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US Quant Research

Do Moving Average Crossover Signals Work in Equities?

We study moving average crossover signals for equity cohorts based on 10-240 day moving averages. The most significant signals are infrequent and last only a month, but have large-magnitude expected returns. They are also complementary to macro signals and prior cohort returns.

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Forecasting Equity Cohort Returns with Moving Average Crossover Signals

A number of managed futures funds and some technical equity traders, and even some fundamental portfolio managers who may not fully admit it, use signals based on moving averages of past prices to make allocation decisions. When a "fast" moving average (say 20 days) crosses from below to above a "slow" moving average (some longer period, say, 120 days), that is interpreted as a buy signal. Conversely, a cross from above to below is used as a sell signal. These signals are binary and do not have set horizons - trades are left on until the opposite cross occurs, or until a risk-based exit is triggered. These features make it more challenging to integrate crossover signals into the typical (monthly) factor model framework used by many equity investors for alpha and risk.

In this note, we construct monthly factors based on moving average crossover signals for 48 equity cohorts. These cohorts include the 10 GICS sectors, plus style, quality, momentum, yield, beta and cyclical/defensive categories. Positive and negative crosses are treated separately, and we use 13 combinations of fast and slow averages, from 10/20 trading days to 60/240 trading days. We then construct three types of 0/1 signal for each crossover on a monthly frequency: (1) crosses occurring in the past 3 months; (2) crosses in the last month; and (3) crosses in the last 5 trading days of the most recent month. For each cohort, we then test the correlations with future 1, 3, 6 and 12 month returns.

Main Results:

- **Signal efficacy is limited to one month.** At 3-month horizons, few signals are significant, and just as many have the "wrong" sign as have the expected sign. At 6 months or longer, signals are not significant.

- **Negative signals are generally stronger than positive ones**. Significant negative crossover signals outnumber significant positive ones by a ratio of 3:2, although expected-return magnitudes are similar for positive and negative signals.

- **The greatest concentration of significant signals have fast moving averages of 10 days and slow moving averages of 30-60 days; many**

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investors seem to use 50 vs. 200 or longer horizons that our work shows
are less effective.

- **The models have the most explanatory power for mid/large cap
spreads, momentum, junk equities, discretionary and industrials.
Cohorts with weak explanatory power from crossover signals include:
technology, high beta, high quality, financials sector and up
momentum (past winners).**

- Expected month-ahead cohort returns associated with last-5-day signals
range from 2% to 10% and -2% to -10%; monthly and quarterly signals are
much weaker, with magnitudes generally below 2%.

- **For April,** seven cohorts have at least one non-zero crossover signal,
including large-cap and junk cohorts with around 5% expected return each.

- Adding macro variables (such as changes in rates, currencies and
commodities) to the set of predictive variables, along with prior cohort returns
only minimally decreases crossover signal strength: of the 103 crossover
signals in the 48 multi-factor crossover models, 87 survive when macro and
past return factors are added. Factors in the "last 5 days" category are
attenuated more than last month or last quarter factors when macro and past
returns are added.

**Summary: Signals based on moving average crossovers produce
occasional high-return, high-risk signals for month-ahead returns of
equity cohorts. Investors who are systematic in identifying these
signals for a large number of equity cohorts, and who act promptly on
them can complement their existing factor timing and idiosyncratic
alpha strategies.**

**Equity Markets Rebound in March as Value Continues its Stealthy
Rebound**

While the S&P 500 rose 6.6% last month to return to positive territory for
2016, there was some unusual microstructure for such a strong rally:
defensives outperformed cyclicals, and accruals was the best quant factor
(and low sales variability was also rewarded). **Accruals** (stocks with
disconnects between earnings and cash flows) has been one of the strongest
factors so far in 2016, and we have included a screen of large stocks in the
bottom quintile of accruals, where the risk of underperformance is greatest.

Investors did not show any market cap preference in March, but they once
again favored **value stocks over growth** stocks. There has been something of
a value rally over the last 3-6 months that is much clearer on a beta and size
adjusted basis than on a raw basis. In March, for example, the raw value-
growth spread was up just 71 bp, while the value-growth residual was up
3.0%. Over the last 12 months, growth still leads value by a wide margin.

Within the style buckets, persistent growth stocks - those that have been in our
growth category for at least 48 months - have lagged recent or newly minted
growth stocks and non-growth stocks, while persistent growth stocks have

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consistently outperformed growth stocks and lapsed growth stocks.

Junk modestly outperformed high quality, but performance was not monotone by quality quartile, making conclusions on quality somewhat tenuous. March was a strong month for high beta stocks, above and beyond the market's gain.

Our short-term alpha model (MOST) had a good month, generating 64 bp of alpha in its Q1-Q5 spread, while our longer term model (BEST) lost 17bp of alpha. Over the last year, MOST has an 8.9% cumulative alpha, compared with 5.5% for BEST.

Hedge funds appear to have continued to struggle with alpha generation in last month's rally. We estimate that the HFRX Equity Hedge Index lost 6bp of alpha in March, while the HFRX Equity Market Neutral Index lost an estimated 87bp of alpha.

Do Moving Average Crossover Signals Work in Equities?

Momentum – past winners continuing to outperform, and past losers continuing to underperform – is an important tool for investing in stocks. This is true not just in the US, but globally. It is also true in other asset classes, such as rates, bonds, currencies and commodities. In fact, there is a large class of funds, called commodity trading advisors (CTAs), wherein a substantial fraction of funds use trend following as their primary strategy.

Despite a shared utilization of momentum, there are differences between trend-followers and equity investors. Trend-following funds typically invest in broad asset classes, such as sovereign bonds, equity indexes, currency pairs and commodity futures. Individual equities or sectors are generally too granular for them. These differences in asset types affect leverage, shorting and portfolio construction. In addition, the way in which trend-following CTAs define and implement momentum signals is different from that of equity investors. In this note, we explore whether the trend-following signals used by many CTAs are applicable to equities, and if so, whether they are incremental to "traditional" equity momentum.

For equity investors, momentum is based on trailing returns over a specified period, often 6 to 20 months. While there are some nuances, such as the look-back period and a possible delay between ranking and allocating to stocks, the various momentum implementations are highly correlated. Prior returns can have a continuum of values, and equity investors must decide what fractions of stocks constitute "up" and "down" momentum; e.g., the top and bottom quintiles, respectively. In fact, whether a stock has good or bad momentum can only be ascertained in the context of other stocks. Equity momentum rankings are rebalanced regularly, such as at month end. Momentum performance is then computed between rebalancing dates.

Among trend-following funds, momentum usually takes the form of discrete trade signals. **Two popular types of signals are breakouts and moving average crossovers.** Breakouts have a single parameter, the number of periods that they look back: in an N-day breakout, the investor goes long if an asset makes an N-day high, and goes short if the asset makes an N-day low. Positions are held until an opposite signal occurs: there is typically no "uninvested" state. **Moving average crossovers have two parameters: a long-term moving average (e.g., 100 trading days) and a short-term moving average (e.g., 20 days). When an asset's short term average rises above (dips below) the long-term average, it is a signal to go long (short). In both trend-following approaches, the trade signal depends only on the asset in question, not on other assets.**

Although crossover signals are binary, there is no set time frame for them. Certain types of signals may have characteristic average trade durations, but these can vary by asset, and over time for a given asset. In practice, trend-followers also exit trades based on portfolio risk considerations – using stop losses or portfolio optimizations to rebalance positions. CTAs do not require expected returns on their signals: they use them to set the direction of their exposures, then select weights based on risk and liquidity considerations.

Equity investors, on the other hand, require signals with expected returns over specific time horizons. While minimum variance portfolios are gaining popularity, most investors still forecast expected returns as part of their portfolio construction process. These expected returns for stocks or cohorts are often based on several factors – fundamental, sentiment and technical, and they need to be integrated into a single expectation. Consequently, trend-following signals need to be adapted to fit into the framework used by equity investors.

Certain features of equities may impact the effectiveness of trend-following signals. Structural difficulties with shorting individual stocks (e.g., sourcing borrow) are not present in futures trading, and may cause the signals to work differently in the long and short directions. In addition, equities exhibit short-term mean reversion, and this is a reason why traditional momentum factors often incorporate delays between ranking and trading based on momentum. It is unclear how this will affect the performance of breakout and crossover signals. Furthermore, dividends, earnings announcements, corporate actions and mergers and acquisitions may produce different subsequent behavior than does the fundamental news that drives asset class returns.

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Moving Average Crossover Signal Construction

1. Select a set of 48 equity market, sector and cohort series and compute daily total returns using cap- or equal-weights, depending on the series

2. Compute historical "price" series for each by compounding daily total returns [1]

3. Compute moving averages of the price series over **10, 20, 30, 40, 60, 120 and 240 days**

4. Combine selected moving averages in "fast" and "slow" pairs: the fast one has the shorter lookback period. Specifically, we use the following 13 combinations: **10/20, 10/30, 10/40, 10/60, 10/120, 10/240, 20/60, 20/120, 20/240, 40/120, 40/240, 60/120 and 60/240.**

5. Separately construct positive and negative crossover signals (so 26 per asset):

a. A positive crossover occurs when the fast moving average crosses from at/below the slow moving average to above it. Using a 20/120 moving average combination to illustrate the signals, a positive crossover occurs on day t, if

$$MA_{20}(t-1) \leq MA_{120}(t-1) \ AND \ MA_{20}(t) > MA_{120}(t)$$

b. Similarly, a negative crossover signal occurs on day t, if:

$$MA_{20}(t-1) \geq MA_{120}(t-1) \ AND \ MA_{20}(t) < MA_{120}(t)$$

6. Construct *monthly* factors based on crossover signals: for each asset/each crossover signal, form three indicator variables each month: one is if there has been a crossover in the last 3 calendar months; the second is if there has been a crossover in the last month; and the third is if there has been a crossover in the last 5 trading days of the month.

$$I_{M,t}^{20:120+} = \begin{cases} 1, & \text{if } MA_{20} \text{ and } MA_{120} \text{ have pos. cross-over in last month} \\ 0, & \text{otherwise} \end{cases}$$

$$I_{Q,t}^{20:120+} = \begin{cases} 1, & \text{if } MA_{20} \text{ and } MA_{120} \text{ have pos. cross-over in last quarter} \\ 0, & \text{otherwise} \end{cases}$$

$$I_{D,t}^{20:120+} = \begin{cases} 1, & \text{if } MA_{20} \text{ and } MA_{120} \text{ have pos. cross-over in last 5 days of month} \\ 0, & \text{otherwise} \end{cases}$$

7. Test the indicator variables for future month, quarter, 6-month and 12-month cohort return forecasts

Moving Average Signals for Equity Cohorts

In this section, we characterize the moving average signals for equity cohorts: the frequency and spacing of signals, and differences among cohorts and positive/negative crosses.

For each cohort, we show the average time (trading days) between signals, taken as the median average time across all 26 moving average crossovers. **There are more frequent crossover signals for small-caps, cyclicals, energy, growth and tech cohorts, and less frequent signals (about 1.5-2.0x as long a time between signals) for low beta, high quality, high yield and staples cohorts (Exhibit 1).** Since we used total returns, rather than price returns to construct the "price" series for the cohorts, there does not appear to be

a mechanical explanation for the difference in signal frequency but rather less cyclical underlying businesses and fundamentals.

Exhibit 1: Cyclicals, Energy, Growth and Tech Cohorts Have More Frequent Crossover Signals than Low Beta, High Yield and High Quality Cohorts
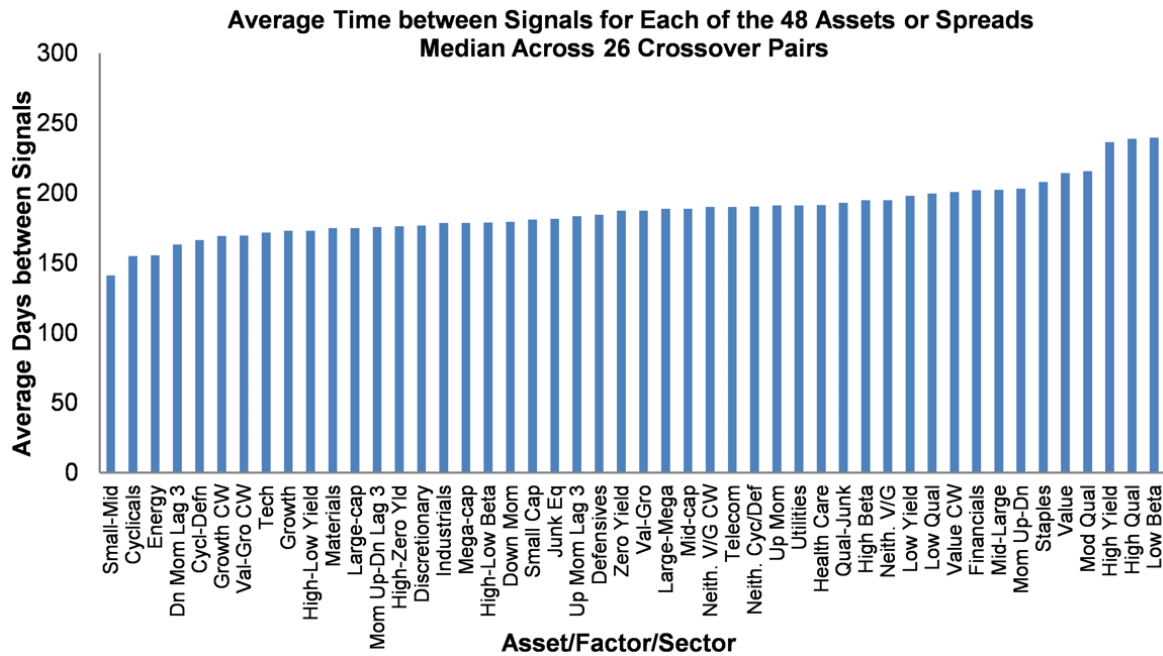
Source: ClariFI, Morgan Stanley Research

The range between the closest together and farthest apart consecutive signals is also wider for high yield, mega-cap, moderate quality and staples cohorts, and shorter for growth, zero yield, high beta and small cap cohorts (Exhibit 2).

