



Goldman Sachs Research

Quantamental Theory

The Seasons & Reasons of Factor Performance

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Quantamental Theory

Key Questions for Active Managers ...



**Is there seasonality
in factor
performance?**

Value has tended to work best in Q1 while underperforming in June. Growth does well in June while Q4 is generally positive for Low Leverage & Financial Returns (e.g., ROCE, ROE, CROCI).

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**Can macro factors
drive micro styles
and performance?**

Overall factor performance is most highly correlated to US Growth and Financial Conditions (FCI). Value stocks have a strong relationship to China Growth, Quality to Inflation Expectations and Financial Leverage to Oil.

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**How quickly do
micro factors
absorb a macro
shock?**

We measure the absorption of macro shocks into micro factors (λ). Macro changes are priced more quickly into Technical Factors (e.g., size, volatility), Leverage and Financial Returns. Value and Growth take longer.

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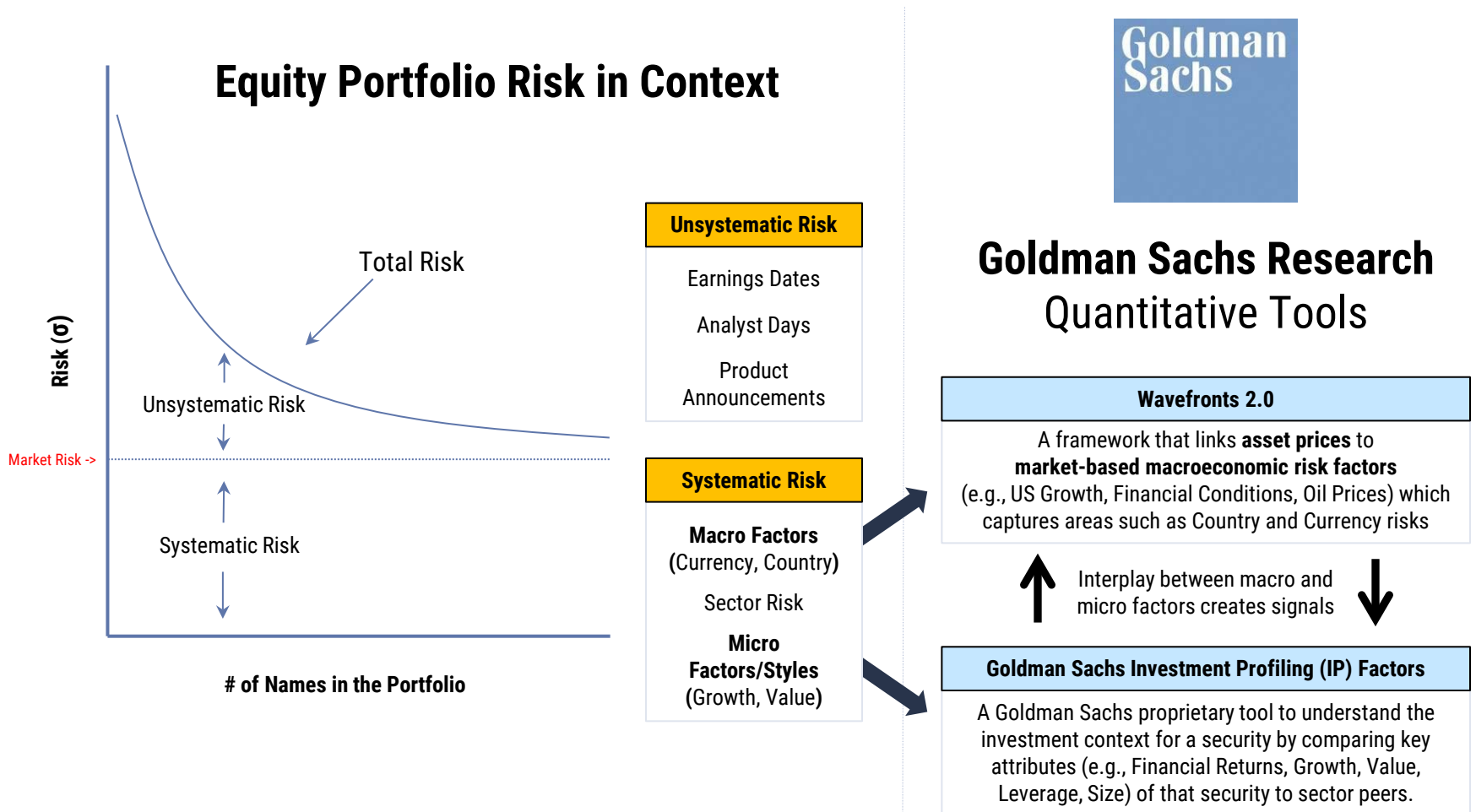
**How expensive are
factors today
versus history?**

