U.S. Stock Selection Model Performance Review

2018: The more things changed, the more they stayed the same

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2018 – The rise of uncertainty: U.S. stock returns faced headwinds from uncertainties in monetary, fiscal and trade policies as well as the midterm elections and government shutdown late in the year. A 15 month streak of positive returns ended in January and four months of the year (Feb., Mar., Oct. and Dec.) saw negative returns for the S&P 500, which ended the year down 7.2% on a cumulative basis. Both the S&P 500 and Russell 3000 also saw higher volatility in 2018 as markets sought to digest the uncertainty.

2018's winning strategies – Just like 2017: Strategy categories that did well in 2017 also did well in 2018 and vice-versa (Figure 1). Price momentum and capital efficiency put up strong and consistent returns in both years whereas size, value, and volatility have lagged. Conditions have favored past winners at the expense of small and cheap companies.

A (mostly) good year for long-short factor models: Despite the volatility and index declines, the four long-short factor models tracked by S&P Global Market Intelligence did well in 2018. The models (Growth, Value, Quality and Price Momentum) benefited from the multifactor approach used in the selection process while the live, out-of-sample results for the four were all positive on both a long-only and long-short return basis. The models performed best in the second half of the year, particularly December, but struggled in April and May.

Healthcare provides a strong dose of performance: The Healthcare sector long-short returns were the strongest among the 11 sectors tracked in 2018 – with double digit returns - except in the Value Benchmark Model where Healthcare was a close second to Energy.

Figure 1- Average Monthly Quintile Return Spreads For Popular Investment Styles (Detailed in Appendix A) S&P 500 (2016, 2017 & 2018)
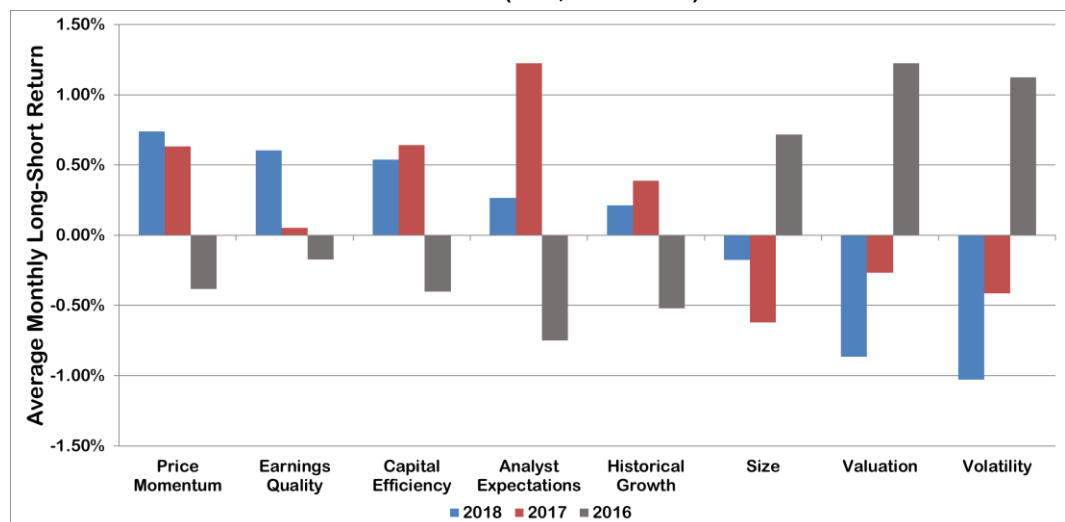
Source: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

What worked in 2018?

Despite market volatility and index declines, long-short factor models did well in 2018. The models benefited from the multifactor approach used in the selection process. For example, the Valuation Model, which heavily weights valuation measures (the second worst performing style for the year), notched an average of 43 bps per month. This is because part of the model is typically producing profitable signals, even when other signals become noisy.

Table 1 - Model Summary Performance
Russell 3000 Growth / Russell 3000 Value / Russell 3000 (January 2018 to December 2018)

Model Name	Universe	Average 1-Month Quintile Spread	Average Q1 Monthly Excess Return	Average 1-Month IC
Growth Benchmark Model ("GBM")	Russell 3000 Growth	0.64%	0.28%	0.024
Value Benchmark Model ("VBM")	Russell 3000 Value	0.43%	0.20%	0.017
Quality Model ("QM")	Russell 3000	0.75%	0.45%	0.040
Price Momentum Model ("PMM")	Russell 3000	0.70%	0.26%	0.029

The live, out-of-sample results for the four models were all solidly positive on both a long-only and long-short return basis.

Table 2- Model Historical Summary Performance – Live Performance
Russell 3000 Growth / Russell 3000 Value / Russell 3000 (January 2011 to December 2018)

| Model Name	Universe	Average 1-Month Quintile Spread	Average Q1 Monthly Excess Return	Average 1-Month IC
Growth Benchmark Model ("GBM")	Russell 3000 Growth	0.97%	0.28%	0.037
Value Benchmark Model ("VBM")	Russell 3000 Value	0.79%	0.21%	0.036
Quality Model ("QM")	Russell 3000	0.71%	0.29%	0.038
Price Momentum Model ("PMM")	Russell 3000	0.80%	0.29%	0.044

Source for Table 1 and 2: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

Ubiquitous across our four models, the Healthcare sector long-short returns were the strongest among the 11 sectors in 2018, except in the Value Benchmark Model where Healthcare was a close second to Energy (Table 3 and Figure 2). The interpretation of this observation is that the factors in our models aptly described the cross-section of Healthcare returns in 2018. Further, the consistency of performance across models indicates that factors common to all four models described Healthcare returns well. Cumulative performance over 2018 in this sector, using any of the Stock Selection models, was impressive double digits.

Table 3- Model Sector Performance – Sector Neutral and Health Care

Russell 3000 Growth / Russell 3000 Value / Russell 3000 (January 2018 to December 2018)

Model Name	Average Sector Neutral Spread	Average Health Care Monthly Spread	Cumulative 2018 Model Performance (Healthcare)
Growth Benchmark Model ("GBM")	0.66%	3.14%	42%
Value Benchmark Model ("VBM")	0.48%	3.03%	21%
Quality Model ("QM")	0.77%	2.39%	43%
Price Momentum Model ("PMM")	0.38%	1.77%	32%

Figure 2- Model Long-Short Average Spread Return

Russell 3000 Growth / Russell 3000 Value / Russell 3000 (January 2018 – December 2018)
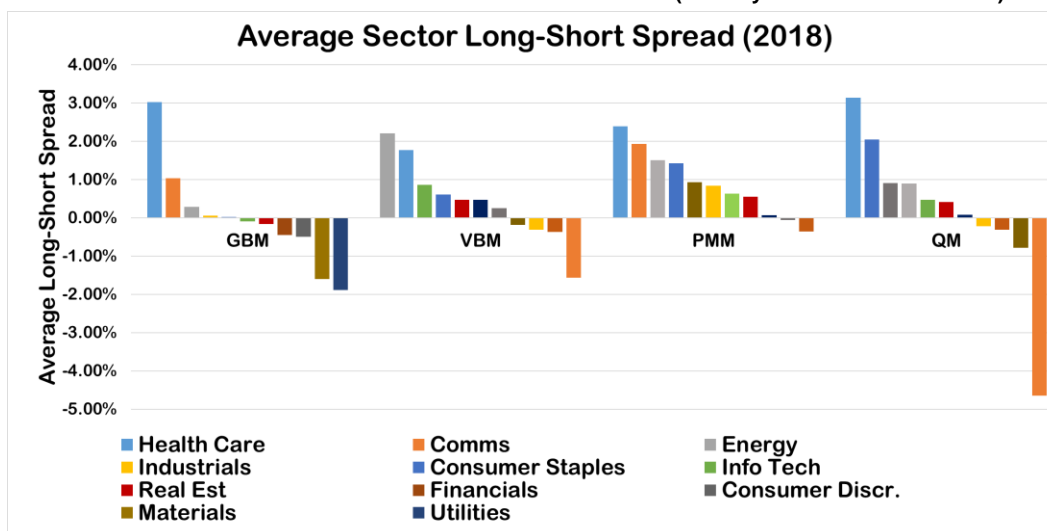
Source for Table 3 and Figure 2: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

Figure 3 and Figure 4 below show the monthly quintile return spreads and information coefficients across our four models in 2018. On an equally-weighted basis, the models performed poorly in April and May with negative quintile spreads across all four models. In contrast, our models performed well in December with the Growth and Price Momentum models recording their highest quintile spread for 2018. The overall performance across the four models was largely driven by larger positive spreads during the latter half of 2018 (July – December) compared to the first half where both Price Momentum and Value models had negative year-to-date spreads heading into July. During the second half of 2018, Price Momentum return spreads outperformed the other models.

