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Canada Quant

Technically Savvy Alpha

In this report we show that quant factors derived from technical indicators have significant predict power in forecasting future stock returns

In this report we show that quant factors derived from technical indicators have significant predict power in forecasting future stock returns. In particular, we find that quant factors derived from technical indicators have clearly outperformed conventional quantitative factors during the past three years, a period of unprecedented market volatility and uncertainty.

Technical indicators have strong predictive ability

We show how to transform high frequency technical indicators into a more useable form that can be utilized by low frequency investors. In addition, we combine technical factors into a composite factor that shows strong predictive power and is weakly correlated with existing quant factors. In addition, technical indicators improve performance significantly when added to a multifactor alpha model.

Please note that all our research is distributed from DBEQS.Americas@db.com. For all factors mentioned in our research reports, we also provide regular quant screens. Please contact us or your sales representative for details.

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A letter to our readers

Welcome to the fourth edition of *Canada Quant*

Conventional investment philosophy typically entails analyzing stocks based on a variety of fundamental attributes and factors. For example, an investor may analyze a company's price-to-earnings ratio, return on equity, current ratio, earnings quality etc. Upon completing a through analysis of the underlying company fundamentals, an investor may choose to take an entry or exit position in a security.

Conventional investment philosophy typically utilizes technical indicators for timing market entry and exit position. In this research we investigate whether technical indicators can be utilized as an underling alpha signal rather than as a market timing tool. We backtest approximately 120 technical indicators to determine if they contain any predictive ability.

Our findings show that technical indicators have significant predictive power in forecasting future stock returns. More importantly, we find that technical indicators have clearly outperformed conventional quantitative factors during the past three years, a period of unprecedented market volatility and uncertainty. In addition, we show how to combine technical-based factors into a composite factor that has a reasonably low correlation with existing quant factors. Furthermore, incorporating technical indicators within a multifactor model can significantly boost performance significantly.

For clients who are unfamiliar with our research, we highly recommend *The DB Quant Handbook*, July 23, 2010, which describes our research methodology in more detail

Please note that all our research is distributed from DBEQS.Americas@db.com. Recent factor performance can be found in Appendix I. You can also find a list of our recent publications in Appendix II.

Regards,

Yin, Rocky, Miguel, Javed, and John
Deutsche Bank North American Quantitative Equity Strategy Team

Groundwork for technical analysis

Impetus for examining technical indicators

The typical reaction by quants when asked to test new types of factors is, "How are these new factors different from conventional quantitative factors?" Our mantra is that technical indicators are very different from traditional quantitative factors because:

1. **Different Perspective:** Technical indicators offer a different perspective when analyzing companies. They do not incorporate underlying company fundamental information. Technical indicators are based predominantly on pricing information and therefore they can provide a unique interpretation on the strength, tendency, and direction of price reaction and movements. In addition to pricing information, technical indicators also contain volume information, which can better attune investors to market reactions.

2. **Timely and Responsive:** Technical indicators are more timely and responsive to current market and company specific conditions. Companies typically report earnings information on a quarterly or semi-annual basis. However, technical indicators can be calculated on daily or intra-day basis, enabling investors to better gauge market reaction and behavior.

3. **Objective and Neutral:** Technical indicators are purely derived from historical pricing and volume information. Therefore, they are not dependant on the subjectivity inherent in underlying fundamental or analyst estimate data. For example, technical indicators are not contingent upon analyst FY1 earnings estimate data nor do they depend upon whether a company chooses to employ last in first out (LIFO) or first in first out (FIFO) inventory valuation methods. Technical indicators are neutral to such subjectivity and therefore, they tend to be more objective.

Defining technical factors

There are literally hundreds of various types of technical indicators employed by investors. Before proceeding further, we feel it is prudent to narrow the scope of our study and specifically define which technical indicators we will be focusing on. Ideally, as quants, we want to study all possible factor combinations. In the case of technical indicators, this is not feasible given the infinite number of permutations of types and parameters. However, for the purposes of this research, we have selected a variety of technical factors that we think are representative of the wider universe of technical rules. Figure 1 below defines the various technical factors we will .analysis in this research.

Figure 1: Technical factor definitions

Technical Indicator	Definition	Scale	Formula	Period	Variants
Williams %R	The Williams %R is a momentum indicator that attempts to measure overbought (bearish) and oversold (bullish) levels. The scale extends from 0 to -100. The overbought level is considered 0 to -20, and oversold -70 to -100. The nearer the close is to the top of the range, the nearer to zero (higher) the indicator will be.The nearer the close is to the bottom of the range, the nearer to -100 (lower) the indicator will be.	0 to (-100)	W%R = (high_over_period - close) / (high_over_period - low_over_period)	5, 14, 20	Realtive to daily and montly deviations
Close Location Value	The Close Location Value is one of the indicators using the location of Close related to Low and High for the same period. It is, therefore, trying to spot the tendency in the price move of the security. This approach is working by determining the location of the Close compared to the Low and High. The indicator oscillates between -1 and 1, the closer the CLOSE is to the High, the closer it is to one, which is considered a bullish signal. The closer period's CLOSE is to Low, the closer the indicator value is to -1, which is considered bearish.	(-1) to 1	CLV = ((Close - daily_low) - (daily_high-Close)) / (daily_high- daily_low)		Realtive to daily and montly deviations
Accumulation/Distribution Line (AD)	Accumulation/Distribution is a momentum indicator which takes into account changes in price and volume together. The idea is that a change in price coupled with an increase in volume may help to confirm market momentum in the direction of the price move. If the Accumulation/Distribution indicator is moving up the buyers are driving the price move and the security is being accumulated. A decreasing A/D value implies that the sellers are driving the market and the security is being distributed. If divergence occurs between the Accumulation/Distribution indicator and the price of the security a change in price direction is probable. The A/D indicator is defined by fluctuations of the price and volume. The volume serves as a weight factor at the price change. The more factor (volume), the bigger is the contribution of the price change for the defined time period in value of the indicator.		AD = sum(CLV*Volume)	5, 14, 20	Realtive to daily and montly deviations
Percentage Price Oscillator (PPO)	The Percentage Price Oscillator (PPO) is an indicator, based on the difference of two moving averages. To make it oscillate within a convenient range, it is then normalized by dividing by the value of a shorter moving average. The PPO reflects the convergence and divergence of two moving averages. PPO is positive when the shorter moving average is above the longer moving average. The indicator moves further into positive territory as the shorter moving average distances itself from the longer moving average. This reflects strong upside momentum. The PPO is negative when the shorter moving average is below the longer moving average. Negative readings grow when the shorter moving average distances itself from the longer moving average (goes further negative). This reflects strong downside momentum.	Max = 100; no minimum	PPO = 100* (Fast_EMA - Slow_EMA) / Fast_EMA	26 and 12	Realtive to daily and montly deviations
Percentage Volume Oscillator (PVO)	The Percentage Volume Oscillator (PVO) indicator is a difference between two moving averages of volume. As the volume moves reflect the buying / selling pressure, the indicator (at least in theory) can precede the price moves. The 12-day exponential moving average (EMA) and 26-exponential moving average are generally used. Typically, these can be changed to suit longer or shorter time periods.	Max = 100; no minimum	PVO = 100* (Fast_EMA - Slow_EMA) / Fast_EMA	26 and 12	Realtive to daily and montly deviations
Stochastic Oscillator (SO)	The Stochastic Oscillator provides information about the location of a current close in relation to the period's high and low. The closer the close is to the period's high, the higher is the buying pressure, and the closer the close is to the period's low, the more selling pressure is. The indicator is considered bullish, when above 80, and bearish, when below 20.		SO = (recent_close - lowest_low) / (highest_high - lowest_low) ; SMA(SO); SMA(SMA(SO)	n=39	Realtive to daily and montly deviations
Moving Average Convergence Divergence (MACD)	The Moving Average Convergence/Divergence indicator (MACD) is calculated by subtracting the value of a 26-period exponential moving average from a 12-period exponential moving average (EMA). A 9-period dotted exponential moving average (the "signal line") of the difference between the 26 and 12 period EMA is used as the signal line. The basic MACD trading rule is to sell when the MACD falls below its 9 day signal line and to buy when the MACD rises above the 9 day signal line.		DIFF : EMA(CLOSE,SHORT) - EMA(CLOSE,LONG); DEA : EMA(DIFF,M); MACD : (DIFF-DEA),	Short=12;Long=26;and M=9	Realtive to daily and montly deviations
Bollinger Bands (BB)	Bollinger Band Width is used to measure volatility by placing trading bands around a moving average. These bands are charted two standard deviations away from the average, so as the average changes, the value of two standard deviations also changes. As standard deviation is a measure of volatility, the bands are self-adjusting: widening during volatile markets and contracting during calmer periods. The purpose of Bollinger Bands is to provide a relative definition of high and low. By definition prices are high at the upper band and low at the lower band.		BB=(Close-MA(Close,N))/stdev(Close,N)	5, 14, 20	Realtive to daily and montly deviations
Chaikin's Money Flow (CMF)	The Chaikin Money Flow is based upon the assumption that a bullish stock will have a relatively high close price within its daily range and have increasing volume. This condition would be indicative of a strong security. However, if it consistently closed with a relatively low close price within its daily range and high volume, this would be indicative of a weak security. Typically a reading below -0.25 is indicative of strong selling pressure. Conversely, a reading above +0.25 is considered to be indicative of strong buying pressure.		AD:=((CLOSE-LOW)-(HIGH-CLOSE))/(HIGH-LOW)*VOL CMF=SUM(AD,N)/SUM(VOL,N)	20	Realtive to daily and montly deviations
Relative Strength Indicator (RSI)	Relative Strength Index (RSI) is a momentum oscillator that measures the speed and change of price movements. RSI oscillates between zero and 100. Traditionally, and according to Wilder, RSI is considered overbought when above 70 and oversold when below 30. One characteristic of the RSI is that it moves slower when it reaches increased overbought or oversold conditions, and then snaps back very quickly when the market enters even a mild correction. This brings the RSI back to more neutral levels and indicates that the price trend may be able to resume.	0 to 100	RSI = 100 - (100/1+RS) RS = Average Gain / Average Loss	14	Realtive to daily and montly deviations

Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Factor variants

Technical quant factors are far different from conventional quantitative factors. Technical factors are typically derived from higher frequency data (including daily and intra-day pricing data) compared to conventional quantitative factors. Therefore, the challenge with utilizing technical factors is to determine how to transform higher frequency data and signals into a lower frequency environment.