Factor valuation can be a useful gauge of sentiment (e.g., crowding). We analyze current valuations versus history. Among the Most Expensive: Large Size, Low Short Interest, Low Volatility. The Least: High EPS-G, Low ROE, High Volatility.

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Equity Portfolio Risk Building Blocks





The GS Research Approach to Factors

Our Proprietary (IP) Framework

Goldman
Sachs



Quantamental 101

Fundamental investors are under pressure to understand what's in their portfolio from a factor, technical & style basis given the rise of smart beta, style-driven ETFs & quantitative strategies. The growth in these strategies increases the need for investors to focus on the “fundamentals” and “quant” characteristics of what they own.

Related Research



A Reminder on Our GS IP Methodology

- The Goldman Sachs Investment Profile (IP Scores) is a tool we use to understand the investment context for a security by comparing key attributes of that security to our coverage universe and sector peers.
- We leverage our in-house analyst models and estimates, which we believe provide a more forward-looking/accurate measurement of company expectations than traditional factor models.
- Rendered metrics are normalized by assigning a Z-score based on the company's position within the overall distribution of all IP scores. The average of these normalized metrics is taken and is then used to generate a percentile score from 1 to 100 for each factor.
- We bucket these company scores into highest quintile (Q1 or top 20%) and lowest quintiles (20%) within each sector, and construct portfolios with an equal number of stocks under Q1 and Q5.
- The performance of these top and bottom quintile tails, as well as a sector-neutral portfolio (Buy Q1, Sell Q5) of the two, is tracked and rebalanced on a weekly basis.

Note: Financials are excluded from certain metrics



The Seasonality Behind Factors

Putting Factor performance into context ...

Seasonality exists in recent historical factor performance. While the past isn't prologue we have witnessed some seasonality in value, growth and financial return factors over the last 5 to 10 years. Technical factors (e.g., such as size, volatility and momentum) have provided less persistent and frequent signals.

Factor Seasonality

Arrows denote months with statistical significance (at 90% confidence); (↑ / ↓) denotes positive/negative performance

GS IP Factors	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Integrated	↑									↑	↑	
Returns										↑	↑	
ROE							↑					
ROCE												
CROCI												
Valuation	↑					↓		↑				
P/E						↓	↑			↑		
EV/EBITDA	↑		↑			↓				↑		
Dividend Yield												
P/B						↓						
EV/FCF			↑			↓				↑		
EV/DACF		↑	↑			↓				↑		
Growth						↑						
Sales Growth						↑				↓	↓	
EBITDA Growth		↑				↑						↑
EPS Growth							↓					
Leverage											↑	
Size												↓
Volatility												
Laggards (6m)				↑		↓						

Note: Primary factors (bolded) includes data since 2006. All others are based on performance data since 2011. See the Appendix for methodology.

Source: Goldman Sachs Global Investment Research. As of June 30, 2016.



Seasonality Heatmaps

Putting Factor performance in context ...

