Technology Model

This Investment Recipe introduces Markit's Technology Model. This model takes a multi-dimensional approach by combining several industry-specific models with a cross-sectional overlay and has achieved impressive long-only and long/short returns over the test period.

INTRODUCTION

The technology sector contains a set of dynamic and challenging investment opportunities. While these stocks are often coupled with business cyclicality and volatility, many investors accept this risk given the potential for revenue growth and cash generation. Technology companies are characterized by rapid product evolution and innovation meant to satisfy new market demands and product channels. It is imperative that they have the ability to successfully

Chart 1

manage growth and allocate capital resources to efficiently expand their product offerings. Examples of new industries within this sector are solar (similar business model as the semiconductor sector, but different demand drivers) and software-as-a-service (software solutions with a subscription-like revenue recognition model). Evolution is prevalent even in mature technology firms. IBM (NYSE: IBM) is one of the oldest computer hardware and software companies in the world; however, a majority of its revenues and profits are now generated from its services business. Another example is Oracle (NYSE: ORCL), a large enterprise software company; it acquired Sun Microsystems, a large server vendor. The key to successful investing in this sector is to understand the general drivers by business type, and use those to construct a dynamic evaluation process.

The greatest modeling difficulties within the technology sector arise due to the significant variability across company business models. Within the Markit Technology Model (QTA2), four industry groups were chosen as the optimal way to delineate amongst the varied firms. Although several additional methods were tested, we found that any benefits achieved through a more granular approach were quickly overwhelmed by increased in model complexity and the presence of spurious results from small sub-universe sizes. The Reuters Business Sector Scheme (RBSS) industry group are codes shown in Chart 1 and were used as the basis for construction of the four distinct technology groups represented in QTA2. Chart 2 presents the return characteristics of the four RBSS technology industry groups over the Russell 3000 on an equal weighted basis versus the broad technology universe.

The divergent return characteristics of these groups is readily apparent, and shows that
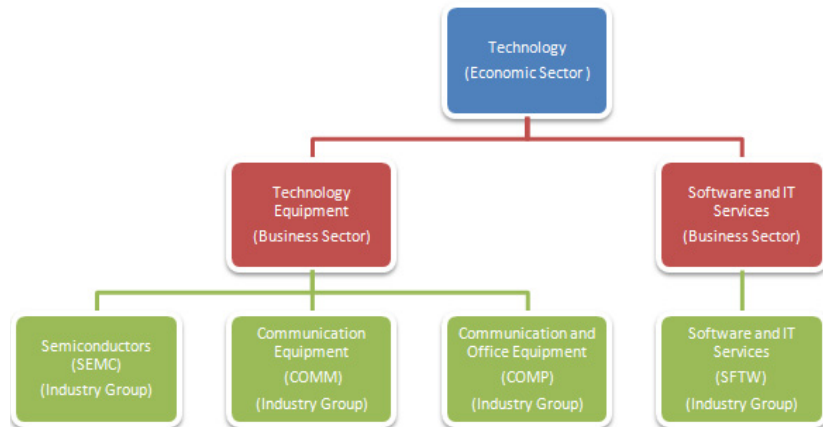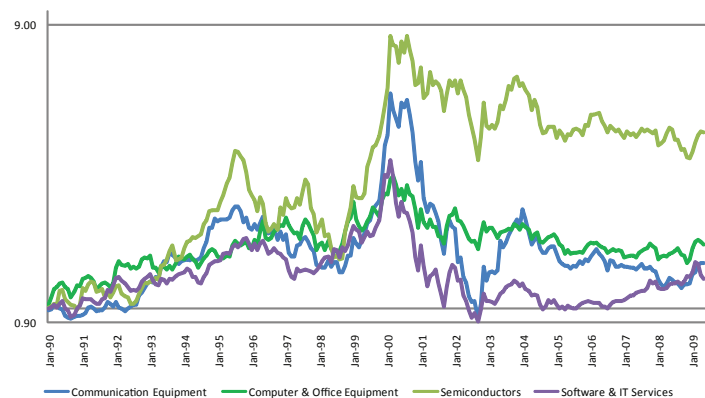