Figure 3- Monthly Historical Equal-Weighted Quintile Return Spread
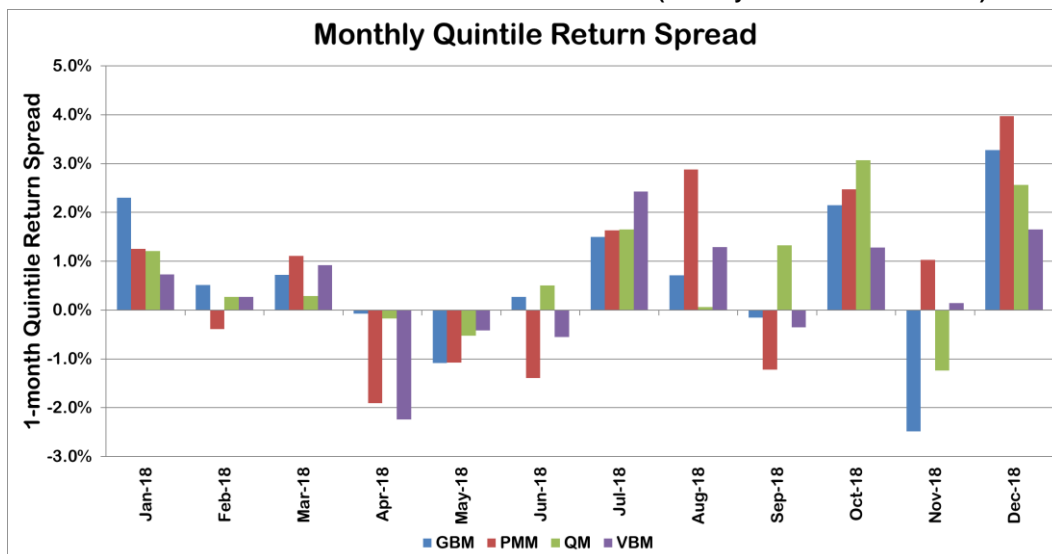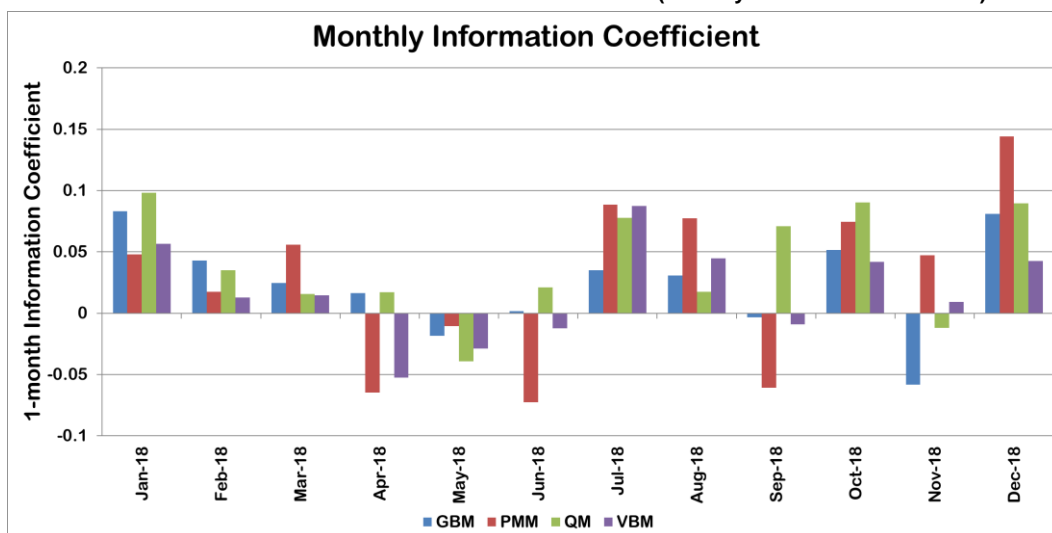**Russell 3000 Growth / Russell 3000 Value / Russell 3000 (January 2018 – December 2018)**

Figure 4- Monthly Information Coefficient
Russell 3000 Growth / Russell 3000 Value / Russell 3000 (January 2018 – December 2018)

Source for Figure 3 and 4: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

Explanation of Returns Presented in this Paper

This paper presents the returns of hypothetical portfolios formed based on the model scores. All returns are calculated based on actual historical returns of the underlying stocks, but do not represent actual trading results and do not include payments of any sales charges, fees, or trading costs. Such costs would have lowered performance. It is not possible to invest directly in an index or the model portfolios on which the results presented here are based. Past performance is not a guarantee of future results.

Glossary of Definitions Used in this Paper
"Spread" returns, also referred to as return spreads or long-short return spreads, are the returns of a screened portfolio of the top 20% of ranked stocks (quintile 1) minus the returns of the bottom 20% screened portfolio (quintile 5). Stock returns within each portfolio are equally-weighted. The model portfolios are rebalanced at calendar month end.

"Excess" returns are returns of model portfolios formed from the top 20% of ranked stocks (referred to as "quintile 1" or "Q1") minus the return of the equally-weighted universe. Where noted in tables, Q2, Q3, Q4, and Q5 present the returns of hypothetical portfolios of the lower-ranked quintiles, each containing a distinct 20% portion of the universe.

"Absolute" returns are the model return of the equally-weighted portfolio without subtracting benchmark returns.

"Information Coefficient", or "IC" is the rank correlation of the model monthly scores with the forward 1-month returns of the underlying stocks. An IC score measures how closely related the model rankings (scores) are to the returns that follow. The closer the score/return relationship, the higher the IC.

"Information Ratio" or "IR", of a result is the average of monthly excess return over the period divided by the standard deviation of these returns.

The benchmark return is the return of a portfolio containing the constituents of the reference index (such as the Russell 3000), with equal weighting and a monthly rebalance.

The models were released in January 2011 and were constructed with benefit of hindsight for returns prior to 2011. We refer to the historical period before 2011 as "back-test". We refer to the performance of the model from 2011 and beyond as the "live" performance.

1. Growth Benchmark Model

The Growth Benchmark Model ("GBM") was created to outperform a growth benchmark, defined as the Russell 3000 Growth Index. The model identifies companies with a consistent track record of earnings growth, as well as emerging growth candidates. The model scores are based on seven subcomponents: Earnings Momentum, Historical Growth, Liquidity and Leverage, Price Momentum, Value, Quality, and Capital Efficiency. Table 4 summarizes the Growth Model Performance from January 1987 through December 2018. The model inception date is January 2011.

Table 4 - Summary Historical Performance Statistics for Growth Benchmark Model
Russell 3000 Growth Universe (January 1987 – December 2018)

	Q1	Q2	Q3	Q4	Q5	Long-Short Quintile Return Spread
Average Monthly Absolute Return[1]	1.54%***	1.14%***	0.89%***	0.62%**	0.00%	1.54%***
Annualized Absolute Return	20.10%	14.58%	11.19%	7.74%	-0.02%	20.12%
Annualized Information Ratio[2]	1.67	0.84	0.04	-1.06	-1.38	0.29

Information Coefficient Summary	
Average 1-Month IC	0.053***
1-Month IC Information Ratio	0.88
1-Month IC Hit Rate[3]	83%***

*** 1% significance; **5% significance; *10% significance

Source: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

1.1 Model Performance in 2018

Figure 5 and Figure 6 displays the 1-month quintile return spreads and 1-month information coefficients (ICs) respectively for the model during 2018. The GBM generated a positive average return spread of 0.64% and IC of 0.02 in 2018. The model's strongest month was December and the model generated positive IC's in 9 of 12 months in 2018. Companies with a favorable outlook and a robust capital structure drove the GBM returns, evinced by the Investor Sentiment and Earnings Momentum sub-composites (Figure 6).

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[1] Average Monthly Returns are absolute returns based on a monthly rebalance portfolio.
[2] Information Ratio calculated on monthly excess returns relative to equal-weighted benchmark.
[3] IC Hit Rate is defined as the percentage of months where the IC is positive.