Exhibit 2: Growth, Zero Yield and High Beta Cohorts Have a Much Lower Range of Days between Signals than High Yield, Mega-Cap, Staples and Moderate Quality Cohorts
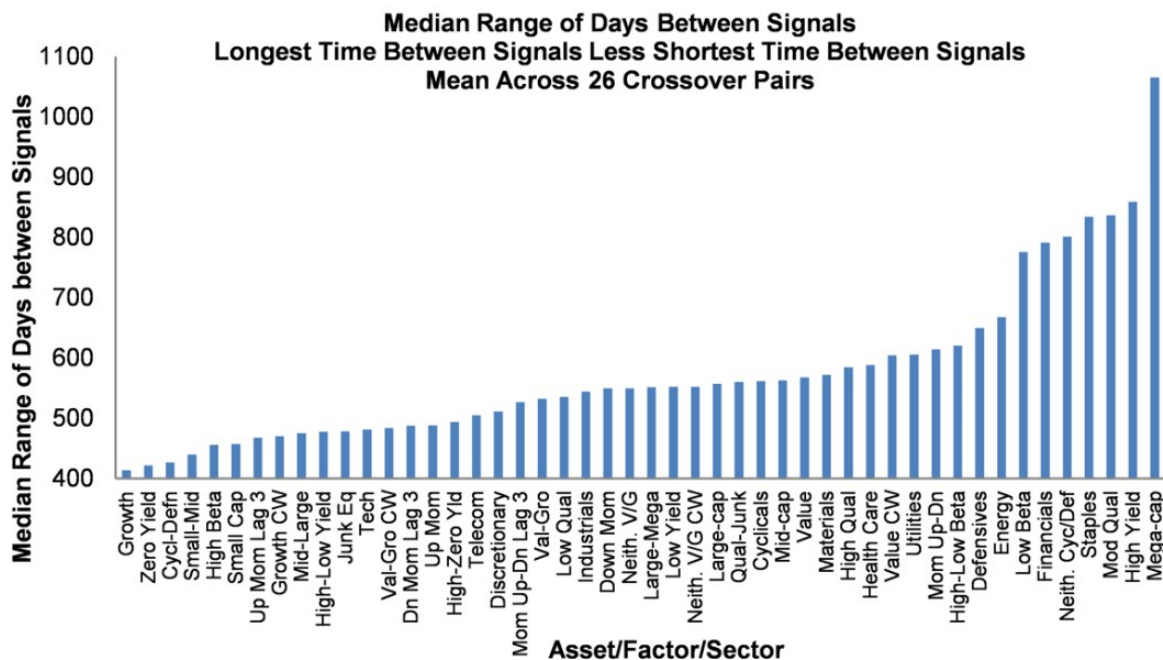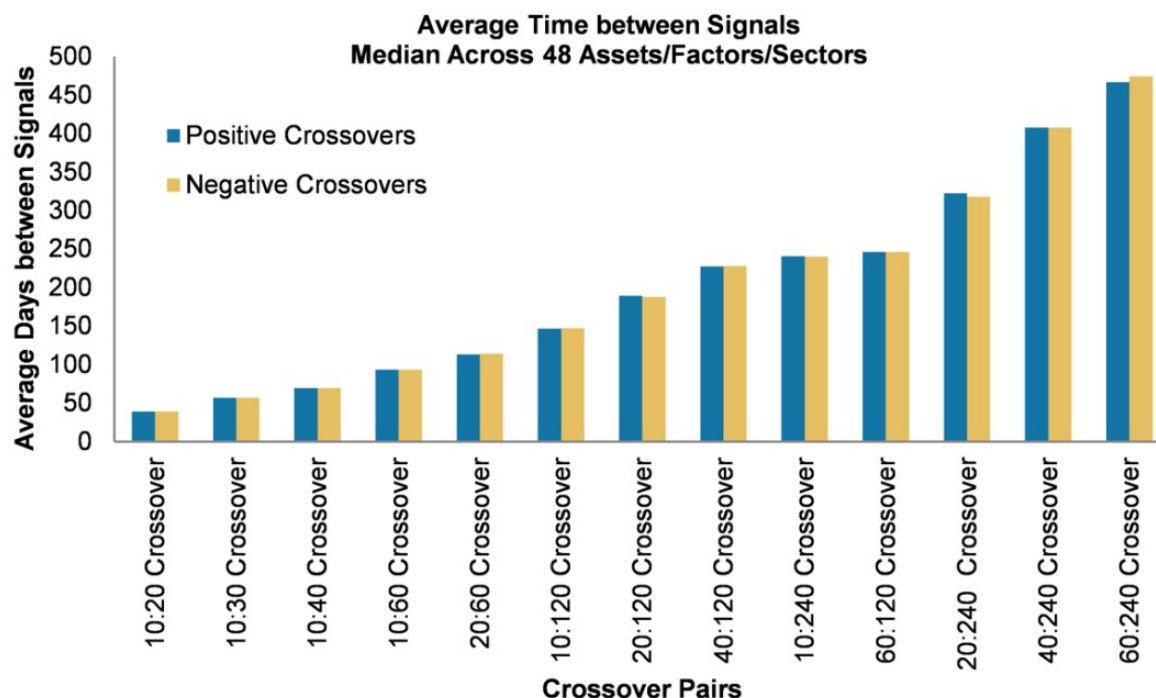

Source: ClariFI, Morgan Stanley Research

The average number of days between signals (taken as the median across all 48 cohorts for each moving
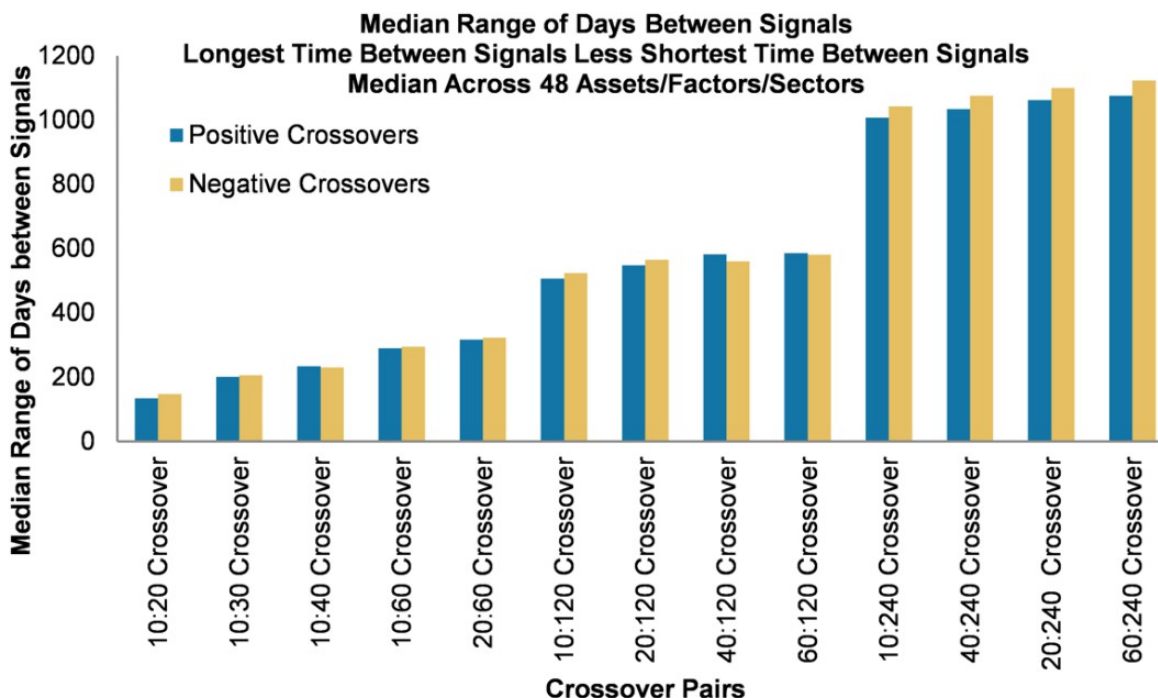
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average pair) increases with both the fast and slow moving average periods. Neither moving average (slow or fast) appears to dominate, as the ordering of signals' average spacings has various slow moving averages interspersed with each other (**Exhibit 3**). There is no difference in positive and negative signal frequency.

Exhibit 3: Average Time between Signals Increases with Both the Fast and Slow Moving Average Period

Source: ClariFI, Morgan Stanley Research

Unlike the average number of days between signals, **the range of days (farthest apart signals less closest together signals) depends mainly on the slow moving average**, and is not sensitive to the fast moving average. For example, the four pairs of bars with 240 day slow moving averages all have approximately the same height, even as the fast moving average increases from 10 to 60 days (**Exhibit 4**).

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Exhibit 4: The Range of Days between Signals Depends Mainly on the Slow Moving Average Period

Median Range of Days Between Signals
Longest Time Between Signals Less Shortest Time Between Signals
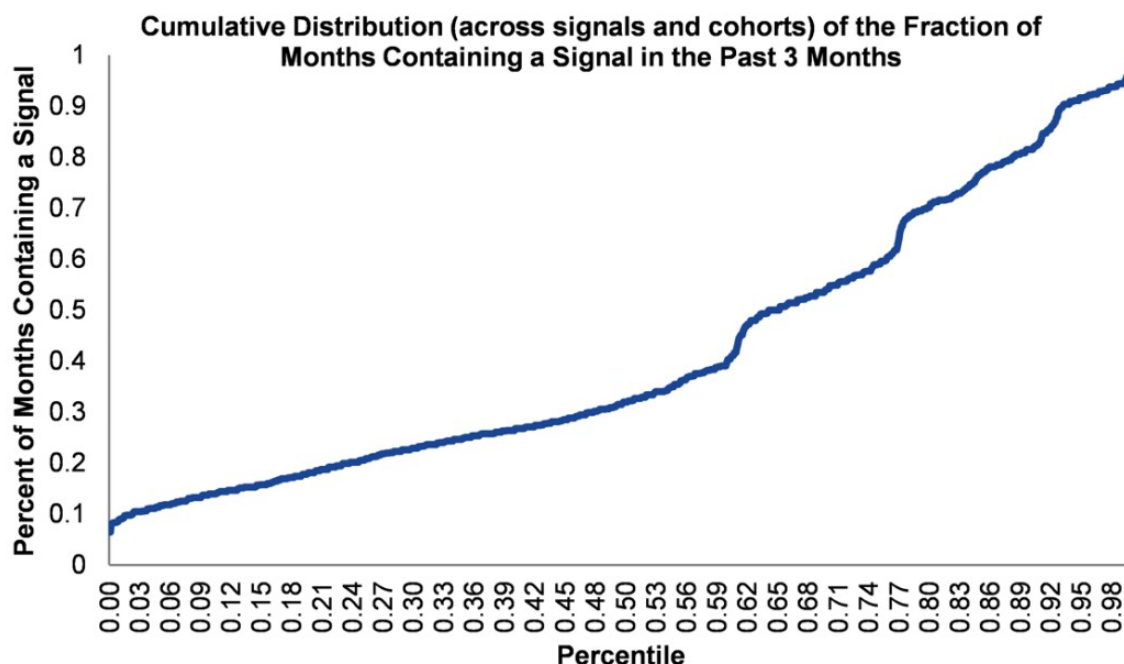Median Across 48 Assets/Factors/Sectors

Source: ClariFI, Morgan Stanley Research

We organize the crossover signals into monthly periods so that we can combine them with other types of quantitative signals (fundamentals, revisions, etc.) and obtain expected returns at regular horizons. At a monthly frequency, we form three types of moving average signals: crossovers that occurred in the past 3 months; those that occurred in the past month; and those that occurred in the final 5 trading days of the last month. **These time frames are meant to be relatively independent from one another, but are not optimized.**

Before studying the performance of the monthly signals for future returns, we examine the frequency at which they occur. Signals that occur almost every month or those that are extremely rare are less likely to show up as statistically significant in our regression tests, even if they produce large subsequent moves when they occur or fail to occur.

Aggregating across all 48 cohorts and all 26 types of crossover signals tested (13 positive and 13 negative), **about 32% of quarters typically contain a signal** (Exhibit 5). For longer moving average pairs and low beta assets, the bottom decile of cohort/signals quarterly frequency is 0.14 (about 1 every 7 quarters). At the other extreme, for shorter moving averages and cyclical cohorts, the top decile of quarterly frequency is 0.82 (about 5 in 6 quarters contain a signal).
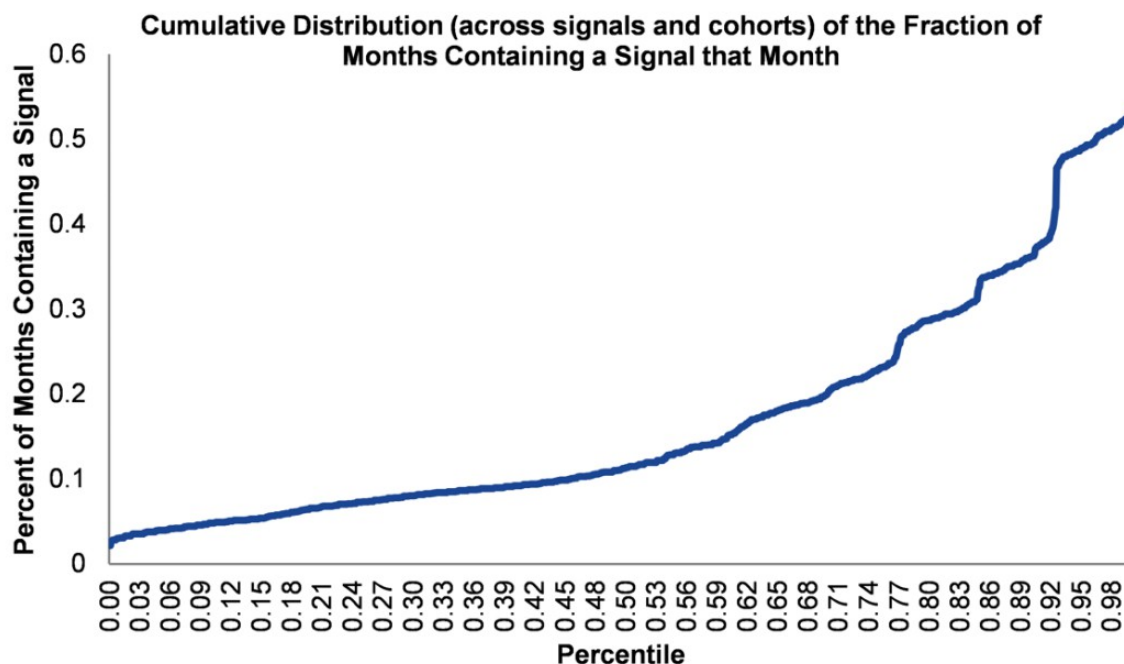
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Exhibit 5: Across over All 48 Cohorts and All 26 Crossover Signals, there is Typically 1 Signal Every 3 Quarters

Cumulative Distribution (across signals and cohorts) of the Fraction of Months Containing a Signal in the Past 3 Months

Source: ClariFI, Morgan Stanley Research

Across all 48 cohorts and 26 signals, about 11% of months typically contain a signal (Exhibit 6). For the lowest frequency decile of cohort/moving average combinations, 4.8% of months (one in 20) contain a signal, whereas for the highest frequency decile, 36% of months contain a signal.