Chart 2

insights captured at the industry group level can have a dramatic effect on overall performance. In order to capitalize on these observations, our QTA2 first includes four unique industry group specific models designed to reflect key attributes within each universe. These industry-specific models are then combined with a cross-sectional overlay built to highlight general trends within the overall sector. While many of the factors used in the model are taken from the Markit factor library, a few industry-specific signals were constructed to reflect the unique nature of the relevant industry group. The intuition and construction of each industry model is outlined below. The test period for this analysis ranges from January 1990 to June 2010. Note that while the Russell 3000 technology sector is used as the test universe for the overall composite, industry-specific model results are presented over the applicable industry group.

SOFTWARE, INTERNET, AND SERVICES GROUP (SFTW)

The Software, Internet, and Services model consists of thirteen factors with a primary focus on valuation, growth and quality. This industry group places significant emphasis on employees and intellectual property as the main business drivers. This reliance on human capital is consistent with the selection of Net Income per Employee as a factor for this group. Additionally, companies within this industry group tend to be less variable in their business results. Many information technology services companies, along with an increasing number of software companies, derive revenue from longer-term contracts, which can lead to more predictable results in the near term. This near-term predictability drives the success of the First Call FY2 EPS Earnings Dispersion factor, which looks for uncertainty in next year estimates, as the current year's results are relatively predictable. Two historical growth factors are included, as these companies tend to expand faster than those companies within the other three groups. The average age of these firms is generally 23-28% less than that of companies in the other three groups.

The SFTW group also has historically had the highest accounts receivables to sales ratios; therefore, the Unexpected Change in Accounts Receivable factor was selected to monitor credit policies and ongoing cash collection ability. When investors see a sudden spike in accounts receivables, it can often be a sign of companies bringing future sales forward at the expense of future quarters.

Throughout the backtest period, the SFTW industry group model had an average 1-Month IC and long-short return spread of 0.06 and 1.41%, respectively. Table 1, Charts 3 and 4 highlight the IC and Return statistics over the Markit Software and Services Universe. It is noted that this industry demonstrates significantly lower return volatility in comparison to the other technology industry groups.

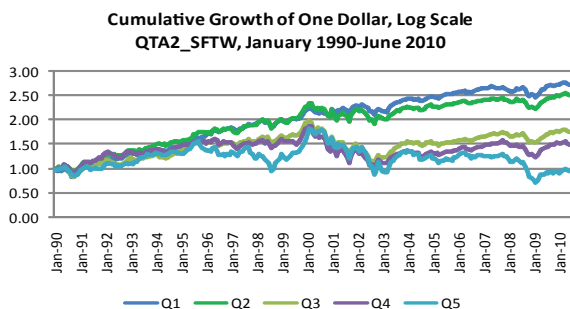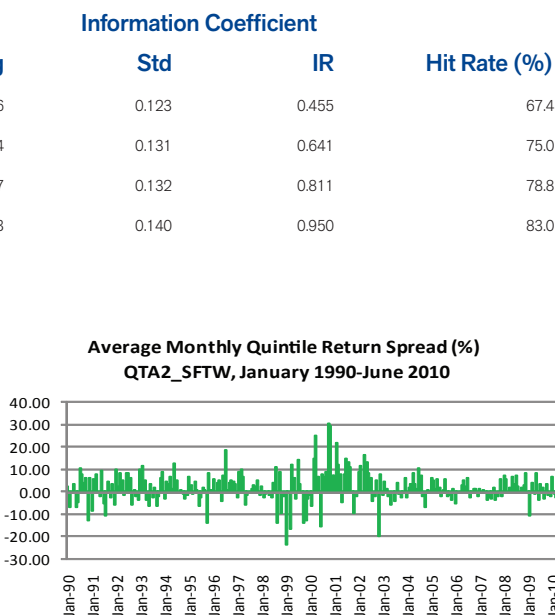| Holding Period	Coverage (%)	Information Coefficient			Hit Rate (%)
		Avg	Std	IR	
1 Month	97.6	0.056	0.123	0.455	67.4
3 Months	97.6	0.084	0.131	0.641	75.0
6 Months	97.6	0.107	0.132	0.811	78.8
12 Months	97.6	0.133	0.140	0.950	83.0

