Deutsche Bank

17 May 2011

Emerging Issues

A roadmap for quantitative investing

Research Summary
In this report we put all our research ideas into a more unified framework. Our goal is to help our clients priortize among the many topics we have studied so far. We also want to draw out the key themes that are common across all our research papers.

A unified framework for our quantitative research

Putting all the pieces together
Since we launched our quantitative research just over a year ago, we have published 57 research papers on a wide range of topics. One of the common questions we get from our clients is: how does it all fit together? In this short report we try to answer this question by putting all our research ideas into a more unified framework that revolves around three key themes:

Ranking our signal research
Finding new alpha sources is a worthwhile goal for quantitative investors, since factors based on fresh information tend to deliver less crowded, more consistent performance. However, finding new factors takes considerable resources. In this report we prioritize all the new alpha factors we have studied.

Making a better factor weighting decision
Once we find good factors, how do we put them together? This is another area that we have researched extensively. Our suggestions range from aggressive factor timing strategies to more passive defensive techniques.

The rise of the macro-quant
The volatile macroeconomic environment has played havoc on many of the traditional, stock-specific quantitative models. Again, we have presented a number of potential strategies for mitigating the impact of macro factors on quant models. In this research we try to make it easier to see how these often competing strategies fit together.

Yin Luo, CFA
Strategist
(+1) 212 250-8983
yin.luo@db.com

Rochester Cahan, CFA
Strategist
(+1) 212 250-8983
rochester.cahan@db.com

Miguel-A Alvarez
Strategist
(+1) 212 250-8983
miguel-a.alvarez@db.com

Javed Jussa
Strategist
(+1) 212 250-4117
javed.jussa@db.com

Zongye Chen
Strategist
(+1) 212 250-2293
john.chen@db.com

Source: Getty Images

Deutsche Bank Securities Inc.

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A letter to our readers

Putting all the pieces together

Our research library can be a little hard to navigate; in this report we try to present all our ideas in a more unified framework

We launched Deutsche Bank's US/Global Quantitative Equity Strategy research just over a year ago, in April 2010. Since then we have published 57 research papers (around 1,300 pages) across a wide range of topics that touch on every aspect of the quantitative investment process, from signal discovery to portfolio construction and risk management.[1] However, one of the problems with such a large research library is that it can be confusing to navigate. For a quantitative investor looking to improve an investment process, where should he or she start? Should one begin by adding some of the new alpha factors we have researched? Or perhaps it's better to start by bringing a macro flavor to one's model, for example by using some of our style rotation research?

A unified framework

We think our research can be classified along three dimensions: signal research, signal weighting research, and macro-quant research

In this report we try to help our readers put all the pieces together, by putting our research ideas into a more unified framework. The idea is to draw out the common themes that run through our research, and in doing so help our clients determine which of our research topics can best help them improve their investment process. Broadly speaking, we think it is helpful to classify our research into three categories:

- **Signal research:** Finding new alpha signals is, in our view, one of the single best ways to improve model performance. However, alpha is scarce, and finding new signals requires hard work and resources. We hope some of the new factors we have researched – such as options factors, bond factors, high frequency factors, and security lending factors – can help reduce some of the search time for our clients.

- **Signal weighting research:** Once we find good factors, how should we incorporate them into the alpha model? The problem of finding optimal factor weights is a tricky one, and we have devoted considerable research time on this front. Our suggestions range from aggressive (dynamic style timing) to defensive (robust factor models).

- **Macro-quant research:** One of the biggest challenges for quantitative models has been the volatile macro environment. Traditional stock-selection models play on firm-level characteristics, and are often ill-suited to capturing the impact of big macro events. A significant number of our recent research papers have focused on solving this difficult problem.

The bottom line

The goal of this short paper is to help our clients prioritize the ideas that can add the most value

As sell-side researchers, we have the luxury of exploring many different ideas simultaneously, without the headache of picking which ones make it into the final model. In this research paper we try to be more pragmatic about which ideas we think are most worth pursuing. In a world of limited resources, prioritizing areas with the highest ROE (in this case, Return on Effort) is a worthwhile exercise.

Regards,

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

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[1] For a complete listing of our research library, see the appendix of this report.

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# A roadmap to quantitative investing

Publication series

If you only read one email from us each month, make it Quantum

Deutsche Bank's US/Global quantitative strategy team produces one monthly newsletter, *Quantum*, and six regular research series (see Figure 1): 1) *Signal Processing* on stock-selection factors/signals; 2) *Portfolios Under Construction* on risk and portfolio construction; 3) *Emerging Issues* on topical and emerging issues); 4) *QCD Model* on stock-selection models; 5) *Academic Insights* on academic research; and 6) *Canada Quant* on topics unique to the Canadian equity market.

Quantum is our monthly newsletter. The aim of *Quantum* is to make it easier for clients to keep track of all the research we publish, and to serve as a forum to highlight the latest news and thinking in the quant investing world. If you only read one email from us every month, make it *Quantum*.

Figure 1: Publication series
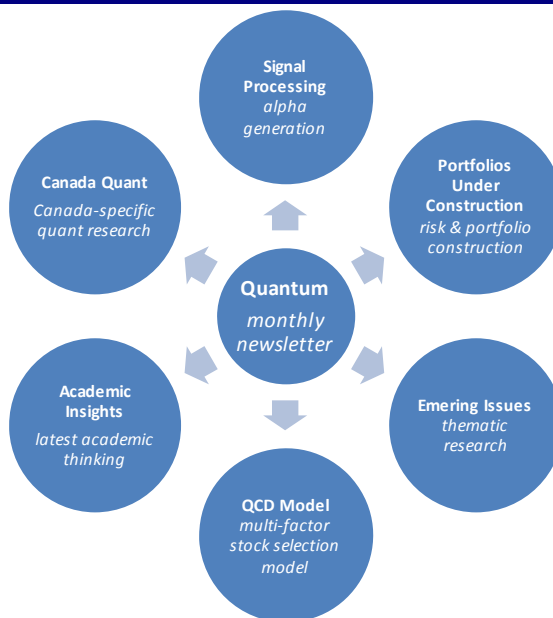
Source: Deutsche Bank Quantitative Strategy

Two main reference papers

*For those looking for an introduction to our research, we recommend two publications*

Clients often ask us what our general modeling methodology looks like. Our first recommendation is our *DB Quant Handbook* (see Figure 2), which goes through the complete quantitative investment process from the beginning to the end. Our second recommendation is our *DB Quant Yearbook* (Figure 3).The yearbook is a book we compiled that contains all the research papers we wrote last year (24 papers, around 700 pages). Currently, the book is available in hard copy only. Please contact us if you are interested in receiving a copy. Going forward, we plan to publish a yearbook every year.

