Quantitative Factor Investing

Equity Risk Premia

Introduction - Stylized Observations

Why quantitative investing?

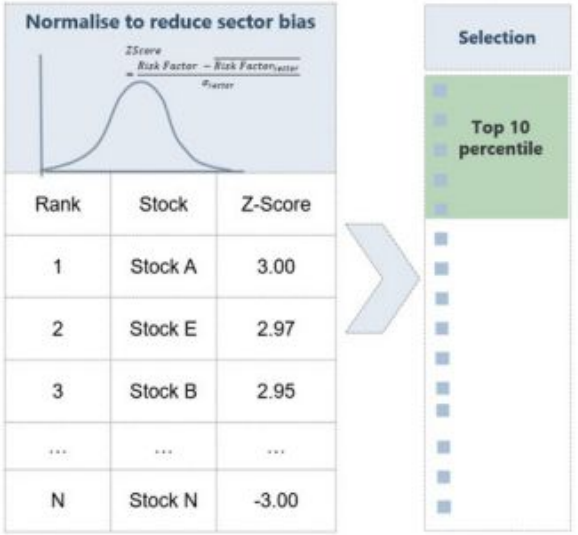
- Allows objective classification of stocks into categories.
- Uses observable and easily computable characteristics.
- Supports easy back-testing and is free from human intervention and behavioral biases.
- Operates under the assumption that historical patterns will repeat.

Factor Efficacy and Holding Periods

- Generally, factor efficacy is higher over shorter holding periods.
- Valuation factors like accruals (earnings quality), EBITDA, and free cash flow-related metrics are most effective over a 1-month horizon.
- Short-term momentum factors (1-month and 3-month price momentum) tend to be mean-reverting, with recent price increases likely to reverse in the following month.
- Over a 12-month horizon, factor efficacy is more diversified, with many factors historically yielding positive returns.
- As holding periods extend to three years, the number of effective factors decreases significantly.

Rationale Behind Equity Risk Premia (I)

1. The quant and disciplined investor community aims to generate consistent returns by eliminating emotional biases from the stock selection process.
2. Stock screens are often positioned at the extreme ends of the normal distribution curve, as these areas are believed to contain more valuable information and a higher potential for exploiting mispricing in equity prices than mid-ranked stocks.
3. Investment theory supports buying stocks with extreme valuation discounts relative to historical or comparable data. Similarly, stocks that have shown strong performance tend to continue doing so if they maintain momentum in stock prices or exceed earnings forecasts.
4. There has been significant focus on the equity risk premium associated with the size of companies (small vs. large caps) and recent interest in low volatility, minimum variance, or high-quality investment strategies.



Rationale Behind Equity Risk Premia (II)

1. Equity Risk Factors (ERPs), also known as Factor Investing, are thematic long-short portfolios that aim to deliver positive long-term returns with low correlation between different risk factors. These portfolios are based on stable risk properties and have a strong economic rationale.
2. These ERPs provide exposure to investment theses such as long-term outperformance of stocks with attributes like small capitalization, low price-to-earnings ratios, high momentum, or low volatility.
3. Individual Equity Risk Factors that exhibit similar characteristics are grouped into Risk Factor Styles.
4. The commoditization of quant investing is driven by aggressive market fluctuations, a focus on lowering investment fees, the availability of off-the-shelf quant products, and advancements in technology, making it increasingly mainstream.
5. Factor Styles encompass various strategies including value, momentum, quality, growth, risk, sentiment, and size.

Source: J.P. Morgan Quantitative and Derivatives Strategy.

Quantitative Investing (I)

- **Definition of a Quantitative Investor:**
  A quantitative investor removes emotion from the investment process, leading to more disciplined and focused decision-making compared to other market participants.

- **Role of Backtesting:**
  Main tool used by quants to evaluate the effectiveness of a strategy. Simulates historical investment decisions of a specific strategy or factor to calculate theoretical historic returns.

- **Key Components of a Backtest:**
  Investment Universe: Often a broad index, continuously updated to include new entries and remove exits to mitigate biases like "survivorship bias".

- **Rebalancing Period:**
  The interval between investment decisions, commonly set at one month to balance market responsiveness and turnover constraints. Longer periods (3, 6, 12 months) are used for slower-moving factors to examine less pronounced Alpha decay.

Quantitative Investing (II)