Table 1 - SFTW

Chart 3

Chart 4

SEMICONDUCTORS GROUP (SEMC)

The Semiconductor (SEMC) industry stands out due to its higher business cyclicality and capital intensity. This industry group model consists of thirteen factors with a weighting scheme more tilted towards management quality and valuation indicators. SEMC stocks are defined by high fixed asset and capital intensity, and investors typically seek evidence of working capital efficiency. Working Capital to Sales, 1-yr Chg in Acct Receivable as % of Sales, and Percent Chg in Quarterly Sales vs. Percent Chg in Quarterly Inventory are included to capture those companies with less working capital intensity. The Working Capital to Sales factor rewards companies with lower capital intensity, while 1-yr Chg in Acct Receivable as % of Sales assigns the best (lowest) rank to companies where the factor value is negative, suggesting that the company is collecting on sales more efficiently than the prior year. Additionally, the Percent Chg in Quarterly Sales vs. Percent Chg in Quarterly Inventory is a new factor developed to assess sales growth relative to inventory. When a semiconductor company grows sales sequentially at a rate greater than inventory growth, stocks often react favorably. If inventory levels grow at a higher rate than sales, investors worry about inventory overbuild, which can result in order cancellations, elevated price competition, or even future writedowns.. It is important to note that these signals demonstrated relatively low correlations throughout the backtest period.

Net Asset Value (NAV) is defined as the total book value of a company's securities. It is calculated as the total assets of a company less the value of intangible assets (goodwill, patents, etc.) and current and long-term liabilities. NAV is helpful in determining underpriced equities by indicating the ultimate value of a company's securities in the event of their liquidation. Net Asset Value to Price works well for Semiconductors as the high fixed asset content of the group lends itself to a valuation metric that is asset-based. The history of consolidation within the space also drives the need to exclude intangible assets from valuation metrics.

The volatile business activity of the SEMC group results in the unpredictability of business results. This can be seen through the high levels of analyst EPS estimate dispersion relative to the other three industry groups. Standardized Unexpected Cash Flow represents a factor designed to take advantage of this volatility. When an unexpected positive spike in cash flow occurs, it can often indicate an upward turn in a cycle. The spike in cash flow is a financial measure of a cyclical turn, so this factor has powerful implications for stock price movements.

Lastly, a management quality factor included in this group is the Cash Burn Rate. The combination of industry cyclicality and high capital intensity creates the likelihood that semiconductor companies will burn cash in a downturn. The companies with lower burn rates will generate more cash flow over the long run, resulting in higher valuations.

Despite industry cyclicality, the SEMC composite module has demonstrated consistent return and IC performance. Cumulative return distributions were generally monotonic, as the emphasis on valuation and management quality indicators helped control

Holding Period	Coverage (%)	Information Coefficient			Hit Rate (%)
		Avg	Std	IR	
1 Month	99.3	0.045	0.120	0.375	63.7
3 Months	99.3	0.065	0.131	0.496	68.4
6 Months	99.3	0.084	0.142	0.592	75.5
12 Months	99.3	0.083	0.149	0.557	73.6