Another noteworthy difference between technical and conventional quantitative factors is the process by which you compare the factors. Conventional quantitative factors are typically calculated and then compared cross-sectionally. For example, an investor may calculate price-to-book for various companies, and then compare the price-to-book ratio cross-sectionally

(i.e. between all the companies at a particular point in time). However, technical indicators are calculated relative to their own history. Therefore, a technical indicator signal is only relevant when compared to its history. So for quant factors based on technical indicators, we compute the deviation of the technical signals relative to their historical averages. Then we compare these deviations cross-sectionally between all the companies in our universe.

We address the two aforementioned issues by developing several variants of each technical indicator. A factor variant is simply an additional or alternative version of a factor. For example, the technical factor Williams %R has been traditionally calculated based on a 14 day window. However, for the purposes of this research, we also test the Williams % R factor based on a 20 and 5 day window

We build on this concept of factor variants by developing additional technical factors based on their historical averages. For example, the factor Z20d_William_14 is Williams %R using a 14 day window calculated relative to its 20 day historical deviation. The factor Z12M_William_5 is Williams %R using a 5 day window calculated relative to its 12 month historical deviation.

Figure 2 below shows all the factor variants for Williams %R. We developed a number of different variants for each technical factor. In total, we created approximately 120 different factors individually based on the above mentioned10 technical indicators defined in figure 1.

Figure 2: Example of variant technical factors calculated

#	Technical Indicator	Variant Type	Variant Name	Variant Window
1	Williams %R	Actual	WILLIAM_20	20 day period, Williams %R
2	Williams %R	Actual	WILLIAM_14	14 day period, Williams %R
3	Williams %R	Actual	WILLIAM_5	5 day period, Williams %R
4	Williams %R	Daily Relative	Z20d_WILLIAM_20	20 day Williams %R, Relative 20 day history
5	Williams %R	Daily Relative	Z10d_WILLIAM_20	20 day Williams %R, Relative 10 day history
6	Williams %R	Daily Relative	Z5d_WILLIAM_20	20 day Williams %R, Relative 5 day history
7	Williams %R	Daily Relative	Z20d_WILLIAM_14	14 day Williams %R, Relative 20 day history
8	Williams %R	Daily Relative	Z10d_WILLIAM_14	14 day Williams %R, Relative 10 day history
9	Williams %R	Daily Relative	Z5d_WILLIAM_14	14 day Williams %R, Relative 5 day history
10	Williams %R	Daily Relative	Z20d_WILLIAM_5	5 day Williams %R, Relative 20 day history
11	Williams %R	Daily Relative	Z10d_WILLIAM_5	5 day Williams %R, Relative 10 day history
12	Williams %R	Daily Relative	Z5d_WILLIAM_5	5 day Williams %R, Relative 5 day history
13	Williams %R	Monthly Relatve	Z12m_WILLIAM_20	20 day Williams %R, Relative 12 month history
14	Williams %R	Monthly Relatve	Z6m_WILLIAM_20	20 day Williams %R, Relative 6 month history
15	Williams %R	Monthly Relatve	Z3m_WILLIAM_20	20 day Williams %R, Relative 3 month history
16	Williams %R	Monthly Relatve	Z12m_WILLIAM_14	14 day Williams %R, Relative 12 month history
17	Williams %R	Monthly Relatve	Z6m_WILLIAM_14	14 day Williams %R, Relative 6 month history
18	Williams %R	Monthly Relatve	Z3m_WILLIAM_14	14 day Williams %R, Relative 3 month history
19	Williams %R	Monthly Relatve	Z12m_WILLIAM_5	5 day Williams %R, Relative 12 month history
20	Williams %R	Monthly Relatve	Z6m_WILLIAM_5	5 day Williams %R, Relative 6 month history
21	Williams %R	Monthly Relatve	Z3m_WILLIAM_5	5 day Williams %R, Relative 3 month history

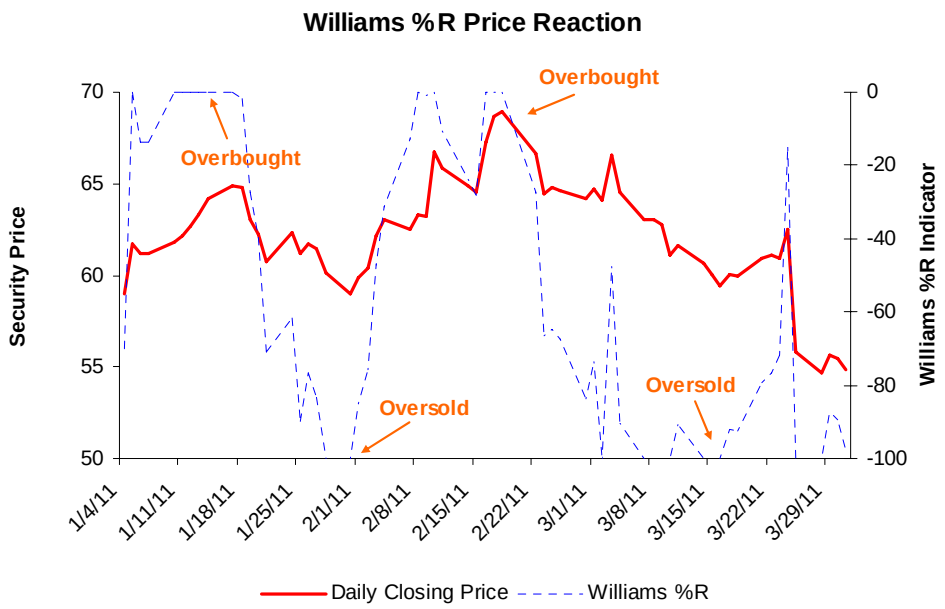
Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Example of technical indicators

Williams %R

Figure 3 shows an example of the Williams %R technical indicator. Recall that the Williams %R is an indicator that attempts to measure overbought (bearish) and oversold (bullish) levels typically over a period of 14 days (or 20 days or 5 days(. The scale extends from 0 to -100. The overbought level is considered 0 to -20, and oversold -70 to -100. The nearer the close price is to the top of the period range, the nearer to zero the indicator will be. However, the nearer the close price is to the bottom of the period range, the nearer to -100 the indicator will be.

Figure 3: Williams %R example

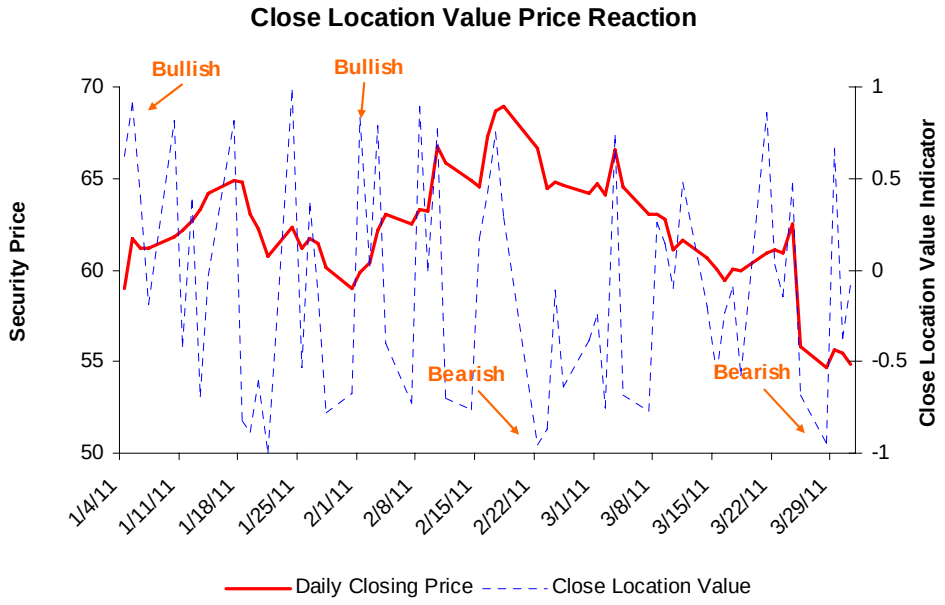


Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Close location value

Figure 4 shows an example of the Close Location Value technical indicator. Recall that the Close Location Value uses the location of Close related to Low and High for the same period. It is, therefore, trying to spot the tendency in the price move of the security. The signal determines the location of the Close compared to the daily low and high. The indicator oscillates between -1 and 1. The closer the close is to the daily high, the closer the signal is to one, which is considered a bullish tendency. The closer the close is to the daily low, the closer the indicator value is to -1, which is considered a bearish tendency.