Figure 5- Growth Benchmark Model: Historical 1-Month Equal Weighted Quintile Return Spread and Information Coefficient - Russell 3000 Growth (January 2018 – December 2018)
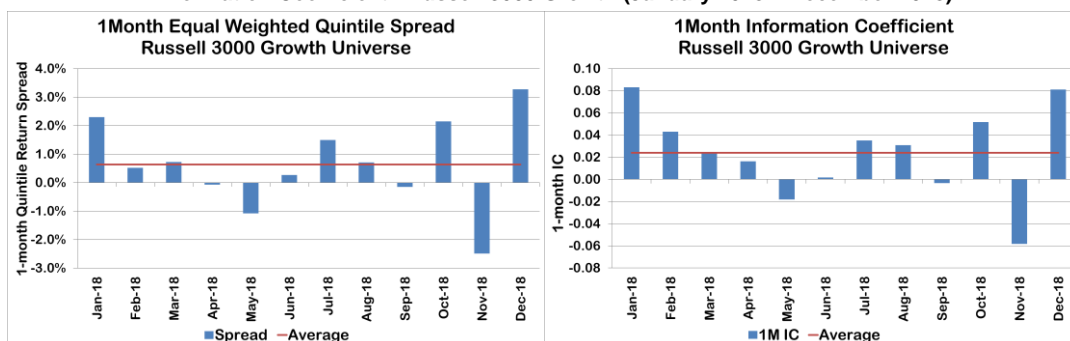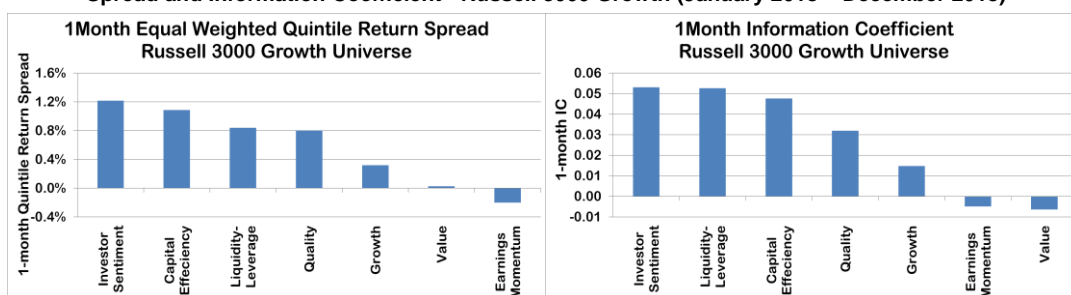

Figure 6- Growth Benchmark Model Subcomponents: Historical 1-Month Equal Weighted Quintile Return Spread and Information Coefficient - Russell 3000 Growth (January 2018 – December 2018)

1.2 Sector Performance in 2018

Figure 7 breaks the performance of the GBM out by sector. The GBM produced positive returns in only 5 of the 11 GICS sectors (explained in Appendix B) and a positive IC in 7 of 11 GICS sectors. The performance in the Healthcare sector was more than triple that of the next best sector (Communications). Utilities underperformed amongst the GICS sectors although we note that there are only 12 stocks in the benchmark (Russell 3000 Growth) as of 12/31/2018.

Figure 7 - Growth Benchmark Model by Sector: 1-Month Equal Weighted Historical Quintile Return Spread and Information Coefficient - Russell 3000 Growth (January 2018 – December 2018)
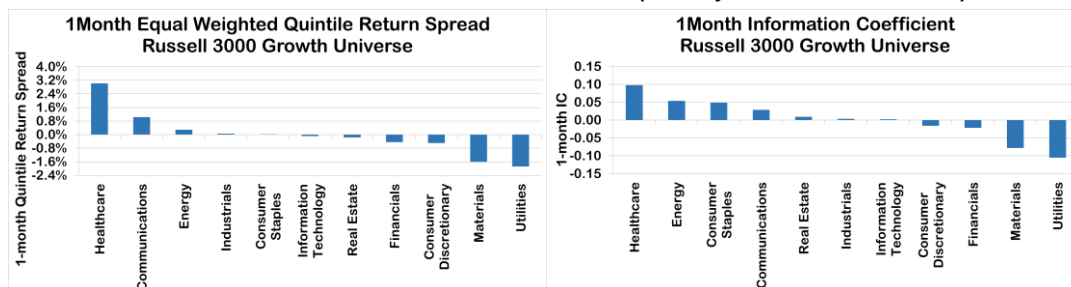
Source for Figure 5, 6 and 7: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

1.3 Quintile Portfolio Characteristics and Portfolio Tilt Neutralization

Table 5 reports the median market capitalization and 60-month Capital Asset Pricing Model (CAPM) beta of the top and bottom quintile portfolios. The median market cap of the long portfolio (Q1) was $2.39B compared to $1.55B for the short portfolio (Q5), indicating a model preference for larger capitalization companies. We saw a similar tilt in previous years. The median betas of the long and short portfolio were similar at 1.10 and 1.02, indicating little influence from the overall equity market.

Table 5 - Growth Benchmark Model: Median Market Cap and 60-Month CAPM Beta
Quintile 1 and Quintile 5 – Russell 3000 Growth Universe (January 2018 – December 2018)

Median Measure	Quintile 1	Quintile 5
Market Cap ($ Million)	2,388	1,548
60M CAPM Beta	1.10	1.02

The Russell 1000 Growth Index (a proxy for larger capitalization growth stocks) outperformed the Russell 2000 Growth Index (a proxy for smaller capitalization growth stocks) by 2.7%. Table 6 shows the model results neutralizing for beta and size. Both the average neutralized 1-month return spread and the average 1-Month IC were largely unaffected.

Table 6 - Growth Benchmark Model: Original and Beta/Size Neutralized Historical Performance
**Russell 3000 Growth Universe (January 2018 – December 2018)**

Model	Average 1-Month Quintile Return Spread	Average 1-Month IC
Original GBM	0.64%	0.024
Size/Beta Neutral GBM	0.68%	0.024

Source for Table 5 and Table 6: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

1.4 Historical Comparison

Figure 8 shows the calendar-year performance of the GBM since 1987. The average monthly return spread for 2018 was strong but relatively low compared to years past. The model performance, as measured by average monthly quintile return spread, for the "live" period (grey bars 2011-2018) was 0.97% compared with 1.73% during the back-test period (black bars 1987-2010). As discussed in previous reports, years with negative returns include 2009 (low price, high beta rally), 1999 ("tech bubble"), and 2003 ("junk rally").

Figure 8 - Growth Benchmark Model: Historical Year Average Monthly Quintile Return Spread
Russell 3000 Growth Universe (January 1987 – December 2018)
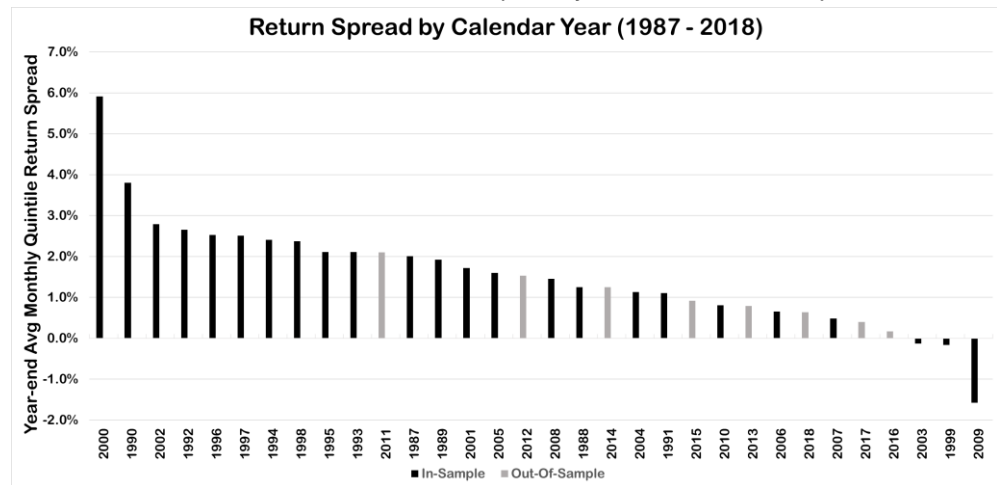
2. Value Benchmark Model

Performance results from January 1987 through December 2018 for the Value Benchmark Model ("VBM") are shown in Table 7. This model selects companies with low valuations, high earnings quality, stable growth rates, and improving analyst sentiment. The VBM has six subcomponents: Valuation, Earnings Quality, Financial Health, Growth Stability, Street Sentiment, and Price Momentum.

Table 7 - Summary Historical Performance Statistics for Growth Benchmark Model
Russell 3000 Value Universe (January 1987 – December 2018)

	Q1	Q2	Q3	Q4	Q5	Long-Short Quintile Return Spread
Average Monthly Absolute Return[4]	1.33%***	1.00%***	0.77%***	0.46%*	-0.27%	1.60%***
Annualized Absolute Return	17.18%	12.68%	9.69%	5.68%	-3.22%	21.01%
Annualized Information Ratio[5]	1.30	0.23	-0.65	-2.31	-2.57	0.36

Information Coefficient Summary	
Average 1-Month IC	0.054***
1-Month IC Information Ratio	0.93
1-Month IC Hit Rate[6]	83%***

*** 1% significance; **5% significance; *10% significance

Source for Figure 8 and Table 7: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

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[4] Average Monthly Returns are absolute returns based on a monthly rebalance portfolio.
[5] Information Ratio calculated on monthly excess returns relative to equal-weighted benchmark.
[6] IC Hit Rate is defined as the percentage of months where the IC is positive.

2.1 Model Performance in 2018

Monthly quintile return spreads and ICs for the VBM in the Russell 3000 Value Index over 2018 are shown in Figure 9. The average monthly return spread and IC were 0.43% and 0.017, respectively. The VBM had difficulty in the spring of 2018, when the market consolidated after consecutive down months in February and March. The latter half of the year, the model performed particularly well, including October and December when equities were performing poorly. The model yielded positive spread and IC in 8 of 12 months.