Table 2 - SEMC

Cumulative Growth of One Dollar, Log Scale
QTA2_SEMC, January 1990-June 2010

Chart 5

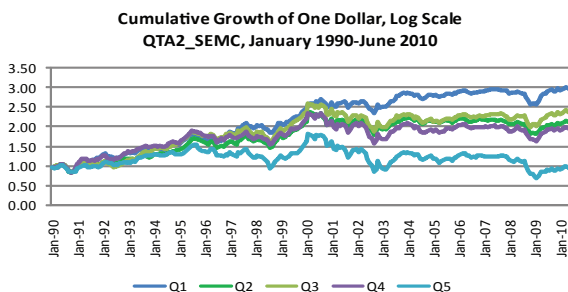Average Monthly Quintile Return Spread (%)
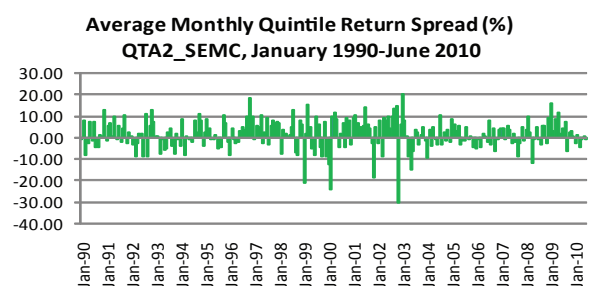QTA2_SEMC, January 1990-June 2010

Chart 6

for performance volatility. Throughout the backtest period, the model exhibited average one-month IC and Return Spread of 0.05 and 1.59%. Test performance through June 2010 is outlined in Table 2, Charts 5 and 6 (see Page 3).

COMPUTERS AND OFFICE EQUIPMENT GROUP (COMP)

In terms of products and business lines, Computers and Office Equipment (COMP) is the most diverse of the four industry groups. Fourteen factors make up this industry-specific model, with 75% of the score concentrated in the valuation and quality areas. It also tends to have the most direct exposure to changes in consumer spending. This group falls in the middle in terms of capital intensity.

Cash Cycle refers to the length of time between the purchase of raw materials and the collection of accounts receivable generated in the sale of the final product that is produced from those raw materials. An increasing cash cycle might indicate a decline in operating efficiency or financial health. This factor works best for the computers and office equipment area due to the fact that this group has a higher percentage of sales to consumers than the other three, which sell mostly to commercial customers. Therefore, these companies have a greater opportunity to differentiate their cash cycles compared to companies because of the ability to exert stricter payables terms on consumer customers.

Similar to the semiconductor industry, Working Capital-to-Trailing 12-Month Sales is also an important key signal to company valuation. The hardware industry has lower average selling prices, thus higher unit sales compared to the software/services and communications equipment industries. Industries that, in aggregate, sell higher volumes of units at lower dollar amounts have an opportunity to differentiate themselves through better working capital management. Therefore, investors tend to focus more on working capital metrics.

Top line growth, as measured by Sales Surprise, also plays an integral role in this group. As mentioned above, the COMP industry is more directly impacted by changes in consumer spending, which tend to change more swiftly than changes in commercial or government spending. Thus, changes in consumer spending can rapidly alter near term top line results.

Just as FY2 EPS Estimates Dispersion works well for industries that have more near term visibility, FY1 EPS Estimates Dispersion works well for COMP firms, whose business results fluctuate more on a near term basis. Again, a likely cause of this fluctuation is its higher direct exposure to consumer spending.

Holding Period	Coverage (%)	Information Coefficient			Hit Rate (%)
		Avg	Std	IR	
1 Month	99.2	0.077	0.151	0.510	70.6
3 Months	99.2	0.112	0.164	0.683	74.2
6 Months	99.2	0.155	0.175	0.886	77.5
12 Months	99.2	0.186	0.167	1.114	87.4

