ANATOMY OF ACTIVE PORTFOLIOS

How Factor Exposures Affect Fund Performance

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CONTENTS

EXECUTIVE SUMMARY

In constructing portfolios, asset managers, intentionally or otherwise, expose the portfolio to factor tilts that greatly influence fund performance. But many managers may not be aware of these exposures, which can be sources of excess returns. For example, if the value factor has performed strongly over time, a persistent negative exposure to value may have impaired returns. Those managers could be on the wrong side of history.

Using MSCI's Peer Analytics dataset, we examined the composition and performance drivers of active global funds through the lens of the Global Total Market Equity Model (GEMLT). We attributed funds' performance to factor exposures and stock selection, and reviewed what distinguished top-performing funds. Key findings were:

- Based only on the size of contributions, common factors, which include country, industry, style and currency, on average accounted for 55% of funds' 5-year active performance, compared to 45% for stock-specific contributions, during a 13-year period. This pattern was consistent for both top- and bottom-quartile performing funds.
- Using a complementary analysis that takes the signs of contributions into account, factors explained an even larger proportion of fund returns than stock-picking. Factor contribution, on average, has been positive for most of the funds (top three performance quartiles), while stock-specific contribution has had greater variability.
- Most active portfolios had significant exposure to style factors, including Systematic Equity Strategies (SES).[1] Among factor groups, style factors had the largest impact on active performance: 34% of factor returns on average, with SES factors explaining the majority of style contributions (54%). Price Momentum, Residual Volatility, Beta, Dividend Yield and Profitability were the most significant individual factors.
- Exposures to factors that differ from managers' objectives had a significant impact on performance. For value managers, contributions from Volatility, Price Momentum and Profitability factors accounted for 19%, 18% and 17% of the total style contribution, respectively, exceeding that of the Value factor (15%).
- Finally, we showed that MSCI Factor Indexes can provide a clear picture of how much of performance comes from factors as opposed to stock contributions. This information may help asset managers address potential benchmark mismatches.

[1] SES factors are proxies for popular systematic investment strategies that have generated excess returns over long time periods, e.g., Value, Momentum and Quality. See Bayraktar et al. (2013) for more detail.

INTRODUCTION

Regulatory changes in the asset management industry, macro-driven markets and the popularity of passive investments have presented challenges for active equity managers over the last decade. The growth of factor investing, manifested by multi-billion dollar inflows to factor-based products, underscores the importance of factor awareness in portfolio management.[2]

Factors are recognized as key drivers of active returns, i.e., returns above the benchmark. Ang, Goetzmann and Schaefer (2009) and Bender, Hammond and Mok (2014) found that 70%-80% of active returns can be explained by exposures to systematic factors. Factor investing, implemented by replicating rules-based transparent indexes, enables institutional investors to capture systematic factor returns that were previously only available via active portfolios.

Active returns can be broken into two broad components: "factor returns" attributable to persistent exposures to systematic factors, and "alpha" attributable to a manager's stock and industry selection, factor rotation/timing and other active decisions. Thus, understanding the return drivers of active portfolios can help asset owners in allocating capital among managers and in combining factor and active mandates (Rao [2017]).

Both quantitative and fundamental managers require a deep grasp of how factors affect their portfolios. Historically, MSCI risk models have included several style factors that have driven stock returns, e.g., Earnings Yield, Book to Price and Price Momentum. Recently, MSCI introduced a suite of new style factors in its risk models based on 16 Systematic Equity Strategies (SES). SES refers to rules-based or computer-based implementation of fundamental or technical investment anomalies/strategies. Historically, these factors have been important sources of systematic returns. These factors are also commonly employed as either factors in the quantitative process, or as screens for fundamental managers. Balint and Melas (2015) found significant exposures to Systematic Equity Strategy factors in U.S. mutual funds.

Exhibit 1 provides an overview of the 16 style factors that are included in the Global Total Market Equity Model for Long-term Investors (GEMLT). SES factors are indicated in blue, while other style factors are highlighted in red. Our classification scheme groups factors into eight factor families (marked in green) that approximately correspond to investment styles.

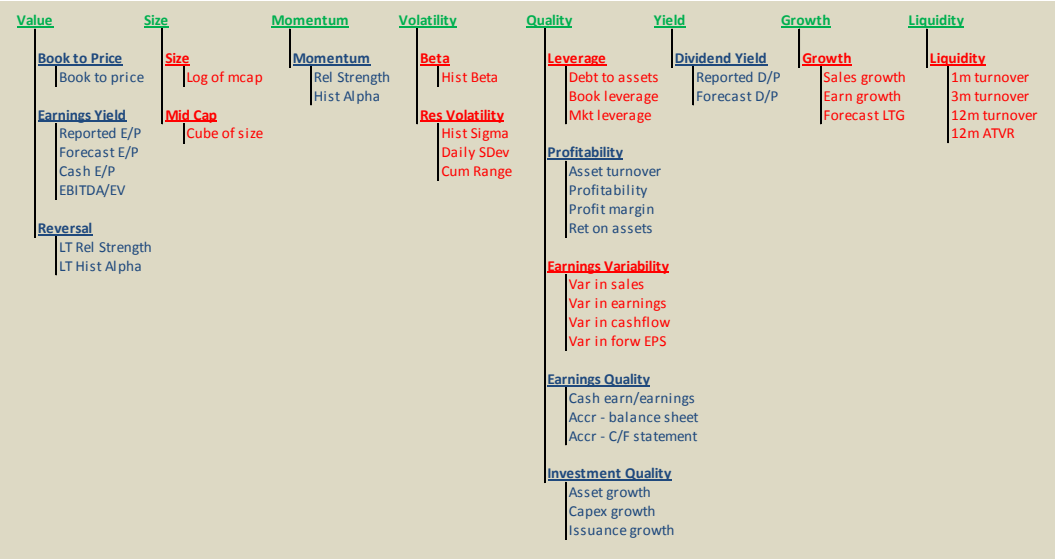
Systematic Equity Strategies may allow asset managers to better understand and monitor the sources of risk and return of equity portfolios. They also have improved forecast accuracy and helped managers construct portfolios that tilt towards or away from these

[2] As of March 31, 2017, there was more than $180 billion in assets benchmarked to MSCI Factor Indexes.

strategies. As drivers of stock returns, SES factors also have served as drivers of volatilities and correlations among stocks.

At the same time, the popularity of some Systematic Equity Strategies has led to crowding risk as large pools of capital have pursued similar strategic goals. Institutional investors using risk models with SES factors have been able to measure and monitor their exposures to these crowded strategies, and as a consequence have made more accurate risk and return tradeoff decisions.[3]

Exhibit 1: Style Factor Family Tree



Abbreviations: "Hist." — Historical; "LTG" — Long Term Growth (multi-year horizon); "ATVR" — Annualized Traded Value Ratio.

In this paper, we address the following questions:

1. What are active global fund exposures to GEMLT factors, especially Systematic Equity Strategies?
2. Do common factor exposures explain the performance of these funds?
3. How can factor indexes be used in evaluating active manager exposures and performance?

[3] See Appendix A and Bayraktar et al. (2013) for a discussion of the benefits of including Systematic Equity Strategy factors in risk models.

ACTIVE EXPOSURE ANALYSIS

In this study, we focus on diversified active global and international (Global ex-U.S.) equity mutual funds for the period from September 2003 through December 2016 (subsequently referred collectively as "global funds"). Using MSCI's Peer Analytics dataset that contains historical holdings for over 25,000 funds, we selected funds based on criteria shown in Appendix 2. Our dataset included 1,315 unique funds over the entire study period. The number of funds at a particular point in time varied, as new funds were added and others liquidated. At the end of 2016, there were 882 funds in our dataset with $671 billion in assets under management. On average, our sample included 35% of all global equity funds and 45% of the total assets under management for this universe over the 13-year period. The primary reason that funds were excluded from the study was because they did not report a benchmark.[4]

EXPOSURES TO FACTORS

Balint and Melas (2015) found that most U.S. active portfolios have significant exposure to SES factors, irrespective of the underlying investment process. As they demonstrated, the SES factors may be very significant to active risk and return (i.e., the risk and return above the benchmark). Active managers often had large exposures to SES factors that have earned excess returns, e.g. Value and Price Momentum. At the same time, they tended to hedge non-SES factors that often made a larger contribution to risk but did not contribute to risk-adjusted returns, e.g., Beta and Leverage.