Figure 9 - Value Benchmark Model: Historical 1-Month Equal Weighted Quintile Spread and Information Coefficient - Russell 3000 Value (January 2018 – December 2018)
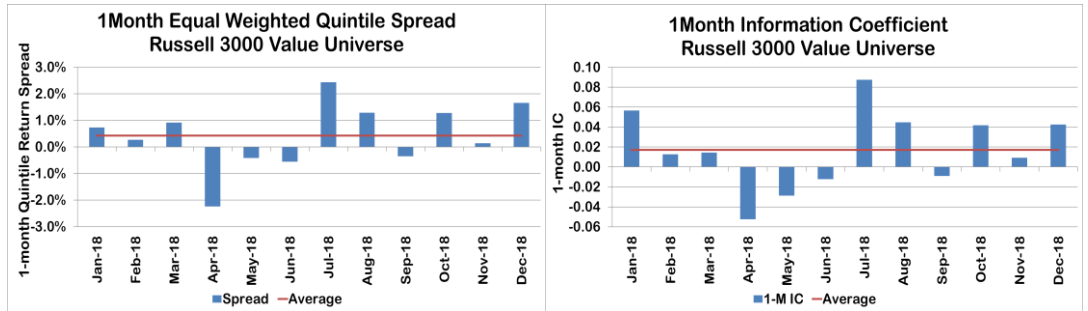
Figure 10 shows the average 1-month quintile return spread and IC for each of the subcomponents of the VBM over the Russell 3000 Value universe for 2018. Despite strong performance for the Growth and Price Momentum category of signals, these subcomponents of the VBM underperformed the other four subcomponents. Five of the six subcomponents had positive IC. The exception, the Growth subcomponent, had near zero IC.

Figure 10 - Value Benchmark Model Subcomponents: Historical 1-Month Equal Weighted Quintile Spread and Information Coefficient - Russell 3000 Value (January 2018 – December 2018)
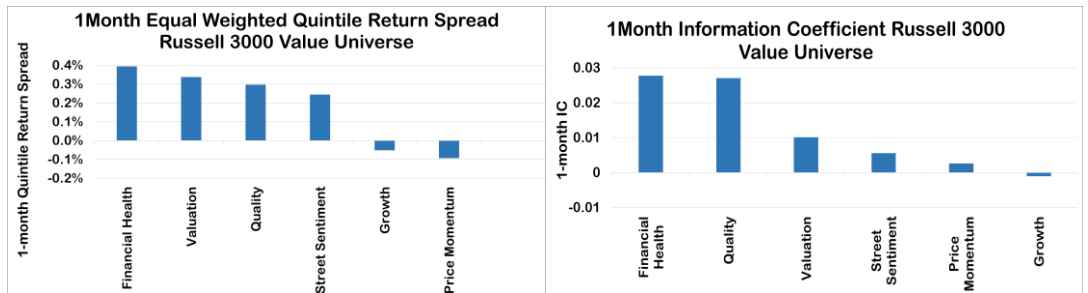

Source for Figures 9 and 10: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

2.2 Sector Performance in 2018

Sector performances are summarized in Figure 11. Energy and Healthcare yielded the largest returns in this model; double that of the third place sector, Information Technology. Of the 11 sectors, 7 produced positive spreads and IC scores.

Figure 11 - Value Benchmark Model by Sector: 1-Month Equal Weighted Historical Quintile Spread and Information Coefficient - Russell 3000 Value (January 2018 – December 2018)
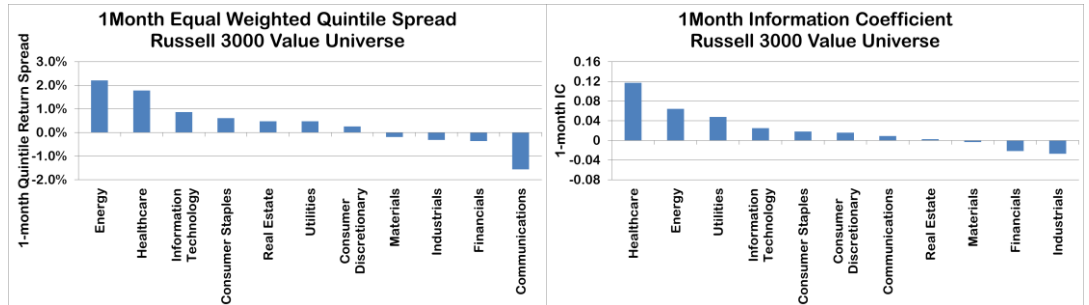
2.3 Quintile Portfolio Characteristics and Portfolio Tilt Neutralization

The market capitalization and median beta of the top (Q1) and bottom (Q5) quintiles are reported in Table 8. Market capitalization of Q1 was $3.2B vs $0.85B for Q5, indicating a large company tilt is prevalent in the model. Given the strong performance of larger firms compared to smaller firms in 2018, based on the performance of the size style category (Figure 1), the tilt towards larger firms was a tailwind to the VBM model. Little variation in CAPM beta exposure was seen between Q1 and Q5. In a size and beta adjusted framework (Table 9), returns and IC scores for the VBM were significantly lower, indicating the model derived a portion of its return from exposure to size and beta.

Table 8 - Value Benchmark Model: Median Market Cap and 60-Month CAPM Beta Quintile 1 and Quintile 5 Russell 3000 Value Universe (January 2018 – December 2018)

Median Measure	Quintile 1	Quintile 5
Market Cap ($ Million)	3,206	851
60M CAPM Beta	1.00	0.95

Table 9 - Value Benchmark Model: Original and Beta/Size Neutralized Historical Performance Russell 3000 Value Universe (January 2018 – December 2018)

Model	Average 1-Month Quintile Return Spread	Average 1-Month IC
Original VBM	0.43%	0.017
Size/Beta Neutral VBM	0.18%	0.008

Source for Table 8, 9 and Figure 12: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

2.4 Historical Comparison

Figure 12 illustrates the VBM annual performance since the beginning of the back-test in 1987. Back-tested performance (1987 – 2010, black bars) averaged 1.87% monthly whereas the live performance (2011 – 2018) averaged 0.79% monthly. While 2018 performance of 0.43% marks an improvement on the negative returns of 2016 and 2017, it is still below both in-sample and live averages.

Figure 12 - Value Benchmark Model: Historical Year Average Monthly Quintile Return Spread
Russell 3000 Value Universe (January 1987 – December 2018)
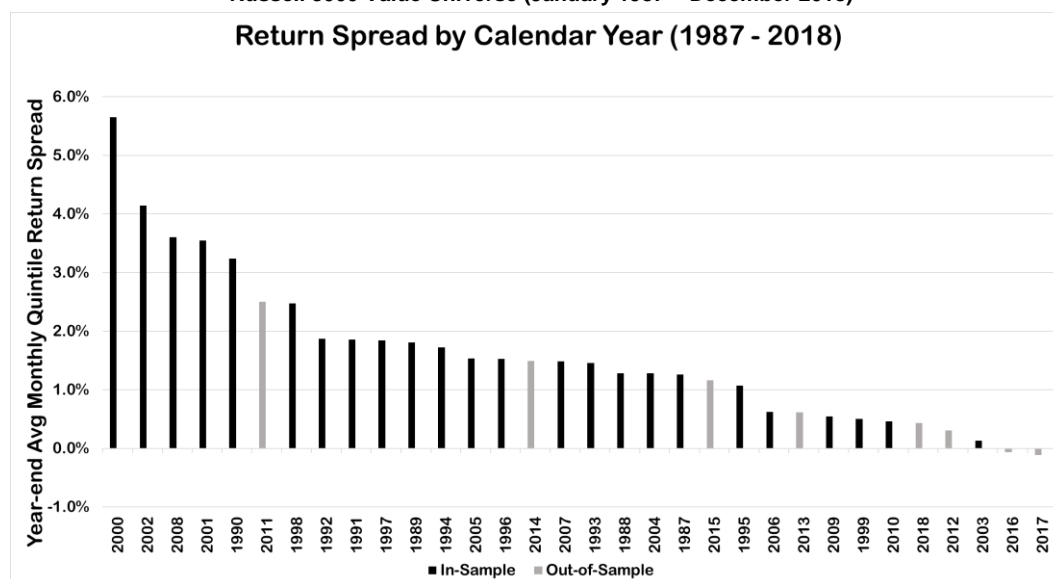
Source: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

3. Quality Model

Earnings quality measures, specifically those based on accruals, seek to align the expected future financials benefits and obligations to a firm over a period. The Quality Model ("QM") extends the analysis of earnings quality beyond accruals and includes several measures of balance sheet efficiency/strength that have been shown to indicate medium and long-term earning quality. The Quality Model is comprised of five subcomponents: Growth Stability, Operating Efficiency, Valuation, Financial Health, and Earnings Quality. Detailed historical performance statistics are summarized in Table 10.