$$z = \frac{x - \mu}{\sigma}$$

μ = Mean

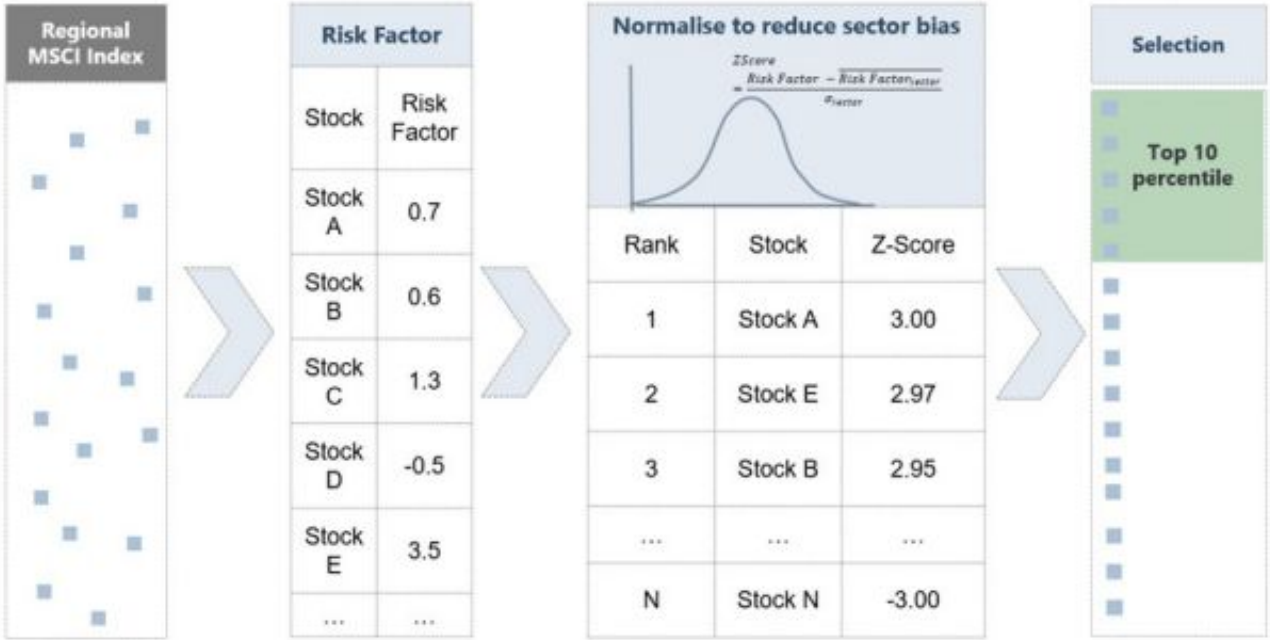
σ = Standard Deviation

- **Quantitative Factors:**
  - Quant strategies use measurable information (e.g., P/E, P/B, P/S, Dividend Yield ratios) to rank stocks and guide investment decisions.
  - Factors are normalized through sector normalization and transformed into z-scores to standardize exposure to a fundamental factor within a given universe.
  - The calculation of z-scores involves deducting the average factor value of the universe from each stock's factor value and scaling the difference by the standard deviation of the universe's factor values.

- **Handling Data Variability and Errors:**
  Z-scores are adjusted for outliers and potential data errors by winsorizing at +/- 3 standard deviations, ensuring a mean of 0 and standard deviation of 1.

- **Factor Classification and Multi-Factor Models:**
  - Factors are categorized into "Families" based on the specific market anomaly they aim to exploit.
  - Composite style factors and multi-factor models are created by combining several normalized factors with varying weights or premiums.

Quantitative Investing (III)



Source: J.P. Morgan Quantitative and Derivatives Strategy.

Quantitative Investing (III)

Long Q-Score

SEDOL	Company	Z Score	Price
4253048	AP Moeller - Maersk A/S	3.0	15760.0
B142S60	Kuehne + Nagel International	2.5	213.4
B1YW440	3i Group PLC	2.5	11.6
BD4TZK8	OCI NV	2.4	38.7
BHC8X90	Novo Nordisk A/S	2.3	819.1
BMD8KX7	Stellantis N.V.	2.1	13.7
BVYVFW2	Auto Trader Group PLC	2.0	5.2
3134865	Barclays PLC	2.0	1.5
B929F46	ASML Holding NV	1.9	478.0
7380482	Cie de Saint-Gobain	1.9	41.4
B1XZS82	Anglo American plc	1.9	26.1
B0C2CQ3	Engie SA	1.8	13.2
BYPBS67	ArcelorMittal SA	1.8	22.7
B4T3BW6	Glencore plc	1.7	5.0
B283W97	CaixaBank SA	1.7	3.4
5959378	Ericsson	1.7	61.4
B0CCH46	Heineken Holding NV	1.7	69.1
0718875	Rio Tinto PLC	1.7	45.4
0790873	SSE PLC	1.6	15.6
0870612	Lloyds Banking Group PLC	1.6	0.4
0454492	Imperial Brands PLC	1.6	21.2
B44XTX8	Pandora A/S	1.6	397.1
BK8VQD9	Warehouses De Pauw SCA	1.5	26.0
7133608	Statoil ASA	1.5	380.4
0287580	British American Tobacco	1.5	34.3
5228658	Randstad Holding NV	1.5	50.4
B1Y1SQ7	Jeronimo Martins SGPS SA	1.4	21.0
B0R7JF1	Ipsen SA	1.4	104.0
B1VZ0M2	Hargreaves Lansdown PLC	1.3	7.6