We extended the previous analysis and examined GEMLT active exposures, i.e., factor exposures of global equity mutual funds relative to each fund's benchmark, using MSCI's Peer Analytics dataset.[5] These active factor exposures are shown in Exhibit 2, where columns correspond to categories of funds determined by keywords in their name (e.g., "income" or "quality") and rows correspond to factors in the GEMLT model. For each of the nine categories, we aggregated holdings of all funds in that category. For example, in the "value" category (in the third column to the left), we combined holdings of all 121 "value" funds. Each aggregate portfolio can be considered as an asset-weighted "average" manager's portfolio.

[4] Appendix 2 provides additional information about our sample over the study period, including the total number of funds and size of assets under management, both overall and for funds with known benchmarks.

[5] This dataset is based on Lipper mutual fund holdings data.

Exhibit 2: Global Active Mutual Fund Manager Classification and Active Factor Exposures

		Key Word								
Factor Family	Factor	Value	Large	Mid	Small	Momentm	Volatility	Quality	Income	Growth
Value	Book to Price	0.34	-0.18	-0.40	0.10	-0.35	-0.19	-0.37	-0.13	-0.25
	Earnings Yield	0.07	-0.02	-0.50	-0.10	-0.12	-0.04	0.04	0.06	-0.10
	Reversal	0.15	-0.03	-0.41	0.03	-0.23	-0.08	-0.13	0.05	-0.17
Size	Size	-0.07	0.02	-1.42	-0.58	-0.34	-0.46	0.21	-0.16	-0.21
	Midcap	-0.02	-0.01	0.54	0.04	0.17	0.35	-0.18	0.08	0.11
Momentum	Momentum	0.10	-0.05	0.12	0.09	0.26	-0.10	-0.14	-0.03	-0.03
Volatility	Beta	0.22	-0.16	-0.02	0.08	-0.34	-0.78	-0.41	-0.16	-0.11
	Residual Volatility	0.01	-0.02	0.23	0.07	0.04	-0.25	-0.11	-0.09	-0.04
Quality	Leverage	-0.01	-0.04	-0.37	-0.15	-0.11	0.03	-0.11	0.08	-0.11
	Profitability	-0.20	0.15	0.42	0.00	0.30	0.21	0.48	0.07	0.28
	Earnings Variability	0.12	-0.13	0.27	0.10	-0.05	-0.22	-0.35	-0.14	-0.07
	Earnings Quality	0.19	-0.04	-0.22	-0.02	0.01	0.04	-0.26	-0.02	-0.06
	Investment Quality	0.10	-0.01	-0.25	0.03	0.00	0.14	0.20	0.06	-0.09
Yield	Dividend Yield	0.10	-0.09	-0.76	-0.25	-0.25	0.16	0.01	0.37	-0.30
Growth	Growth	-0.03	0.04	0.38	0.06	0.17	-0.19	-0.03	-0.13	0.14
Liquidity	Liquidity	0.07	-0.07	0.01	-0.11	0.01	-0.07	-0.28	-0.08	-0.04
	Number of Funds	**121**	**55**	**9**	**40**	**4**	**7**	**5**	**79**	**133**
	AUM $B	**161.7**	**69.0**	**10.8**	**37.4**	**0.5**	**1.3**	**3.1**	**61.2**	**167.0**
	Number of Stocks	**5182**	**2102**	**750**	**3988**	**656**	**695**	**236**	**1445**	**3398**
	Effective Number	**332**	**229**	**162**	**783**	**213**	**209**	**75**	**196**	**375**

-3 -2 -1 0 1 2 3

<-Large negative exposure Large positive exposure ->

Source: MSCI Peer Analytics, as of December 31, 2016

Not surprisingly, funds tended to have large exposures to their target factors. For example, funds with "momentum" in their name had the second largest positive active exposure (0.26) to the Momentum factor, while "income" funds predictably had the largest active exposure (0.37) to the Dividend Yield factor.

Exhibit 2 also shows that many fund types had significant exposures to factors other than the one they are targeting. "Mid-cap" funds are a case in point. As expected, the largest negative/positive exposures were to the Size and Mid-cap factors, respectively. However, mid-cap funds also had large positive exposures to Profitability and Earnings Variability, and a large negative exposure to Dividend Yield. Separately, "value" funds had the largest positive exposure to Book to Price, but also a large negative exposure to Profitability. Historically, some of these untargeted factor exposures could have impaired or enhanced performance.

HOW SIGNIFICANT ARE ACTIVE EXPOSURES?

Investors can determine the significance of a fund's exposures based on its individual position weights and exposures. A fund's exposure is deemed statistically significant if its t-statistic is either above 2 or below -2.[6] Exhibit 3 displays t-statistics of factor exposures for nine aggregate portfolios.

Traditionally, mutual fund managers have been separated into "Value" and "Growth" categories. When we focus on the statistically significant positive and negative exposures, we find that value managers have shown positive exposure to the Book to Price, Price Momentum, Beta and Dividend Yield factors. In contrast, growth managers have on average displayed significant positive exposure to the Growth factor and negative exposure to the Book to Price, Earnings Yield, Beta and Dividend Yield factors.

SES factors (as described in GEMLT) offer greater granularity. Value managers experienced significant positive active exposures to Long-term Reversal, Earnings Variability, Earnings Quality and Investment Quality factors and negative exposure to the Profitability factor, while growth managers tended to have significant positive active exposures to Profitability and negative exposures to Long-term Reversal and Investment Quality.

[6] A t-statistic for a particular factor exposure can be obtained by dividing a fund's exposure by its standard deviation. The standard deviation provides a measure of variability in a fund's exposure. It will be inversely proportional to the concentration of the fund's holdings. The methodology for computing standard deviation of a portfolio exposure to a factor is discussed in Appendix 3.

Exhibit 3: T-Statistics of Active Factor Exposures of Aggregate Category Portfolios

		Key Word								
Factor Family	Factor	Value	Large	Mid	Small	Momentm	Volatility	Quality	Income	Growth
Value	Book to Price	8.52	-3.64	-4.48	2.91	-5.89	-2.70	-3.73	-2.21	-6.06
	Earnings Yield	1.76	-0.47	-5.69	-2.87	-1.98	-0.57	0.38	1.05	-2.45
	Reversal	3.72	-0.67	-4.63	0.89	-3.89	-1.07	-1.32	0.92	-4.13
Size	Size	-1.70	0.42	-16.05	-16.60	-5.80	-6.41	2.13	-2.78	-5.15
	Midcap	-0.47	-0.26	6.07	1.03	2.87	4.86	-1.87	1.36	2.73
Momentum	Momentum	2.42	-0.99	1.34	2.70	4.38	-1.42	-1.46	-0.47	-0.73
Volatility	Beta	5.32	-3.28	-0.24	2.26	-5.80	-10.84	-4.16	-2.70	-2.64
	Residual Volatility	0.34	-0.31	2.61	2.10	0.76	-3.49	-1.08	-1.46	-0.86
Quality	Leverage	-0.14	-0.85	-4.15	-4.17	-1.85	0.42	-1.09	1.35	-2.75
	Profitability	-4.89	2.95	4.70	0.12	5.03	2.98	4.87	1.12	6.61
	Earnings Variability	3.05	-2.51	3.09	2.77	-0.84	-3.04	-3.52	-2.36	-1.63
	Earnings Quality	4.65	-0.78	-2.53	-0.52	0.16	0.50	-2.63	-0.37	-1.56
	Investment Quality	2.53	-0.11	-2.82	0.94	-0.06	1.97	1.99	1.02	-2.23
Yield	Dividend Yield	2.51	-1.72	-8.55	-7.26	-4.22	2.18	0.13	6.30	-7.26
Growth	Growth	-0.71	0.77	4.28	1.73	2.90	-2.66	-0.26	-2.28	3.33
Liquidity	Liquidity	1.61	-1.49	0.13	-3.16	0.20	-1.01	-2.83	-1.34	-0.93

-3	-2	-1	0	1	2	3
<-Large negative exposure						Large positive exposure ->

Source: MSCI Peer Analytics, as of December 31, 2016

COMMONALITIES IN ACTIVE EXPOSURES

We now examine the exposures of a broad universe of funds over time to identify commonalities in fund active exposures, i.e., the extent to which funds' exposure to one factor is correlated with exposures to other factors. Looking at 1,315 funds' active exposures over the 13-year period, we computed average active monthly exposure (versus each fund's reported benchmark) to 16 GEMLT style factors over each fund's available holdings history. The number of months for which holdings were available varied.