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Figure 2: DB Quant Handbook
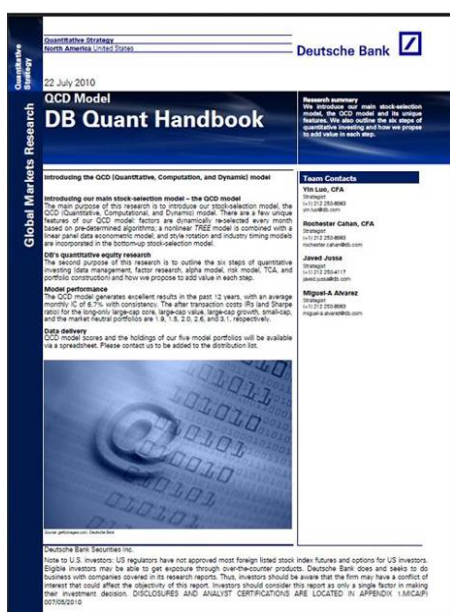
Source: Deutsche Bank Quantitative Strategy

Figure 3: DB Quant Yearbook
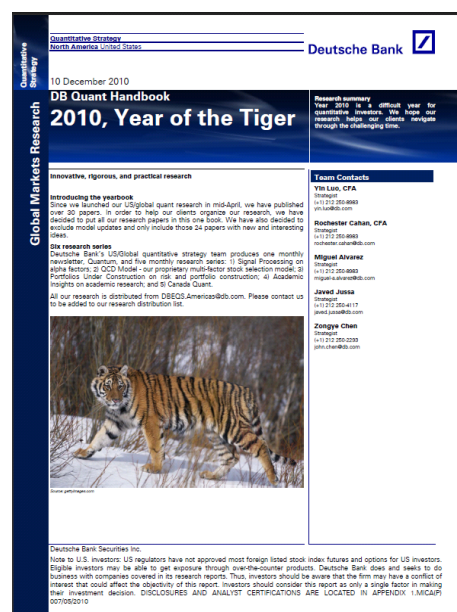
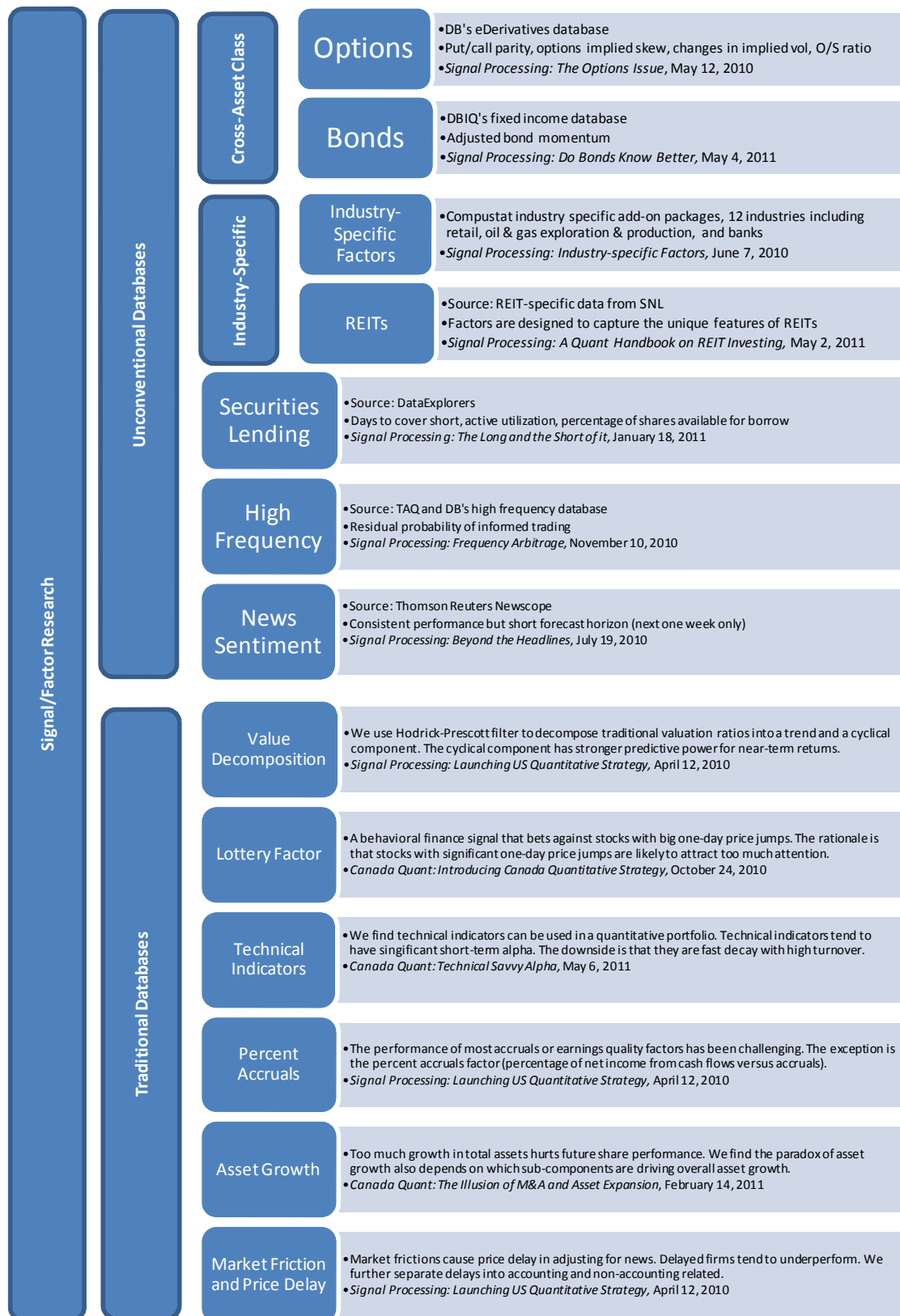Source: Deutsche Bank Quantitative Strategy

Signal research

Signal research is one of the most important areas of quantitative research

Factor research has always been a key focus. Over the past year or so, we have targeted two areas:

- **Smarter use of traditional databases:** While finding new databases and alpha sources have always been the holy grail of quant investing, we believe there is still untapped alpha in the more traditional databases (e.g. Compustat, Worldscope, Datastream, IBES). The trick is to be smarter in how we use them.