Table 10 - Summary Historical Performance Statistics for Quality Model
Russell 3000 (January 1987 – December 2018)

	Q1	Q2	Q3	Q4	Q5	Long-Short Quintile Return Spread
Average Monthly Absolute Return[7]	1.28%***	1.03%***	0.74%***	0.41%	-0.21%	1.49%***
Annualized Absolute Return	16.42%	13.08%	9.20%	4.97%	-2.52%	19.39%
Annualized Information Ratio[8]	0.99	0.45	-0.81	-2.23	-2.16	0.28

Information Coefficient Summary	
Average 1-Month IC	0.053***
1-Month IC Information Ratio	0.84
1-Month IC Hit Rate[9]	81%***

*** 1% significance; **5% significance; *10% significance

3.1 Model Performance in 2018

The QM produced an average 1-month equally-weighted return spread and 1-month IC of 0.75% and 0.040, respectively in 2018 (Figure 13). After struggling in 2017 due to a market environment that favored high growth companies, the quality model etched solid performance in 2018. Return spreads and IC scores were positive in 9 and 10 of the 12 months, respectively. Operating efficiency and financial health were the highest earning subcomponents (Figure 14).

Figure 13 - Quality Model: Historical 1-Month Equal Weighted Quintile Return Spread and Information Coefficient - Russell 3000 (January 2018 – December 2018)
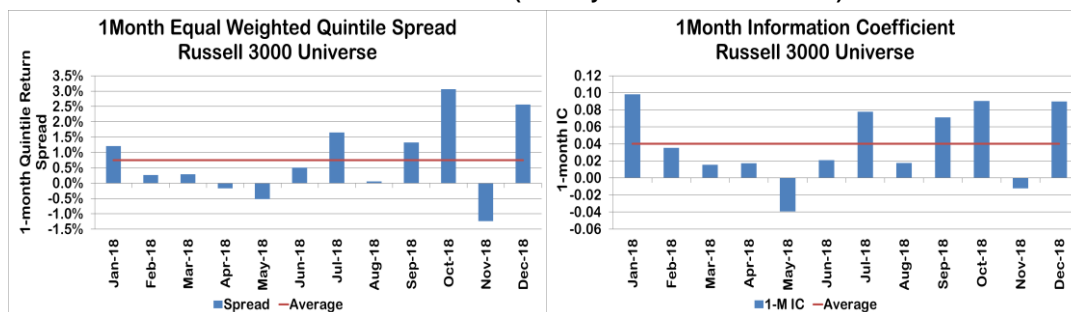

Source for Table 10 and Figure 13: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

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[7] Average Monthly Returns are absolute returns based on a monthly rebalance portfolio.
[8] Information Ratio calculated on monthly excess returns relative to equal-weighted benchmark.
[9] IC Hit Rate is defined as the percentage of months where the IC is positive.

Figure 14 - Quality Model Subcomponents: Historical 1-Month Equal Weighted Quintile Return Spread and Information Coefficient - Russell 3000 (January 2018 – December 2018)
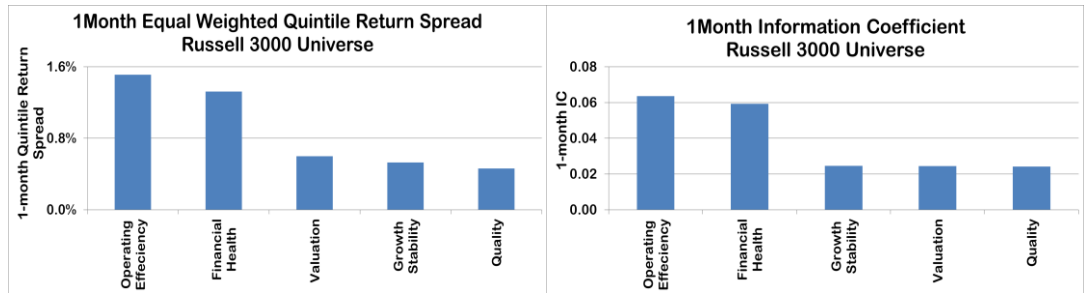
3.2 Sector Performance in 2018

The QM performed well across sectors, producing positive spreads in 7 sectors and positive ICs in 8 sectors. Communications lagged, averaging a loss of more than 4.0% per month; whereas Healthcare outperformed, averaging more than 3.0% per month.

Figure 15 - Quality Model Sector: 1-Month Equal Weighted Historical Quintile Spread and Information Coefficient - Russell 3000 Universe (January 2018 – December 2018)
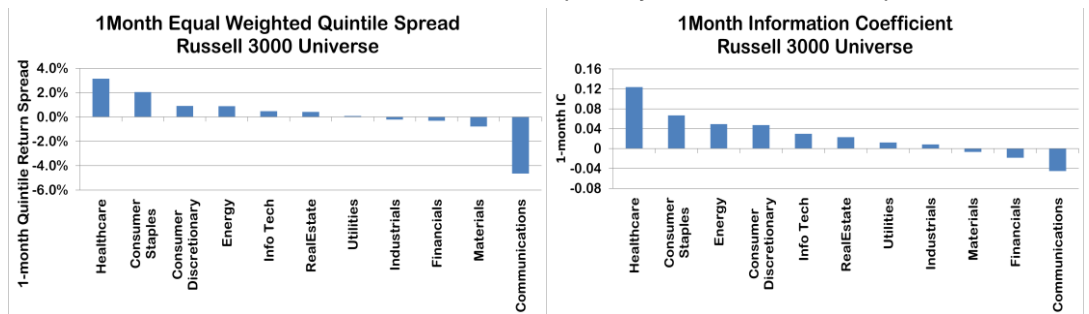
3.3 Quintile Portfolio Characteristics and Portfolio Tilt Neutralization

The QM had a strong preference for larger companies, based on the $3.1B market capitalization of the Q1 portfolio compared to the $0.94B capitalization for Q5 (Table 11). The difference between CAPM beta exposure for Q1 and Q5 was insignificant. In a size and beta adjusted framework, the QM performance was lower (Table 12).

Table 11 - Quality Model: Median Market Cap and 60-Month CAPM Beta Quintile 1 and Quintile 5 Russell 3000 Universe (January 2018– December 2018)

Median Measure	Quintile 1	Quintile 5
Market Cap ($ Million)	3,104	935
60M CAPM Beta	0.99	1.05

Source for Figure 15 and Table 11: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

Table 12 - Quality Model: Original and Beta/Size Neutralized Historical Performance
Russell 3000 Universe (January 2018 – December 2018)

Model	Average 1-Month Quintile Return Spread	Average 1-Month IC
Original QM	0.75%	0.040
Size/Beta Neutral QM	0.53%	0.030

3.4 Historical Comparison

Figure 16 illustrates the average 1-month quintile spread by calendar year. The average performance over the in-sample period (black bars) was 1.75% whereas the live performance average (2011 – 2018, grey bars) was 0.71%. The 2018 performance of 0.75% was consistent with the live period performance.

Figure 16 – Quality Model: Historical Year Average Monthly Quintile Return Spread
Russell 3000 Universe (January 1987 – December 2018)
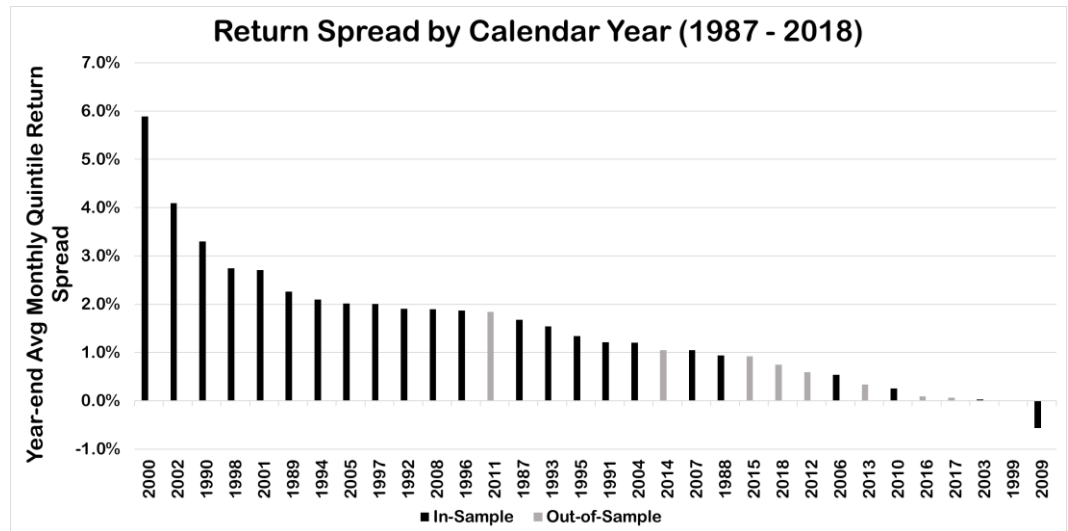
Source for Table 12 and Figure 16: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

4. Price Momentum Model

The Price Momentum Model ("PMM") was constructed to capture relative strength in stocks based on trailing price momentum and trading volume data. The model is made up of Short-Term and Long-Term components: the short-term component uses a lookback window of 1 to 3 months, while the longer-term component is based on a window of 3 to 12 months. We detail the summary performance statistics for the PMM in Table 13.