Exhibit 4 shows how each active factor exposure is correlated to other active factor exposures. Looking at the first row of the matrix, the funds' correlation of average active exposures to Book to Price with their exposures to Earnings Yield was 0.47, while the correlation of Book to Price exposures with Profitability was -0.78. Examination of the first three rows (dimensions of the Value factor) suggests that funds that tilt to Value tended to have similar tilts to Earnings Quality, Investment Quality and Dividend Yield, and the opposite sign exposures to Momentum, Profitability and Growth.

Exhibit 4: Correlations of Average Active Exposures to Factors

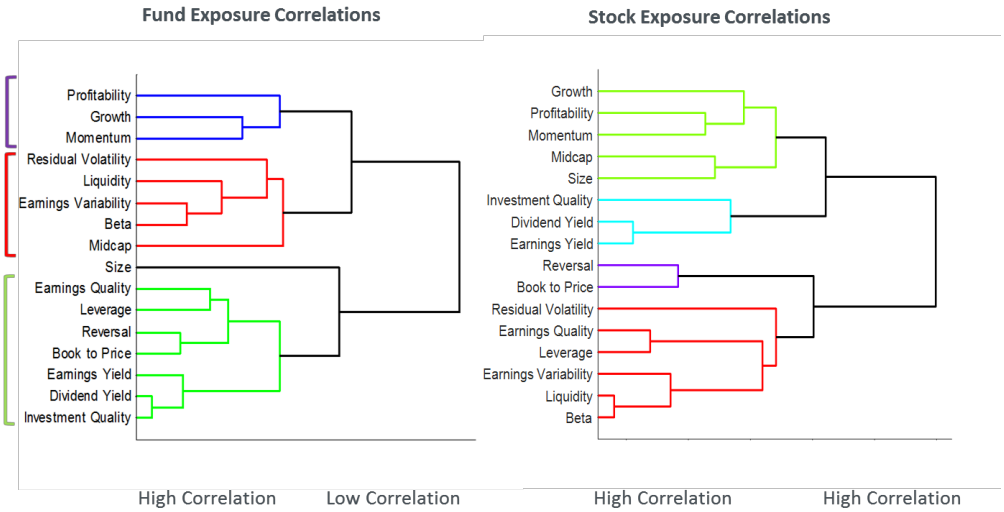
Factor Family	Factor	Book to Price	Earnings Yield	Reversal	Size	Midcap	Momentum	Beta	Residual Volatility
Value	Book to Price		0.47	0.69	-0.15	-0.08	-0.50	0.26	-0.06
	Earnings Yield	0.47		0.29	0.35	-0.23	-0.24	-0.12	-0.15
	Reversal	0.69	0.29		-0.11	-0.08	-0.61	-0.04	-0.11
Size	Size	-0.15	0.35	-0.11		-0.51	-0.03	-0.13	0.15
	Midcap	-0.08	-0.23	-0.08	-0.51		0.14	0.14	-0.17
Momentum	Momentum	-0.50	-0.24	-0.61	-0.03	0.14		0.02	0.23
Volatility	Beta	0.26	-0.12	-0.04	-0.13	0.14	0.02		0.24
	Residual Volatility	-0.06	-0.15	-0.11	0.15	-0.17	0.23	0.24	
Quality	Leverage	0.33	0.33	0.34	0.01	0.11	-0.18	-0.05	-0.14
	Profitability	-0.78	-0.27	-0.48	0.07	0.04	0.35	-0.37	0.11
	Earnings Variability	0.47	-0.18	0.18	-0.45	0.23	0.01	0.63	0.41
	Earnings Quality	0.53	0.32	0.55	0.00	0.01	-0.25	0.06	0.15
	Investment Quality	0.40	0.59	0.52	0.27	-0.27	-0.31	-0.39	-0.37
Yield	Dividend Yield	0.37	0.72	0.41	0.39	-0.30	-0.35	-0.43	-0.30
Growth	Growth	-0.55	-0.65	-0.65	-0.21	0.21	0.53	0.37	0.40
Liquidity	Liquidity	-0.02	-0.09	-0.16	-0.03	0.47	0.17	0.56	0.24

Factor Family	Factor	Leverage	Profitability	Earnings Variability	Earnings Quality	Investment Quality	Dividend Yield	Growth	Liquidity
Value	Book to Price	0.33	-0.78	0.47	0.53	0.40	0.37	-0.55	-0.02
	Earnings Yield	0.33	-0.27	-0.18	0.32	0.59	0.72	-0.65	-0.09
	Reversal	0.34	-0.48	0.18	0.55	0.52	0.41	-0.65	-0.16
Size	Size	0.01	0.07	-0.45	0.00	0.27	0.39	-0.21	-0.03
	Midcap	0.11	0.04	0.23	0.01	-0.27	-0.30	0.21	0.47
Momentum	Momentum	-0.18	0.35	0.01	-0.25	-0.31	-0.35	0.53	0.17
Volatility	Beta	-0.05	-0.37	0.63	0.06	-0.39	-0.43	0.37	0.56
	Residual Volatility	-0.14	0.11	0.41	0.15	-0.37	-0.30	0.40	0.24
Quality	Leverage		-0.46	0.09	0.42	0.28	0.41	-0.41	0.08
	Profitability	-0.46		-0.43	-0.35	-0.18	-0.25	0.39	-0.08
	Earnings Variability	0.09	-0.43		0.30	-0.39	-0.38	0.27	0.42
	Earnings Quality	0.42	-0.35	0.30		0.29	0.36	-0.39	0.18
	Investment Quality	0.28	-0.18	-0.39	0.29		0.71	-0.80	-0.41
Yield	Dividend Yield	0.41	-0.25	-0.38	0.36	0.71		-0.83	-0.29
Growth	Growth	-0.41	0.39	0.27	-0.39	-0.80	-0.83		0.37
Liquidity	Liquidity	0.08	-0.08	0.42	0.18	-0.41	-0.29	0.37	

Source: MSCI Peer Analytics, September 2003 – December 2016

In the left panel of Exhibit 5, we group exposures into clusters (groups) based on the correlations shown in Exhibit 4. Exposures that had higher correlations are paired first, e.g., Profitability and Growth at the top of the left panel of Exhibit 5 or Dividend Yield and Investment Quality at the bottom. Shorter bars indicate high correlations. For example, funds with a large active positive exposure to Profitability also had a large positve exposure to Growth. They also tended to have a large active negative exposure to Dividend Yield and Investment Quality.

Exhibit 5: Factor Groups based on Fund and Stock Exposure Correlations



September 2003 – December 2016

To a certain extent, exposures at the fund level reflect the exposures of the underlying stocks, which are shown in the right panel. While correlations at the fund and individual stock levels are similar, they are not identical. First, manager allocations to stocks may affect overall fund exposures. Second, these differences in correlations can be explained by how individual stocks' fundamentals and factor definitions vary over time.

Comparing the two panels, one can see that fund exposures to Profitability, Growth and Momentum paralleled those of individual stocks. At the same time, the delineation between Profitability and Growth versus Dividend Yield and Investment Quality was much less pronounced for individual stocks than for mutual funds.

In short, we find that active funds had significant exposures to their target factors, and that most funds also had significant exposure to others factors, including SES factors. Later, we address to what extent fund exposures are consistent with fund objectives. But the implication for asset managers is that they need to monitor and manage their exposure to factors.

Another reason for monitoring exposures to SES factors is the possibility of occasional large drawdowns, such as the August 2007 "Quant Crunch." Numerous observers believe this event stemmed from many investors attempting to simultaneously unwind positions in crowded strategies (for example, see Khandani and Lo [2011]). Since SES factors aim to

capture strategies that are widely implemented by investors, crowding is a real risk. For further information on measuring and managing crowding risk, see Bayraktar et al. (2015).