Short Q-Score

SEDOL	Company	Z Score	Price
B01CP21	Siemens Gamesa Renewable	-3.0	18.0
B3MBS74	Ocado Group PLC	-3.0	4.7
BYQ7HZ6	Takeaway.com Holding BV	-3.0	17.4
BZ6CZ43	Uniper SE	-3.0	3.0
BZCNB42	DELIVERY HERO AG	-2.9	33.4
BNHKYX4	arGEN-X SE	-2.8	394.8
BX90C05	Cellnex Telecom SA	-2.6	33.1
B0DJ8Q5	Alstom SA	-2.5	20.9
BNKF607	Kinnevik AB	-2.4	136.5
4572709	Bollore SA	-2.4	5.1
BN4MYF5	Vestas Wind Systems A/S	-2.2	148.4
BJ1F880	Nexi S.p.A.	-2.2	8.8
BWT6H89	Flutter Entertainment Plc	-2.2	133.9
B1FW751	GALP Energia	-2.2	10.3
7171589	Credit Suisse Group AG	-2.1	4.1
7097328	Groupe Bruxelles Lambert SA	-1.9	74.6
BBJPFY1	Vonovia SE	-1.8	22.4
BNBNSG0	Euronext NV	-1.8	64.3
B058TZ6	Safran SA	-1.7	112.7
B1FH8J7	Severn Trent PLC	-1.7	25.0
4588825	Danske Bank A/S	-1.7	121.6
BJ0DP40	Adevinta ASA	-1.7	71.2
5980613	Givaudan SA	-1.6	2990.0
5962309	Lindt & Spruengli AG	-1.6	97300.0
0989529	AstraZeneca PLC	-1.6	102.5
4501093	GN Store Nord A/S	-1.5	160.2
7333378	Lonza Group AG	-1.5	515.4
BD5GN60	SIG Combibloc Group Ltd	-1.4	19.2
B01FLQ6	ACS	-1.4	26.0

Quantitative Investing (IV)

- **Initiation of Rebalance Period: At the start of each rebalance period:**
  - Source the composition of the universe.
  - Source the values of the selected Factor.
- **Stock Selection for Backtesting:**
  - For backtests based on deciles, select the top 10% of stocks as the Long investment based on the chosen Factor.
  - Select the bottom 10% of stocks as the Short investment.
- **Return Calculation and Storage:**
  - At the end of each rebalance period, compute the returns of these decile portfolios.
  - Store the computed returns.
  - Repeat the process for the next rebalance period.
- **Consideration of Constraints in Real-World Application:**
  - Recognize that single Factor backtests are preliminary and do not simulate "real world" portfolios.
  - Understand that to create realistic portfolios, additional constraints such as target risk, turnover, active asset exposure, and leverage are applied during the portfolio construction phase.
  - The primary goal at this stage is to assess whether the signal under investigation provides any useful information.

Quantitative Investing (V)

- **Data Sources Utilized:** Leveraging databases from I/B/E/S, MSCI, Thomson Reuters, Worldscope, and FactSet.
- **Selection Process:** Identify the most extreme companies within our universe to create top and bottom decile stock screens for each factor.
- **Characterization of Baskets:** Classify these baskets of stocks as either top (long) or bottom (short) screens based on their factor performance.
- **Performance Calculation:** Measure performance and composition of these basic stock screens, updating with the latest month's factor screen data.
- **Return Calculation:** Factor screen returns are calculated as an equal-weighted average in USD from the previous month-end to the latest month-end.
- **Style and Factor Definitions:** Detailed explanations of Style and Factor definitions are provided on the following page.
- **Presentation of Price Indices:** Display price indices as time-series, showing the performance of specific factors relative to the market benchmark.
- **Return Data Specifics:** Return data is based on total returns, includes dividend payments, and excludes transaction costs.
- **Inclusion of Stocks:** Both restricted and unrestricted stocks may be included in the top and bottom stock screens.

Quantitative Investing (VI)

STYLE & FACTOR NAME	DEFINITION
VALUE	**Equal weight composite of forecast EY, PEG ratio, historical EY, DY, Cash EPS Yield, Free Cash Flow Yield, Book Yield, Sales Yield & Shareholder Yield**
Historical Earnings Yield	Last reported annual EPS divided by month-end price
Forecast Earnings Yield	I/B/E/S 12-month EPS forward divided by month-end price
Historical Dividend Yield	Last reported annual DPS divided by month-end price
Historical Cash EPS Yield	Last reported annual Cash EPS divided by month-end price
Free Cash Flow Yield	Last reported total annual Free Cash Flow divided by Enterprise Value
Historical Book Yield	Last reported annual Book Value per share divided by month-end price
Historical Sales Yield	Last reported annual Sales per share divided by month-end price
Shareholder Yield	(Total Dividends + net changes to Debt + net Repurchases)/ Market Cap
Forecast PEG Ratio	I/B/E/S FY1 P/E divided by I/B/E/S long-term EPS growth estimate
GROWTH	**Equal weight composite of forecast EPS growth, historical EPS growth, DPS growth, Ebit Margin and Cash Flow growth**
Forecast EPS Growth	Year on year percentage change between I/B/E/S FY2 and FY1 EPS forecasts
Historical EPS Growth	Year on year percentage change between last reported annual EPS and annual EPS reported 12-months prior
Historical DPS Growth	Year on year percentage change between last reported annual DPS and annual DPS reported 12-months prior
Historical EBIT Margin	Earnings before interest and tax (EBIT) divided by total revenue
Historical Cash Flow Growth	Year on year percentage change between last reported annual CF per share and annual CF per share reported 12-months prior
MOMENTUM	**Equal weight composite of EPS momentum, DPS momentum, net EPS revisions, net DPS revisions, net Sales revisions, 1mth and 12mth Price momentum**
Forward Earnings Momentum	3-month percentage change in I/B/E/S FY1 & FY2 Mean EPS
Forward Dividend Momentum	3-month percentage change in I/B/E/S FY1 & FY2 Mean DPS
Net EPS Revisions	(# of FY1/FY2 upward EPS est. over past 3mths minus # of FY1/FY2 downward EPS est. over past 3mths) divided by the # of EPS chgs
Net DPS Revisions	(# of FY1/FY2 upward DPS est. over past 3mths minus # of FY1/FY2 downward DPS est. over past 3mths) divided by the # of DPS chgs
Net Sales Revisions	(# of FY1/FY2 upward Sales est. over past 3mth minus # of FY1/FY2 downward Sales est. over past 3mth) divided by the # of Sales chgs
1 Month Price Reversion	Total return over the previous month
12 Month Price Momentum	Total return over the previous 12-months

