

Factor Review and 2017 Outlook

Equity Research

Avoiding reversal is key in 2017; introducing a Momentum Reversal Indicator (MRI)

It is all about factors and reversal in 2016

Understanding factor exposures and the systematic risk in portfolios continues to be an important aspect for the fundamental investment community. Controlling factor exposures might have been a deciding factor between outperformers and underperformers due to elevated factor volatility and correlation in 2016, in our view.

Value is not yet over

We believe the rotation into Value has room to run in Japan and Asia. If history were to be a guide, we note that when Value works, it tends to last for multiple years. We see both macro and micro factors providing positive support for Value outperformance: 1) US rates, 2) FX, 3) US inflation expectations (Inflation breakeven), and 4) overall earnings revision trend.

Finding the link between crowding and reversal

Price Momentum factors performance is a reflection of trend. A reversal of Price Momentum factors implies style rotation. We tested our crowdedness measures to predict a potential reversal of Momentum factors. The measures include; 1) Relative valuation, 2) RSI of factor basket return, 3) Pairwise correlation, 4) Factor correlation to Momentum factors, 5) Momentum factors acceleration.

Avoiding reversal with MRI

We have developed a systematic signal to predict a reversal of Momentum factors, leveraging our earlier work on crowdedness. We use Price Momentum factors (6M and 12M). We have developed a combined signal of predictive factors to create a Momentum Reversal Indicator (MRI). Our backtest shows that it is effective in predicting a short-term (1M) reversal of Price Momentum factors. Currently both Japan and MXAPJ MRIs suggest near-term reversal is unlikely.

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Portfolio Managers' Summary: Asian Factor Review and 2017 Outlook

QUANTAMENTALS

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[Asian Quantamental: Alpha vs Beta 2, December 9, 2016](#)

[Asian Quantamental: Alpha vs Beta, November 23, 2016](#)

[Asian Quantamental: Myths vs Reality, July 14, 2016](#)

*We have been arguing that understanding factor exposures and the systematic risk in portfolios is increasingly an important aspect for the fundamental investment community. 2016 was indeed a year where controlling factor exposures might have been a deciding factor between outperformers and underperformers due to **elevated factor volatility and correlation**. In this *Factor Review and Outlook*¹ piece, we provide an overview on performance in 2016 and an outlook for 2017 as well as introduce a new measure, **GS MRI**, to gauge the nature of reversal, leveraging our earlier work on crowdedness.*

- 1) Factor performance in 2016 in Japan and MXAPJ: A strong style rotation coincided with a rebound of the overall equity market. This meant a strong rebound of **Value** factors such as **P/E** (first yearly positive return since 2013) and **P/B** (best in MXAPJ and 2nd best performing factor in Japan for 2016) and strong return **reversal of Momentum** factors.
- 2) 2017 Outlook: We believe the rotation into **Value** has room to run in Japan and Asia. If history were to be a guide, we note that when Value works, it tends to last for multiple years. We see both macro and micro factors providing positive support for Value outperformance. **US rates** are likely to remain a key driver of Value performance as it also affects FX. The correlation between Value and US 10Y treasury yield has picked up recently and currently at 64% (Japan) and 44% (MXAPJ) vs historical average of 27% and 12%. Value performance also tracks closely with **US inflation expectations** as inflation is also seen to influence FX rates. We also draw investor focus towards the overall **Earnings Revision trend** as the historical relationship between the Earnings Revision index and Value performance has been strong, correlation at 35% and 30%, Japan and MXAPJ respectively.
- 3) Introducing MRI: On the back of recent Value outperformance, one of the common questions we have been receiving is “What measures can one use to avoid getting caught in factor reversals?” To help answer this question, we have developed a systematic signal to predict a reversal of Momentum factors, leveraging our earlier work on crowdedness. We use Price Momentum factors (6M and 12M). We have developed a combined signal of predictive factors to create MRI. Our backtest shows that it is effective in predicting a short-term (1M) reversal of Price Momentum factors.

¹ For US factor review and outlook, please refer to Bob Boroujerdi's *Quantamentals: Factor Review and Outlook, January 4, 2017*

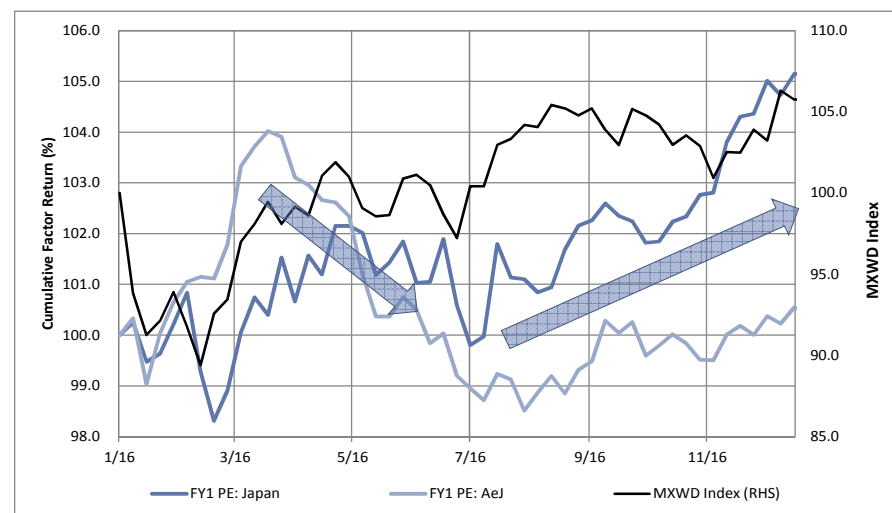
2016 Factor Review: Momentum/Quality in 1H, Value/Reversal in 2H

In our Quant Strategy 2016 Outlook², we had argued for: 1) correction of valuation dispersion, and 2) revival of Value strategy. Although it did not happen in the first half of 2016, both occurred in the second half (from July) both in Japan and Asia Pacific ex-Japan (MXAPJ). 2016 has been a year of two halves not only in Asia, but globally³. It was a significant style-based regime shift, in our view. Other highlights include:

- Style rotation coincided with a rebound of overall equity market such as MSCI AC World (MXWD) index. This suggests a significant sentiment improvement (Exhibit 1).
- ... and it meant a strong reversal for Momentum factors (Exhibit 2).
- Strong rebound of Value factors such as P/E (first yearly positive return since 2013) and P/B (best in MXAPJ and 2nd best performing factor in Japan for 2016).

Exhibit 1: Rotation into Value (P/E) coincided with a rebound of the equity market

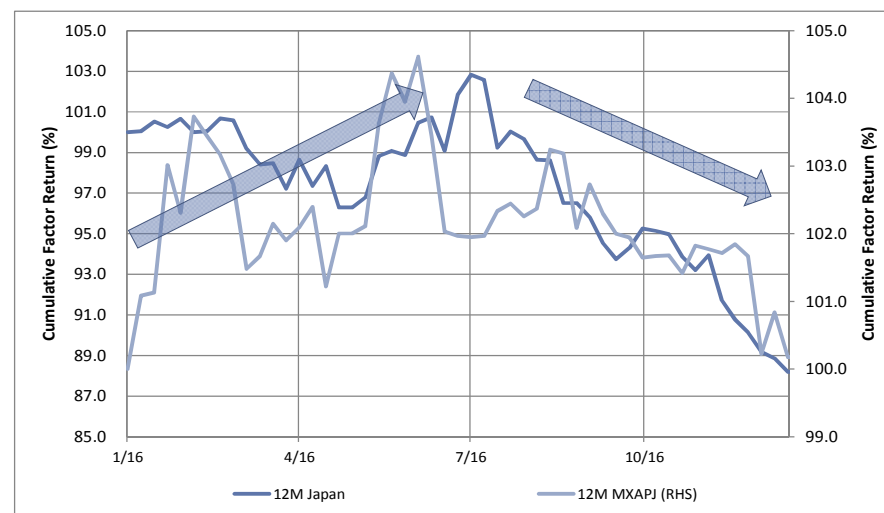
FY1 P/E cumulative factor performance & MXWD



Source: Bloomberg, FactSet, Goldman Sachs Global Investment Research

Exhibit 2: Reversal trend was a consistent theme in 2H 2016 in Japan and Asia

12M Momentum cumulative factor performance



Source: Bloomberg, FactSet, Goldman Sachs Global Investment Research

² Japan: Portfolio Strategy: Quant Strategy 2016 Outlook, November 30, 2015

³ For European Factor performance, please refer to *European Factor Review*, December 29, 2016

Japan: Momentum/Quality in 1H, Value/Reversal in 2H

The overall trends were similar in Japan and Asia Pacific ex-Japan, but single factor performance varied. As shown by colors in Exhibits 3 and 4, what worked in 1H 2016 reversed in 2H. This rotation of styles was particularly strong in Value, Quality, Profitability and Momentum factor groups in Japan. Other highlights include:

- Forward Dividend Yield posted the best 2016 yearly performance (+19.7%) while FY1 Sales Growth was the worst (-21.2%).
- 12M Price Momentum factor posted the worst negative performance in August with -10.8% (3.1 standard deviation below vs 5yr historical average).
- Profitability factor underperformed significantly going into the year end (Nov and Dec).
- Analyst Sentiment factors were insignificant throughout the year perhaps due to industry wide self-imposed control of earnings preview meetings.

Exhibit 3: Rotation of style was strong dividing 2016 into two halves.