Exhibit 6: About One in Nine Months Contains a Crossover Signal for the Typical Cohort/Moving Average Pair

Cumulative Distribution (across signals and cohorts) of the Fraction of Months Containing a Signal that Month
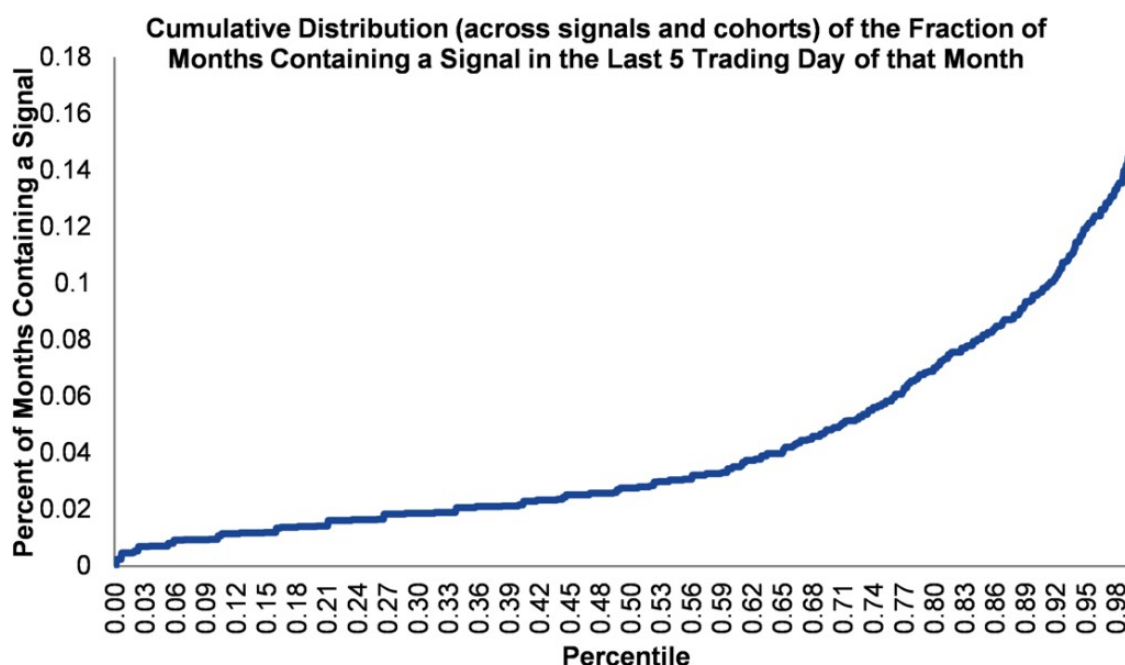
Source: ClariFI, Morgan Stanley Research

In the last 5 trading days of the month, the typical cohort/moving average combination has a signal in 2.75% of months (about once in three years). For the low frequency decile of cohort/moving average, only 0.9% of months have a signal in the last 5 trading days. At the other end, about 9.6% of months have

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signals in the last 5 days for the high frequency decile of cohort/moving average (**Exhibit 7**). **These "last 5 days" signals are opportunistic events, rather than regular occurrences.**

Exhibit 7: For the Typical Cohort/Moving Average Combination, there Is a Signal in the Last 5 Trading Days of the Month about Once Every 3 Years

Source: ClariFI, Morgan Stanley Research

Effectiveness of Cohort Return Forecasting with Crossover Signals

In this section, we test the monthly indicators individually for each asset, then in combination with each other. Finally, we include macro factor signals and past cohort returns as additional predictive variables, to see whether they are complementary or redundant with the moving average indicator variables.

Single-Factor Analysis

We tested the monthly 1/0 variables obtained from crossovers by running full-period (1980 - 2016 YTD) regressions on forward 1, 3, 6 and 12 month cohort returns. Each of the 48 cohorts has 78 possible variables: 26 factors of 1/0 for each of the last 5 days, last month and last 3 months. In the table below, we show the number of factors that are at least 10% significant at each horizon. One could argue that 10% significance is appropriate because we have an a priori expectation on the sign of the expected return from a positive or negative crossover signal, and we enforce it in constructing multi-factor models, separated by those that have the anticipated sign (i.e., positive [neg] for positive [neg] crossovers) (**Exhibit 8**). **There are a relatively large number of significant and "correctly" signed factors at a 1-month horizon (380), with a much smaller number of oppositely signed factors (73).**

As the horizon expands, however, the number of significant factors declines rapidly, and the balance no longer favors the anticipated sign of effect. **At a 3 month horizon, there are as many significant factors with the "wrong" sign as with the correct one, while at a 6-month horizon, the small number of significant factors mainly have the unanticipated sign. No factors are even 10% significant at a 12-month horizon.**

The information content of the monthly moving average crossover signals decays quickly: beyond 1-month, none of them appears to be effective for equity cohorts. For this reason, we focus on the 1-month horizon in our stepwise multi-factor models

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Exhibit 8: Moving Average Crossover Signals Are Effective at a 1-Month Horizon, but Not at Longer Horizons

Number of Significant Moving Average Cross-Over Signals

Horizon	Anticipated Sign	Opposite Sign
One Month	380	73
3 Months	43	39
6 Months	3	7
12 Months	0	0

Source: ClariFI, Morgan Stanley Research

Focusing on the 380 monthly signals with the anticipated sign, we look at the distribution of occurrence by fast/slow moving average. All 13 combinations (both positive and negative crossovers are combined) are represented, and there are not extreme differences among combinations. However, **there appears to be a concentration of signals in the 10/30, 10/40 and 10/60 fast/slow moving average pairs.** (**Exhibit 9**).

The most frequently effective fast-slow moving average combinations for monthly horizon cohort returns have 10-day fast moving averages and 30-60 day slow moving averages. These time scales may be shorter than those used by many investors, as 50-day fast moving averages and 200-day slow moving averages are often cited.

Exhibit 9: 10-Day Fast Moving Averages and 30-60 Day Slow Moving Averages Are Most Frequently Effective at a 1-Month Horizon

Number of Significant Signals by Fast/Slow Moving Average Pair

FAST Moving Avg. (Days):	Slow Moving Avg (Days):					
	20	30	40	60	120	240
10	29	43	40	46	26	32
20				31	24	27
40					20	23
60					21	18

Source: ClariFI, Morgan Stanley Research

Monthly look-back signals are more frequently significant than "last 5 days" and last quarter signals - this may be due to cohorts with very few last 5 days signals and very frequent last 3 month signals (such groups would be less likely to achieve statistical significance) (**Exhibit 10**).

Exhibit 10: There Are More Significant Signals in the Last Month than in the Last 5 Days or Last 3 Months

Number of Significant Signals by Lookback Period

Period	Count
Last 5 days	115
Last Month	161
Last Quarter	104

Source: ClariFI, Morgan Stanley Research

Negative crossover signals are more often significant than positive crossover signals, by about a 3:2 ratio (Exhibit 11); this suggests that investors may want to give more attention to negative crossovers than positive ones. This result is reminiscent of the oftentimes stronger performance of momentum on the

downside than on the upside.

Exhibit 11: Negative Crossover Signals Are More Often Significant than Positive Crossover Signals

Number of Signals that Are Statistically Significant
By Direction of Crossover

Positive/Negative	Count
Negative Crossover	226
Positive Crossover	154

Source: ClariFI, Morgan Stanley Research

Multi-Factor (Stepwise) Models

Since some of the indicator variables related to different crossover pairs and lookback periods may be correlated with each other, we ran stepwise multi-factor regressions to obtain overall models for each cohort. These models typically contain an intercept and 2-3 variables that are either 0 or 1.

In the multi-factor models, the number of crossover signals falls from 380 to 103 for the 48 cohorts. The distribution by fast-slow moving average pair is scaled down, but similar to the single-factor distribution: **there is still a higher concentration of signals with 10-day fast moving averages and 40 or 60 day slow moving averages (Exhibit 12).** These 10/40 and 10/60 pairs appear to generally be the most effective for 1-month equity cohort forecasts.

Exhibit 12: Signals Based on 10-Day Fast and 40 or 60-Day Slow Moving Averages Are the Most Frequent in Multi-Factor Models

Number of Signals Appearing in Stepwise Multifactor Models by
Fast/Slow Moving Average Pair

Fast Moving Avg. (Days):	Slow Moving Avg. (Days):					
	20	30	40	60	120	240
10	7	8	12	15	5	10
20				7	4	7
40					5	8
60					7	8

Source: ClariFI, Morgan Stanley Research

In the multi-factor models, the last 5 day signals are more common than those in the last month or last quarter (**Exhibit 13**). This reinforces the short-term nature of information in crossover signals. **It also means that these multi-factor models are opportunistic: last 5 day signals are infrequent and have a short half-life, so managers need to scan for them and allocate when the opportunity arises.** This also suggests that investors use a systematic approach to identifying such signals, rather than relying on *ad hoc* checks on a few indexes.

Exhibit 13: Signals in the Last 5 Days of the Month Are Most Common in Multi-Factor Models

Number of Signals Appearing in
Stepwise Multifactor Models by Lookback Period

Period	Count
Last 5 days	47
Last Month	38
Last Quarter	18

Source: ClariFI, Morgan Stanley Research

As was the case with individual crossover signals, negative crossovers appear more often in multi-factor models than positive crossover signals; the ratio (4:3) is lower than in the individual signal case, however (**Exhibit 14**).

Negative crossover signals are generally more prominent than positive ones in multi-factor cohort return models.

Exhibit 14: Among Multi-Factor Cohort Models, Negative Crossover Signals Are More Common than Positive Crossover Signals

Number of Signals Appearing in the Stepwise
Multifactor Models by Direction of Crossover

Positive/Negative	Count
Negative Crossover	59
Positive Crossover	44

Source: ClariFI, Morgan Stanley Research

To indicate the magnitude of expected returns associated with different lookback periods, we took all the crossover pairs of last 5 days, all the pairs of last month, and all the pairs of last quarter, and ranked them separately by their expected return (i.e., their multi-factor regression coefficient). **Expected returns for last 5 day signals range from -10% to nearly +10%, whereas those of last month range from only -4% to +4%, and quarterly expected returns range from about -3% to +2%. In addition, the monthly signals are asymmetric: about 75% are negative crossover signals (Exhibit 15).**

Trading equity cohorts on moving-average crossover signals is an opportunistic strategy: there are large-magnitude (and high risk), short-term expected returns, but the signals occur infrequently.

Exhibit 15: Last 5 Day Signals Have a Much Larger Magnitude Expected Return than Last Month and Last Quarter Signals
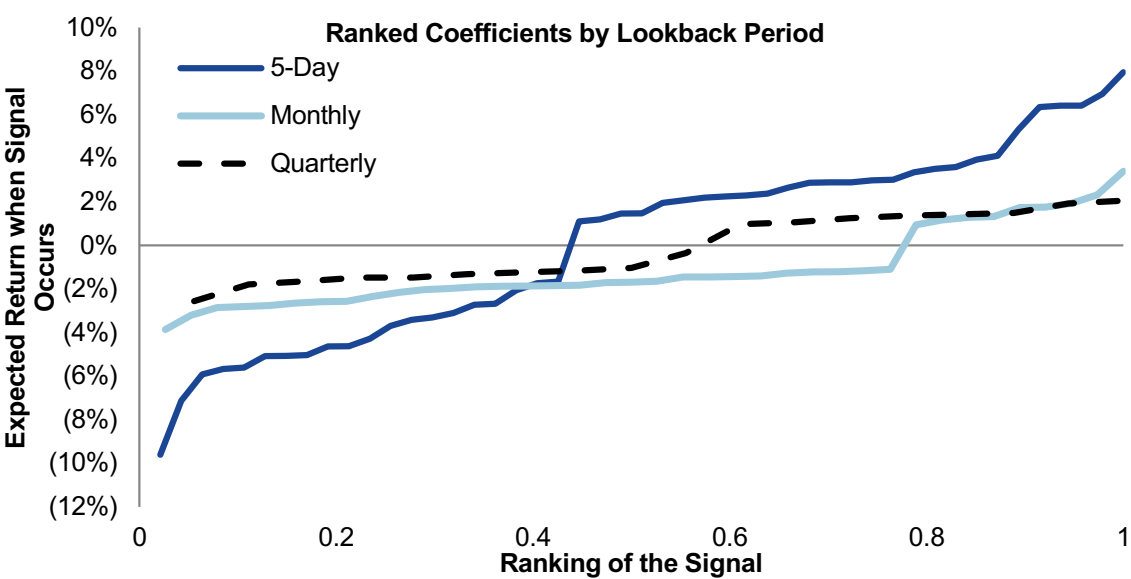
Source: ClariFI, Morgan Stanley Research

With only a few 1/0 variables per cohort, we do not expect to capture a large fraction of their monthly risk, and indeed this is the case: typical explanatory power (R-squared) is around 3%, with a number of cohorts explaining under 2% of risk. **Three cohorts have no significant crossover signals - all sectors: technology, telecom and energy**. In some cohorts, such as junk equities, momentum, and discretionary, R-squared exceeds 6% (**Exhibit 16**).

Exhibit 16: Crossover Signals Have the Greatest Explanatory Power in Junk Equities, Momentum, and Discretionary
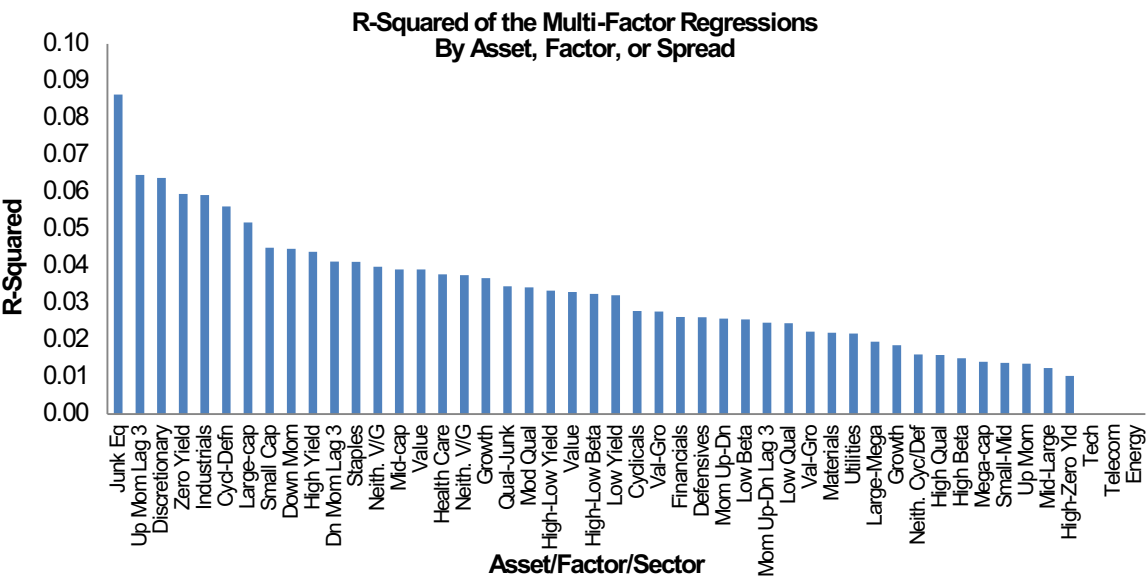
Source: ClariFI, Morgan Stanley Research

In the table below, we show the multi-factor model coefficients for the 10 GICS sectors. In all, 13 different moving average pairs appear, with a mix of positive and negative signs (note: coefficients with positive signs correspond to positive crossovers) (**Exhibit 17**). **Three sectors - tech, energy and telecom - have no crossover signals in their models**, so their expected returns are just the intercepts or long run averages. Of the 13 signals, 7 are from the last 5 days.