Table 13 – Summary Historical Performance Statistics for Price Momentum Model
Russell 3000 (January 1987 – December 2018)

	Q1	Q2	Q3	Q4	Q5	Long-Short Quintile Return Spread
Average Monthly Absolute Return[10]	1.44%***	1.09%***	0.76%***	0.27%	-0.42%	1.86%***
Annualized Absolute Return	18.68%	13.89%	9.45%	3.32%	-4.96%	24.77%
Annualized Information Ratio[11]	1.00	0.55	-0.90	-2.39	-2.42	0.44

Information Coefficient Summary	
Average 1-Month IC	0.065***
1-Month IC Information Ratio	0.73
1-Month IC Hit Rate[12]	80%***

*** 1% significance; **5% significance; *10% significance

4.1 Model Performance in 2018

The PMM produced an average 1-month equal-weighted return spread and 1-month IC of 0.70% and 0.029, respectively in 2018 (Figure 17). As in years past, the model performance over the year was variable with seven months of positive return spread out of twelve. The IC scores were positive eight of twelve months. PMM also underperformed during the first half of 2018 posting an average spread of -0.40% heading into July, which was the lowest among the four models. PMM performed very well in the latter half of the year, posting a July-December average of 1.79% - the highest among the models.

Figure 17 - Price Momentum Model: Historical 1-Month Equal Weighted Quintile Return Spread and Information Coefficient - Russell 3000 (January 2018 – December 2018)
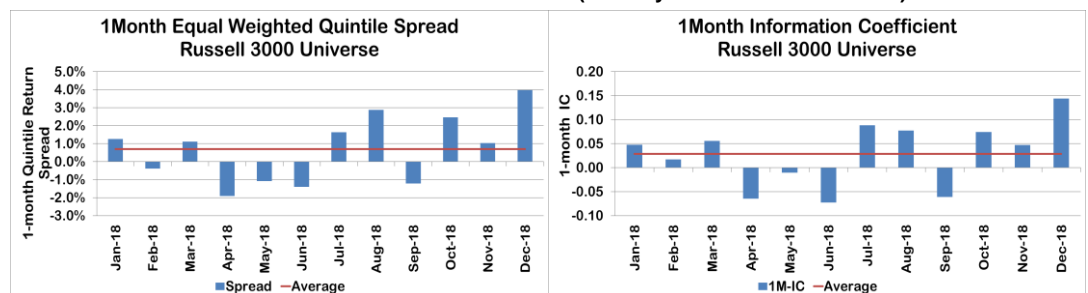
Source for Table 13 and Figure 17: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

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[10] Average Monthly Returns are absolute returns based on a monthly rebalance portfolio.
[11] Information Ratio calculated on monthly excess returns relative to equal-weighted benchmark.
[12] IC Hit Rate is defined as the percentage of months where the IC is positive.

Table 14 - Summary Historical Performance Statistics for Price Momentum Model Subcomponents Russell 3000 (January 2018 – December 2018)

| Component	Average 1-Month Quintile Return Spread	Average 1-Month IC
Short-Term Component	0.85%	0.028
Long-Term Component	0.41%	0.021

Figure 18 - Price Momentum Model Subcomponents: Historical 1-Month Equal Weighted Quintile Return Spread - Russell 3000 (January 2018 – December 2018)
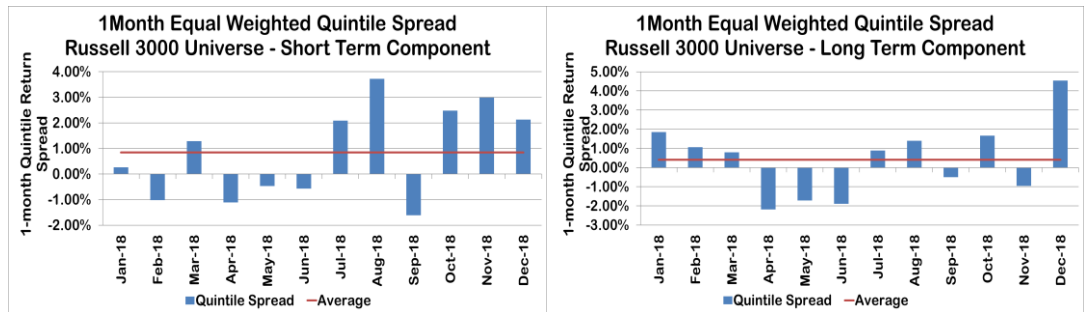
4.2 Sector Performance in 2018

The PM had the most robust performance across sectors, of the four models. Positive spreads and IC scores were recorded in 9 of 11 sectors. Financials and consumer discretionary generated negative spreads and Financials and Utilities generated negative IC scores. Healthcare returned more than 2.0% on average per month.

Figure 19 - Price Momentum Model Sector: 1-Month Equal Weighted Historical Quintile Spread and Information Coefficient - Russell 3000 Universe (January 2018 – December 2018)
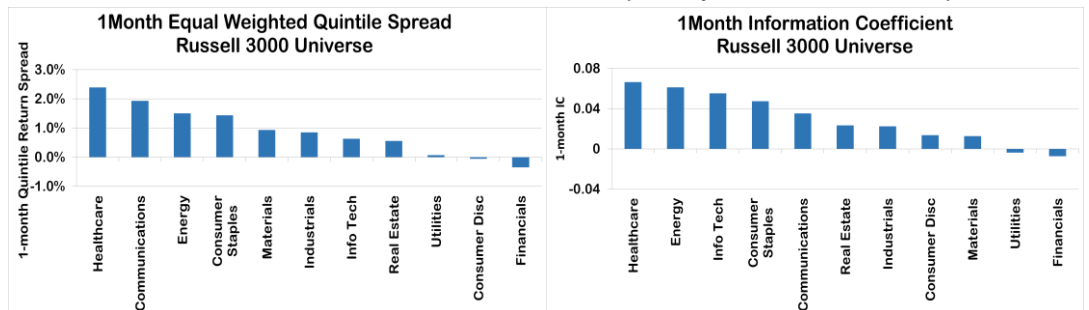
Source for Table 14 and Figure 18 and 19: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

4.3 Quintile Portfolio Characteristics and Portfolio Tilt Neutralization

Tables 15 and 16 identify market capitalization and CAPM beta characteristics of the long (Q1) and short (Q5) portfolios. The PMM had a large company biased in 2018, with a $3.2B market capitalization for Q1 and $1.1B for Q5. The difference in CAPM beta was likely

insignificant. The model performance on a size and CAPM beta adjusted basis was about half of the absolute return.

Table 15 - Price Momentum Model: Median Market Cap and 60-Month CAPM Beta Quintile 1 – Quintile 5
Russell 3000 Universe (January 2018 – December 2018)

Median Measure	Quintile 1	Quintile 5
Market Cap ($ Million)	3,206	1,072
60M CAPM Beta	0.99	1.07

Table 16 - Price Momentum Model: Original and Beta/Size Neutralized Historical Performance
Russell 3000 Universe (January 2018 – December 2018)

Model	Average 1-Month Quintile Return Spread	Average 1-Month IC
Original PMM	0.70%	0.029
Beta/Size Neutral PMM	0.39%	0.020

4.4 Historical Comparison

The PMM model produced 2.22% average monthly return in-sample (1987 – 2010, black bars) and 0.80% in live performance (2011 – 2018, grey bars). The 2018 performance of 0.70% was slightly below, but inline, with the live performance average.

Figure 20 - Price Momentum Model: Historical Year Average Monthly Quintile Return Spread
Russell 3000 Universe (January 1987 – December 2018)
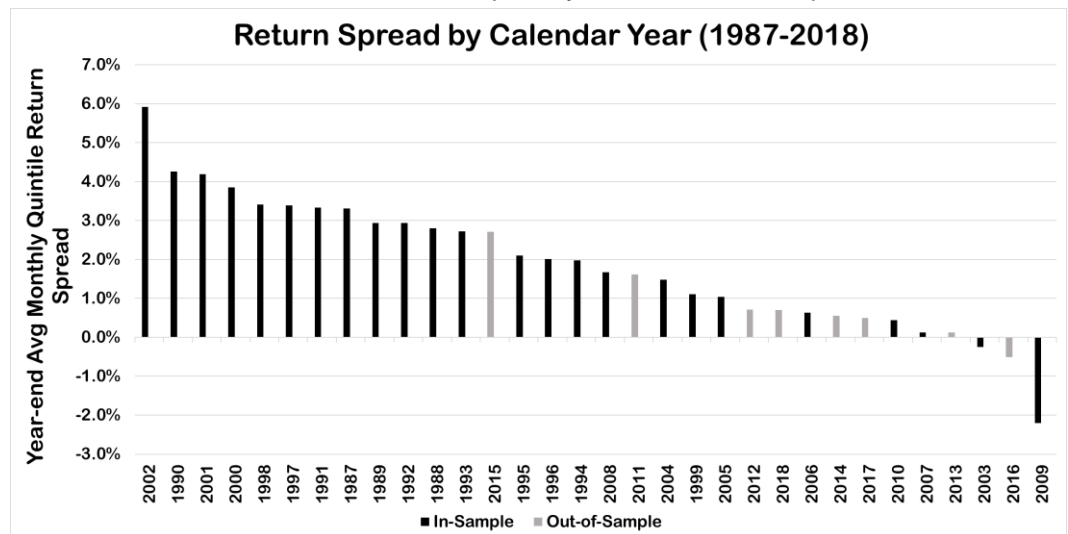
Source for Table 15 and 16 and Figure 20: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

5. Model Stability

We measure model stability in 2018 using the autocorrelation of monthly ranks, shown in Table 17. The correlations were in line with back-test values. The relatively high autocorrelation for the GBM, VBM, and QM suggest that there was limited turnover in the quantile portfolios formed based on these models. This is a favorable characteristic as it indicates reduced portfolio turnover and trading costs.