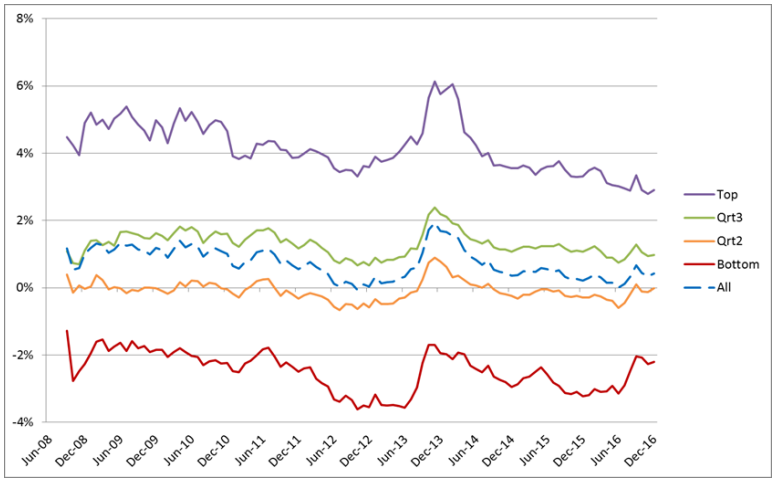
Monitoring the contribution of SES factors to fund performance and risk can help maintain alignment with the fund mandate and managing crowding risk.

DO FACTOR EXPOSURES EXPLAIN PERFORMANCE?

Managers have on average shown distinct factor exposures. But to what extent do factor exposures affect performance? Which factors have the greatest influence on returns?

We compute funds' gross active returns (returns versus the benchmark before transaction costs and fees) for five years — the standard long-term performance measurement horizon. Exhibit 6 displays 5-year active returns and summary statistics for the entire sample and by performance quartiles.[7] Over the entire period, the average trailing 5-year active performance was 73 basis points (bps) per year before transaction costs and fees, and 4.16% and -2.48% for funds in the top and bottom quartiles, respectively.

Exhibit 6: Mean 5-Year Active Annual Returns for Active Funds



	Performance Quartile				
	Bottom	2	3	Top	All Funds
Mean	-2.48%	-0.09%	1.30%	4.16%	0.73%
Median	-2.37%	-0.10%	1.25%	3.99%	0.65%
Max	-1.28%	0.89%	2.38%	6.13%	1.93%
Min	-3.61%	-0.67%	0.66%	2.79%	-0.06%

Based on trailing 5-year active returns from September 2008 to December 2016.

Returns are before transaction costs and fees.

[7] Every month, we computed a trailing 5-year active return for every fund that had monthly returns available for all of the preceding 60 months. Thus, the first 5-year period was October 2003 – September 2008. We then calculated a mean 5-year active return for these funds and a mean for each 5-year active return quartile.

DRIVERS OF RETURNS

What drove performance during this period? We examined funds' performance based on their active exposures to GEMLT factors and factor returns using two complementary approaches.[8] *Contribution fractions* (CFs) measure the impact of both stock selection and factors. The 5-year active return for our Sample Fund was 3.71%, of which stock selection contributed 5.15% and factors -1.44%. Therefore, the CFs were 0.78 and -0.22, respectively.

However, there may be instances when positive and negative contributions from stock across multiple funds and time periods cancel each other. For this reason, it may help to look at the magnitudes, i.e., the *absolute values of contribution fractions* (ACF) that sum to 1. For the Sample Fund, we use their absolute values (5.15% and 1.44%), divided by the sum of those two terms (6.59%). Thus, stock selection contributed 78% of returns while stock selection contributed 22%.

Exhibit 7: Contribution Fraction Computation Methodology

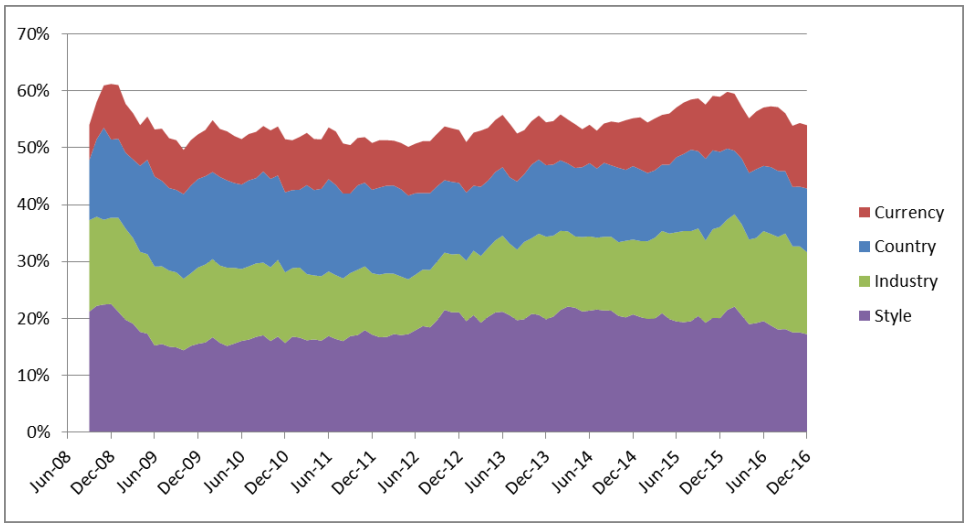
Sample Fund Contribution Analysis

	Contribution	Absolute Value	Contribution Fraction (CF)	Absolute Value (ACF)
Stock-specific	5.15%	5.15%	0.78	0.78
Factors	-1.44%	1.44%	-0.22	0.22
Total	**3.71%**	**6.59%**		**1.00**
Factor Groups				
Country	1.34%	1.34%	0.06	0.06
Currency	-7.51%	7.51%	-0.33	0.33
Industries	-4.51%	4.51%	-0.20	0.20
World	0.00%	0.00%	0.00	0.00
Style - SES	3.65%	3.65%	0.16	0.16
Style - others	5.59%	5.59%	0.25	0.25
Total	**-1.44%**	**22.60%**		**1.00**

[8] We use the Carino (1999) algorithm used in MSCI analytics products to attribute multi-month active performance to individual factors and factor groups.

Exhibit 8 shows the time series of monthly mean absolute contribution factors (ACFs) for all funds from all four factor groups defined by GEMLT. From September 2008 to December 2016 (100 months), exposure to common factors (the sum of the four groups in the exhibit) accounted on average for 55% of funds' 5-year active performance, with a range of 50% to 61%.[9] Contributions equal to or exceeding 50% for the entire period underscore the importance of factor exposures.

Exhibit 8: Mean Absolute Contribution Fraction by Factor Group



If we look solely at the four different types of factors – countries, currencies, industries and styles — how important were *style factors*? Exhibit 8 shows that based on *absolute contributions*, style factors dominated factor returns, with a mean of 34% and a range of 28%–41% over the study period. Next were country and industry factors with mean contributions of 25% and 24%, respectively.

We now look at performance for the whole universe and by quartiles using contribution factors (taking contribution signs into account), providing deeper insight into the contributions made by different types of factors. When signs of contributions are taken into account, factor contributions explain even larger fractions of active returns. In Exhibit 9,

[9] Mean factor ACF was comparable for the funds across performance quartiles. n the top and bottom performance quartiles, mean factor ACF was 57% and 54%, respectively, with the bottom quartile in particular experiencing larger fluctuations.

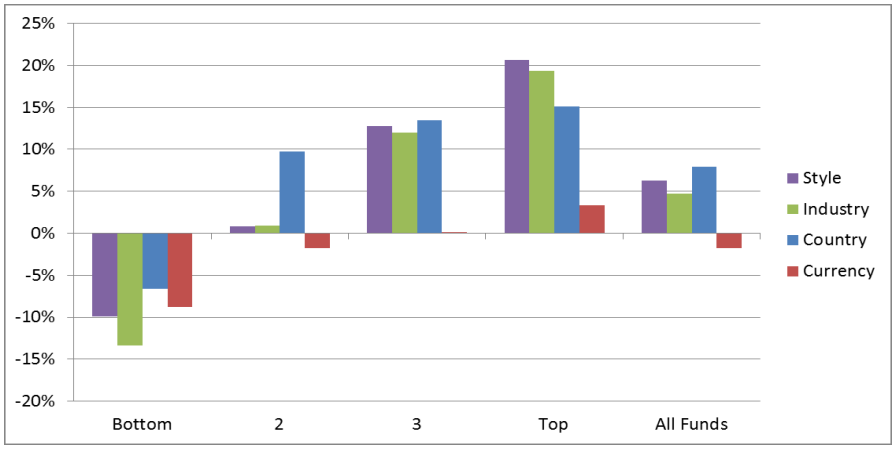
factor contributions, on average, have been positive for most of the funds (top three quartiles), while the stock-specific contribution has had greater variability — positive for the top two quartiles and negative for the rest.