Japan Sector Neutral Long/Short basket performance in 2016

Factor Performance TOPIX 500														
* Performance data as of Dec 30, 2016		Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016	2016
TOPIX		-7.4%	-9.4%	3.8%	-0.5%	2.9%	-9.7%	6.2%	0.5%	-0.5%	5.3%	5.5%	3.3%	-1.9%
Value	Earnings Yield NTM (P/E)	-4.1%	-5.4%	1.2%	0.4%	1.6%	-6.6%	3.4%	6.1%	-0.7%	2.6%	3.5%	0.8%	2.0%
	Earnings Yield FY0 (P/E)	-4.5%	-3.1%	1.3%	-1.0%	2.2%	-3.1%	4.2%	5.0%	-0.5%	3.5%	2.7%	2.0%	8.2%
	Book Yield - FY0 (P/B)	-0.9%	-1.5%	-1.2%	2.0%	-0.1%	-5.0%	5.6%	4.5%	0.3%	3.0%	5.7%	3.2%	16.0%
	Dividend Yield FY1	0.9%	1.4%	1.4%	0.4%	-0.9%	-3.9%	3.4%	6.7%	-0.9%	2.1%	5.5%	2.5%	19.7%
Growth	Sales Growth FY1	0.0%	-0.9%	0.4%	0.1%	-3.8%	2.8%	-3.9%	-8.3%	2.7%	-4.6%	-4.2%	-3.1%	-21.2%
	OP Growth FY1	1.2%	-2.2%	0.7%	0.6%	-2.2%	2.7%	-4.5%	-1.4%	1.9%	-2.9%	-2.7%	-1.6%	-10.1%
	EPS Growth FY1	1.8%	-0.7%	0.7%	1.4%	-2.4%	-1.7%	-1.8%	0.9%	-0.3%	-2.2%	-0.2%	-1.5%	-5.9%
Momentum	Price Return 1M	1.9%	1.2%	-2.2%	-1.7%	-0.5%	3.2%	-5.9%	2.5%	-4.7%	-1.6%	1.8%	0.3%	-6.1%
	Price Return 3M	0.7%	0.7%	-3.0%	-3.0%	0.9%	2.6%	-4.6%	-6.8%	-2.2%	0.9%	0.9%	0.5%	-12.2%
	Price Return 6M	6.0%	0.3%	-2.4%	-1.3%	0.3%	8.3%	-6.2%	-6.4%	-1.0%	-0.1%	-1.7%	-0.6%	-5.7%
	Price Return 12M	3.1%	0.0%	0.7%	-3.7%	1.3%	8.5%	-7.9%	-10.8%	1.0%	-2.6%	-3.9%	-2.5%	-16.7%
Analyst Sentiment	Rating Revision (1M)	0.9%	-1.0%	-0.5%	1.7%	-2.1%	-1.1%	-0.4%	-2.5%	1.2%	-1.2%	0.1%	0.4%	-4.5%
	FY1 EPS Revision (1M)	2.2%	-0.8%	-0.6%	-1.1%	-1.5%	2.2%	-1.7%	-6.8%	-0.7%	-0.9%	-2.1%	-3.1%	-14.2%
Quality	Net Cash / Market-Cap	2.5%	2.1%	-1.1%	-3.0%	1.5%	1.0%	1.8%	-1.9%	0.7%	0.5%	-3.7%	0.3%	0.5%
	Equity / Debt	-0.2%	2.7%	0.9%	-1.6%	1.9%	2.5%	0.7%	-3.1%	1.2%	1.3%	-1.5%	-1.9%	2.7%
Profitability	ROE FY1	0.0%	-0.5%	2.7%	-2.5%	2.0%	0.7%	-2.8%	-1.8%	-0.1%	-1.7%	-3.0%	-2.0%	-9.0%
	ROA FY1	0.7%	-1.8%	2.7%	-2.2%	1.0%	1.7%	-0.4%	-2.8%	0.1%	-0.5%	-4.1%	-2.2%	-7.9%

Source: FactSet, Toyo Keizai, I/B/E/S, Goldman Sachs Global Investment Research

MXAPJ: Same story for Value and Momentum as Japan, but other factors were ineffective

The Momentum to Value rotation was also evident in MXAPJ though the reversal Momentum factors were the strongest in March than the year end unlike the rest of the world. Other highlights include:

- P/B (Book Yield) was the best performing factor yielding +18.5%, while 3M Price Momentum factor posted the worst performance with -14.1%.
- Growth group performed poorly throughout the year perhaps due to over-optimistic earnings forecasts in the beginning of the year.
- Analyst Sentiment group was also insignificant in MXAPJ, first negative yearly return for EPS Revision since 2012.
- Profitability and Quality were not effective, not too surprising, given low correlation to either Value or Momentum factors.

Exhibit 4: Momentum to Value rotation was strong, but other factors did not see reversal as much

MXAPJ Sector Neutral Long/Short basket performance in 2016

Factor Performance MXAPJ														
* Performance data as of Dec 30, 2016		Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016	2016
MXAPJ		-6.6%	-1.0%	7.0%	0.0%	0.5%	0.0%	4.3%	1.8%	0.9%	-0.8%	-0.8%	-0.4%	4.4%
Value	Earnings Yield NTM (P/E)	-2.6%	0.7%	5.8%	-2.1%	-2.4%	-1.6%	1.4%	3.9%	1.5%	2.3%	3.3%	1.9%	12.3%
	Earnings Yield FY0 (P/E)	1.6%	2.2%	1.7%	-1.7%	-0.9%	0.6%	0.8%	2.9%	0.8%	1.4%	1.8%	0.4%	12.0%
	Book Yield - FY0 (P/B)	0.8%	4.5%	1.9%	2.4%	-4.6%	1.0%	1.4%	1.1%	1.0%	3.8%	2.1%	2.1%	18.5%
	Dividend Yield FY1	1.5%	2.9%	0.2%	-1.5%	0.1%	0.4%	2.9%	1.3%	-0.4%	-0.5%	4.0%	1.9%	13.2%
Growth	Sales Growth FY1	-2.3%	-4.2%	-0.4%	0.5%	0.6%	0.3%	0.6%	2.4%	-1.7%	-0.5%	-3.3%	-0.4%	-8.3%
	OP Growth FY1	-1.6%	-3.4%	1.4%	-1.6%	1.3%	0.5%	1.4%	0.7%	-0.6%	1.0%	-3.3%	-1.3%	-5.6%
	EPS Growth FY1	0.7%	-1.7%	-0.3%	0.4%	-0.6%	-0.5%	0.6%	2.7%	-1.1%	0.9%	-4.4%	0.1%	-3.4%
Momentum	Price Return 1M	-0.4%	0.3%	-3.8%	0.2%	-0.5%	0.7%	-1.0%	-0.4%	-1.3%	0.3%	2.2%	-3.4%	-7.1%
	Price Return 3M	-2.0%	-1.2%	-7.5%	-1.5%	-0.6%	0.9%	-1.4%	-0.3%	-2.0%	2.8%	2.1%	-3.9%	-14.1%
	Price Return 6M	7.0%	-0.6%	-8.3%	-1.5%	2.5%	1.8%	-0.9%	-0.1%	-1.9%	1.8%	-0.6%	-4.7%	-6.1%
	Price Return 12M	1.4%	-2.6%	-8.9%	0.3%	6.0%	-0.6%	-1.3%	-1.5%	-1.9%	0.7%	-3.4%	-1.1%	-12.9%
Analyst Sentiment	Rating Revision (1M)	0.5%	0.5%	2.1%	-0.1%	-1.8%	0.7%	-0.9%	0.3%	-0.4%	0.6%	0.1%	-0.1%	1.3%
	FY1 EPS Revision (1M)	0.5%	-0.6%	-1.5%	-1.7%	2.1%	-0.2%	0.5%	0.6%	-1.4%	0.6%	-1.6%	-2.6%	-5.1%
Quality	Net Cash / Market-Cap	1.8%	-2.4%	-2.9%	-2.1%	3.3%	-0.1%	-2.5%	-1.1%	1.1%	-1.8%	-0.9%	-1.9%	-9.3%
	Equity / Debt	0.2%	-1.4%	-0.2%	1.3%	-0.6%	-0.6%	-0.4%	0.7%	1.0%	-0.1%	1.9%	-1.8%	-0.2%
Profitability	ROE FY1	-1.8%	-1.4%	0.2%	-3.5%	2.5%	-0.6%	0.4%	1.4%	-0.6%	-1.0%	-1.2%	-2.3%	-7.8%
	ROA FY1	1.7%	-1.5%	-2.5%	-2.5%	4.7%	0.6%	0.1%	0.0%	-0.8%	-0.7%	-2.1%	-0.3%	-3.6%

Source: FactSet, I/B/E/S, Goldman Sachs Global Investment Research

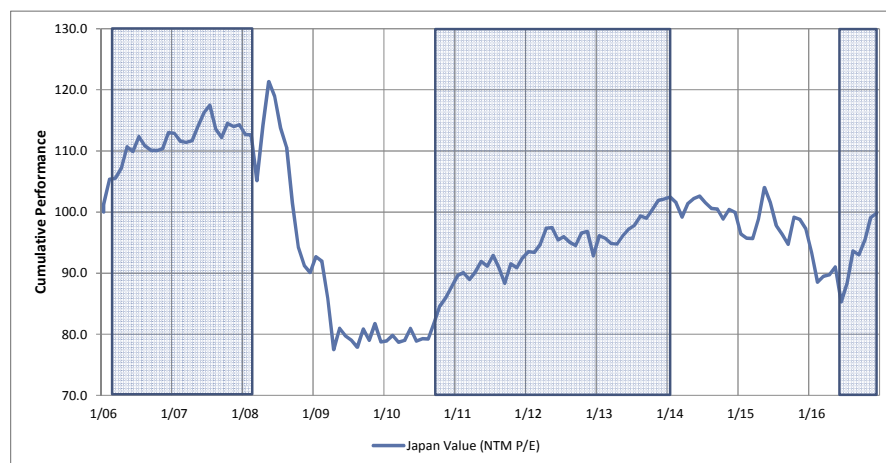
2017 Outlook: Macro is important, but positive earnings revision is also needed