Goldman Sachs

Value posts strong performance in January and August, and is weak in June

Valuation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	1.7%	2.8%	3.8%	-1.3%	-0.8%	-2.2%						
2015	1.0%	-0.1%	1.0%	1.4%	-0.4%	-2.3%	-0.8%	0.7%	-0.1%	2.7%	0.4%	-0.3%
2014	0.3%	-1.7%	3.8%	3.2%	1.8%	-1.4%	3.1%	0.3%	1.7%	0.2%	1.3%	0.5%
2013	1.5%	1.1%	1.3%	1.0%	0.0%	-1.2%	1.6%	-1.3%	-2.1%	4.3%	1.2%	-1.2%
2012	0.3%	-1.0%	-0.5%	-1.3%	-0.7%	-1.8%	1.6%	1.9%	0.0%	2.4%	1.4%	1.0%
2011	0.5%	-1.1%	0.2%	-0.1%	0.2%	-1.4%	-0.1%	0.9%	-2.1%	3.6%	-0.3%	0.2%
2010	2.2%	-0.2%	-0.8%	-2.1%	-0.7%	-0.1%	1.6%	0.3%	0.7%	0.9%	-3.1%	2.6%
2009	1.1%	-2.7%	2.0%	6.6%	5.0%	1.4%	1.7%	2.0%	0.0%	2.1%	0.7%	-0.6%
2008	5.5%	0.0%	-1.4%	-2.0%	3.4%	-2.5%	-1.9%	0.4%	-0.4%	-1.3%	-2.2%	7.4%
2007	0.4%	0.9%	0.5%	1.2%	0.0%	-0.9%	-2.5%	1.2%	-2.3%	-3.0%	-2.4%	-0.6%
2006									0.9%	-0.1%	-0.9%	1.2%
Mean	1.4%	-0.2%	1.0%	0.7%	0.8%	-1.2%	0.5%	0.7%	-0.3%	1.2%	-0.4%	1.0%
Stat. Sig.?	yes	no	no	no	no	yes	no	yes	no	no	no	no

Growth tends to outperform in June

Growth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	-3.6%	1.1%	-3.7%	2.2%	3.0%	1.4%						
2015	-0.7%	1.1%	0.7%	0.5%	0.4%	2.2%	1.0%	-2.7%	-1.5%	-1.6%	0.7%	1.2%
2014	1.3%	1.3%	-2.8%	-3.4%	-0.5%	2.4%	-1.9%	-1.0%	-1.7%	0.1%	-1.0%	1.7%
2013	0.1%	0.0%	-0.6%	-0.7%	0.8%	1.9%	-2.8%	1.5%	1.9%	-2.6%	0.0%	0.7%
2012	4.1%	0.3%	0.7%	-0.4%	0.1%	2.2%	-0.8%	0.1%	-0.3%	-2.7%	-0.6%	-0.2%
2011	2.0%	-0.2%	-1.0%	0.3%	-1.2%	-0.5%	-0.2%	-1.6%	-0.9%	-0.1%	-0.6%	0.0%
2010	0.1%	-0.8%	0.6%	2.7%	0.4%	-0.3%	-0.5%	-1.4%	3.0%	1.2%	2.5%	0.5%
2009	-1.1%	1.6%	2.9%	7.9%	0.4%	3.3%	0.6%	1.0%	1.6%	-2.0%	-0.7%	2.1%
2008	-4.3%	-0.9%	-1.4%	0.8%	-0.8%	-1.7%	1.4%	-0.9%	0.7%	-6.2%	-1.7%	-1.0%
2007	1.5%	-1.8%	1.3%	-1.0%	1.6%	-0.1%	1.5%	-0.2%	2.7%	2.1%	0.7%	0.1%
2006									0.1%	0.4%	0.8%	-1.0%
Mean	0.0%	0.2%	-0.3%	0.9%	0.4%	1.1%	-0.2%	-0.6%	0.6%	-1.2%	0.0%	0.4%
Stat. Sig.?	no	no	no	no	no	yes	no	no	no	no	no	no

Financial Returns (e.g. ROCE, ROE, CROCI) posts it's best performance in October and November

Returns	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	2.9%	-0.7%	-7.9%	-5.0%	1.01%	-0.3%						
2015	2.1%	-0.3%	0.7%	-1.1%	0.5%	1.4%	4.7%	-2.0%	5.0%	0.3%	0.8%	3.0%
2014	-0.5%	-0.1%	1.1%	0.7%	2.1%	-1.4%	2.8%	0.6%	3.0%	0.4%	2.2%	-2.8%
2013	-0.8%	1.3%	-1.1%	0.2%	0.1%	-0.2%	-1.2%	0.6%	-0.9%	1.3%	-1.1%	-1.1%
2012	-0.3%	-2.1%	0.1%	2.5%	-1.2%	-3.1%	2.1%	0.4%	-1.6%	0.5%	1.2%	-1.7%
2011	-0.3%	0.6%	-0.4%	0.4%	0.1%	1.4%	1.0%	2.5%	1.3%	-1.8%	0.8%	-0.6%
2010	-1.4%	-1.4%	-2.3%	-4.2%	0.5%	3.9%	-2.1%	3.2%	-1.9%	0.5%	0.1%	-2.0%
2009	0.6%	3.4%	-4.5%	-15.1%	-2.4%	1.2%	-3.3%	-3.9%	-1.5%	4.7%	1.7%	-3.3%
2008	-3.0%	2.3%	1.4%	1.5%	1.6%	4.7%	-4.9%	-1.2%	-1.8%	7.4%	1.8%	0.4%
2007	0.0%	-1.7%	1.0%	2.6%	-0.4%	0.2%	2.2%	1.5%	4.1%	2.1%	2.8%	1.7%
2006									2.0%	1.2%	-0.1%	0.4%
Mean	-0.1%	0.1%	-1.2%	-1.8%	0.2%	0.8%	0.2%	0.2%	0.8%	1.7%	1.0%	-0.6%
Stat. Sig.?	no	no	no	no	no	no	no	no	no	yes	yes	no

