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Research Paper

Slugging Percentage

A New Metric for Evaluating Manager Performance

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Key Observations

- *Tracking Error is a flawed metric. Its role as the denominator in Information Ratio inhibits Information Ratio's capacity to retroactively assess the success of a strategy.*
- *A productive and helpful way to discern differences in anticipated performance patterns is to disaggregate a strategy's performance into periods when it outperforms its benchmark and periods when it underperforms.*
- *When disaggregating a strategy's performance into periods of outperformance and underperformance, investors should focus on the relative magnitude of excess returns in each environment and the frequency with which a strategy outperforms its benchmark.*

Myriad metrics exist to evaluate the historical performance of an actively managed investment strategy. Many of these metrics are risk-adjusted and provide unique insights into a strategy's past performance. Since no metric is perfect, each of these retrospective measures has its own strengths and weaknesses. Some of the widely adopted performance metrics that we use include:

- Sharpe Ratio
- Jensen's Alpha ("Alpha")
- Information Ratio

The Sharpe Ratio

The Sharpe Ratio measures the excess return a strategy generates over the risk-free rate per unit of standard deviation, a commonly used proxy for the total risk of an investment. What makes the Sharpe Ratio effective is the ease with which it facilitates comparisons between investments with different risk profiles by scaling a strategy's excess return over the risk-free rate by the amount of risk taken by the strategy. The primary drawback of the Sharpe

Ratio is that the risk-free rate is not a relevant benchmark for most actively managed strategies; instead, investors are mostly concerned with whether an actively managed strategy generates a return greater than its relevant benchmark. If a strategy fails in that endeavor, many would consider it to have failed its primary objective even if it generated a strong Sharpe Ratio.

Additionally, the Sharpe Ratio fails to distinguish between risk drivers. For example, a strategy could be penalized for having a high standard deviation even if it is driven by a few periods of strong outperformance. To partially remedy this issue, the Sortino Ratio scales excess return over the risk-free rate by downside deviation, which measures the standard deviation of returns in periods when the strategy's return is negative or fails to meet a predefined threshold. Unfortunately, this adjustment has the same conditional volatility flaw that we address later in our discussion of Information Ratio. Furthermore, in regard to the Sortino Ratio, a manager can still generate outperformance in periods when its return is negative (or fails to meet the predetermined threshold).

Jensen's Alpha ("Alpha")

Another common metric is Jensen's Alpha, which measures the excess return a strategy generated after adjusting for the amount of systematic risk taken by the strategy. This metric is most commonly based on a strategy's Beta to its benchmark. While Alpha can be calculated using any asset-pricing model, the most commonly used methodology is the Capital Asset Pricing Model ("CAPM"). The CAPM states that a manager's expected return equals the risk-free rate plus the beta of the security multiplied by the equity market risk premium, which is equal to the market's return over the risk-free rate. The remainder after the adjustment is Alpha, which equals the difference between the strategy's actual return and its expected return. If a strategy generates positive Alpha, it means that it generated a positive excess return after adjusting for systematic risk. While this metric is widely used, we question whether Beta and the market risk premium are the best measures of systematic risk and the price of risk, respectively. In addition, Alpha fails to account for its own variability and says nothing about a strategy's ability to consistently generate Alpha, making it difficult to determine if the positive result was due to luck or skill.

The Information Ratio

Of all the widely accepted performance evaluation metrics, Information Ratio is the closest to an optimal metric in our view. Information Ratio assesses how consistently a strategy generates excess return, or Alpha depending on the version used. Information Ratio is equal to a strategy's active return, which equals the strategy's excess return relative to the appropriate benchmark, divided by the strategy's active risk, or tracking error. Tracking error equals the standard deviation of the strategy's excess returns, thereby framing risk as deviation from the benchmark.

Therefore, Information Ratio highlights how much active return a strategy generates per unit of active risk compared to the benchmark. Higher tracking error means the strategy's active returns exhibit higher variability; Information Ratio penalizes for this higher variability. However, should higher active returns result from this variability,

Information Ratio would be positively impacted. Information Ratio assesses a strategy's ability to consistently produce positive excess returns, a key objective of any active manager.

However, a major disadvantage of Information Ratio as a performance metric is its use of tracking error in the denominator. Tracking error neglects to differentiate between the drivers of active risk. For example, a strategy can have high tracking error driven by large negative active returns when it underperforms. Conversely, the magnitude of a strategy's active returns may be small when they are negative, but the strategy still may have high tracking error if it generates large active returns when it outperforms its benchmark. Even though we view such a performance pattern positively, Information Ratio would penalize such a strategy, all else equal. These drawbacks have led our research team to question whether we could disaggregate tracking error into "good" and "bad" tracking errors, thus constructing a metric that rewards "good" tracking error while penalizing "bad" tracking error.

The problem with trying to disaggregate volatility into periods of outperformance and underperformance is that it is impossible to know if high or low volatility is good without knowing the magnitude of the excess return in a given environment. For instance, if on average, when a strategy outperforms, it generates 10 percentage points of excess return per month, an investor should want no volatility in periods of outperformance, since most investors would gladly take 10 percentage points of excess return every month. However, if on average, when a strategy outperforms, it only generates 0.01 percentage points of excess return per month, an investor should want higher volatility in periods where the strategy outperforms, as one basis point of excess return is de minimus and an active investor would seek more in return for bearing active risk.

The opposite holds true in periods of underperformance as well. If on average when a strategy underperforms, it underperforms by an extremely small amount, an investor should want their active returns in periods of underperformance to exhibit low volatility.

This example highlights the difficulty of blindly assessing conditional volatility. It is necessary to know the magnitude of the strategy's performance in each conditioned state – both periods of outperformance and periods of underperformance.

Introducing Slugging Percentage

To address the primary weakness of Information Ratio caused by tracking error's inclusion in its calculation, we developed a new metric called "Slugging Percentage." In our view, a metric that focuses on the characteristics of excess return best addresses the shortcomings of tracking error. We believe that instead of trying to disaggregate volatility during "good" and "bad" periods, it would be more relevant to disaggregate a strategy's performance into periods of outperformance and underperformance relative to its benchmark.

Thus, we have created the metric "Slugging Percentage," which aims to assess differences in a strategy's return profile depending on the direction of relative performance. Slugging Percentage is calculated as follows:

$$\textbf{Slugging Percentage}_t = \left(\overline{ERt^O} \;/\; \left|\overline{ERt^U}\right|\right) * \textbf{BA}_t$$

Where:

$\left|\overline{ER_t^O}\right|$ = *Average monthly excess return when the strategy outperforms*

$\left|\overline{ER_t^U}\right|$ = *Absolute value of the average monthly excess return when the strategy underperforms*

BA_t = *Batting average = Percentage of months the strategy outperforms the benchmark*

Ultimately, we decided there are two important factors when disaggregating a strategy's performance into periods where the strategy outperforms and periods where the strategy underperforms.

1. The relative magnitude of excess returns when the strategy outperforms compared to when it underperforms. We call the first component of the equation the "Relative Magnitude Ratio", which equals the average monthly excess return in periods of outperformance divided by the absolute value of the average monthly excess return in periods of underperformance.
2. The frequency with which the strategy outperforms. If a strategy generates a greater Relative Magnitude Ratio, it can outperform less frequently than its peers, all else equal. This logic provides the key philosophical underpinnings for Slugging Percentage.

After formulating the idea of Slugging Percentage, we sought to test the new metric. Slugging Percentage is not intended to be used to predict future performance but rather as an additional metric to evaluate a strategy's performance on an ex post basis. Mostly, Slugging Percentage should align well with existing metrics; in addition, it should provide some unique insight into a strategy's performance. In other words, evaluating Slugging Percentage relative to other widely accepted performance metrics would help illustrate its efficacy.

We decided to test Slugging Percentage separately within each asset class, evaluating three broad metrics to determine if Slugging Percentage aligned with existing performance metrics:

1. We determined the percentage overlap of top quartile strategies in each asset class based on Slugging Percentage as well as several different metrics, since many agree on the premise that inclusion in the top quartile of peers is a successful outcome.
2. We included the cross-sectional correlations between trailing five-year Slugging Percentage and each of the return and performance metrics we included in our analysis. Broadly speaking, we expected Slugging

Percentage to be highly correlated with Information Ratio but we also felt it should have a relatively high correlation to Alpha and Sharpe Ratio.

3. We percentile ranked the strategies based on each of the metrics and calculated the cross-sectional correlations between the Slugging Percentage percentile rankings and the percentile rankings based on each of the other metrics in each asset class.

Results

The summary statistics shown in the exhibits below for each asset class are calculated for rolling five-year periods on a quarterly basis between June 2000 and May 2020, with the first rolling five-year period ending May 2005; the summary statistics are calculated across the entire time series. For example, the average top quartile overlap for a given asset class between Slugging Percentage and another performance metric takes the average across the entire time series, as the top quartile overlap changed across the various time periods. Also significant is the sample size within each asset class – it changes over time as new strategies achieve long-enough track records to be included in the data and other strategies cease to exist for one reason or another. Historically, the sample size across all asset classes tends to increase over time.

Exhibit 1 illustrates the top quartile overlap between Slugging Percentage and several other common performance metrics.