Figure 4: Close location value example

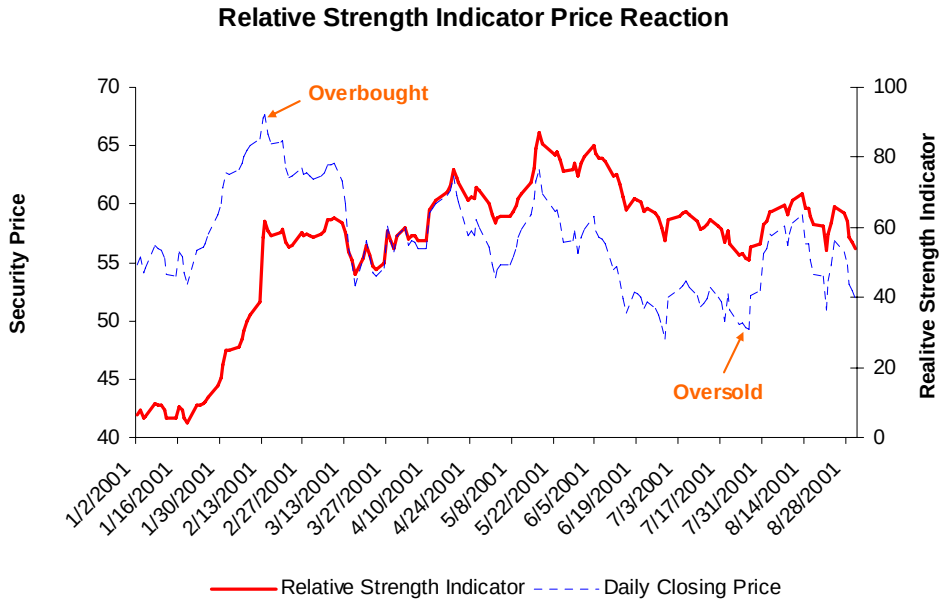


Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Relative strength indicator

Figure 5 shows an example of the Relative Strength Indicator (RSI). Recall that the Relative Strength Index (RSI) measures the speed and change of price movements. The RSI measures the average gains and losses over a period of time (typically a 14 day window). RSI oscillates between 0 and 100. Traditionally, RSI is considered overbought when above 70 and oversold when below 30.

Figure 5: Relative strength indicator example



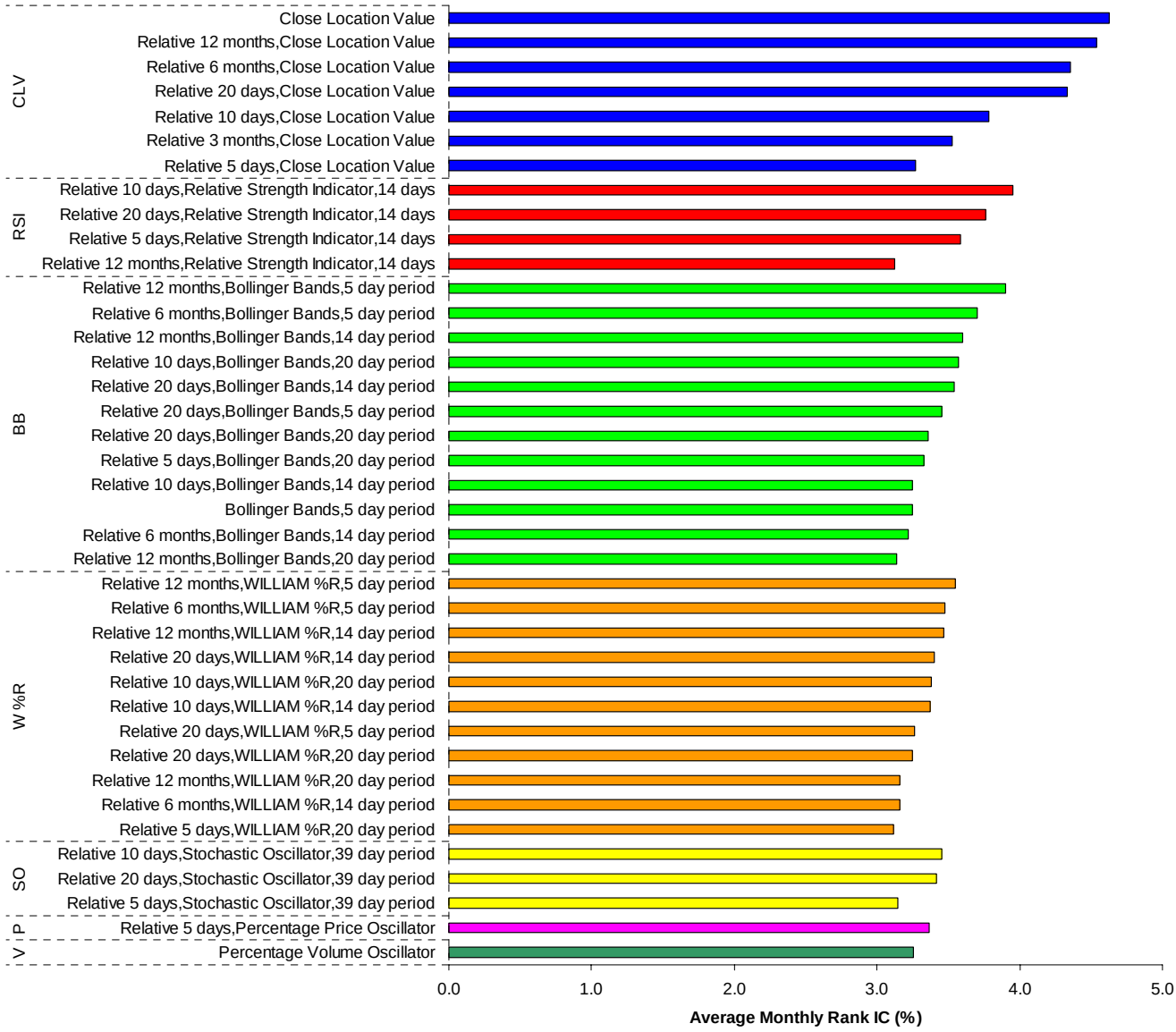
Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Univariate backtest

Backtesting results are promising

The first step in our analysis is, as usual, a univariate analysis of each potential factor. We backtest all the technical factors in our database (including the factor variants). Figure 6 below shows the average rank information coefficient performance of the top forty technical factors. All the factor variants are grouped according to the underlying technical indicator.

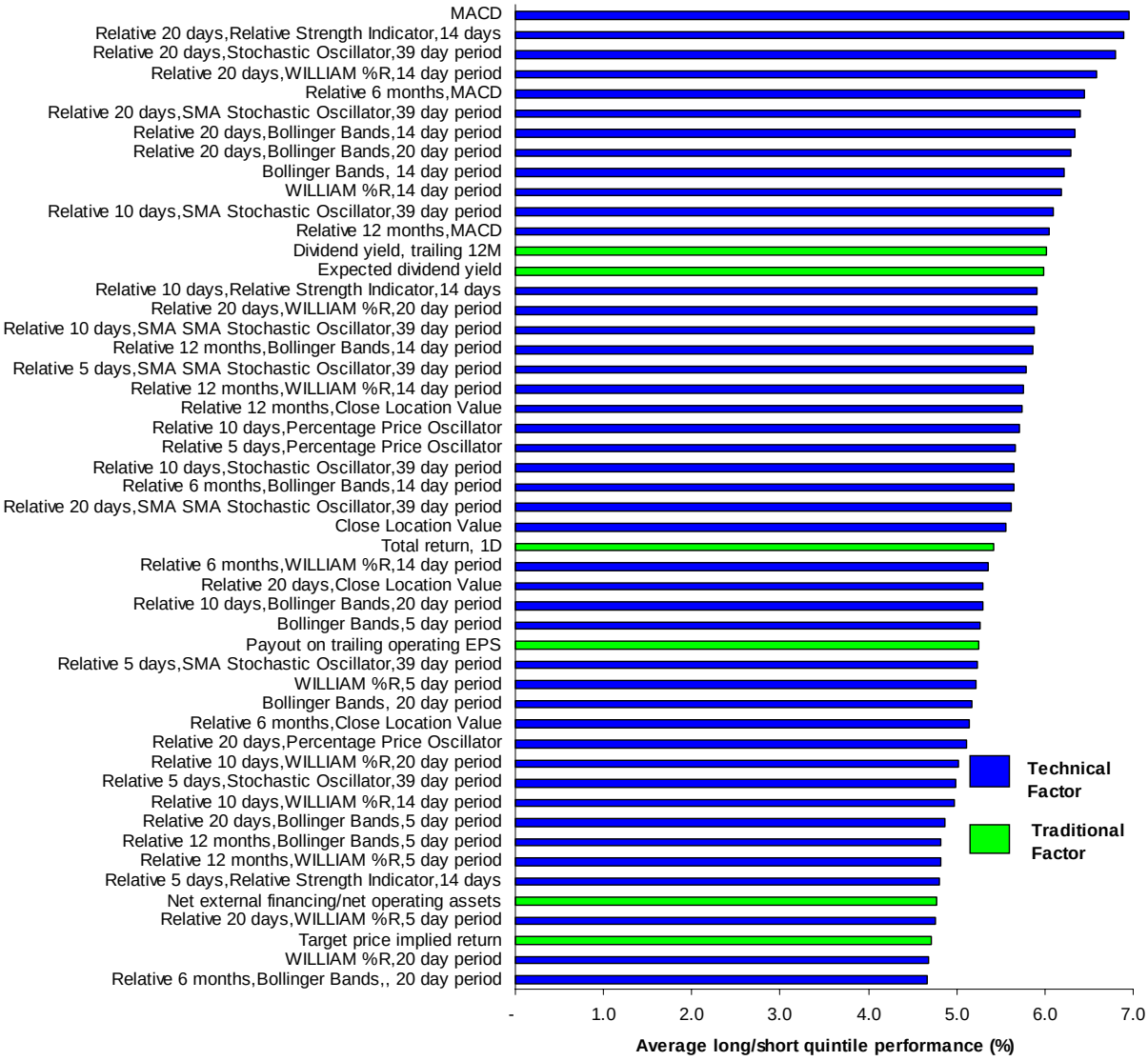
Figure 6: Best 40 factors sorted by average monthly rank information coefficient (IC), grouped by technical indictor



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 7 below shows the average rank information coefficient performance of the top fifty factors during the past three years. Clearly technical based quantitative factors have dominated.