- **Finding new databases:** We have tested a wide range of innovative databases over the past year. These include options data, bond data, news sentiment data, and high frequency data. Integrating new databases is always time-consuming, but we believe the upside in terms of finding fresh alpha sources is significant.

We rank all the new factors we have studied from best to worse in terms of our future expectations

In both approaches, the common goal is to come up with factors that have better efficacy, are less crowded, and are likely to have longer shelf life. One of the questions we frequently get asked is: among all these new factors, how would we rank them based on our expectation of their future performance? In Figure 4, we rank the factors based on our preference, instead of the normal chronological order. For each factor we also reference the underlying white paper where more information can be found. If you are missing any of these papers please let us know and we would be happy to send you a copy.

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Figure 4: Ranking of DB Quant's new signal ideas (from best to worse)

Signal/Factor Research

Unconventional Databases

Cross-Asset Class

Options
- DB's eDerivatives database
- Put/call parity, options implied skew, changes in implied vol, O/S ratio
- *Signal Processing: The Options Issue*, May 12, 2010

Bonds
- DBIQ's fixed income database
- Adjusted bond momentum
- *Signal Processing: Do Bonds Know Better,* May 4, 2011

Industry-Specific

Industry-Specific Factors
- Compustat industry specific add-on packages, 12 industries including retail, oil & gas exploration & production, and banks
- *Signal Processing: Industry-specific Factors,* June 7, 2010

REITs
- Source: REIT-specific data from SNL
- Factors are designed to capture the unique features of REITs
- *Signal Processing: A Quant Handbook on REIT Investing,* May 2, 2011

Securities Lending
- Source: DataExplorers
- Days to cover short, active utilization, percentage of shares available for borrow
- *Signal Processing: The Long and the Short of it,* January 18, 2011

High Frequency
- Source: TAQ and DB's high frequency database
- Residual probability of informed trading
- *Signal Processing: Frequency Arbitrage,* November 10, 2010

News Sentiment
- Source: Thomson Reuters Newscope
- Consistent performance but short forecast horizon (next one week only)
- *Signal Processing: Beyond the Headlines,* July 19, 2010

Traditional Databases

Value Decomposition
- We use Hodrick-Prescott filter to decompose traditional valuation ratios into a trend and a cyclical component. The cyclical component has stronger predictive power for near-term returns.
- *Signal Processing: Launching US Quantitative Strategy,* April 12, 2010

Lottery Factor
- A behavioral finance signal that bets against stocks with big one-day price jumps. The rationale is that stocks with significant one-day price jumps are likely to attract too much attention.
- *Canada Quant: Introducing Canada Quantitative Strategy,* October 24, 2010

Technical Indicators
- We find technical indicators can be used in a quantitative portfolio. Technical indicators tend to have significant short-term alpha. The downside is that they are fast decay with high turnover.
- *Canada Quant: Technical Savvy Alpha,* May 6, 2011

Percent Accruals
- The performance of most accruals or earnings quality factors has been challenging. The exception is the percent accruals factor (percentage of net income from cash flows versus accruals).
- *Signal Processing: Launching US Quantitative Strategy,* April 12, 2010

Asset Growth
- Too much growth in total assets hurts future share performance. We find the paradox of asset growth also depends on which sub-components are driving overall asset growth.
- *Canada Quant: The Illusion of M&A and Asset Expansion*, February 14, 2011

Market Friction and Price Delay
- Market frictions cause price delay in adjusting for news. Delayed firms tend to underperform. We further separate delays into accounting and non-accounting related.
- *Signal Processing: Launching US Quantitative Strategy,* April 12, 2010

Source: Deutsche Bank Quantitative Strategy

Factor weighting research

There are two main approaches to factor weighting: optimization-based and regression-based

Coming up with a list of potential factors is only step one. Finding the best way to combine the factors together is equally important. Factor weighting has been our second main focus after signal research. There are two main approaches to determine factor weights:

- **Optimization-based:** This involves treating each factor as an "asset class" and using mean-variance optimization to find an optimal combination, or portfolio, of factors. In the literature this approach is usually called the Grinold & Kahn (GK) or Qian, Hua, and Sorensen (QHS) approach.

- **Regression-based:** In the regression framework, forward stock returns are regressed onto a set of factors. The coefficients from the regression are effectively the factor weights. Our QCD stock-selection model is an example of a regression-based model.

Refining the optimization approach

When using optimization, two ingredients are essential: factor return predictions and the factor covariance matrix

When using an optimization-based framework (which is the more common approach), there are two required ingredients that go into the optimization (see Figure 5):

- **Expected factor returns:** These are our predictions for how we think each factor will perform in the next period. Techniques for estimating these range from simple (e.g. assume the best estimate of next period's factor performance is the long-term average) to complex (e.g. build a fully-fledged style rotation model). Our research has suggested that a systematic style rotation model that incorporates macroeconomic variables can improve our estimate of future factor returns significantly (see *Signal Processing: Style rotation*, 7 September 2010).

- **Expected factor risk:** The risk and co-movement of factors is encapsulated in the factor covariance matrix. As with factor returns, there are many ways to estimate this, ranging from the simple (e.g. use the sample covariance matrix) to the complex (e.g. use a structured covariance model like the Single Index Model). Our research suggests that building a robust factor covariance matrix is very important (see *Portfolios Under Construction: Robust factor models*, 24 January 2011).

In summary, we found in our research that we can significantly improve the factor weighting decision by being smarter in how we estimate these two inputs, so we would suggest these two areas are worth prioritizing. However, we don't have to stop here.