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To compute expected sector returns, we identify which of the sector's signals, if any, are 1's, and sum their coefficients and the intercept. Due to the large number of independent variables that appear, we do not show the models for all 48 cohorts here.

Exhibit 17: The 10 GICS Sectors Utilize 13 Different Moving Average Pairs in their Multi-Factor Models

Regression Model Coefficients

Sector	Intercept	F10S20_5D	F10S30_5D	F10S60_5D	F20S60_5D	F20S120_5D	F20S240_5D	F60S240_5D	F10S30_M	F20S120_M	F10S240_M	F10S20_Q	F40S120_Q	F10S240_Q
Discretionary	1.39%			2.90%	(5.61%)						(2.76%)			
Energy	0.91%													
Financials	1.77%								(1.43%)					(1.65%)
Health Care	1.44%				(3.41%)					1.75%				(1.32%)
Industrials	(0.41%)		2.07%		(2.73%)							2.05%	(1.79%)	
Materials	0.85%		2.87%					(5.08%)						
Staples	1.48%	(1.66%)				(2.06%)	(4.63%)							
Tech	1.13%													
Telecom	0.92%													
Utilities	1.06%				2.30%									(1.23%)

Source: ClariFI, Morgan Stanley Research

Among the 47 cohorts with at least one moving-average crossover signal in their models, seven have one or more non-zero (active) factors as of the end of March, 2016. Based on the combination of factors that are triggered, we compute month ahead expected returns for these groups (**Exhibit 18**). **Large-cap stocks and junk equities have the highest expected returns, at around 5%.** For the remaining cohorts (i.e., the ones not shown below), April expected returns would simply be their long run average returns.

Exhibit 18: Based on their Monthly Moving Average Crossover Signals as of the End of March, Large-Cap Stocks and Junk Equities Have 5% Expected Returns for April
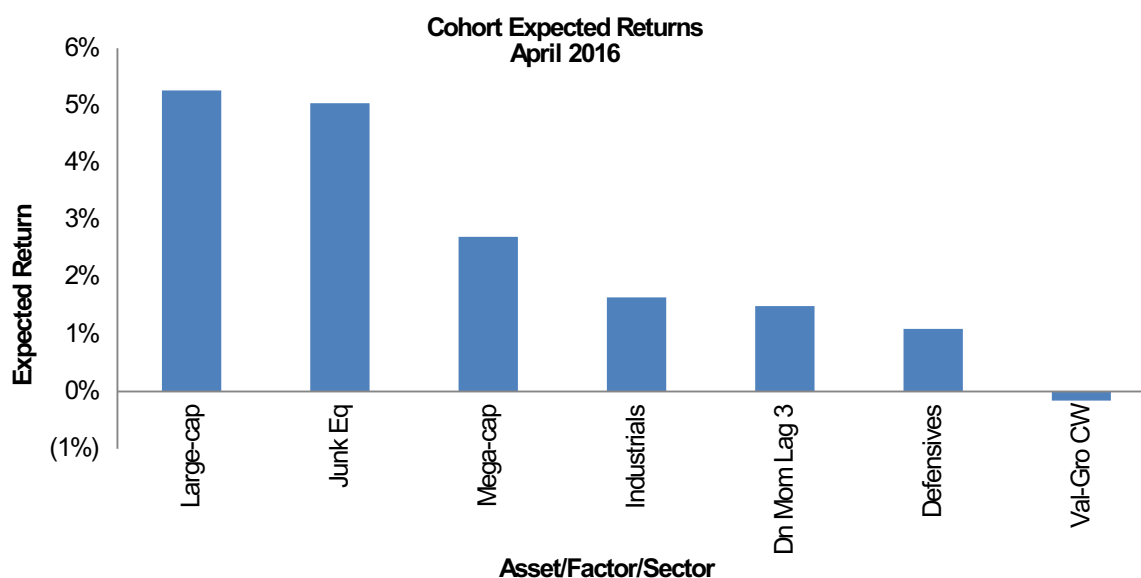
Source: ClariFI, Morgan Stanley Research

We did some further analysis - see the Appendix for results - showing that the impact of the moving-average crossover signals does not diminish materially when other types of predictive variables are included in the model. We used macro variables, such as yield curve slope and level changes, currency factors, and others, along with past cohort returns. Stepwise regressions with this augmented set of factors show that about 85% of the original crossover variables remain in the models. **Thus, the information contained in the 1/0 signals from moving average crossover signals is not subsumed by macro factors or past returns of cohorts.**

March Rally Had Some Atypical Microstructure

While the S&P 500 rose 6.6% last month to return to positive territory for 2016, there was some unusual microstructure for such a strong rally: defensives outperformed cyclicals, and accruals was the best quant factor (and low sales variability was also rewarded). Accruals has been one of the strongest factors so far in 2016, and we have included a screen of large stocks in the bottom quintile of accruals, where the risk of underperformance is greatest.

Investors did not show any market cap preference in March, but they once again favored value stocks over growth stocks. There has been something of a value rally over the last 3-6 months that is much clearer on a beta- and size-adjusted basis than on a raw basis. In March, for example, the raw value-growth spread was up just 71 bp, while the value-growth residual was up 3.0%. Over the last 12 months, growth still leads value by a wide margin.

Within our style buckets, persistent growth stocks - those that have been in our growth category for at least 48 months, have lagged recent (mixed) growth stocks and non-growth stocks, while persistent growth stocks have consistently outperformed growth stocks and lapsed growth stocks.

Junk modestly outperformed high quality, but performance was not monotone by quality quartile, making conclusions on quality somewhat tenuous. March was a strong month for high beta stocks, above and beyond the market's gain.

Our short-term alpha model (MOST) had a good month, generating 64 bp of alpha in its Q1-Q5 spread, while our longer term model (BEST) lost 17bp of alpha. Over the last year, MOST has an 8.9% cumulative alpha, compared with 5.5% for BEST.

Hedge funds appear to have continued to struggle with alpha generation in last month's rally. We estimate that the HFRX Equity Hedge Index lost 6bp of alpha in March, while the HFRX Equity Market Neutral Index lost an estimated 87bp of alpha, both relative to our 6-factor risk model..

Dollar Weakness and Crude Strength Highlight March Macro Moves

Brent crude oil rose by over 10% last month, while the US Dollar Index (DXY) declined by 3.7% (**Exhibit 19**). The DXY is now at the low end of its range over the last year.

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Exhibit 19: In March, the US Dollar Index Weakened by 3.7%, while Crude Oil Prices Rose 10.1%

Brent and the Dollar Index
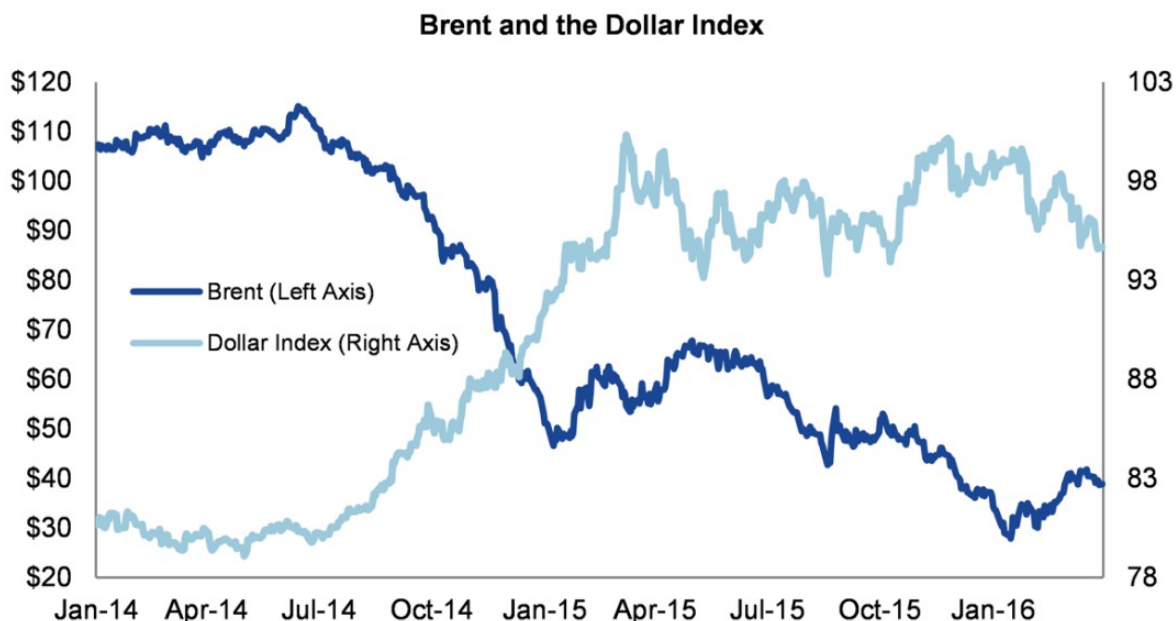
Source: ClariFI, Morgan Stanley Research

Credit spreads tightened by 47bp in March, and they have now narrowed by 2bp thus far in 2016, after having widened by 54bp through February 18 (**Exhibit 20**). Consistent with our macro model for the US equity market, equities are up slightly year-to-date (see *US Equity Strategy: Rates, Dollar, and Oil - What's the Playbook?*, October 6, 2014 and *US Quant Research: Do the Opposite of What Worked Last Time?, May 11, 2015)*. The yield curve level fell by 10bp and it steepened by 9bp, reflecting a slower expected pace for rate hikes.

Exhibit 20: Credit Spreads Tightened by 47bp in March, more than Reversing their YTD Widening

Yield Curve Level and Slope with Baa Spread
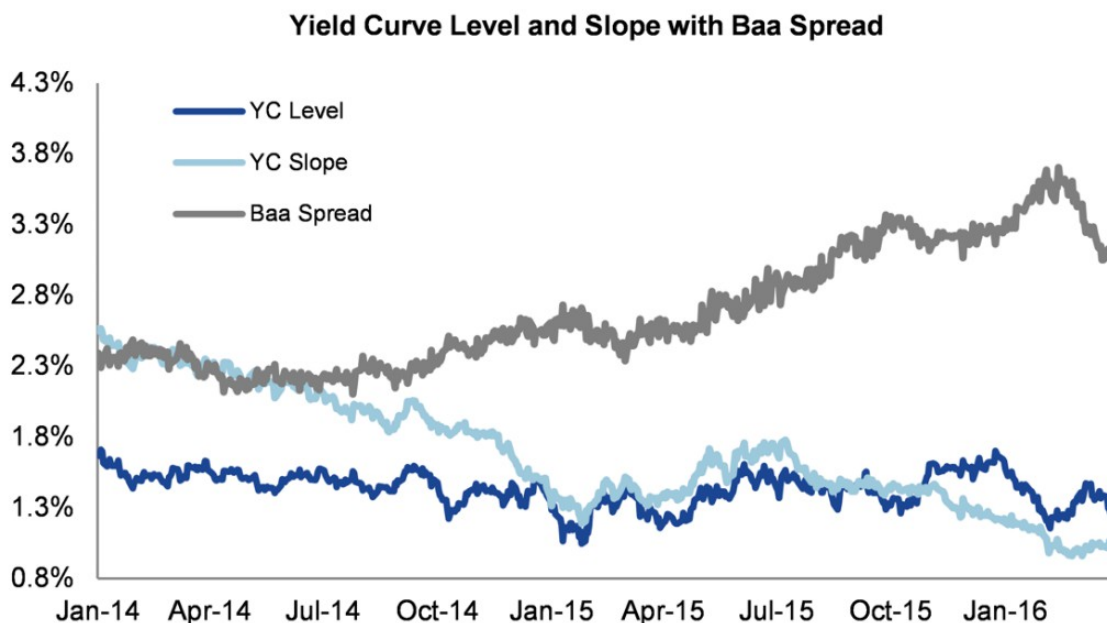
Source: ClariFI, Morgan Stanley Research

Stock-specific risk increased modestly in March when measured over both 252-day periods (**Exhibit 21**) and 63-day periods. The less-volatile 252-day measure rose from 0.445 to 0.45, while the 63-day version rose from 0.401 to 0.412. This means that at the margin, stocks were a little more idiosyncratic in March than they

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were in February. **Stock specific risk remains well below its year-ago level (0.531), however, and our prior research has shown that year-over-year declines in stock-specific risk are negative for subsequent alpha generation**(see *US Quant Research: Idiosyncratic Risk Returns*, **Jan. 11, 2013**).

Exhibit 21: Stock Specific Risk Increased Slightly in March, but Remains well Below Year-Ago Levels

Top 500: Stock Specific Risk, Rolling 252-Day Through March 31, 2016

Source: ClariFI, Morgan Stanley Research

Market-Cap Has Been a Non-Factor in 2016

Through large negative and positive market swings in the first quarter, all of the market cap cohorts we track have had very similar performance: on a beta-adjusted basis, large caps are down a mere 5bp, while mega-caps are down 6bp; mid-caps are up 40bp, while small-caps are down 90bp **(Exhibit 22).** In March, beta-adjusted cap-cohort performance was also nearly flat, with large-caps lagging by 57bp and small-caps leading by 44bp.

As recently as last year, there were larger moves in market cap cohorts, as small-caps have underperformed mega-caps by 10% over the last 12 months (beta adjusted), and, in fact, mega-caps lead by 5.3% over the last 6 months. Thus, the lack of market-cap dynamics is a recent phenomenon.

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Exhibit 22: Market-Cap Cohort Returns Have Been Essentially Flat on a Beta-Adjusted Basis in 2016. Previously, Mega-Cap Stocks Had Outperformed

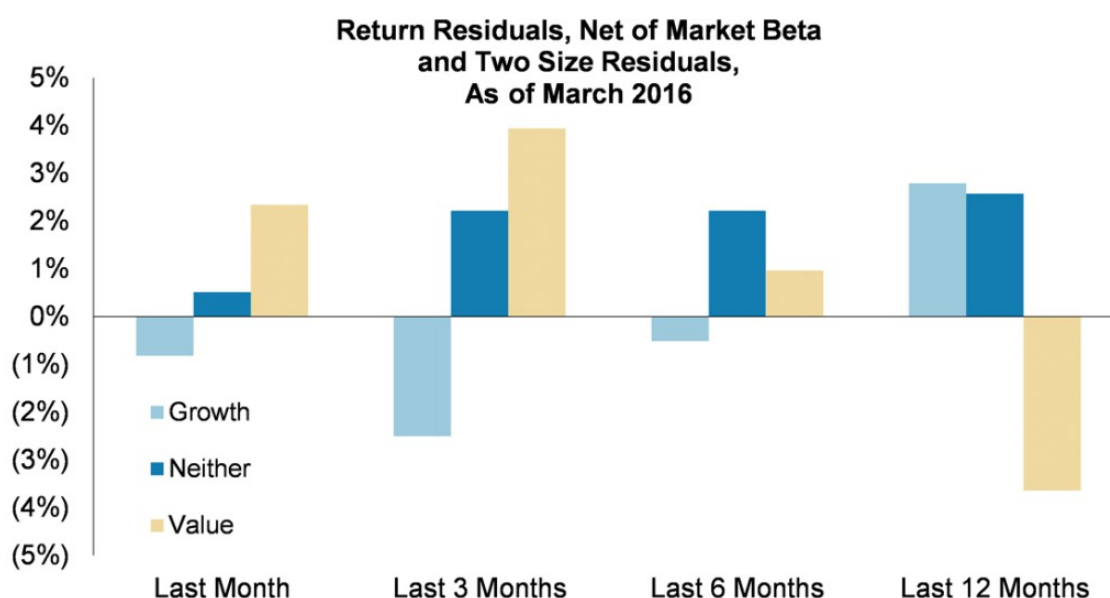**Return Residuals by Market Cap Through March 2016**

■ Mega
■ Large
■ Mid
■ Small

Source: ClariFI, Morgan Stanley Research

Value Outperforms Growth for the Third Straight Month

On a beta and size-adjusted basis, value outperformed growth by 3.0% in March, its third straight month of outperformance (the first time since May 2009 that this has happened). Not only has value beaten growth in 2016, but it is ahead by 1.5% over the last 6 months, as well (**Exhibit 23**). Over the last 12 months, growth still leads value by 6.4%, however.