November is also a good month for Strong Balance Sheets (Net Debt/EBITDA)

Leverage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	1.6%	1.1%	-5.7%	-5.5%	0.05%	0.4%						
2015	0.4%	-1.3%	1.0%	-1.5%	2.1%	1.0%	3.3%	-3.5%	5.8%	0.2%	0.9%	3.0%
2014	1.1%	-0.8%	-1.4%	-1.6%	-0.4%	1.0%	-0.9%	0.4%	2.9%	2.0%	-0.1%	-0.1%
2013	-0.3%	0.5%	-2.1%	0.5%	-0.6%	0.9%	-0.6%	-0.8%	0.2%	0.2%	-0.3%	-0.5%
2012	-1.0%	-1.9%	0.6%	-0.7%	2.7%	-2.0%	-0.9%	0.2%	0.3%	-2.3%	2.4%	-2.4%
2011	0.4%	-1.0%	2.4%	-1.6%	-0.2%	0.7%	-0.8%	5.9%	-0.5%	-0.1%	-0.5%	-0.9%
2010	1.0%	1.4%	0.4%	-1.9%	2.3%	1.0%	0.2%	3.0%	-0.8%	1.1%	2.0%	-2.4%
2009	0.4%	3.8%	-2.0%	-11.7%	-5.3%	1.4%	-2.0%	-3.7%	-1.8%	1.1%	1.5%	-2.7%
2008	-4.1%	3.1%	0.8%	1.7%	-0.7%	3.9%	-0.7%	-2.3%	-0.6%	9.2%	3.5%	-1.2%
2007	0.1%	-1.1%	2.2%	0.6%	-0.2%	0.0%	2.6%	1.5%	1.4%	2.2%	1.5%	1.0%
2006									0.5%	0.0%	1.8%	-0.7%
Mean	0.0%	0.4%	-0.4%	-2.2%	0.0%	0.8%	0.0%	0.1%	0.7%	1.4%	1.3%	-0.7%
Stat. Sig.?	no	no	no	no	no	no	no	no	no	no	yes	no

Note: We categorize observations as statistically significant at a 90% confidence interval (small sample size). See the Appendix for definition and formula.

Source: Goldman Sachs Global Investment Research. As of June 30, 2016.

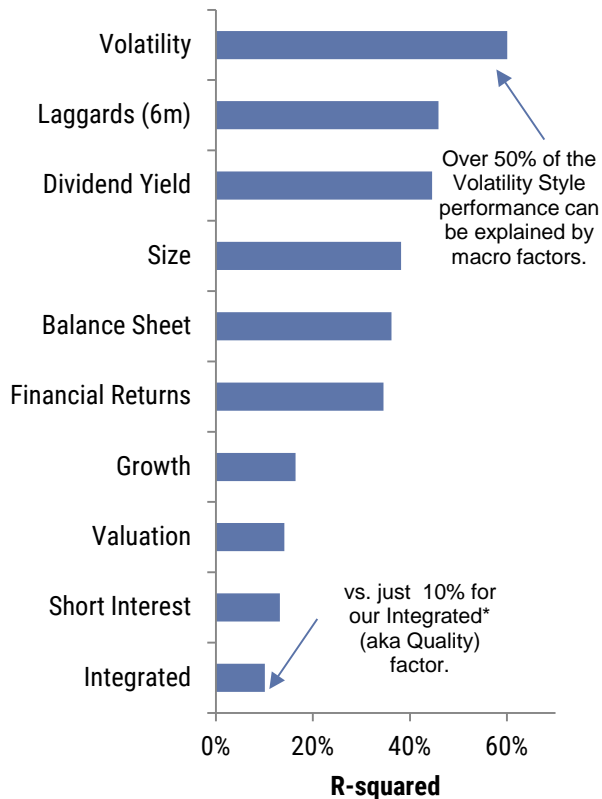


The Macro to Micro Relationship

Through a Factor Lens ...

