expected to deliver positive style exposure at reasonable cost.

For TEER, the range of values was -0.41 to $+0.38$. The minimum value, for example, indicates that particular fund is expected to provide -0.41 bps of style return per bps of tracking error (or identically -41 bps of style return per 100 bps of tracking error). As with CER, investors may want to considering eliminating funds with negative TEER from consideration.

For both metrics, investors and their advisors should keep in mind what drives the output. In particular, both calculations rely on the style betas estimated by a regression model and an assumption about the size of the associated factor premia.

References

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