Quantitative Investing (VI)

QUALITY	Equal weight composite of the Altman Z-score, RoE, Gearing, Asset Turnover, RoIC, RoA, and Accruals'
Altman Z-Score	A combination of 5 different financial ratios to determine the likelihood of bankruptcy
Historical Return on Equity	Last reported annual Earnings divided by last reported annual Book Value
Gearing / Debt to Equity	Annual LT debt divided by (annual LT Debt + annual Book Value)
Historical Asset Turnover	Last reported annual sales divided by last reported annual Total Assets
Historical Return on Capital	Annual net Earnings divided by Total Invested Capital
Historical Return on Asset	Last reported annual Earnings divided by last reported Total Assets
Accruals' - Balance Sheet	(Annual growth in Total Assets minus Annual growth in Cash & Equivalents minus the annual growth in Total Liabilities) divided by avg Total Assets
RISK	**Equal weight composite of Beta, Earnings Risk and Volatility**
Beta	A regression analysis of weekly price performance vs. the benchmark over the past 2 years
Earnings Risk	I/B/E/S FY1 and FY2 mean EPS coefficient of Variation
Volatility	90 day historical Volatility
SENTIMENT	**Equal weight composite of 6mth change in Price Target, 3mth change in Recommendation and level of Recommendation**
6 Mth Change in Target Price	6-month change in the I/B/E/S consensus mean price target
3 Mth Chg in Recommendation	3-month change in I/B/E/S consensus mean recommendation
Consensus Recommendation	I/B/E/S consensus mean recommendation
MISCELLANEOUS	**Size**
Market Capitalisation	Investible Market Cap in Millions

Source: J.P. Morgan Quantitative and Derivatives Strategy.

Quantitative Investing (VI)

Factor Summary and Information Coefficients (IC) Sorted by Monthly L/S return (LHS) and by Factor Family (RHS)

Name	Mar-2024 L/S	Mar-2024 Long	Mar-2024 Short	12 Month L/S	Year To Date L/S	Qtr To Date L/S	IC
12M Price Mom, vol adjusted	4.4%	1.4%	-3.0%	32.9%	16.1%	16.1%	14%
12 Mth Price Momentum	4.2%	0.7%	-3.7%	23.1%	12.8%	12.8%	14%
3 Mth Price Momentum	4.0%	0.4%	-3.7%	2.3%	0.0%	0.0%	12%
12mth Change In ROE	3.4%	2.3%	-1.1%	19.2%	10.3%	10.3%	9%
Historical P/Cash Earnings Ratio	3.4%	0.5%	-2.9%	32.5%	12.8%	12.8%	7%
RSI 30 day	3.3%	0.9%	-2.5%	4.2%	3.2%	3.2%	9%
Percent Off 52 Week High	3.2%	-0.2%	-3.2%	14.5%	10.9%	10.9%	14%
Net Revisions to FY1	3.2%	1.1%	-2.0%	18.3%	11.2%	11.2%	7%
1 year forward forecast PE	3.0%	1.6%	-1.3%	31.0%	14.2%	14.2%	3%
3 Mth Change in Consensus Recommendation	2.9%	0.7%	-2.1%	7.0%	7.7%	7.7%	-4%
Forecast PE Relative To Sector	2.8%	1.4%	-1.3%	16.3%	7.5%	7.5%	9%
Composite Forward Earnings Momentum	2.3%	0.8%	-1.5%	24.7%	12.8%	12.8%	-1%
Net Revisions to FY2	2.3%	1.2%	-1.1%	14.9%	9.1%	9.1%	6%
1 Mth Price Momentum	2.3%	1.5%	-0.8%	2.0%	-0.3%	-0.3%	0%
Cash Flow Yield Mean of FY1 and FY2	2.0%	0.8%	-1.1%	27.8%	8.7%	8.7%	-5%
6 Mth Price Momentum	2.0%	-0.3%	-2.3%	10.3%	7.7%	7.7%	7%
Forward Earnings Momentum (1Mth Change)	2.0%	0.7%	-1.4%	22.4%	13.0%	13.0%	1%
Consensus Recommendation	2.0%	-0.3%	-2.3%	0.0%	6.0%	6.0%	-6%
Forward Earnings Momentum / Co-Eff Of Variation	1.9%	0.9%	-1.0%	20.8%	13.5%	13.5%	6%
Historical Earnings Yield	1.7%	-0.7%	-2.3%	25.7%	13.4%	13.4%	7%
60 Day Volatility	1.7%	0.9%	-0.8%	17.8%	5.7%	5.7%	-9%
Historical Return On Equity	1.5%	-0.4%	-1.9%	5.0%	7.2%	7.2%	2%
Forward Earnings Momentum (3Mth Change)	1.4%	-0.3%	-1.7%	23.6%	11.7%	11.7%	-1%
ROA (FY1)	1.0%	-1.5%	-2.6%	-8.5%	1.8%	1.8%	5%
Number of Consensus Estimates (FY1)	1.0%	0.5%	-0.4%	-12.5%	-2.4%	-2.4%	7%
RSI 10 day	0.7%	0.1%	-0.7%	-6.6%	-1.6%	-1.6%	0%
Forecast Earnings Growth FY1 to FY2	0.6%	-0.2%	-0.9%	-15.3%	-8.5%	-8.5%	-3%
Historical P/Sales Ratio	0.4%	0.2%	0.0%	14.8%	2.8%	2.8%	-3%
Forecast PE Relative To History	0.2%	-0.4%	-0.6%	-5.8%	-0.1%	-0.1%	2%
1 Mth Change in Consensus Recommendation	-0.1%	0.4%	0.5%	0.2%	1.4%	1.4%	0%
5 years Historical Earnings Growth	-0.6%	0.3%	0.8%	-8.6%	-2.4%	-2.4%	-2%
Historical Dividend Yield	-0.6%	-2.0%	-1.3%	26.6%	7.8%	7.8%	-7%
Historical P/Book Value Ratio	-1.4%	-1.4%	0.3%	13.8%	3.0%	3.0%	-11%
Composite Coefficient of Variation	-1.4%	-2.1%	-0.8%	-5.7%	-7.0%	-7.0%	-4%
Price Acceleration 6M	-1.5%	-1.6%	-0.1%	4.4%	1.0%	1.0%	-3%
MSCI Beta vs Local Country Index	-1.5%	-1.3%	0.2%	-19.6%	-7.7%	-7.7%	-2%
Price Acceleration 3M	-2.6%	-2.1%	0.6%	-5.6%	-2.9%	-2.9%	-2%