MACRO Factors explain **25%** of
MICRO Factor Performance

Tale of the Tape



- 1) Micro Factors contain a non-trivial amount of macro content.
- 2) Regressing monthly changes in micro factors vs. macro styles renders significant correlation.
- 3) In certain cases up to 60% of select micro factor performance can be explained by the variability of macro factors.

* Integrated is calculated as an aggregate score based on Returns, Growth and Valuation. Based on data since 2006; Laggards (6m), Dividend Yield and Short Interest are since 2011.
Source: Goldman Sachs Global Investment Research.



The Macro to Micro Relationship

Through a Factor Lens ...

- Statistics 101:** A t-statistic is a tool to generally measure whether two samples are different, i.e., the regression coefficients are greater than zero. Any figure >2 suggests a macro factor is a driver of micro performance.
- Findings:** US Financial Conditions (FCI) and US Growth are universally significant drivers of almost all micro factors. Growth (e.g., Sales, EBIT, EPS) has significant exposure to European Financial Conditions and Euro Growth while Value has a strong linkage to China Growth, Quality to Inflation and Leverage to Oil Prices.

Factor Performance is most highly correlated to US Growth & Financial Conditions

Blue shading indicates relationships that are statistically significant (t-statistic $>\pm 2$)

Factor	Predictive Significance (t-statistic)						
	China Growth	Euro Financial Conditions	European Growth	US Financial Conditions	Oil Prices	US Inflation	US Growth
Growth	-1.0	-2.3	3.3	2.1	0.6	-0.1	4.5
Valuation	3.5	0.7	-1.7	-2.3	-1.7	1.9	-1.7
Returns	0.7	0.3	0.2	2.9	-1.4	0.6	-5.5
Integrated	1.7	-1.6	1.3	1.4	-1.7	3.0	-2.7
Balance Sheet	0.9	1.7	0.6	3.4	-2.6	1.7	-3.9
Size	0.2	0.2	-0.6	1.8	-1.3	0.0	-8.1
Volatility	-1.0	1.7	-2.4	2.3	-2.2	0.2	-11.1
Laggards (6m)	1.2	-0.5	-0.2	-3.4	1.0	0.4	3.6
Short Interest	0.6	-0.8	0.3	2.1	-0.4	1.1	-1.9

Note: Based on concurrent monthly data since 2006; Laggards (6m), Dividend Yield and Short Interest are since 2011. A positive t-statistic indicates a positive relationship (e.g. Strong Balance Sheets outperform Weak Balance Sheets; Financial Conditions tighten/move higher); a negative t-statistic indicates an inverse relationship (e.g. Volatility (low vs. high) does poorly when US Growth improves). Source: Goldman Sachs Global Investment Research.



How Factors Absorb a Macro Shock

Pricing in the “half-life” of a change in the landscape

- We quantitatively measure the macro shock absorption dynamics across each micro factor (λ) as the estimated “half-life” of decay. **Translation:** The number of months it takes for half the shock to be priced in.
- Changes in macro factors such as US Growth are absorbed most quickly followed by US Financial Conditions. Changes in European Growth and Oil Prices trigger slower and more drawn-out responses.
- Macro shocks are priced into Technical Factors (e.g., Size, Volatility), Balance Sheets and Returns fairly quickly; it generally takes longer for certain Fundamental metrics, such as Value and Growth to absorb the regime change.

Shocks in US Growth and US FCI tend to be priced in the most quickly, while US Inflation and European FCI take longer on average

Blue shading indicates shocks are priced in very quickly (e.g., half-life of 1 month or less)

Factor	Time Decay (# of months it takes for half the "shock" to be priced in)						
	China Growth	Euro Financial Conditions	European Growth	US Financial Conditions	Oil Prices	US Inflation	US Growth
Growth	2.2	2.8	2.7	4.1	3.3	3.2	2.6
Valuation	2.7	3.2	3.5	3.5	3.0	4.7	3.9
Returns	1.0	2.9	2.2	2.7	<0.5	3.3	0.8
Integrated	3.5	7.8	2.1	2.8	5.8	3.4	1.5
Balance Sheet	1.0	1.0	1.9	0.6	<0.5	1.0	0.8
Size	1.4	1.0	1.3	0.6	2.8	2.8	0.8
Volatility	1.0	1.1	1.7	1.1	1.3	<0.5	0.9
Laggards (6m)	<0.5	2.8	4.6	0.9	1.4	1.3	2.2
Short Interest	5.0	<0.5	8.7	<0.5	7.7	2.3	1.9

Note: Based on monthly data since 2006; Laggards (6m), Dividend Yield and Short Interest are since 2011. See appendix for methodology. Source: Goldman Sachs Global Investment Research.