Figure 7: Best 50 factors during the past 3 years, sorted by average monthly rank information coefficient (IC)



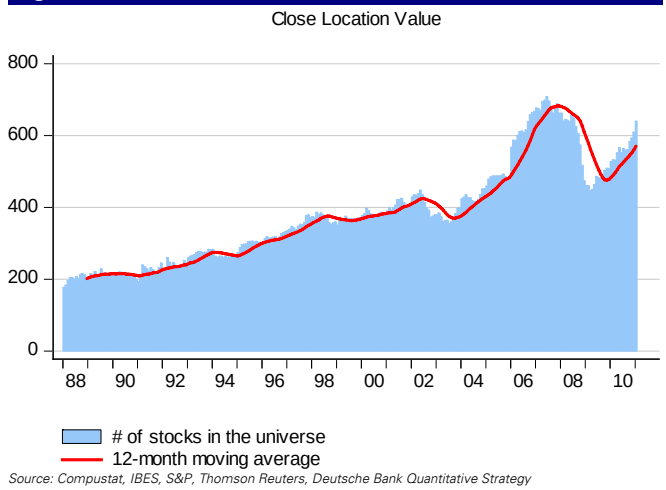
Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Time series analysis

Figure 8 shows the coverage for the Close Location Value factor. Since most technical indicators can predominantly be calculated using daily pricing (including daily highs and lows) and volume, we would expect that most factors will have descent coverage. In fact, technical based quant factors likely have better coverage than most conventional quantitative factors. In addition, most technical factors are fairly simple to calculate.

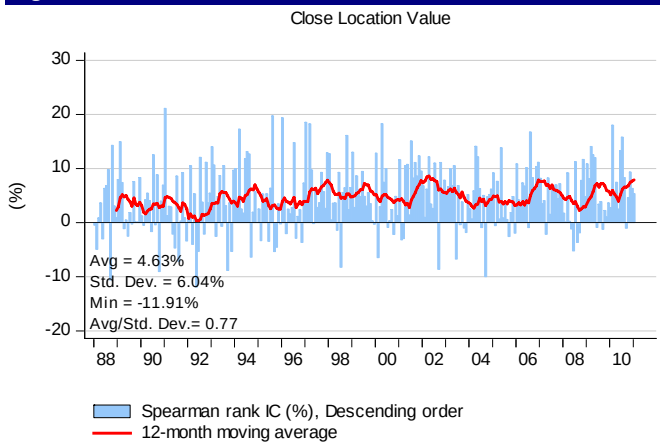
Focusing on the backtest results, Figure 9 shows the rank IC performance of the Close Location Value factor. The backtest results are promising. The overall rank IC for Close Location Value is approximately 4.6%. Interestingly, the 12 month average rank IC is always positive during the entire 25 year backtesting period.

Figure 8: Number of stocks for Close Location Value



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

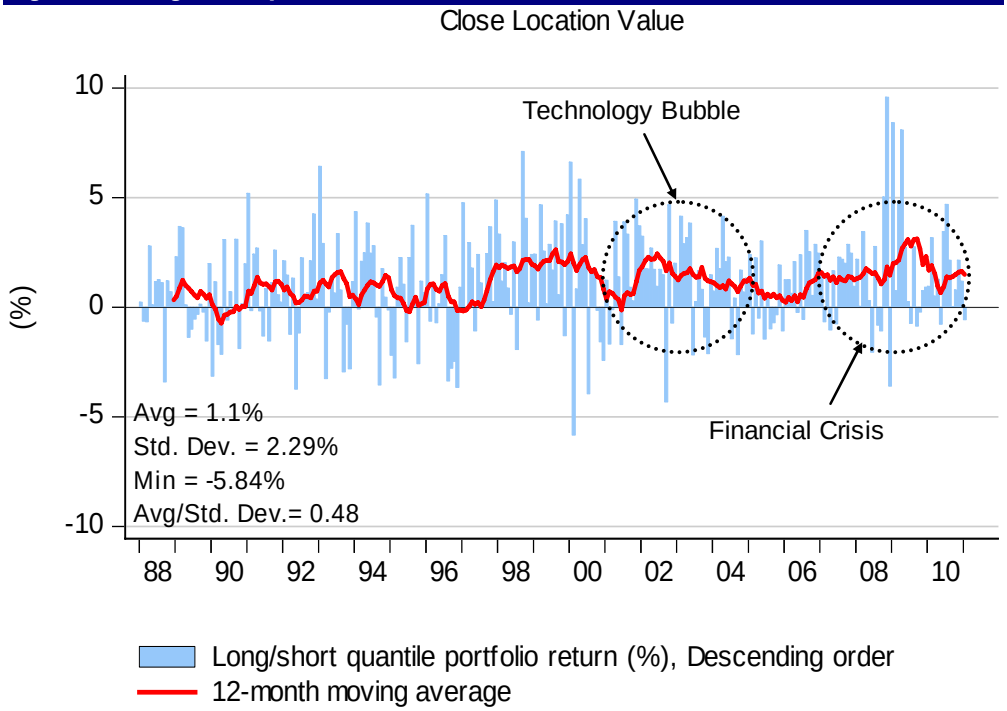
Figure 9: Rank IC for Close Location Value



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 10, shows the long/short performance of Close Location Value. The average monthly quintile return for a strategy based on Close Location Value is approximately 1.1%. In addition, during the internet bubble and financial crisis, periods of excessive volatility and uncertainty, Close Location Value also performed reasonably well.

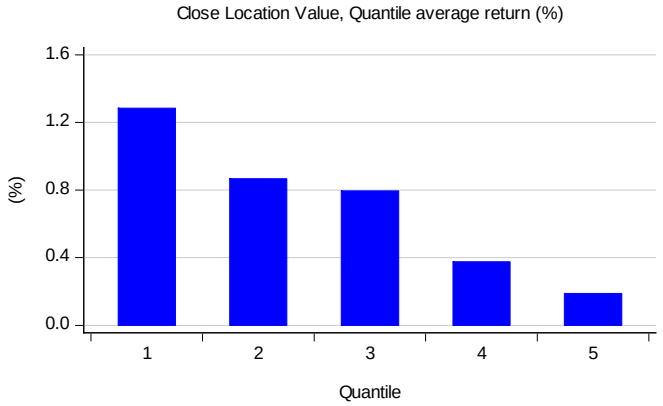
Figure 10: Long/short quantile return for close location value



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

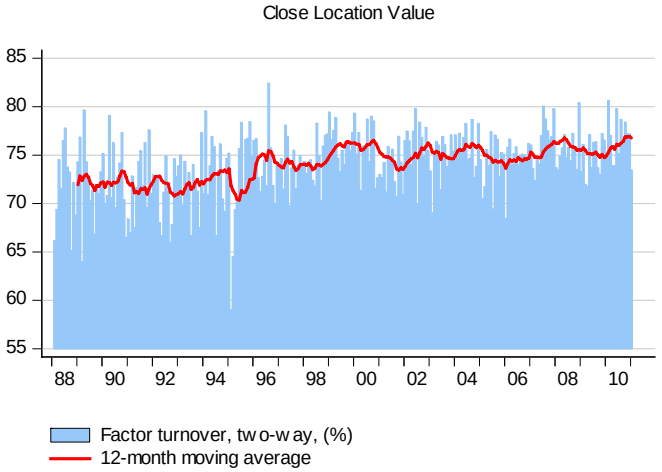
Figure 11 shows the performance of each quintile. An attractive feature of the factor is that it has a fairly linear return payoff pattern. The overarching concern that most investors share with regards to utilizing technical based indicators is the excessive amount of portfolio turnover. Figure 12 clearly articulates this concern. The two-way, portfolio turnover is approximately 70%. This of courses raises several questions with respect to implementing a strategy based on technical quant factors. We will address these concerns later in this report.