Family	Name	Mar-2024 L/S	12mth Avg	IC
Value	Historical P/Book Value Ratio	-1.4%	1.2%	-11%
Value	Historical Dividend Yield	-0.6%	2.1%	-7%
Value	Forecast PE Relative To History	0.2%	-0.5%	2%
Value	Historical P/Sales Ratio	0.4%	1.2%	-3%
Value	Historical Earnings Yield	1.7%	2.0%	7%
Value	Cash Flow Yield Mean of FY1 and FY2	2.0%	2.2%	-5%
Value	Forecast PE Relative To Sector	2.8%	1.3%	9%
Value	1 year forward forecast PE	3.0%	2.4%	3%
Value	Historical P/Cash Earnings Ratio	3.4%	2.5%	7%
Sentiment	1 Mth Change in Consensus Recommendation	-0.1%	0.0%	0%
Sentiment	Consensus Recommendation	2.0%	0.0%	-6%
Sentiment	3 Mth Change in Consensus Recommendation	2.9%	0.6%	-4%
Risk	MSCI Beta vs Local Country Index	-1.5%	-1.7%	-2%
Quality	Composite Coefficient of Variation	-1.4%	-0.5%	-4%
Quality	Number of Consensus Estimates (FY1)	1.0%	-1.1%	7%
Quality	ROA (FY1)	1.0%	-0.7%	5%
Quality	Historical Return On Equity	1.5%	0.4%	2%
Quality	12mth Change In ROE	3.4%	1.5%	9%
Price	Price Acceleration 3M	-2.6%	-0.5%	-2%
Price	Price Acceleration 6M	-1.5%	0.4%	-3%
Price	RSI 10 day	0.7%	-0.5%	0%
Price	60 Day Volatility	1.7%	1.5%	-9%
Price	6 Mth Price Momentum	2.0%	0.9%	7%
Price	1 Mth Price Momentum	2.3%	0.2%	0%
Price	Percent Off 52 Week High	3.2%	1.2%	14%
Price	RSI 30 day	3.3%	0.4%	9%
Price	3 Mth Price Momentum	4.0%	0.2%	12%
Price	12 Mth Price Momentum	4.2%	1.8%	14%
Price	12M Price Mom, vol adjusted	4.4%	2.5%	14%
Earnings	5 years Historical Earnings Growth	-0.6%	-0.7%	-2%
Earnings	Forecast Earnings Growth FY1 to FY2	0.6%	-1.3%	-3%
Earnings	Forward Earnings Momentum (3Mth Change)	1.4%	1.8%	-1%
Earnings	Forward Earnings Momentum / Co-Eff Of Variation	1.9%	1.6%	6%
Earnings	Forward Earnings Momentum (1Mth Change)	2.0%	1.7%	1%
Earnings	Net Revisions to FY2	2.3%	1.2%	6%
Earnings	Composite Forward Earnings Momentum	2.3%	1.9%	-1%
Earnings	Net Revisions to FY1	3.2%	1.4%	7%

Source: MSCI, Factset,Reuters, J.P. Morgan Macro QDS

Quantitative Investing (VI)