Exhibit 23: Value Has Outperformed Growth (Risk-Adjusted) Each Month in 2016, and Leads by 1.5% over the Last 6 Months

Return Residuals, Net of Market Beta and Two Size Residuals, As of March 2016

■ Growth
■ Neither
■ Value

Source: ClariFI, Morgan Stanley Research

Value outperformance has been more muted on a raw basis, as the gap was only 71bp in March and 1.1% over the last 6 months. In addition, "neither" value nor growth has had the best raw performance over

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the last 3 and 6 months (**Exhibit 24**). **Unless investors regularly compute risk-adjusted style performance, they may not be aware of the recent value rebound.** Further clouding style performance conclusions is the large fraction of measurement error in style benchmarks (see *US Quant Research: Agreeing to Disagree: Measurement Error in Equity Factor Models*, July 27, 2015).

Exhibit 24: On a Raw Basis, Value Has Outperformed Growth over the Last 6 Months, but the Differences Have Been Slighter

Raw Returns by Style
As of March 2016
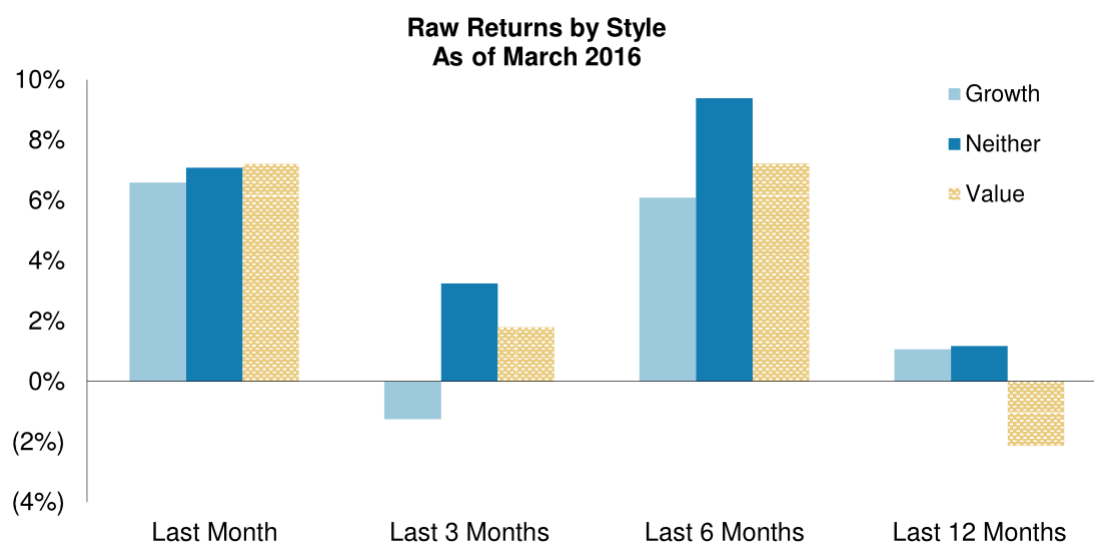
Source: ClariFI, Morgan Stanley Research

If we drill down into style performance by persistent and recent growth sub-classifications (see *US Equity Strategy: Growth Matters*, May 28, 2013), we see that on a raw basis, **persistent growth stocks have had the most severe underperformance over the last 6 months, while persistent non-growth stocks have consistently outperformed** (**Exhibit 25**).

Exhibit 25: Over the Last 6 Months, Persistent Growth Stocks Have Underperformed, while Persistent Non-Growth Stocks Have Consistently Outperformed

Raw Returns by Growth Persistence Cohort
As of March 2016
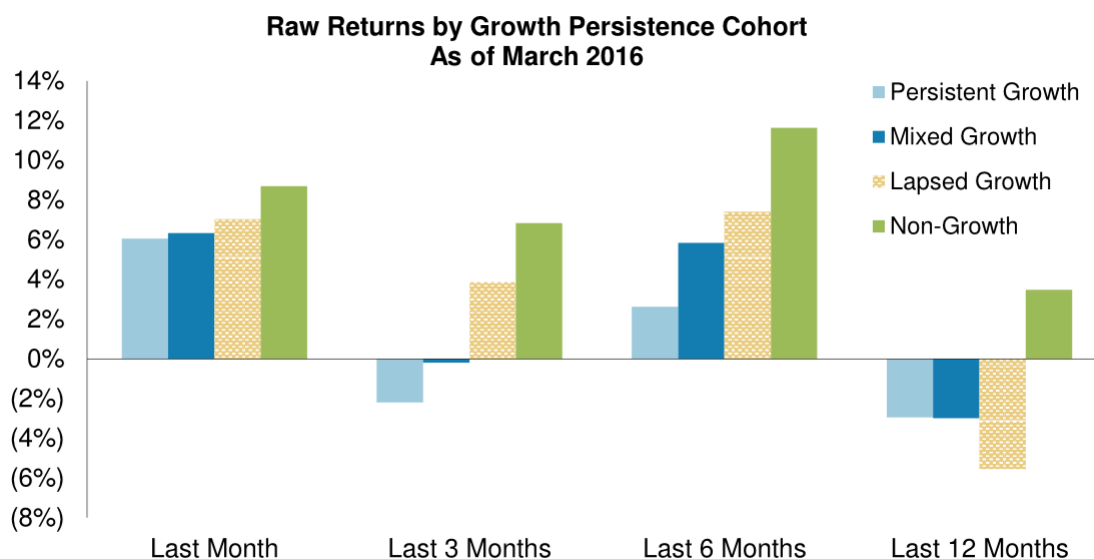
Source: ClariFI, Morgan Stanley Research

Based on our style cluster analysis (see *US Quant Research: This Is Not 2000*, August 10, 2015), **both February and March fell into Cluster #9**, which is notable for value outperforming growth; momentum,

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revisions and long term growth rate factors not working; and neither value nor growth outperforming the average of value and growth - all these features agree with March performance; the category is not a perfect fit, however, as persistent growth typically beats mixed growth, and persistent non-growth tends to lag lapsed growth (**Exhibit 26**).

Exhibit 26: February and March Both Fall into Style Cluster 9, which Has Been a Frequent Type of Value Outperformance since the Financial Crisis

Monthly Cluster Occurrences
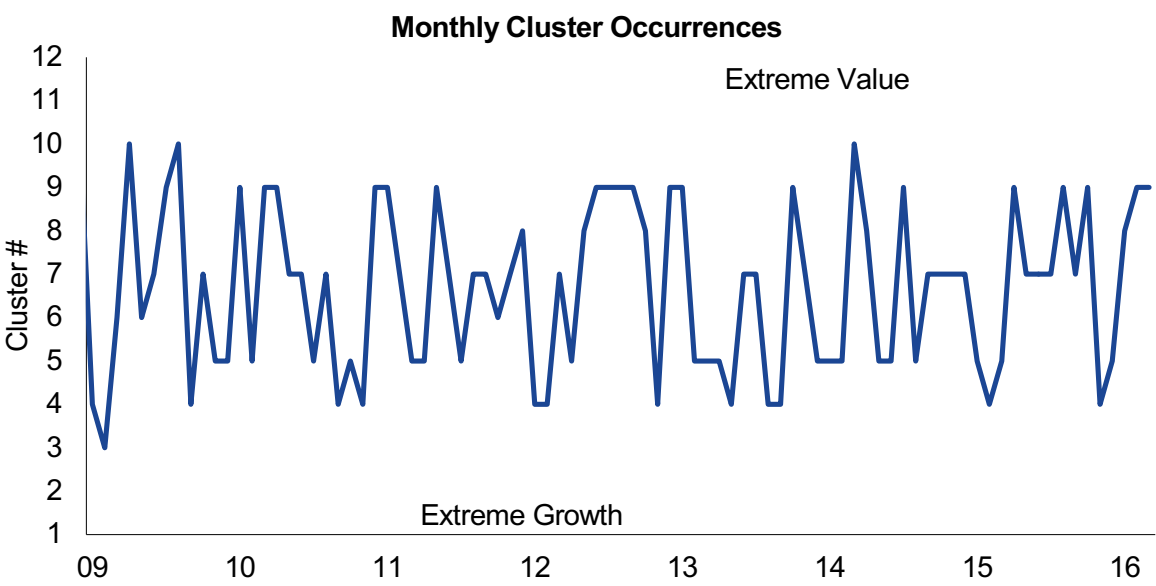
Source: ClariFI, Morgan Stanley Research

Low Quality Leads in March, but with Little Conviction

As has recently been the case, investors did not have a clear quality preference in March. Although junk beat high quality by 50bp last month, low quality had the highest return (2.5% risk adjusted) and moderate quality the next highest **(Exhibit 27).** Over the last 6 and 12 months, quality performance has been "junk versus everything else", as high quality leads junk by 9.8**%.**

Exhibit 27: Junk and Low Quality Equities Outperformed in March, but there Was Little Difference in the Quality Cohort Returns

Residual Quality Quartile Returns, As of Mar. 2016

Source: ClariFI, Morgan Stanley Research

Strong Month for High Beta Stocks - Even Accounting for the Market Rally

High beta stocks outperformed low beta stocks by 9.4% in March, when the market was up "just" 6.8% (**Exhibit 28**). With a beta differential of around 1.0 for the top and bottom quintiles of equity beta, we would expect around 7% high beta outperformance to be in-line; in this sense, high-beta stocks exceeded expectations last month.

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Exhibit 28: High Beta Stocks Outperformed by 9.4% in March, Surpassing the Market Return of 6.8%
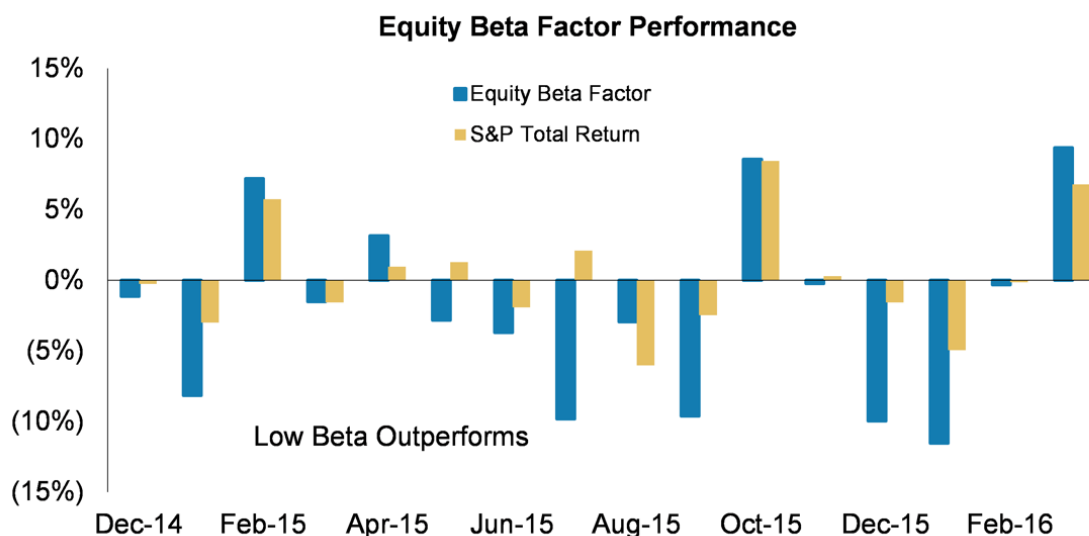
Source: ClariFI, Morgan Stanley Research

Defensives Beat Cyclicals in March, but still Lag over the Last Year

Defensives outperformed cyclicals by 2.1% in March, marking their third consecutive month of outperformance. Over the last 6 months, defensives are the best group, but they still trail cyclicals and (especially) neither cyclicals nor defensives over the last 12 months **(Exhibit 29)**. Lower interest rates, and a slower expected timetable for Fed hikes have likely benefitted defensives over "neither" stocks (as the latter include many rate-sensitive financials). Our analysis indicates that momentum and earnings revisions are key drivers of cyclical versus defensive returns (see *US Equity Strategy: Are Expensive Defensives Offensive?*, July 16, 2012).

Exhibit 29: Defensives Outperformed in March, and they Have Been the Best Group over the Last Six Months
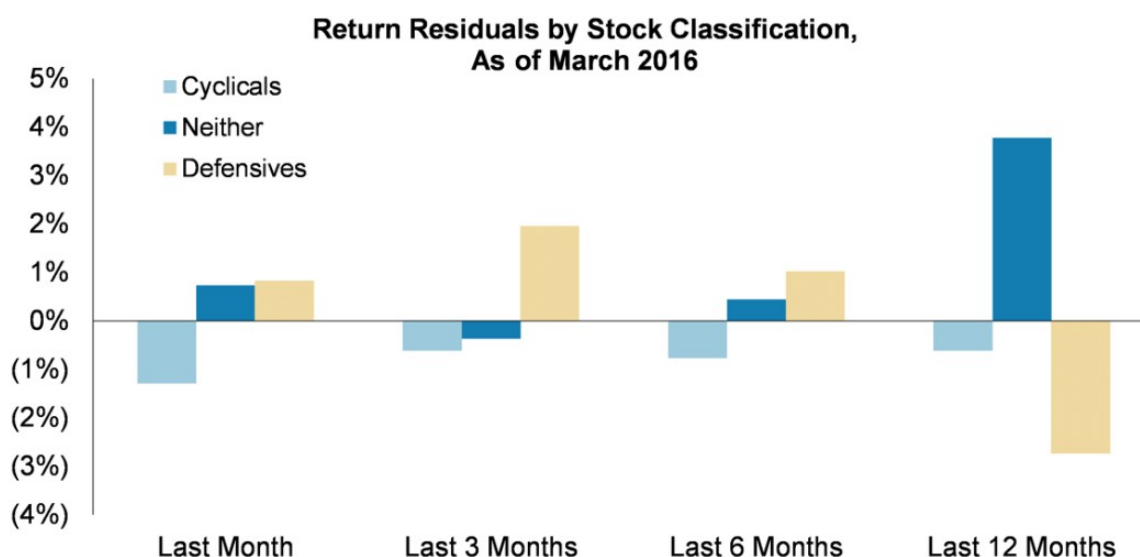
Source: ClariFI, Morgan Stanley Research

PRISM Sub-Models Underperformed in March, but Have Worked over Last Year

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We developed an industry alpha model (PRISM) that ranks industries in two groups (cyclicals and defensive/neither) by expected risk-adjusted quarter-ahead return (see *US Equity Strategy: Seeing Industries in a New Light with PRISM*, Sept. 3, 2013). Alpha forecasts for around 65 cap-weighted GICS industries are based on valuation, momentum, capital use and balance sheet metrics, profitability, and dispersion of returns and valuation within industries. Industries are classified into cyclicals, defensive or neither according to our dynamic model (see *US Equity Strategy: Cyclicals or Defensives*, Feb. 26, 2012), with different factors in PRISM, depending on their classification. Investors can use PRISM to select industries within defensives/neither and cyclicals, and to decompose expected alpha into 8-10 factor drivers. Historically, the turnover of PRISM has been limited, with 2-3 industries out of 13 in each of the top and bottom quintiles expected to be replaced each month.