We believe the rotation into Value has room to run in Japan and Asia. Value strategy was negative in 2014, 2015 and first half of 2016. If history were to be a guide, we note that when Value works, it tends to last for multiple years as Exhibits 5 and 6 show. In our recent note⁴, we highlighted that Value factors tend to perform well both under rising 10Y US treasury yield, USD strengthening (stronger influence for Japan), rising inflation, and rising oil prices. Since July, our Japan and MXAPJ forward P/E sector neutral long/short factor portfolio has yielded +16.7% and +15.3% respectively. While it has already rebounded, we see several key drivers in place:

- US rates are likely to remain a key driver of Value factors performance as it also affects FX in the region. The correlation between Value and US 10Y treasury yield has picked up recently and currently at 64% (Japan) and 44% (MXAPJ) vs historical average of 27% and 12% (Exhibits 7 and 8).
- Value performance also tracks closely with US inflation expectations as inflation is also seen to influence FX rates (Exhibit 9 and 10).
- We also draw investor focus towards the overall earnings revision trend as the historical relationship between the Earnings Revision index and Value performance has been strong, correlation at 35% and 30%, Japan and MXAPJ respectively (Exhibits 7 and 8).

Exhibit 5: Value (P/E) tends to work for several years post a rotation

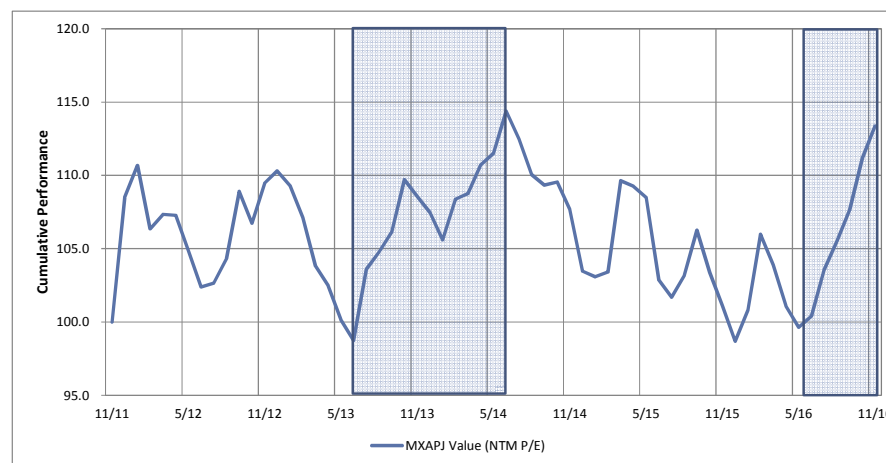
Japan Sector Neutral Value Factor Performance, Shaded = Value outperformance



Source: Bloomberg, FactSet, Goldman Sachs Global Investment Research

Exhibit 6: Value (P/E) has rebounded after 2 years of underperformance

MXAPJ Sector Neutral Value Factor Performance, Shaded = Value outperformance

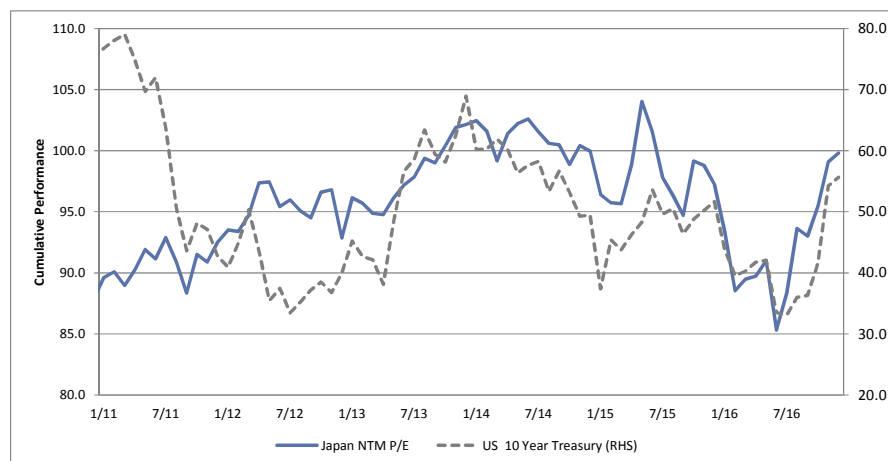


Source: Bloomberg, FactSet, Goldman Sachs Global Investment Research

⁴ Asia Quantitative Research: What happens to factors after a shock, November 16, 2016

Exhibit 7: Correlation has recently picked up

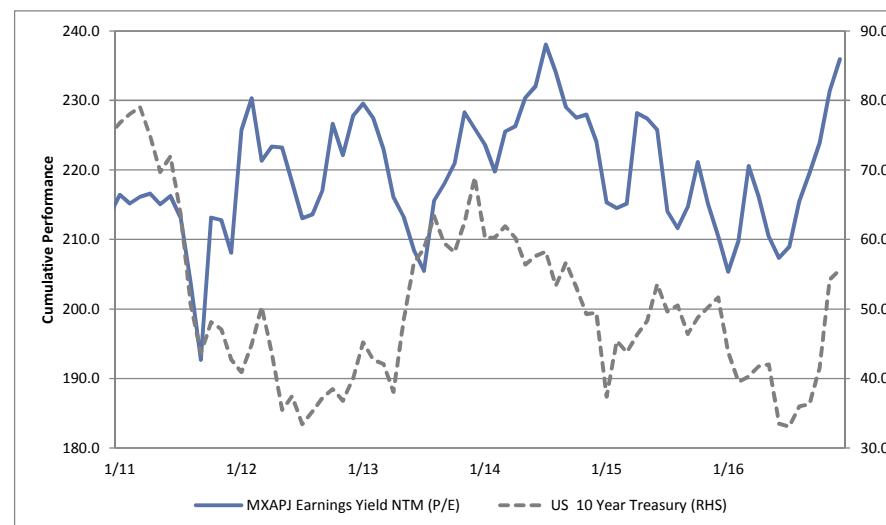
Japan Sector Neutral Value Factor Performance & US 10Y Treasury



Source: Bloomberg, FactSet, Goldman Sachs Global Investment Research

Exhibit 8: Correlation has been relatively high

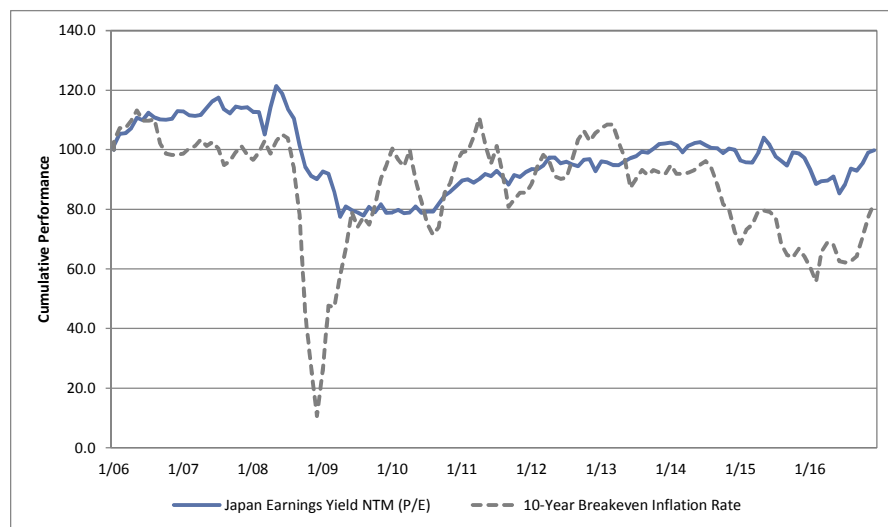
MXAPJ Sector Neutral Value Factor Performance & US 10Y Treasury



Source: Bloomberg, FactSet, Goldman Sachs Global Investment Research

Exhibit 9: Value has been correlating strongly with inflation expectations

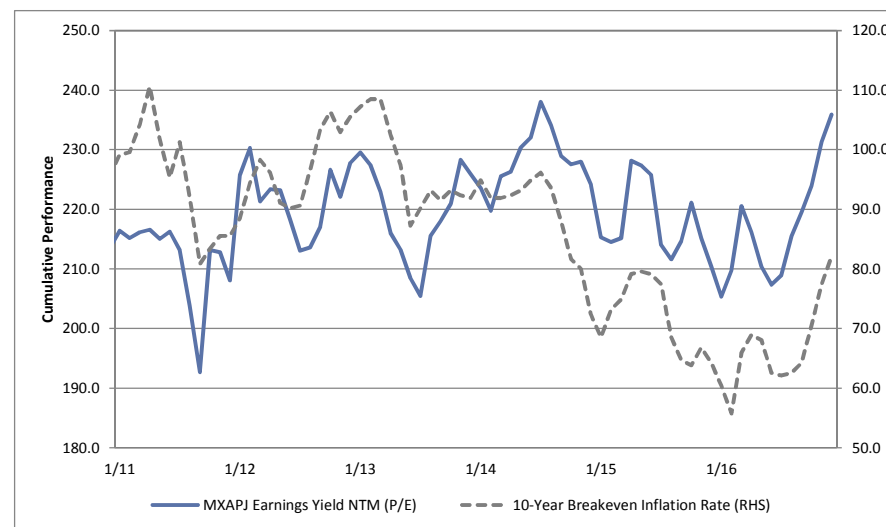
Japan Sector Neutral Value Factor Performance & US 10Y Breakeven Inflation