Factor Efficacy within Health Care

Factor	Category	T1	T3	T1-T3
Accruals*	Capital Use/Profitability	5.77%	(5.02%)	10.79%
CapEx-to-Depreciation*	Capital Use/Profitability	4.34%	(3.55%)	7.89%
Price-to-Forward Earnings*	Valuation	3.98%	(3.78%)	7.76%
Reduction in Shares Outstanding*	Capital Use/Profitability	4.58%	(2.88%)	7.46%
Up-to-Down Revisions	Growth/Investor Sentiment	3.22%	(4.11%)	7.33%
Free Cash Flow Yield	Valuation	4.38%	(2.66%)	7.04%
Price-to-Operating Income*	Valuation	3.60%	(3.28%)	6.88%
Enterprise Value-to-Free Cash Flow*	Valuation	4.38%	(2.45%)	6.83%
CapEx-to-Sales*	Capital Use/Profitability	3.97%	(2.64%)	6.61%
Price-to-EBITDA*	Valuation	3.36%	(2.67%)	6.04%
Operating Leverage	Capital Use/Profitability	(0.33%)	1.71%	(2.04%)
Dividend Payout Ratio	Capital Use/Profitability	(0.21%)	2.37%	(2.58%)
1-Year Sales Growth	Growth/Investor Sentiment	(0.60%)	2.03%	(2.63%)
Net Margin	Capital Use/Profitability	0.76%	3.45%	(2.69%)
ROE Variability*	Capital Use/Profitability	0.63%	3.35%	(2.71%)
Inventory-to-Sales	Capital Use/Profitability	(0.88%)	2.03%	(2.92%)
1-Year Dividend per share growth	Growth/Investor Sentiment	(0.19%)	3.29%	(3.46%)
EPS Variability*	Growth/Investor Sentiment	(0.25%)	3.23%	(3.48%)
Y-o-Y Change in number of employees	Capital Use/Profitability	(1.43%)	3.70%	(5.14%)
Forecast long term growth	Growth/Investor Sentiment	(2.17%)	5.02%	(7.19%)

Source: Factset, Morgan Stanley Research

Factor Efficacy within Technology

Factor	Category	T1	T3	T1-T3
6-Month Price Momentum	Growth/Investor Sentiment	5.06%	(3.52%)	8.58%
Price-to-Cash Flow*	Valuation	4.44%	(2.64%)	7.08%
Up-to-Down Revisions	Growth/Investor Sentiment	2.03%	(4.51%)	6.55%
1-Year EPS Growth	Growth/Investor Sentiment	3.30%	(2.35%)	5.65%
Sales Stability	Growth/Investor Sentiment	2.88%	(2.17%)	5.06%
Sales per Employee	Capital Use/Profitability	2.39%	(2.51%)	4.90%
Free Cash Flow Yield	Valuation	3.17%	(1.67%)	4.84%
Cash-to-Assets	Capital Structure/Financial Leverage	1.52%	(1.35%)	2.86%
Incremental Margin	Capital Use/Profitability	0.52%	(1.85%)	2.37%
Estimate Dispersion*	Growth/Investor Sentiment	1.14%	(1.22%)	2.36%
Sales Acceleration	Growth/Investor Sentiment	(5.16%)	(2.08%)	(3.09%)
EPS Variability*	Growth/Investor Sentiment	(2.24%)	0.95%	(3.20%)
Debt-to-Equity*	Capital Structure/Financial Leverage	(2.22%)	1.56%	(3.78%)
ROE Variability*	Capital Use/Profitability	(2.26%)	1.58%	(3.84%)
Operating Income Variability*	Capital Use/Profitability	(3.42%)	0.76%	(4.18%)
CapEx-to-Sales*	Capital Use/Profitability	(1.84%)	2.50%	(4.35%)
CapEx-to-Depreciation*	Capital Use/Profitability	(1.10%)	3.64%	(4.74%)
CapEx-to-Assets*	Capital Use/Profitability	(1.62%)	3.29%	(4.91%)
Dividend Payout Ratio	Capital Use/Profitability	(4.41%)	1.44%	(5.85%)
5-Year Dividend per Share Growth	Growth/Investor Sentiment	(6.51%)	(0.01%)	(6.50%)

Source: Factset, Morgan Stanley Research

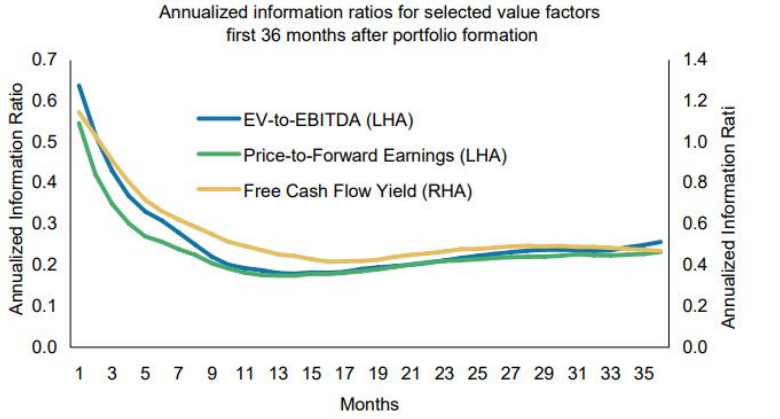
Quantitative Investing (VI)

Valuation Metrics are Particularly Effective for Banks at This Point of the Interest Rate Cycle