Both of PRISM's sub-models underperformed in March: the cyclical sub-model had a -2.2% Q1-Q5 spread, while the defensive/neither sub-model had a -1.5% spread. Both models have worked well over the past 12 months, however, with cumulative spreads of 4.7% (cyclicals) and 14.8% (defensive/neither) (**Exhibit 30**). Both models are volatile, with few industries per quintile and substantial systematic risk present in the industry returns. Since the models went live in October 2013, the defensive/neither model has had a 26% monthly volatility.

Exhibit 30: In March, Both PRISM Sub-models Underperformed, but they Have Worked Well over the Last Year
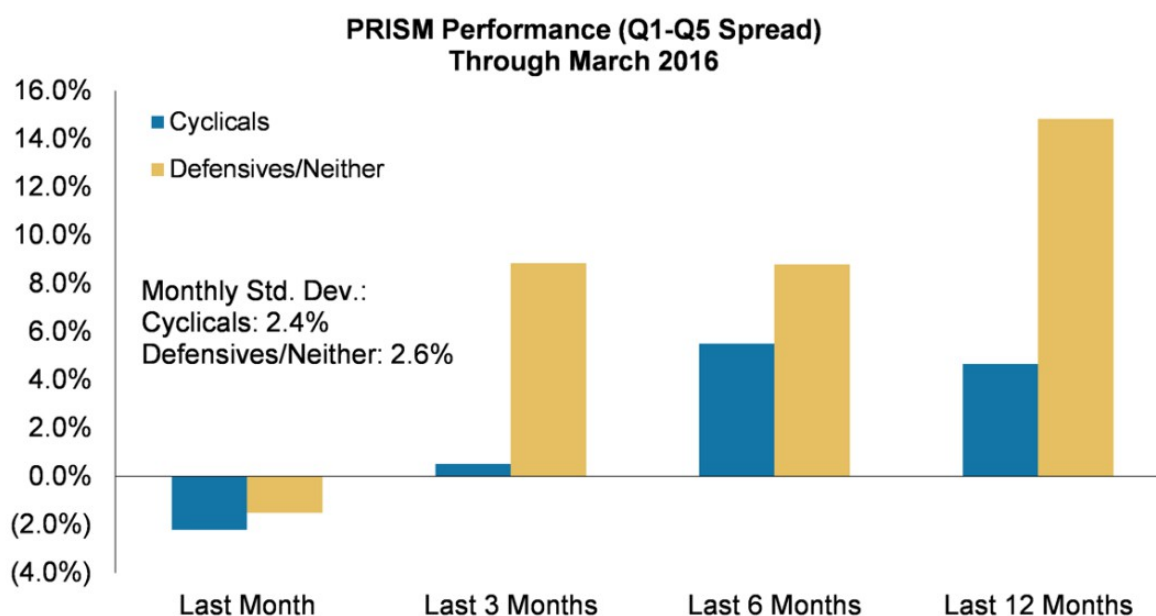
Source: ClariFI, Morgan Stanley Research

Semiconductors & semiconductor equipment was the sole addition to the top quintile of PRISM in March. Atypically, there was higher Q5 turnover last month, with four entries, including building products and consumer services **(Exhibit 31).**

Exhibit 31: Semiconductors & Semiconductor Equipment Was the Sole Entry into Q1 of PRISM in March

PRISM Industry Ranks - March and February 2016

Industry	Current Quintile	Previous Quintile
Aerospace & Defense	Q1	Q1
Air Freight & Logistics	Q1	Q1
Airlines	Q1	Q1
Auto Components	Q1	Q1
Commercial Banks	Q1	Q1
Communications Equipment	Q1	Q1
Distributors	Q1	Q1
Electric Utilities	Q1	Q1
Industrial Conglomerates	Q1	Q1
Multi-Utilities	Q1	Q1
Semiconductors & Semiconductor Equipment	Q1	Q2
Tobacco	Q1	Q1
Water Utilities	Q1	Q1
Beverages	Q2	Q2
Biotechnology	Q2	Q3
Computers & Peripherals	Q2	Q2
Construction & Engineering	Q2	Q1
Electronic Equipment, Instruments & Components	Q2	Q2
Food Products	Q2	Q3
Gas Utilities	Q2	Q2
Hotels, Restaurants & Leisure	Q2	Q2
Household Products	Q2	Q2
IT Services	Q2	Q3
Insurance	Q2	Q2
Multiline Retail	Q2	Q3
Professional Services	Q2	Q3
Road & Rail	Q2	Q2
Chemicals	Q3	Q3
Commercial Services & Supplies	Q3	Q3
Containers & Packaging	Q3	Q3
Diversified Telecommunication Services	Q3	Q4
Electrical Equipment	Q3	Q2
Food & Staples Retailing	Q3	Q3
Health Care Providers & Services	Q3	Q2
Internet & Catalog Retail	Q3	Q4
Leisure Equipment & Products	Q3	Q4
Life Sciences Tools & Services	Q3	Q2
Machinery	Q3	Q2
Personal Products	Q3	Q4
Textiles, Apparel & Luxury Goods	Q3	Q3
Automobiles	Q4	Q5
Capital Markets	Q4	Q3
Construction Materials	Q4	Q5
Consumer Finance	Q4	Q5
Diversified Financial Services	Q4	Q4
Energy Equipment & Services	Q4	Q4
Health Care Equipment & Supplies	Q4	Q3
Health Care Technology	Q4	Q4
Independent Power Producers & Energy Traders	Q4	Q2
Marine	Q4	Q4
Media	Q4	Q4
Software	Q4	Q4
Specialty Retail	Q4	Q5
Wireless Telecommunication Services	Q4	Q4
Building Products	Q5	Q4
Diversified Consumer Services	Q5	Q4
Household Durables	Q5	Q5
Internet Software & Services	Q5	Q5
Metals & Mining	Q5	Q5
Oil, Gas & Consumable Fuels	Q5	Q5
Paper & Forest Products	Q5	Q3
Pharmaceuticals	Q5	Q5
Real Estate Investment Trusts (REITs)	Q5	Q5
Real Estate Management & Development	Q5	Q5
Thrifts & Mortgage Finance	Q5	Q5
Trading Companies & Distributors	Q5	Q4
Transportation Infrastructure	Q5	Q5

Source: ClariFI, Morgan Stanley Research

MOST, BEST and Synergy

We have two models that rank stocks according to their expected risk-adjusted returns (i.e., alphas), one for the upcoming 3-month period [MOST] (see *US Equity Strategy: Introducing MOST: Morgan Stanley's Quantitative Stock-Selection Model*, February 13, 2011) and one for the upcoming 24-month period [BEST]

(*US Equity Strategy: Introducing BEST: Morgan Stanley's New Biannual Equity Selection Tool*, September 11, 2011). In addition to the non-standard forecasting horizons, these alpha models have other distinctive features, including individualized models for custom sectors, no momentum factor in MOST, a negative long-term momentum in BEST, and robust estimation methods.

After building MOST and BEST, we found that they are synergistic; i.e., at horizons of 1 to 6 months, stocks that appear in the top two quintiles of both models simultaneously outperform stocks that appear in the bottom two quintiles of both models by more than the Q1-Q5 spread of either model. Since the stocks that meet our criteria are roughly 20% of total historical observations for the top two quintiles and 20% for the bottom two, we refer to the combined relative performance as the Q1-Q5 Synergy model.

Although our alpha models are designed to extract stock-specific returns, they contain some systematic risk exposures. For example, BEST – with a long horizon – has a persistent value bias: all else equal, BEST has better returns when value beats growth. MOST does not have a value bias, but has preferred mid-cap stocks over large- and mega-cap stocks. For details on our alpha model exposures, see *US Equity Strategy: Unemotional Approaches*, October 4, 2011.

When we remove contributions from systematic risk, we isolate the alpha generation of our alpha models. Since BEST tends to have a value bias, and MOST tends to favor mid-cap stocks, stripping away factor contributions is important in months like this past April that have value and mega-cap rallies. Otherwise, the performance of BEST may be inflated by its inherent style bet, while MOST may be penalized for its underlying size bias.

In March, MOST (our short term alpha model) generated 64bp of alpha from its Q1-Q5 spread, whereas both BEST (long term alpha model) and their synergy had slightly negative alphas (Exhibit 32). MOST has been the stronger model over the last quarter, 6-months and year, as well, with a 8.9% cumulative alpha at the latter horizon. The longer term model, BEST, has generated 5.5% cumulative alpha over the last year, despite declining by 17bp last month.

Exhibit 32: Our Short-Term Model (MOST) Generated 64bp of Q1-Q5 Alpha in March, Bringing its 12-Month Cumulative Total to 8.9%
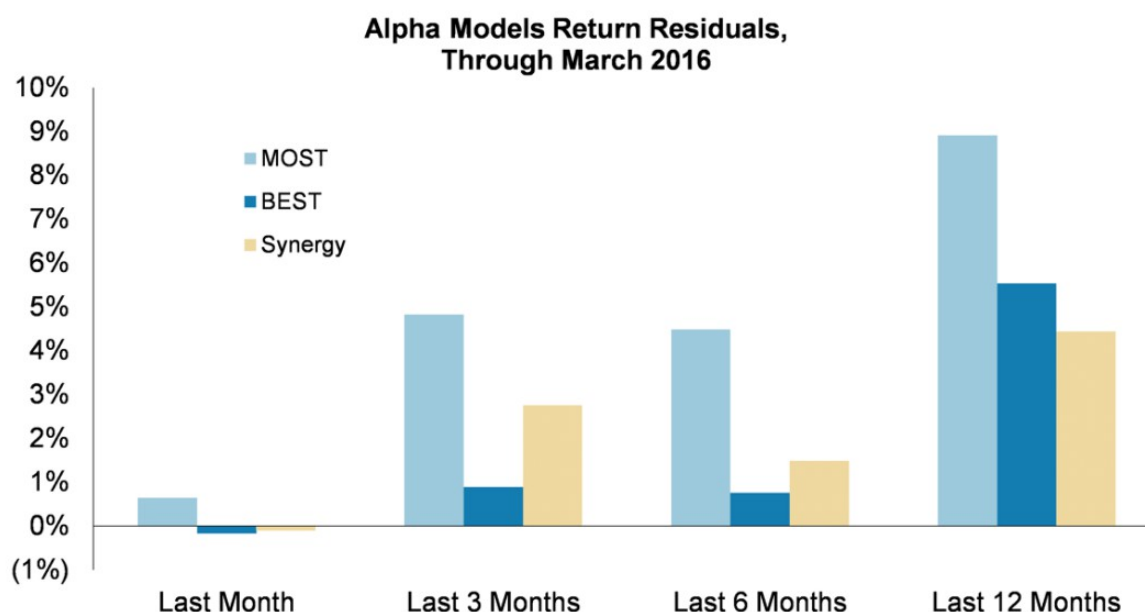
Source: ClariFI, Morgan Stanley Research

Measuring Factor Efficacy

We maintain a library of quantitative factors that spans several categories, including valuation, growth and sentiment, capital use, and technicals. In addition to being the building blocks of our quantitative alpha models, these factors are used by investors in screens and performance attribution. Factor performance is measured as the equal-weight top quintile return minus that of the bottom quintile. Economic principles, intuition and long-run performance combine to give a natural choice for the "good" and "bad" quintiles. Our factor library and detailed sector-level efficacy results are contained in US Equity Strategy: The Factor Reference Guide, August 5, 2014.

As is the case with portfolios of equities, factors embed differing levels of systematic risk. To quantify these systematic risks in our factor library, we conducted a principal components analysis of the factor covariance matrix; see US Quant Research: Quantabees Beware: Explaining Factor Efficacy, March 7, 2012. From this analysis, we found four main effects that explain 82% of the factor variation; these effects include a valuation factor and a multi-time-scale momentum factor. When we strip off these effects, we obtain the idiosyncratic performance of factors. For example, idiosyncratic performance sheds light on whether investors focused generally on valuation or specifically on price-to-book over some period. Since factors have different sensitivities to the principal components, their idiosyncratic factor returns may be vastly re-ordered from the raw factor returns.

There was a bit of a reversal in factor performance in March, particularly among the worst performing factors, as several factors in the Top 10 of last 12 month performance were in the Bottom 10 from March (Exhibit 33). Accruals was the best factor in March, while stability of sales and low net cash variability were also rewarded - an unusual combination for a strong market rally.

Factors that underperformed in March include those with high margins, low debt to equity, low estimate dispersion (which has been the best factor over the last year) and low capital spending.

Exhibit 33: Accruals Was the Best Factor in March, as Investors Rewarded Stability of Sales and Net Leverage, even as the Market Rallied

Top 1500 US Stocks: Adjusted Factor Efficacy
Through March 2016

Factor Ranks

Factor	1-Month Adjusted	1-Month Raw	3-Month Adjusted	3-Month Raw	6-Month Adjusted	6-Month Raw	12-Month Adjusted	12-Month Raw
Accruals*	1	1	3	7	3	9	9	15
Sales Stability	2	6	33	60	50	62	73	73
Price-to-Sales*	3	3	13	3	16	4	47	22
Inventory Turnover	4	5	23	24	43	42	36	42
Operating Leverage	5	9	35	39	28	36	65	62
Net Cash Variability*	6	10	8	22	15	29	50	61
Price-to-EBITDA*	7	2	4	1	9	1	37	18
Enterprise Value-to-EBITDA*	8	7	5	2	10	2	35	14
Incremental Margin	9	13	24	41	21	30	56	59
Analyst Coverage	10	8	44	26	51	35	52	49
Debt-to-Equity*	64	47	67	40	58	39	26	25
Gross Margin	65	67	60	55	26	33	18	27
Operating Margin	66	57	10	13	8	11	7	13
Net Margin	67	60	6	18	4	12	5	8
Free Cash Flow-to-Debt	68	71	55	29	34	20	17	10
CapEx-to-Assets*	69	62	72	66	63	51	45	46
Debt-to-EBITDA*	70	54	65	38	61	43	32	35
Estimate Dispersion*	71	64	14	32	11	22	1	2
Net Debt-to-Market Cap*	72	63	73	59	73	47	41	31
CapEx-to-Sales*	73	61	40	47	25	34	6	21

Source: ClariFI, Thomson Reuters, Morgan Stanley Research. Note: *indicates that low values are preferred.