Figure 5: Required raw inputs for an optimal weighting decision

Source: Deutsche Bank Quantitative Strategy
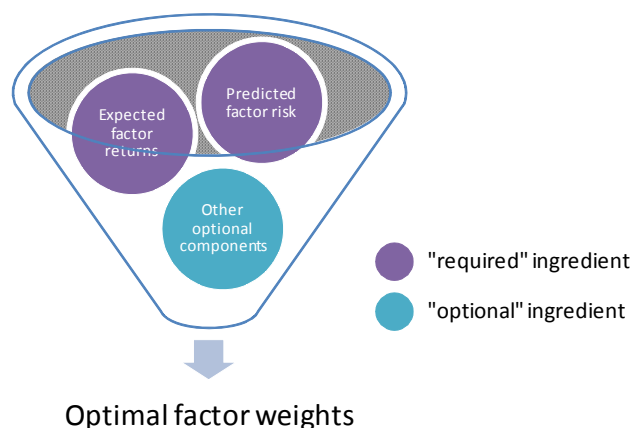
Going beyond expected risk and returns

We have also researched a number of "optional" enhancements to the process

In addition to the factor return and factor risk estimates, there are many other "optional" ingredients that can help us make better factor weighting decisions. These include:

- **Factor decay and turnover:** In the real world, transaction costs have a significant impact on the optimal factor mix. Some fast decay signals look good on paper, but are difficult to implement in a turnover-constrained world. In our research, we have suggested a framework that can help solve this problem (see *Portfolios Under Construction: Learning to drive in the fast lane*, 26 April 2011).

- **Shorting costs:** For many quants who invest long-short, implementation costs are further complicated by cost of shorting considerations. In our research we found that many common factors have significant costs on the short side. This is an additional metric that needs to be included in the factor weighting decision (see *Signal Processing: The long and the short of it*, 18 January 2011).

- **Tail risk management:** All the above points have assumed we live in a well behaved, normally distributed world. The reality is we don't. One of our current research projects is to better incorporate tail risk into the factor weighting decision.

Among all the moving parts, things can get quite confusing from time to time. Clients often ask us how all these pieces are linked together; what the priority should be; and more importantly, what the incremental value is for each of these components. Figure 6 shows how we think about the factor weighting decision.

Figure 6: Two approaches to the factor weighting decision
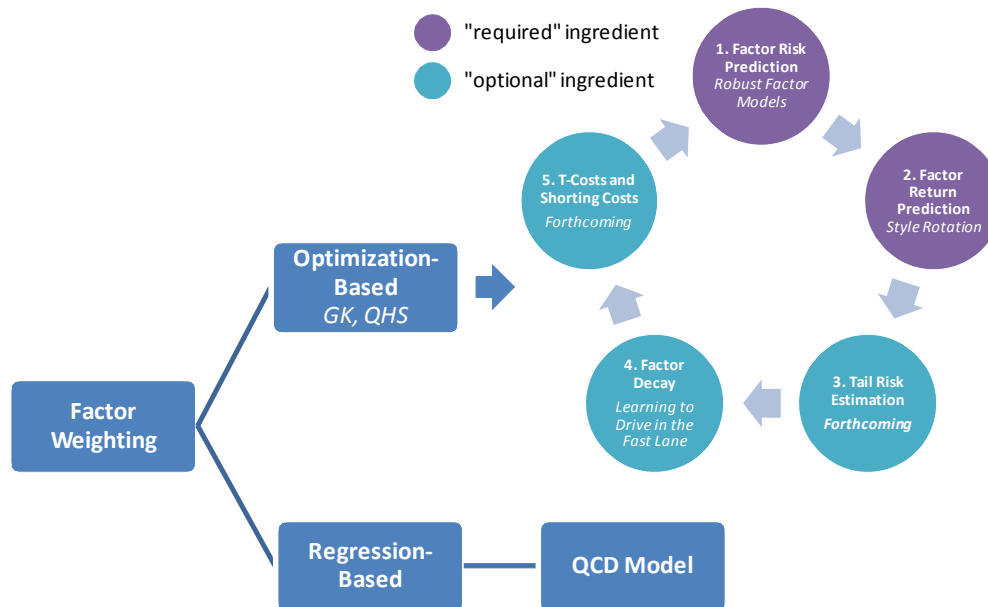
Source: Deutsche Bank Quantitative Strategy

Macro-quant: Fashion or fad?

The opportunity set from macro timing is at an all time high

One of the biggest challenges quants have faced in recent years is the growing importance of the macro environment in driving asset returns. Most traditional quant models – which play on firm-level characteristics – are ill-suited to capturing the impact of big macro themes. Our view is that the macroeconomic environment poses both risks and opportunities. If not managed properly, macro drivers could overshadow stock-selection opportunities, but if
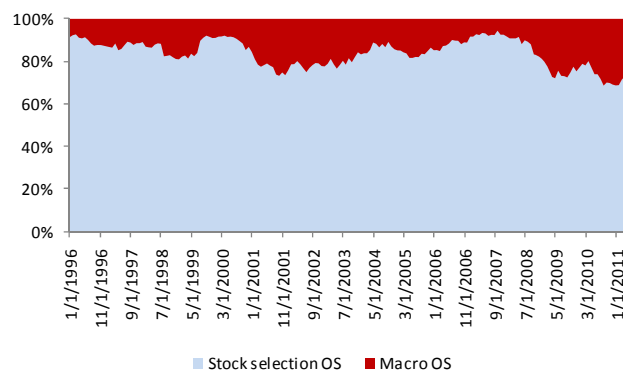
harnessed effectively the same macro factors could open up a whole new opportunity set for systematic investors.

Figure 7: Level of opportunity from stock selection versus macro timing
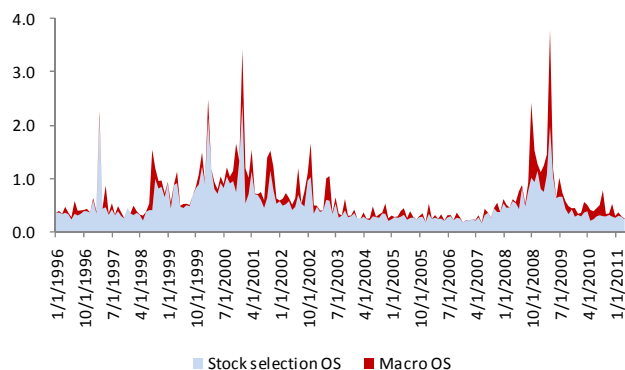
Source: Deutsche Bank Quantitative Strategy