		Interest Rate & Yield Curve Environment			
Category	Factor	Falling & Flattening	Falling & Steepening	Rising & Flattening	Rising & Steepening
Capital Structure/Financial Leverage	Cash-to-Assets	5.26%	1.57%	1.77%	(0.98%)
	Cash-to-Debt	5.33%	3.01%	0.66%	(4.05%)
	Debt-to-Assets*	4.79%	2.20%	1.57%	(2.62%)
	Debt-to-Capital*	4.06%	2.33%	(0.42%)	(6.61%)
	Debt-to-Equity*	4.41%	2.91%	0.45%	(2.86%)
Capital Use/Profitability	Dividend Payout Ratio	(3.34%)	(2.47%)	(2.72%)	(5.54%)
	ROE	1.10%	(3.97%)	0.50%	3.11%
	ROE Variability*	3.43%	(0.60%)	(2.80%)	(2.34%)
	Reduction in Shares Outstanding*	1.02%	(1.95%)	7.60%	2.37%
	Y-o-Y Change in number of employees	1.46%	(3.40%)	(4.03%)	(2.10%)
Growth/Investor Sentiment	1-Month Price Momentum	0.59%	(0.58%)	(1.19%)	(0.55%)
	1-Year Dividend per share growth	3.13%	(2.47%)	0.09%	(1.55%)
	12-Month Price Momentum	2.79%	0.41%	2.29%	(0.93%)
	3-Month Price Momentum	1.20%	1.23%	(0.34%)	0.74%
	5-Year Dividend per share growth	0.31%	(2.59%)	(1.56%)	(0.02%)
	Forecast long term growth	1.00%	(4.91%)	(1.43%)	6.31%
	Up-to-Down Revisions	0.92%	3.07%	5.87%	6.94%
Valuation	Dividend Yield	(2.86%)	1.37%	1.51%	(2.54%)
	Price-to-Book*	(3.16%)	9.70%	4.44%	2.71%
	Price-to-Earnings*	(2.98%)	1.77%	7.19%	1.85%
	Price-to-Forward Earnings*	(4.92%)	3.11%	5.72%	1.67%
	Total Yield	(0.74%)	1.93%	2.02%	0.36%

Source: Factset, Morgan Stanley Research

There Is Little Efficacy Beyond Nine Months for Most Valuation Metrics



Source: Factset, Morgan Stanley Research

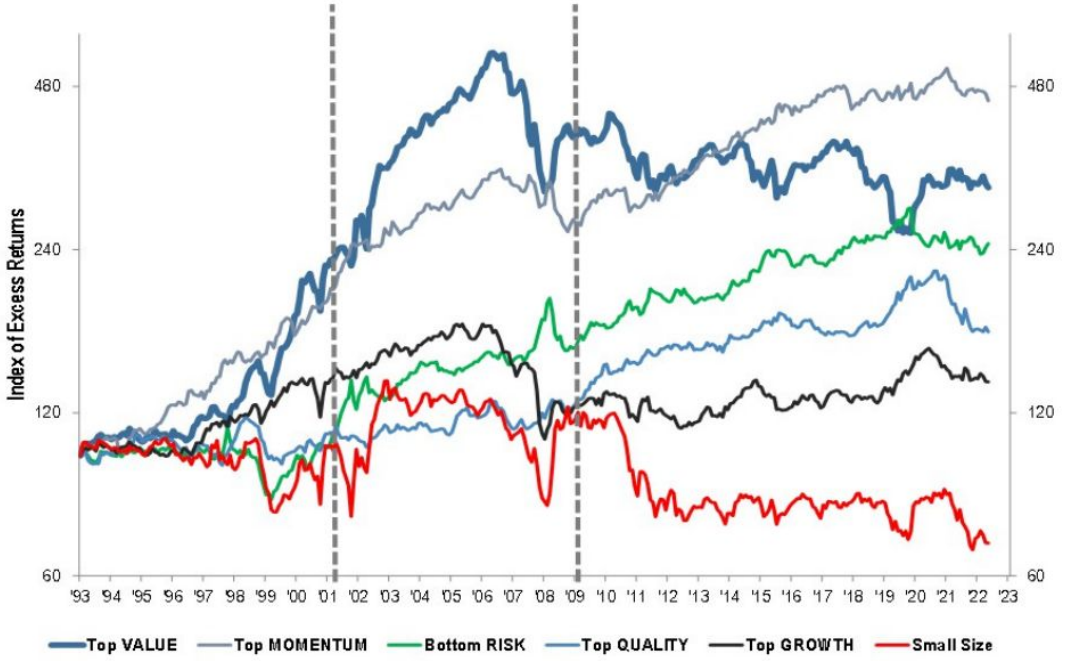
2

Evolution of Quant Factor Investing

Evolution of Quant Factor Investing

Performance of Value Stocks Post-GFC
Post-GFC, Value stocks have underperformed relative to the broader market.These stocks are behaving more like traditional cyclicals, contrasting sharply with their strong performance in the secular bull trend observed after the TMT bubble in 2000.

Performance Trends of Other Stock Categories
Momentum stocks have largely recovered from their losses during the 2008/09 drawdown. Both high Quality and low Risk stocks have outperformed the market significantly more post-financial crisis than before the crisis.