Table 3 - COMP

Cumulative Growth of One Dollar, Log Scale
QTA2_COMP, January 1990-June 2010

Chart 7

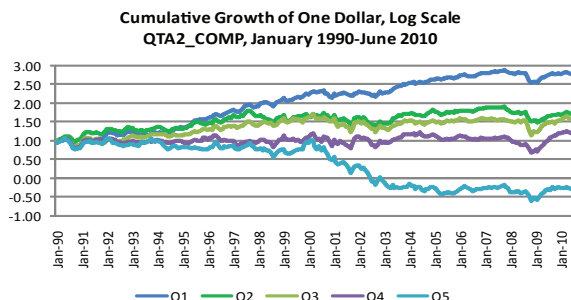**Average Monthly Quintile Return Spread (%)**
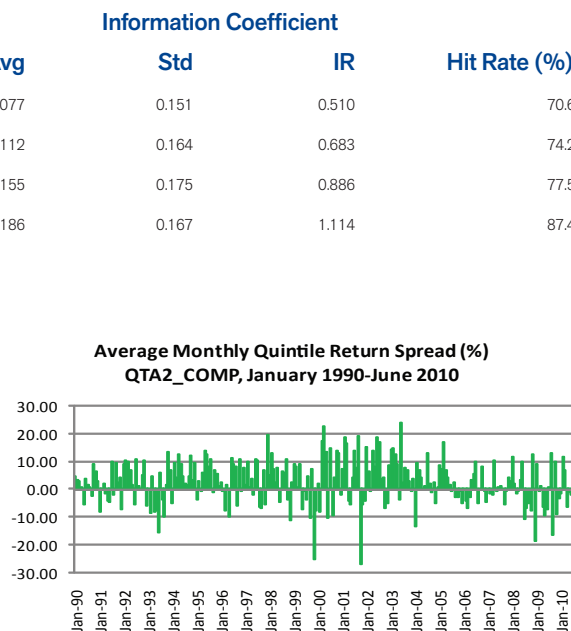**QTA2_COMP, January 1990-June 2010**

Chart 8

Test period performance for the COMP industry model (See Table 3, Charts 7 and 8 on Page 4) displayed the highest statistics on both an IC and return basis. The Valuation and Earnings Quality modules were key drivers of these results and also helped control for overall model volatility. It is noted that as the holding period increased, the model demonstrated higher information ratio performance statistics.

COMMUNICATIONS EQUIPMENT GROUP (COMM)

The Communications Equipment (COMM) contains more homogeneous firms with similar business drivers affecting sales. The industry's its customer base is more concentrated than the other three industries due to its high sales exposure to telecommunication services providers. With a tilt towards quality, valuation and growth, the communications equipment module contains fourteen factors across all style groups.

Telecommunication services companies are relatively small in number (versus other customer types) since their industry is regulated in most countries. Consequently, the capital spending budgets of these firms, which translate into sales for the COMM companies, are relatively stable over the near term horizon. Because of the relative spending stability exhibited by a meaningful portion of its customers, companies in this industry group tend to exhibit less variability in business results. This near term predictability is again what leads to the success of the First Call FY2 EPS Forecast Dispersion factor, which looks for uncertainty in the out year.

COMM has the highest R&D to Sales ratio of the four groups—defined as average research & development expenses in the trailing 12-months deflated by the sum of total sales in the same period. The industry also has relatively high asset levels and capital expenditures, exhibiting the lowest mean and median operating profit margins of the four groups. The Asset Turnover Ratio is a key component to this module as companies in low profit margin industries require high asset turnover to generate high returns on capital. A new factor, Percent Change in FQ1 Sales vs. Percent Chg in FQ1 Net Margin, also works well in this group as those companies that can exhibit higher sequential operating leverage are rewarded with superior stock performance.

This industry module demonstrates greater performance stability in comparison to the other four industry groups, as the factor emphasis on price multiple and asset levels were able to effectively distinguish top performing COMM companies in both the pre and post-bubble period. See Table 4, Charts 9 and 10 for details. This module demonstrated exceptional 12-month holding period IC statistics of 0.14 with an 81.7% 1-M IC hit rate.

| | | Information Coefficient | | | |
Holding Period	Coverage (%)	Avg	Std	IR	Hit Rate (%)
1 Month	98.5	0.049	0.163	0.301	61.2
3 Months	98.5	0.079	0.165	0.479	66.4
6 Months	98.4	0.101	0.156	0.647	72.6
12 Months	98.4	0.136	0.154	0.883	80.9