Figure 11: Quantile returns for Close Location Value



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

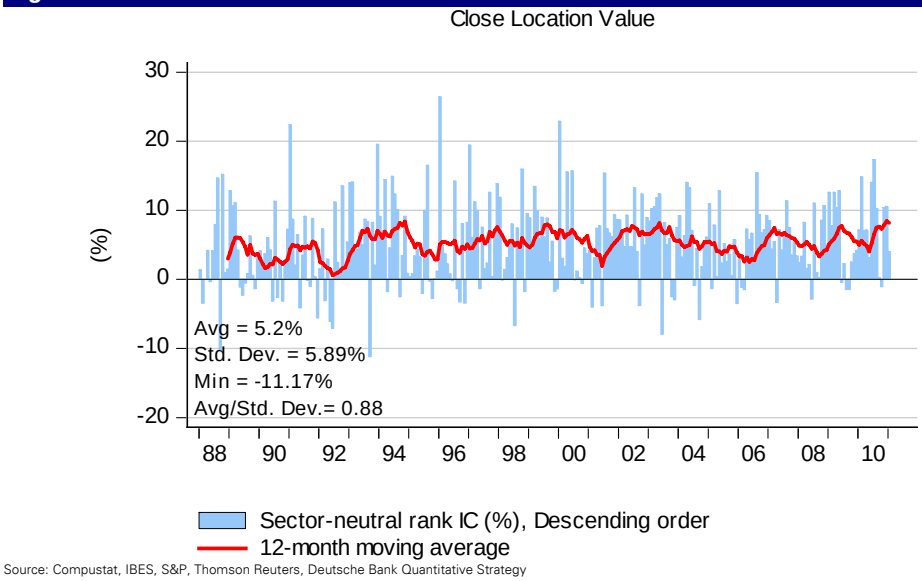
Figure 12: Turnover for Close Location Value



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 13 shows the sector neutral rank information coefficient (rank IC) for Close Location Value. The sector neural rank IC actually outperforms the sector unadjusted rank IC. This means that Close Location value has stronger stock selection skill than sector timing ability.

Figure 13: Sector neutral rank IC for Close Location Value



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Building a composite technical factor

Diversification benefits

Each of the technical factors we have studied show promise as stock-selection signals. The next logical question to ask is how correlated they are. If we find that the factors are somewhat uncorrelated, then we can potentially derive diversification benefits by combining them into a composite factor. Figure 14 shows a correlation matrix for a select set of technical factors. The results are promising. The correlations are relatively low as no pair of factors have a correlation greater than 0.5. Now a correlation of approximately 0.5 may at first glance seem somewhat high. However, recall that most technical indicators are derived from the same underlying data, price and volume. As such, we would expect that the correlation between most technical factors to be higher than the correlation between most conventional quant factors.

Figure 14: Rank IC correlation matrix for composite technical factor components

		Z10d_CLV	Z12m_BB_14	Z10d_WILLIAM_14
Relative 10 days,Close Location Val	Z10d_CLV	1	0.23	0.39
Relative 12 months,Bollinger Bands	Z12m_BB_14		1	0.5
Relative 10 days,WILLIAM %R,14 da	Z10d_WILLIAM_14			1

Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

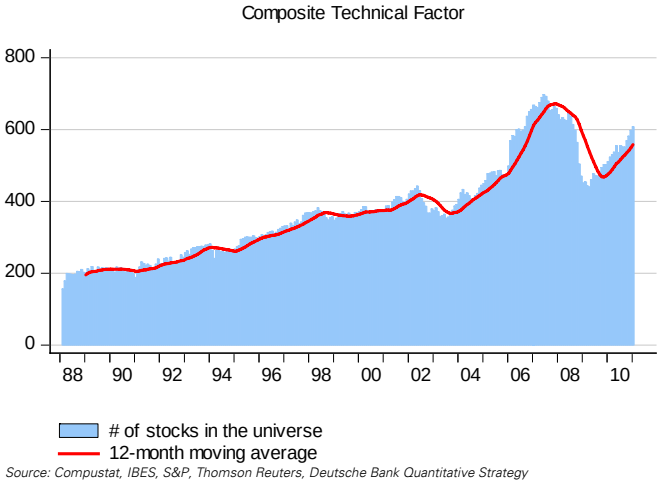
These relatively low correlations suggest there are diversification benefits by combining these factors. However, before we proceed with more detailed analysis, the choice of the three technical factors mentioned above requires some discussion. One of the prevailing issues with regards to quantitative research is the infusion of look ahead bias while selecting factors for a model (i.e. choosing factors that we already know have worked well in the past).

However, for the purposes of our analysis, we did not merely pick factors that worked well in the past. In addition to selecting factors that have relatively low correlations, we also chose factors from distinct technical indicator groups. The factors shows in figure 14 are variant factors derived from Close Location Value, Williams %R, and Bollinger bands. Selecting factors from distinct technical groups potentially ensures maximum diversification benefit.

Backtesting results

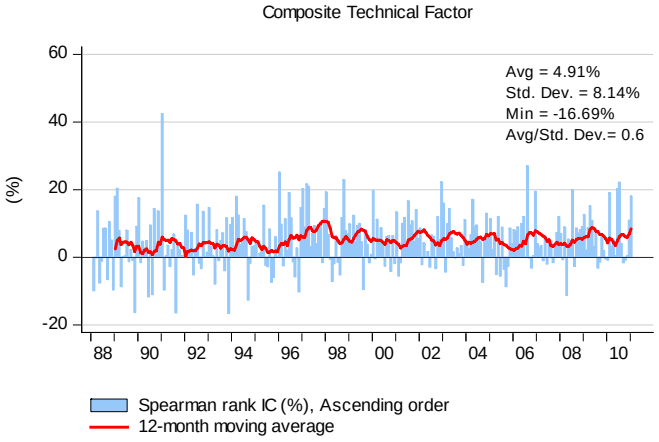
Using the three aforementioned factors (Close Location Value, Bollinger Bands, Williams %R) we construct a simple, equally weighted composite technical factor and call it DB_TECH_COMP. Figure 15 shows the coverage for the DB_TECH_COMP factor. As previously mentioned, since most technical indicators can predominantly be calculated using daily pricing (including daily highs and lows) and volume, we would expect that most factors to have strong coverage. Figure 16 shows the rank IC for the technical composite factor. The factor performs well as measured by the average rank IC. The 12-month average IC almost never dips below zero.

Figure 15: Number of stocks DB_TECH_COMP



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

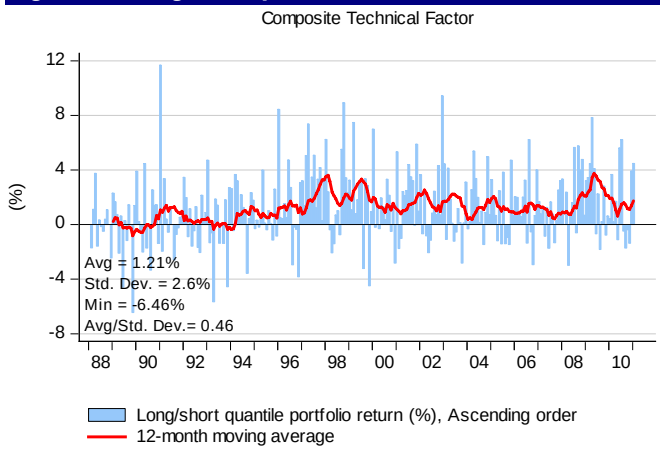
Figure 16: Rank IC for DB_TECH_COMP



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

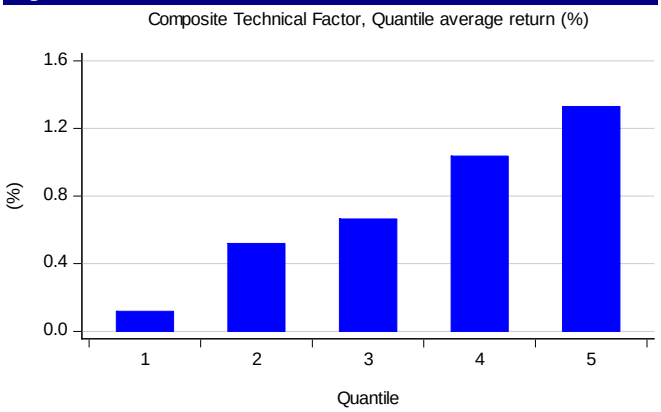
Figure 17 shows the long/short return performance of the composite factor. The results in return space are solid. The 12-month moving average of the long-short quantile spread rarely dips below zero. Looking at the average returns to each quantile portfolio, we again find a fairly linear payoff scheme indicating that each quantile is fairly consistent in terms of forecasting future one month returns.

Figure 17: Long/short performance: DB_TECH_COMP



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

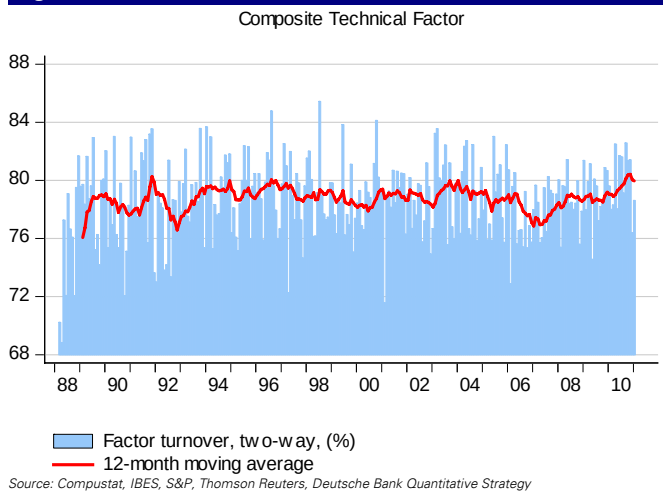
Figure 18: Quantile returns for DB_TECH_COMP



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

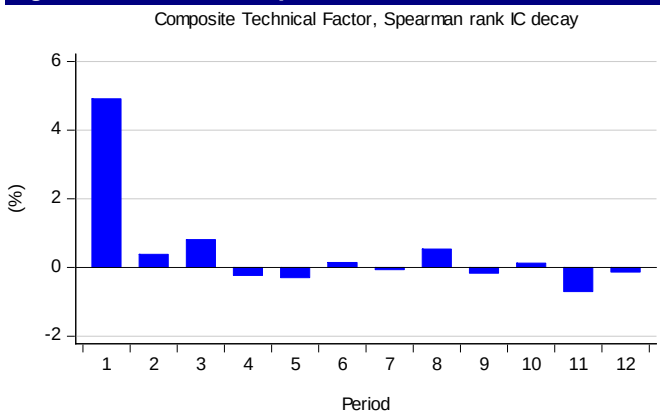
The turnover of the composite factor is in line with the underlying factors. Figure 19 shows the average monthly turnover is approximately 78% two-way per month. Clearly this is too high for longer-term investors to use in isolation. In the next section we will examine how this factor can be combined with other factors to increase the performance of a standard multifactor model without inadvertently boosting the turnover. On the other hand, the rank IC information decay is very fast indicating that there is very little forecasting power beyond one month.