Figure 8: Percentage of total opportunity set coming from stock selection versus macro timing
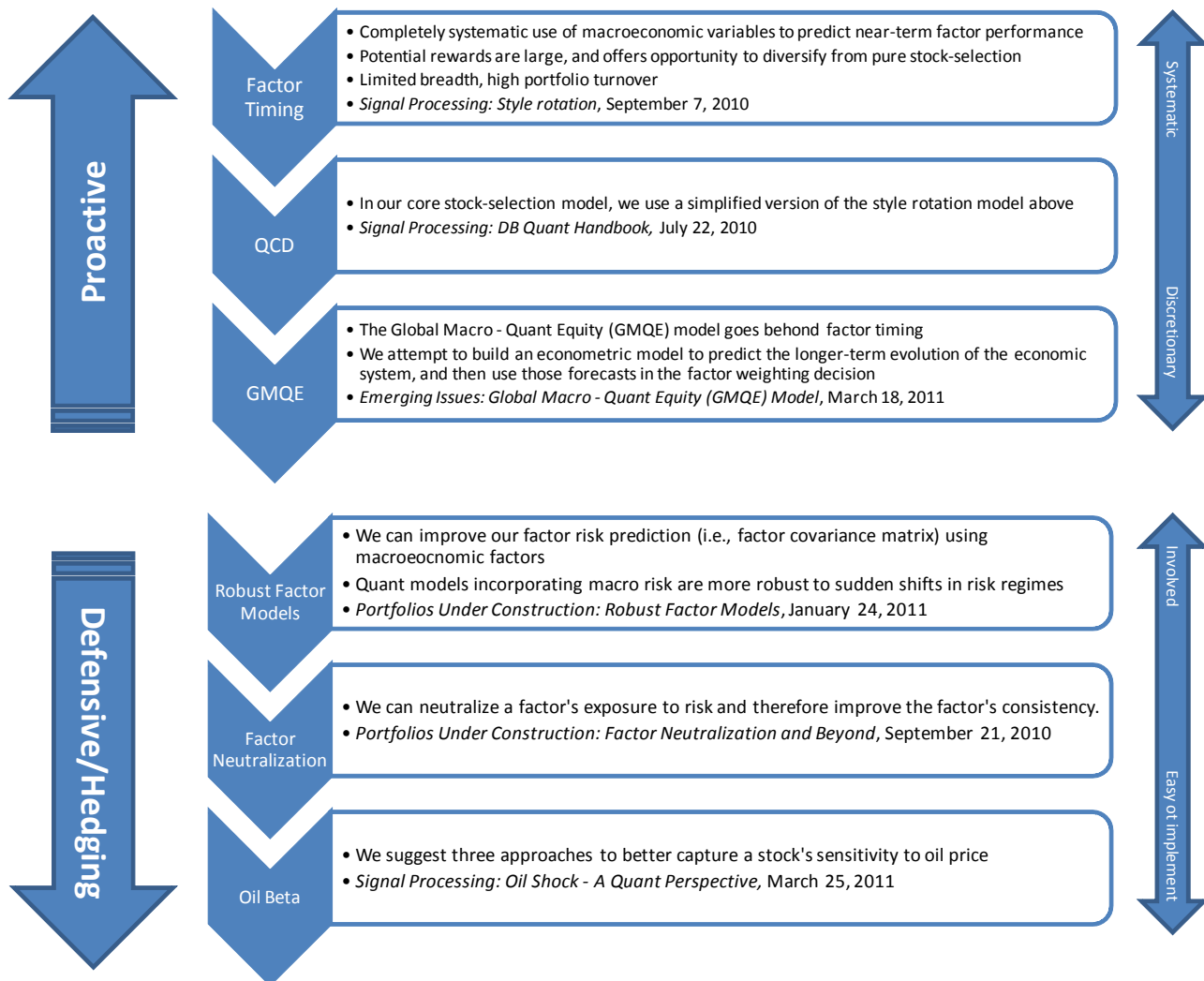

Source: Deutsche Bank

Our research has focused on two mutually exclusive approaches: proactive strategies and defensive strategies

As shown in Figure 7 and Figure 8, the opportunity from macro timing has reached all-time highs in recent years.[2] This explains why we have seen more and more interest in macro related research relative to bottom-up stock selection (see *Emerging Issues: What's hot in the world of quant?*, 12 April 2011). We have published a series of research papers focusing on the macro challenge. We can classify these into two alternative approaches:

- **Proactive strategies:** One way to deal with the macro challenge is to proactively adjust our model to account for the evolving macroeconomic backdrop. This typically involves doing style rotation, and is a fairly aggressive approach in terms of turnover. It is also quite controversial because many investors do not believe there is sufficient breadth in style-timing to generate enough alpha to overcome the increased turnover.

- **Defensive strategies:** On the other hand, even if we don't think style rotation is possible, we can still try to neutralize the impact of macro shifts on our model. In other words, we don't try to predict when things will go wrong, instead we try to position our model so that when things do go wrong – as they inevitably will from time to time – the drawdown is limited.

Figure 9 illustrates the logical ordering of these two somewhat mutually exclusive approaches.

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[2] More details on how we measure the opportunity set are available in *Portfolios Under Construction: Correlation and opportunity*, 3 December 2011.

Figure 9: Logical ordering of our macro research

Proactive

Factor Timing
- Completely systematic use of macroeconomic variables to predict near-term factor performance
- Potential rewards are large, and offers opportunity to diversify from pure stock-selection
- Limited breadth, high portfolio turnover
- *Signal Processing: Style rotation*, September 7, 2010

QCD
- In our core stock-selection model, we use a simplified version of the style rotation model above
- *Signal Processing: DB Quant Handbook,* July 22, 2010

GMQE
- The Global Macro - Quant Equity (GMQE) model goes behond factor timing
- We attempt to build an econometric model to predict the longer-term evolution of the economic system, and then use those forecasts in the factor weighting decision
- *Emerging Issues: Global Macro - Quant Equity (GMQE) Model*, March 18, 2011

Systematic

Discretionary

Defensive/Hedging

Robust Factor Models
- We can improve our factor risk prediction (i.e., factor covariance matrix) using macroeocnomic factors
- Quant models incorporating macro risk are more robust to sudden shifts in risk regimes
- *Portfolios Under Construction: Robust Factor Models*, January 24, 2011