Exhibit 1

Summary Statistics for Top Quartile Overlap Between Slugging Percentage and Various Performance Metrics

	Excess Return					Alpha					Sharpe Ratio					Information Ratio				
Asset Class	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**
Core Fixed	67.6%	66.7%	40.5%	89.2%	12.7%	57.1%	53.8%	33.3%	91.9%	14.7%	62.7%	61.4%	35.3%	91.9%	11.7%	76.6%	77.5%	54.8%	91.9%	8.5%
Emerging Markets Equity	79.8%	80.0%	60.0%	100.0%	8.9%	75.4%	78.3%	30.0%	92.3%	12.2%	76.2%	78.9%	40.0%	92.3%	10.9%	79.4%	80.0%	61.1%	100.0%	7.8%
High Yield Bond	74.9%	75.0%	56.5%	96.0%	10.7%	64.9%	66.7%	24.0%	88.6%	14.6%	63.3%	67.6%	24.0%	88.6%	14.6%	79.4%	81.3%	62.5%	100.0%	8.7%
High Yield Munis	79.8%	83.3%	50.0%	100.0%	13.6%	70.9%	75.0%	14.3%	100.0%	21.0%	64.6%	66.7%	14.3%	100.0%	21.0%	82.3%	83.3%	50.0%	100.0%	12.2%
Intl Developed Core - ACWI	82.3%	83.3%	64.0%	100.0%	7.4%	80.4%	80.8%	64.7%	94.4%	7.8%	80.1%	80.0%	64.7%	94.4%	7.1%	83.1%	82.4%	64.0%	94.4%	7.2%
Intl Developed Core - EAFE	78.6%	78.6%	60.0%	94.1%	7.6%	77.3%	76.9%	63.2%	94.1%	7.4%	77.2%	76.9%	63.2%	94.1%	7.1%	79.4%	80.0%	60.0%	94.1%	7.3%
Intl Developed Growth - ACWI	77.9%	78.9%	43.8%	100.0%	11.8%	72.0%	77.8%	43.8%	94.7%	13.8%	73.1%	77.8%	40.0%	100.0%	13.9%	78.5%	78.9%	52.9%	100.0%	10.5%
Intl Developed Growth - EAFE	80.2%	80.0%	62.5%	100.0%	8.1%	74.8%	75.0%	50.0%	90.0%	9.6%	77.2%	76.9%	50.0%	100.0%	10.6%	81.0%	80.0%	60.0%	100.0%	8.5%
Intl Developed Value - ACWI	76.2%	73.3%	53.8%	100.0%	12.9%	71.7%	71.4%	46.2%	100.0%	12.1%	71.7%	70.0%	46.2%	100.0%	11.2%	77.0%	77.8%	50.0%	100.0%	13.1%
Intl Developed Value - EAFE	74.2%	73.3%	44.4%	100.0%	13.0%	71.8%	69.2%	45.5%	100.0%	12.1%	71.7%	70.0%	44.4%	100.0%	11.8%	73.6%	73.3%	44.4%	100.0%	14.2%
Investment Grade Munis	67.0%	70.0%	37.5%	84.6%	11.5%	63.9%	64.3%	40.0%	85.7%	12.3%	64.2%	64.3%	42.9%	85.7%	11.2%	72.1%	71.4%	53.3%	92.3%	7.9%
Large Cap Core	77.0%	76.5%	67.2%	92.2%	5.2%	69.2%	72.1%	47.1%	83.7%	9.8%	70.5%	73.8%	45.1%	85.4%	9.5%	80.4%	80.4%	69.7%	90.6%	4.9%
Large Cap Growth	77.0%	77.9%	60.9%	89.1%	7.3%	71.0%	70.1%	50.0%	87.3%	9.0%	71.4%	69.6%	55.7%	89.1%	9.2%	80.2%	81.0%	68.3%	90.1%	5.3%
Large Cap Value	79.7%	80.6%	65.2%	94.6%	5.9%	66.7%	66.7%	34.0%	90.3%	14.0%	68.8%	71.1%	34.0%	90.3%	13.5%	81.4%	82.2%	71.9%	94.6%	4.3%
Mid Cap Core	81.8%	80.0%	66.7%	100.0%	8.5%	70.8%	76.9%	37.5%	93.3%	14.9%	72.5%	75.0%	37.5%	93.3%	13.3%	83.9%	83.3%	69.2%	100.0%	8.3%
Mid Cap Growth	80.3%	81.3%	65.2%	93.8%	5.8%	74.8%	76.7%	48.1%	89.7%	8.6%	73.4%	73.9%	51.9%	89.7%	9.2%	81.9%	82.6%	65.4%	90.5%	5.6%
Mid Cap Value	81.9%	81.8%	57.9%	100.0%	8.3%	68.4%	73.3%	18.8%	93.3%	17.4%	67.6%	68.8%	25.0%	100.0%	17.0%	83.2%	83.3%	64.3%	100.0%	7.6%
Small Cap Core	78.3%	77.8%	58.1%	95.0%	7.3%	69.1%	73.7%	41.9%	92.3%	13.5%	68.5%	73.7%	39.3%	91.9%	13.7%	80.1%	80.0%	64.5%	92.9%	5.9%
Small Cap Growth	76.6%	76.7%	56.0%	87.1%	6.2%	71.7%	71.4%	40.0%	86.2%	8.0%	70.4%	71.0%	40.0%	91.7%	8.8%	77.2%	77.8%	60.0%	90.9%	6.5%
Small Cap Value	77.4%	78.3%	61.1%	92.9%	6.9%	67.2%	68.8%	35.0%	83.3%	11.4%	69.6%	73.3%	35.0%	88.2%	13.3%	79.5%	81.0%	60.0%	90.0%	6.7%

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

As the table shows, the overlap in top quartile strategies based on Slugging Percentage and each of the performance metrics shown is significant, suggesting Slugging Percentage provides relevant information. However, the overlap was not perfect; this implies that Slugging Percentage provides some unique information about a strategy's performance. In terms of the overlap in top quartile strategies, it appears to be highest with Information Ratio by a slight margin, followed by excess return. Additionally, the standard deviation of the overlap in top quartile strategies across the time series is lowest for Information Ratio and excess return. In other words, the percentage of top quartile

strategy overlap between Slugging Percentage and other performance metrics exhibited the least variability with Information Ratio and excess return.

We were highly encouraged by the significant overlap and the consistency of the overlap with Information Ratio, a metric we view favorably. We also viewed this extremely positively because Slugging Percentage was created to adjust for some of the flaws of Information Ratio but still should be highly correlated the metric. The data supports this conjecture.

A few aspects of the data stood out from our analysis. Across all metrics tested, in general the top quartile overlap tended to be larger in equity asset classes relative to fixed income. Additionally, the standard deviation of top quartile overlap for both Information Ratio and excess return tended to be lower for U.S. equity asset classes.

Exhibit 2 displays the cross-sectional correlations between Slugging Percentage and various other metrics.

Exhibit 2

Summary Statistics for Correlations Between Slugging Percentage and Various Performance Metrics

	Excess Return					Alpha					Sharpe Ratio					Information Ratio				
Asset Class	Avg	Median	Min	Max	Std Dev	Avg	Median	Min	Max	Std Dev	Avg	Median	Min	Max	Std Dev	Avg	Median	Min	Max	Std Dev
Core Fixed	0.77	0.78	0.62	0.85	0.05	0.68	0.69	0.51	0.87	0.09	0.70	0.70	0.50	0.88	0.10	0.89	0.90	0.75	0.94	0.04
Emerging Markets Equity	0.83	0.85	0.66	0.92	0.08	0.82	0.84	0.57	0.91	0.08	0.77	0.80	0.57	0.92	0.09	0.92	0.92	0.86	0.96	0.02
High Yield Bond	0.69	0.66	0.51	0.90	0.12	0.67	0.72	0.05	0.90	0.18	0.57	0.62	(0.11)	0.90	0.25	0.91	0.91	0.85	0.97	0.03
High Yield Munis	0.89	0.90	0.74	0.96	0.04	0.72	0.86	(0.37)	0.95	0.29	0.75	0.83	(0.19)	0.97	0.25	0.93	0.94	0.85	0.98	0.04
Intl Developed Core - ACWI	0.88	0.88	0.82	0.95	0.03	0.86	0.87	0.75	0.95	0.05	0.84	0.86	0.67	0.94	0.07	0.92	0.92	0.87	0.97	0.03
Intl Developed Core - EAFE	0.88	0.88	0.82	0.93	0.03	0.85	0.85	0.75	0.94	0.05	0.84	0.86	0.66	0.93	0.06	0.92	0.91	0.89	0.95	0.02
Intl Developed Growth - ACWI	0.87	0.88	0.73	0.93	0.05	0.83	0.85	0.66	0.94	0.07	0.84	0.86	0.61	0.94	0.08	0.92	0.93	0.81	0.98	0.04
Intl Developed Growth - EAFE	0.87	0.88	0.80	0.93	0.04	0.84	0.84	0.72	0.94	0.05	0.86	0.86	0.67	0.95	0.06	0.92	0.93	0.85	0.96	0.03
Intl Developed Value - ACWI	0.84	0.86	0.68	0.93	0.06	0.85	0.85	0.65	0.93	0.06	0.75	0.80	0.41	0.87	0.13	0.92	0.91	0.84	0.98	0.03
Intl Developed Value - EAFE	0.82	0.83	0.72	0.94	0.05	0.82	0.81	0.66	0.95	0.07	0.74	0.77	0.48	0.89	0.10	0.88	0.87	0.75	0.97	0.06
Investment Grade Munis	0.76	0.77	0.56	0.89	0.09	0.69	0.75	0.30	0.90	0.19	0.70	0.76	0.33	0.92	0.19	0.87	0.88	0.76	0.94	0.04
Large Cap Core	0.78	0.79	0.65	0.87	0.05	0.69	0.70	0.48	0.81	0.09	0.73	0.76	0.47	0.87	0.11	0.91	0.92	0.80	0.95	0.03
Large Cap Growth	0.84	0.84	0.77	0.90	0.03	0.77	0.79	0.60	0.90	0.09	0.77	0.79	0.57	0.90	0.10	0.92	0.92	0.90	0.95	0.01
Large Cap Value	0.83	0.84	0.75	0.89	0.04	0.74	0.79	0.43	0.89	0.12	0.75	0.80	0.42	0.90	0.12	0.92	0.93	0.89	0.95	0.02
Mid Cap Core	0.85	0.83	0.79	0.93	0.04	0.76	0.81	0.23	0.92	0.13	0.78	0.83	0.29	0.91	0.12	0.94	0.94	0.90	0.97	0.02
Mid Cap Growth	0.88	0.89	0.82	0.91	0.02	0.83	0.83	0.57	0.92	0.07	0.81	0.81	0.61	0.92	0.09	0.93	0.93	0.91	0.95	0.01
Mid Cap Value	0.84	0.84	0.73	0.92	0.05	0.71	0.75	0.04	0.90	0.18	0.73	0.76	0.18	0.91	0.17	0.93	0.93	0.88	0.95	0.02
Small Cap Core	0.86	0.86	0.79	0.92	0.04	0.80	0.85	0.56	0.91	0.09	0.81	0.83	0.53	0.93	0.09	0.92	0.93	0.88	0.95	0.02
Small Cap Growth	0.85	0.86	0.77	0.92	0.04	0.83	0.86	0.67	0.93	0.06	0.81	0.84	0.64	0.90	0.07	0.92	0.92	0.87	0.95	0.02
Small Cap Value	0.83	0.82	0.71	0.94	0.06	0.76	0.78	0.44	0.90	0.10	0.73	0.77	0.34	0.87	0.13	0.91	0.92	0.86	0.96	0.02