Figure 19: Turnover for DB_TECH_COMP



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

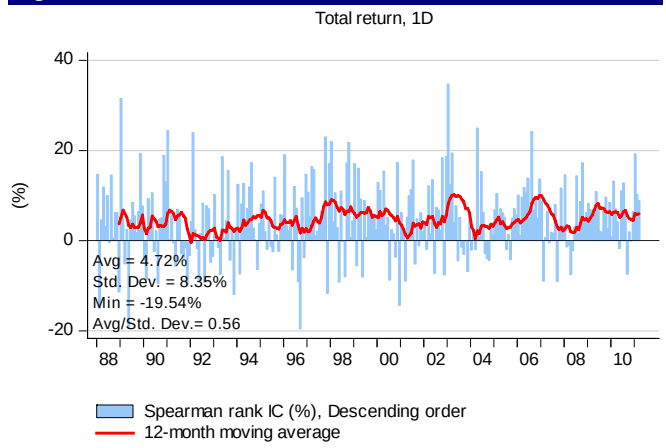
Figure 20: Rank IC decay for DB_TECH_COMP



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

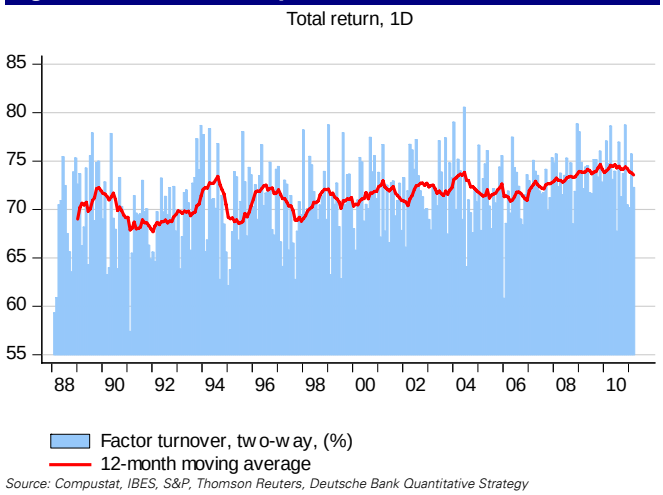
Lastly, comparing the performance of total one day return (a factor with similar turnover) with DB_TECH_COMP, we find that DB_TECH_COMP has better performance as measured by rank IC with reasonably similar turnover (figure 21 and 22).

Figure 21: Turnover for DB_TECH_COMP



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 22: Rank IC decay for DB_TECH_COMP



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Incorporating technicals into a multifactor model

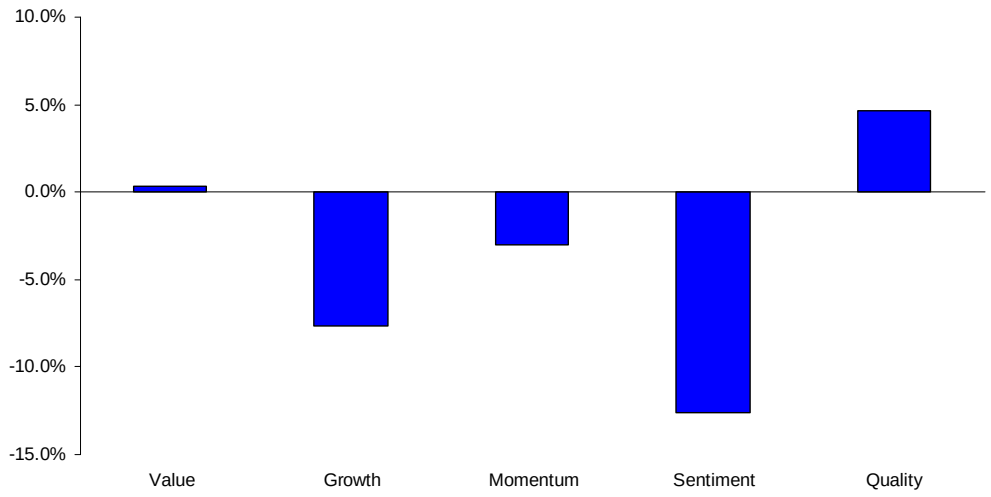
Factor correlations

The real test is whether combining the composite technical factor into a multi-factor model will improve performance results. The composite technical factor showed strong predictive power in Canada. However, strong performance is not merely enough to incorporate a new factor into a quantitative model. We must ensure that this factor is somewhat uncorrelated with exiting factors. This is to ensure some diversification in factor selection.

We analyze the correlation between the composite technical factor and other standard factors. The figure below shows the average rank IC correlation of composite technical factor with five broad style categories. Overall, the results look very promising. The composite technical factor is weakly correlated (or even negatively correlated) with all factor buckets. All factor buckets are less than 10% correlated with the composite technical factor.

In addition, the composite technical factor is strongly negatively correlated with the sentiment factor bucket. This is somewhat expected since sentiment based factors are typically long term momentum factors whereas technical indicators are more short-term reversal type strategies. This finding reinforces the fact that technical indicators provide a different perspective on a company's specific performance since they do not incorporate underlying fundamental information. This result indicates that the composite technical factor is likely to add good diversification benefits when applied to a multi-factor model. We will test this assumption next.

Figure 23: Rank IC correlation DB_TECH_COMP and other style buckets



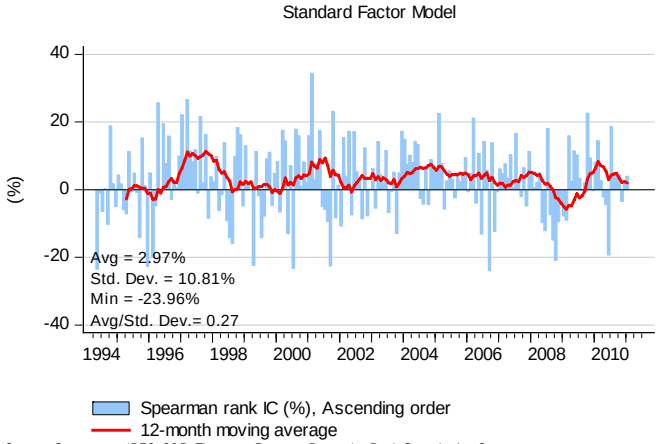
Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Multifactor models

The apex of this analysis will be to test whether the composite technical factor adds value to a multi-factor model. To determine whether its inclusion adds alpha, we backtest the performance of a multi-factor model, with and without the composite technical factor. We start with an equally weighted, standard factor model that contains a blend of growth, value,

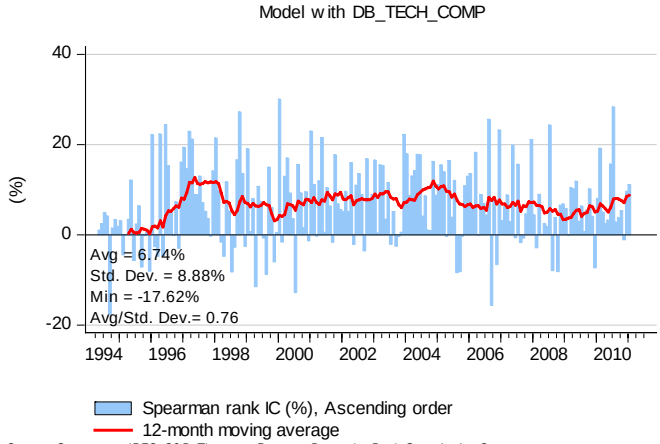
momentum, quality, and sentiment. First, we backtest this standard factor model and then add the composite technical factor as an additional factor. The figures below show the Rank IC charts of both models as well as the annualized information ratio. The annualized information ratio is based on quintile portfolios before transaction costs. Clearly, adding the composite technical factor improves before cost performance significantly.