Factor Neutralization
- We can neutralize a factor's exposure to risk and therefore improve the factor's consistency.
- *Portfolios Under Construction: Factor Neutralization and Beyond*, September 21, 2010

Oil Beta
- We suggest three approaches to better capture a stock's sensitivity to oil price
- *Signal Processing: Oil Shock - A Quant Perspective,* March 25, 2011

Involved

Easy ot implement

Source: Deutsche Bank Quantitative Strategy

Thematic research

We have also written a number of thematic pieces that touch on current issues in the world of quant

Outside of our signal research, factor weighting research, and macro research, we have also written a number of one-off publications examining the topical issues for today's quant investors. This includes research on January's "mini quant crisis" (*Emerging Issues: Quant Crisis? What Crisis?*, 31 January 2011), minimum variance strategies (*Portfolios Under Construction: Minimum variance – Exposing the magic*, 9 February 2011), comparing quantile portfolios to mean-variance portfolios (*Portfolios Under Construction: Quantiles versus mean-variance*, 23 April 2010), and the shifting opportunity set for quant investors (*Portfolios Under Construction: Correlation and opportunity*, 2 December 2010).

Figure 10: Thematic research

- We believe that quantitative investment rests on serious research rather than reactionary commentary on market events

- Portfolio construction is not one-size-fits-all
- The right methodology depends on the characterstics of the underlying alpha process

Quant Crisis? What Crisis?

Quantiles vs. Mean Variance

Minimum Variance

Correlation & Opportunity

- Minimum variance strategies are not necessarily low risk or passive
- We attempt to make some improvements

- High pairwise correlation does not automatically mean stock selection is dead
- Managing macro exposure is the key

Source: Deutsche Bank Quantitative Strategy

What is everyone else talking about?

We update our What's Hot in Quant charts, to capture our most recent meetings

Following the same methodology as we published in our *What's Hot in Quant* research, we update the popularity of our research based on how often they appear in our client meetings (see Figure 11). The ranking is skewed toward older publications, as newer research topics have been available for less client meetings. In Figure 12, we show an opportunity-adjusted ranking.

Since we last published these charts, the big movers on the alpha front have been our recent research on factors from the fixed income market (see *Signal Processing: Do bonds know better?*, 5 May 2011), and our work on applying quant strategies to the REITs space (see *Signal Processing: A quant handbook on REIT investing*, 2 May 2011). In the portfolio construction space, our research on incorporating signal decay into the factor weighting decision is proving quite popular (see *Portfolios Under Construction: Learning to drive in the fast lane*, 26 April 2011).

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Figure 11: Popularity ranking
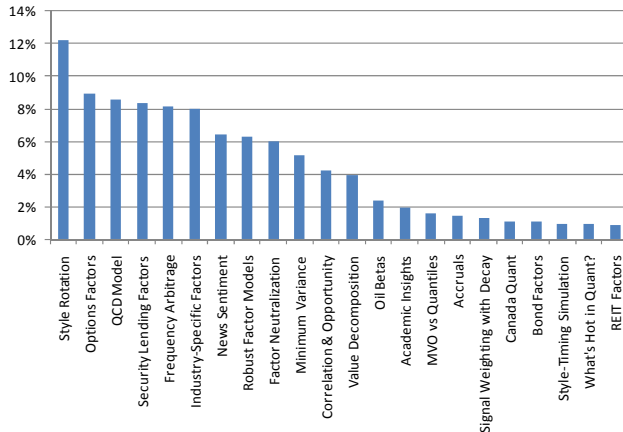
Source: Deutsche Bank Quantitative Strategy

Figure 12: Opportunity adjusted popularity ranking

Source: Deutsche Bank Quantitative Strategy
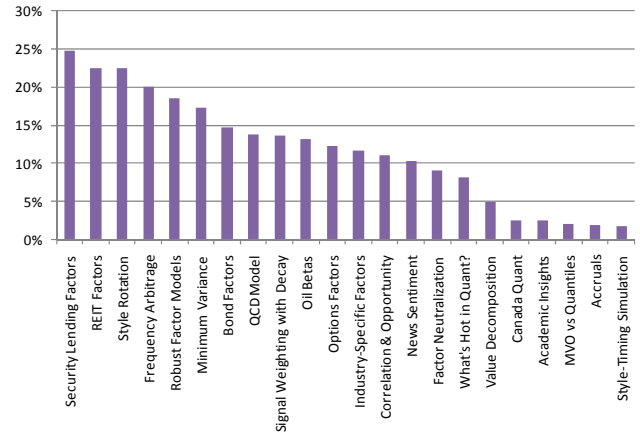
QCD model: How do we put it all together?

Our QCD model illustrates how we would implement many of the ideas discussed in this report

As a sell-side research team, we believe our first priority is to help our clients come up with innovative new ideas that add value to their investment processes. We think the best way we can do this is by continually publishing new research papers on cutting-edge topics. As a result, we tend to put less emphasis on regularly updating our models, and more emphasis on stand-along "idea" pieces (e.g. our *Signal Processing* and *Portfolios Under Construction* research series).

Nonetheless, we do still think it is important to illustrate how everything fits together in a real-world model. Hence we have our own multi-factor stock selection model – the QCD Model (for the complete details see *QCD Model: DB Quant Handbook*, 22 July 2010). In this section, we provide a high level overview and elaborate on how the research topics we have discussed in this report fit into the QCD structure (see Figure 13). One word of caution is that there is a delay of approximately six to nine months from when we publish an idea to when we incorporate it into our QCD model.

In the coming months, we will be focusing on ways to improve our QCD model further:

- Productionize some of our latest signal research so that the QCD model has the option of picking these newer factors if it believes they will add value in the future.

- Further improve our factor timing and industry rotation algorithms by incorporating point-in-time macroeconomic variables[3].

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[3] Currently the style rotation and industry rotation algorithms in the QCD model only use capital market variables and seasonal dummy variables, not macroeconomic variables.