Exhibit 9: Mean Contribution Fraction - Factors vs. Stock-Specific (by Quartile)

September 2003 – December 2016

When we analyze the type of factor by contribution fractions, we see that country factors had the largest contribution followed by style and industry factors (Exhibit 10). The country factor contribution, on average, has been positive for most of the funds (top three quartiles), while the style and industry factor contributions were different for the best versus worst performing funds — positive for the top two quartiles, and virtually zero and negative for the worst funds. For the top funds, style factors had the largest contribution, followed by industry factors. For the bottom funds, industry factors were the biggest detractors, followed by style factors.

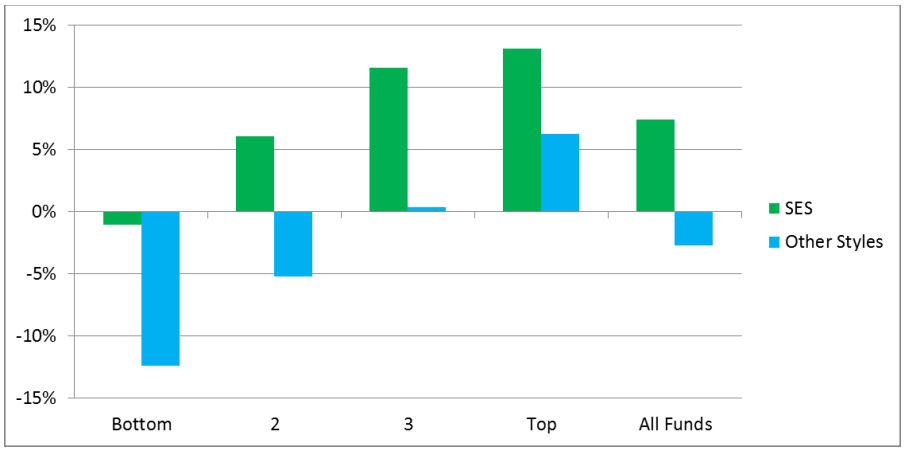
Exhibit 10: Mean Contribution Fraction by Factor Group (by Quartile)



In short, we found that, based on absolute contribution fractions, 16 Style factors (including both SES and non-SES factors) collectively had the largest impact on a typical fund's performance.

When we dig deeper, we see that eight of the style factors based on Systematic Equity Strategies on average accounted for 54% of the total style contribution (using absolute values). Using mean contribution factors (Exhibit 11), we see that both SES and other style factors became increasingly more positive contributors to performance from the worst- to the best-performing funds.

Exhibit 11: Mean Factor Contribution - SES vs. Other Style Factors (by Quartile)



These findings underscore how SES factors have contributed to the performance and risk of active portfolios.

INDIVIDUAL STYLE FACTORS

Which of the 16 style factors were most significant in explaining active performance? We examine individual factor contribution fractions and their absolute values. To simplify the analysis, we condense factors, based on our classification scheme, into eight families that approximately correspond to investment styles.[10]

Exhibit 12 displays mean contribution fractions grouped by factor families across performance quartiles. We see that managers' exposures to Price Momentum and Quality-SES factors (largely the Profitability factor) on the positive side and Volatility and Dividend Yield on the negative side were among the key drivers of active performance. For Price Momentum and Quality-SES, the positive contribution improved steadily going from the worst- to the best-performing funds. Similarly, the negative impact of Volatility factors (Beta and Residual Volatility) declined across performance quartiles.

Exhibit 12: Mean Factor Contribution - Style Factor Families

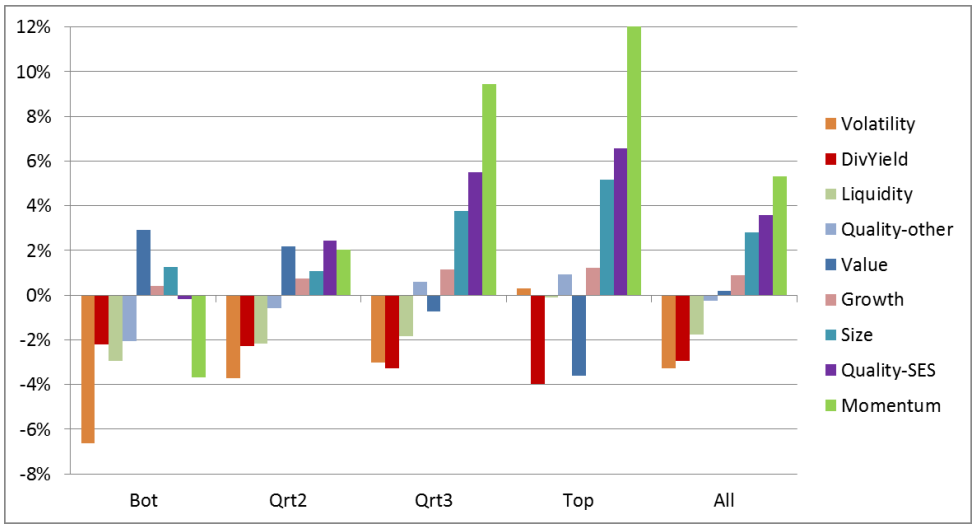


Exhibit 13 indicates how many managers benefitted from exposure to a particular factor family. The average percentages are consistent with Exhibit 12, as the percentage of funds with positive contributions from a particular factor increases with the average factor

[10] See Appendix 5 for an example of our individual style factor contribution methodology. Among the five factors in the Quality family, the top two factors, Leverage and Earnings Variability, are non-SES factors, while the other three are SES factors.

contribution. It highlights the importance of the Momentum factor (the second most volatile factor in GEMLT) in differentiating between top- and bottom-performing funds. We note a large difference between the top- and bottom-performing funds in the percentage with a positive contribution from the Momentum factor (74% vs. 44%); the difference in the Quality-SES was smaller (57% vs. 49%).

We also note a narrower range among the top- and bottom-performing funds for the Volatility factors. The Volatility factor family consists of Beta and Residual Volatility factors, the second and third most volatile factors, respectively. The difference in the Beta fraction is more pronounced (55% vs. 36%) for the top and bottom managers, while the Residual Volatility fraction is much more consistent, falling in the 42%-48% range across quartiles.

Exhibit 13: Average Percentage of Funds with Positive Contribution

	Div Yield	Volatility	Liquidity	Value	
Bottom	45%	42%	25%	51%	
Qrt2	41%	43%	33%	50%	
Qrt3	36%	43%	33%	45%	
Top	31%	49%	49%	40%	
All	38%	44%	35%	46%	
	Quality-other	Growth	Size	Quality-SES	Momentum
Bottom	42%	54%	57%	49%	44%
Qrt2	48%	58%	56%	51%	55%
Qrt3	51%	68%	66%	56%	68%
Top	51%	70%	71%	57%	74%
All	48%	63%	63%	53%	60%

CONTRIBUTIONS FROM FACTORS NOT CONSISTENT WITH FUND OBJECTIVES

Sometimes, funds receive significant contributions from factors that may not be consistent with their fund objectives.

To illustrate this point, we examined the performance of value funds. When we look at the mean absolute fractions, we find the absolute factor contributions for value funds are comparable to those for non-value funds. Strikingly, contributions from Momentum, Quality-SES (mostly the Profitability factor) and Volatility were larger than the contributions from the Value factors (Exhibit 14).

A similar pattern appears when we look at factor contributions with signs taken into account. Exhibit 15 shows that value managers realized a more positive contribution from the Quality-SES (mostly the Profitability) factors than from the Value factor. When compared to non-value funds, value funds received a greater positive contribution from the Dividend Yield factor, and a more negative contribution from the Momentum factor. Exhibit 16 shows the average percentages of value funds and others that had positive contributions from particular factors. The fractions were consistent with the previous panel, as at least 60% of value funds had positive contributions from Value, as well as the Profitability and Dividend Yield factors, and 44% and 46% from Volatility and Price Momentum, respectively.