Table 17- Model 1-Month Rank Autocorrelation
Russell 3000 Growth / Russell 3000 Value / Russell 3000 (January 2018 – December 2018)

Model	1-month Rank Autocorrelation
Growth Benchmark Model	0.91
Value Benchmark Model	0.92
Quality Model	0.90
Price Momentum Model	0.61

Source: S&P Global Market Intelligence Quantamental Research. All returns and indices are unmanaged, statistical composites and their returns do not include payment of any sales charges or fees an investor would pay to purchase the securities they represent. Such costs would lower performance. It is not possible to invest directly in an index. Past performance is not a guarantee of future results. Data as of 12/31/2018.

6. Conclusions

The prior year, 2018, marked the return of uncertainty. Despite volatility and an overall pullback in equity prices, factor models performed consistently well over the year. Our stock selection models performed particularly well in the Healthcare sector in 2018. The returns within each selection model over the benchmark universes, and in the Healthcare sector specifically, were impressive compared to the performance of the benchmark universes.

Appendix A

Definitions of Strategy Style Composites

Style Composites	Description
Analyst Expectations	A combination of analyst forecast based factors that reflect the sentiment among the analysts.
Capital Efficiency	A combination of factors that measure a firm's ability to deliver excess returns over its cost of capital.
Earnings Quality	A combination of factors that measure the persistence and stability of a firm's earnings.
Historical Growth	A combination of growth in a firm's earnings, cash flows and turnover.
Price Momentum	A combination of short- and long-term stock price movements.
Size	A combination of market capitalization and sales of a firm.
Valuation	A combination of six valuation metrics to assess the relative attractiveness of a firm based on its fundamentals.
Volatility	A combination of stock return dispersions and beta.

Appendix B

The Global Industry Classification Standard (GICS®) was jointly developed by Standard & Poor's and MSCI Barra to meet the global financial community's need for one complete, consistent set of global sector and industry definitions. The GICS methodology has helped pave the way for sector-based investing by providing transparency and efficiency to the investment process. With GICS, sell-side research and reporting can be organized around industry data without geographic limitations.

The GICS methodology has been commonly accepted as an industry analysis framework for investment research, portfolio management and asset allocation. The GICS classification system currently consists of 11 sectors, 24 industry groups, 68 industries and 157 sub-industries. The GICS sectors are:

• Consumer Discretionary
• Consumer Staples
• Energy
• Financials
• Health Care
• Industrials
• Information Technology
• Materials
• Telecommunication Services
• Utilities
• Real Estate

Our Recent Research

February 2019: <u>International Small Cap Investing: Unlocking Alpha Opportunities in an Underutilized Asset Class</u>

Institutional investors typically overlook or underweight small cap equities in global mandates for a number of reasons, including a higher risk level (relative to large caps), a lack of operational history, liquidity, and information/data gaps which make it challenging to make informed investment decisions. However, investors who are willing to embrace the risk in small cap investing also stand to reap the benefits of allocating to this asset class – potentially earning higher risk-adjusted performance and portfolio diversification. In this report, we examine international small cap performance across various themes and provide actionable insights for both fundamental and quantitative investors, by identifying key drivers of small cap stock performance.

January 2019: <u>Value and Momentum: Everywhere, But Not All the Time</u>

"Momentum" and "Value" strategies have had well-documented return premia in multiple geographies and asset classes. Average monthly returns to momentum are larger than average returns to value, caveated by large pullbacks ("crashes") in the momentum portfolio. Practitioners often include both approaches in their investment strategy.

- Dynamically weighting value and momentum strategies by a function of the trailing volatility in the momentum portfolio produces a superior information ratio (IR), total return, and lower maximum drawdown compared to a naïve equal weighting.

- Results are consistent in six regions (U.S., Europe, Asia Ex-Japan, Japan, Latin America, and Emerging Markets) and in multiple robustness checks. We maintain dollar neutrality and persistent leverage of 1.0 in all specifications.

- Monte Carlo simulation supports the conclusion that the shift of tail density from left- to right-tail drives the performance improvements. That is, large drawdowns are avoided.

November 2018: <u>Forging Stronger Links: Using Supply Chain Data in the Investing Process</u>

- Lower latency, higher frequency and finer granularity vs. financial data: Insights into corporate activity can be enhanced with Panjiva's Supply chain data which can be updated as often as on a daily basis - well ahead of, and at a higher frequency than - financial reports at a high level of product granularity. Examples include the underperformance vs. consensus earnings by UPS and LG Electronics in Q3 2018 as well as the near-term impact of solar panel duties.

- Detection of anomalous activity: Spikes in imports can indicate inventory build, new products introductions, attempts to boost market share or even capital markets events. Honda's accelerated imports ahead of new tariffs, Sony's launch of the "PlayStation Classic", Target's aim to replace Toys'R'Us and PepsiCo's bid for Sodastream are all examples of this use case.

- Risk event impact assessment: Panjiva's supply chain graph includes geographical references for corporate entities, allowing the rapid assessment of the impact of natural disasters and geopolitical actions such as border closures.

September 2018: <u>Their Sentiments Exactly: Sentiment Signal Diversity Creates Alpha Opportunity</u>

- Companies where management is both positive/optimistic and fact-focused outperform historically.
- Hedge fund sentiment confirms and complements management sentiment.
- Market sentiment surrounding earnings calls amplifies the effectiveness of earnings transcript-based signals.

Analyst sentiment, as reflected in target price/recommendation changes, adds an important voice to ownership-based signals.

September 2018: <u>Natural Language Processing – Part II: Stock Selection: Alpha Unscripted: The Message within the Message in Earnings Calls</u>
Highlights include:

- Sentiment-based signals: Firms whose executives and analysts exhibited the highest positivity in sentiment during earnings calls outperformed their counterparts. Firms with the largest year-over-year positive sentiment change and firms with the strongest positive sentiment trend outperformed their respective counterparts.
- Behavioral-based signals: Firms whose executives provided the most transparency by using the simplest language and by presenting results with numbers outperformed their respective counterparts.
- Sentiment- and behavioral-based signals are not subsumed by commonly used alpha and risk signals.
- Positive language from the unscripted responses by the executives during the Q&A drove the overall predictability of the positive sentiment signal.
- The sentiment of CEOs has historically been more important than the sentiment of other executives.
- The aggregate sentiment of analysts historically enhanced the predictability of the 3-month FY1 EPS analyst revision signal.

July 2018: <u>A Case of 'Wag the Dog'? - ETFs and Stock-Level Liquidity</u>
Highlights include:

- We present an ETF price impact model, which posits single-day impact of up to 370 bps / day on an individual security and up to 250 bps / day on the index itself. Analyses indicate the effect is transitory and reverses over a period of 3-5 trading days.
- The Feb 2018 market correction was accompanied by a $25B outflow of assets from ticker SPY, the SSGA S&P 500 Trust ETF. Modeling suggests that as much as one-third of the

pullback was due to price pressure from ETF trading and that securities more sensitive to ETF flow underperformed.

- Sensitivity to ETF flow is used to build a risk model, which generates improved performance in a historical optimization. We offer a method for estimating ETF sensitivity for funds, using the S&P Global Ownership dataset.

June 2018: <u>The (Gross Profitability) Trend is Your Friend</u>

Trend strategies based on changes in stock price or earnings are widely used by investors. In this report, we examine the performance of a trend strategy derived from gross profitability ("GP"). Gross profitability trend ("GPtrend"), was proposed by Akbas et al. who argued that the trajectory of a firm's profitability is just as important as the level (GP). We define GPtrend as the year-on-year difference in either quarterly or trailing twelve month GP, where GP is calculated as revenue minus cost of goods sold, divided by total assets. Our back-tests confirm that GPtrend has historically been an effective stock selection signal globally, with the added benefit of low to moderate correlation with commonly used investment strategies.