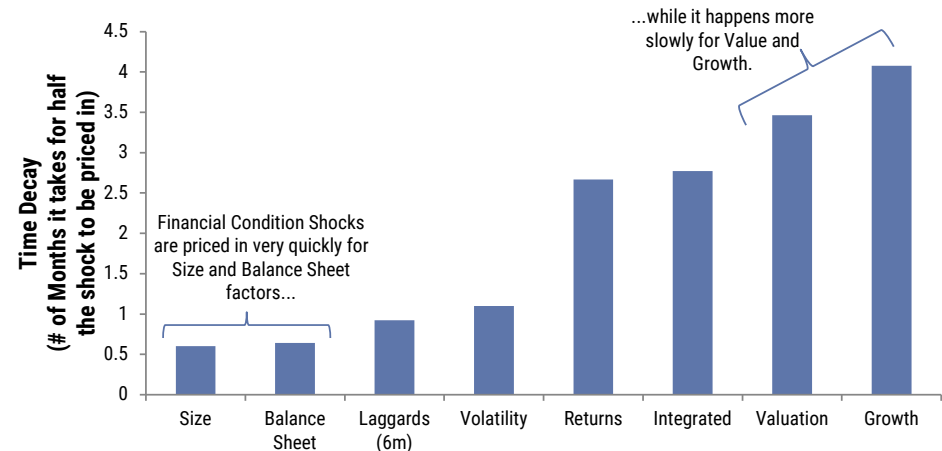
How Factors Absorb a Macro Shock

Pricing in the “half-life” of a change in the landscape

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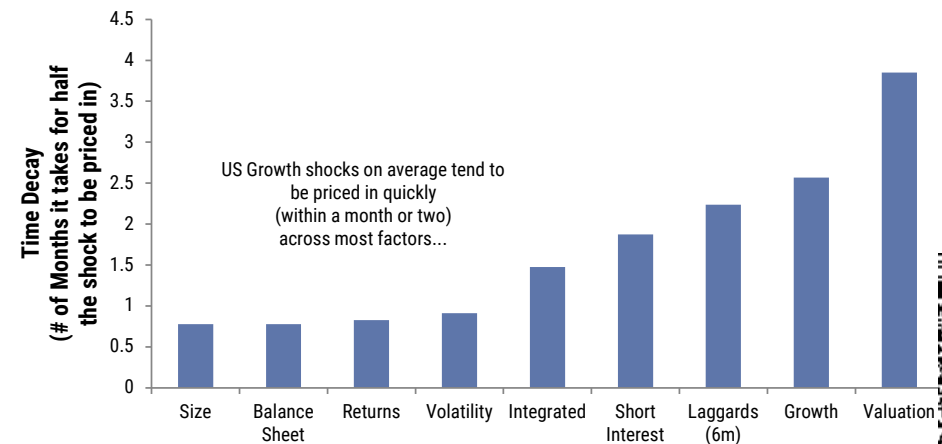
Case Study #1: Changes in US Financial Conditions

Changes in Financial Conditions are priced in faster for Technical Factors (e.g., Size, Laggards, Volatility) **vs. Fundamental Styles** (e.g., Growth, Value, Returns).