Exhibit 14: Mean Absolute Factor Contribution – Value Funds

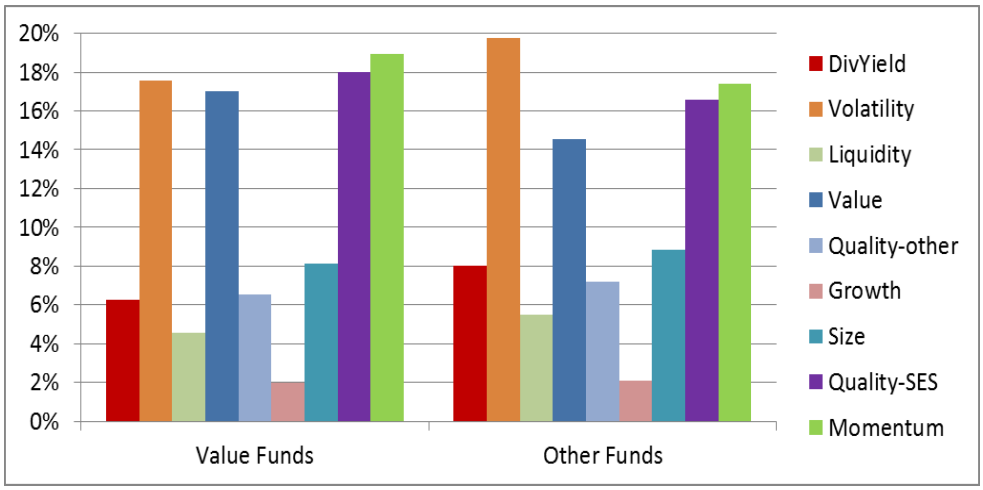


Exhibit 15: Mean Factor Contribution – Value Funds

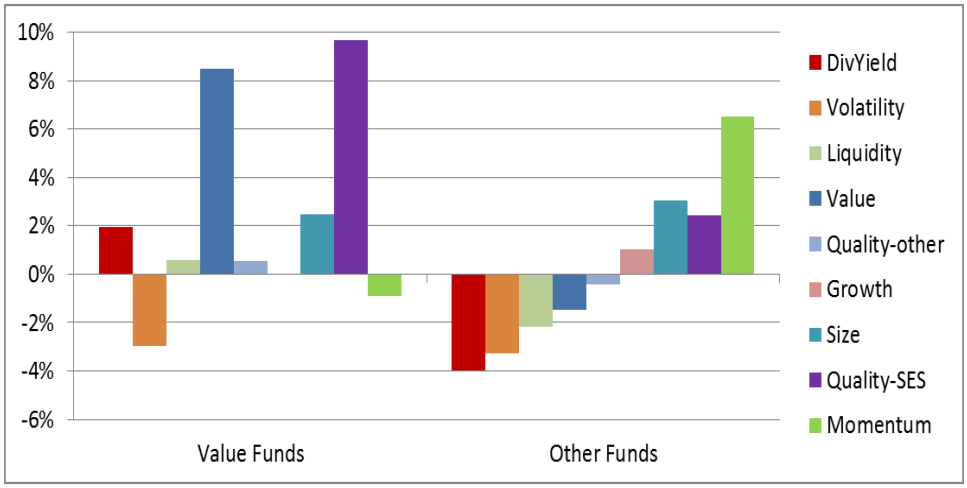


Exhibit 16: Average Fraction of Funds with Positive Contribution – Value Funds

	Div Yield	Volatility	Liquidity	Value	
Value Funds	60%	44%	53%	63%	
Other Funds	34%	44%	31%	43%	
	Quality-other	Growth	Size	Quality-SES	Momentum
Value Funds	53%	53%	63%	69%	46%
Other Funds	47%	47%	63%	50%	63%

HOW DO EXPOSURES COMPARE WITH FACTOR INDEXES?

Global funds, unlike their U.S. counterparts, are typically benchmarked against core indexes, not style indexes. We examine the effect of "benchmark mismatch" by first comparing value funds' active exposures against their chosen benchmark versus the MSCI Enhanced Value Index.[11] Exhibit 17 displays active exposures and t-statistics of the aggregate holdings of 121 value funds from Exhibits 2 and 3. The two leftmost columns show exposures against the chosen (mostly core) benchmarks, while the two rightmost columns display exposures against the corresponding rule-based MSCI Enhanced Value Indexes.

When compared to style-specific MSCI Enhanced Value indexes, the exposures for the two target factors, Book to Price and Earnings Yield, changed from significantly positive to significantly negative. We also see significant sign reversals for Volatility factors (Beta and Residual Volatility) and most Quality factors. These findings underscore the importance of using an appropriate benchmark, consistent with a fund's investment style.

[11] The MSCI Enhanced Value Indexes are designed to represent the performance of companies that exhibit relatively higher value characteristics based on several value descriptors and mirror the parent index's sector allocation.

Exhibit 17: Value Funds - Average Active Exposures vs. Different Benchmarks

Factor Family	Factor	Active Exposure vs. Chosen Bmk	T-stat	Active Exposure vs. MSCI Enh Value	T-stat
Value	Book to Price	0.34	8.52	-0.26	-3.91
	Earnings Yield	0.07	1.76	-0.22	-3.28
	Reversal	0.15	3.72	0.04	0.61
Size	Size	-0.07	-1.70	-0.05	-0.73
	Midcap	-0.02	-0.47	-0.05	-0.74
Momentum	Momentum	0.10	2.42	0.06	0.96
Volatility	Beta	0.22	5.32	-0.18	-2.64
	Residual Volatility	0.01	0.34	-0.16	-2.31
Quality	Leverage	-0.01	-0.14	-0.20	-2.92
	Profitability	-0.20	-4.89	0.02	0.23
	Earnings Variability	0.12	3.05	-0.13	-1.95
	Earnings Quality	0.19	4.65	-0.05	-0.78
	Investment Quality	0.10	2.53	0.06	0.97
Yield	Dividend Yield	0.10	2.51	0.02	0.28
Growth	Growth	-0.03	-0.71	0.07	0.98
Liquidity	Liquidity	0.07	1.61	-0.15	-2.18

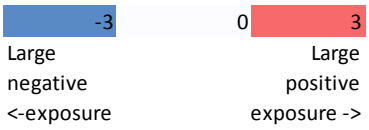


Exhibit 18 compares value funds' performance against alternative benchmarks. The Value column shows 5-year active performance (versus the fund's reported benchmark) of 121 value funds (mean, median, etc.). We then re-compute active performance against a corresponding MSCI Enhanced Value Index. For example, if a fund's original benchmark was EAFE, we re-compute its active performance against the EAFE Enhanced Value Index. Exhibit 18 shows that the average 5-year active performance for value funds was comparable during the 13-year period.

Exhibit 18: Value Funds' Active Returns vs. Different Benchmarks

	Value	Value vs. MSCI Enh Value Index
Mean	0.80%	0.73%
Median	0.69%	1.20%
Max	2.11%	2.54%
Min	0.04%	-2.54%
Std Dev	0.54%	0.45%

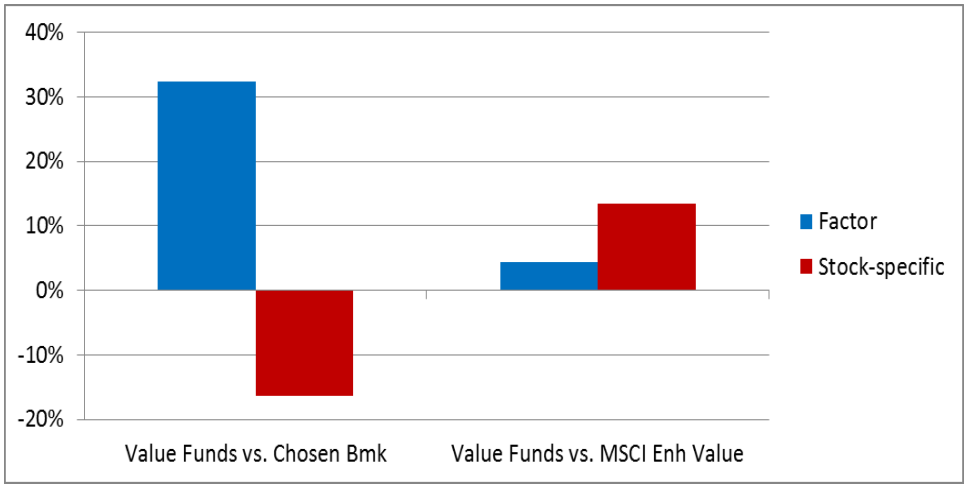
Based on trailing 5-year active returns from September 2008 to December 2016.

Returns are before transaction costs and fees. Past performance is not indicative of future performance.

However, using a style benchmark, such as the MSCI Enhanced Value Index, instead of a core benchmark tells a very different story, as seen in Exhibit 19. When the original core benchmarks are used, factors make a positive contribution, while the stock-specific contribution is negative. In particular, Value and Quality-SES (Profitability, Earnings Quality, and Investment Quality) have the largest positive impacts on performance. When a corresponding MSCI Enhanced Value index is used as the benchmark, the factor contribution diminishes drastically, while the stock-specific contribution becomes positive and exceeds the factor contribution. Exhibit 20 shows that the difference is driven by the effect of the target Value factors. For an active stock-picking manager, this analysis can be very helpful in explaining returns to clients.