May 2018: <u>Buying the Dip: Did Your Portfolio Holding Go on Sale?</u>

'Buy the Dip' ("BTD"), the concept of buying shares after a steep decline in stock price or market index, is both a Wall Street maxim, and a widely used investment strategy. Investors pursuing a BTD strategy are essentially buying shares at a "discounted" price, with the opportunity to reap a large pay-off if the price drop is temporary and the stock subsequently rebounds. BTD strategies are especially popular during bull markets, when a market rally can be punctuated by multiple pullbacks in equity prices as stock prices march upwards.

March 2018: <u>In The Money: What Really Motivates Executive Performance?</u>

CEO compensation has soared over the past four decades, aided by consultants, compensation committees, the CEOs themselves, and an extended bull market (1982- 1999). "Pay for performance" has become dogma and large equity grants de rigueur. But there is a cost to such largesse. Figure 1 shows that realized pay1 for a company's top five executives can approach 6%-11% of earnings before interest and taxes (EBIT), on the index level, for small and mid-cap firms. What types of compensation motivate top executives to boost shareholder returns? And what are the fundamental characteristics of companies in which executives are motivated to boost stock performance?

February 2018: <u>The Art of (no) Deal: Identifying the Drivers of Cancelled M&A Deals</u>

Terminated deals impact capital market participants in various ways. Predicting deals that are likely to be canceled is of interest to both M&A advisers and equity investors. This report identifies several drivers of cancelled deals, including size, deal proportionality, perceived price discount, CEO age, and regulatory risk, and concludes with a model built from four of these drivers.

January 2018: <u>U.S Stock Selection Model Performance Review</u>

September 2017: <u>Natural Language Processing - Part I: Primer</u>

July 2017: <u>Natural Language Processing Literature Survey</u>

June 2017: <u>Research Brief: Four Important Things to Know About Banks in a Rising Rate Environment</u>

April 2017: <u>Banking on Alpha: Uncovering Investing Signals Using SNL Bank Data</u>

March 2017: <u>Capital Market Implications of Spinoffs</u>

January 2017: <u>U.S. Stock Selection Model Performance Review 2016</u>

November 2016: <u>Electrify Stock Returns in U.S. Utilities</u>
October 2016: <u>**A League of their Own: Batting for Returns in the REIT Industry - Part 2**</u>

September 2016: <u>**A League of their Own: Batting for Returns in the REIT Industry - Part 1**</u>

August 2016: <u>Mergers & Acquisitions: The Good, the Bad and the Ugly (and how to tell them apart)</u>

July 2016: <u>Preparing for a Slide in Oil Prices -- History May Be Your Guide</u>

June 2016: <u>Social Media and Stock Returns: Is There Value in Cyberspace?</u>

April 2016: <u>An IQ Test for the "Smart Money" – Is the Reputation of Institutional Investors Warranted?</u>

March 2016: <u>Stock-Level Liquidity – Alpha or Risk? - Stocks with Rising Liquidity Outperform Globally</u>

February 2016: <u>U.S. Stock Selection Model Performance Review - The most effective investment strategies in 2015</u>

January 2016: <u>What Does Earnings Guidance Tell Us? – Listen When Management Announces Good News</u>

December 2015: <u>Equity Market Pulse – Quarterly Equity Market Insights Issue 6</u>

November 2015: <u>Late to File - The Costs of Delayed 10-Q and 10-K Company Filings</u>

October 2015: <u>Global Country Allocation Strategies</u>

September 2015: <u>Equity Market Pulse – Quarterly Equity Market Insights Issue 5</u>

September 2015: <u>Research Brief: Building Smart Beta Portfolios</u>

September 2015: <u>Research Brief – Airline Industry Factors</u>

August 2015: <u>Point-In-Time vs. Lagged Fundamentals – This time i(t')s different?</u>

August 2015: <u>Introducing S&P Capital IQ Stock Selection Model for the Japanese Market</u>

July 2015: <u>Research Brief – Liquidity Fragility</u>
June 2015: <u>Equity Market Pulse – Quarterly Equity Market Insights Issue 4</u>

May 2015: <u>Investing in a World with Increasing Investor Activism</u>

April 2015: <u>Drilling for Alpha in the Oil and Gas Industry – Insights from Industry Specific Data & Company Financials</u>

March 2015: <u>Equity Market Pulse – Quarterly Equity Market Insights Issue 3</u>

February 2015: <u>U.S. Stock Selection Model Performance Review - The most effective investment strategies in 2014</u>

January 2015: <u>Research Brief: Global Pension Plans - Are Fully Funded Plans a Relic of the Past?</u>

January 2015: <u>Profitability: Growth-Like Strategy, Value-Like Returns - Profiting from Companies with Large Economic Moats</u>
November 2014: <u>Equity Market Pulse – Quarterly Equity Market Insights Issue 2</u>

October 2014: <u>Lenders Lead, Owners Follow - The Relationship between Credit Indicators and Equity Returns</u>

August 2014: <u>Equity Market Pulse – Quarterly Equity Market Insights Issue 1</u>

July 2014: <u>Factor Insight: Reducing the Downside of a Trend Following Strategy</u>

May 2014: <u>Introducing S&P Capital IQ's Fundamental China A-Share Equity Risk Model</u>

April 2014: <u>Riding the Coattails of Activist Investors Yields Short and Long Term Outperformance</u>

March 2014: <u>Insights from Academic Literature: Corporate Character, Trading Insights, & New Data Sources</u>

February 2014: <u>Obtaining an Edge in Emerging Markets</u>

February 2014: <u>U.S. Stock Selection Model Performance Review</u>

January 2014: <u>Buying Outperformance: Do share repurchase announcements lead to higher returns?</u>
October 2013: <u>Informative Insider Trading - The Hidden Profits in Corporate Insider Filings</u>

September 2013: <u>Beggar Thy Neighbor – Research Brief: Exploring Pension Plans</u>

August 2013: <u>Introducing S&P Capital IQ Global Stock Selection Models for Developed Markets: The Foundations of Outperformance</u>
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June 2013: <u>Supply Chain Interactions Part 2: Companies – Connected Company Returns Examined as Event Signals</u>

June 2013: <u>Behind the Asset Growth Anomaly – Over-promising but Under-delivering</u>

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March 2013: <u>Risk Models That Work When You Need Them - Short Term Risk Model Enhancements</u>

March 2013: <u>Follow the Smart Money - Riding the Coattails of Activist Investors</u>

February 2013: <u>Stock Selection Model Performance Review: Assessing the Drivers of Performance in 2012</u>

January 2013: <u>Research Brief: Exploiting the January Effect Examining Variations in Trend Following Strategies</u>

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November 2012: <u>11 Industries, 70 Alpha Signals -The Value of Industry-Specific Metrics</u>

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September 2012: <u>Factor Insight: Earnings Announcement Return – Is A Return Based Surprise Superior to an Earnings Based Surprise?</u>

August 2012: <u>Supply Chain Interactions Part 1: Industries Profiting from Lead-Lag Industry Relationships</u>

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June 2012: <u>Riding Industry Momentum – Enhancing the Residual Reversal Factor</u>

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May 2012: <u>Case Study: S&P Capital IQ – The Platform for Investment Decisions</u>

March 2012: <u>Exploring Alpha from the Securities Lending Market – New Alpha Stemming from Improved Data</u>

January 2012: <u>S&P Capital IQ Stock Selection Model Review – Understanding the Drivers of Performance in 2011</u>

January 2012: <u>Intelligent Estimates – A Superior Model of Earnings Surprise</u>

December 2011: <u>Factor Insight – Residual Reversal</u>

November 2011: <u>Research Brief: Return Correlation and Dispersion – All or Nothing</u>

October 2011: <u>The Banking Industry</u>

September 2011: <u>Methods in Dynamic Weighting</u>

September 2011: <u>Research Brief: Return Correlation and Dispersion</u>

July 2011: <u>Research Brief - A Topical Digest of Investment Strategy Insights</u>

June 2011: <u>A Retail Industry Strategy: Does Industry Specific Data tell a different story?</u>

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April 2011: <u>Can Dividend Policy Changes Yield Alpha?</u>

April 2011: <u>CQA Spring 2011 Conference Notes</u>

March 2011: <u>How Much Alpha is in Preliminary Data?</u>
February 2011: <u>Industry Insights – Biotechnology: FDA Approval Catalyst Strategy</u>
January 2011: <u>US Stock Selection Models Introduction</u>

January 2011: <u>Variations on Minimum Variance</u>

January 2011: <u>Interesting and Influential Papers We Read in 2010</u>

November 2010: <u>Is your Bank Under Stress? Introducing our Dynamic Bank Model</u>

October 2010: <u>Getting the Most from Point-in-Time Data</u>

October 2010: <u>Another Brick in the Wall: The Historic Failure of Price Momentum</u>

July 2010: <u>Introducing S&P Capital IQ's Fundamental US Equity Risk Model</u>