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

The data once again confirms a strong positive relationship between Slugging Percentage and several of the observed metrics, most notably Information Ratio. Across the time series, the correlation with Information Ratio exhibited significantly lower volatility than the correlation with other performance metrics. The average correlation across the time series between Slugging Percentage and Information Ratio was at least 0.87 in every asset class, suggesting a consistently strong, positive relationship.

Furthermore, across all asset classes, the minimum correlation in the time series between Slugging Percentage and Information Ratio was 0.75. The correlations with Alpha and Sharpe Ratio exhibited much greater variation throughout the sample and notably turned negative for at least one period in several spread fixed income asset classes. Moreover, the correlations between Slugging Percentage and Information Ratio exhibited the lowest volatility in U.S. equity asset classes.

Exhibit 3 shows the cross-sectional correlations between the Slugging Percentage percentile rankings and the percentile rankings based on various other metrics.

Exhibit 3

Summary Statistics for Correlations Between Slugging Percentage Percentile Rank and Percentile Rank Based On Various Performance Metrics

	Excess Return					Alpha					Sharpe Ratio					Information Ratio				
Asset Class	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**
Core Fixed	0.85	0.87	0.57	0.93	0.07	0.73	0.73	0.50	0.94	0.12	0.73	0.73	0.48	0.94	0.12	0.91	0.92	0.77	0.96	0.04
Emerging Markets Equity	0.90	0.90	0.79	0.96	0.04	0.86	0.88	0.53	0.95	0.08	0.86	0.87	0.61	0.94	0.06	0.92	0.93	0.87	0.97	0.03
High Yield Bond	0.77	0.73	0.48	0.94	0.11	0.77	0.83	(0.05)	0.93	0.21	0.72	0.78	0.04	0.92	0.21	0.91	0.92	0.78	0.98	0.05
High Yield Munis	0.91	0.94	0.62	0.98	0.07	0.77	0.86	(0.14)	0.98	0.25	0.74	0.77	(0.06)	0.98	0.24	0.93	0.94	0.73	0.99	0.06
Intl Developed Core - ACWI	0.90	0.90	0.82	0.95	0.03	0.89	0.89	0.82	0.96	0.03	0.88	0.88	0.79	0.95	0.04	0.93	0.95	0.84	0.99	0.05
Intl Developed Core - EAFE	0.91	0.91	0.83	0.96	0.03	0.89	0.89	0.80	0.96	0.03	0.89	0.90	0.80	0.95	0.04	0.93	0.92	0.89	0.97	0.02
Intl Developed Growth - ACWI	0.89	0.90	0.67	0.97	0.06	0.85	0.88	0.62	0.96	0.08	0.85	0.87	0.64	0.96	0.08	0.92	0.93	0.71	0.99	0.05
Intl Developed Growth - EAFE	0.90	0.90	0.78	0.97	0.04	0.87	0.88	0.73	0.95	0.05	0.88	0.89	0.74	0.97	0.05	0.92	0.92	0.80	0.98	0.04
Intl Developed Value - ACWI	0.86	0.88	0.70	0.96	0.05	0.84	0.84	0.68	0.97	0.06	0.82	0.84	0.66	0.90	0.06	0.91	0.91	0.76	0.99	0.04
Intl Developed Value - EAFE	0.85	0.86	0.71	0.96	0.06	0.82	0.82	0.66	0.97	0.08	0.82	0.83	0.69	0.93	0.07	0.86	0.87	0.65	0.99	0.08
Investment Grade Munis	0.73	0.75	0.48	0.87	0.11	0.68	0.75	0.25	0.91	0.19	0.68	0.75	0.28	0.92	0.20	0.81	0.82	0.67	0.91	0.06
Large Cap Core	0.88	0.89	0.77	0.94	0.04	0.79	0.81	0.43	0.92	0.12	0.79	0.81	0.43	0.93	0.12	0.94	0.94	0.89	0.97	0.01
Large Cap Growth	0.88	0.89	0.81	0.95	0.03	0.80	0.81	0.64	0.92	0.09	0.79	0.82	0.60	0.91	0.10	0.93	0.93	0.90	0.97	0.02
Large Cap Value	0.89	0.89	0.79	0.94	0.03	0.78	0.83	0.34	0.94	0.14	0.79	0.85	0.37	0.94	0.13	0.94	0.94	0.90	0.97	0.01
Mid Cap Core	0.89	0.90	0.79	0.96	0.03	0.76	0.82	0.27	0.95	0.16	0.77	0.81	0.31	0.94	0.15	0.94	0.94	0.89	0.97	0.02
Mid Cap Growth	0.90	0.91	0.85	0.94	0.03	0.84	0.86	0.55	0.94	0.09	0.82	0.85	0.58	0.94	0.10	0.94	0.94	0.89	0.96	0.02
Mid Cap Value	0.89	0.89	0.78	0.96	0.04	0.72	0.78	0.12	0.93	0.20	0.73	0.78	0.24	0.94	0.18	0.93	0.94	0.86	0.97	0.02
Small Cap Core	0.90	0.90	0.82	0.96	0.03	0.83	0.87	0.54	0.94	0.09	0.83	0.85	0.51	0.95	0.10	0.92	0.93	0.83	0.97	0.03
Small Cap Growth	0.90	0.90	0.84	0.94	0.02	0.87	0.89	0.70	0.93	0.06	0.86	0.89	0.68	0.94	0.07	0.92	0.92	0.87	0.97	0.02
Small Cap Value	0.87	0.88	0.75	0.95	0.05	0.78	0.82	0.28	0.93	0.13	0.77	0.80	0.28	0.92	0.14	0.91	0.92	0.80	0.96	0.03

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

As the table illustrates, the percentile rankings based on Slugging Percentage display a strong positive relationship with the percentile rankings based on various other performance metrics. The correlation between the peer percentile rankings based on Slugging Percentage and other performance metrics was important to compare how Slugging Percentage views all strategies in an asset class relative to other performance metrics.

Information Ratio exhibited the highest percentile ranking correlation with Slugging Percentage while also experiencing the lowest volatility throughout the sample period. The average correlation between the percentile rankings based on Slugging Percentage and Information Ratio throughout the time series was greater than or equal to 0.9 in every asset class except for International Developed Value – EAFE and Investment Grade Municipal Bonds ("Munis").

The next highest percentile ranking correlation, on average, was with excess return while the percentile ranking correlations with Sharpe Ratio and Alpha were slightly lower and exhibited greater volatility. These results are encouraging as they show that Slugging Percentage values strategies similarly to other widely accepted performance metrics across the entire distribution of strategies and not just simply for top quartile strategies. Additionally, while there is a high correlation with all metrics, it is highest with Information Ratio, which we reiterate is desirable.

Slugging Percentage Limitations

While we believe Slugging Percentage provides unique and relevant perspective into a strategy's performance, it also has its drawbacks:

1. The Relative Magnitude Ratio simply uses the arithmetic average of excess returns. For strategies with either a low (or high) batting average, there will be a significantly higher number of periods when the strategy underperforms (or outperforms). This might result in a small subset of periods to evaluate in one of the environments. If we were to use the metric on a forward-looking basis or even just to estimate the "true" way that a strategy performs in a given period, there is much more uncertainty around the environment with a much smaller sample size. As a result, the confidence interval around the magnitude of excess returns in that environment would be much wider.