Source: Federal Reserve Economic Data, FactSet, Goldman Sachs Global Investment Research

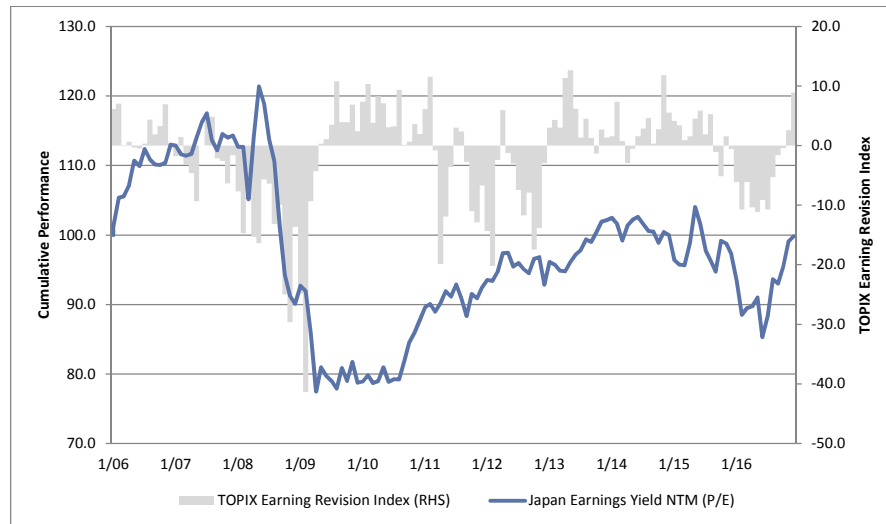
Exhibit 10: Value factor performance tracks US inflation expectations

MXAPJ Sector Neutral Value Factor Performance & US 10Y Breakeven Inflation



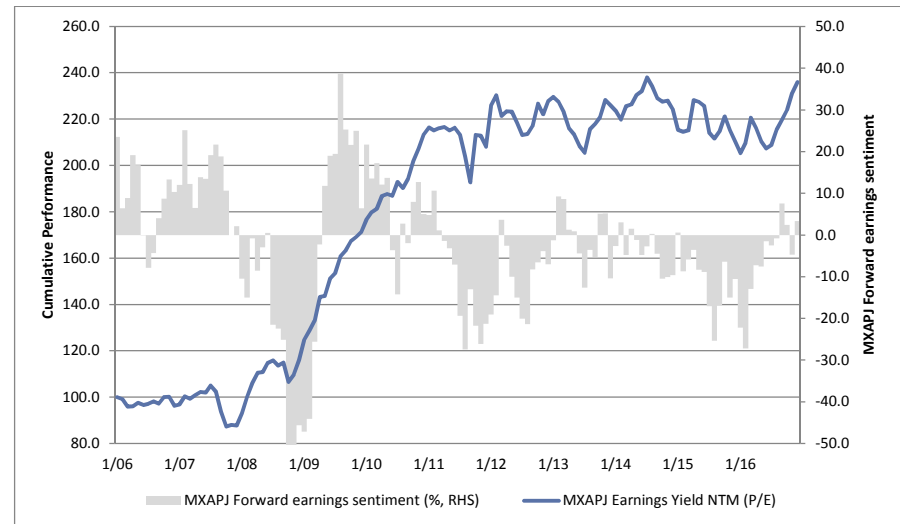
Source: Federal Reserve Economic Data, FactSet, Goldman Sachs Global Investment Research

Exhibit 11: Earnings Revision influences Value factor performance
 Japan Sector Neutral Value Factor Performance & Earning Revision Index



Source: FactSet, I/B/E/S, Toyo Keizai Goldman Sachs Global Investment Research.

Exhibit 12: Earnings Revision turning positive has supported Value factor performance
 MXAPJ Sector Neutral Value Factor Performance & Fwd Earnings sentiment



Source: FactSet, I/B/E/S, MSCI, Goldman Sachs Global Investment Research.

Avoiding a reversal: A New Momentum Reversal Indicator (MRI) Can Help

On the back of recent Value outperformance, one of the common questions we have been receiving is “What measures can one use to avoid getting caught in factor reversals?” Investors care about reversals because reversals can significantly damage portfolio performance especially if it was a reversal of crowded strategy. Majority of participants at our first quant conference in London last year expressed that crowding is their major concern. To help answer this question, we have developed a systematic signal to predict a reversal of Momentum factors, leveraging our earlier work on crowdedness⁵.

We use Price Momentum factors (6M and 12M) as our base for developing a signal. Price Momentum factor performance is a reflection of trend. The aim is to predict a potential reversal of Momentum factors as it implies a reversal of a strategy. Crowding in itself is not a problem, but it becomes a problem when everyone tries to unwind the strategy simultaneously. The measures individually vary in effectiveness of predicting a reversal. We developed a combined signal of predictive factors to create an MRI. Our backtest shows that it is effective in predicting a reversal of Price Momentum factors. In our backtest (please see appendix 1 for more details), we test the statistical significance of the subsequent 1M return following the date when the signal reached +1 standard deviation above the historical average. Our MRI signal consists of the following measures:

- 1) Relative valuation – Forward P/E of each of quintile relative to history
- 2) RSI of factor basket return – an effective tool of short-term prediction
- 3) Pairwise correlation within each quintile – gauges crowding of stocks in a certain segment of a strategy
- 4) Factor correlation to Momentum factors (i.e. Value vs Momentum, Quality vs Momentum)
- 5) Momentum acceleration – another short-term prediction measure

Relative Valuation: Does high valuation indicate a future reversal?

Yes for MXAPJ, but much weaker signal for Japan. Our backtest shows that when relative valuation of Q1 vs Q5 exceeds 1 sigma above the 5-year average, the performance of Momentum factors deteriorates in the subsequent month in Asia-Pac ex-Japan.

Measuring relative valuation of a strategy offers an insight as to whether the market is willing to pay more premiums to the particular strategy. If the premiums relative to historical average continue to rise as it did in 2014 and 2015, it indicates incremental buyers of the strategy. If it continues to rise further, it could imply a potential crowding of the strategy. Empirical evidence suggests that exceeding 1 sigma above the 5-year historical average level, it tends to reverse. We highlighted the overstretched valuation of low volatility strategy and potential reversal in our earlier report⁶.

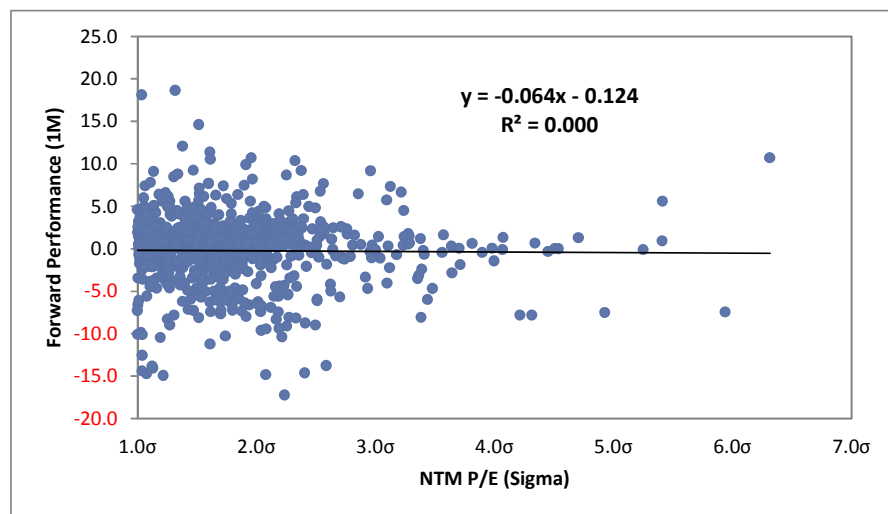
⁵ See reports such as *Asia Quantitative Research: Building a Better Low Vol Mousetrap in Asia*, Aug 9, 2016, *Crowding Insights from LS Hedge Fund Strategies*, Aug 21, 2015

⁶ *Building a Better Low Vol Mousetrap in Asia*, August 9, 2016

We applied the same logic to Momentum factors. Tracking the average valuation of quintile 1 (Q1) and 5 (Q5) and the relative of the two compared with the historical 5-year average should inform us whether there is premium/discount to the strategy. Exhibits 13 and 14 below show the relationship of historical relative average valuation (Fwd 12M P/E) and the performance of Momentum factors. We find that the relationship was stronger in MXAPJ than that in Japan where historical relative valuation is negatively correlated with performance over the subsequent month.