Figure 24: Standard factor model rank IC



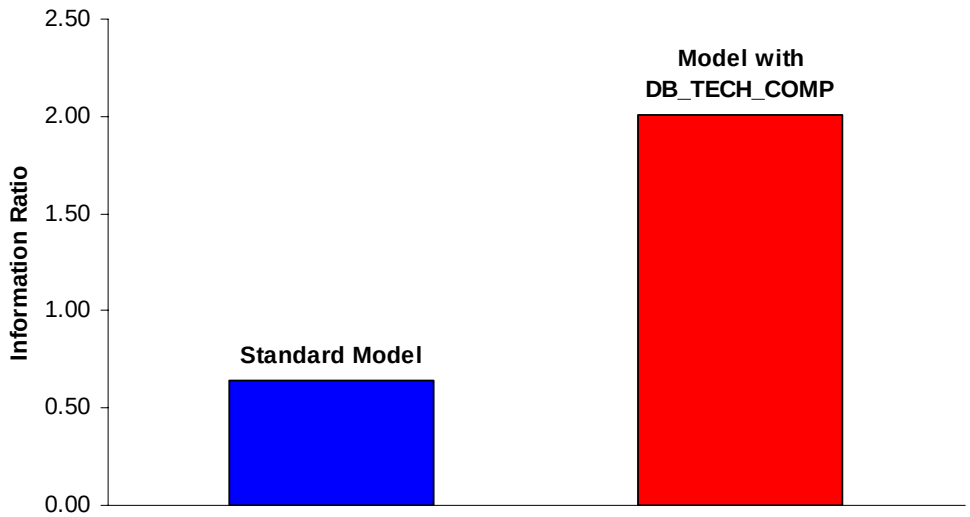
Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 25: Model with DB_TECH_COMP rank IC



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 26: Annualized information ratio



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

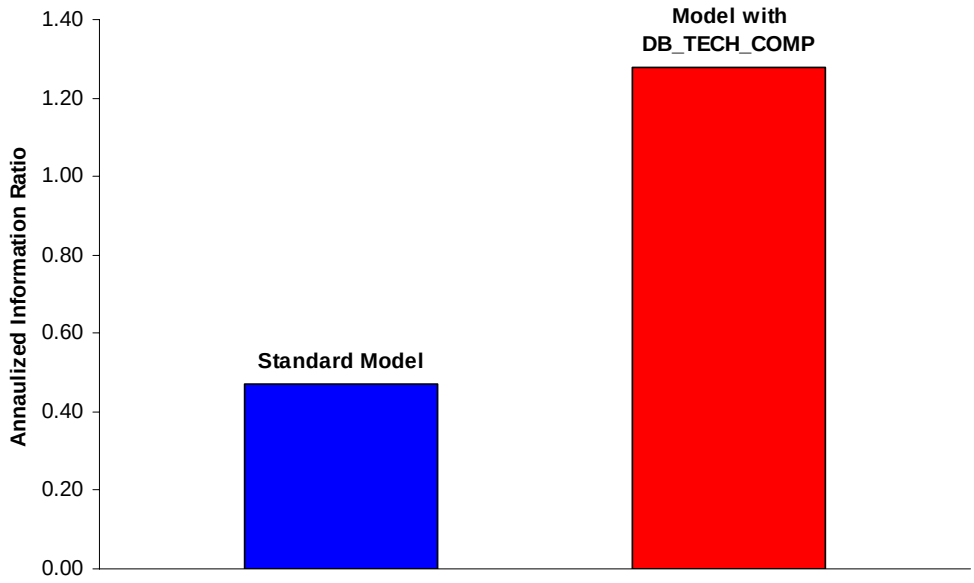
Real-world example

All our results so far have been pre-transactions costs. But clearly, given this is a high turnover strategy, transaction costs are a significant consideration. To test the efficacy of the strategy after transaction costs, we perform a more real-world portfolio simulation. To do this we use the Axioma portfolio optimizers. We simulate two portfolios and compare the results. We create one portfolio based on the generic standard model and the other based on the model that incorporates the composite technical factor. For our portfolio simulation, we try to maximize expected return with the following constraints:

- Long/short market neutral strategy
- Dollar neutral
- One way turnover constrained at 30%
- Calibrated risk aversion parameter so ex-ante risk was running between 5% and 7%
- Transaction cost of 20bps each way
- Beta neutral
- Sector neutral

As shown in figure 27, the model with the DB_TECH_COMP factor outperformed the generic factor model.

Figure 27: Annualized information ratio



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Digging deeper

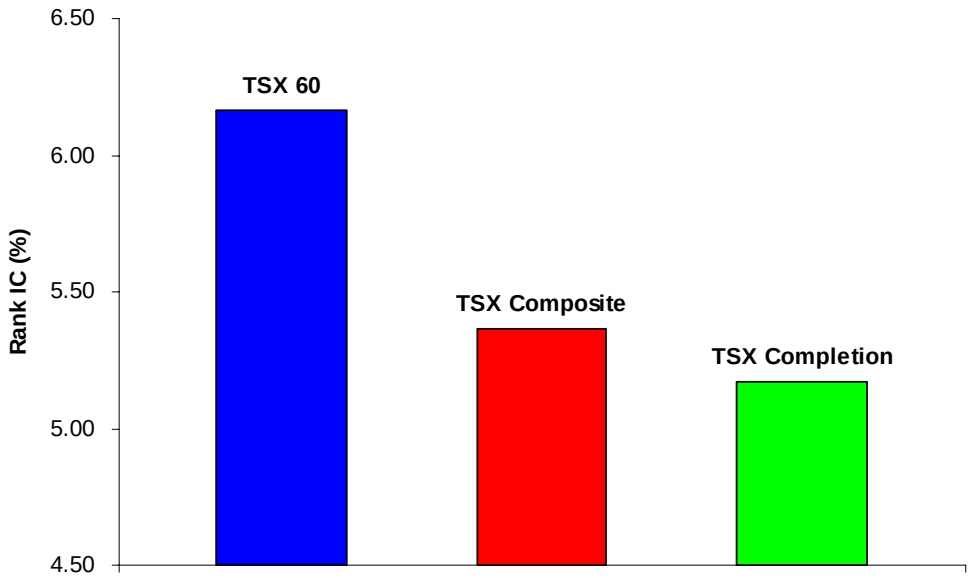
Size and sector effects

On the surface, the results for our DB_TECH_COMP factor look promising. However, one of the drawbacks with univariate analysis is that the factor could simply be loading up on other risk exposures. For example, we might just be buying small cap or low liquidity stocks. As such, we feel it's prudent to investigate these potential risk exposures in the context of the technical indicators in our study.

Figure 28 shows the rank IC performance of the DB_TECH_COMP factor for three TSX indices: TSX 60, TSX Composite, and the TSX Completion. The results show that the DB_TECH_COMP has more predictive power in large cap universe. This is a promising finding for two main reasons.

First, the fact that DB_TECH_COMP works better for highly liquid, large cap securities implies that we are not unduly taking on exposure to small cap, low liquidity stocks. Second, it's often a difficult feat to find quantitative factors that work well in the large cap space. Large cap stocks are typically the most widely held securities. As such, we would expect that most quantitative factors would be arbitraged away in this space. Therefore, it's very promising to find that DB_TECH_COMP works better in large cap universes.

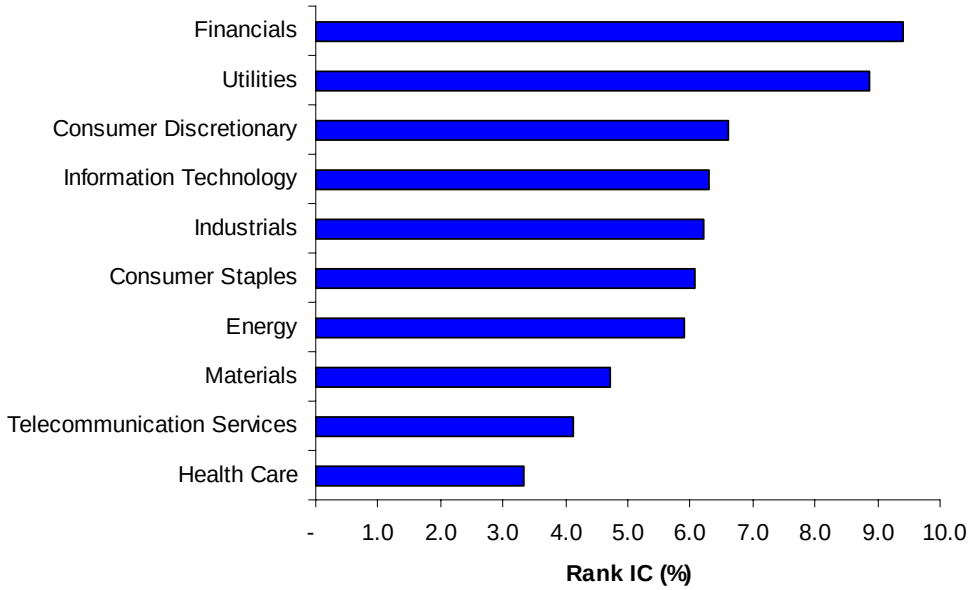
Figure 28: DB_TECH_COMP rank IC for TSX 60, Composite, and Completion indices



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Figure 29 shows the rank IC performance of the DB_TECH_COMP factor within each GICS sector universe. The results indicate that DB_TECH_COMP works better within the Financial and Utilities compared to all the other sectors. This is yet again a very promising finding. The Financial sector is typically the most dominant sector not only in Canada, but also in most global markets. It is much harder to find factors that work in the Financial sector which tends to be a difficult sector for most quant factors.

Figure 29: DB_COMP_TECH rank IC for each sector



Source: Compustat, IBES, S&P, Thomson Reuters, Deutsche Bank Quantitative Strategy

Further research

We are aware of the fact that most technical factors have high turnover and fast decay. For investors with lower turnover constraints, our recent research "Learning to drive in the Fast Lane", April 26, 2011 provides a framework to combining high turnover factors with more traditional slow decay factors.