Case Study #2: US Growth Shocks

Changes in US growth views are priced in fairly quick; the exception being value stocks. Size (e.g., Small v Large) **has the fastest absorption.**



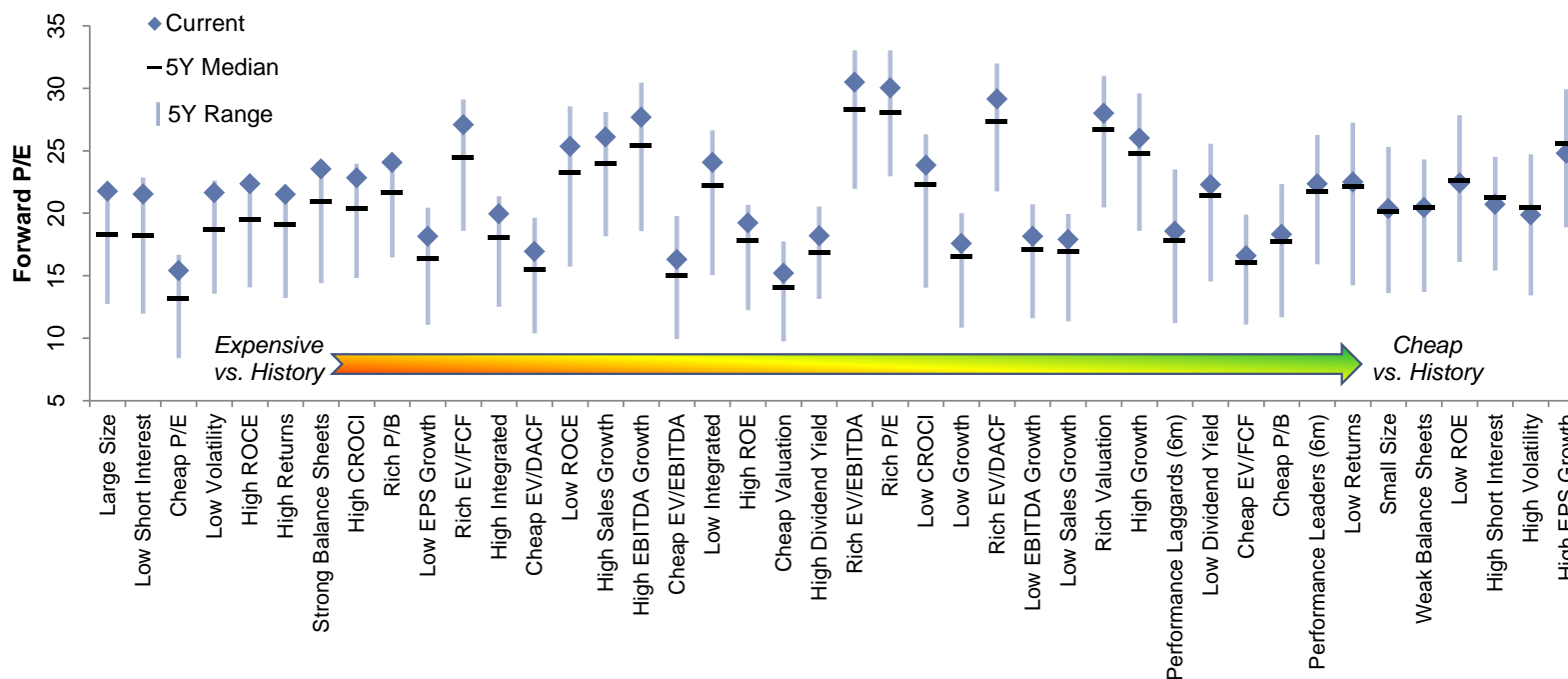
Note: Based on data since 2006; Laggards (6m), Dividend Yield and Short Interest are since 2011. Source: Goldman Sachs Global Investment Research.



Valuation of Factors

Positioning and Sentiment Gauge

- Factor valuation can be a useful gauge of sentiment with stretched levels helping point to crowdedness and potential downside risk. The same can be said for contrarian positioning.
- Like the market, valuations are currently above the 5-year median for over 90% of factors (individual Q1/5 tails)
- Valuation Snapshot** (July 2016): Most Expensive: *Large Size, Low Short Interest, Cheap P/E and Low Vol.* Least: *High EPS Growth, High Vol, High Short Interest and Low ROE.*

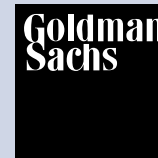


Note: As of July 11, 2016. Source: Goldman Sachs Global Investment Research.

Appendix



Select Methodologies and Definitions



Wavefronts 2.0 Market-based macroeconomic risk factor constituents:

- *US Growth*: UST 10Y Yield, Trade-weighted CAD, Wavefront Consumer Growth.
- *European Growth*: Eurostoxx Consumer Discretionary & Industrials vs. Staples, German 10Y Yield, Trade-weighted PLN and SEK.
- *China Growth*: China H-shares vs. SPX, 12M CNY Forward, 3M Copper Futures.
- *US Financial Conditions*: Fed Funds, TED Spread, US 10Y Yield, BBB Credit Spread, Trade-weighted USD.
- *European Financial Conditions*: 3-month Euribor, Real Aggregate Corporate Bond Yield, Equities relative to nominal GDP, Trade-weighted EUR.
- *US Inflation*: 1-year US Inflation Swap.
- *Oil Price*: 2-year Oil Swap.