Figure 13: QCD model methodology
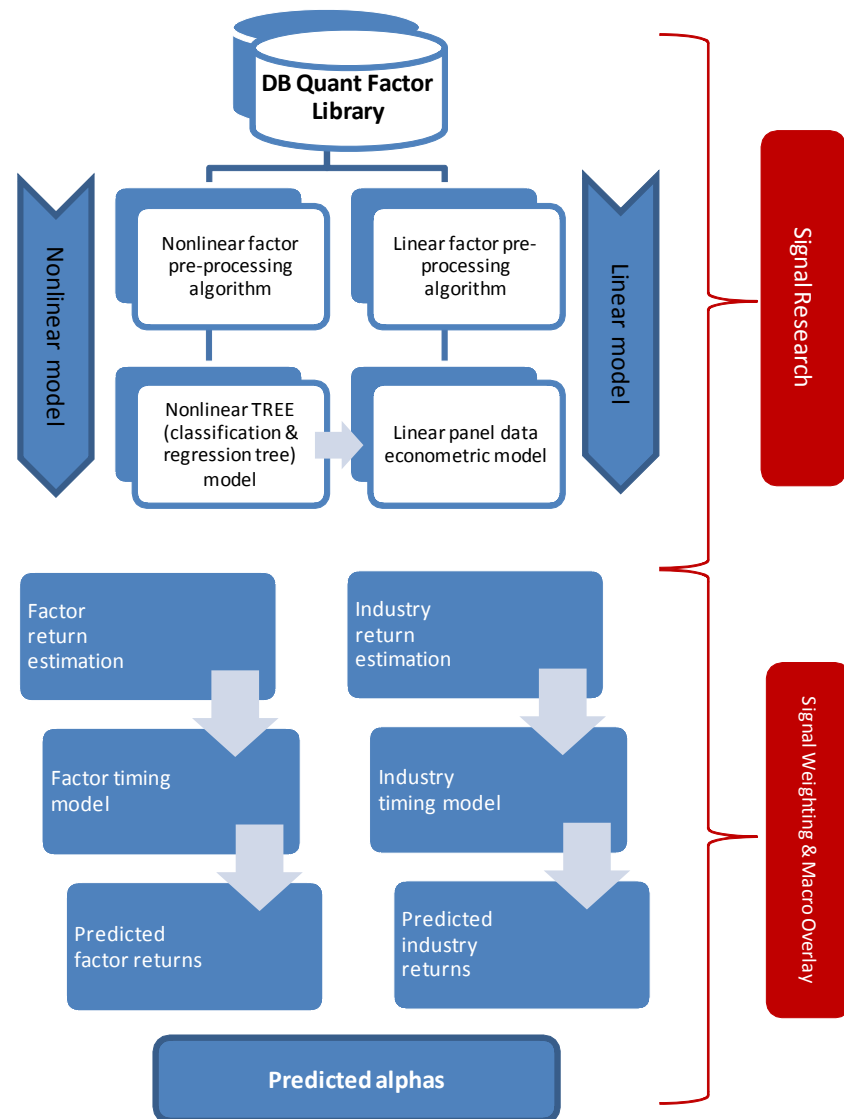
Source: Deutsche Bank Quantitative Strategy

Technology infrastructure

A robust and extensible technology infrastructure is crucial to the quant investment process

We are firm believers that data and infrastructure is a crucial part of the quant process. Therefore, in addition to our published research, we also spend a considerable amount of time optimizing our back-end processes so that we can easily incorporate new data sources into our framework.

Broadly speaking, we have two separate technology infrastructures, one for the traditional low frequency data (i.e., daily, weekly, monthly, quarterly, semi-annual, and annual) and one for the high frequency data (i.e., tick-by-tick). The low frequency data warehouse is essentially a UNIX + Oracle + Java + R system (see Figure 14), while the high frequency data is handled by a KDB + Q + Java + R system (see Figure 15).

Figure 14: DB Quant low frequency data infrastructure

We subscribe to data from a large number of vendors, mostly in flat file via FTP

Traditional

Fundamental data: Compustat, Worldscope, Reuters

Pricing: Datastream, IDC, Bloomberg, Factset

Index constituent data: S&P, MSCI, Russell, Stoxx, BMI

Risk and optimizer: Axioma, Barra

Economics: Haver, Bloomberg

Unconventional

Multi-asset: eDerivatives (options), DBIQ (bonds)

Industry specific data: Compustat industry add-ons, Capital IQ, SNL

Country specific data: CPMS (Canada), Toyo Keizai (Japan), Aspect Huntley (Australia), Wind (China)

News sentiment: Thomson Reuters News Analytics

Securities lending data: DataExplorers

We integrate data from various vendors into a centralized database and data warehouse

Data are initially loaded/saved in a normalized relational database (Oracle + UNIX)

Most data items are stored in a virtual data warehouse and de-normalized on-the-fly via JQuant (Java + R)

Commonly used data items and factors are stored in a physical data warehouse (Oracle + UNIX)

R&D Research is conducted using mostly statistical packages (e.g., R, SAS, EViews, Stata, etc.)

Production Daily factor calculation (~1,500 factors) is done in a combination of R, SAS, Java, and C++ on an UNIX computing grid

Storage Data are stored in both development and production servers in Oracle databases in an UNIX environment