The accruals factor, measuring the disconnect between earnings and cash flows, was the best performing factor in March, and has been one of the strongest factor thus far in 2016. **The effectiveness of the accruals factor is greater in identifying companies at risk of underperforming than for selecting the very best stocks.**

Consequently, our focus with accruals is on stocks in the bottom quintile. In the table below, we show the largest stocks in the bottom quintile of accruals, as of early April (**Exhibit 34**).

Exhibit 34: Stocks in the Bottom Quintile of Accruals Are at Risk of Underperforming

Stocks in Bottom Quintile of Accruals
As of April 05, 2016

Ticker	Company	Sector	Market Cap ($ bn.)
T	AT&T Inc	Telecommunication Services	240.8
GILD	Gilead Sciences Inc	Health Care	135.9
UNH	Unitedhealth Group Inc	Health Care	121.1
CVS	Cvs Health Corp	Consumer Staples	113.6
MDT	Medtronic Plc	Health Care	105.8
ABBV	Abbvie Inc	Health Care	94.2
CELG	Celgene Corp	Health Care	80.3
RAI	Reynolds American Inc	Consumer Staples	72.1
ACN	Accenture Plc	Information Technology	71.2
COST	Costco Wholesale Corp	Consumer Staples	68.5
LMT	Lockheed Martin Corp	Industrials	68.4
DHR	Danaher Corp	Industrials	64.1
PCLN	Priceline Group Inc	Consumer Discretionary	63.5
BIIB	Biogen Inc	Health Care	58.1
NFLX	Netflix Inc	Consumer Discretionary	44.9
GM	General Motors Co	Consumer Discretionary	44.4
REGN	Regeneron Pharmaceuticals	Health Care	42.2
ADP	Automatic Data Processing	Information Technology	41.2
TSLA	Tesla Motors Inc	Consumer Discretionary	33.6
ALXN	Alexion Pharmaceuticals Inc	Health Care	33.4

Source: ClariFI, Morgan Stanley Research. For important disclosures regarding companies that are the subject of this screen, please see the Morgan Stanley Research Disclosure Website at www.morganstanley.com/researchdisclosures. Prices as of 04/06/2016: T: $38.64, GILD: $97.44, UNH: $128.03, CVS: $103.39, MDT: $77.31, ABBV: $59.89, CELG: $108.22, RAI: $50.36, ACN: $114.67, COST: $156.77, LMT: $226.63, DHR: $93.84, PCLN: $1293.01, BIIB: $279.57, NFLX: $104.83, GM: $29.94, REGN: $427.2, ADP: $90.84, TSLA: $265.42, ALXN: $157.02. For valuation methodology and risks associated with any price targets, ratings and recommendations referenced in this research report, please contact the Client Support Team as follows: US/Canada +1 800 303-2495; Hong Kong +852 2848-5999; Latin America +1 718 754-5444 (U.S.); London +44 (0)20-7425-8169; Singapore +65 6834-6860; Sydney +61 (0)2-9770-1505; Tokyo +81 (0)3-5424-4349. Alternatively you may contact your investment representative or Morgan Stanley Research at 1585 Broadway (Attention: Research Management), New York, NY 10036 USA.

Stocks with low capital spending to sales had their worst relative performance in a year in March (Exhibit 35). Performance was similarly negative for capex to assets, but capex to depreciation was only down modestly last month. In all three normalizations of cap spending, the low-spending (typically "good") quintile underperformed the market by 1.5-2.5%, whereas the high spending quintile only outperformed in the sales and assets normalizations.

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Exhibit 35: Companies with Low Capex to Sales Had their Worst Underperformance in a Year in March

Capex/Sales Factor Efficacy
Monthly Returns
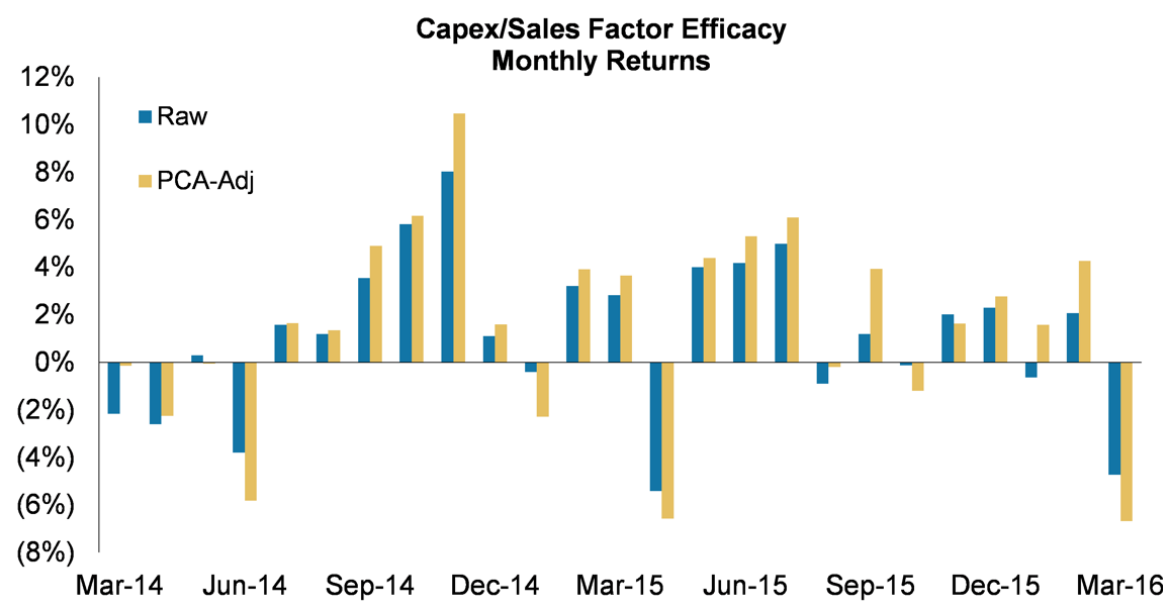
Source: ClariFI, Morgan Stanley Research
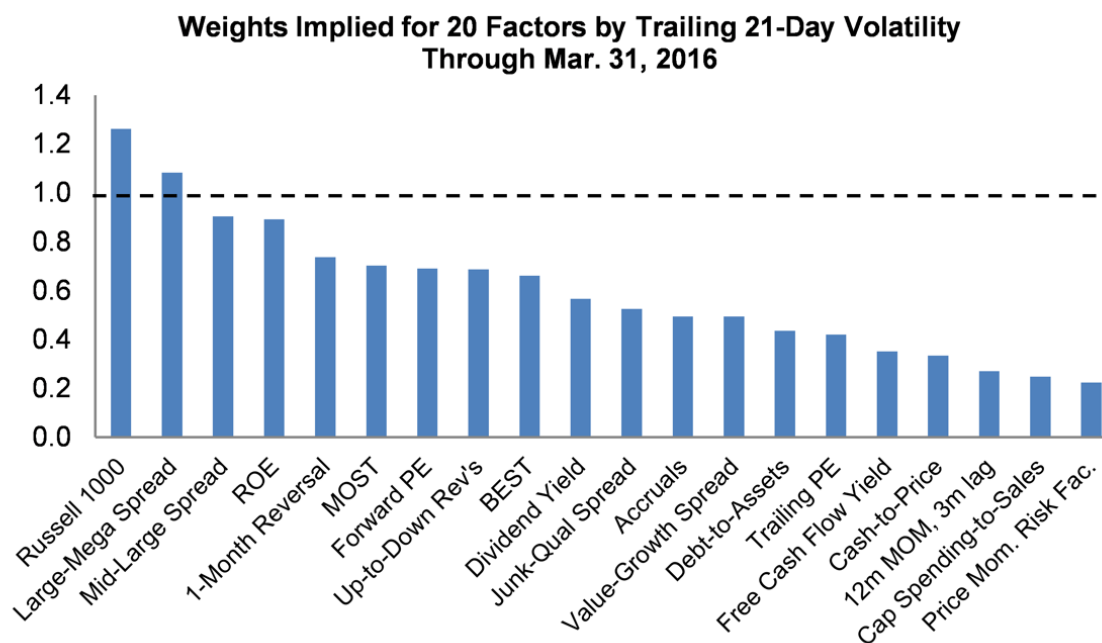
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Risk-Weighted Factor Timing: Market Weight Rises above 1.0

In December, we analyzed risk-based factor timing schemes, in which factors get less weight (exposure) in the coming month if they have recently been volatile, and vice versa (see *US Quant Research: Making Factor Consistency Pay Off*, December 7, 2015). This approach improved risk-adjusted and cumulative returns for the equity market, momentum and other factors.

In the chart below, we show the scalings of a number of popular factors, as of March 31, based on their trailing 21-day volatilities (**Exhibit 36**). **While recent volatilities of many factors remain above their respective long-run averages, both the equity market and the large-mega spread have risk weightings above 1.0.** This means that those two factors have recent volatilities below those of their 1979-1989 calibration periods. **Momentum and capex-to-sales continue to have highly attenuated weights, reflecting their volatilities.**

Exhibit 36: Both the Market and the Large-Mega Spreads Had Risk Weightings above 1.0 in March, Indicating that their Recent Risk Is Low Relative to its Historical Average

Source: ClariFI, Morgan Stanley Research

Equity Hedge Fund Alpha Generation Remained Challenging in March

Although the rebound in equity markets greatly benefitted headline returns, March remained a difficult month for alpha generation. We estimate that the HFRX lost an estimated 6bp of alpha relative to our 6-factor risk model last month. Within the month, the first week was the most difficult for alpha, with no apparent pattern thereafter (**Exhibit 37**). In the last year, cumulative alpha for the HFRX Equity Hedge Index has been about -8%, underscoring the difficult environment for stock selection faced by equity managers.

Exhibit 37: The HFRX Equity Hedge Index Lost an Estimated 6 bp of Alpha in March, Bringing its Cumulative Alpha to -8.0% since April 2015
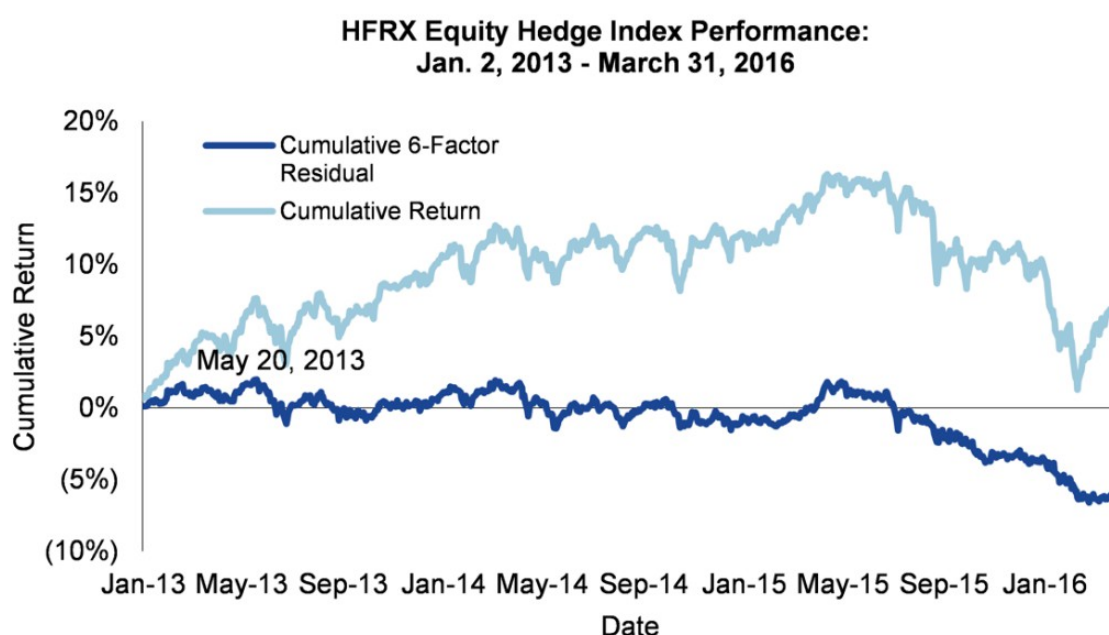
Source: ClariFI, Hedge Fund Research, Morgan Stanley Research

March also appears to have been a difficult month for alpha generation among quant equity funds. We estimate that the HFRX Equity Market Neutral Index lost 87bp of alpha during last month, with much of the loss coming in the first week. While cumulative alpha generation for the Equity Market Neutral Index since 2013 has been better than that for the Equity Hedge Index, cumulative alpha has been flat to down since last October (**Exhibit 38**).

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Exhibit 38: The HFRX Equity Market Neutral Index Lost an Estimated 87bp of Alpha in March, with Losses Concentrated during the First Week of the Month

Cumulative Six-Factor Residuals of HFRX
Equity Market Neutral Index Since September 2012
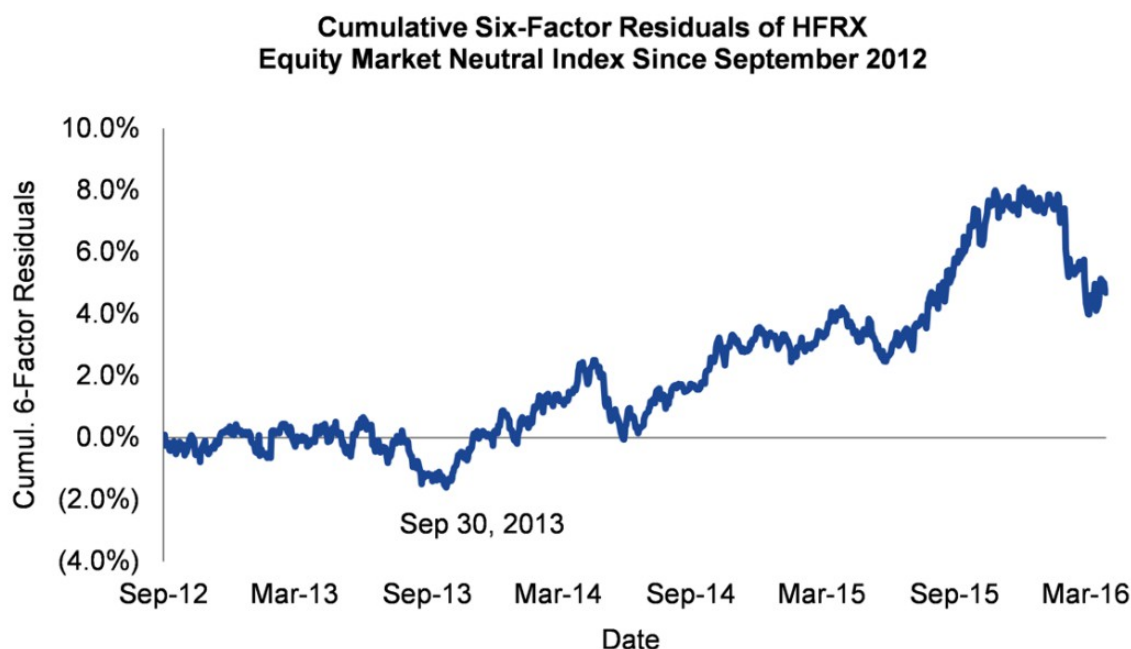
Source: ClariFI, Hedge Fund Research, Morgan Stanley Research

Hedge Funds' Anti-Mega-Cap Bias Widens as Momentum Bias Contracts

The low quality/junk bias of equity long/short funds remains wide, while the growth bias compressed somewhat in March (Exhibit 39). In the current low growth era, fundamental long/short managers are sharply favoring stocks with growth characteristics. As discussed in an earlier note (see *US Quant Research: Non-Normal Activity*, Nov. 4, 2013), growth and junk biases tend to increase the skewness (i.e., positive asymmetry) of equity return distributions and are consistent with hedge funds seeking lottery-like payoffs.