Select statistical methods:

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.

t-statistic: 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.

Confidence Interval: The range within which a random variable is expected to fall a predetermined percentage of the time. For example: for a 90% confidence interval, the variable is expected to fall within that range 9 out of 10 times. The formula (given the small sample size) is: $\bar{Y} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$ where \bar{Y} is the observed mean, s is the sample standard deviation, n is the number of observations, t is the critical value and α is 1-the confidence level (e.g. 90%).

Lambda, in our example, is defined as the rate of decay of macro shocks (aka “half-life”) being priced into micro factors using the formula $\frac{dN}{dt} = -\lambda N$, where N is the quantity and t is time. For purposes of this presentation we provide an estimated view of the impact.

Calculation methodology for the GS Investment Profile (IP) scores:

- The Goldman Sachs Investment Profile (IP Scores) is a tool we use to better understand the investment context for a security by comparing key attributes of that security to the market (i.e., our coverage universe) and sector peers. We leverage our in-house analyst models and estimates, which we believe provide a more forward looking/accurate measurement of company expectations/performance.
- Returns and multiple use the Goldman Sachs analyst forecasts at the fiscal year-end at least three quarters away. Growth uses the value for the fiscal year at least seven quarters away compared with the year at least three quarters away (on a per-share basis for all metrics).
- These metrics are normalized by assigning a Z-score based on the company's position within the overall distribution of all IP scores (assuming a normal distribution). The average of these normalized metrics is taken (or average of the applicable metrics in case of financials) and is then used to generate a percentile score from 1 to 100 for each factor.
- We bucket these company scores into highest quintile (Q1 or top 20%) and lowest quintiles (20%) within each coverage sector, and construct portfolios with an equal number of stocks under Q1 and Q5. The performance of these top and bottom quintile tails, as well as a sector-neutral portfolio (Buy Q1, Sell Q5) of the two, is tracked and rebalanced on a weekly basis.

Measures used in each factor:

- **Returns:** calculated using an average of return on equity (ROE), return on capital employed (ROCE), and cash return on cash invested (CROCI) for each stock. Only ROE is considered for financial stocks. Top Quintile (Q1): stocks with the highest 20% returns within their coverage sector; Bottom Quintile (Q5): stocks with the lowest 20% returns.
- **Growth:** calculated using an average of a company's sales, EBITDA and EPS growth. For financials, we use only EPS and sales growth. Q1: stocks with the highest sector relative growth; Q5: stocks with the lowest growth.
- **Valuation:** calculated using an average of price/earnings, price/book, dividend yield, enterprise value/EBITDA, enterprise value/free cash flow and enterprise value/debt adjusted cash flow. Only P/E, P/B and dividend yield are used for Financials. Q1: stocks with the lowest multiples within their sector; Q5: stocks with the highest multiples.
- **Integrated:** calculated as an aggregate score based on Returns, Growth and Valuation. Q1: stocks with the highest integrated score within their sectors; Q5: stocks with the lowest integrated score.
- **Volatility:** calculated as the standard deviation of daily total returns over a trailing 12-month period. Q1: stocks with the lowest volatility on a sector relative basis; Q5: stocks with the highest volatility.
- **Balance sheet:** calculated using net debt/EBITDA (leverage). This is used only for nonfinancial stocks. Q1: stocks with the lowest leverage within their sectors; Q5: stocks with the highest leverage.
- **Size:** calculated using market capitalization. Q1: Largest 20% stocks on a sector relative basis; Q5: Smallest 20% stocks.
- **Laggards:** based on stock performance over a 6 month lookback period (Q5-Q1). Q1: Sector leaders (top 20% performers); Q5: Sector laggards (bottom 20%).
- **Short Interest:** based on Short Interest Days (SI / ADTV). Q1: Lowest Days-to-Cover; Q5: Highest Days-to-Cover. Based on exchange data which is released with a lag.

Disclosure Appendix

July 13, 2016



Disclosure Appendix

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