Exhibit 13: Relative valuation is negatively correlated with 12M Momentum factor, but the relationship is weak in Japan

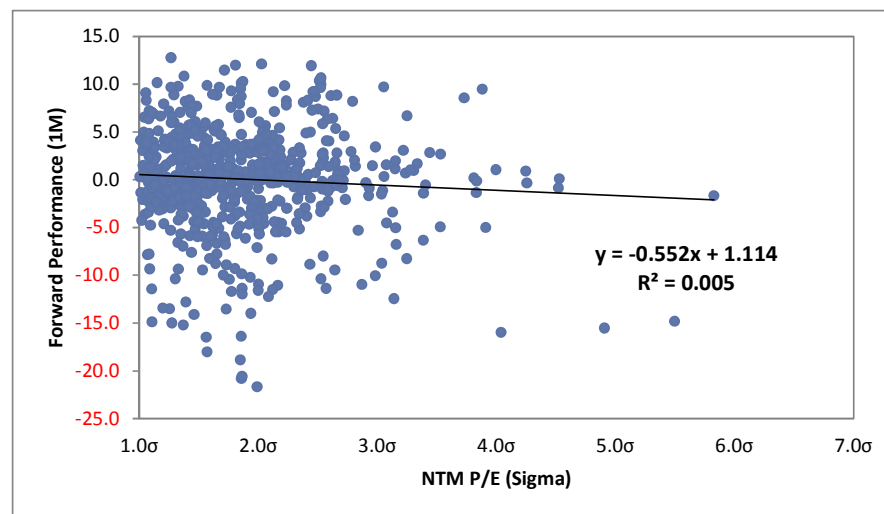
Historical relative NTM P/E of 12M Momentum factor and 12M Momentum factor performance in Japan



Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 14: Negative correlation is stronger in MXAPJ

Historical relative NTM P/E of 6M Momentum factor and 6M Momentum factor performance in MXAPJ



Source: FactSet, Goldman Sachs Global Investment Research

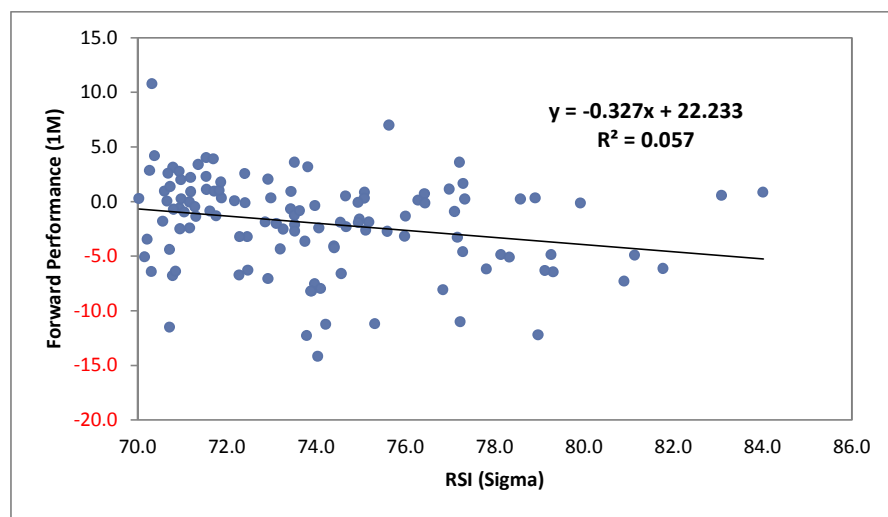
RSI: Does a technical indicator work for Momentum factors?

Yes for Japan and no for MXAPJ. Our backtest shows that performance tends to reverse after RSI reaches the 70 threshold in Japan.

Many of the technical indicators, especially Momentum oscillators, are designed to measure the velocity and magnitude of directional movement, and typically used to measure short-term overshoot and undershoot. The Relative Strength Index (RSI) is probably one of the most common one⁷. We used 70 and 30 as the high and low trigger levels. Highlights from our backtest include:

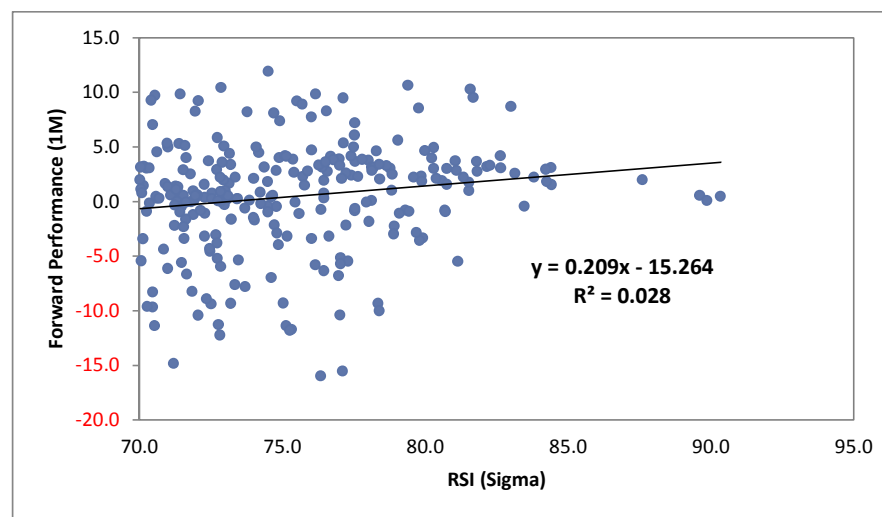
- Short leg (Q5) of 6M and 12M Price Momentum tends to reverse over 1-month post reaching the 70 threshold. Statistically stronger relationship was observed in Japan than MXAPJ.
- Q1-Q5 portfolio spread of 6M and 12M Price Momentum tends to reverse over 1-month post reaching the 70 threshold. Statistically stronger relationship was observed in Japan than MXAPJ.

Exhibit 15: 6M Momentum factor tends to reverse after reaching the 70 level
Japan 6M Momentum Factor Return & 14-Day RSI (6M)



Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 16: RSI is a weak predictive signal for reversal in MXAPJ
MXAPJ 6M Momentum Factor Return & 14-Day RSI (6M)



Source: FactSet, Goldman Sachs Global Investment Research

⁷ RSI: It is designed to measure the ratio of higher closes to lower closes over a given period, typically a 14-day period, and scaled from 0 to 100. It is often stated that an RSI of 70 indicates overbought, hence it tends to reverse to the downside subsequently. Similarly a RSI of 30 or below indicates oversold, it tends to reverse upward subsequently. We apply the same concept to Momentum factor performance and test to see if RSI helps predict future reversal.

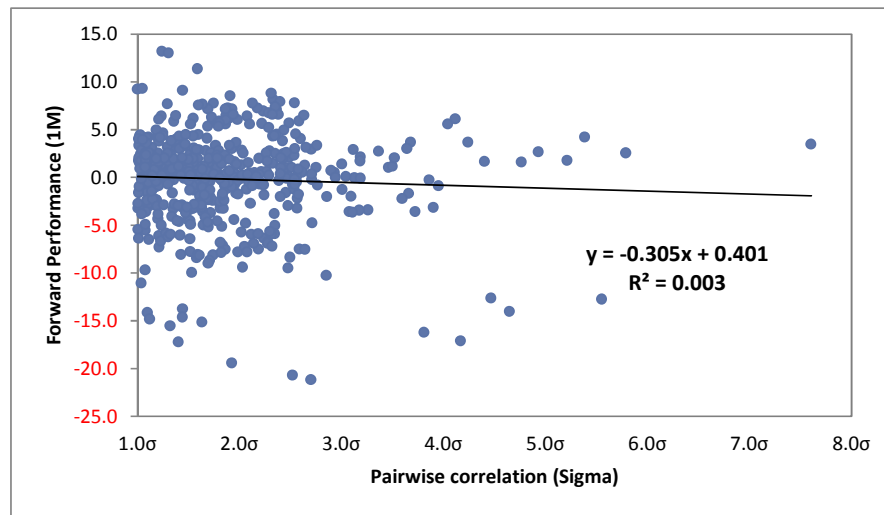
Pairwise correlation: Does synchronicity tell us anything?

Yes, but limited. We find a negative correlation between Momentum factor performance and the stock-to-stock pairwise correlation, especially above the historical 5-year average but the relationship is weak both in Japan and MXAPJ.

Stock-to-stock pairwise correlation measures how closely stocks move together over a given period. High correlation within a particular segment of a strategy is likely to indicate that stocks with same characteristics are being bought or sold together. Positive performance of a factor along with rising correlation could be an indication of crowding. Exhibits 17 and 18 show the relationship between historical average pairwise correlations of the Momentum factor with the performance of Momentum factor. We do find the peak of the pairwise correlation and the peak of Momentum factor performance loosely indicate a negative correlation. However, the overall negative correlation lacks statistical significance.