Source: Deutsche Bank Quantitative Strategy

Figure 15: DB Quant high frequency data infrastructure

Tick-by-tick transaction data

Quote data

KDB+ *in-memory database*

Q query language

Java layer

R layer

DB Factor Libary *Oracle relational*
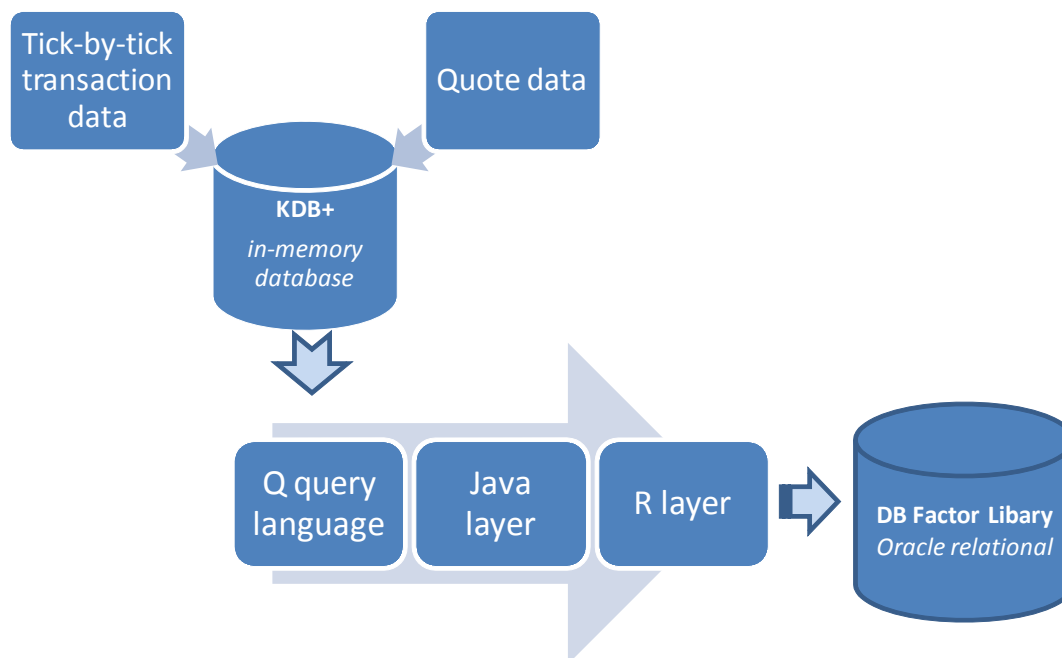
Source: Deutsche Bank Quantitative Strategy

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Appendix – Deutsche Bank US/Global Quant Research Library

Deutsche Bank's US/Global quantitative strategy team produces one monthly newsletter, *Quantum*, and six regular research series: *Signal Processing* on stock-selection factors/signals; 2) *Portfolios Under Construction* on risk and portfolio construction; 3) *Emerging Issues* on topical and emerging issues); 4) *QCD Model* on stock-selection models; 5) *Academic Insights* on academic research; and 6) *Canada Quant* on topics unique to the Canadian equity market.

All our research is distributed from DBEQS.Americas@db.com. Please contact us to be added to our research distribution list.

Quantum

Quantum is our monthly newsletter. The aim of Quantum is to make it easier for clients to keep track of all the research we publish, and to serve as a forum to highlight the latest news and thinking in the quant investing world. If you only read one email from us every month, make it *Quantum*.

- **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 on 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). 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. We also develop a way to adjust the factor scores for shorting costs, which helps steer the factor towards less costly names on the short side.

- **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.

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: Exposing the "Magic"** (February 9, 2011). There are some nice properties for minimum variance portfolios, i.e., higher IR than the market portfolios, low turnover, and low correlation with traditional strategies. However, we find MVP is not necessarily a low-risk strategy. In the end, we propose a slight and simple enhancement to the strategy, which significantly improves MVP IR without increasing its risk. We also demonstrate that we can combine the MVP strategy with other active alpha models.

- **Robust Factor Models** (January 24, 2011). Traditionally, managers focus on selecting factors, while using the sample factor covariance matrix in constructing multifactor models. We compare the performance of the sample factor covariance matrix with 12 structured models (constant correlation, single index, four Bayesian shrinkage estimators, and six multivariate GARCH models). Our backtesting suggests that robust factor models incorporating structured covariance matrices improve portfolio IR significantly.

- **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?

Emerging Issues

- **What's Hot in the World of Quant?** (April 12, 2011). Since we launched our research in April 2010, we have had the privilege of doing over 700 one-on-one meetings with quantitative investors around the world. In each of those meetings, we noted down the topics that you, the clients, requested we present on. This report aggregates that information into a unique set of statistics that tell an interesting story about what ideas are top of mind for buy-side quants rights now.

- **Global Macro–Quant Equity (GMQE) Model** (March 18, 2011). Even a temporary shock of a single economic variable is likely to affect other economic variables for a period of time. In this research, we build a VAR-based macroeconomic model to predict the shocks on the VIX index and oil price. From our economic forecasts, we further calculate the implied factor, industry, and stock performance. We call the bottom-up stock selection model with macro input, Global Macro–Quant Equity (GMQE) model.

- **Quant Crisis? What Crisis?** (January 28, 2011). We believe that sound quantitative research and investment should rest on in-depth and serious research rather than passive reaction to market speculation. We propose factor neutralization and robust factor modeling as two techniques dealing with sudden changes in risk regimes.

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, 2011).

- **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.

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** (May 6, 2011)

- **QCD Model Update** (April 7, 2011)

- **QCD Model Update** (March 9, 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)

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Appendix 1

Important Disclosures

Additional information available upon request

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Deutsche Bank Securities Inc.

North American location

Deutsche Bank Securities Inc.
60 Wall Street
New York, NY 10005
Tel: (212) 250 2500

Deutsche Bank Securities Inc.
One International Place
12th Floor
Boston, MA 02110
United States of America
Tel: (1) 617 217 6100

Deutsche Bank Securities Inc.
222 South Riverside Plaza
30th Floor
Chicago, IL 60606
Tel: (312) 537-3758

Deutsche Bank Securities Inc.
3033 East First Avenue
Suite 303, Third Floor
Denver, CO 80206
Tel: (303) 394 6800

Deutsche Bank Securities Inc.
1735 Market Street
24th Floor
Philadelphia, PA 19103
Tel: (215) 854 1546

Deutsche Bank Securities Inc.
101 California Street
46th Floor
San Francisco, CA 94111
Tel: (415) 617 2800

Deutsche Bank Securities Inc.
700 Louisiana Street
Houston, TX 77002
Tel: (832) 239-4600

International Locations

Deutsche Bank Securities Inc.
60 Wall Street
New York, NY 10005
United States of America
Tel: (1) 212 250 2500

Deutsche Bank AG London
1 Great Winchester Street
London EC2N 2EQ
United Kingdom
Tel: (44) 20 7545 8000

Deutsche Bank AG
Große Gallusstraße 10-14
60272 Frankfurt am Main
Germany
Tel: (49) 69 910 00

Deutsche Bank AG
Deutsche Bank Place
Level 16
Corner of Hunter & Phillip Streets
Sydney, NSW 2000
Australia
Tel: (61) 2 8258 1234

Deutsche Bank AG
Filiale Hongkong
International Commerce Centre,
1 Austin Road West,Kowloon,
Hong Kong
Tel: (852) 2203 8888

Deutsche Securities Inc.
2-11-1 Nagatacho
Sanno Park Tower
Chiyoda-ku, Tokyo 100-6171
Japan
Tel: (81) 3 5156 6770

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