2. The average magnitude of excess returns is also more likely to be skewed by one or two extreme observations in the environment with a small sample size. In other words, if a strategy only outperforms in three of the 60 months used to calculate trailing five-year Slugging Percentage, the average excess return in periods of outperformance could easily be driven by one month with a very large positive excess return. Future variations of Slugging Percentage may seek to address this issue by incorporating the volatility of the magnitude of excess returns in each environment. Since we specifically sought to avoid the issues associated with conditional volatility, we did not test a variation of Slugging Percentage with this adjustment in our analysis but may do so in the future.

3. Slugging Percentage's use of arithmetic average excess returns rather than geometric average excess returns could be problematic based on the sequence of excess returns in periods of out and underperformance. However, we tested a version of Slugging Percentage using geometric average excess returns and the results were virtually identical.

4. Slugging Percentage is not risk adjusted. The metric simply uses the average magnitude of excess returns in periods of outperformance and underperformance along with the frequency of outperformance.

Conclusion

While Information Ratio attempts to quantify a strategy's value-add to an investor, we view its use of tracking error to be flawed. Instead, we developed Slugging Percentage, which looks at the relative magnitude of excess returns in periods when the strategy outperforms relative to periods when the strategy underperforms and multiplies it by the strategy's batting average, or the frequency with which the strategy outperforms its benchmark.

Slugging Percentage disaggregates a strategy's performance into periods of outperformance and underperformance and looks for differences in risk and return patterns in each environment. Slugging Percentage has its own drawbacks, which we may seek to address in future variations of the metric, but we believe that it provides unique insight into a strategy's performance. We plan to begin using it in our process for assessing a strategy's performance on an ex post basis.

Appendix

Our sample period for testing Slugging Percentage used the last 20 years of monthly returns from June 2000 through May 2020. While we used monthly returns to calculate metrics such as Slugging Percentage, we evaluated the cross-sectional top quartile overlap, correlations, and percentile ranking correlations between Slugging Percentage and other metrics on a quarterly basis to reduce the serial correlation in the data. We looked at metrics on a rolling five-year basis.

Trailing five-year Slugging Percentage at time t is calculated using the last 60 months of returns for a strategy and its benchmark. We looked at rolling five-year periods on a quarterly basis to reduce the serial correlation present in the data when looking at rolling five-year periods on a monthly basis.

Peer groups were constructed based on Morningstar's classifications. Passive funds were eliminated given our focus on active management. To account for strategies with multiple share classes, we used the cheapest share class for each strategy; if the cheapest share class had a much shorter track record, then we used the strategy's oldest share class instead of the cheapest. We used the following benchmarks for each asset class:

Asset Class	Benchmark
Core Fixed	BBgBarc US Agg Bond TR USD
Emerging Markets Equity	MSCI EM NR USD
High Yield Bond	BBgBarc US Corporate High Yield TR USD
High Yield Munis	BBgBarc HY Muni TR USD
Intl Developed Core - ACWI	MSCI ACWI Ex USA NR USD
Intl Developed Core - EAFE	MSCI EAFE NR USD
Intl Developed Growth - ACWI	MSCI ACWI Ex USA Growth NR USD
Intl Developed Growth - EAFE	MSCI EAFE Growth NR USD
Intl Developed Value - ACWI	MSCI ACWI Ex USA Value NR USD
Intl Developed Value - EAFE	MSCI EAFE Value NR USD
Investment Grade Munis	BBgBarc Municipal 5 Yr 4-6 TR USD
Large Cap Core	S&P 500 TR USD
Large Cap Growth	Russell 1000 Growth TR USD
Large Cap Value	Russell 1000 Value TR USD
Mid Cap Core	Russell Mid Cap TR USD
Mid Cap Growth	Russell Mid Cap Growth TR USD
Mid Cap Value	Russell Mid Cap Value TR USD
Small Cap Core	Russell 2000 TR USD
Small Cap Growth	Russell 2000 Growth TR USD
Small Cap Value	Russell 2000 Value TR USD

The additional exhibits below show the cross-sectional top quartile overlap, correlations and percentile rank correlations between Slugging Percentage and various other metrics that we tested.

Exhibit 4

Summary Statistics for Top Quartile Overlap Between Slugging Percentage and Various Performance Metrics

	Batting Average					Relative Magnitude Ratio					Sortino Ratio				
Asset Class	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**
Core Fixed	46.9%	47.8%	16.7%	71.4%	13.1%	72.5%	72.5%	56.7%	92.9%	8.2%	62.5%	60.4%	39.2%	91.9%	10.9%
Emerging Markets Equity	55.2%	54.5%	31.4%	90.0%	13.0%	54.8%	55.6%	28.6%	80.0%	11.4%	77.2%	80.0%	36.4%	92.9%	11.1%
High Yield Bond	48.5%	48.5%	17.4%	77.8%	16.4%	61.5%	61.1%	37.5%	81.8%	9.7%	63.7%	66.7%	20.0%	85.7%	15.2%
High Yield Munis	52.3%	50.0%	16.7%	100.0%	18.3%	54.6%	60.0%	12.5%	100.0%	22.8%	67.1%	70.0%	14.3%	100.0%	21.6%
Intl Developed Core - ACWI	52.5%	50.0%	29.2%	81.3%	13.0%	69.8%	70.0%	52.9%	82.4%	6.5%	81.0%	82.1%	62.5%	94.4%	7.9%
Intl Developed Core - EAFE	49.3%	47.1%	21.1%	72.4%	12.1%	71.1%	72.2%	50.0%	94.7%	11.8%	78.4%	78.6%	63.2%	94.1%	7.6%
Intl Developed Growth - ACWI	47.0%	44.4%	18.8%	85.0%	15.5%	67.9%	68.8%	27.3%	100.0%	13.4%	72.9%	77.8%	41.2%	100.0%	13.8%
Intl Developed Growth - EAFE	54.6%	53.3%	27.3%	88.9%	12.0%	70.4%	71.4%	38.9%	100.0%	13.4%	77.6%	77.8%	50.0%	100.0%	10.7%
Intl Developed Value - ACWI	50.2%	50.0%	22.2%	87.5%	16.0%	64.1%	63.6%	40.0%	87.5%	10.6%	70.9%	70.0%	46.2%	100.0%	11.8%
Intl Developed Value - EAFE	40.4%	38.5%	6.3%	87.5%	19.8%	62.5%	62.5%	33.3%	87.5%	12.0%	71.6%	72.7%	44.4%	100.0%	12.2%
Investment Grade Munis	36.5%	35.7%	14.3%	71.4%	15.3%	60.5%	62.5%	33.3%	80.0%	10.6%	64.4%	64.7%	42.9%	85.7%	11.4%
Large Cap Core	53.4%	52.9%	36.7%	69.8%	7.8%	69.1%	68.9%	55.9%	87.5%	5.9%	70.4%	72.6%	47.2%	85.4%	9.6%
Large Cap Growth	54.8%	54.3%	37.5%	71.7%	8.4%	65.1%	65.2%	52.9%	80.5%	5.8%	70.5%	70.6%	51.5%	89.1%	9.9%
Large Cap Value	53.0%	54.3%	34.0%	71.1%	9.6%	69.8%	72.7%	49.1%	89.1%	9.5%	69.5%	71.1%	36.0%	91.2%	13.8%
Mid Cap Core	57.1%	58.8%	31.3%	90.9%	13.9%	64.0%	62.5%	36.4%	100.0%	11.6%	72.0%	73.7%	37.5%	93.3%	15.1%
Mid Cap Growth	53.7%	53.3%	33.3%	71.4%	7.3%	69.1%	69.2%	50.0%	94.4%	8.9%	72.9%	73.3%	51.6%	88.9%	9.0%
Mid Cap Value	49.6%	47.6%	25.0%	75.0%	12.3%	70.0%	70.0%	46.2%	100.0%	10.2%	69.3%	73.7%	25.0%	100.0%	16.5%
Small Cap Core	51.6%	52.6%	30.4%	70.0%	8.7%	71.3%	72.0%	51.7%	86.7%	7.9%	69.0%	73.7%	42.9%	92.3%	13.5%
Small Cap Growth	50.1%	50.0%	31.0%	71.9%	7.9%	65.8%	68.6%	42.4%	90.9%	11.9%	71.1%	71.4%	46.7%	91.7%	8.2%
Small Cap Value	48.5%	47.8%	26.3%	75.0%	11.1%	67.0%	68.0%	45.0%	86.7%	8.7%	68.6%	72.2%	35.0%	87.5%	13.5%

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

Exhibit 5

Summary Statistics for Correlations Between Slugging Percentage and Various Performance Metrics