Table 4 COMM

Cumulative Growth of One Dollar, Log Scale
QTA2_COMM, January 1990-June 2010

Chart 9

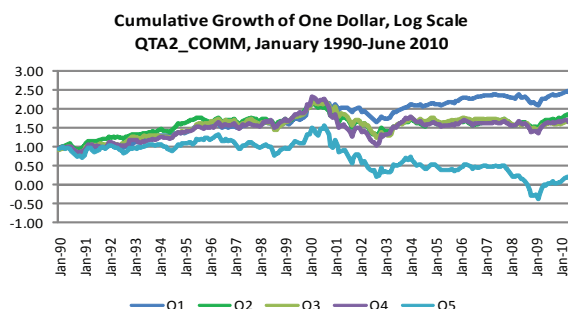Average Monthly Quintile Return Spread (%)
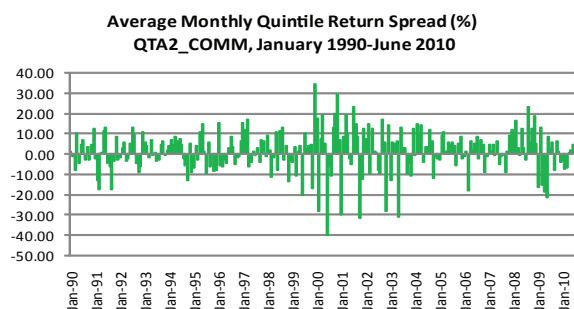QTA2_COMM, January 1990-June 2010

Chart 10

COMPOSITE MODEL CONSTRUCTION

The Industry-specific Composite is the union of the four industry models described above. Each industry has a unique cross-sectional and industry-specific weighting, and the overall QTA2 composite is then calculated by re-ranking the industry and cross-sectional weighted sum for all stocks. The most attractive securities are given a percentile rank of one, while the least attractive are given a score of 100. The cross-sectional module provides a combination detailed within the next section.

CROSS SECTIONAL FACTORS

Given that overall industry returns play a relevant role in technology sector results as groups move in an out of favor, ranking some factors on a cross-sectional basis allows our model to subtly tilt the overall results towards aggregate areas displaying positive characteristics. Essentially, by combining group specific information in the industry models with cross-sectional trends, we can strike an optimal balance between fundamentally driven and purely quantitative approaches.

Certain factors work well for one or two industry groups within the technology sector. Others, such as the ones listed here, demonstrate positive performance over all our industry groups. TTM Sales-to-Enterprise Value, 3-yr Growth in TTM Earnings per Share, and several Price Momentum factors are all included within the cross-sectional module.

The technology sector grows faster than most other sectors, often with significant volatility. Companies that exhibit more consistent, less unstable growth will typically fair better. A history of volatile sales growth reduces the predictability of future sales growth, creating volatility in stock prices. Because earnings can be manipulated, Sales Growth Rate Standard Deviation is included at the coss-sectional level,as it has proven to be a better measure of future success than earnings growth. Furthermore, as the ultimate enterprise value creation source, sales drive earnings and cash flows, so a measure of sales power should be considered. There is proof that for many high growth companies there is a stronger reaction to increases in sales than expense reduction (read EPS increase without sales increases).

Given the high relative growth rates, we also include TTM Sales-to-Enterprise Value. Here we scale sales by enterprise value. Enterprise value measures what it would actually cost to purchase the entire company considering the market value, amount of debt and the cash in the bank. This allows investors to determine the total capital employed to generate these sales. Alternatively, a relative high sales-to-enterprise value ratio might indicate the stock is cheap.

MODEL COMPOSITE DATA, PERFORMANCE AND RESULTS

It can be seen in Chart 12 (see Page 7) and Table 5 that the Markit Technology model composite demonstrated encouraging performance on both an IC and spread basis. The monotonic return distributions displayed in Chart 11 (see Page 7) confirm the model's ability to anticipate the unpredictable nature of the technology sector.

| Holding Period | Coverage (%) | Information Coefficient | | | | Long-Short Spread | | Quintile 1 Excess Return | |
		Avg	Std	IR	Hit Rate (%)	Avg (%)	Hit Rate (%)	Avg (%)	Hit Rate (%)
Markit Tech Model Composite	98.0	0.070	0.098	0.714	76.3	2.619	69.9	1.243	67.0
Cross-Sectional Composite	98.0	0.066	0.092	0.717	77.9	2.832	72.0	1.435	68.3
Industry-Specific Composite	98.0	0.055	0.091	0.604	72.7	1.700	66.7	0.703	60.6