Exhibit 17: Pairwise correlation showed some predictive power, but statistically insignificant in Japan

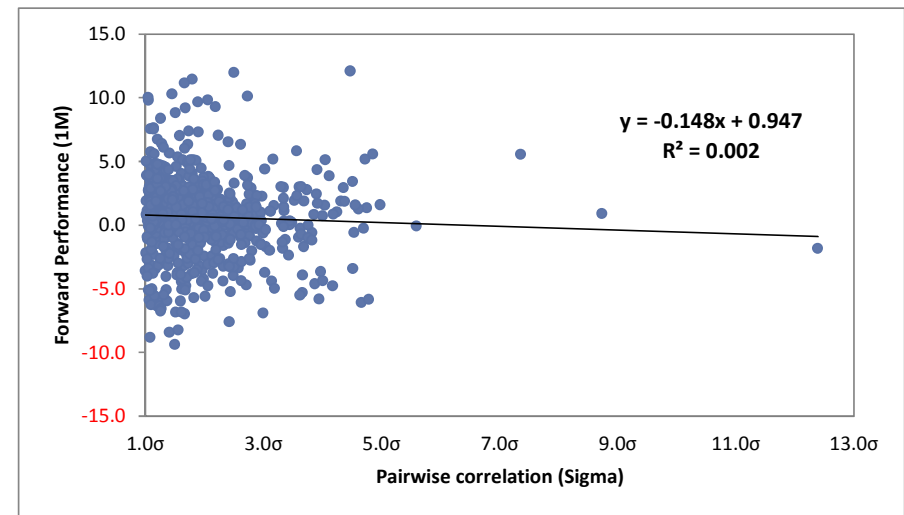
Pairwise correlation (Q1/Q5, 12M Momentum) and 12M Momentum. factor performance in Japan



Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 18: Pairwise correlation predicted future reversal better in MXAPJ

Pairwise correlation (Q1/Q5, 6M Momentum) and 6M Momentum. factor performance in MXAPJ



Source: FactSet, Goldman Sachs Global Investment Research

Acceleration: Is going faster a signal of a reversal?

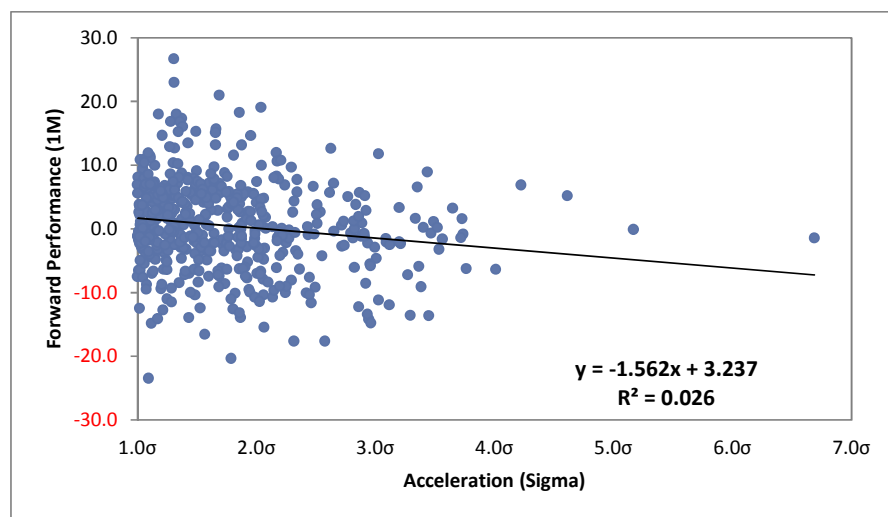
Yes for Japan but no for MXAPJ. Our backtest shows that higher-than-historical average acceleration of Momentum factors can predict a 1M reversal in Japan.

We think if crowding becomes stronger, it is reflected in acceleration of Momentum factors. We analyzed the performance of Momentum factors when the acceleration signal of Momentum factors exceeds more than 1 standard deviation against the rolling 3M average⁸. Historical 12M Momentum acceleration exhibited some predictive power as a short-term reversal signal. Exhibits 19 and 20 below show the relationship between historical 12M Momentum acceleration and Price Momentum factor performance. We show Q5 (Short leg) here as we find a stronger relationship compared with results to Q1-Q5. Our backtest results showed:

- Acceleration signal at Q1-Q5 of 12M Momentum factor shows a stronger signal in predicting 1M reversal in Japan.
- However, the predictive power of acceleration in MXAPJ is weaker for both 6M and 12M Price Momentum factors, and did not produce statistical significance.

Exhibit 19: Acceleration is a good short-term reversal indicator in Japan

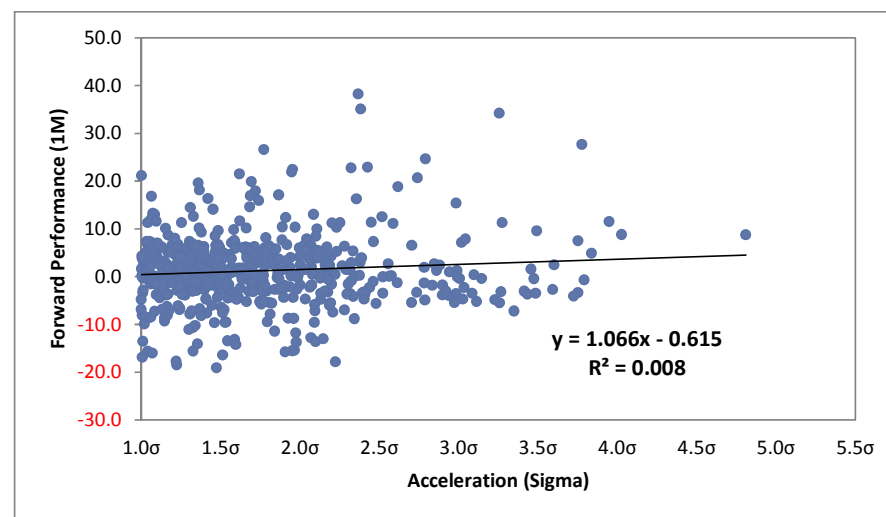
12M acceleration and 12M Price Momentum factor performance in Japan



Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 20: ...but less predictive in MXAPJ

12M acceleration and 12M Price Momentum factor performance in MXAPJ



Source: FactSet, Goldman Sachs Global Investment Research

⁸ We leverage the idea of acceleration of Momentum from James X. Xiong and Roger G. Ibbotson, "Momentum, Acceleration, and Reversal", First Quarter 2015, *Journal of Investment Management*. Acceleration is simply calculated by taking the difference of the average of latest 20 day Momentum factor returns and the average of 20days prior to the latest 20 days (i.e., 40 days to 20 days).

Factor correlation: Does level of correlation to Momentum factors offer an insight?

Yes, our backtest shows that the level of correlation with Momentum factors relative to historical average can be a signal for future reversal for some factors.

Correlation of factor returns (sector neutral long/short portfolio) and long term Momentum factors (6M and 12M) provides an insight as to whether the strategy is getting popular and potentially crowded in the market, in our view. This is because Momentum factor performance is a reflection of what is working in the market. Correlations between factors and Momentum factors change significantly over time as factors come in and out of market favor. We highlighted recent increase in correlation relative to the historical average (10 years) in Exhibits 21 and 22. In both Japan and MXAPJ, it is evident that:

- Value factors are significantly negatively correlated with 6M and 12M Momentum, meaning cheap valuation stocks are negative/low momentum stocks and rich valuation stocks are the positive/high momentum stocks.
- Correlations between Value and Quality (negative) and Quality and Momentum (positive) historically have not been high. However it has significantly increased recently.

Given the changes in correlation over time, correlation to Momentum factors can be a signal to gauge which factors are moving most with what is working in the market. Our backtest shows that when this correlation is high (above 1 standard deviation above the 5 years average), some factors exhibited negative relationship with future Momentum factor returns and is indicative of what may be at risk in the event of a momentum unwind. More specifically, we find that:

- Correlation between FY0 P/E and 6M and 12M Momentum factors, and Consensus Rating Revision and 6M Momentum factor produced statistical significance in predictive 1M reversal in Japan.
- Correlation between Consensus EPS Revision and 6M Momentum factor, and FY0 P/B and 12M Momentum factor produced statistical significance in predictive 1M reversal in MXAPJ.

Exhibit 21: Negative correlation between Value and Momentum (6M & 12M), Value and Quality has significantly increased in last 12M compared to last 10 years

Japan Sector Neutral Long/Short Factor Return Correlation over last 1 year and 10 years