	Batting Average					Relative Magnitude Ratio					Sortino Ratio				
Asset Class	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**
Core Fixed	0.53	0.60	0.10	0.73	0.18	0.85	0.85	0.73	0.95	0.05	0.70	0.68	0.54	0.89	0.10
Emerging Markets Equity	0.49	0.47	0.25	0.79	0.14	0.83	0.83	0.73	0.92	0.05	0.79	0.80	0.57	0.92	0.08
High Yield Bond	0.43	0.46	0.02	0.82	0.25	0.79	0.78	0.65	0.93	0.08	0.58	0.66	(0.02)	0.89	0.24
High Yield Munis	0.49	0.54	(0.04)	0.78	0.20	0.66	0.72	(0.15)	0.94	0.27	0.77	0.84	0.06	0.98	0.22
Intl Developed Core - ACWI	0.51	0.48	0.17	0.82	0.18	0.84	0.83	0.76	0.93	0.04	0.84	0.86	0.65	0.93	0.07
Intl Developed Core - EAFE	0.49	0.45	0.21	0.74	0.14	0.85	0.85	0.72	0.95	0.05	0.83	0.85	0.71	0.92	0.06
Intl Developed Growth - ACWI	0.49	0.47	0.21	0.82	0.16	0.85	0.86	0.73	0.93	0.05	0.84	0.87	0.61	0.95	0.08
Intl Developed Growth - EAFE	0.47	0.47	0.20	0.79	0.17	0.86	0.88	0.67	0.94	0.07	0.86	0.86	0.68	0.95	0.06
Intl Developed Value - ACWI	0.54	0.53	0.01	0.82	0.16	0.81	0.82	0.63	0.95	0.07	0.73	0.78	0.15	0.87	0.13
Intl Developed Value - EAFE	0.36	0.32	(0.15)	0.80	0.23	0.82	0.82	0.69	0.96	0.06	0.73	0.77	0.24	0.83	0.09
Investment Grade Munis	0.41	0.45	(0.08)	0.73	0.21	0.80	0.80	0.62	0.92	0.06	0.70	0.78	0.33	0.92	0.20
Large Cap Core	0.55	0.57	0.28	0.70	0.09	0.86	0.86	0.78	0.95	0.03	0.74	0.78	0.54	0.86	0.10
Large Cap Growth	0.53	0.54	0.35	0.70	0.09	0.82	0.83	0.68	0.94	0.06	0.77	0.79	0.53	0.90	0.10
Large Cap Value	0.53	0.52	0.37	0.73	0.09	0.84	0.85	0.74	0.92	0.05	0.76	0.80	0.53	0.88	0.11
Mid Cap Core	0.57	0.61	0.19	0.77	0.15	0.82	0.83	0.69	0.91	0.06	0.79	0.84	0.43	0.90	0.12
Mid Cap Growth	0.54	0.53	0.43	0.69	0.07	0.85	0.85	0.78	0.95	0.03	0.80	0.81	0.63	0.92	0.09
Mid Cap Value	0.49	0.49	0.30	0.64	0.09	0.84	0.85	0.74	0.91	0.04	0.76	0.78	0.37	0.92	0.15
Small Cap Core	0.45	0.46	0.21	0.62	0.09	0.85	0.86	0.74	0.96	0.06	0.81	0.83	0.59	0.93	0.09
Small Cap Growth	0.51	0.50	0.34	0.70	0.08	0.82	0.83	0.59	0.97	0.08	0.81	0.84	0.65	0.90	0.07
Small Cap Value	0.38	0.42	0.00	0.60	0.16	0.86	0.87	0.77	0.94	0.04	0.73	0.78	0.31	0.87	0.12

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

Exhibit 6

Summary Statistics for Correlations Between Slugging Percentage Percentile Rank and Percentile Rank Based On Various Performance Metrics															
	Batting Average					Relative Magnitude Ratio					Sortino Ratio				
Asset Class	Avg	Median	Min	Max	Std Dev	Avg	Median	Min	Max	Std Dev	Avg	Median	Min	Max	Std Dev
Core Fixed	0.49	0.54	0.07	0.76	0.19	0.83	0.83	0.69	0.95	0.05	0.74	0.75	0.48	0.94	0.12
Emerging Markets Equity	0.49	0.47	0.27	0.81	0.15	0.80	0.81	0.62	0.90	0.07	0.86	0.87	0.59	0.94	0.07
High Yield Bond	0.41	0.44	(0.00)	0.85	0.26	0.80	0.82	0.62	0.94	0.08	0.74	0.80	0.08	0.93	0.20
High Yield Munis	0.47	0.50	0.02	0.78	0.20	0.65	0.69	(0.13)	0.95	0.26	0.76	0.79	0.12	0.98	0.21
Intl Developed Core - ACWI	0.51	0.49	0.13	0.85	0.21	0.82	0.83	0.73	0.89	0.04	0.89	0.88	0.79	0.95	0.04
Intl Developed Core - EAFE	0.52	0.48	0.18	0.79	0.16	0.83	0.85	0.70	0.92	0.06	0.89	0.89	0.79	0.96	0.04
Intl Developed Growth - ACWI	0.48	0.46	0.14	0.82	0.17	0.83	0.85	0.70	0.91	0.06	0.86	0.88	0.69	0.96	0.07
Intl Developed Growth - EAFE	0.48	0.46	0.17	0.81	0.19	0.85	0.89	0.64	0.94	0.08	0.88	0.89	0.76	0.97	0.05
Intl Developed Value - ACWI	0.50	0.46	0.04	0.82	0.17	0.79	0.78	0.63	0.95	0.09	0.82	0.83	0.68	0.90	0.06
Intl Developed Value - EAFE	0.32	0.26	(0.15)	0.81	0.25	0.80	0.81	0.64	0.94	0.07	0.82	0.83	0.67	0.93	0.07
Investment Grade Munis	0.28	0.29	(0.14)	0.66	0.19	0.79	0.80	0.65	0.89	0.06	0.69	0.78	0.26	0.92	0.21
Large Cap Core	0.56	0.58	0.27	0.69	0.09	0.83	0.83	0.75	0.94	0.05	0.80	0.82	0.53	0.93	0.12
Large Cap Growth	0.53	0.54	0.33	0.74	0.11	0.80	0.81	0.67	0.94	0.06	0.79	0.82	0.52	0.91	0.11
Large Cap Value	0.52	0.52	0.34	0.76	0.11	0.82	0.83	0.70	0.91	0.06	0.80	0.85	0.44	0.94	0.13
Mid Cap Core	0.58	0.61	0.21	0.80	0.13	0.77	0.77	0.64	0.90	0.06	0.77	0.82	0.42	0.94	0.15
Mid Cap Growth	0.53	0.52	0.41	0.71	0.08	0.84	0.84	0.71	0.95	0.04	0.82	0.86	0.58	0.94	0.10
Mid Cap Value	0.49	0.48	0.30	0.69	0.08	0.82	0.83	0.71	0.92	0.05	0.75	0.79	0.36	0.94	0.17
Small Cap Core	0.42	0.43	0.20	0.61	0.10	0.84	0.86	0.70	0.95	0.06	0.83	0.87	0.55	0.94	0.09
Small Cap Growth	0.50	0.50	0.32	0.71	0.08	0.80	0.81	0.60	0.97	0.08	0.85	0.89	0.68	0.93	0.07
Small Cap Value	0.38	0.40	0.03	0.68	0.16	0.83	0.85	0.63	0.94	0.08	0.78	0.81	0.34	0.93	0.14

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

Exhibit 7

Summary Statistics for Top Quartile Overlap Between Slugging Percentage and Various Performance Metrics															
	Tracking Error					Beta					Treynor Ratio				
Asset Class	Avg	Median	Min	Max	Std Dev	Avg	Median	Min	Max	Std Dev	Avg	Median	Min	Max	Std Dev
Core Fixed	26.0%	23.3%	10.8%	50.0%	9.2%	34.1%	31.9%	20.0%	52.4%	7.5%	53.3%	48.7%	29.4%	91.9%	15.7%
Emerging Markets Equity	39.1%	36.4%	18.2%	68.4%	12.0%	19.8%	20.0%	0.0%	54.5%	13.8%	74.4%	77.8%	30.0%	90.9%	12.3%
High Yield Bond	34.3%	33.3%	21.7%	52.6%	5.9%	24.5%	18.8%	0.0%	80.0%	16.9%	62.7%	64.7%	24.0%	88.6%	14.5%
High Yield Munis	26.7%	25.0%	0.0%	71.4%	19.3%	29.6%	33.3%	0.0%	100.0%	26.7%	62.6%	62.5%	14.3%	100.0%	20.9%
Intl Developed Core - ACWI	41.9%	40.9%	23.3%	71.4%	9.6%	23.2%	21.7%	3.8%	52.9%	10.6%	80.2%	80.8%	58.8%	94.4%	8.0%
Intl Developed Core - EAFE	37.4%	35.7%	17.6%	62.5%	9.4%	19.7%	17.9%	3.8%	47.1%	9.4%	77.8%	77.8%	63.2%	94.1%	7.5%
Intl Developed Growth - ACWI	32.9%	36.4%	0.0%	66.7%	14.2%	20.5%	20.0%	0.0%	66.7%	15.1%	72.5%	77.8%	43.8%	100.0%	13.7%
Intl Developed Growth - EAFE	33.0%	35.0%	0.0%	56.3%	14.2%	17.1%	11.8%	0.0%	66.7%	15.2%	76.4%	75.0%	55.6%	100.0%	9.9%
Intl Developed Value - ACWI	35.5%	35.7%	15.4%	66.7%	10.5%	20.1%	20.0%	0.0%	55.6%	13.4%	69.9%	70.0%	46.2%	88.9%	10.0%
Intl Developed Value - EAFE	34.6%	35.7%	11.1%	56.3%	11.3%	19.2%	18.2%	0.0%	66.7%	13.7%	70.2%	70.0%	44.4%	92.9%	11.8%
Investment Grade Munis	32.6%	28.6%	6.7%	68.4%	17.6%	35.7%	35.7%	14.3%	58.8%	10.4%	64.7%	64.3%	40.0%	81.3%	10.1%
Large Cap Core	28.0%	27.3%	17.9%	48.5%	6.2%	21.1%	20.0%	2.5%	47.1%	10.5%	69.9%	73.8%	47.1%	82.5%	9.7%
Large Cap Growth	33.3%	32.8%	23.8%	45.9%	5.6%	28.4%	29.1%	0.0%	51.5%	10.4%	72.0%	71.0%	58.0%	89.1%	8.3%
Large Cap Value	27.7%	27.5%	10.5%	43.2%	6.8%	18.9%	17.6%	1.7%	54.1%	14.7%	67.0%	71.1%	32.0%	90.3%	14.8%
Mid Cap Core	24.6%	20.0%	0.0%	63.6%	14.3%	25.9%	22.2%	0.0%	75.0%	16.3%	71.7%	75.0%	37.5%	93.3%	14.7%
Mid Cap Growth	27.9%	29.6%	4.3%	45.5%	10.0%	18.1%	17.9%	3.8%	45.5%	9.0%	73.6%	73.3%	48.1%	89.7%	8.6%
Mid Cap Value	27.0%	27.3%	0.0%	56.3%	12.6%	24.6%	22.2%	0.0%	81.3%	16.1%	68.0%	70.0%	18.8%	100.0%	17.0%
Small Cap Core	20.8%	22.2%	3.2%	46.4%	9.9%	21.9%	20.8%	0.0%	53.6%	14.7%	67.2%	73.7%	38.7%	95.0%	15.2%
Small Cap Growth	32.6%	33.3%	13.3%	42.9%	6.8%	19.2%	18.8%	0.0%	40.0%	9.7%	69.6%	70.0%	40.0%	87.5%	8.3%
Small Cap Value	27.3%	25.0%	4.8%	50.0%	10.4%	21.3%	20.0%	0.0%	65.0%	15.7%	68.4%	72.2%	35.0%	87.5%	14.0%