Appendix A– Deutsche Bank US/Global Quant Research Library

Deutsche Bank's US/Global quantitative strategy team produces one monthly newsletter, *Quantum*, and five monthly research series: 1) *Signal Processing* on alpha factors; 2) *QCD Model* on stock-selection models; 3) *Portfolios Under Construction* on risk and portfolio construction; 4) *Academic Insights* on academic research; and 5) *Canada Quant*.

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Quantum

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- **Quantum** (April 29, 2011)
- **Quantum** (March 31, 2011)
- **Quantum** (February 28, 2011)
- **Quantum** (January 27, 2011)
- **Quantum** (November 29, 2010)
- **Quantum** (October 28, 2010)
- **Quantum** (September 20, 2010)

Signal Processing

This is our flagship monthly alpha signal research series. We try to identify new data sources, build new and innovative factors, and investigate various style rotation models.

- **Do Bonds Know Better? (**May 4, 2011**).** In this report, we show that fixed income data is useful for quantitative equity investors. We use a unique Deutsche Bank database of corporate bonds – the DBIQ database – to analyze whether fixed income metrics have predictive power for future stock returns. We find that certain signals from the bond market do lead the equity market and as such can offer a new alpha source, even for those who can only trade equities.
- **A Quant Handbook of REIT Investing (**May 2, 2011). We find REITs stocks behave differently from non-REIT stocks. We test both traditional factors, but also a new data source – SNL, the de facto standard on REIT industry data. We find performance can be significantly improved by incorporating REIT-specific factors. In fact, our QCD-REIT model has outperformed our generic QCD model, by boosting portfolio IR by 81% in the past 11 years and 240% in the past three years.
- **Oil Shock: A Quant Perspective** (March 25, 2011**).** Once again the price of oil is caught up in a nexus of political and economic uncertainty. In this report we develop a better

way to measure a stock's sensitivity to oil price movements. The enhanced oil beta that we develop is less backwards-looking than the traditional regression beta, and does a better job at capturing future oil price sensitivity.

- **The long and the short of it** (January 18, 2011). In this report we use the DataExplorers securities lending database to develop new alpha signals based on stock lending and borrowing data. We show that we can combine these signals into a composite factor that works well in forecasting month-ahead stock returns.
- **Frequency Arbitrage** (November 10, 2010). We try to bridge the gap between high and low frequency quant, and find that factors derived from high frequency data do have predictive power even for "traditional", lower-frequency quant investors.
- **Style Rotation** (September 7, 2010). We investigate three potential data sources to predict style factor performance: macroeconomic, capital market, and seasonal patterns. We find most academic research using economic variables in style timing suffers significant look-ahead bias. We test ten style prediction models, ranging from simple averages (assuming no style timing ability), linear regression, robust regression, Markov-switching, state-space, to nonlinear *TREE*, *FOREST*, and *PLANET* techniques. We find style rotation strategies can exhibit significant timing ability, which translates into better portfolio performance. Indeed, the multi-factor model built on style rotation strategies outperforms the naïve model (assuming no style rotation) by 54% in IR in the past 10 years. In the past three years, style rotation boosts IR by 1.30.
- **Beyond the Headlines** (July 19, 2010). In this research, we study text mining and natural language processing (NLP) in stock selection. We use three nonlinear model techniques (*TREE*, *FOREST*, and *PLANET*) to analyze news sentiment data and find signals can be used in both high and low frequency strategies.
- **Industry-Specific Factors** (June 7, 2010). Industry-specific data and factors like loan loss provision, same store sales growth, or break-even load factor have better predicative power than traditional/generic factors. We study 164 industry-specific factors in 12 industries. We found adding industry-specific factors to traditional multi-factor models can enhance model IC and portfolio IR.
- **The Options Issue** (May 12, 2010). We find options market tends to lead equity market. We find four signals from the options market have significant predictive power in forecasting month-ahead stock returns.
- **Launching US Quantitative Strategy** (April 12, 2010). We study three factors: 1) decomposing value factors – valuation ratios can be decomposed into a trend component (persistent) and cyclical component – both can be used to enhance value factor performance; 2) accruals and earnings quality – a small scaling adjustment can make a big difference; 3) market friction and price delay.

QCD Model

QCD is our flagship stock-selection model and illustrates our philosophy for picking stocks quantitatively. The model is updated every month, and is accompanied by an interactive spreadsheet.

- **DB Quant Handbook** (July 22, 2010). QCD is our main stock-selection model with a few unique features: factors are dynamically re-selected every month based on pre-determined algorithms; a nonlinear *TREE* model is combined with a linear panel data econometric model; and style rotation and industry timing models are incorporated in the bottom-up stock-selection model.
- **QCD Model Update** (April 29, 2011)
- **QCD Model Update** (March 31, 2011)

- **QCD Model Update** (February 7, 2011)
- **QCD Model Update** (January 6, 2011)
- **QCD Model Update** (December 6, 2010)
- **QCD Model Update** (November 2, 2010)
- **QCD Model Update** (October 6, 2010)
- **QCD Model Update** (September 8, 2010)
- **QCD Model Update** (August 6, 2010)

Portfolios Under Construction

In this series, we study various issues related to risk modeling and portfolio construction.

- **Learning to Drive in the Fast Lane** (April 26, 2011). This research analyzes and tests a new methodology that incorporates factor and portfolio dynamics into the optimal factor weighting decision. Specifically, we look at the efficacy of a new and simple technique that uses the underlying decay of each factor and the portfolio turnover policy to arrive at the optimal factor weighting decision. The framework and technique tells us how to find the optimal allocation to a fast decay signal when turnover constraints are stringent.
- **Minimum Variance Portfolios** (February 9, 2011). In this report, we analyze the minimum variance portfolio strategy thoroughly to discover a few of its interesting properties as well as some of its vulnerabilities. In addition, we propose an enhancement which achieves better return with the same risk control.
- **Robust Factor Models** (January 24, 2011). In this paper, we want to see whether we can improve our ability to estimate the factor covariance matrix by structured models. More importantly, we want to see whether a more precise factor covariance matrix estimator leads to better portfolio performance.
- **Correlation and Opportunity** (December 3, 2010). We find that stock return correlation has a long-term cyclical component that is linked to economic cycles. Negative economic sentiment is linked to increasing correlation.
- **Factor Neutralization and Beyond** (September 21, 2010). We expand our previous factor neutralization for the US market to Europe and find similar evidence. Many alpha factors have significant exposures to volatility. Neutralizing volatility exposure can improve factor consistency.
- **It's all in the Timing** (August 19, 2010). We examine, using "perfect foresight" simulations, whether style-timing actually adds value above and beyond the additional turnover costs incurred. We also use a real-world example, our QCD model, and find style timing is difficult, but not impossible.
- **Volatility = 1/N** (June 16, 2010). Many alpha factors have significant exposures to volatility. Neutralizing volatility exposure can improve factor consistency.
- **Quantiles versus Mean Variance** (April 23, 2010). Comparing quantile portfolios with mean-variance optimization. Two extreme cases of constructing a portfolio – quantiling or mean-variance optimization – can we learn something from both sides?

Academic Insights

On a monthly basis, we compile a list of practical academic papers related to investing. Every third month we also delve deeper into the most interesting ideas by carrying out our own backtesting and analysis.

- **Academic Insights** (April 28, 2011).
- **Academic Insights** (March 29, 2010).
- **Academic Insights** (February 25, 2011).
- **Academic Insights** (January 20, 2011).
- **Academic Insights** (November 23, 2010).
- **Academic Insights** (October 27, 2010). *Backtesting edition* – We explore an interesting academic finding that momentum works better for high volatility stocks and reversal works better for low volatility stocks. We suggest four potential ways to exploit this relationship.
- **Academic Insights** (September 27, 2010)
- **Academic Insights** (August 23, 2010)
- **Academic Insights** (July 22, 2010). *Backtesting edition* – We confirm an academic finding that gross profitability over total assets is a better measure of profitability than traditional metrics like ROE and ROA. Furthermore, we show that this ratio is useful for conditioning value factors.
- **Academic Insights** (June 16, 2010)
- **Academic Insights** (May 20, 2010)
- **Academic Insights** (April 16, 2010). *Backtesting edition* – We show how a concept called the "capital gains overhang" can be used to exploit a behavioural bias and enhance the earnings surprise factor.
- **Academic Insights** (March 15, 2010)
- **Academic Insights** (February 12, 2010)

Canada quant

On a monthly basis, we publish quant strategies unique to the Canadian equity market.

- **The Illusion of M&A and Asset Expansion** (February 14, 2011). In this research piece, we test whether M&A activity and other asset expansion transactions actually lead to a subsequent increase in stock returns. Contrary to the common belief, we find that companies that increase and expand their asset base actually have a tendency underperform.
- **New Options in Canada** (November 23, 2010). In this research, we expand a previous US quant research and find factors based on options data (put/call ratio, options implied volatility, skew, relative volume, and put-call parity) are useful in predicting stock returns in Canada.
- **Introducing Canada Quantitative Strategy** (October 24, 2010). Quant investing in Canada used to be easy – all you needed was price momentum and earnings revision. In the past three years, however, as more and more quant investors outside of Canada start to diversify into less crowded markets like Canada, the performance of traditional factors has dropped severely. In this research, we suggest two potential ways to add alpha in Canada in this challenging environment – identifying new and less crowded factors; and style rotation.

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Appendix

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