			2016 Correlation																
			Value				Growth			Momentum				Analyst		Quality		Profitability	
			Earnings Yield NTM (P/E)	Earnings Yield FY0 (P/E)	Book Yield - FY0 (P/B)	Div Yield FY1	Sales Growth FY1	OP Growth FY1	EPS Growth FY1	Price Return 1M	Price Return 3M	Price Return 6M	Price Return 12M	Rating Rev (1M)	FY1 EPS Rev (1M)	Net Cash / Market-Cap	Equity / Debt	ROE FY1	ROA FY1
10 Year Correlation	Value	Earnings Yield NTM (P/E)		87%	67%	76%	-39%	-46%	-26%	-39%	-67%	-84%	-84%	-44%	-48%	-58%	-33%	-4%	-22%
		Earnings Yield FY0 (P/E)	77%		70%	74%	-51%	-60%	-56%	-35%	-58%	-73%	-77%	-45%	-50%	-45%	-23%	-20%	-26%
		Book Yield - FY0 (P/B)	22%	32%		81%	-68%	-67%	-40%	-4%	-44%	-66%	-81%	-36%	-65%	-52%	-54%	-70%	-73%
		Div Yield FY1	57%	68%	59%		-62%	-61%	-35%	-13%	-52%	-68%	-81%	-42%	-62%	-45%	-40%	-41%	-51%
	Growth	Sales Growth FY1	3%	-21%	-48%	-25%		74%	44%	-23%	5%	33%	60%	21%	70%	33%	38%	56%	59%
		OP Growth FY1	-15%	-45%	-29%	-33%	45%		56%	1%	23%	48%	66%	33%	62%	35%	35%	49%	50%
		EPS Growth FY1	-21%	-53%	-26%	-38%	32%	61%		6%	22%	28%	37%	21%	32%	16%	10%	41%	27%
	Momentum	Price Return 1M	-51%	-42%	-22%	-34%	1%	5%	9%		56%	49%	24%	24%	-13%	3%	-16%	-29%	-29%
		Price Return 3M	-57%	-56%	-42%	-55%	13%	20%	22%	73%		79%	63%	43%	28%	30%	20%	3%	5%
		Price Return 6M	-50%	-57%	-55%	-65%	21%	31%	31%	54%	83%		89%	55%	51%	45%	29%	17%	21%
		Price Return 12M	-43%	-51%	-64%	-65%	41%	33%	31%	44%	68%	81%		52%	67%	56%	44%	36%	44%
	Analyst Sentiment	Rating Rev (1M)	-29%	-34%	-27%	-38%	13%	17%	17%	31%	40%	46%	36%		30%	27%	7%	12%	16%
		FY1 EPS Rev (1M)	-24%	-37%	-41%	-46%	29%	34%	30%	22%	48%	64%	57%	38%		35%	42%	43%	48%
Quality	Net Cash / MktCap	-14%	-1%	-20%	-9%	12%	-6%	-4%	8%	14%	19%	31%	4%	12%		59%	19%	52%	
	Equity / Debt	-2%	14%	-21%	0%	11%	-8%	-16%	3%	7%	9%	18%	0%	9%	55%		38%	65%	
Profitability	ROE FY1	52%	43%	-53%	9%	41%	10%	0%	-27%	-19%	-3%	13%	-9%	10%	11%	24%		78%	
	ROA FY1	38%	36%	-52%	5%	43%	5%	-3%	-16%	-8%	4%	25%	-6%	14%	42%	45%	84%		

Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 22: Similarly in MXAPJ, negative correlation between Value and Momentum (6M & 12M), Value and Quality has significantly increased in last 12M compared with last 10 years.

MXAPJ Sector Neutral Long/Short Factor Return Correlation over last 1 year and 10 years

			2016 Correlation																
			Value				Growth			Momentum				Analyst		Quality		Profitability	
			Earnings Yield NTM (P/E)	Earnings Yield FY0 (P/E)	Book Yield - FY0 (P/B)	Div Yield FY1	Sales Growth FY1	OP Growth FY1	EPS Growth FY1	Price Return 1M	Price Return 3M	Price Return 6M	Price Return 12M	Rating Rev (1M)	FY1 EPS Rev (1M)	Net Cash / Market-Cap	Equity / Debt	ROE FY1	ROA FY1
10 Year Correlation	Value	Earnings Yield NTM (P/E)		63%	67%	10%	-25%	-2%	-14%	-40%	-48%	-66%	-74%	3%	-41%	-62%	-14%	-37%	-67%
		Earnings Yield FY0 (P/E)	44%		40%	15%	-9%	-2%	-7%	-10%	-11%	-21%	-29%	9%	-4%	-33%	-10%	-8%	-25%
		Book Yield - FY0 (P/B)	35%	40%		9%	-55%	-16%	-15%	-13%	-21%	-40%	-54%	10%	-42%	-80%	-9%	-80%	-80%
		Div Yield FY1	20%	32%	10%		-47%	-33%	-30%	-6%	-4%	-9%	-9%	-7%	-11%	4%	1%	-8%	8%
	Growth	Sales Growth FY1	0%	-24%	-46%	-39%		50%	48%	-4%	6%	16%	30%	-11%	35%	29%	0%	60%	38%
		OP Growth FY1	-4%	-11%	-22%	-12%	40%		63%	-16%	-6%	0%	19%	-12%	24%	1%	0%	28%	16%
		EPS Growth FY1	-4%	-21%	-13%	-31%	38%	50%		-8%	3%	17%	35%	-5%	32%	5%	-9%	27%	25%
	Momentum	Price Return 1M	-35%	14%	8%	1%	-15%	-11%	-5%		67%	62%	43%	19%	34%	13%	1%	7%	23%
		Price Return 3M	-48%	15%	6%	-7%	-12%	-4%	4%	64%		75%	62%	4%	45%	23%	0%	17%	37%
		Price Return 6M	-54%	7%	-7%	-14%	-4%	8%	16%	49%	79%		81%	5%	56%	41%	2%	34%	60%
		Price Return 12M	-55%	1%	-23%	-12%	2%	22%	27%	34%	62%	79%		0%	61%	54%	5%	42%	72%
	Analyst Sentiment	Rating Rev (1M)	-7%	2%	3%	4%	-7%	4%	1%	10%	1%	8%	11%		1%	-4%	3%	-10%	-10%
		FY1 EPS Rev (1M)	-22%	-3%	-17%	-13%	15%	13%	28%	14%	35%	44%	45%	9%		41%	-7%	41%	49%
	Quality	Net Cash / MktCap	-33%	-16%	-54%	25%	13%	1%	3%	6%	9%	17%	26%	1%	15%		16%	59%	76%
Equity / Debt		0%	-4%	6%	-20%	4%	-4%	8%	-7%	-9%	-9%	-8%	0%	-5%	3%		1%	18%	
Profitability	ROE FY1	-1%	2%	-68%	-11%	46%	21%	22%	-5%	-1%	10%	23%	-4%	22%	34%	1%		74%	
	ROA FY1	-20%	7%	-57%	30%	8%	9%	5%	13%	14%	23%	34%	4%	19%	59%	-3%	65%		

Source: FactSet, Goldman Sachs Global Investment Research

Putting all together: Does the MRI predict future reversal?

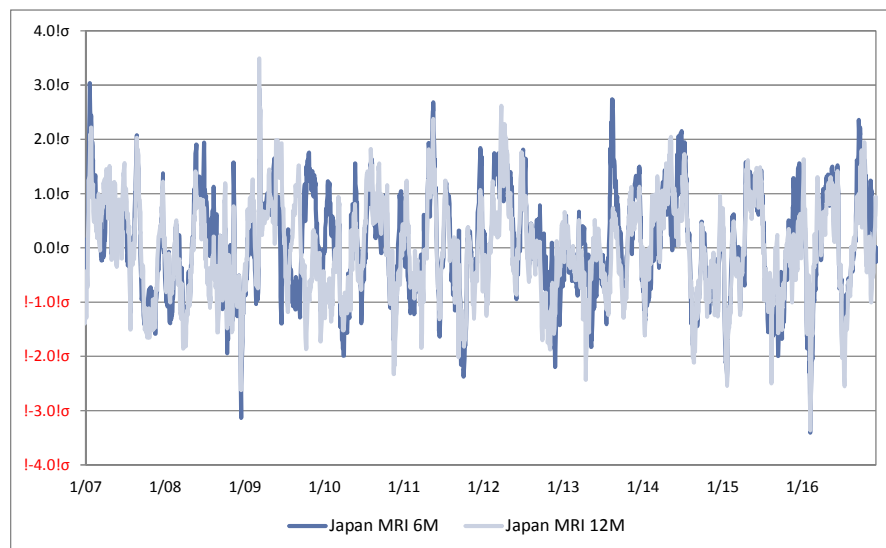
Yes, the MRI results show a statistically significant predictive power of 1M forward Momentum factor reversal in Japan and MXAPJ after hitting 1 sigma.

To construct the MRI, we systematically selected factors with statistically significant predictive power from single factor backtest. More specifically, we selected factors with t-stats above +/- 2 and p-value less than 0.1 (10%) and constructed an equal-weighted indicator for Japan and MXAPJ⁹. The Japan MRI consists of measures such as Acceleration, RSI and factor correlation, while in MXAPJ MRI it includes NTM P/E and factor correlation. Exhibits 23 and 24 show the historical value of the MRIs. As Exhibits 25 and 26 show, the MRIs show strong predictive power of short term (1M) reversal of both 6M and 12M Momentum factor performance.

⁹ Our analysis includes observations where MRI hits +1 sigma for the first time for Japan, and all observations for MXAPJ.

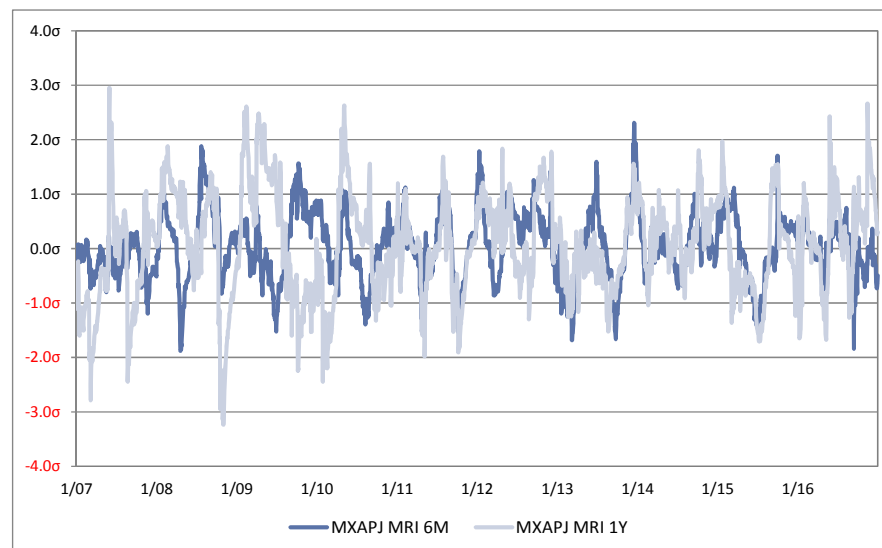
Currently, the Japan MRIs are at 0.0 sigma (6M Momentum) and +0.9 sigma (12M Momentum), indicating reversal is unlikely over next 1M. MXAPJ MRIs also suggest no near-term reversal as both readings are at -0.5 sigma (6M Momentum) and +0.3 sigma (12M Momentum).