Evolution of Quant Factor Investing

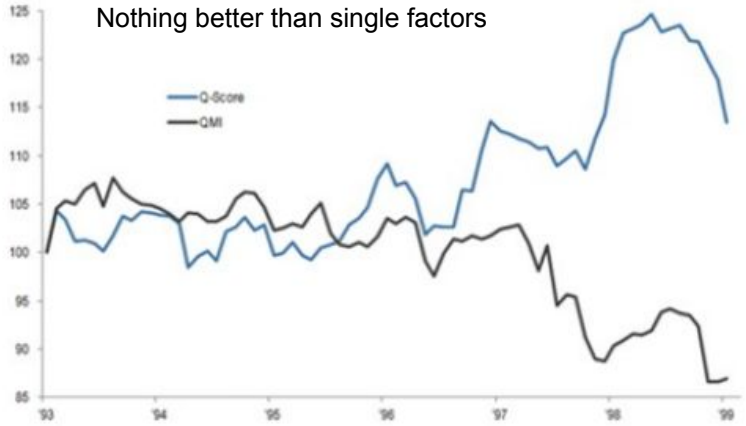
- **Shift to Multi-Factor Models:** Post the global financial crisis, the quant community has increasingly adopted multi-factor stock allocation models instead of relying on single factors.
- **Response to Market Shocks:** The significant drawdowns in style and factor returns, particularly for Value factors, prompted even the most disciplined quant investors to reconsider their strategies.
- **Benefits of Multi-Factor Investing:** The multi-factor approach to quant investing is favored today because it:
  - Provides diversification.
  -Potentially offers lower correlations with the broader market.
  - Results in less volatile return profiles.

	IC	t-Stat	Ann. Returns	Ann. Vol	Sharpe Ratio	Hit-Rate	Max DD	Turnover
Long-only (excess)								
Value	1.9%	1.99	3.9%	12.2%	0.32	54.8%	-39.2%	18.9%
Growth	-1.8%	0.22	0.0%	8.3%	0.00	52.8%	-42.3%	19.8%
Momentum	1.8%	4.26	6.3%	8.2%	0.78	58.3%	-20.4%	42.8%
Quality	0.9%	2.46	2.7%	6.2%	0.44	56.6%	-23.2%	8.2%
Q-Score	**0.6%**	**5.33**	**7.4%**	**7.5%**	**0.99**	**63.3%**	**-20.9%**	**32.8%**
Long/Short								
Value	1.8%	2.02	4.6%	14.9%	0.31	58.6%	-65.4%	35.0%
Growth	-0.2%	-0.06	-0.5%	8.9%	-0.06	51.0%	-51.1%	41.1%
Momentum	3.9%	4.17	10.9%	14.7%	0.74	65.6%	-45.9%	83.7%
Quality	1.5%	2.60	4.7%	10.6%	0.44	59.2%	-24.2%	19.2%
Q-Score	**3.7%**	**5.68**	**11.0%**	**10.4%**	**1.06**	**65.3%**	**-25.0%**	**61.6%**

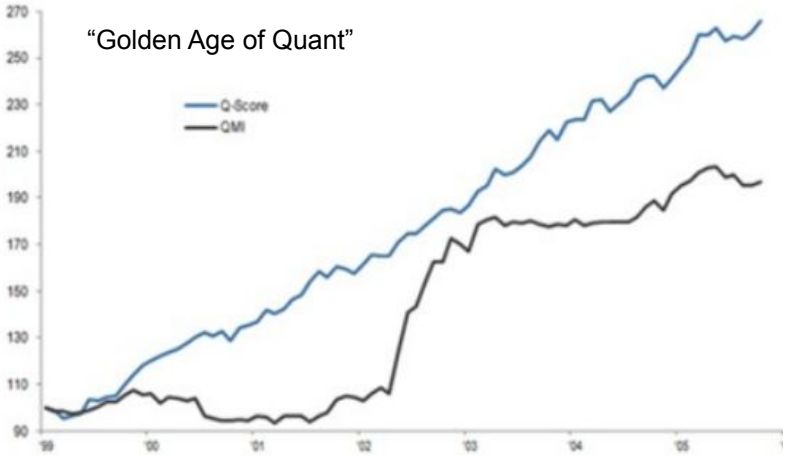
Evolution of Quant Factor Investing

Early Phase (Late 1980s to Late 1990s)

- Initially, single factors were as effective, or more so, than multi-factor models. During this period, strategies like Value, Growth, and Momentum generally yielded positive returns. The importance of portfolio diversification was less pronounced.
- The chart on the right shows mixed performance (both positive and negative returns) for composite, multi-factor models during the mid-to-late nineties, indicating a challenging period for these strategies.
- Here, the multi-factor model integrates four investment factors equally: Value, Growth, Quality, and Momentum - providing diversification benefits and stability by offsetting periods when certain factors underperform due to unfavorable market regimes.



Evolution of Quant Factor Investing



Golden Age of Quant (Early 2000s to Pre-Financial Crisis)

- Rise of Multi-Factor Models: This era saw a shift towards diversified multi-factor models, which consistently outperformed single-factor approaches due to better risk distribution.
- The chart on the left highlights the strong performance of the composite factor models throughout this period, marking it as a successful phase for diversified quant strategies.

Evolution of Quant Factor Investing

Financial Crisis and Subsequent Period (2007 Onwards)

- Market Turbulence: During the late stages of the bull market and throughout the financial crisis, as well as during the recovery phases, the Q-Score generally underperformed.
- Regime Changes Impact: Sharp regime changes had a significant impact. The QMI adapted better to abrupt market shifts, enhancing its performance relative to the more static, diversified multi-factor model.
- This third chart captures the Q-Score's struggles during the financial crisis and the slow recovery thereafter. In contrast, the QMI showed improved responsiveness to market risk changes, leading to better overall performance during this turbulent period.

More regime changes - QMI shines