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

Exhibit 8

Summary Statistics for Correlations Between Slugging Percentage and Various Performance Metrics

	Tracking Error					Beta					Treynor Ratio				
Asset Class	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**
Core Fixed	0.07	0.02	(0.26)	0.49	0.21	0.18	0.19	(0.12)	0.36	0.10	0.46	0.47	0.04	0.69	0.16
Emerging Markets Equity	0.16	0.12	(0.32)	0.60	0.22	(0.09)	(0.07)	(0.65)	0.52	0.29	0.75	0.76	0.50	0.92	0.10
High Yield Bond	0.22	0.22	0.02	0.39	0.09	(0.12)	(0.22)	(0.65)	0.58	0.30	0.58	0.62	0.16	0.86	0.19
High Yield Munis	(0.09)	(0.20)	(0.44)	0.71	0.31	0.03	0.24	(0.85)	0.85	0.54	0.71	0.75	(0.14)	0.97	0.25
Intl Developed Core - ACWI	0.28	0.27	(0.03)	0.65	0.19	(0.25)	(0.32)	(0.59)	0.45	0.23	0.83	0.85	0.62	0.93	0.08
Intl Developed Core - EAFE	0.25	0.22	0.04	0.53	0.13	(0.24)	(0.30)	(0.62)	0.47	0.23	0.83	0.85	0.62	0.92	0.07
Intl Developed Growth - ACWI	0.08	0.12	(0.32)	0.35	0.15	(0.14)	(0.14)	(0.63)	0.54	0.28	0.82	0.86	0.60	0.94	0.09
Intl Developed Growth - EAFE	0.06	0.07	(0.32)	0.37	0.16	(0.22)	(0.25)	(0.64)	0.51	0.26	0.85	0.86	0.70	0.95	0.06
Intl Developed Value - ACWI	0.16	0.08	(0.33)	0.68	0.30	(0.25)	(0.32)	(0.65)	0.36	0.29	0.63	0.77	(0.17)	0.85	0.27
Intl Developed Value - EAFE	0.12	0.03	(0.33)	0.59	0.28	(0.21)	(0.26)	(0.63)	0.49	0.29	0.60	0.72	(0.24)	0.84	0.27
Investment Grade Munis	0.23	0.24	(0.37)	0.71	0.26	0.25	0.27	(0.24)	0.50	0.17	0.71	0.75	0.36	0.90	0.15
Large Cap Core	0.06	0.04	(0.16)	0.33	0.12	(0.08)	(0.13)	(0.56)	0.48	0.25	0.71	0.72	0.52	0.85	0.09
Large Cap Growth	0.18	0.19	(0.02)	0.33	0.08	0.02	0.02	(0.60)	0.50	0.24	0.78	0.79	0.64	0.89	0.07
Large Cap Value	0.11	0.12	(0.16)	0.41	0.12	(0.18)	(0.15)	(0.68)	0.36	0.25	0.72	0.77	0.36	0.86	0.13
Mid Cap Core	0.03	0.01	(0.23)	0.46	0.16	(0.06)	(0.13)	(0.47)	0.64	0.28	0.78	0.82	0.35	0.88	0.11
Mid Cap Growth	0.09	0.14	(0.27)	0.41	0.17	(0.17)	(0.17)	(0.59)	0.36	0.20	0.81	0.81	0.58	0.91	0.07
Mid Cap Value	0.01	0.03	(0.37)	0.49	0.18	0.02	0.01	(0.60)	0.76	0.28	0.74	0.77	0.21	0.91	0.16
Small Cap Core	(0.08)	(0.04)	(0.45)	0.21	0.19	(0.14)	(0.15)	(0.70)	0.48	0.28	0.79	0.82	0.53	0.91	0.10
Small Cap Growth	0.07	0.05	(0.16)	0.31	0.13	(0.17)	(0.19)	(0.59)	0.28	0.21	0.80	0.82	0.63	0.89	0.07
Small Cap Value	0.01	0.04	(0.42)	0.49	0.20	(0.08)	(0.07)	(0.68)	0.56	0.29	0.69	0.72	0.24	0.84	0.15

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

Exhibit 9

Summary Statistics for Correlations Between Slugging Percentage Percentile Rank and Percentile Rank Based On Various Performance Metrics

	Tracking Error					Beta					Treynor Ratio				
Asset Class	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**
Core Fixed	0.08	0.02	(0.30)	0.46	0.21	0.18	0.18	(0.16)	0.40	0.12	0.70	0.70	0.47	0.93	0.14
Emerging Markets Equity	0.28	0.28	(0.27)	0.59	0.16	(0.16)	(0.18)	(0.69)	0.59	0.30	0.85	0.86	0.56	0.94	0.07
High Yield Bond	0.22	0.23	(0.13)	0.39	0.11	(0.16)	(0.31)	(0.74)	0.68	0.34	0.76	0.81	0.01	0.92	0.19
High Yield Munis	(0.01)	(0.06)	(0.42)	0.53	0.24	0.00	0.29	(0.87)	0.76	0.57	0.72	0.77	(0.04)	0.98	0.24
Intl Developed Core - ACWI	0.27	0.24	(0.03)	0.74	0.19	(0.21)	(0.25)	(0.55)	0.36	0.20	0.89	0.89	0.80	0.95	0.04
Intl Developed Core - EAFE	0.27	0.25	0.01	0.63	0.16	(0.19)	(0.24)	(0.53)	0.46	0.22	0.89	0.90	0.79	0.96	0.04
Intl Developed Growth - ACWI	0.13	0.19	(0.33)	0.41	0.19	(0.17)	(0.12)	(0.58)	0.52	0.28	0.85	0.88	0.59	0.96	0.08
Intl Developed Growth - EAFE	0.10	0.08	(0.33)	0.37	0.17	(0.23)	(0.24)	(0.59)	0.47	0.27	0.88	0.89	0.71	0.96	0.05
Intl Developed Value - ACWI	0.12	0.16	(0.39)	0.43	0.19	(0.26)	(0.33)	(0.66)	0.48	0.27	0.82	0.83	0.61	0.95	0.07
Intl Developed Value - EAFE	0.11	0.11	(0.34)	0.43	0.18	(0.23)	(0.32)	(0.68)	0.68	0.28	0.80	0.81	0.60	0.92	0.07
Investment Grade Munis	0.22	0.21	(0.38)	0.60	0.23	0.18	0.19	(0.18)	0.47	0.15	0.70	0.75	0.34	0.92	0.16
Large Cap Core	0.08	0.08	(0.15)	0.30	0.12	(0.10)	(0.17)	(0.67)	0.54	0.31	0.80	0.82	0.48	0.92	0.11
Large Cap Growth	0.20	0.21	0.00	0.37	0.09	0.04	0.01	(0.68)	0.50	0.25	0.81	0.83	0.68	0.91	0.07
Large Cap Value	0.14	0.15	(0.15)	0.45	0.12	(0.23)	(0.18)	(0.73)	0.37	0.29	0.79	0.85	0.36	0.94	0.14
Mid Cap Core	0.06	0.03	(0.28)	0.41	0.17	(0.09)	(0.20)	(0.55)	0.49	0.30	0.78	0.83	0.39	0.94	0.14
Mid Cap Growth	0.09	0.15	(0.27)	0.46	0.18	(0.21)	(0.19)	(0.62)	0.34	0.20	0.84	0.87	0.59	0.94	0.08
Mid Cap Value	0.01	0.01	(0.35)	0.28	0.14	0.02	0.02	(0.56)	0.71	0.28	0.74	0.79	0.25	0.94	0.17
Small Cap Core	(0.04)	0.02	(0.43)	0.22	0.20	(0.15)	(0.15)	(0.76)	0.53	0.30	0.81	0.85	0.52	0.94	0.11
Small Cap Growth	0.17	0.17	(0.08)	0.41	0.12	(0.22)	(0.24)	(0.65)	0.20	0.20	0.86	0.88	0.67	0.93	0.07
Small Cap Value	(0.01)	0.01	(0.40)	0.45	0.20	(0.10)	(0.12)	(0.82)	0.69	0.32	0.76	0.80	0.22	0.92	0.15