Exhibit 23: Japan MRIs currently indicate no reversal in short term
Momentum Reversal Indicator for Japan



Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 24: ...and so do MXAPJ MRIs
Momentum Reversal Indicator for MXAPJ



Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 25: Japan MRI shows strong predictive power of short-term reversal
Backtest result of Japan MRI

Momentum Reversal Indicator (MRI)			Japan				
			# of hits	Ann. Avg Return (%)	t-stats	p-value	RSQ
Cumulative 1M return	Q1/Q5	6M momentum	66	-0.3	-3.00	0.004	12.3%
		12M momentum	67	-6.7	-3.10	0.003	12.9%

Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 26: Historically MXAPJ MRI has been predictive of reversal as well
Backtest result of MXAPJ MRI

Momentum Reversal Indicator (MRI)			MXAPJ				
			# of hits	Ann. Avg Return (%)	t-stats	p-value	RSQ
Cumulative 1M return	Q1/Q5	6M momentum	152	-12.4	-3.17	0.002	6.3%
		12M momentum	429	-18.0	-3.72	0.000	3.1%

Source: FactSet, Goldman Sachs Global Investment Research

Appendix 1: Backtest results

Below we show our backtest results of each factor in detail. Each backtest is conducted to test subsequent 1M return after each time each factor exceeds 1 standard deviation except for RSI. For RSI, we used the 70 threshold.

t-stats: A tool to measure whether two samples are different using the formula: $t = \frac{\bar{Y} - \mu}{s/\sqrt{n}}$ where \bar{Y} is the observed mean, μ is the population mean, s is the sample standard deviation and n is the number of observations. A higher value indicates a higher degree of confidence.

p-value: It measures how compatible the data are with the null hypothesis. A low p-value suggests that the sample data provides enough evidence to reject the null hypothesis at different confidence levels (5% or 10%).

R-squared: A measure (ranging from 0 to 1) of how well a dependent variable is explained by a model (collection of independent variables). A strong fit will be indicated by higher levels (closer to 1); lower numbers suggest less explanatory power.

Exhibit 27: Valuation relative to history more effective in MXAPJ

Backtest results for NTM P/E, p-value < 0.1 with negative t-stats shaded

Avg. NTM P/E		Japan				MXAPJ			
		Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)	Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)
Q1	6M Momentum	8.1	3.69	0.00	2.1%	3.5	2.20	0.03	0.7%
	12M Momentum	2.2	4.33	0.00	2.9%	9.7	1.96	0.05	0.5%
Q5	6M Momentum	23.9	1.78	0.07	0.5%	17.9	2.21	0.03	0.6%
	12M Momentum	20.3	3.42	0.00	1.9%	13.1	5.88	0.00	4.3%
Q1/Q5	6M Momentum	-6.1	1.46	0.14	0.4%	1.1	-1.81	0.07	0.5%
	12M Momentum	-2.8	-0.30	0.77	0.0%	-5.0	-0.04	0.97	0.0%

Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 29: Acceleration of Momentum factor works in Japan

Backtest results for acceleration, p-value < 0.1 with negative t-stats shaded

Acceleration		Japan				MXAPJ			
		Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)	Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)
Q1	6M Momentum	-2.4	0.56	0.58	0.1%	8.5	2.00	0.05	0.7%
	12M Momentum	4.0	1.44	0.15	0.5%	7.1	1.67	0.10	0.5%
Q5	6M Momentum	4.7	-2.23	0.03	1.0%	15.9	1.35	0.18	0.3%
	12M Momentum	5.6	-3.63	0.00	2.6%	16.0	2.17	0.03	0.8%
Q1/Q5	6M Momentum	-9.3	-1.72	0.09	0.6%	6.8	4.02	0.00	3.0%
	12M Momentum	-10.7	0.52	0.61	0.1%	10.7	1.21	0.23	0.3%

Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 28: Pairwise correlation is effective in Q1 of Momentum factors

Backtest results for pairwise correlation, p-value < 0.1 with negative t-stats shaded

Pairwise correlation		Japan				MXAPJ			
		Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)	Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)
Q1	6M Momentum	10.5	5.86	0.00	5.6%	14.6	2.23	0.03	0.7%
	12M Momentum	13.6	4.48	0.00	3.1%	16.2	3.24	0.00	1.4%
Q5	6M Momentum	5.9	3.08	0.00	1.5%	13.0	1.57	0.12	0.4%
	12M Momentum	9.9	2.56	0.01	1.1%	9.6	-0.53	0.60	0.0%
Q1/Q5	6M Momentum	-1.2	0.06	0.95	0.0%	8.0	-1.17	0.24	0.2%
	12M Momentum	-2.0	-1.17	0.24	0.3%	3.7	0.31	0.75	0.0%

Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 30: RSI has predictive power both in Japan and MXAPJ

Backtest results for RSI, p-value < 0.1 with negative t-stats shaded

RSI		Japan				MXAPJ			
		Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)	Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)
Q1	6M Momentum	10.2	-1.90	0.06	2.3%	17.8	2.60	0.01	1.6%
	12M Momentum	12.6	1.55	0.12	1.4%	14.0	1.45	0.15	0.5%
Q5	6M Momentum	28.6	-0.65	0.52	0.1%	18.2	-1.75	0.08	0.7%
	12M Momentum	22.4	-1.43	0.15	0.8%	18.1	0.60	0.55	0.1%
Q1/Q5	6M Momentum	-21.4	-2.65	0.01	5.7%	-2.2	2.72	0.01	2.8%
	12M Momentum	-21.8	-0.69	0.49	0.5%	13.8	2.58	0.01	1.7%

Source: FactSet, Goldman Sachs Global Investment Research

Exhibit 31: Certain factor correlation is predictive of forward Momentum reversal

Backtest results for factor correlation p-value < 0.1 with negative t-stats shaded

Factor correlation		Japan				MXAPJ			
		Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)	Avg 1M Return (%)	t-stats (1M)	p-value	RSQ (1M)
vs 6M Momentum	NTM P/E	-11.3	-6.68	0.00	5.4%	-1.9	-3.27	0.00	1.1%
	FY0 P/E	3.2	-5.58	0.00	3.3%	0.7	1.44	0.15	0.2%
	P/B	-0.9	3.78	0.00	1.8%	4.9	-0.56	0.58	0.0%
	FY1 Div. Yield	-6.8	-0.08	0.94	0.0%	-6.2	-4.11	0.00	2.0%
	Sales Growth	-13.4	-0.51	0.61	0.0%	4.3	-4.76	0.00	2.4%
	OP Growth	-10.2	2.12	0.03	0.5%	-3.9	-2.58	0.01	0.8%
	EPS Growth	-8.8	-1.98	0.05	0.4%	7.3	-2.31	0.02	0.6%
	Consensus Rating Revision	-2.8	7.93	0.00	7.8%	-6.9	-5.75	0.00	3.7%
	Consensus EPS Revision	-10.5	3.69	0.00	1.8%	-3.7	5.65	0.00	3.6%
	Net Cash/Mkt Cap	-11.6	-0.81	0.42	0.1%	-5.7	-1.72	0.08	0.3%
	Debt / Equity	-11.7	-3.74	0.00	1.4%	10.0	-5.97	0.00	4.5%
	FY1 ROE	-8.4	-2.55	0.01	0.7%	-4.1	-3.22	0.00	1.1%
	FY1 ROA	-8.8	-3.31	0.00	1.2%	-6.1	-2.60	0.01	0.7%
vs 12M Momentum	NTM P/E	-9.6	-8.64	0.00	8.9%	-6.5	-1.79	0.07	0.3%
	FY0 P/E	-2.8	-3.80	0.00	1.7%	1.4	-0.01	1.00	0.0%
	P/B	1.7	-4.80	0.00	2.7%	4.3	2.25	0.02	0.5%
	FY1 Div. Yield	-7.7	-0.68	0.50	0.1%	-2.4	0.07	0.94	0.0%
	Sales Growth	-14.0	0.01	0.99	0.0%	2.7	0.04	0.97	0.0%
	OP Growth	-10.1	4.80	0.00	2.3%	0.2	0.52	0.61	0.0%
	EPS Growth	-2.9	-2.93	0.00	0.8%	5.0	1.23	0.22	0.2%
	Consensus Rating Revision	-5.9	3.81	0.00	1.9%	-3.0	-1.58	0.11	0.3%
	Consensus EPS Revision	-9.6	3.98	0.00	1.8%	8.5	4.66	0.00	2.7%
	Net Cash/Mkt Cap	-9.4	-3.89	0.00	1.6%	-7.9	-1.92	0.06	0.4%
	Debt / Equity	-11.2	-1.27	0.21	0.2%	18.0	-0.99	0.32	0.1%
	FY1 ROE	-9.8	-4.44	0.00	2.4%	-3.1	-1.93	0.05	0.4%
	FY1 ROA	-14.7	-5.43	0.00	3.8%	0.2	1.64	0.10	0.3%

Source: FactSet, Goldman Sachs Global Investment Research

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