The selection of a benchmark consistent with fund objectives is essential in measuring and attributing active performance.

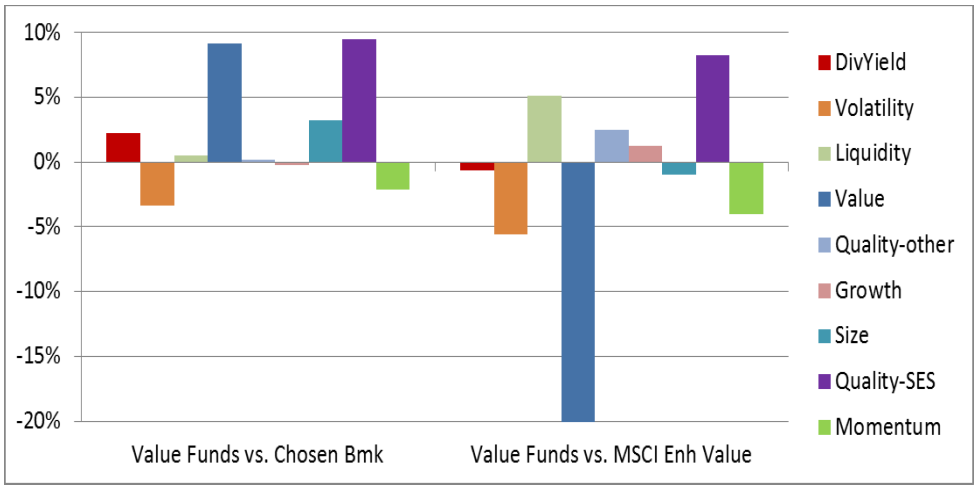
Exhibit 19: Mean Factor Contribution – Factor vs. Stock-specific



Based on trailing 5-year active returns from September 2008 to December 2016.

Returns are before transaction costs and fees. Past performance is not indicative of future performance.

Exhibit 20: Mean Factor Contribution – Style Factor Families



Based on trailing 5-year active returns from September 2008 to December 2016.

Returns are before transaction costs and fees. Past performance is not indicative of future performance.

CONCLUSION

Most active portfolios we studied had significant exposure to SES factors, irrespective of the underlying investment process. We showed that fund exposures to common factors have had a larger impact on active manager performance than stock-specific exposures — 55% vs. 45% on average. Among factor groups, fund exposures to style factors were the largest contributors, accounting for 34% of the total factor contribution, with SES factors explaining the majority of the style contributions (54%).

Using a complementary analysis that takes the signs of contributions into account, factors explain an even larger fraction of active returns. Factor contribution has been positive, on average, for most funds (top three performance quartiles), while stock-specific contribution has had greater variability – positive for the top two performance quartiles and negative for the rest.

Exposures to factors different from managers' investment objectives have had significant impacts on performance. In the case of value funds, when we look at the contribution to performance of different style factors, Volatility, Price Momentum and Profitability made larger contributions (19%, 18% and 17%, respectively) than the Value factor (15%).

Finally, using value funds as an example, we showed how MSCI Factor Indexes may be used to address potential benchmark mismatches between manager investment styles and their chosen benchmarks, and to better understand the drivers of investment performance.

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APPENDIX 1: SYSTEMATIC EQUITY STRATEGIES AS RISK FACTORS

Systematic Equity Strategies (SES) refer to the systematic (i.e., rules-based or computer-based) implementation of fundamental or technical investment anomalies/strategies. The concept of Systematic Equity Strategies was introduced and discussed by Bayraktar, Radchenko, Winkelmann and Zangari (2013) and is implemented in the recently introduced Barra equity models.[12] The MSCI Global Total Market Equity Model (GEM) includes these strategies as style risk factors. The following Systematic Equity Strategy factors are incorporated:

- Dividend Yield: Captures differences in stock returns attributable to the stock's historical and predicted dividend-to-price ratios.
- Earnings Yield: Describes stock return differences due to various ratios of the company's earnings relative to its price.
- Profitability: A combination of profitability measures that characterizes the efficiency of a firm's operations and total activities.
- Earnings Quality: Explains stock return differences due to the uncertainty around company operating fundamentals (sales, earnings, cash flows) and the accrual components of their earnings.
- Investment Quality: A combination of asset, investment and net issuance growth measures that captures common variation in stock returns of companies experiencing rapid growth or contraction of assets.
- Momentum: Explains common variation in stock returns related to recent (12-month) stock price behavior.
- Long-Term Reversal: Explains common variation in returns related to long-term (5-year ex. recent 13 months) stock price behavior.
- Value: Captures the extent to which a company is overpriced or underpriced, using a combination of several relative valuation metrics and one structural valuation factor.

Value, Earnings Yield, Dividend Yield and Momentum are available in the predecessor model, GEM3, but Profitability, Earnings Quality, Investment Quality and Long-Term Reversal

[12] Systematic Equity Strategies were introduced in the recently released US Total Market Equity Model, as well as the Barra Japan Equity Model (JPE4), the Barra Korea Equity Model (KRE3), the Barra US Sector Equity Models (USSM1), the Barra US Small Cap Equity Model, and the Barra Emerging Market Equity Model (EMM1).

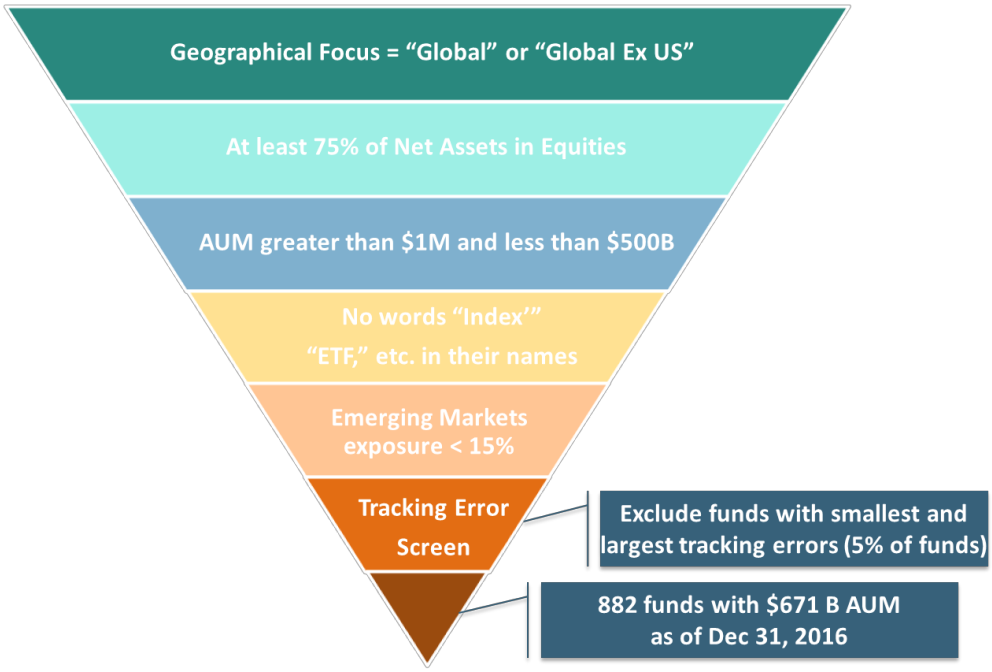
are new additions. These factors are also commonly employed by investment practitioners, either as factors in the quantitative process, or as screens for fundamental managers.

The MSCI Global Total Market Equity Model allows investors to measure their exposure to popular but potentially crowded investment strategies. Furthermore, asset managers can attribute realized risk and returns to these factors and obtain more meaningful insights into drivers of their investment strategies.

Including these Systematic Equity Strategy factors in a risk model can lead to more accurate risk forecasts and enhanced portfolio performance, particularly for portfolios that are based on a systematic investment approach.