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

Exhibit 10

Summary Statistics for Top Quartile Overlap Between Slugging Percentage and Various Performance Metrics

	Overall Capture Ratio					Up Capture Ratio					Down Capture Ratio					R-Squared				
Asset Class	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**
Core Fixed	48.9%	48.5%	15.7%	81.1%	10.3%	52.4%	50.0%	26.2%	79.6%	11.0%	14.2%	13.5%	2.8%	26.5%	5.6%	26.1%	25.0%	2.9%	45.2%	11.4%
Emerging Markets Equity	74.4%	77.8%	30.0%	90.9%	12.3%	37.3%	35.5%	4.2%	80.0%	19.2%	6.8%	5.6%	0.0%	45.5%	9.3%	8.0%	6.7%	0.0%	45.5%	8.5%
High Yield Bond	60.8%	61.1%	24.0%	83.3%	12.6%	47.0%	40.7%	15.0%	88.0%	19.5%	13.8%	8.7%	0.0%	60.0%	13.3%	22.2%	20.0%	7.7%	41.7%	9.0%
High Yield Munis	56.2%	50.0%	0.0%	100.0%	26.6%	41.3%	50.0%	0.0%	100.0%	28.2%	21.8%	22.2%	0.0%	85.7%	21.0%	29.1%	28.6%	0.0%	66.7%	17.2%
Intl Developed Core - ACWI	80.0%	80.0%	58.8%	94.4%	8.3%	40.9%	38.9%	15.4%	82.4%	16.0%	8.7%	7.7%	0.0%	29.4%	6.9%	14.5%	15.8%	0.0%	28.0%	6.9%
Intl Developed Core - EAFE	77.1%	76.7%	58.8%	94.1%	7.4%	40.1%	36.0%	15.4%	76.5%	15.7%	8.8%	7.7%	0.0%	29.4%	6.7%	12.5%	11.8%	0.0%	28.0%	7.6%
Intl Developed Growth - ACWI	71.0%	75.0%	44.4%	100.0%	15.0%	41.0%	42.9%	8.3%	88.9%	19.8%	12.0%	10.5%	0.0%	44.4%	11.2%	20.1%	16.7%	0.0%	50.0%	12.4%
Intl Developed Growth - EAFE	75.9%	76.9%	44.4%	100.0%	11.7%	38.8%	41.2%	0.0%	77.8%	18.5%	9.0%	9.1%	0.0%	44.4%	9.2%	16.3%	11.1%	0.0%	62.5%	11.1%
Intl Developed Value - ACWI	69.6%	69.2%	44.4%	100.0%	10.9%	36.8%	33.3%	7.1%	75.0%	17.6%	8.8%	6.7%	0.0%	44.4%	10.2%	21.7%	20.0%	0.0%	53.8%	11.9%
Intl Developed Value - EAFE	70.4%	73.3%	44.4%	92.9%	12.0%	40.6%	36.4%	6.3%	77.8%	18.0%	7.5%	6.7%	0.0%	33.3%	8.2%	15.3%	12.5%	0.0%	33.3%	8.4%
Investment Grade Munis	56.1%	57.1%	21.4%	86.7%	15.3%	51.4%	53.8%	28.6%	71.4%	10.8%	23.2%	21.4%	0.0%	50.0%	12.7%	15.1%	13.3%	0.0%	42.9%	9.9%
Large Cap Core	69.6%	73.5%	47.1%	83.3%	10.4%	45.1%	44.7%	16.7%	70.7%	13.8%	10.2%	9.1%	0.0%	25.9%	6.6%	22.5%	22.2%	0.0%	48.1%	10.8%
Large Cap Growth	72.2%	71.0%	57.4%	89.1%	8.4%	48.7%	50.0%	14.6%	67.8%	11.7%	13.5%	14.8%	0.0%	25.4%	6.4%	15.7%	15.5%	4.3%	25.4%	4.5%
Large Cap Value	67.0%	71.1%	34.0%	92.5%	15.3%	37.6%	40.5%	10.6%	71.1%	18.4%	9.6%	6.3%	0.0%	38.0%	9.7%	22.2%	21.9%	5.4%	39.2%	6.9%
Mid Cap Core	70.3%	72.7%	37.5%	93.3%	14.8%	41.5%	40.0%	6.3%	80.0%	18.7%	12.7%	9.1%	0.0%	50.0%	12.3%	24.3%	25.0%	6.3%	47.1%	9.3%
Mid Cap Growth	74.1%	75.0%	54.5%	89.7%	8.4%	39.3%	40.7%	10.5%	65.6%	13.4%	5.7%	3.7%	0.0%	36.4%	6.8%	22.2%	19.4%	5.3%	43.5%	9.9%
Mid Cap Value	69.0%	72.7%	31.3%	100.0%	16.3%	40.6%	41.2%	14.3%	81.3%	13.6%	15.2%	11.8%	0.0%	62.5%	13.6%	23.0%	22.2%	9.1%	41.7%	6.8%
Small Cap Core	67.1%	68.4%	35.7%	95.0%	15.2%	42.5%	47.1%	4.5%	67.9%	15.8%	10.2%	10.3%	0.0%	32.1%	8.9%	25.8%	22.2%	8.3%	50.0%	11.0%
Small Cap Growth	69.3%	70.0%	36.7%	87.5%	9.5%	39.0%	37.9%	16.0%	66.7%	12.5%	7.2%	6.7%	0.0%	20.0%	5.6%	17.9%	15.2%	4.2%	40.0%	9.7%
Small Cap Value	67.5%	72.0%	35.0%	84.6%	13.7%	41.8%	45.5%	11.1%	70.0%	17.4%	12.0%	8.7%	0.0%	45.0%	11.7%	27.0%	26.7%	7.7%	55.0%	10.0%

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

Exhibit 11

Summary Statistics for Correlations Between Slugging Percentage and Various Performance Metrics

	Overall Capture Ratio					Up Capture Ratio					Down Capture Ratio					R-Squared				
Asset Class	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**
Core Fixed	0.27	0.30	(0.18)	0.78	0.22	0.54	0.57	0.28	0.69	0.09	(0.22)	(0.21)	(0.52)	0.07	0.12	(0.04)	(0.03)	(0.46)	0.33	0.22
Emerging Markets Equity	0.73	0.74	0.38	0.91	0.11	0.18	0.18	(0.45)	0.68	0.30	(0.39)	(0.39)	(0.79)	0.34	0.25	(0.10)	(0.07)	(0.59)	0.34	0.25
High Yield Bond	0.37	0.39	(0.28)	0.73	0.27	0.17	0.04	(0.23)	0.79	0.30	(0.33)	(0.39)	(0.75)	0.15	0.22	(0.18)	(0.18)	(0.39)	0.11	0.11
High Yield Munis	0.57	0.63	(0.18)	0.97	0.36	0.29	0.57	(0.61)	0.92	0.54	(0.16)	(0.06)	(0.86)	0.72	0.46	(0.11)	(0.12)	(0.73)	0.30	0.28
Intl Developed Core - ACWI	0.78	0.82	0.49	0.91	0.12	0.20	0.16	(0.22)	0.75	0.25	(0.55)	(0.58)	(0.83)	0.01	0.17	(0.26)	(0.24)	(0.60)	(0.02)	0.15
Intl Developed Core - EAFE	0.76	0.82	0.51	0.91	0.12	0.22	0.18	(0.18)	0.78	0.26	(0.53)	(0.55)	(0.85)	0.09	0.18	(0.23)	(0.21)	(0.50)	(0.03)	0.12
Intl Developed Growth - ACWI	0.79	0.86	0.44	0.94	0.13	0.37	0.40	(0.15)	0.82	0.28	(0.49)	(0.56)	(0.78)	0.12	0.19	(0.05)	(0.06)	(0.29)	0.28	0.11
Intl Developed Growth - EAFE	0.83	0.85	0.57	0.95	0.08	0.32	0.34	(0.18)	0.85	0.26	(0.55)	(0.59)	(0.82)	0.02	0.18	(0.08)	(0.06)	(0.34)	0.28	0.14
Intl Developed Value - ACWI	0.63	0.70	(0.12)	0.84	0.18	0.03	0.12	(0.53)	0.60	0.34	(0.48)	(0.54)	(0.78)	0.18	0.25	(0.16)	(0.06)	(0.66)	0.29	0.29
Intl Developed Value - EAFE	0.63	0.66	(0.00)	0.81	0.15	0.07	0.09	(0.47)	0.70	0.34	(0.45)	(0.51)	(0.73)	0.28	0.25	(0.11)	(0.04)	(0.58)	0.35	0.29
Investment Grade Munis	0.50	0.51	0.15	0.84	0.20	0.55	0.57	0.18	0.70	0.11	(0.11)	(0.13)	(0.57)	0.36	0.23	(0.20)	(0.22)	(0.73)	0.48	0.29
Large Cap Core	0.67	0.69	0.12	0.85	0.15	0.35	0.37	(0.06)	0.71	0.25	(0.34)	(0.36)	(0.73)	0.10	0.20	(0.07)	(0.06)	(0.45)	0.18	0.16
Large Cap Growth	0.75	0.75	0.46	0.90	0.09	0.40	0.45	(0.29)	0.75	0.24	(0.32)	(0.32)	(0.74)	(0.04)	0.15	(0.19)	(0.21)	(0.38)	0.04	0.11
Large Cap Value	0.67	0.70	0.37	0.85	0.13	0.20	0.23	(0.21)	0.64	0.26	(0.42)	(0.50)	(0.80)	0.06	0.21	(0.10)	(0.10)	(0.40)	0.19	0.11
Mid Cap Core	0.78	0.84	0.39	0.89	0.12	0.33	0.38	(0.15)	0.76	0.27	(0.32)	(0.39)	(0.65)	0.25	0.22	0.00	(0.01)	(0.33)	0.32	0.14
Mid Cap Growth	0.80	0.82	0.49	0.92	0.11	0.37	0.38	(0.11)	0.67	0.19	(0.50)	(0.53)	(0.71)	(0.02)	0.14	(0.10)	(0.13)	(0.36)	0.19	0.16
Mid Cap Value	0.74	0.77	0.31	0.92	0.16	0.40	0.42	(0.03)	0.83	0.21	(0.27)	(0.28)	(0.76)	0.49	0.26	0.03	0.01	(0.15)	0.38	0.15
Small Cap Core	0.77	0.78	0.53	0.92	0.12	0.32	0.32	0.01	0.73	0.20	(0.43)	(0.44)	(0.82)	0.04	0.23	0.09	0.06	(0.21)	0.39	0.16
Small Cap Growth	0.79	0.80	0.58	0.89	0.08	0.31	0.32	(0.07)	0.65	0.19	(0.49)	(0.53)	(0.76)	(0.14)	0.15	(0.04)	(0.03)	(0.31)	0.23	0.14
Small Cap Value	0.63	0.68	0.18	0.82	0.16	0.25	0.39	(0.24)	0.71	0.27	(0.32)	(0.36)	(0.77)	0.29	0.26	(0.00)	(0.03)	(0.32)	0.38	0.18