Table 5

Cumulative Growth of One Dollar, Log Scale
QTA2, January 1990-June 2010

Chart 11

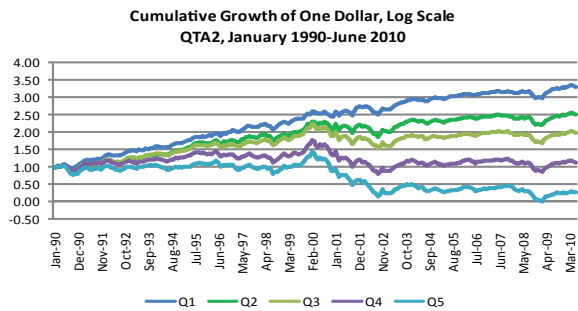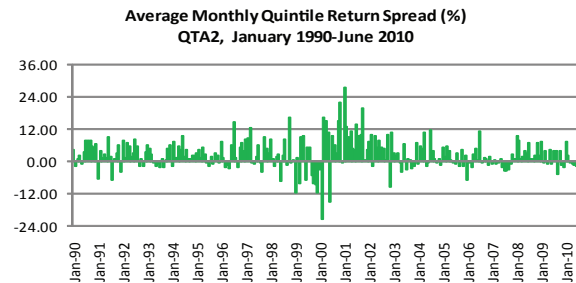Average Monthly Quintile Return Spread (%)
QTA2, January 1990-June 2010

Chart 12

MODEL EXPOSURES

In this section, we use the Exposures function from the Markit Advanced Research Platform to analyze the composition of the model over regions, sectors and Markit factors. The region/sector exposure represents a portfolio's percentage composition within regions/sectors, and is presented relative to the benchmark. Factor exposures evaluate how the specified portfolio is ranked according to another Markit factor. We compare three equal-weighted portfolios, the benchmark Markit Technology universe (model ranks 1 to 100), the Q1 portfolio (QTA2 ranks 1 to 20) and Q5 portfolio (QTA2 ranks 81 to 100). Recall that all ranks are in percentile form.

FACTOR STYLE EXPOSURES

To test factor exposures, we selected three additional signals from the Markit factor library: 60-Month Beta, Book-to-Market and Market Capitalization, which closely relate to the anomalies employed in the traditional Fama-French three-factor model. The 60-Month Beta and Market Capitalization are ranked in ascending order. Low beta and small cap stocks receive better (smaller) ranks. The Book-to-Market factor is ranked in descending order. Stocks with high book value of equity relative to their market capitalization will be ranked as more attractive (smaller).

Throughout the test period, the Markit Technology Model demonstrated a bias towards companies with high book values of equity and low betas. These tilts were more dramatic in the post-bubble timeframe.

Factor	Q1	Q5	Active
60-Month Beta	40.9	58.3	0.098
Book-to-Market	40.4	62.2	21.8
Market Capitalization	55.1	47.5	-7.6

Table 6

Conclusion

QTA2 addresses the complex dynamics of the technology sector through industry-level model construction designed to reflect key attributes within each group. These insights are combined with a cross-sectional overlay to highlight more general market trends. During our test period, we saw impressive average 1-month performance on a long only (Q1 excess) and long/short basis at 1.243% and 2.619%, respectively. Signal efficacy increased with holding period, and was accompanied by impressive

hit rates. Factor exposures demonstrated a bias towards high book values and low betas, especially during the post-bubble period to the present. Given the sound fundamental underpinnings of our factor selections, these results indeed suggest that an optimal balance has been struck between qualitative reasoning and quantitative modeling.

About Markit

Markit is a leading, global financial information services company with over 2,200+ employees.

The company provides independent data, valuations and trade processing across all asset classes in order to enhance transparency, reduce risk and improve operational efficiency.

Its client base includes the most significant institutional participants in the financial marketplace.

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