APPENDIX 2: PEER ANALYTICS DATASET

Exhibit A1: Fund Selection Criteria



BENCHMARKS AND CLASSIFICATION

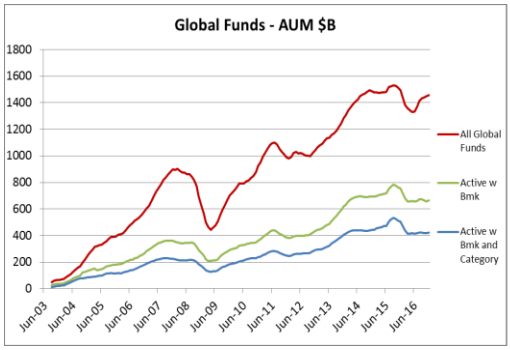
As of December 31, 2016, the dataset contained 882 funds with AUM of $671 billion. Nearly two-thirds of the AUM (63%) of diversified global funds that provided their benchmark is managed versus The MSCI World Index and 31% versus the MSCI ACWI Index. 68% of diversified global funds that provided their benchmark are managed against the MSCI World Index, 22% versus the MSCI ACWI Index, and 10% against other benchmarks.

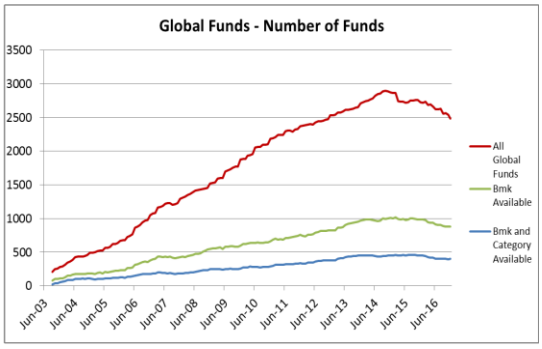
To capture self-classification, we screened the fund name for specific keywords: Value, Large, Mid, Small, Volatility, Momentum, Quality, Income/ Dividend and Growth. In addition to self-classification, we also used the Lipper US Mutual Fund classification:

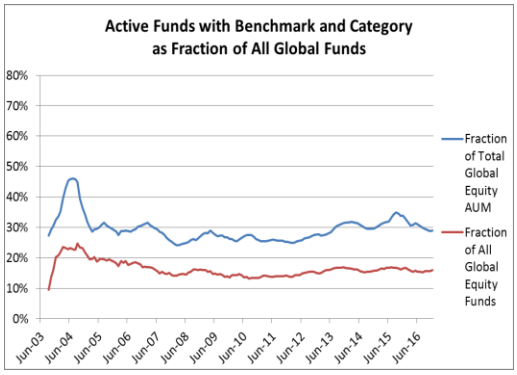
- Value, Core, Growth
- Large, Small/Mid, Multi
- Income

As of December 31, 2016, 399 funds were assigned to categories (53 with more than one keyword) with AUM of $434 billion. Most global style funds use core benchmarks; this results in larger active exposures for global style funds (versus U.S. funds) to their target factor.

Exhibit A2: Global Funds Data







APPENDIX 3: DEFINITION OF SIGNIFICANT FACTOR EXPOSURE

In order to facilitate comparison across style factors, individual stock factor exposures are standardized to have a cap-weighted mean of 0 and an equal-weighted standard deviation of 1.

Portfolio exposure to a particular factor = $\sum_{i=1}^{n} wi$* Xi where wi are individual stock weights and Xi are individual stock exposures.

Assuming stock exposures are independent and have identical distributions,

Variance of portfolio exposure = $\sum_{i=1}^{n} w_i^2$* Var(X_i) = $\sum_{i=1}^{n} w_i^2$

The weight of each stock in an equal-weighted portfolio with n stocks is 1/n. Therefore, variance of an equal-weighted portfolio's exposure = $\sum_{i=1}^{n} w_i^2$ = n$\frac{1}{n^2}$ = 1/n and its standard deviation = $1/\sqrt{n}$.

Equivalently, Variance of Portfolio Exposure can be expressed in terms of Effective Number of Stocks (EN). Effective number of stocks (EN) is a measure of portfolio concentration and ranges between 1 (for a single stock) and the number of stocks in the index (for an equal-weighted index). Generally, the lower the EN, the more concentrated an index:

EN = $1 / \sum_{i=1}^{n} w_i^2$, where wi are the weights of the n stocks in the portfolio.

Variance of Portfolio Exposure with n stocks = $\sum_{i=1}^{n} w_i^2$ = 1/EN and Standard deviation of Portfolio Exposure with n stocks = $1/\sqrt{EN}$.

Example 1:

An equal-weighted portfolio with 100 stocks will have a factor exposure with a standard deviation of $1/\sqrt{100}$ = 0.1

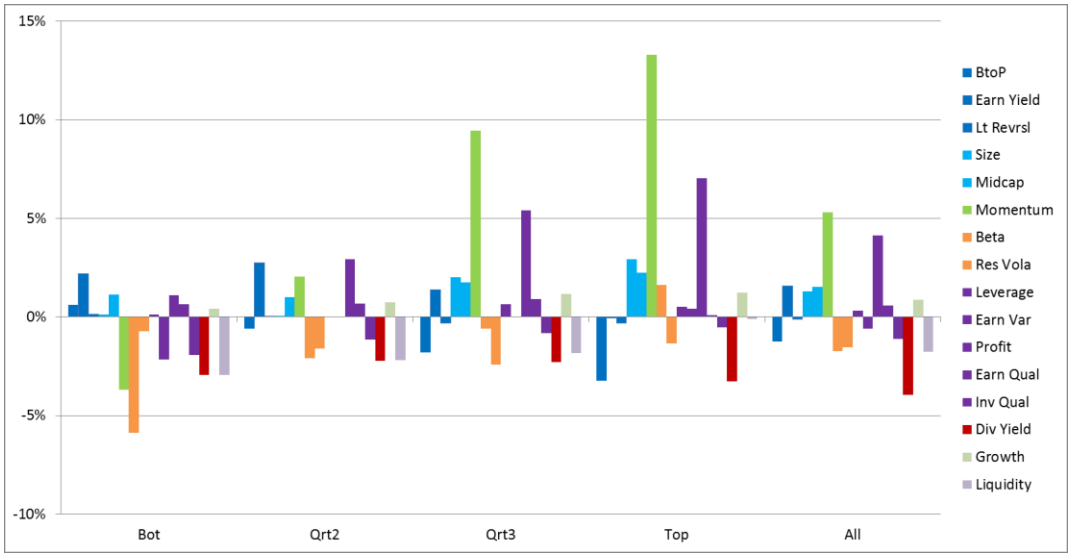
An exposure less than or equal to -0.2 or greater than or equal to 0.2 would be statistically significant at the 95% level.

Example 2:

An equal-weighted portfolio with 1600 stocks in the MSCI World index will have a factor exposure with a standard deviation of $1/\sqrt{1600}$ = 0.025. The cap-weighted MSCI World index has 1645 stocks. Based on individual stock market capitalizations, its EN = 361 names. Therefore, its factor exposure has a standard deviation of $1/\sqrt{361}$ = 0.053.

APPENDIX 4: ADDITIONAL CONTRIBUTION ANALYSIS

Exhibit A3: Mean Factor Contribution – by Style Factor



APPENDIX 5: INDIVIDUAL STYLE FACTORS - CONTRIBUTION FRACTION COMPUTATION METHODOLOGY

Exhibit A4: Contribution Fraction Computation Methodology

Sample Fund Contribution Analysis

	Style Factors	Contribution	Absolute Value	Contributi Fraction (CF)	Absolute Value (ACF)
Value	Book to Price	-0.12%	0.12%	-0.01	0.01
	Earnings Yield	-0.55%	0.55%	-0.03	0.03
	Long-Term Reversal	1.84%	1.84%	0.09	0.09
Size	Size	1.66%	1.66%	0.08	0.08
	Midcap	1.56%	1.56%	0.08	0.08
Momentum	Momentum	-1.86%	1.86%	-0.09	0.09
Volatility	Beta	-1.32%	1.32%	-0.07	0.07
	Residual Volatility	3.20%	3.20%	0.16	0.16
Quality	Leverage	0.30%	0.30%	0.02	0.02
	Earnings Variability	1.27%	1.27%	0.06	0.06
	Profitability	0.39%	0.39%	0.02	0.02
	Earnings Quality	0.20%	0.20%	0.01	0.01
	Investment Quality	1.98%	1.98%	0.10	0.10
Yield	Dividend Yield	1.77%	1.77%	0.09	0.09
Growth	Growth	-1.36%	1.36%	-0.07	0.07
Liquidity	Liquidity	0.27%	0.27%	0.01	0.01
	Total	**9.24%**	**19.66%**		**1.00**

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