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

Exhibit 12

Summary Statistics for Correlations Between Slugging Percentage Percentile Rank and Percentile Rank Based On Various Performance Metrics

	Overall Capture Ratio					Up Capture Ratio					Down Capture Ratio					R-Squared				
Asset Class	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**	**Avg**	**Median**	**Min**	**Max**	**Std Dev**
Core Fixed	0.61	0.60	0.33	0.83	0.10	0.59	0.61	0.28	0.74	0.11	(0.25)	(0.23)	(0.62)	0.07	0.14	(0.07)	(0.03)	(0.48)	0.32	0.22
Emerging Markets Equity	0.85	0.87	0.45	0.94	0.09	0.20	0.13	(0.42)	0.88	0.34	(0.45)	(0.47)	(0.85)	0.33	0.25	(0.28)	(0.28)	(0.63)	0.26	0.17
High Yield Bond	0.75	0.78	0.20	0.92	0.15	0.21	0.12	(0.21)	0.85	0.32	(0.43)	(0.53)	(0.87)	0.26	0.25	(0.19)	(0.18)	(0.40)	0.16	0.13
High Yield Munis	0.62	0.69	(0.05)	0.98	0.30	0.36	0.65	(0.42)	0.90	0.51	(0.24)	(0.10)	(0.92)	0.49	0.45	(0.10)	(0.10)	(0.60)	0.28	0.25
Intl Developed Core - ACWI	0.89	0.90	0.81	0.95	0.04	0.27	0.22	(0.08)	0.72	0.21	(0.56)	(0.58)	(0.88)	(0.12)	0.16	(0.25)	(0.20)	(0.74)	0.09	0.19
Intl Developed Core - EAFE	0.88	0.90	0.73	0.95	0.05	0.30	0.26	(0.10)	0.83	0.24	(0.53)	(0.56)	(0.86)	0.05	0.19	(0.28)	(0.27)	(0.65)	(0.01)	0.16
Intl Developed Growth - ACWI	0.84	0.88	0.57	0.96	0.10	0.36	0.41	(0.13)	0.85	0.28	(0.50)	(0.56)	(0.79)	0.13	0.20	(0.11)	(0.17)	(0.38)	0.29	0.17
Intl Developed Growth - EAFE	0.87	0.89	0.62	0.96	0.07	0.33	0.33	(0.16)	0.86	0.27	(0.55)	(0.60)	(0.87)	0.06	0.19	(0.16)	(0.15)	(0.38)	0.31	0.14
Intl Developed Value - ACWI	0.81	0.82	0.62	0.90	0.06	0.17	0.10	(0.35)	0.79	0.30	(0.54)	(0.60)	(0.84)	0.05	0.21	(0.14)	(0.18)	(0.43)	0.36	0.19
Intl Developed Value - EAFE	0.81	0.82	0.64	0.92	0.06	0.21	0.16	(0.41)	0.88	0.32	(0.54)	(0.58)	(0.81)	0.17	0.20	(0.13)	(0.11)	(0.45)	0.33	0.21
Investment Grade Munis	0.57	0.65	0.15	0.85	0.22	0.51	0.52	0.18	0.82	0.14	(0.15)	(0.18)	(0.54)	0.33	0.23	(0.22)	(0.28)	(0.62)	0.47	0.27
Large Cap Core	0.79	0.81	0.46	0.92	0.12	0.37	0.41	(0.12)	0.78	0.29	(0.39)	(0.42)	(0.80)	0.15	0.23	(0.08)	(0.07)	(0.42)	0.19	0.15
Large Cap Growth	0.81	0.84	0.67	0.91	0.08	0.44	0.50	(0.26)	0.78	0.25	(0.33)	(0.31)	(0.81)	(0.07)	0.16	(0.20)	(0.23)	(0.45)	0.01	0.12
Large Cap Value	0.79	0.85	0.39	0.93	0.13	0.20	0.24	(0.34)	0.70	0.31	(0.47)	(0.53)	(0.88)	0.04	0.24	(0.14)	(0.15)	(0.41)	0.17	0.11
Mid Cap Core	0.77	0.82	0.40	0.94	0.15	0.35	0.41	(0.14)	0.78	0.28	(0.37)	(0.46)	(0.78)	0.15	0.27	(0.04)	(0.04)	(0.31)	0.27	0.13
Mid Cap Growth	0.84	0.87	0.58	0.94	0.09	0.34	0.32	(0.15)	0.69	0.21	(0.53)	(0.56)	(0.75)	0.00	0.15	(0.11)	(0.16)	(0.51)	0.21	0.19
Mid Cap Value	0.74	0.79	0.35	0.94	0.17	0.42	0.46	(0.04)	0.81	0.23	(0.30)	(0.28)	(0.78)	0.45	0.27	0.01	0.00	(0.18)	0.20	0.10
Small Cap Core	0.81	0.84	0.52	0.95	0.11	0.31	0.34	(0.08)	0.75	0.22	(0.44)	(0.46)	(0.86)	0.06	0.24	0.05	(0.04)	(0.18)	0.44	0.19
Small Cap Growth	0.85	0.88	0.68	0.92	0.07	0.26	0.25	(0.12)	0.63	0.20	(0.52)	(0.56)	(0.79)	(0.18)	0.15	(0.15)	(0.16)	(0.41)	0.12	0.14
Small Cap Value	0.77	0.80	0.30	0.93	0.15	0.32	0.38	(0.14)	0.82	0.27	(0.37)	(0.40)	(0.90)	0.34	0.29	0.02	0.01	(0.36)	0.39	0.20

Source: Morningstar. The analysis covers the period from June 2000 through May 2020 and uses rolling five-year periods on a quarterly basis, with the first rolling five-year period ending May 2005.

About the Authors

As a member of our Global Public Markets Group, Joel researches and performs operational due diligence on core investment managers. Prior to joining the firm in 2018, Joel served as a Senior Analyst at Birch Lake Associates. He received a Bachelor of Arts in Politics with a Minor in Communications from Lake Forest College. Joel also earned a Master of Business Administration from the University of Chicago Booth School of Business with concentrations in Analytic Finance, Economics, Econometrics and Statistics and Entrepreneurship. Joel is a CFA® charterholder and member of the CFA Society of Chicago and CFA Institute. He enjoys playing guitar, traveling the world, playing tennis and golf, and rooting for his favorite Chicago sports teams.

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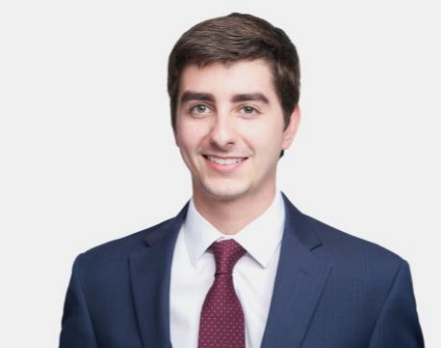

Matt researches and performs operational due diligence on core investment managers and joined the firm in 2018 as a member of our Global Public Markets Group. Matt's prior work experience includes Morgan Stanley on their private wealth management team and The Heico Companies on their benefits team. He received a Bachelor of Arts and Science in Business Administration, majoring in Accounting and Finance, from Marquette University and passed the CFA Level II exam. In his free time, Matt enjoys watching sports, golfing and reading.

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