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Exhibit 39: The Junk Bias of Long/Short Equity Hedge Funds Remains Wide, while the Growth Bias Contracted Somewhat in March

Factor Exposures: HFRX Equity Hedge Index
Through March 31, 2016
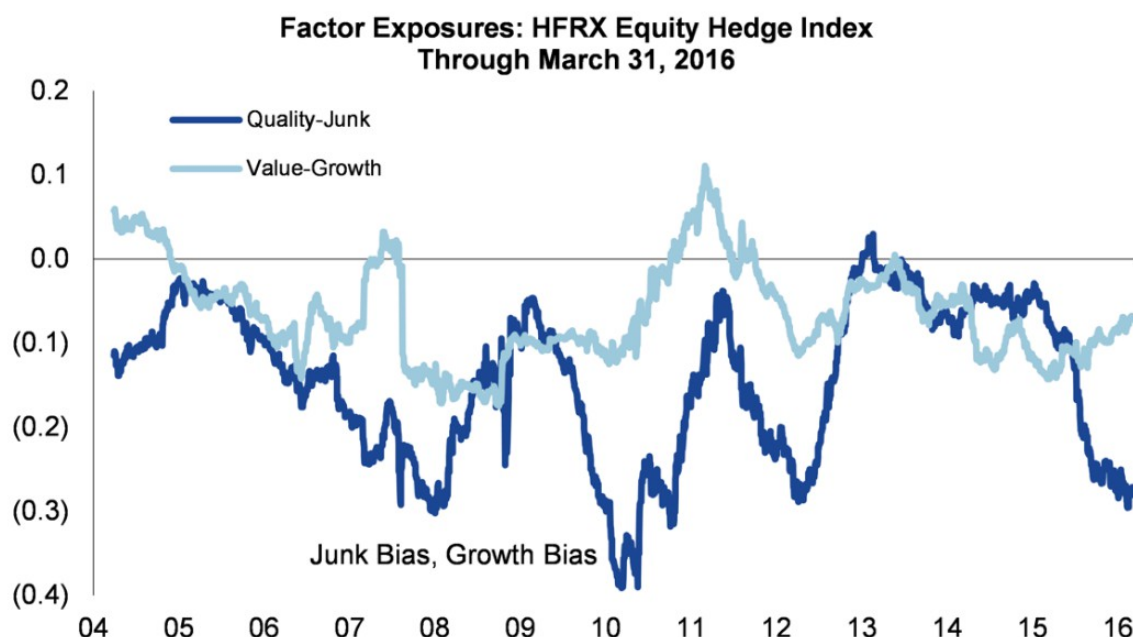
Source: ClariFI, Hedge Fund Research, Morgan Stanley Research

The anti-mega-cap bias of equity long/short hedge funds continued to rise in March, reaching a multi-year high. Meanwhile, momentum bias has declined nearly to neutral. (**Exhibit 40**). Due to the fact that market-cap spreads were small and momentum sensitivity was low, neither factor contributed strongly to HFRX Equity Hedge returns in March.

Exhibit 40: The Anti-Mega-Cap Bias of Equity Long/Short Funds Continued to Rise in March, while the Momentum Bias Declined almost to Neutral

Factor Exposures: HFRX Equity Hedge Index
Through March 31, 2016
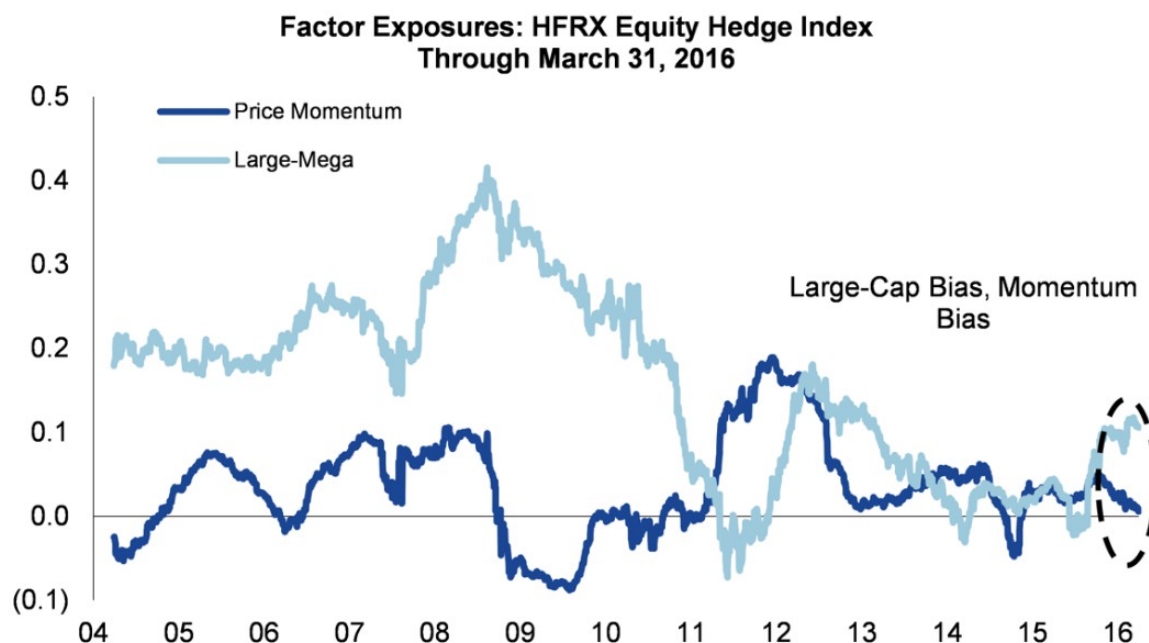
Source: ClariFI, Hedge Fund Research, Morgan Stanley Research

We construct screens of stocks that are consistent with or opposite to the current multi-factor exposures of the HFRX Equity Hedge Index. As was the case last month, we include stocks in either the mega- or large-cap cohorts, acknowledging the near-neutrality of the index on mega-cap versus large-cap bias.

In **Exhibit 41**, we show stocks with exposures *consistent* with those of the index: large-cap stocks (but not mega-cap stocks), with a growth bias (i.e., not value or neither), a low-quality bias (bottom two quartiles), and a momentum bias (top three quintiles of price momentum). **This list of overweight-consistent names continues to be dominated by consumer discretionary, airline and technology stocks, along with some health care stocks.**

Exhibit 41: Discretionary, Airline and Technology Stocks Dominate the Overweight-Consistent List

**Stocks with Exposures
Consistent with Equity Long/Short Hedge Funds
As of April 1, 2016**

Ticker	Company	Sector	Market Cap ($B)
CRM	Salesforce.Com Inc	Information Technology	50.8
NFLX	Netflix Inc	Consumer Discretionary	45.2
LVS	Las Vegas Sands Corp	Consumer Discretionary	41.1
DAL	Delta Air Lines Inc	Industrials	36.6
TSLA	Tesla Motors Inc	Consumer Discretionary	31.2
STZ	Constellation Brands	Consumer Staples	30.4
LUV	Southwest Airlines	Industrials	28.9
ORLY	O'reilly Automotive Inc	Consumer Discretionary	27.2
MHFI	Mcgraw Hill Financial	Financials	26.4
BSX	Boston Scientific Corp	Health Care	25.5
AMAT	Applied Materials Inc	Information Technology	24.2
EQIX	Equinix Inc	Financials	20.5
EA	Electronic Arts Inc	Information Technology	20.4
EW	Edwards Lifesciences Corp	Health Care	19.4

Source: ClariFi, Morgan Stanley Research. For important disclosures regarding companies that are the subject of this screen, please see the Morgan Stanley Research Disclosure Website at www.morganstanley.com/researchdisclosures. CRM: $75.58, NFLX: $104.83, LVS: $49.78, DAL: $47.2, TSLA: $265.42, STZ: $160.34, LUV: $43.67, ORLY: $271.66, MHFI: $97.71, BSX: $19.56, AMAT: $21.06, EQIX: $327.41, EA: $65.83, EW: $107.48. For valuation methodology and risks associated with any price targets, ratings or recommendations referenced in this research report, please contact the Client Support Team as follows: US/Canada +1 800 303-2495; Hong Kong +852 2848-5999; Latin America +1 718 754-5444 (U.S.); London +44 (0)20-7425-8169; Singapore +65 6834-6860; Sydney +61 (0)2-9770-1505; Tokyo +81 (0)3-5424-4349. Alternatively you may contact your investment representative or Morgan Stanley Research at 1585 Broadway, (Attention: Research Management), New York, NY 10036 USA.

In **Exhibit 42**, we show stocks with the opposite factor sensitivities to equity hedge fund indexes, drawn from either the mega-cap and large-cap cohorts. These stocks have a value bias (not growth or neither), a high quality bias (top two quartiles in our quality model), and a negative momentum bias (bottom three quintiles of price momentum). **The criteria for this list have not changed in several months.**

Stocks consistent with underweights by equity hedge funds are dominated by financial stocks, along with some energy companies.

Exhibit 42: Large Financial Stocks Dominate the List of Companies with Exposures Opposite to those of Hedge Funds

**Stocks with Exposures
Opposite to Equity Long/Short Hedge Funds
As of April 1, 2016**

Ticker	Company	Sector	Market Cap ($B)
BRK.B	Berkshire Hathaway	Financials	354.5
WFC	Wells Fargo & Co	Financials	246.7
JPM	Jpmorgan Chase & Co	Financials	219.3
WMT	Wal-Mart Stores Inc	Consumer Staples	218.4
MDT	Medtronic Plc	Health Care	105.6
SLB	Schlumberger Ltd	Energy	90.6
USB	U S Bancorp	Financials	71.0
GS	Goldman Sachs Group Inc	Financials	70.6
BLK	Blackrock Inc	Financials	56.7
OXY	Occidental Petroleum Corp	Energy	52.1
COP	Conocophillips	Energy	49.2
CAT	Caterpillar Inc	Industrials	44.7
PNC	Pnc Financial Svcs Group Inc	Financials	43.0
BK	Bank Of New York Mellon Corp	Financials	40.1
KMI	Kinder Morgan Inc	Energy	38.6

Source: ClariFi, Morgan Stanley Research. For important disclosures regarding companies that are the subject of this screen, please see the Morgan Stanley Research Disclosure Website at www.morganstanley.com/researchdisclosures. Prices as 04/06/2016: BRK.B: $141.7, WFC: $48.08, JPM: $58.81, WMT: $69.04, MDT: $77.31, SLB: $73.16, USB: $40.09, GS: $155.19, BLK: $337.2, OXY: $70.12, COP: $40.75, CAT: $75.22, PNC: $83.8, BK: $36.97, KMI: $17.6. For valuation methodology and risks associated with any price targets, ratings or recommendations referenced in this research report, please contact the Client Support Team as follows: US/Canada +1 800 303-2495; Hong Kong +852 2848-5999; Latin America +1 718 754-5444 (U.S.); London +44 (0)20-7425-8169; Singapore +65 6834-6860; Sydney +61 (0)2-9770-1505; Tokyo +81 (0)3-5424-4349. Alternatively you may contact your investment representative or Morgan Stanley Research at 1585 Broadway, (Attention: Research Management), New York, NY 10036 USA.

Appendix: Performance of Moving Average Signals when Combined with Macro Signals and Past Returns

A total of 87 moving average factors remain in the multi-factor cohort models after including significant macro factors and past cohort returns in the stepwise regressions (**Exhibit 43**). This is down from 103 without the macro factors and past returns, so 85% of the moving-average signals survive when we add these conditioning variables. It therefore appears that moving average signals provide complementary information to other types of predictive variables.

The highest concentration of signals is still in the 10/40 and 10/60 moving average pairs.

Exhibit 43: A Total of 87 Moving Average Signals Persist when Macro and Past Cohort Returns Are Included. The Highest Concentration Remains at the 10/40 and 10/60 Pairs

Number of Signals Appearing in Stepwise Multifactor Models
With Macro and Past Cohort Returns by Fast/Slow Moving Average Pair

Fast Moving Avg. (Days):	Slow Moving Avg. (Days):					
	20	**30**	**40**	**60**	**120**	**240**
10	6	6	11	11	5	9
20				5	3	7
40					6	6
60					5	7

Source: ClariFI, Morgan Stanley Research

Last 5 day signals appear to be somewhat more attenuated than last month or last quarter signals, when macro and past returns are included. The number of "last 5 day" factors appearing falls from 47 to 38, which is a greater percent decline than the other two types experienced (**Exhibit 44**).

Exhibit 44: Signals in the Last 5 Days Category Appear to Be Most Impacted by the Inclusion of Macro and Past Return Factors in the Multi-Factor Models

Number of Signals Appearing in Stepwise Multifactor
Models with Macro and Past Cohort Returns
By Lookback Period

Period	Count
Last 5 days	37
Last Month	34
Last Quarter	16

Source: ClariFI, Morgan Stanley Research

The bias toward negative crossover signals persists when macro and past return factors are included (**Exhibit 45**)

Exhibit 45: Even with Macro Factors and Past Cohort Returns Included, Negative Crossover Factors Appear More Often than Positive Crossovers

Number of Signals Appearing in the Stepwise Multifactor Models with Macro and Past Cohort Returns By Direction of Crossover

Positive/Negative	Count
Negative Crossover	50
Positive Crossover	37

Source: ClariFI, Morgan Stanley Research

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Endnotes

[1] The motivation for using total returns for price series, rather than the price returns, is that dividends can cause abrupt changes in the latter – possibly inducing crossovers that are unrelated to information about the asset.

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	COUNT	% OF TOTAL	COUNT	% OF TOTAL IBC	% OF RATING CATEGORY
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Equal-weight/Hold	**1405**	**41%**	**333**	**45%**	**24%**
Not-Rated/Hold	**81**	**2%**	**5**	**1%**	**6%**
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